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MAILED
JUL 03 2014
OFFICE OF PETITIONS

Doc Code: TRACK1.GRANT

Decision Granting Request for Prioritized Examination (Track I or After RCE)	Application No.: 14/294,106

1. THE REQUEST FILED June 2, 2014 IS **GRANTED**.

The above-identified application has met the requirements for prioritized examination

A. ☒ for an original nonprovisional application (Track I).
B. ☐ for an application undergoing continued examination (RCE).

2. **The above-identified application will undergo prioritized examination.** The application will be accorded special status throughout its entire course of prosecution until one of the following occurs:

A. filing a **petition for extension of time** to extend the time period for filing a reply;

B. filing an **amendment to amend the application to contain more than four independent claims, more than thirty total claims**, or a multiple dependent claim;

C. filing a **request for continued examination**;

D. filing a notice of appeal;

E. filing a request for suspension of action;

F. mailing of a notice of allowance;

G. mailing of a final Office action;

H. completion of examination as defined in 37 CFR 41.102; or

I. abandonment of the application.

Telephone inquiries with regard to this decision should be directed to Irvin Dingle at (571)272-3210, Office of Petitions.

Irvin Dingle
/Irvin Dingle/
[*Signature*]

Paralegal Specialist
(Title)

UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
14/294,106	06/02/2014	Xiaodong Li	176.0003-06000	9020

22882 7590 06/27/2014

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EXAMINER	
ZEWDU, MELESS NMN	

ART UNIT	PAPER NUMBER
2643	

MAIL DATE	DELIVERY MODE
06/27/2014	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No. 14/294,106	Applicant(s) LI ET AL.	
	Examiner MELESS ZEWDU	Art Unit 2643	AIA (First Inventor to File) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5)☐ Claim(s) *1-30* is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☒ Claim(s) *1 and 16* is/are rejected.

8)☒ Claim(s) *2-15 and 17-30* is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☒ The drawing(s) filed on *06/02/2014* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☒ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.

4) ☐ Other: _____.

DETAILED ACTION

The present application is being examined under the pre-AIA first to invent provisions.

1. This action is the first on the merit of the instant application.

2. Claims 1-30 are pending in this action.

Information Disclosure Statement

The information disclosure statement (IDS) submitted on 06/02/2014 has been considered except those references which are crossed out for failing to include a complete date as required. Furthermore, it is to be noted and to be made of a record, that the number of references submitted is unreasonably large quantity and without any indication of relevancy. Examiner made only a best effort in considering all of them. Any reference that may have escaped examiner's attention thus is because of this large number of reference and applicant shares the burden for both, submitting a large quantity of references and failing to indicate the relevant ones.

Claim Objections

Claims 1 and 16 are objected to because of the following informalities:

in claim 1,on lines 6-7, the feature "feedback information relating to a plurality of feedback clusters" is not clear. In other words, cluster of what? The same unclear is also found in claim 16 (see lines 7-8).

In claim 1, on line 18, "channel information" should be ---- the channel information ----,

In claim 1, on line 21, "feedback information" should be ---- the feedback information ----. Appropriate correction is required.

Claim 16 is objected to because of the following informalities:

On line 2, "the subscriber comprising" should be ---- the subscriber unit comprising ----,

On line 8, "a measure of" should be ---- the measure of ----,

On line 19, "channel information" should be ---- the channel information ----,

On line 22, "provide feedback' should be ---- provide the feedback ----,

On line 23, "a measurement" should be ---- the measurement ----. Appropriate correction is required.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112(a):

> (a) IN GENERAL.—The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor or joint inventor of carrying out the invention.

The following is a quotation of the first paragraph of pre-AIA 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention.

Claims 1 and 16 rejected under 35 U.S.C. 112(a) or 35 U.S.C. 112 (pre-AIA), first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. On lines 18-20, claim 1 recites "**measuring, at a second time by the subscriber unit, channel in channel information for the first plurality of subcarriers based on a second plurality of pilot symbols received from the base station**". Claim 16 also includes such a recitation (see lines 19-21). There is such a description found in the specification.

> The following is a quotation of 35 U.S.C. 112(b):
> (b) CONCLUSION.—The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the inventor or a joint inventor regards as the invention.

> The following is a quotation of 35 U.S.C. 112 (pre-AIA), second paragraph:
> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1 and 16 are rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the inventor or a joint inventor, or for pre-AIA the applicant regards as the invention. Consider the following.

1. The relationship between "**a first modulation and coding rate**) (recited on line 12) and "a modulation and coding rate" (recited on line 16) is not clear.

2. The relationship between "a first allocation of OFDMA" (recited on line 14) and "a second allocation of OFDMA" (recited on line 28) is not clear. In a different description, why the second allocation of OFDMA is required? Is it for increasing a bandwidth size? Or to replace the first allocated OFDMA? Or, is it to provide resources a second user/subscriber? It is also to be noted that claim 16 includes such informal issues.

Allowable Subject Matter

Claims 1 and 16 would be allowable if rewritten or amended to overcome the rejection(s) under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), 2nd paragraph, set forth in this Office action.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to MELESS ZEWDU whose telephone number is (571)272-7873. The examiner can normally be reached on 8:30 am to 5:00 pm..

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Hu Jinsong can be reached on (571) 272-3965. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Any inquiry of a general nature relating to the status or proceeding of this application should be directed to the receptionist whose telephone number is (571) 272-2600.

/MELESS ZEWDU/
Primary Examiner, Art Unit 2643
6/25/2014

Notice of References Cited	Application/Control No. 14/294,106	Applicant(s)/Patent Under Reexamination LI ET AL.	
	Examiner MELESS ZEWDU	Art Unit 2643	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-8,406,700 B2	03-2013	Oota, Yoshiyuki	455/69
*	B	US-2007/0147536 A1	06-2007	Melzer et al.	375/267
*	C	US-6,526,281 B1	02-2003	Gorsuch et al.	455/452.1
*	D	US-6,985,432 B1	01-2006	Hadad, Zion	370/203
*	E	US-6,795,424 B1	09-2004	Kapoor et al.	370/343
*	F	US-6,928,120 B1	08-2005	Zhang, Hongliang	375/260
*	G	US-6,473,467 B1	10-2002	Wallace et al.	375/267
*	H	US-6,904,283 B2	06-2005	Li et al.	455/450
*	I	US-6,947,748 B2	09-2005	Li et al.	455/450
*	J	US-7,454,212 B2	11-2008	Li et al.	455/452.2
*	K	US-7,573,850 B2	08-2009	Li et al.	370/329
*	L	US-7,933,244 B2	04-2011	Li et al.	370/329
*	M	US-7,355,962 B2	04-2008	Li et al.	370/208

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	994878	(("455"/("420", 423-425, "434", 450-451, "452.1-452.2", "453", 509-510, 512-514, 516-517, "522", 524-525, 61-62, "63.1", "67.11", "67.13", 68-69, 702-703, 70-71, "550.1", "556.2", 560-561).ccls.) or ("370"/("252", 328-329, "338", "341", 343-444, "347", 349-350, "447").ccls.))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:25
L2	333	((Xiaodong) near2 (Li)).INV.	US-PGPUB; USPAT; USOCR	OR	ON	2014/06/25 16:25
L3	496	((Hui) near2 (Liu)).INV.	US-PGPUB; USPAT; USOCR	OR	ON	2014/06/25 16:25
L4	76	((Kemin) near2 (Li)).INV.	US-PGPUB; USPAT; USOCR	OR	ON	2014/06/25 16:26
L5	100	((Wenzhong) near2 (Zhang)).INV.	US-PGPUB; USPAT; USOCR	OR	ON	2014/06/25 16:26
L6	845	l2 or l3 or l4 or l5	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:26
L7	4	(BROADSTORM ADJ TELECOMMUNICATIONS).AS.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:26
L8	4	(BROADSTORM ADJ2 TELECOMMUNICATIONS).AS.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:27
L9	220	ADAPTIX.AS.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:27
L10	13	BROADSTORM.AS.	US-PGPUB; USPAT;	OR	ON	2014/06/25 16:28

			USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			
L11	0	(J&K ADJ SERVICES).AS.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:28
L12	5	(KAON ADJ SYSTEMS).AS.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:28
L13	229	L7 OR L8 OR L9 OR L10 OR L12	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:29
L14	33	("20070147536" | "6473467" | "6526281" | "6795424" | "6904283" | "6928120" | "6947748" | "6985432" | "7355962" | "7454212" | "7573850" | "7933244" | "8406700").PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:30
L15	3092	(((allocat$3 or assign$5) near10 (subcarrier or sub-carrier or subchannel or sub-channel or subband or sub-band)) and ((subcarrier or sub-carrier or subchannel or sub-channel or subband or sub-band) near12 (OFDM or OFDMA or (division near8 (orthogonal)))) and ((report$3 or feedback) near20 ((measur$5 or condition or quality or strength) near8 (channel or signal or reception))))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:35
L16	174	(((allocat$3 or assign$5) near10 (subcarrier or sub-carrier or subchannel or sub-channel or subband or sub-band)) and ((subcarrier or sub-carrier or subchannel or sub-channel or subband or sub-band) near12 (OFDM or OFDMA or (division near8 (orthogonal)))) and ((report$3 or feedback) near20 ((measur$5 or condition or quality or strength or information) near8 (channel or signal or reception))) and ((pilot near8 symbol) near20 (modulation near12 cod$3)))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:37
L17	0	(((allocat$3 or assign$5) near10 (subcarrier or sub-carrier or subchannel or sub-channel or subband or sub-band)) and ((subcarrier or sub-carrier or subchannel or sub-channel or subband	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	ON	2014/06/25 16:38

		or sub-band) near12 (OFDM or OFDMA or (division near8 (orthogonal)))) and ((report$3 or feedback) near20 ((measur$5 or condition or quality or strength or information) near8 (channel or signal or reception))) and ((pilot near8 symbol) near20 (modulation near12 cod$3))).clm.	DERWENT; IBM_TDB			
L18	66	l1 and l16	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:38
L19	3	l6 and l16	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:39
L20	0	l13 and l16	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:39
L21	0	l14 and l16	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:39
L22	68	l18 or l19	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:39
L23	61394	(H04B17/00, H04B1/00, H04B15/00, H04B7/00, H04M3/00, H04W24/00, H04W4/00, H04W72/00, H04B1/38, H04B1/10, G08C15/00, H04J1/00, H04B7/208, H04B7/212, H04J3/24, H04J3/06).CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 17:23
L24	9	l16 and l23	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 17:23
L25	58747	((measur$5 near12 pilot) and (feedback or report$3) nad (allocat$3 near10 (subcarrier or sub-carrier or subchannel orsub-channel)))	US-PGPUB; USPAT; USOCR; FPRS;	OR	ON	2014/06/25 17:26

			EPO; JPO; DERWENT; IBM_TDB			
L26	12052	25 AND ((H04B7/005 OR H04B11/00 OR H04B1/0003 OR H04B1/1027 OR H04B1/692 OR H04B7/02 OR H04B7/0404 OR H04B7/0413 OR H04B7/0486 OR G01C5/005).CPC. OR (370/329 OR 370/252 OR 370/336 OR 370/331 OR 370/277 OR 370/278 OR 370/280 OR 370/328 OR 370/330 OR 370/350 OR 370/436 OR 375/232 OR 375/229 OR 375/260 OR 375/131 OR 375/233 OR 375/299 OR 375/324 OR 375/340 OR 375/346 OR 375/347 OR 455/456.1 OR 455/67.13 OR 455/3.01 OR 455/437 OR 455/550.1 OR 455/435.1 OR 455/450 OR 455/452.2 OR 455/575.7 OR 709/221).CCLS. OR (H04W56/00 OR H04W72/04 OR H04W4/02 OR H04W52/24 OR H04W24/02 OR H04W24/10 OR H04W36/00 OR H04W72/08 OR H04W24/00 OR H04W36/08 OR H04W52/40 OR H04W52/50 OR H04W64/00 OR H04W68/00 OR H04W72/12 OR H04W74/08 OR H04W8/20 OR H04B7/005 OR H04B7/04 OR H04B1/00 OR H04B1/10 OR H04B1/692 OR H04B7/02).IPCR.)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 17:29
L27	115	l16 and l25	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 17:29
L28	42	l27 and (indicat$3 near20 (cod$3 near16 modulation))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 17:30
L29	5	l27 and (pilot with (indicat$3 near20 (cod$3 near16 modulation)))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 17:30

EAST Search History (Interference)

<This search history is empty>

6/25/2014 5:32:01 PM
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Substitute for FORM PTO-1449	Attorney Docket Number 176.0003-06000	Customer No. 22882	
INFORMATION DISCLOSURE CITATION IN AN APPLICATION	Applicant Xiaodong Li et al.	Application Number (Cont. of 13/230,625) 14/294,106	
(Use several sheets if necessary) Sheet 1 of 48	Filing Date June 2, 2014	Group Art Unit (2643)	Examiner (M. Zewdu)

U.S. PATENT DOCUMENTS

EXAMINER INITIAL	DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
Lits. 1, 4, 7-8, and 17-18	4,355,411	10/1982	Reudink et al.			
Lits. 7-8 and 17-18	4,488,445	12/1984	Aske			
Lits. 1, 4, and 7-8	4,670,889	6/1987	Hewitt et al.			
	4,794,635	12/1988	Hess			
Lits. 1, 4, and 7-8	5,038,399	8/1991	Bruckert			
Lits. 17-18	5,048,059	9/1991	Dent			
Lits. 7-8 and 17-18	5,200,957	4/1993	Dahlin			
ITC 1	5,212,831	5/1993	Chuang et al.			
Lits. 1, 4, and 7-8	5,239,676	8/1993	Strawczynski et al.			
ITC 1	5,260,967	11/1993	Schilling			
Lits. 2, 3, 5, 6, 9-12, 21-28, and 30	5,267,261	11/1993	Blakeney, II et al.			
Lits. 1, 4, and 7-8; ITC 1	5,280,630	1/1994	Wang			
Lits. 1-12, 21-28, and 30	5,282,222	1/1994	Fattouche et al.			
ITC 1	5,291,475	3/1994	Bruckert			
ITC 1	5,319,634	6/1994	Bartholomew			
	5,323,447	6/1994	Gillis et al.			
	5,327,576	7/1994	Uddenfeldt et al.			
ITC 1	5,345,599	9/1994	Paulraj et al.			
Lits. 7-8 and 17-18	5,410,538	4/1995	Roche et al.			
Lits. 1, 4, and 7-8	5,437,054	7/1995	Rappaport et al.			
Lits. 2, 3, 5, 6, 9-12, 21-28, and 30	5,444,697	8/1995	Leung et al.			
Lits. 7-8 and 17-18	5,448,750	9/1995	Eriksson et al.			
Lits. 1-12, 21-28, and 30	5,471,647	11/1995	Gerlach et al.			
Lits. 1-12, 21-28, and 30; ITC 1	5,479,447	12/1995	Chow et al.			

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /M.Z

Lits. 1-12, 17-18, 21-28, and 30	5,491,837	2/1996	Haartsen			
Lits. 4 and 7-8	5,492,837	8/1993	Naser-Kilahzadeh			
ITC 1	5,504,775	4/1996	Chouly et al.			
	5,504,783	4/1996	Tomisato et al.			
Lits. 7-8	5,507,008	4/1996	Kanai et al.			
Lits. 2, 3, 5, 6, 9-12, 21-28, and 30; ITC 1	5,507,034	4/1996	Bodin et al.			
Lits. 1, 4, 7-8 and 17-18; ITC 1	5,515,378	5/1996	Roy, III et al.			
Lits. 4, 7-8, and 17-18; ITC 1	5,546,090	8/1996	Roy, III et al.			
Lits. 7-8 and 17-18	5,548,582	8/1996	Brajal et al.			
Lits. 1, 4, and 7-8; ITC 1	5,555,268	9/1996	Fattouche et al.			
Lits. 2, 3, 5, 6, 9-12, 21-28, and 30	5,577,022	11/1996	Padovani			
Lits. 7-8 and 17-18	5,581,548	12/1996	Ugland et al.			
	5,586,148	12/1996	Furukawa et al.			
ITC 1	5,588,020	12/1996	Schilling			
	5,590,156	12/1996	Carney			
Lits. 4, 7-8, and 17-18; ITC 1	5,592,490	1/1997	Barratt et al.			
Lits. 2, 3, 5, 6, 9-12, 21-28, and 30	5,598,417	1/1997	Crisler			
Lits. 2, 3, 5, 6, 9-12, 21-28, and 30	5,623,484	4/1997	Muszynski			
Lits. 1, 4, and 7-8	5,634,199	5/1997	Gerlach et al.			
Lits. 4, 7-8, and 17-18; ITC 1	5,642,353	6/1997	Roy, III et al.			
ITC 1	5,687,194	11/1997	Paneth et al.			
Lits. 4, 7-8, and 17-18; ITC 1	5,708,973	1/1998	Ritter			
Lits. 1-12, 17-18, 21-28, and 30; ITC 1; JP Lit. 1; JP Trial 3	5,726,978	3/1998	Frodigh et al.			
Lits. 1, 4, 7-8, and 17-18	5,732,353	3/1998	Haartsen			
Lits. 1, 4, and 7-8; ITC 1	5,734,967	3/1998	Kotzin et al.			
Lits. 1-12, 21-28, and 30	5,764,699	6/1998	Needham et al.			

ITC 1	5,774,808	6/1998	Sarkioja et al.			
	5,784,363	7/1998	Engstrom et al.			
	5,793,759	8/1998	Rakib et al.			
	5,796,722	8/1998	Kotzin et al.			
ITC 1	5,799,000	8/1998	Hoole			
Lits. 4, 7-8, and 17-18	5,819,168	10/1998	Golden et al.			
ITC 1	5,822,372	10/1998	Emami			
Lits. 7-8 and 17-18; ITC 1	5,828,658	10/1998	Ottersten et al.			
	5,838,673	11/1998	Mordechai			
	5,839,074	11/1998	Plehn et al.			
ITC 1	5,848,358	12/1998	Forssen et al.			
Lits. 7-8 and 17-18	5,854,981	12/1998	Wallstedt et al.			
	5,862,487	1/1999	Fuji et al.			
Lits. 1-12, 21-28, and 30; ITC 1	5,867,478	2/1999	Baum et al.			
Lits. 1-12, 21-28, and 30	5,884,145	3/1999	Haartsen			
Lits. 1, 4, 7-8, and 17-18; ITC 1	5,886,988	3/1999	Yun et al.			
ITC 1	5,887,245	3/1999	Lindroth et al.			
	5,887,263	3/1999	Ishii			
Lits. 1, 4, and 7-8; ITC 1	5,909,436	6/1999	Engstrom et al.			
Lits. 7-8	5,912,876	6/1999	H'Mimy			
Lits. 2, 3, 5, 6, 9-12, 21-28, and 30	5,912,931	6/1999	Matsumoto			
Lits. 1-12, 17-18, 21-28, and 30; ITC 1	5,914,933	6/1999	Cimini et al.			
ITC 1	5,914,946	6/1999	Avidor et al.			
Lits. 1, 4, 7-8, 15, 17-18, and 23-28; ITC 1	5,933,421	8/1999	Alamouti et al.			
ITC 1	5,943,375	8/1999	Veintimilla			
Lits. 1-12, 17-18, 21-28, and 30; ITC 1	5,956,642	9/1999	Larsson et al.			
Lits. 7-8	5,966,644	10/1999	Suzuki			
ITC 1	5,973,642	10/1999	Li et al.			
Lits. 4 and 7-8	5,982,327	11/1999	Vook et al.			
	5,982,760	11/1999	Chen			
	5,991,273	11/1999	Abu-Dayya et al.			
Lits. 4, 7-8, 15, and 17-18	5,991,331	11/1999	Chennakeshu et al.			
Lits. 7-8 and 17-18; ITC 1	6,005,876	12/1999	Cimini, Jr. et al.			

Lits. 4, 7-8, 15, and 17-18	6,006,075	12/1999	Smith et al.			
Lits. 1-12, 17-18, 21-28, and 30	6,009,332	12/1999	Haartsen			
ITC 1	6,009,553	12/1999	Martinez et al.			
Lits. 2, 3, 5, 6, 9-12, 21-28, and 30	6,016,311	1/2000	Gilbert			
Lits. 7-8 and 17-18	6,018,528	1/2000	Gitlin et al.			
Lits. 1, 4, 7-8, and 17-18	6,023,622	2/2000	Plaschke et al.			
Lits. 1, 4, and 7-8; ITC 1	6,026,123	2/2000	Williams			
ITC 1	6,037,898	3/2000	Parish et al.			
Lits. 1-12, 17-18, 21-28, and 30	6,038,450	3/2000	Brink et al.			
Lits. 1, 4, 7-8, 15, and 17-18; ITC 1	6,041,237	3/2000	Farsakh			
Lits. 7-8 and 17-18	6,044,067	3/2000	Suzuki			
Lits 2, 3, 5, 6, 9-12, 21-28 and 30	6,047,189	4/2000	Yun et al.			
Lits. 1-12, 17-18, 21-28, and 30; ITC 1	6,052,594	4/2000	Chuang et al.			
ITC 1	6,061,568	5/2000	Dent			
ITC 1	6,064,339	5/2000	Wax et al.			
ITC 1	6,064,692	5/2000	Chow			
ITC 1	6,064,694	5/2000	Clark et al.			
Lits. 1-12, 17-18, 21-28, and 30; ITC 1	6,067,290	5/2000	Paulraj et al.			
Lits. 2, 3, 5, 6, 9-12, 21-28, and 30	6,081,536	6/2000	Gorsuch			
ITC 1	6,085,114	7/2000	Gibbons			
Lits. 1, 4, and 7-8	6,091,717	7/2000	Honkasalo et al.			
	6,091,955	7/2000	Aalto et al.			
Lits. 1, 4, and 7-8; ITC 1	6,108,374	8/2000	Balachandran et al.			
ITC 1	6,108,565	8/2000	Scherzer			
ITC 1	6,111,919	8/2000	Yonge, III			
	6,115,614	9/2000	Furukawa			
	6,119,011	9/2000	Borst et al.			
ITC 1	6,122,260	9/2000	Liu et al.			
Lits. 7-8; ITC 1	6,128,276	10/2000	Agee			
ITC 1	6,131,016	10/2000	Greenstein et al.			

Lits. 1, 4, and 7-8; ITC 1	6,141,565	10/2000	Feuerstein et al.			
ITC 1	6,141,567	10/2000	Youssefmir et al.			
Lits. 7-8 and 17-18	6,144,652	11/2000	Avidor et al.			
Lits. 7-8 and 17-18	6,144,654	11/2000	Ibanez-Meier et al.			
	6,144,696	11/2000	Shively et al.			
Lits. 7-8 and 17-18; ITC 1	6,144,711	11/2000	Raleigh et al.			
ITC 1	6,154,661	11/2000	Goldburg			
Lits. 7-8	6,160,791	12/2000	Bohnke			
Lits. 2, 3, 5-12, 17-18, 21-28, and 30	6,175,550	1/2001	van Nee			
Lits. 1, 4, 7-8, and 17-18; ITC 1	6,192,026	2/2001	Pollack et al.			
	6,198,928	3/2001	Keurulainen et al.			
Lits. 1, 4, and 7-8	6,208,663	3/2001	Schramm et al.			
Lits. 4, 7-8, 15, and 17-18	6,212,242	4/2001	Smith et al.			
	6,212,388	4/2001	Seo			
	6,215,815	4/2001	Chen et al.			
ITC 1	6,226,320	5/2001	Hakkinen et al.			
	6,246,713	6/2001	Mattisson			
	6,246,881	6/2001	Parantainen et al.			
	6,253,063	6/2001	Cudak et al.			
	6,253,094	6/2001	Schmutz			
Lits. 7-8 and 17-18	6,259,686	7/2001	Blanc et al.			
	6,276,297	8/2001	van den Berg et al.			
	6,281,840	8/2001	Miyoshi et al.			
Lits. 1, 4, and 7-8; ITC 1	6,282,185	8/2001	Hakkinen et al.			
Lits. 1, 4, and 7-8; ITC 1	6,298,092	10/2001	Heath, Jr. et al.			
Lits. 1, 4, and 7-8	6,304,593	10/2001	Alouini et al.			
Lits. 7-8; ITC 1	6,307,851	10/2001	Jung et al.			
	6,314,082	11/2001	Malmgren			
ITC 1	6,327,314	12/2001	Cimini, Jr. et al.			
Lits. 1, 4, and 7-8; ITC 1	6,327,472	12/2001	Westroos et al.			
	6,330,429	12/2001	He			
ITC 1	6,330,460	12/2001	Wong et al.			
	6,334,047	12/2001	Andersson et al.			
Lits. 1-12, 21-28 and 30; ITC 1	6,351,499	2/2002	Paulraj et al.			

Lits. 1-12, 21-28, and 30	6,351,643	2/2002	Haartsen			
Lits. 2, 3, 5, 6, 9-12, 21-28, and 30	6,359,867	3/2002	Vehmas			
Lits. 7-8 and 17-18; ITC 1	6,359,923	3/2002	Agee et al.			
Lits. 1, 4, and 7-8; ITC 1	6,366,195	4/2002	Harel et al.			
ITC 1	6,377,631	4/2002	Raleigh			
ITC 1	6,377,632	4/2002	Paulraj et al.			
Lits. 1-12, 17-18, and 30; ITC 1	6,377,636	4/2002	Paulraj et al.			
	6,388,999	5/2002	Gorsuch et al.			
	6,400,679	6/2002	Suzuki			
Lits. 1-12, 17-18, 21-28, and 30	6,400,699	6/2002	Airy et al.			
Lits. 1, 4, and 7-8	6,404,783	6/2002	Cimini, Jr. et al.			
	6,405,044	6/2002	Smith et al.			
Lits. 1-12, 17-18, 21-28, and 30	6,405,048	6/2002	Haartsen			
	6,411,186	6/2002	Lilleberg et al.			
	6,415,153	7/2002	Liew			
	6,424,836	7/2002	Gil et al.			
	6,430,148	8/2002	Ring			
Lits. 2, 3, 5, 6, 9-12, 21-28, and 30	6,434,392	8/2002	Posti			
	6,442,130	8/2002	Jones et al.			
	6,445,916	9/2002	Rahman			
ITC 1	6,449,246	9/2002	Barton et al.			
ITC 1	6,452,981	9/2002	Raleigh et al.			
Lits. 1-12, 17-18, 21-28, and 30	6,463,096	10/2002	Raleigh et al.			
ITC 1	6,463,295	10/2002	Yun			
	6,463,296	10/2002	Esmailzadeh et al.			
	6,470,044	10/2002	Kowalski			
Lits. 7-8 and 17-18; ITC 1	6,473,418	10/2002	Laroia et al.			
Lits. 1, 4, and 7-8; ITC 1	6,473,467	10/2002	Wallace et al.			
ITC 1	6,477,158	11/2002	Take			
Lits. 1, 4, and 7-8	6,487,253	11/2002	Jones, IV et al.			
	6,493,331	12/2002	Walton et al.			
Lits. 1, 4, and 7-8	6,496,490	12/2002	Andrews et al.			
	6,501,785	12/2002	Chang et al.			

ITC 1	6,512,737	1/2003	Agee			
Lits. 1, 4, and 7-8	6,526,281	2/2003	Gorsuch et al.			
	6,529,488	3/2003	Urs et al.			
	6,535,501	3/2003	Bohnke			
	6,539,233	3/2003	Taketsugu et al.			
Lits. 1, 4, and 7-8; ITC 1	6,545,997	4/2003	Bohnke et al.			
Lits. 7-8 and 17-18	6,546,249	4/2003	Imai et al.			
	6,553,001	4/2003	Indira			
	6,553,011	4/2003	Yan et al.			
	6,553,234	4/2003	Florea			
ITC 1	6,556,557	4/2003	Cimini Jr. et al.			
ITC 1	6,563,786	5/2003	Van Nee			
	6,567,383	5/2003	Bohnke et al.			
Lits. 1-12, 21-28 and 30	6,567,387	5/2003	Dulin et al.			
	6,574,476	6/2003	Williams			
	6,584,330	6/2003	Ruuska			
Lits. 2, 3, 5, 6, 9-12, 21-28, and 30	6,587,696	7/2003	Ma			
	6,600,772	7/2003	Zeira et al.			
Lits. 1, 4, and 7-8	6,600,776	7/2003	Alamouti et al.			
	6,600,934	7/2003	Yun et al.			
	6,606,296	8/2003	Kokkonen			
	6,608,863	8/2003	Onizawa et al.			
	6,609,039	8/2003	Schoen			
	6,611,506	8/2003	Huang et al.			
Lits. 7-8 and 17-18; ITC 1	6,615,024	9/2003	Boros et al.			
	6,633,614	10/2003	Barton et al.			
Lits. 2, 3, 5, 6, 9-12, 21-28, and 30	6,647,078	11/2003	Thomas			
ITC 1	6,647,271	11/2003	Doi			
	6,654,431	11/2003	Barton et al.			
	6,654,612	11/2003	Avidor et al.			
Lits. 1, 4, and 7-8; ITC 1	6,657,949	12/2003	Jones, IV et al.			
Lits. 7-8 and 17-18	6,674,732	1/2004	Boehnke et al.			
	6,681,256	1/2004	Kuntze et al.			
	6,690,944	2/2004	Lee et al.			
Lits. 1, 4, and 7-8	6,693,884	2/2004	Gutowski			
Lits. 1-12, 17-18, 21-28, and 30	6,694,147	2/2004	Viswanath et al.			

	6,699,784	3/2004	Xia et al.			
Lits. 1-12, 21-28, and 30	6,701,129	3/2004	Hashem et al.			
Lits. 7-8	6,711,416	10/2000	Zhang			
Lit. 1	6,721,159	4/2004	Takashige et al.			
Lits. 2, 3, 5-12, 17-18, 21-28, and 30	6,721,569	4/2004	Hashem et al.			
Lits. 1, 4, and 7-8	6,726,297	4/2004	Uesugi et al.			
	6,726,978	4/2004	Sehr			
Lits. 4, 7-8, and 17-18	6,741,861	5/2004	Bender et al.			
Lits. 2, 3, 5, 6, 9-12, 21-28, and 30	6,748,222	6/2004	Hashem et al.			
	6,751,193	6/2004	Kudrimoti et al.			
Lits. 7-8	6,751,261	6/2004	Olsson et al.			
	6,751,444	6/2004	Meiyappan			
Lits. 4, 7-8, and 17-18	6,751,480	6/2004	Kogiantis et al.			
Lits. 7-8 and 17-18; ITC 1	6,757,265	6/2004	Sebastian et al.			
Lits. 1-12, 21-28, and 30	6,760,882	7/2004	Gesbert et al.			
Lits. 23-28	6,775,320	8/2004	Tzannes et al.			
	6,781,974	8/2004	Tsumura			
Lits. 1, 4, and 7-8	6,782,037	8/2004	Krishnamoorthy et al.			
Lits. 1, 4, and 7-8	6,788,349	9/2004	Wu et al.			
	6,795,392	9/2004	Li et al.			
Lits. 2, 3, 5-12, 17-18, 21-28, and 30; ITC 1	6,795,424	9/2004	Kapoor et al.			
Lits. 7-8	6,816,452	11/2004	Maehata et al.			
	6,826,240	11/2004	Thomas et al.			
	6,834,045	12/2004	Lappetelainen et al.			
	6,850,506	2/2005	Holtzman et al.			
Lits. 1-12, 21-28, and 30	6,862,272	3/2005	Dulin et al.			
	6,868,277	3/2005	Cerwall et al.			
Lits. 4, 7-8, 15, and 17-18	6,870,808	3/2005	Liu et al.			
	6,870,826	3/2005	Ishizu			
	6,873,612	3/2005	Steer et al.			
Lits. 4, 7-8, 15, and 17-18	6,882,619	4/2005	Gerakoulis			
ITC 1	6,888,899	5/2005	Raleigh et al.			
ITC 1	6,891,792	5/2005	Cimini, Jr. et al.			
	6,892,059	5/2005	Kim et al.			
	6,904,030	6/2005	Lee et al.			

Lits. 3-5, 7-8, 11, 15, 17-18, and 23-28	6,904,283	6/2005	Li et al.			
Lits. 2, 3, and 5-12	6,904,284	6/2005	Saito, et al.			
Lits. 1, 4, and 7-8	6,907,244	6/2005	Santhoff et al.			
Lits. 1, 4, and 7-8	6,920,122	7/2005	Hanaoka et al.			
Lits. 4, 7-8, 15, and 17-18	6,922,388	7/2005	Laroia et al.			
Lits. 1-12, 17-18, 21-28, and 30; ITC 1	6,922,445	7/2005	Sampath et al.			
Lits. 1, 4, and 7-8	6,928,120	8/2005	Zhang			
Lits. 23-28	6,937,557	8/2005	Sudo			
Lits. 7-8 and 17-18; ITC 1	6,937,665	8/2005	Vandenameele			
Lits. 1, 4, 7-8, and 17-18	6,944,120	9/2005	Wu et al.			
Lits. 3-5, 7-8, 11, 15, 17-18, and 23-28; JP Lit. 6	6,947,748	9/2005	Li et al.			
Lits. 2, 3, 5, 6, 9-12, 21-28, and 30	6,961,364	11/2005	Laroia et al.			
	6,975,603	12/2005	Dicker et al.			
	6,975,611	12/2005	Balachandran et al.			
Lits. 1, 4, and 7-8	6,985,432	1/2006	Hadad et al.			
	6,985,434	1/2006	Wu et al.			
	6,996,056	2/2006	Chheda et al.			
Lits. 1, 4, 7-8, and 17-18	6,996,075	2/2006	Santhoff et al.			
	6,996,100	2/2006	Haartsen			
Lits. 7-8	7,010,048	3/2006	Shattil et al.			
Lits. 4 and 7-8	7,020,072	3/2006	Li et al.			
Lits. 4 and 7-8	7,031,753	4/2006	Hashem			
	7,047,011	5/2006	Wikman et al.			
	7,051,268	5/2006	Sindhushayana et al.			
	7,058,146	6/2006	Paulraj et al.			
	7,062,246	6/2006	Owen			
	7,062,295	6/2006	Yoshii et al.			
	7,068,628	6/2006	Li et al.			
Lits. 2-12, 15, 17-18, 21-28, and 30; ITC 1	7,072,315	7/2006	Liu et al.			
Lits. 1-12, 21-28, and 30	7,095,719	8/2006	Wilhelmsson et al.			
	7,099,413	8/2006	Chuang et al.			
	7,116,944	10/2006	Das et al.			

Lits. 1, 4, and 7-8	7,133,352	11/2006	Hadad			
	7,133,380	11/2006	Winters et al.			
Lits. 4, 7-8, 15, and 17-18	7,135,358	11/2006	Sugino et al.			
ITC 1	7,139,592	11/2006	Leifer et al.			
ITC 1	7,145,971	12/2006	Raleigh et al.			
Lits. 4, 7-8, 15, and 17-18	7,146,172	12/2006	Li et al.			
Lits. 4, 7-8, and 17-18; ITC 1	7,180,877	2/2007	Benveniste			
	7,203,191	4/2007	Garcia-Luna-Aceves et al.			
ITC 1	7,203,249	4/2007	Raleigh et al.			
	7,209,745	4/2007	Sebastian et al.			
	7,224,741	5/2007	Hadad			
Lits. 1-12, 21-28, and 30	7,230,908	6/2007	Vanderaar et al.			
	7,269,389	9/2007	Petrus et al.			
	7,310,522	12/2007	Geile			
	7,355,962	4/2008	Li et al.			
Lits. 4, 7-8, and 17-18	7,366,253	4/2008	Kim et al.			
Lits. 1, 4, and 7-8	7,373,151	5/2008	Ahmed			
	7,376,172	5/2008	Laroia et al.			
Lits. 4 and 7-8	7,379,506	5/2008	Boariu et al.			
	7,379,742	5/2008	Li et al.			
	7,450,604	11/2008	Gardner et al.			
Lits. 3-5, 7-8, 11, 15, 17-18, and 23-28	7,454,212	11/2008	Li et al.			
	7,489,934	2/2009	Li et al.			
	7,509,138	3/2009	Shin et al.			
ITC 1	7,555,060	6/2009	Raleigh et al.			
	7,573,850	8/2009	Li et al.			
Lits. 4, 7-8, 15, and 17-18	7,573,851	8/2009	Xing et al.			
	7,590,095	9/2009	Chen et al.			
	7,650,152	1/2010	Li et al.			
ITC 1	7,664,188	2/2010	Raleigh et al.			
	7,675,938	3/2010	Kolze			
	7,706,315	4/2010	Vaneraar et al.			
	7,715,358	5/2010	Li et al.			
ITC 1	7,751,854	7/2010	Leifer et al.			
	7,783,285	8/2010	Chater-Lea			
	7,787,514	8/2010	Shattil			
	7,787,872	8/2010	Minborg et al.			
ITC 1	7,826,560	11/2010	Raleigh et al.			

	7,827,581	11/2010	Eiger et al.			
	7,933,244	4/2011	Li et al.			
	8,005,479	8/2011	Meiyappan			
ITC 1	8,036,307	10/2011	Raleigh et al.			
	8,036,164	10/2011	Winters et al.			
	8,036,199	10/2011	Li et al.			
Lits. 4, 7-8, 15, and 17-18	8,358,574	1/2013	Gerakoulis			
	8,553,521	10/2013	Zhang et al.			
	8,738,020	5/2014	Li et al.			
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	2001/0040089	11/2001	Hemingway et al.			
	2001/0040880	11/2001	Chen et al.			
	2002/0006120	1/2002	Suzuki et al.			
	2002/0006167	1/2002	McFarland			
	2002/0016173	2/2002	Hunzinger			
	2002/0114269	8/2002	Onggosanusi et al.			
	2002/0115468	8/2002	Haim			
	2002/0160783	10/2002	Holtzman et al.			
	2002/0181436	12/2002	Mueckenheim et al.			
ITC 1	2002/0183010	12/2002	Catreux et al.			
	2002/0188723	12/2002	Choi et al.			
	2002/0191535	12/2002	Sugiyama et al.			
	2003/0003937	1/2003	Ohkubo et al.			
ITC 1	2003/0021245	1/2003	Haumonte et al.			
	2003/0035491	2/2003	Walton et al.			
ITC 1	2003/0067890	4/2003	Goel et al.			
	2003/0068984	4/2003	Shin et al.			
	2003/0108089	6/2003	Lee et al.			
	2003/0148738	8/2003	Arnab et al.			
Lits. 4, 7-8, and 17-18	2003/0165123	9/2003	Saunders			
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Lits. 3, 5, and 11	Webster's New Ninth Collegiate Dictionary, Page 1503, 1991, 3 pgs.
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Lits. 7-8 and 17-18	Weinstein et al., "Data Transmission by Frequency-Division Multiplexing using the Discrete Fourier Transform," IEEE Trans. On Comm. Tech., Vol. com-19, No. 5, Pages 628-634, October 1971, 7 pgs.
Lits. 7-8	Willars et al., "Distribution of WW3 October-95 Deliverable," dated September 29, 1995, 296 pgs.
ITC 1	Winters et al., "The Impact of Antenna Diversity on the Capacity of Wireless Communication Systems," IEEE Trans. On Communications, vol. 42, no. 2/3/4, pages 1740-1751, February/March/April 1994, 12 pgs.
ITC 1	Winters, "Signal Acquisition and Tracking with Adaptive Arrays in the Digital Mobile Radio System IS-54 with Flat Fading," IEEE Transactions on Vehicular Technology, Vol. 43, No. 4, pages 377-384, November 1993, 8 pgs.
JP Lit. 2	"Wireless City Planning," ZTE Webpage, available at www.zte.co.jp/press_center/news/ztejapan/201109/t20110928_9277.html, February 21, 2013, 1 pg.
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Lits. 1, 4, and 7-8	Wong et al., "A Real-Time Sub-Carrier Allocation Scheme for Multiple Access Downlink OFDM Transmission," IEEE 0-7803-5435-4/99, Pages 1124-1128, September 1999, 5 pgs.
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Lits. 7-8	Wong, Kai-Kit, et al., "Adaptive Antennas at the Mobile and Base Stations in an OFDM/TDMA Systems," IEEE Transactions on Communications, Vol. 49, No. 1, pages 195-206, January 2001, 12 pgs.
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Lits. 4, 7-8, 15, and 17-18	Xu et al., "Experimental Studies of Space-Division-Multiple-Access Schemes for Spectral Efficient Wireless Communications," IEEE 0-7803-1825-0/94, Pages 800-804, May 1994, 5 pgs.
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	Yeh, C., et al., "Channel Estimation Using Pilot Tones in OFDM Systems," IEEE Transactions on Broadcasting, Vol. 45, No. 4, pages 400-409, December 1999, 10 pgs.
ITC 1	Yener et al., "Combined temporal and spatial filter structures for CDMA systems," IEEE Vehicular Technology Conference, vol. 5, 0-7803-6507-0/00, Pages 2386-2393, September 2000, 8 pgs.
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Lits. 7-8 and 17-18; ITC 1	Yin & Liu, "An SDMA Protocol for Wireless Multimedia Networks," 2000 IEEE International Conference on Acoustics, Speech, and Signal Processing, Vol. 5, IEEE, 0-7803-6293-4/00, Pages 2613-2616, June 2000, 4 pgs.
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Lits. 7-8 and 17-18	Yu et al., "Transmit Selection Diversity Technique in the MIMO-OFDM System for HSDPA," Vehicular Technology Conference 2004, VTC 2004, Spring 2004, IEEE 59th, Vol. 1, pages 362-366, May 2004, 5 pgs.
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Lits. 7-8	Zysman et al., "Technology Evolution for Mobile and Personal Communications," Bell Labs Technical Journal, Pages 107-129, January-March 2000, 23 pgs.
Lits. 4 and 7-8	~~"PictaNode," Nortel, available at http://www.nortelnetworks.com/products/01/gsm/pn.html, 1999, 4 pgs.~~
Lits. 4 and 7-8	"Wireless LAN," Nokia, available at http://www.nokia.com/corporate/wlan/woffice.html, December 2000, 2 pgs.

EXAMINER /Meless Zewdu/	**DATE CONSIDERED** 06/25/2014

EXAMINER: Initial if citation considered, whether or not citation is in conformance with MPEP § 609; Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to the applicant.

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	14294106	LI ET AL.
	Examiner	Art Unit
	MELESS ZEWDU	2643

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	06/25/2014								
	1	✓								
	2	O								
	3	O								
	4	O								
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	21	O								
	22	O								
	23	O								
	24	O								
	25	O								
	26	O								
	27	O								
	28	O								
	29	O								
	30	O								

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	14294106	LI ET AL.
	Examiner	Art Unit
	MELESS ZEWDU	2643

CPC- SEARCHED

Symbol	Date	Examiner
H04B17/00, H04B1/00, H04B15/00, H04B7/00, H04M3/00, H04W24/00, H04W4/00, H04W72/00, H04B1/38, H04B1/10, G08C15/00, H04J1/00, H04B7/208, H04B7/212, H04J3/24, H04J3/06	7/2/2014	M.Z.

CPC COMBINATION SETS - SEARCHED

Symbol	Date	Examiner

US CLASSIFICATION SEARCHED

Class	Subclass	Date	Examiner
455	420, 423-425, 434, 450-451, 452.1-452.2, 453, 509-510, 512-514, 516-517, 522, 524-525, 61-62, 63.1, 67.11, 67.13, 68-69, 702-703, 70-71, 550.1, 556.2, 560-561).ccls.) or (370/(252, 328-329, 338, 341, 343-344, 347, 349-350, 447	6/25/2014	M.Z.

SEARCH NOTES

Search Notes	Date	Examiner
Searched in EAST: US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT & IBM_TDB	6/25/2014	M.Z.
Searchedby: Assignee; Inventors; Keywords; Class-subclasses and CPC symbols (for more detail, please refer to the attached search history printout)	6/25/2014	M>Z.

INTERFERENCE SEARCH

US Class/ CPC Symbol	US Subclass / CPC Group	Date	Examiner

	/MELESS ZEWDU/ Primary Examiner, Art Unit 2643

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BIB DATA SHEET

CONFIRMATION NO. 9020

SERIAL NUMBER	FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
14/294,106	06/02/2014 RULE	370	2643	176.0003-06000

APPLICANTS

ADAPTIX, INC., Plano, TX, Assignee (with 37 CFR 1.172 Interest);

INVENTORS

Xiaodong Li, Bellevue, WA;
Hui Liu, Clyde Hill, WA;
Kemin Li, Bellevue, WA;
Wenzhong Zhang, Bellevue, WA;

** **CONTINUING DATA** **********

This application is a CON of 13/230,625 09/12/2011
which is a CON of 12/748,781 03/29/2010 PAT 8036199
which is a CON of 11/931,926 10/31/2007 PAT 7715358
which is a CON of 11/199,586 08/08/2005 PAT 7454212
which is a CON of 09/738,086 12/15/2000 PAT 6947748

** **FOREIGN APPLICATIONS** **********

** **IF REQUIRED, FOREIGN FILING LICENSE GRANTED** **

06/11/2014

Foreign Priority claimed	35 USC 119(a-d) conditions met	Verified and Acknowledged	Met after Allowance	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
☐ Yes ☑ No	☐ Yes ☑ No	/MELESS NMN ZEWDU/ Examiner's Signature	☐ Initials	WA	7	30	2

ADDRESS

MARTIN & FERRARO, LLP
1557 LAKE O'PINES STREET, NE
HARTVILLE, OH 44632
UNITED STATES

TITLE

OFDMA WITH ADAPTIVE SUBCARRIER-CLUSTER CONFIGURATION AND SELECTIVE LOADING

FILING FEE RECEIVED	FEES: Authority has been given in Paper	
2400	No._____ to charge/credit DEPOSIT ACCOUNT No._____ for following:	☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit

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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
14/294,106	06/02/2014		2400	176.0003-06000	30	2

CONFIRMATION NO. 9020

22882
MARTIN & FERRARO, LLP
1557 LAKE O'PINES STREET, NE
HARTVILLE, OH 44632

FILING RECEIPT

OC000000068973933

Date Mailed: 06/12/2014

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Inventor(s)

Xiaodong Li, Bellevue, WA;
Hui Liu, Clyde Hill, WA;
Kemin Li, Bellevue, WA;
Wenzhong Zhang, Bellevue, WA;

Applicant(s)

ADAPTIX, INC., Plano, TX

Assignment For Published Patent Application

ADAPTIX, INC., Plano, TX

Power of Attorney: The patent practitioners associated with Customer Number 22882

Domestic Priority data as claimed by applicant

This application is a CON of 13/230,625 09/12/2011
which is a CON of 12/748,781 03/29/2010 PAT 8036199
which is a CON of 11/931,926 10/31/2007 PAT 7715358
which is a CON of 11/199,586 08/08/2005 PAT 7454212
which is a CON of 09/738,086 12/15/2000 PAT 6947748

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

If Required, Foreign Filing License Granted: 06/11/2014

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 14/294,106**

Projected Publication Date: 09/18/2014

Non-Publication Request: No

Early Publication Request: No

Title

OFDMA WITH ADAPTIVE SUBCARRIER-CLUSTER CONFIGURATION AND SELECTIVE LOADING

Preliminary Class

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

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NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 14/294,106

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	280
SEARCH FEE (37 CFR 1.16(k), (l), or (m))	N/A	N/A	N/A			N/A	600
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	720
TOTAL CLAIMS (37 CFR 1.16(i))	30 minus 20 =	* 10			OR	x 80 =	800
INDEPENDENT CLAIMS (37 CFR 1.16(h))	2 minus 3 =	*				x 420 =	0.00
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0.00
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	2400

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE($)	ADDITIONAL FEE($)		RATE($)	ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
14/294,106	06/02/2014	Xiaodong Li	176.0003-06000

CONFIRMATION NO. 9020

22882
MARTIN & FERRARO, LLP
1557 LAKE O'PINES STREET, NE
HARTVILLE, OH 44632

NOTICE

OC000000068973934

Date Mailed: 06/12/2014

INFORMATIONAL NOTICE TO APPLICANT

Applicant is notified that the above-identified application contains the deficiencies noted below. No period for reply is set forth in this notice for correction of these deficiencies. However, if a deficiency relates to the inventor's oath or declaration, the applicant must file an oath or declaration in compliance with 37 CFR 1.63, or a substitute statement in compliance with 37 CFR 1.64, executed by or with respect to each actual inventor no later than the expiration of the time period set in the "Notice of Allowability" to avoid abandonment. See 37 CFR 1.53(f).

The item(s) indicated below are also required and should be submitted with any reply to this notice to avoid further processing delays.

A new inventor's oath or declaration that identifies this application (e.g., by Application Number and filing date) is required. The inventor's oath or declaration does not comply with 37 CFR 1.63 in that it:

- does not state that the above-identified application was made or authorized to be made by the person executing the oath or declaration.

  Xiaodong Li
  Hui Liu
  Kemin Li
  Wenzhong Zhang

Doc Code: TRACK1.REQ
Document Description: TrackOne Request

PTO/AIA/424 (03-14)

CERTIFICATION AND REQUEST FOR PRIORITIZED EXAMINATION UNDER 37 CFR 1.102(e) (Page 1 of 1)

First Named Inventor:	Xiaodong Li	Nonprovisional Application Number (if known):	(Cont. of 13/230,625)
Title of Invention:	OFDMA WITH ADAPTIVE SUBCARRIER-CLUSTER CONFIGURATION AND SELECTIVE LOADING		

APPLICANT HEREBY CERTIFIES THE FOLLOWING AND REQUESTS PRIORITIZED EXAMINATION FOR THE ABOVE-IDENTIFIED APPLICATION.

1. The processing fee set forth in 37 CFR 1.17(i)(1), the prioritized examination fee set forth in 37 CFR 1.17(c), and if not already paid, the publication fee set forth in 37 CFR 1.18(d) have been filed with the request. The basic filing fee, search fee, and examination fee are filed with the request or have been already been paid. I understand that any required excess claims fees or application size fee must be paid for the application.

2. I understand that the application may not contain, or be amended to contain, more than four independent claims, more than thirty total claims, or any multiple dependent claims.

3. The applicable box is checked below:

I. ☑ Original Application (Track One) - Prioritized Examination under § 1.102(e)(1)

i. (a) The application is an original nonprovisional utility application filed under 35 U.S.C. 111(a). This certification and request is being filed with the utility application via EFS-Web.

---OR---

(b) The application is an original nonprovisional plant application filed under 35 U.S.C. 111(a). This certification and request is being filed with the plant application in paper.

ii. An executed inventor's oath or declaration under 37 CFR 1.63 or 37 CFR 1.64 for each inventor, **or** the application data sheet meeting the conditions specified in 37 CFR 1.53(f)(3)(i) is filed with the application.

II. ☐ Request for Continued Examination - Prioritized Examination under § 1.102(e)(2)

i. A request for continued examination has been filed with, or prior to, this form.
ii. If the application is a utility application, this certification and request is being filed via EFS-Web.
iii. The application is an original nonprovisional utility application filed under 35 U.S.C. 111(a), or is a national stage entry under 35 U.S.C. 371.
iv. This certification and request is being filed prior to the mailing of a first Office action responsive to the request for continued examination.
v. No prior request for continued examination has been granted prioritized examination status under 37 CFR 1.102(e)(2).

Signature /Alfred Y. Chu/	Date June 2, 2014
Name (Print/Typed) Alfred Y. Chu	Practitioner Registration Number 62,317

Note: *This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. Submit multiple forms if more than one signature is required.**

☑ *Total of 1 forms are submitted.

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	176.0003-06000
	Application Number	

Title of Invention	OFDMA WITH ADAPTIVE SUBCARRIER-CLUSTER CONFIGURATION AND SELECTIVE LOADING

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Xiaodong		Li	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	Bellevue	State/Province	WA	Country of Residence i	US

Mailing Address of Inventor:

Address 1	13075 SE 26th, Apt. E208		
Address 2			
City	Bellevue	State/Province	WA
Postal Code	98005	Country i	US

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Hui		Liu	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	Clyde Hill	State/Province	WA	Country of Residence i	US

Mailing Address of Inventor:

Address 1	8629 NE 26th Place		
Address 2			
City	Clyde Hill	State/Province	WA
Postal Code	98004	Country i	US

Inventor 3 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Kemin		Li	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	176.0003-06000
	Application Number	
Title of Invention	OFDMA WITH ADAPTIVE SUBCARRIER-CLUSTER CONFIGURATION AND SELECTIVE LOADING	

City	Bellevue	State/Province	WA	Country of Residence i	US

Mailing Address of Inventor:

Address 1	14733 NE 1st Place #E6		
Address 2			
City	Bellevue	State/Province	WA
Postal Code	98007	Country i	US

Remove

Inventor 4

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Wenzhong		Zhang	

Residence Information (Select One) (•) US Residency ( ) Non US Residency ( ) Active US Military Service

City	Bellevue	State/Province	WA	Country of Residence i	US

Mailing Address of Inventor:

Address 1	4275 148th Avenue, NE, F20		
Address 2			
City	Bellevue	State/Province	WA
Postal Code	98007	Country i	US

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	22882		
Email Address		Add Email	Remove Email

Application Information:

Title of the Invention	OFDMA WITH ADAPTIVE SUBCARRIER-CLUSTER CONFIGURATION AND SELECTIVE LOADING		
Attorney Docket Number	176.0003-06000	Small Entity Status Claimed	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	7	Suggested Figure for Publication (if any)	

Filing By Reference :

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	176.0003-06000
	Application Number	
Title of Invention	OFDMA WITH ADAPTIVE SUBCARRIER-CLUSTER CONFIGURATION AND SELECTIVE LOADING	

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	◉ Customer Number	○ US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	22882		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, or 365(c) or indicate National Stage entry from a PCT application. Providing this information in the application data sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the application number blank.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)
	Continuation of	13230625	2011-09-12

Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
13230625	Continuation of	12748781	2010-03-29	8036199	2011-10-11

Prior Application Status	Patented	Remove

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	176.0003-06000
	Application Number	
Title of Invention	OFDMA WITH ADAPTIVE SUBCARRIER-CLUSTER CONFIGURATION AND SELECTIVE LOADING	

Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
12748781	Continuation of	11931926	2007-10-31	7715358	2010-05-11
Prior Application Status	Patented			Remove	
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
11931926	Continuation of	11199586	2005-08-08	7454212	2008-11-18
Prior Application Status	Patented			Remove	
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
11199586	Continuation of	09738086	2000-12-15	6947748	2005-09-20

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button. Add

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55(d). When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX) [i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(h)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Remove

Application Number	Country [i]	Filing Date (YYYY-MM-DD)	Access Code [i] (if applicable)

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button. Add

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	176.0003-06000
	Application Number	
Title of Invention	OFDMA WITH ADAPTIVE SUBCARRIER-CLUSTER CONFIGURATION AND SELECTIVE LOADING	

Authorization to Permit Access:

☐ Authorization to Permit Access to the Instant Application by the Participating Offices

If checked, the undersigned hereby grants the USPTO authority to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the World Intellectual Property Office (WIPO), and any other intellectual property offices in which a foreign application claiming priority to the instant patent application is filed access to the instant patent application. See 37 CFR 1.14(c) and (h). This box should not be checked if the applicant does not wish the EPO, JPO, KIPO, WIPO, or other intellectual property office in which a foreign application claiming priority to the instant patent application is filed to have access to the instant patent application.

In accordance with 37 CFR 1.14(h)(3), access will be provided to a copy of the instant patent application with respect to: 1) the instant patent application-as-filed; 2) any foreign application to which the instant patent application claims priority under 35 U.S.C. 119(a)-(d) if a copy of the foreign application that satisfies the certified copy requirement of 37 CFR 1.55 has been filed in the instant patent application; and 3) any U.S. application-as-filed from which benefit is sought in the instant patent application.

In accordance with 37 CFR 1.14(c), access may be provided to information concerning the date of filing this Authorization.

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1 Remove

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

◉ Assignee	○ Legal Representative under 35 U.S.C. 117	○ Joint Inventor
○ Person to whom the inventor is obligated to assign.	○ Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor :

If the Applicant is an Organization check here. ☒

Organization Name	Adaptix, Inc.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	176.0003-06000
	Application Number	
Title of Invention	OFDMA WITH ADAPTIVE SUBCARRIER-CLUSTER CONFIGURATION AND SELECTIVE LOADING	

Mailing Address Information:			
Address 1	2400 Dallas Parkway		
Address 2	Suite 200		
City	Plano	**State/Province**	TX
Country i	US	Postal Code	75093
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button. Add

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not subsitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication . An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

Remove

If the Assignee or Non-Applicant Assignee is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Mailing Address Information For Assignee including Non-Applicant Assignee:			
Address 1			
Address 2			
City		**State/Province**	
Country i		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button. Add

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	176.0003-06000
	Application Number	
Title of Invention	OFDMA WITH ADAPTIVE SUBCARRIER-CLUSTER CONFIGURATION AND SELECTIVE LOADING	

Signature:

Remove

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications					
Signature	/Alfred Y. Chu/			Date (YYYY-MM-DD)	2014-06-02
First Name	Alfred	Last Name	Chu	Registration Number	62317
Additional Signature may be generated within this form by selecting the Add button. Add					

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Attorney's Docket No.: 05158.P002 Patent

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below, next to my name.

I believe I am the original, first, and sole inventor (if only one name is listed below) or an original, first, and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled
OFDMA WITH ADAPTIVE SUBCARRIER-CLUSTER CONFIGURATION AND SELECTIVE LOADING

the specification of which

___ is attached hereto.
X was filed on (MM/DD/YYYY) 12/15/2000 as
United States Application Number 09/738,086
or PCT International Application Number _____
and was amended on (MM/DD/YYYY) _____.
(if applicable)

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claim(s), as amended by any amendment referred to above. I do not know and do not believe that the claimed invention was ever known or used in the United States of America before my invention thereof, or patented or described in any printed publication in any country before my invention thereof or more than one year prior to this application, that the same was not in public use or on sale in the United States of America more than one year prior to this application, and that the invention has not been patented or made the subject of an inventor's certificate issued before the date of this application in any country foreign to the United States of America on an application filed by me or my legal representatives or assigns more than twelve months (for a utility patent application) or six months (for a design patent application) prior to this application.

I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, Section 119(a)-(d), of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Prior Foreign Application(s)			Priority Claimed	
(Number)	(Country)	(Foreign Filing Date - MM/DD/YYYY)	Yes	No
(Number)	(Country)	(Foreign Filing Date - MM/DD/YYYY)	Yes	No
(Number)	(Country)	(Foreign Filing Date - MM/DD/YYYY)	Yes	No

I hereby claim the benefit under title 35, United States Code, Section 119(e) of any United States provisional application(s) listed below:

(Application Number)	(Filing Date – MM/DD/YYYY)
(Application Number)	(Filing Date – MM/DD/YYYY)

I hereby claim the benefit under Title 35, United States Code, Section 120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, Section 112, I acknowledge the duty to disclose all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, Section 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

(Application Number)	(Filing Date – MM/DD/YYYY)	(Status -- patented, pending, abandoned)
(Application Number)	(Filing Date – MM/DD/YYYY)	(Status -- patented, pending, abandoned)

I hereby appoint the persons listed on Appendix A hereto (which is incorporated by reference and a part of this document) as my respective patent attorneys and patent agents, with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected herewith.

Send correspondence to Michael J. Mallie, BLAKELY, SOKOLOFF, TAYLOR & ZAFMAN LLP, 12400 Wilshire Boulevard 7th Floor, Los Angeles, California 90025 and direct telephone calls to Michael J. Mallie, (408) 720-8300.

(Name of Attorney or Agent)

(Name of Attorney or Agent)

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of Sole/First Inventor Xiaodong Li

Inventor's Signature _____ Date 6/19/2001

Residence Bellevue, Washington (City, State) Citizenship China (Country)

Post Office Address 13075 SE 26th, Apt. E208
Bellevue, Washington 98005

Full Name of Second/Joint Inventor Hui Liu

Inventor's Signature _____ Date 6/19/2001

Residence Sammamish, Washington (City, State) Citizenship China (Country)

Post Office Address 2708 226th Ave., SE
Sammamish, Washington 98075

Full Name of Third/Joint Inventor Kemin Li

Inventor's Signature _____ Date 6/19/2001

Residence Bellevue, Washington (City, State) Citizenship China (Country)

Post Office Address 14733 NE 1st Place #E6
Bellevue, Washington 98007

Full Name of Fourth/Joint Inventor Wenzhong Zhang

Inventor's Signature _____ Date 6/19/2001

Residence Bellevue, Washington (City, State) Citizenship China (Country)

Post Office Address 4275 148th Avenue, NE, F20
Bellevue, Washington 98007

APPENDIX A

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APPENDIX B

Title 37, Code of Federal Regulations, Section 1.56
Duty to Disclose Information Material to Patentability

(a) A patent by its very nature is affected with a public interest. The public interest is best served, and the most effective patent examination occurs when, at the time an application is being examined, the Office is aware of and evaluates the teachings of all information material to patentability. Each individual associated with the filing and prosecution of a patent application has a duty of candor and good faith in dealing with the Office, which includes a duty to disclose to the Office all information known to that individual to be material to patentability as defined in this section. The duty to disclosure information exists with respect to each pending claim until the claim is cancelled or withdrawn from consideration, or the application becomes abandoned. Information material to the patentability of a claim that is cancelled or withdrawn from consideration need not be submitted if the information is not material to the patentability of any claim remaining under consideration in the application. There is no duty to submit information which is not material to the patentability of any existing claim. The duty to disclosure all information known to be material to patentability is deemed to be satisfied if all information known to be material to patentability of any claim issued in a patent was cited by the Office or submitted to the Office in the manner prescribed by §§1.97(b)-(d) and 1.98. However, no patent will be granted on an application in connection with which fraud on the Office was practiced or attempted or the duty of disclosure was violated through bad faith or intentional misconduct. The Office encourages applicants to carefully examine:

(1) Prior art cited in search reports of a foreign patent office in a counterpart application, and

(2) The closest information over which individuals associated with the filing or prosecution of a patent application believe any pending claim patentably defines, to make sure that any material information contained therein is disclosed to the Office.

(b) Under this section, information is material to patentability when it is not cumulative to information already of record or being made or record in the application, and

(1) It establishes, by itself or in combination with other information, a prima facie case of unpatentability of a claim; or

(2) It refutes, or is inconsistent with, a position the applicant takes in:

(i) Opposing an argument of unpatentability relied on by the Office, or

(ii) Asserting an argument of patentability.

A prima facie case of unpatentability is established when the information compels a conclusion that a claim is unpatentable under the preponderance of evidence, burden-of-proof standard, giving each term in the claim its broadest reasonable construction consistent with the specification, and before any consideration is given to evidence which may be submitted in an attempt to establish a contrary conclusion of patentability.

(c) Individuals associated with the filing or prosecution of a patent application within the meaning of this section are:

(1) Each inventor named in the application;

(2) Each attorney or agent who prepares or prosecutes the application; and

(3) Every other person who is substantively involved in the preparation or prosecution of the application and who is associated with the inventor, with the assignee or with anyone to whom there is an obligation to assign the application.

(d) Individuals other than the attorney, agent or inventor may comply with this section by disclosing information to the attorney, agent, or inventor.

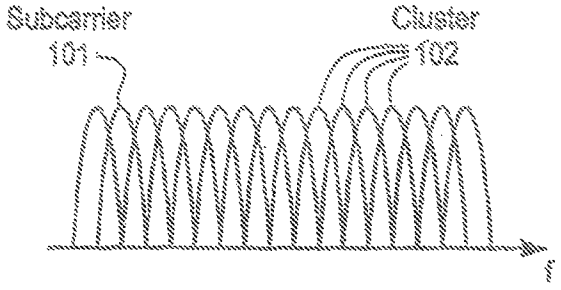
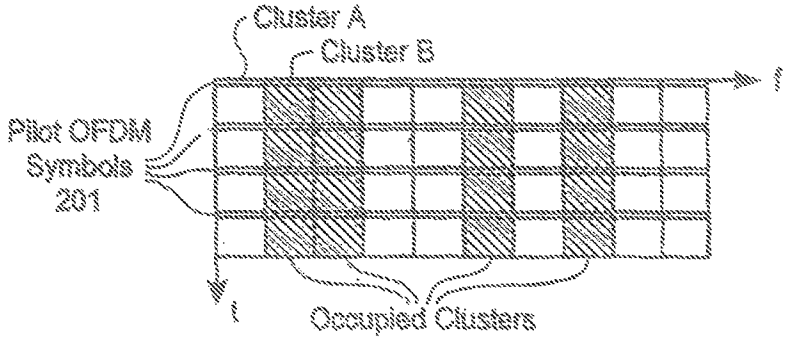
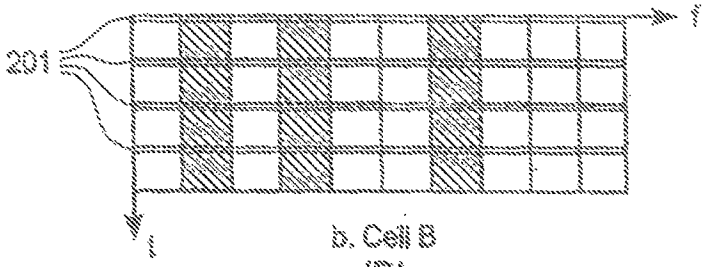


FIG. 1A



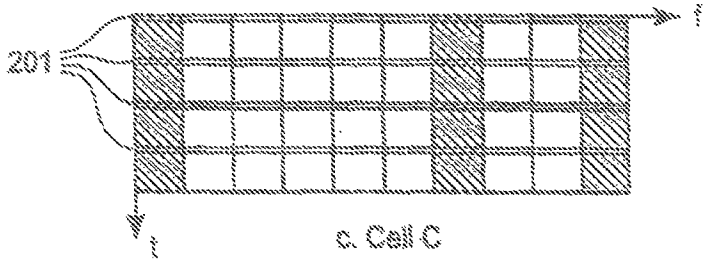
a. Cell A

(A)



b. Cell B

(B)



c. Cell C

(C)

FIG. 2

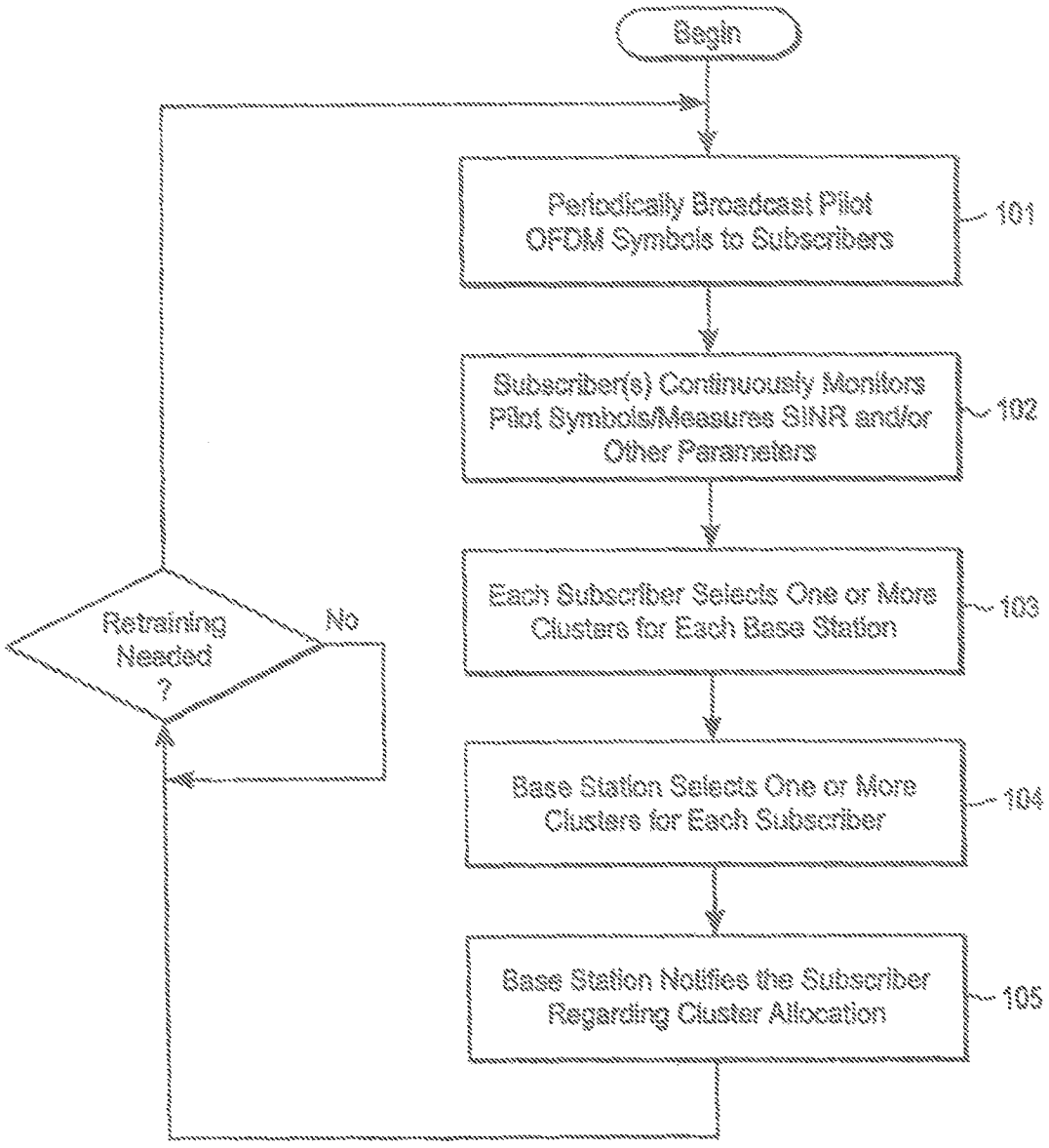

Begin
Periodically Broadcast Pilot OFDM Symbols to Subscribers
101
Subscriber(s) Continuously Monitors Pilot Symbols/Measures SINR and/or Other Parameters
102
Each Subscriber Selects One or More Clusters for Each Base Station
103
Base Station Selects One or More Clusters for Each Subscriber
104
Base Station Notifies the Subscriber Regarding Cluster Allocation
105
Retraining Needed ?
No

FIG. 1B

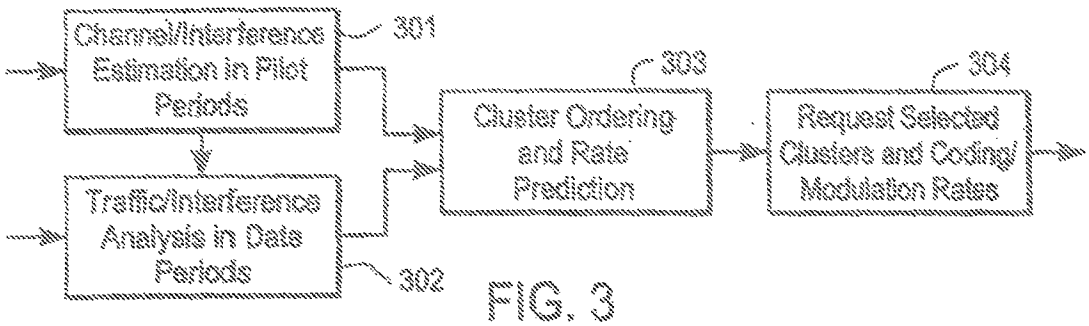


FIG. 3

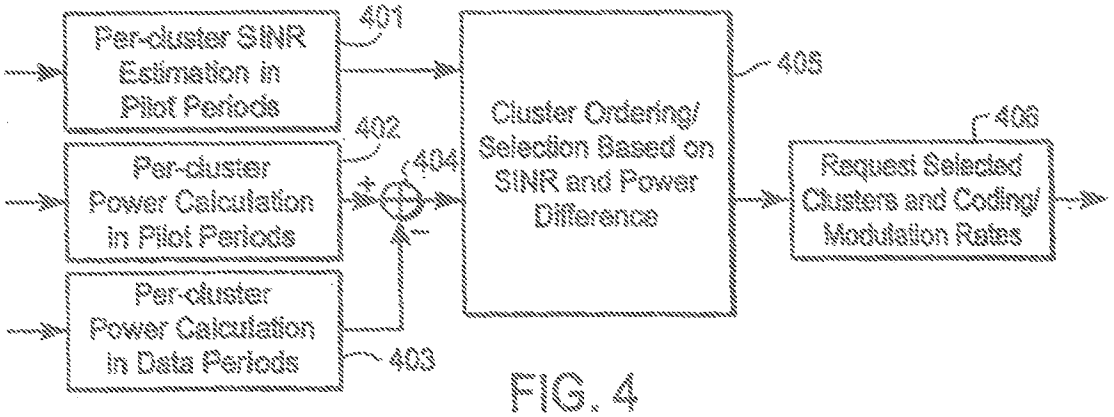


FIG. 4

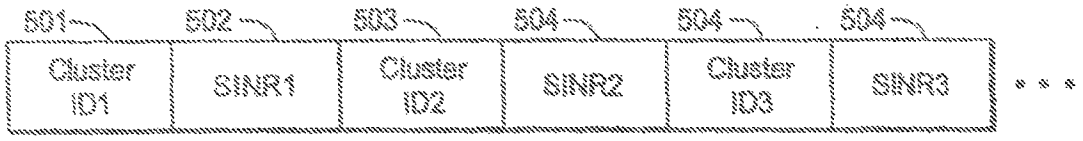


FIG. 5

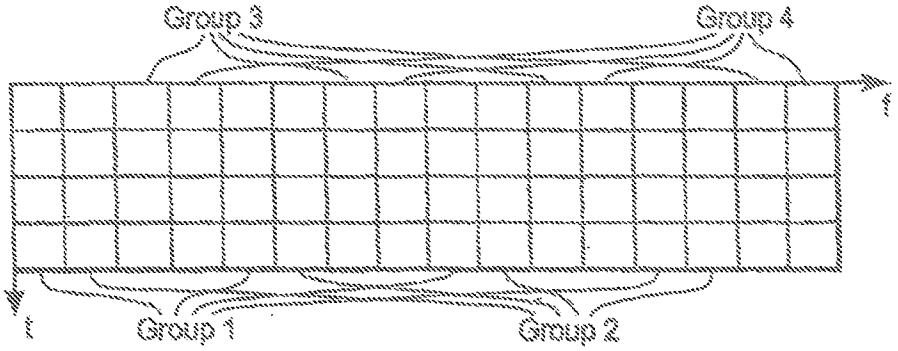


FIG. 6

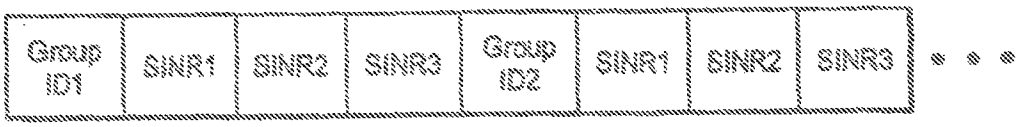

Group ID1
SINR1
SINR2
SINR3
Group ID2
SINR1
SINR2
SINR3

FIG. 7

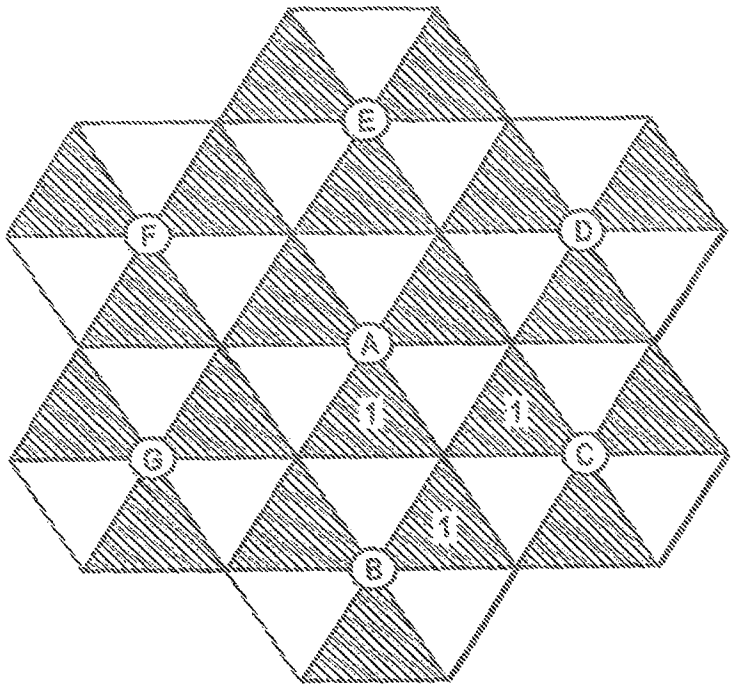

E
F
D
A
1
1
1
G
C
1
B

FIG. 8

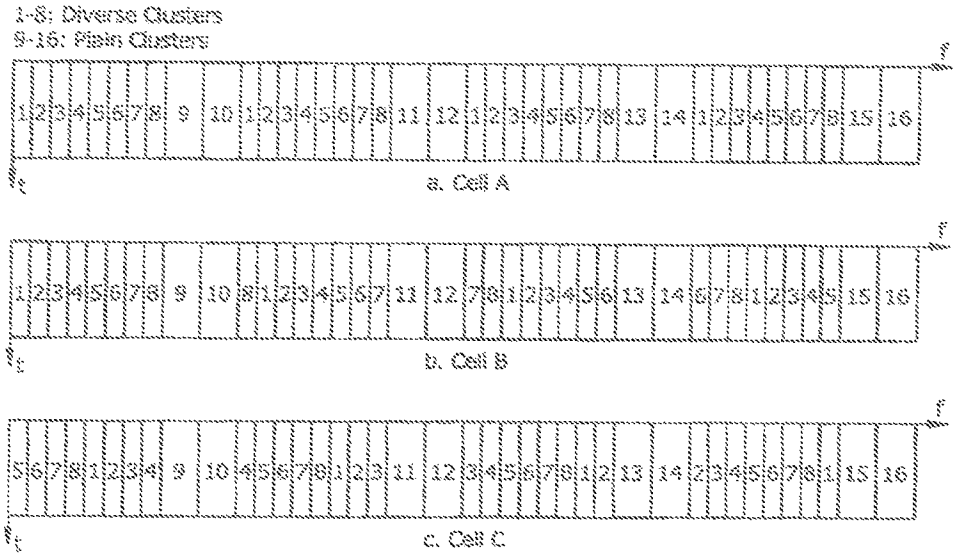

1-8: Diverse Clusters
9-16: Plain Clusters
a. Cell A
b. Cell B
c. Cell C

FIG. 9

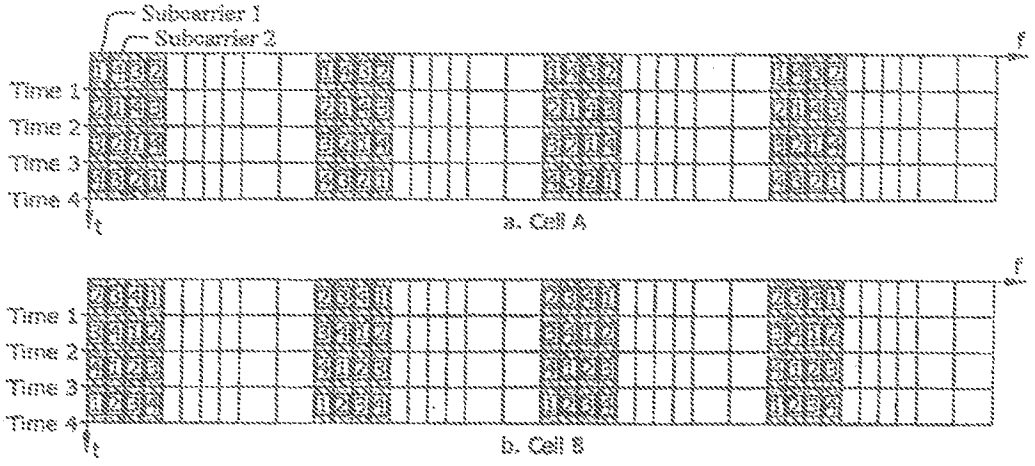

Subcarrier 1
Subcarrier 2
Time 1
Time 2
Time 3
Time 4
a. Cell A
b. Cell B

FIG. 10

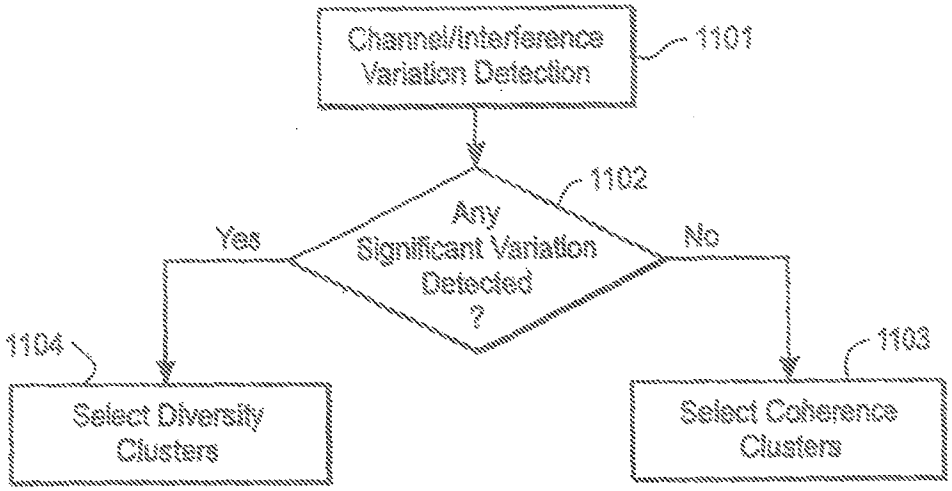
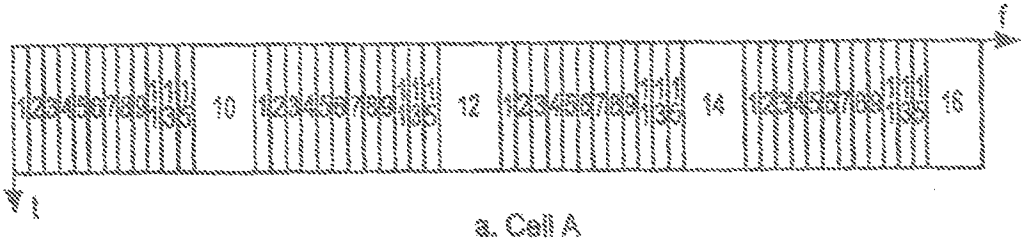


FIG. 11



a. Cell A

FIG. 12

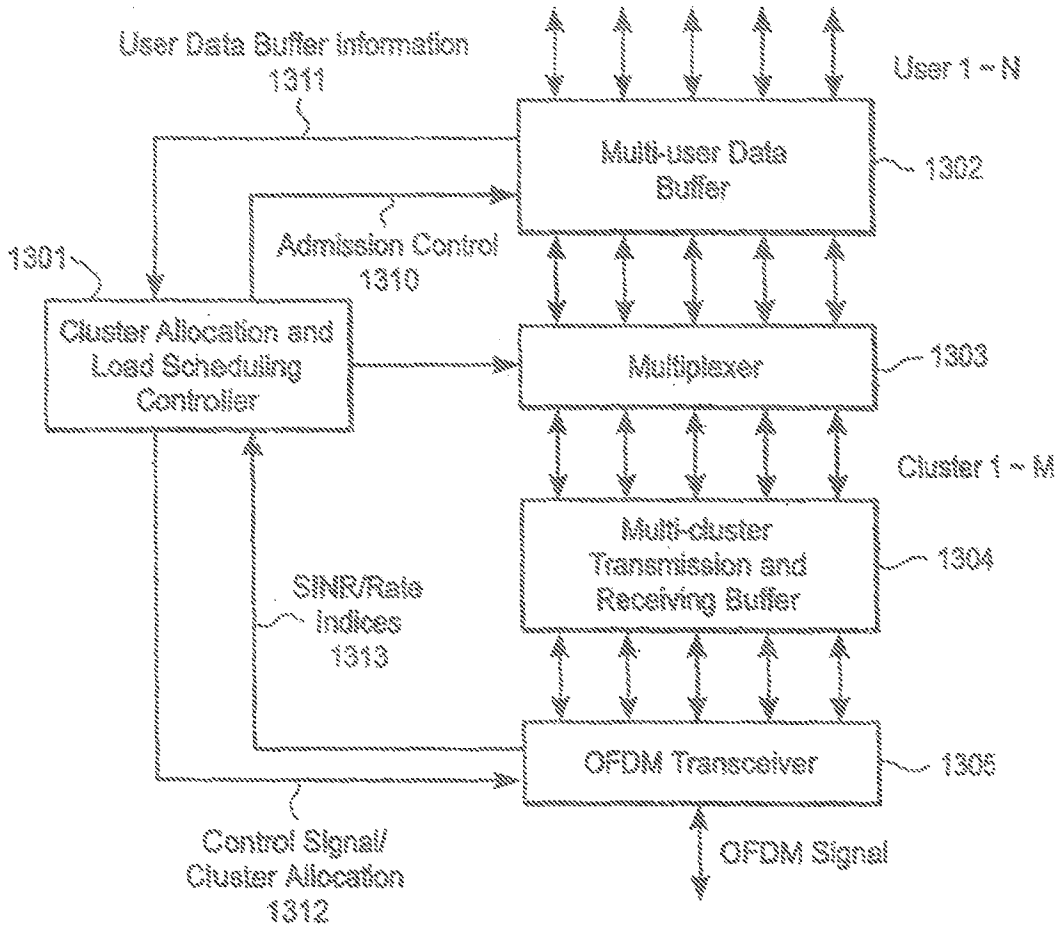

User Data Buffer Information
1311
User 1 ~ N
Multi-user Data Buffer
1302
Admission Control
1310
1301
Cluster Allocation and Load Scheduling Controller
Multiplexer
1303
Cluster 1 ~ M
Multi-cluster Transmission and Receiving Buffer
1304
SINR/Rate Indices
1313
OFDM Transceiver
1305
Control Signal/ Cluster Allocation
1312
OFDM Signal

FIG. 13

Substitute for FORM PTO-1449	Attorney Docket Number 176.0003-06000	Customer No. 22882	
INFORMATION DISCLOSURE CITATION IN AN APPLICATION	Applicant Xiaodong Li et al.	Application Number (Cont. of 13/230,625)	
(Use several sheets if necessary) Sheet 1 of 48	Filing Date June 2, 2014	Group Art Unit (2643)	Examiner (M. Zewdu)

U.S. PATENT DOCUMENTS

EXAMINER INITIAL	DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
Lits. 1, 4, 7-8, and 17-18	4,355,411	10/1982	Reudink et al.			
Lits. 7-8 and 17-18	4,488,445	12/1984	Aske			
Lits. 1, 4, and 7-8	4,670,889	6/1987	Hewitt et al.			
	4,794,635	12/1988	Hess			
Lits. 1, 4, and 7-8	5,038,399	8/1991	Bruckert			
Lits. 17-18	5,048,059	9/1991	Dent			
Lits. 7-8 and 17-18	5,200,957	4/1993	Dahlin			
ITC 1	5,212,831	5/1993	Chuang et al.			
Lits. 1, 4, and 7-8	5,239,676	8/1993	Strawczynski et al.			
ITC 1	5,260,967	11/1993	Schilling			
Lits. 2, 3, 5, 6, 9-12, 21-28, and 30	5,267,261	11/1993	Blakeney, II et al.			
Lits. 1, 4, and 7-8; ITC 1	5,280,630	1/1994	Wang			
Lits. 1-12, 21-28, and 30	5,282,222	1/1994	Fattouche et al.			
ITC 1	5,291,475	3/1994	Bruckert			
ITC 1	5,319,634	6/1994	Bartholomew			
	5,323,447	6/1994	Gillis et al.			
	5,327,576	7/1994	Uddenfeldt et al.			
ITC 1	5,345,599	9/1994	Paulraj et al.			
Lits. 7-8 and 17-18	5,410,538	4/1995	Roche et al.			
Lits. 1, 4, and 7-8	5,437,054	7/1995	Rappaport et al.			
Lits. 2, 3, 5, 6, 9-12, 21-28, and 30	5,444,697	8/1995	Leung et al.			
Lits. 7-8 and 17-18	5,448,750	9/1995	Eriksson et al.			
Lits. 1-12, 21-28, and 30	5,471,647	11/1995	Gerlach et al.			
Lits. 1-12, 21-28, and 30; ITC 1	5,479,447	12/1995	Chow et al.			

Lits. 1-12, 17-18, 21-28, and 30	5,491,837	2/1996	Haartsen			
Lits. 4 and 7-8	5,492,837	8/1993	Naser-Kilahzadeh			
ITC 1	5,504,775	4/1996	Chouly et al.			
	5,504,783	4/1996	Tomisato et al.			
Lits. 7-8	5,507,008	4/1996	Kanai et al.			
Lits. 2, 3, 5, 6, 9-12, 21-28, and 30; ITC 1	5,507,034	4/1996	Bodin et al.			
Lits. 1, 4, 7-8 and 17-18; ITC 1	5,515,378	5/1996	Roy, III et al.			
Lits. 4, 7-8, and 17-18; ITC 1	5,546,090	8/1996	Roy, III et al.			
Lits. 7-8 and 17-18	5,548,582	8/1996	Brajal et al.			
Lits. 1, 4, and 7-8; ITC 1	5,555,268	9/1996	Fattouche et al.			
Lits. 2, 3, 5, 6, 9-12, 21-28, and 30	5,577,022	11/1996	Padovani			
Lits. 7-8 and 17-18	5,581,548	12/1996	Ugland et al.			
	5,586,148	12/1996	Furukawa et al.			
ITC 1	5,588,020	12/1996	Schilling			
	5,590,156	12/1996	Carney			
Lits. 4, 7-8, and 17-18; ITC 1	5,592,490	1/1997	Barratt et al.			
Lits. 2, 3, 5, 6, 9-12, 21-28, and 30	5,598,417	1/1997	Crisler			
Lits. 2, 3, 5, 6, 9-12, 21-28, and 30	5,623,484	4/1997	Muszynski			
Lits. 1, 4, and 7-8	5,634,199	5/1997	Gerlach et al.			
Lits. 4, 7-8, and 17-18; ITC 1	5,642,353	6/1997	Roy, III et al.			
ITC 1	5,687,194	11/1997	Paneth et al.			
Lits. 4, 7-8, and 17-18; ITC 1	5,708,973	1/1998	Ritter			
Lits. 1-12, 17-18, 21-28, and 30; ITC 1; JP Lit. 1; JP Trial 3	5,726,978	3/1998	Frodigh et al.			
Lits. 1, 4, 7-8, and 17-18	5,732,353	3/1998	Haartsen			
Lits. 1, 4, and 7-8; ITC 1	5,734,967	3/1998	Kotzin et al.			
Lits. 1-12, 21-28, and 30	5,764,699	6/1998	Needham et al.			

ITC 1	5,774,808	6/1998	Sarkioja et al.			
	5,784,363	7/1998	Engstrom et al.			
	5,793,759	8/1998	Rakib et al.			
	5,796,722	8/1998	Kotzin et al.			
ITC 1	5,799,000	8/1998	Hoole			
Lits. 4, 7-8, and 17-18	5,819,168	10/1998	Golden et al.			
ITC 1	5,822,372	10/1998	Emami			
Lits. 7-8 and 17-18; ITC 1	5,828,658	10/1998	Ottersten et al.			
	5,838,673	11/1998	Mordechai			
	5,839,074	11/1998	Plehn et al.			
ITC 1	5,848,358	12/1998	Forssen et al.			
Lits. 7-8 and 17-18	5,854,981	12/1998	Wallstedt et al.			
	5,862,487	1/1999	Fuji et al.			
Lits. 1-12, 21-28, and 30; ITC 1	5,867,478	2/1999	Baum et al.			
Lits. 1-12, 21-28, and 30	5,884,145	3/1999	Haartsen			
Lits. 1, 4, 7-8, and 17-18; ITC 1	5,886,988	3/1999	Yun et al.			
ITC 1	5,887,245	3/1999	Lindroth et al.			
	5,887,263	3/1999	Ishii			
Lits. 1, 4, and 7-8; ITC 1	5,909,436	6/1999	Engstrom et al.			
Lits. 7-8	5,912,876	6/1999	H'Mimy			
Lits. 2, 3, 5, 6, 9-12, 21-28, and 30	5,912,931	6/1999	Matsumoto			
Lits. 1-12, 17-18, 21-28, and 30; ITC 1	5,914,933	6/1999	Cimini et al.			
ITC 1	5,914,946	6/1999	Avidor et al.			
Lits. 1, 4, 7-8, 15, 17-18, and 23-28; ITC 1	5,933,421	8/1999	Alamouti et al.			
ITC 1	5,943,375	8/1999	Veintimilla			
Lits. 1-12, 17-18, 21-28, and 30; ITC 1	5,956,642	9/1999	Larsson et al.			
Lits. 7-8	5,966,644	10/1999	Suzuki			
ITC 1	5,973,642	10/1999	Li et al.			
Lits. 4 and 7-8	5,982,327	11/1999	Vook et al.			
	5,982,760	11/1999	Chen			
	5,991,273	11/1999	Abu-Dayya et al.			
Lits. 4, 7-8, 15, and 17-18	5,991,331	11/1999	Chennakeshu et al.			
Lits. 7-8 and 17-18; ITC 1	6,005,876	12/1999	Cimini, Jr. et al.			

Lits. 4, 7-8, 15, and 17-18	6,006,075	12/1999	Smith et al.			
Lits. 1-12, 17-18, 21-28, and 30	6,009,332	12/1999	Haartsen			
ITC 1	6,009,553	12/1999	Martinez et al.			
Lits. 2, 3, 5, 6, 9-12, 21-28, and 30	6,016,311	1/2000	Gilbert			
Lits. 7-8 and 17-18	6,018,528	1/2000	Gitlin et al.			
Lits. 1, 4, 7-8, and 17-18	6,023,622	2/2000	Plaschke et al.			
Lits. 1, 4, and 7-8; ITC 1	6,026,123	2/2000	Williams			
ITC 1	6,037,898	3/2000	Parish et al.			
Lits. 1-12, 17-18, 21-28, and 30	6,038,450	3/2000	Brink et al.			
Lits. 1, 4, 7-8, 15, and 17-18; ITC 1	6,041,237	3/2000	Farsakh			
Lits. 7-8 and 17-18	6,044,067	3/2000	Suzuki			
Lits 2, 3, 5, 6, 9-12, 21-28 and 30	6,047,189	4/2000	Yun et al.			
Lits. 1-12, 17-18, 21-28, and 30; ITC 1	6,052,594	4/2000	Chuang et al.			
ITC 1	6,061,568	5/2000	Dent			
ITC 1	6,064,339	5/2000	Wax et al.			
ITC 1	6,064,692	5/2000	Chow			
ITC 1	6,064,694	5/2000	Clark et al.			
Lits. 1-12, 17-18, 21-28, and 30; ITC 1	6,067,290	5/2000	Paulraj et al.			
Lits. 2, 3, 5, 6, 9-12, 21-28, and 30	6,081,536	6/2000	Gorsuch			
ITC 1	6,085,114	7/2000	Gibbons			
Lits. 1, 4, and 7-8	6,091,717	7/2000	Honkasalo et al.			
	6,091,955	7/2000	Aalto et al.			
Lits. 1, 4, and 7-8; ITC 1	6,108,374	8/2000	Balachandran et al.			
ITC 1	6,108,565	8/2000	Scherzer			
ITC 1	6,111,919	8/2000	Yonge, III			
	6,115,614	9/2000	Furukawa			
	6,119,011	9/2000	Borst et al.			
ITC 1	6,122,260	9/2000	Liu et al.			
Lits. 7-8; ITC 1	6,128,276	10/2000	Agee			
ITC 1	6,131,016	10/2000	Greenstein et al.			

Lits. 1, 4, and 7-8; ITC 1	6,141,565	10/2000	Feuerstein et al.			
ITC 1	6,141,567	10/2000	Youssefmir et al.			
Lits. 7-8 and 17-18	6,144,652	11/2000	Avidor et al.			
Lits. 7-8 and 17-18	6,144,654	11/2000	Ibanez-Meier et al.			
	6,144,696	11/2000	Shively et al.			
Lits. 7-8 and 17-18; ITC 1	6,144,711	11/2000	Raleigh et al.			
ITC 1	6,154,661	11/2000	Goldburg			
Lits. 7-8	6,160,791	12/2000	Bohnke			
Lits. 2, 3, 5-12, 17-18, 21-28, and 30	6,175,550	1/2001	van Nee			
Lits. 1, 4, 7-8, and 17-18; ITC 1	6,192,026	2/2001	Pollack et al.			
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Lits. 1, 4, and 7-8	6,208,663	3/2001	Schramm et al.			
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ITC 1	6,226,320	5/2001	Hakkinen et al.			
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Lits. 7-8 and 17-18	6,259,686	7/2001	Blanc et al.			
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OFDMA WITH ADAPTIVE SUBCARRIER-CLUSTER CONFIGURATION AND SELECTIVE LOADING

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a Continuation of U.S. Patent Application No. 13/230,625 filed September 12, 2011, which is a Continuation of U.S. Patent Application No. 12/748,781 filed March 29, 2010 and issued October 11, 2011 as U.S. Patent No. 8,036,199, which is a Continuation of U.S. Patent Application No. 11/931,926 filed October 31, 2007 and issued May 11, 2010 as U.S. Patent No. 7,715,358, which is a Continuation of U.S. Patent Application No. 11/199,586 filed August 8, 2005 and issued November 18, 2008 as U.S. Patent No. 7,454,212, which is a Continuation of U.S. Patent Application No. 09/738,086 filed December 15, 2000 and issued September 20, 2005 as U.S. Patent No. 6,947,748, the disclosure of which are incorporated herein by reference.

FIELD OF THE INVENTION

[0002] The invention relates to the field of wireless communications; more particularly, the invention relates to multi-cell, multi-subscriber wireless systems using orthogonal frequency division multiplexing (OFDM).

BACKGROUND OF THE INVENTION

[0003] Orthogonal frequency division multiplexing (OFDM) is an efficient modulation scheme for signal transmission over frequency-selective channels. In OFDM, a wide bandwidth is divided into multiple narrowband subcarriers, which are arranged to be orthogonal with each other. The signals modulated on the subcarriers are transmitted in parallel. For more information, see Cimini, Jr., "Analysis and Simulation of a Digital Mobile Channel Using Orthogonal Frequency Division Multiplexing," IEEE Trans. Commun., vol. COM-33, no. 7, July 1985, pp. 665-75; Chung and Sollenberger, "Beyond 3G: Wideband Wireless Data Access Based on OFDM and Dynamic Packet Assignment," IEEE Communications Magazine, Vol. 38, No. 7, pp. 78-87, July 2000.

[0004] One way to use OFDM to support multiple access for multiple subscribers is through time division multiple access (TDMA), in which each subscriber uses all the subcarriers within its assigned time slots. Orthogonal frequency division multiple access (OFDMA) is another method for multiple access, using the basic format of OFDM. In OFDMA, multiple subscribers simultaneously use different subcarriers, in a fashion similar to frequency division multiple access (FDMA). For more information, see Sari and Karam, "Orthogonal Frequency-Division Multiple Access and its Application to CATV Networks," European Transactions on Telecommunications, Vol. 9 (6), pp. 507-516, Nov./Dec. 1998 and Nogueroles, Bossert, Donder, and Zyablov, "Improved Performance of a Random OFDMA Mobile Communication System," Proceedings of IEEE VTC'98, pp. 2502 -2506.

[0005] Multipath causes frequency-selective fading. The channel gains are different for different subcarriers. Furthermore, the channels are typically uncorrelated for different subscribers. The subcarriers that are in deep fade for one subscriber may provide high channel gains for another subscriber. Therefore, it is advantageous in an OFDMA system to adaptively allocate the subcarriers to subscribers so that each subscriber enjoys a high channel gain. For more information, see Wong et al., "Multiuser OFDM with Adaptive Subcarrier, Bit and Power Allocation," IEEE J. Select. Areas Commun., Vol. 17(10), pp. 1747-1758, October 1999.

[0006] Within one cell, the subscribers can be coordinated to have different subcarriers in OFDMA. The signals for different subscribers can be made orthogonal and there is little intracell interference. However, with aggressive frequency reuse plan, e.g., the same spectrum is used for multiple neighboring cells, the problem of intercell interference arises. It is clear that the intercell interference in an OFDMA system is also frequency selective and it is advantageous to adaptively allocate the subcarriers so as to mitigate the effect of intercell interference.

[0007] One approach to subcarrier allocation for OFDMA is a joint optimization operation, not only requiring the activity and channel knowledge of all the subscribers in all the cells, but also requiring frequent rescheduling every time an existing subscriber is dropped off the network or a new subscriber is added onto the network. This is often

impractical in real wireless system, mainly due to the bandwidth cost for updating the subscriber information and the computation cost for the joint optimization.

SUMMARY OF THE INVENTION

[0008] A method and apparatus for allocating subcarriers in an orthogonal frequency division multiple access (OFDMA) system is described. In one embodiment, the method comprises allocating at least one diversity cluster of subcarriers to a first subscriber and allocating at least one coherence cluster to a second subscriber.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The present invention will be understood more fully from the detailed description given below and from the accompanying drawings of various embodiments of the invention, which, however, should not be taken to limit the invention to the specific embodiments, but are for explanation and understanding only.

[0010] Figure 1A illustrates subcarriers and clusters.

[0011] Figure 1B is a flow diagram of one embodiment of a process for allocating subcarriers.

[0012] Figure 2 illustrates time and frequency grid of OFDM symbols, pilots and clusters.

[0013] Figure 3 illustrates subscriber processing.

[0014] Figure 4 illustrates one example of Figure 3.

[0015] Figure 5 illustrates one embodiment of a format for arbitrary cluster feedback.

[0016] Figure 6 illustrates one embodiment of a partition the clusters into groups.

[0017] Figure 7 illustrates one embodiment of a feedback format for group-based cluster allocation.

[0018] Figure 8 illustrates frequency reuse and interference in a multi-cell, multi-sector network.

[0019] Figure 9 illustrates different cluster formats for coherence clusters and diversity clusters.

[0020] Figure 10 illustrates diversity clusters with subcarrier hopping.

[0021] Figure 11 illustrates intelligent switching between diversity clusters and coherence clusters depending on subscribers mobility.

[0022] Figure 12 illustrates one embodiment of a reconfiguration of cluster classification.

[0023] Figure 13 illustrates one embodiment of a base station.

DETAILED DESCRIPTION OF THE PRESENT INVENTION

[0024] A method and apparatus for allocating subcarriers in an orthogonal frequency division multiple access (OFDMA) system is described. In one embodiment, the method comprises allocating at least one diversity cluster of subcarriers to a first subscriber and allocating at least one coherence cluster to a second subscriber.

[0025] The techniques disclosed herein are described using OFDMA (clusters) as an example. However, they are not limited to OFDMA-based systems. The techniques apply to multi-carrier systems in general, where, for example, a carrier can be a cluster in OFDMA, a spreading code in CDMA, an antenna beam in SDMA (space-division multiple access), etc. In one embodiment, subcarrier allocation is performed in each cell separately. Within each cell, the allocation for individual subscribers (e.g., mobiles) is also made progressively as each new subscriber is added to the system as opposed to joint allocation for subscribers within each cell in which allocation decisions are made taking into account all subscribers in a cell for each allocation.

[0026] For downlink channels, each subscriber first measures the channel and interference information for all the subcarriers and then selects multiple subcarriers with good performance (e.g., a high signal-to-interference plus noise ratio (SINR)) and feeds back the

information on these candidate subcarriers to the base station. The feedback may comprise channel and interference information (e.g., signal-to-interference-plus-noise-ratio information) on all subcarriers or just a portion of subcarriers. In case of providing information on only a portion of the subcarriers, a subscriber may provide a list of subcarriers ordered starting with those subcarriers which the subscriber desires to use, usually because their performance is good or better than that of other subcarriers.

[0027] Upon receiving the information from the subscriber, the base station further selects the subcarriers among the candidates, utilizing additional information available at the base station, e.g., the traffic load information on each subcarrier, amount of traffic requests queued at the base station for each frequency band, whether frequency bands are overused, and/or how long a subscriber has been waiting to send information. In one embodiment, the subcarrier loading information of neighboring cells can also be exchanged between base stations. The base stations can use this information in subcarrier allocation to reduce inter-cell interference.

[0028] In one embodiment, the selection by the base station of the channels to allocate, based on the feedback, results in the selection of coding/modulation rates. Such coding/modulation rates may be specified by the subscriber when specifying subcarriers that it finds favorable to use. For example, if the SINR is less than a certain threshold (e.g., 12 dB), quadrature phase shift keying (QPSK) modulation is used; otherwise, 16 quadrature amplitude modulation (QAM) is used. Then the base station informs the subscribers about the subcarrier allocation and the coding/modulation rates to use.

[0029] In one embodiment, the feedback information for downlink subcarrier allocation is transmitted to the base station through the uplink access channel, which occurs in a short period every transmission time slot, e.g., 400 microseconds in every 10-millisecond time slot. In one embodiment, the access channel occupies the entire frequency bandwidth. Then the base station can collect the uplink SINR of each subcarrier directly from the access channel. The SINR as well as the traffic load information on the uplink subcarriers are used for uplink subcarrier allocation.

[0030] For either direction, the base station makes the final decision of subcarrier allocation for each subscriber.

[0031] In the following description, a procedure of selective subcarrier allocation is also disclosed, including methods of channel and interference sensing, methods of information feedback from the subscribers to the base station, and algorithms used by the base station for subcarrier selections.

[0032] In the following description, numerous details are set forth to provide a thorough understanding of the present invention. It will be apparent, however, to one skilled in the art, that the present invention may be practiced without these specific details. In other instances, well-known structures and devices are shown in block diagram form, rather than in detail, in order to avoid obscuring the present invention.

[0033] Some portions of the detailed descriptions which follow are presented in terms of algorithms and symbolic representations of operations on data bits within a computer memory. These algorithmic descriptions and representations are the means used by those skilled in the data processing arts to most effectively convey the substance of their work to others skilled in the art. An algorithm is here, and generally, conceived to be a self-consistent sequence of steps leading to a desired result. The steps are those requiring physical manipulations of physical quantities. Usually, though not necessarily, these quantities take the form of electrical or magnetic signals capable of being stored, transferred, combined, compared, and otherwise manipulated. It has proven convenient at times, principally for reasons of common usage, to refer to these signals as bits, values, elements, symbols, characters, terms, numbers, or the like.

[0034] It should be borne in mind, however, that all of these and similar terms are to be associated with the appropriate physical quantities and are merely convenient labels applied to these quantities. Unless specifically stated otherwise as apparent from the following discussion, it is appreciated that throughout the description, discussions utilizing terms such as "processing" or "computing" or "calculating" or "determining" or "displaying" or the like, refer to the action and processes of a computer system, or similar electronic computing device, that manipulates and transforms data represented as physical (electronic) quantities within the computer system's registers and memories into other data similarly represented as physical quantities within the computer system memories or registers or other such information storage, transmission or display devices.

[0035] The present invention also relates to apparatus for performing the operations herein. This apparatus may be specially constructed for the required purposes, or it may comprise a general purpose computer selectively activated or reconfigured by a computer program stored in the computer. Such a computer program may be stored in a computer readable storage medium, such as, but is not limited to, any type of disk including floppy disks, optical disks, CD-ROMs, and magneto-optical disks, read-only memories (ROMs), random access memories (RAMs), EPROMs, EEPROMs, magneto or optical cards, or any type of media suitable for storing electronic instructions, and each coupled to a computer system bus.

[0036] The algorithms and displays presented herein are not inherently related to any particular computer or other apparatus. Various general purpose systems may be used with programs in accordance with the teachings herein, or it may prove convenient to construct more specialized apparatus to perform the required method steps. The required structure for a variety of these systems will appear from the description below. In addition, the present invention is not described with reference to any particular programming language. It will be appreciated that a variety of programming languages may be used to implement the teachings of the invention as described herein.

[0037] A machine-readable medium includes any mechanism for storing or transmitting information in a form readable by a machine (e.g., a computer). For example, a machine-readable medium includes read only memory ("ROM"); random access memory ("RAM"); magnetic disk storage media; optical storage media; flash memory devices; electrical, optical, acoustical or other form of propagated signals (e.g., carrier waves, infrared signals, digital signals, etc.); etc.

Subcarrier Clustering

[0038] The techniques described herein are directed to subcarrier allocation for data traffic channels. In a cellular system, there are typically other channels, pre-allocated for the exchange of control information and other purpose. These channels often include down link and up link control channels, uplink access channels, and time and frequency synchronization channels.

[0039] Figure 1A illustrates multiple subcarriers, such as subcarrier 101, and cluster 102. A cluster, such as cluster 102, is defined as a logical unit that contains at least one physical subcarrier, as shown in Figure 1A. A cluster can contain consecutive or disjoint subcarriers. The mapping between a cluster and its subcarriers can be fixed or reconfigurable. In the latter case, the base station informs the subscribers when the clusters are redefined. In one embodiment, the frequency spectrum includes 512 subcarriers and each cluster includes four consecutive subcarriers, thereby resulting in 128 clusters.

An Exemplary Subcarrier/Cluster Allocation Procedure

[0040] Figure 1B is a flow diagram of one embodiment of a process for allocation clusters to subscribers. The process is performed by processing logic that may comprise hardware (e.g., dedicated logic, circuitry, etc.), software (such as that which runs on, for example, a general purpose computer system or dedicated machine), or a combination of both.

[0041] Referring to Figure 1B, each base station periodically broadcasts pilot OFDM symbols to every subscriber within its cell (or sector) (processing block 101). The pilot symbols, often referred to as a sounding sequence or signal, are known to both the base station and the subscribers. In one embodiment, each pilot symbol covers the entire OFDM frequency bandwidth. The pilot symbols may be different for different cells (or sectors). The pilot symbols can serve multiple purposes: time and frequency synchronization, channel estimation and signal-to-interference/noise (SINR) ratio measurement for cluster allocation.

[0042] Next, each subscriber continuously monitors the reception of the pilot symbols and measures the SINR and/or other parameters, including inter-cell interference and intra-cell traffic, of each cluster (processing block 102). Based on this information, each subscriber selects one or more clusters with good performance (e.g., high SINR and low traffic loading) relative to each other and feeds back the information on these candidate clusters to the base station through predefined uplink access channels (processing block 103). For example, SINR values higher than 10 dB may indicate good performance. Likewise, a cluster utilization factor less than 50% may be indicative of good performance. Each subscriber selects the clusters with relatively better performance than others. The selection

results in each subscriber selecting clusters they would prefer to use based on the measured parameters.

[0043] In one embodiment, each subscriber measures the SINR of each subcarrier cluster and reports these SINR measurements to their base station through an access channel. The SINR value may comprise the average of the SINR values of each of the subcarriers in the cluster. Alternatively, the SINR value for the cluster may be the worst SINR among the SINR values of the subcarriers in the cluster. In still another embodiment, a weighted averaging of SINR values of the subcarriers in the cluster is used to generate an SINR value for the cluster. This may be particularly useful in diversity clusters where the weighting applied to the subcarriers may be different.

[0044] The feedback of information from each subscriber to the base station contains a SINR value for each cluster and also indicates the coding/modulation rate that the subscriber desires to use. No cluster index is needed to indicate which SINR value in the feedback corresponds to which cluster as long as the order of information in the feedback is known to the base station. In an alternative embodiment, the information in the feedback is ordered according to which clusters have the best performance relative to each other for the subscriber. In such a case, an index is needed to indicate to which cluster the accompanying SINR value corresponds.

[0045] Upon receiving the feedback from a subscriber, the base station further selects one or more clusters for the subscriber among the candidates (processing block 104). The base station may utilize additional information available at the base station, e.g., the traffic load information on each subcarrier, amount of traffic requests queued at the base station for each frequency band, whether frequency bands are overused, and how long a subscriber has been waiting to send information. The subcarrier loading information of neighboring cells can also be exchanged between base stations. The base stations can use this information in subcarrier allocation to reduce inter-cell interference.

[0046] After cluster selection, the base station notifies the subscriber about the cluster allocation through a downlink common control channel or through a dedicated downlink traffic channel if the connection to the subscriber has already been established

(processing block 105). In one embodiment, the base station also informs the subscriber about the appropriate modulation/coding rates.

[0047] Once the basic communication link is established, each subscriber can continue to send the feedback to the base station using a dedicated traffic channel (e.g., one or more predefined uplink access channels).

[0048] In one embodiment, the base station allocates all the clusters to be used by a subscriber at once. In an alternative embodiment, the base station first allocates multiple clusters, referred to herein as the basic clusters, to establish a data link between the base station and the subscriber. The base station then subsequently allocates more clusters, referred to herein as the auxiliary clusters, to the subscriber to increase the communication bandwidth. Higher priorities can be given to the assignment of basic clusters and lower priorities may be given to that of auxiliary clusters. For example, the base station first ensures the assignment of the basic clusters to the subscribers and then tries to satisfy further requests on the auxiliary clusters from the subscribers. Alternatively, the base station may assign auxiliary clusters to one or more subscribers before allocating basic clusters to other subscribers. For example, a base station may allocate basic and auxiliary clusters to one subscriber before allocating any clusters to other subscribers. In one embodiment, the base station allocates basic clusters to a new subscriber and then determines if there are any other subscribers requesting clusters. If not, then the base station allocates the auxiliary clusters to that new subscriber.

[0049] From time to time, processing logic performs retraining by repeating the process described above (processing block 106). The retraining may be performed periodically. This retraining compensates for subscriber movement and any changes in interference. In one embodiment, each subscriber reports to the base station its updated selection of clusters and their associated SINRs. Then the base station further performs the reselection and informs the subscriber about the new cluster allocation. Retraining can be initiated by the base station, and in which case, the base station requests a specific subscriber to report its updated cluster selection. Retraining can also be initiated by the subscriber when it observes channel deterioration.

Adaptive Modulation and Coding

[0050] In one embodiment, different modulation and coding rates are used to support reliable transmission over channels with different SINR. Signal spreading over multiple subcarriers may also be used to improve the reliability at very low SINR.

[0051] An example coding/modulation table is given below in Table 1.

Table 1

Scheme	Modulation	Code Rate
0	QPSK, 1/8 Spreading	½
1	QPSK, ¼ Spreading	½
2	QPSK, ½ Spreading	½
3	QPSK	¾
4	8PSK	2/3
5	16QAM	¾
6	64QAM	5/6

[0052] In the example above, 1/8 spreading indicates that one QPSK modulation symbol is repeated over eight subcarriers. The repetition/spreading may also be extended to the time domain. For example, one QPSK symbol can be repeated over four subcarriers of two OFDM symbols, resulting also 1/8 spreading.

[0053] The coding/modulation rate can be adaptively changed according to the channel conditions observed at the receiver after the initial cluster allocation and rate selection.

Pilot Symbols and SINR Measurement

[0054] In one embodiment, each base station transmits pilot symbols simultaneously, and each pilot symbol occupies the entire OFDM frequency bandwidth, as shown in Figures 2A-C. Referring to Figures 2A-C, pilot symbols 201 are shown traversing the entire OFDM frequency bandwidth for cells A, B and C, respectively. In one embodiment, each of the pilot symbols have a length or duration of 128 microseconds with a guard time, the combination of which is approximately 152 microseconds. After each pilot period, there are a predetermined number of data periods followed by another set of pilot

symbols. In one embodiment, there are four data periods used to transmit data after each pilot, and each of the data periods is 152 microseconds.

[0055] A subscriber estimates the SINR for each cluster from the pilot symbols. In one embodiment, the subscriber first estimates the channel response, including the amplitude and phase, as if there is no interference or noise. Once the channel is estimated, the subscriber calculates the interference/noise from the received signal.

[0056] The estimated SINR values may be ordered from largest to smallest SINRs and the clusters with large SINR values are selected. In one embodiment, the selected clusters have SINR values that are larger than the minimum SINR which still allows a reliable (albeit low-rate) transmission supported by the system. The number of clusters selected may depend on the feedback bandwidth and the request transmission rate. In one embodiment, the subscriber always tries to send the information about as many clusters as possible from which the base station chooses.

[0057] The estimated SINR values are also used to choose the appropriate coding/modulation rate for each cluster as discussed above. By using an appropriate SINR indexing scheme, an SINR index may also indicate a particular coding and modulation rate that a subscriber desires to use. Note that even for the same subscribers, different clusters can have different modulation/coding rates.

[0058] Pilot symbols serve an additional purpose in determining interference among the cells. Since the pilots of multiple cells are broadcast at the same time, they will interfere with each other (because they occupy the entire frequency band). This collision of pilot symbols may be used to determine the amount of interference as a worst case scenario. Therefore, in one embodiment, the above SINR estimation using this method is conservative in that the measured interference level is the worst-case scenario, assuming that all the interference sources are on. Thus, the structure of pilot symbols is such that it occupies the entire frequency band and causes collisions among different cells for use in detecting the worst case SINR in packet transmission systems.

[0059] During data traffic periods, the subscribers can determine the level of interference again. The data traffic periods are used to estimate the intra-cell traffic as well as

the inter-cell interference level. Specifically, the power difference during the pilot and traffic periods may be used to sense the (intra-cell) traffic loading and inter-cell interference to select the desirable clusters.

[0060] The interference level on certain clusters may be lower, because these clusters may be unused in the neighboring cells. For example, in cell A, with respect to cluster A there is less interference because cluster A is unused in cell B (while it is used in cell C). Similarly, in cell A, cluster B will experience lower interference from cell B because cluster B is used in cell B but not in cell C.

[0061] The modulation/coding rate based on this estimation is robust to frequent interference changes resulted from bursty packet transmission. This is because the rate prediction is based on the worst case situation in which all interference sources are transmitting.

[0062] In one embodiment, a subscriber utilizes the information available from both the pilot symbol periods and the data traffic periods to analyze the presence of both the intra-cell traffic load and inter-cell interference. The goal of the subscriber is to provide an indication to the base station as to those clusters that the subscriber desires to use. Ideally, the result of the selection by the subscriber is clusters with high channel gain, low interference from other cells, and high availability. The subscriber provides feedback information that includes the results, listing desired clusters in order or not as described herein.

[0063] Figure 3 illustrates one embodiment of subscriber processing. The processing is performed by processing logic that may comprise hardware (e.g., dedicated logic, circuitry, etc.), software (such as that which runs on, for example, a general purpose computer system or dedicated machine), or a combination of both.

[0064] Referring to Figure 3, channel/interference estimation processing block 301 performs channel and interference estimation in pilot periods in response to pilot symbols. Traffic/ interference analysis processing block 302 performs traffic and interference analysis in data periods in response to signal information and information from channel/interference estimation block 301.

[0065] Cluster ordering and rate prediction processing block 303 is coupled to outputs of channel/interference estimation processing block 301 and traffic/interference analysis processing block 302 to perform cluster ordering and selection along with rate prediction.

[0066] The output of cluster ordering processing block 303 is input to cluster request processing block 304, which requests clusters and modulation/coding rates. Indications of these selections are sent to the base station. In one embodiment, the SINR on each cluster is reported to the base station through an access channel. The information is used for cluster selection to avoid clusters with heavy intra-cell traffic loading and/or strong interference from other cells. That is, a new subscriber may not be allocated use of a particular cluster if heavy intra-cell traffic loading already exists with respect to that cluster. Also, clusters may not be allocated if the interference is so strong that the SINR only allows for low-rate transmission or no reliable transmission at all.

[0067] The channel/interference estimation by processing block 301 is well-known in the art by monitoring the interference that is generated due to full-bandwidth pilot symbols being simultaneously broadcast in multiple cells. The interface information is forwarded to processing block 302 which uses the information to solve the following equation:

$$H_i S_i + I_i + n_i = y_i$$

where S_i represents the signal for subcarrier (freq. band) i, I_i is the interference for subcarrier i, n_i is the noise associated with subcarrier i, and y_i is the observation for subcarrier i. In the case of 512 subcarriers, i may range from 0 to 511. The I_i and n_i are not separated and may be considered one quantity. The interference/noise and channel gain H_i are not known. During pilot periods, the signal S_i representing the pilot symbols, and the observation y_i are known, thereby allowing determination of the channel gain H_i for the case where there is no interference or noise. Once this is known, it may be plugged back into the equation to determine the interference/noise during data periods since H_i, S_i and y_i are all known.

[0068] The interference information from processing blocks 301 and 302 are used by the subscriber to select desirable clusters. In one embodiment, using processing

block 303, the subscriber orders clusters and also predicts the data rate that would be available using such clusters. The predicted data rate information may be obtained from a look up table with precalculated data rate values. Such a look up table may store the pairs of each SINR and its associated desirable transmission rate. Based on this information, the subscriber selects clusters that it desires to use based on predetermined performance criteria. Using the ordered list of clusters, the subscriber requests the desired clusters along with coding and modulation rates known to the subscriber to achieve desired data rates.

[0069] Figure 4 is one embodiment of an apparatus for the selection of clusters based on power difference. The approach uses information available during both pilot symbol periods and data traffic periods to perform energy detection. The processing of Figure 4 may be implemented in hardware, (e.g., dedicated logic, circuitry, etc.), software (such as is run on, for example, a general purpose computer system or dedicated machine), or a combination of both.

[0070] Referring to Figure 4, a subscriber includes SINR estimation processing block 401 to perform SINR estimation for each cluster in pilot periods, power calculation processing block 402 to perform power calculations for each cluster in pilot periods, and power calculation processing block 403 to perform power calculations in data periods for each cluster. Subtractor 404 subtracts the power calculations for data periods from processing block 403 from those in pilot periods from processing block 402. The output of subtractor 404 is input to power difference ordering (and group selection) processing block 405 that performs cluster ordering and selection based on SINR and the power difference between pilot periods and data periods. Once the clusters have been selected, the subscriber requests the selected clusters and the coding/modulation rates with processing block 406.

[0071] More specifically, in one embodiment, the signal power of each cluster during the pilot periods is compared with that during the traffic periods, according to the following:

$$P_P = P_S + P_I + P_N,$$

$$P_D = \begin{cases} P_N, \text{ with no signal and interference} \\ P_S + P_N, \text{ with signal only} \\ P_I + P_N, \text{ with interference only} \\ P_S + P_I + P_N, \text{ with both signal and interference} \end{cases}$$

$$P_P - P_D = \begin{cases} P_S + P_I, \text{ with no signal and interference} \\ P_I, \text{ with signal only} \\ P_S, \text{ with interference only} \\ O, \text{ with both signal and interference} \end{cases}$$

where P_P is the measured power corresponding to each cluster during pilot periods, P_D is the measured power during the traffic periods, P_S is the signal power, P_I is the interference power, and P_N is the noise power.

[0072] In one embodiment, the subscriber selects clusters with relatively large $P_P/(P_P - P_D)$ (e.g., larger than a threshold such as 10dB) and avoids clusters with low $P_P/(P_P - P_D)$ (e.g., lower than a threshold such as 10dB) when possible.

[0073] Alternatively, the difference may be based on the energy difference between observed samples during the pilot period and during the data traffic period for each of the subcarriers in a cluster such as the following:

$$\Delta_i = |y_i^P| - |y_i^D|$$

Thus, the subscriber sums the differences for all subcarriers.

[0074] Depending on the actual implementation, a subscriber may use the following metric, a combined function of both SINR and $P_B - P_D$, to select the clusters:

$$\beta = f(\text{SINR}, P_B - P_D)$$

where f is a function of the two inputs. One example of f is weighted averaging (e.g., equal weights). Alternatively, a subscriber selects a cluster based on its SINR and only uses the power difference $P_B - P_D$ to distinguish clusters with similar SINR. The difference may be smaller than a threshold (e.g., 1 dB).

[0075] Both the measurement of SINR and $P_B - P_D$ can be averaged over time to reduce variance and improve accuracy. In one embodiment, a moving-average time window is used that is long enough to average out the statistical abnormity yet short enough to capture the time-varying nature of channel and interference, e.g., 1 millisecond.

Feedback Format for Downlink Cluster Allocation

[0076] In one embodiment, for the downlink, the feedback contains both the indices of selected clusters and their SINR. An exemplary format for arbitrary cluster feedback is shown in Figure 5. Referring to Figure 5, the subscriber provides a cluster index (ID) to indicate the cluster and its associated SINR value. For example, in the feedback, the subscriber provides cluster ID1 (501) and the SINR for the cluster, SINR1 (502), cluster ID2 (503) and the SINR for the cluster, SINR2 (504), and cluster ID3 (505), and the SINR for the cluster, SINR3 (506), etc. The SINR for the cluster may be created using an average of the SINRs of the subcarriers. Thus, multiple arbitrary clusters can be selected as the candidates. As discussed above, the selected clusters can also be ordered in the feedback to indicate priority. In one embodiment, the subscriber may form a priority list of clusters and sends back the SINR information in a descending order of priority.

[0077] Typically, an index to the SINR level, instead of the SINR itself is sufficient to indicate the appropriate coding/modulation for the cluster. For example, a 3-bit field can be used for SINR indexing to indicate 8 different rates of adaptive coding/modulation.

An Exemplary Base Station

[0078] The base station assigns desirable clusters to the subscriber making the request. In one embodiment, the availability of the cluster for allocation to a subscriber depends on the total traffic load on the cluster. Therefore, the base station selects the clusters not only with high SINR, but also with low traffic load.

[0079] Figure 13 is a block diagram of one embodiment of a base station. Referring to Figure 13, cluster allocation and load scheduling controller 1301 (cluster allocator) collects all the necessary information, including the downlink/uplink SINR of clusters specified for each subscriber (e.g., via SINR/rate indices signals 1313 received from OFDM transceiver 1305) and user data, queue fullness/traffic load (e.g., via user data buffer information 1311 from multi-user data buffer 1302). Using this information, controller 1301 makes the decision on cluster allocation and load scheduling for each user, and stores the decision information in a memory (not shown). Controller 1301 informs the subscribers about the decisions through control signal channels (e.g., control signal/cluster allocation 1312 via OFDM transceiver 1305). Controller 1301 updates the decisions during retraining.

[0080] In one embodiment, controller 1301 also performs admission control to user access since it knows the traffic load of the system. This may be performed by controlling user data buffers 1302 using admission control signals 1310.

[0081] The packet data of User 1 ~ N are stored in the user data buffers 1302. For downlink, with the control of controller 1301, multiplexer 1303 loads the user data to cluster data buffers (for Cluster 1 ~ M) waiting to be transmitted. For the uplink, multiplexer 1303 sends the data in the cluster buffers to the corresponding user buffers. Cluster buffer 1304 stores the signal to be transmitted through OFDM transceiver 1305 (for downlink) and the signal received from transceiver 1305. In one embodiment, each user might occupy multiple clusters and each cluster might be shared by multiple users (in a time-division-multiplexing fashion).

Group-Based Cluster Allocation

[0082] In another embodiment, for the downlink, the clusters are partitioned into groups. Each group can include multiple clusters. Figure 6 illustrates an exemplary partitioning. Referring to Figure 6, groups 1-4 are shown with arrows pointing to clusters

that are in each group as a result of the partitioning. In one embodiment, the clusters within each group are spaced far apart over the entire bandwidth. In one embodiment, the clusters within each group are spaced apart farther than the channel coherence bandwidth, i.e. the bandwidth within which the channel response remains roughly the same. A typical value of coherence bandwidth is 100 kHz for many cellular systems. This improves frequency diversity within each group and increases the probability that at least some of the clusters within a group can provide high SINR. The clusters may be allocated in groups.

[0083] Goals of group-based cluster allocation include reducing the data bits for cluster indexing, thereby reducing the bandwidth requirements of the feedback channel (information) and control channel (information) for cluster allocation. Group-based cluster allocation may also be used to reduce inter-cell interference.

[0084] After receiving the pilot signal from the base station, a subscriber sends back the channel information on one or more cluster groups, simultaneously or sequentially. In one embodiment, only the information on some of the groups is sent back to the base station. Many criteria can be used to choose and order the groups, based on the channel information, the inter-cell interference levels, and the intra-cell traffic load on each cluster.

[0085] In one embodiment, a subscriber first selects the group with the best overall performance and then feedbacks the SINR information for the clusters in that group. The subscriber may order the groups based on their number of clusters for which the SINR is higher than a predefined threshold. By transmitting the SINR of all the clusters in the group sequentially, only the group index, instead of all the cluster indices, needs to be transmitted. Thus, the feedback for each group generally contains two types of information: the group index and the SINR value of each cluster within the group. Figure 7 illustrates an exemplary format for indicating a group-based cluster allocation. Referring to Figure 7, a group ID, ID1, is followed by the SINR values for each of the clusters in the group. This can significantly reduce the feedback overhead.

[0086] Upon receiving the feedback information from the subscriber, the cluster allocator at the base station selects multiple clusters from one or more groups, if available, and then assigns the clusters to the subscriber. This selection may be performed by an allocation in a media access control portion of the base station.

[0087] Furthermore, in a multi-cell environment, groups can have different priorities associated with different cells. In one embodiment, the subscriber's selection of a group is biased by the group priority, which means that certain subscribers have higher priorities on the usage of some groups than the other subscribers.

[0088] In one embodiment, there is no fixed association between one subscriber and one cluster group; however, in an alternative embodiment there may be such a fixed association. In an implementation having a fixed association between a subscriber and one or more cluster groups, the group index in the feedback information can be omitted, because this information is known to both subscriber and base station by default.

[0089] In another embodiment, the pilot signal sent from the base station to the subscriber also indicates the availability of each cluster, e.g., the pilot signal shows which clusters have already been allocated for other subscribers and which clusters are available for new allocations. For example, the base station can transmit a pilot sequence 1111 1111 on the subcarriers of a cluster to indicate that the cluster is available, and 1111 -1-1-1-1 to indicate the cluster is not available. At the receiver, the subscriber first distinguishes the two sequences using the signal processing methods which are well known in the art, e.g., the correlation methods, and then estimates the channel and interference level.

[0090] With the combination of this information and the channel characteristics obtained by the subscriber, the subscriber can prioritize the groups to achieve both high SINR and good load balancing.

[0091] In one embodiment, the subscriber protects the feedback information by using error correcting codes. In one embodiment, the SINR information in the feedback is first compressed using source coding techniques, e.g., differential encoding, and then encoded by the channel codes.

[0092] Figure 8 shows one embodiment of a frequency reuse pattern for an exemplary cellular set up. Each cell has hexagonal structure with six sectors using directional antennas at the base stations. Between the cells, the frequency reuse factor is one. Within each cell, the frequency reuse factor is 2 where the sectors use two frequencies alternatively. As shown in Figure 8, each shaded sector uses half of the available OFDMA

clusters and each unshaded sector uses the other half of the clusters. Without loss of generality, the clusters used by the shaded sectors are referred to herein as odd clusters and those used by the unshaded sectors are referred to herein as even clusters.

[0093] Consider the downlink signaling with omni-directional antennas at the subscribers. From Figure 8, it is clear that for the downlink in the shaded sectors, Cell A interferes with Cell B, which in turn interferes with Cell C, which in turn interferes with Cell A, namely, A -> B -> C ->A. For the unshaded sectors, Cell A interferes with Cell C, which in turn interferes with Cell B, which in turn interferes with Cell A, namely, A -> C -> B ->A.

[0094] Sector A1 receives interference from Sector C1, but its transmission interferes with Sector B1. Namely, its interference source and the victims with which it interferes are not the same. This might cause a stability problem in a distributed cluster-allocation system using interference avoidance: if a frequency cluster is assigned in Sector B1 but not in Sector C1, the cluster may be assigned in A1 because it may be seen as clean in A1. However, the assignment of this cluster A1 can cause interference problem to the existing assignment in B1.

[0095] In one embodiment, different cluster groups are assigned different priorities for use in different cells to alleviate the aforementioned problem when the traffic load is progressively added to a sector. The priority orders are jointly designed such that a cluster can be selectively assigned to avoid interference from its interference source, while reducing, and potentially minimizing, the probability of causing interference problem to existing assignments in other cells.

[0096] Using the aforementioned example, the odd clusters (used by the shaded sectors) are partitioned into 3 groups: Group 1,2,3. The priority orders are listed in Table 2.

Table 2: Priority ordering for the downlink of the shaded sectors.Table

Priority Ordering	Cell A	Cell B	Cell C
1	Group 1	Group 3	Group 2
2	Group 2	Group 1	Group 3
3	Group 3	Group 2	Group 1

[0097] Consider Sector A1. First, the clusters in Group 1 are selectively assigned. If there are still more subscribers demanding clusters, the clusters in Group 2 are selectively assigned to subscribers, depending on the measured SINR (avoiding the clusters receiving strong interference from Sector C1). Note that the newly assigned clusters from Group 2 to Sector A1 shall not cause interference problem in Sector B1, unless the load in Sector B1 is so heavy that the clusters in both Group 3 and 1 are used up and the clusters in Group 2 are also used. Table 3 shows the cluster usage when less than 2/3 of all the available clusters are used in Sector A1, B1, and C1.

Table 3: Cluster usage for the downlink of the shaded sectors with less than 2/3 of the full load.

Cluster Usage	Cell A	Cell B	Cell C
1	Group 1	Group 3	Group 2
2	Group 2	Group 1	Group 3
3			

[0098] Table 4 shows the priority orders for the unshaded sectors, which are different from those for the shaded sectors, since the interfering relationship is reversed.

Table 4: Priority ordering for the downlink of the unshaded sectors.

Priority Ordering	Cell A	Cell B	Cell C
1	Group 1	Group 2	Group 3
2	Group 2	Group 3	Group 1
3	Group 3	Group 1	Group 2

Intelligent Switching between Coherence and Diversity Clusters

[0099] In one embodiment, there are two categories of clusters: coherence clusters, containing multiple subcarriers close to each other and diversity clusters, containing multiple subcarriers with at least some of the subcarriers spread far apart over the spectrum. The closeness of the multiple subcarriers in coherence clusters is preferably within the channel coherence bandwidth, i.e. the bandwidth within which the channel response remains roughly the same, which is typically within 100 kHz for many cellular systems. On the other hand, the spread of subcarriers in diversity clusters is preferably larger than the channel coherence bandwidth, typically within 100 kHz for many cellular systems. Of course, the

larger the spread, the better the diversity. Therefore, a general goal in such cases is to maximize the spread.

[0100] Figure 9 illustrates exemplary cluster formats for coherence clusters and diversity clusters for Cells A-C. Referring to Figure 9, for cells A-C, the labeling of frequencies (subcarriers) indicates whether the frequencies are part of coherence or diversity clusters. For example, those frequencies labeled 1-8 are diversity clusters and those labeled 9-16 are coherence clusters. For example, all frequencies labeled 1 in a cell are part of one diversity cluster, all frequencies labeled 2 in a cell are part of another diversity cluster, etc., while the group of frequencies labeled 9 are one coherence cluster, the group of frequencies labeled 10 are another coherence cluster, etc. The diversity clusters can be configured differently for different cells to reduce the effect of inter-cell interference through interference averaging.

[0101] Figure 9 shows example cluster configurations for three neighboring cells. The interference from a particular cluster in one cell are distributed to many clusters in other cells, e.g., the interference from Cluster 1 in Cell A are distributed to Cluster 1, 8, 7, 6 in Cell B. This significantly reduces the interference power to any particular cluster in Cell B. Likewise, the interference to any particular cluster in one cell comes from many different clusters in other cells. Since not all clusters are strong interferers, diversity clusters, with channel coding across its subcarriers, provide interference diversity gain. Therefore, it is advantageous to assign diversity clusters to subscribers that are close (e.g., within the coherent bandwidth) to the cell boundaries and are more subject to inter-cell interference.

[0102] Since the subcarriers in a coherence cluster are consecutive or close (e.g., within the coherent bandwidth) to each other, they are likely within the coherent bandwidth of the channel fading. Therefore, the channel gain of a coherence cluster can vary significantly and cluster selection can greatly improve the performance. On the other hand, the average channel gain of a diversity cluster has less of a degree of variation due to the inherent frequency diversity among the multiple subcarriers spread over the spectrum. With channel coding across the subcarriers within the cluster, diversity clusters are more robust to cluster mis-selection (by the nature of diversification itself), while yielding possibly less gain from cluster selection. Channel coding across the subcarriers means that each codeword

contains bits transmitted from multiple subcarriers, and more specifically, the difference bits between codewords (error vector) are distributed among multiple subcarriers.

[0103] More frequency diversity can be obtained through subcarrier hopping over time in which a subscriber occupies a set of subcarriers at one time slot and another different set of subcarriers at a different time slot. One coding unit (frame) contains multiple such time slots and the transmitted bits are encoded across the entire frame.

[0104] Figure 10 illustrates diversity cluster with subcarrier hopping. Referring to Figure 10, there are four diversity clusters in each of cells A and B shown, with each subcarrier in individual diversity clusters having the same label (1, 2, 3, or 4). There are four separate time slots shown and during each of the time slots, the subcarriers for each of the diversity clusters change. For example, in cell A, subcarrier 1 is part of diversity cluster 1 during time slot 1, is part of diversity cluster 2 during time slot 2, is part of diversity cluster 3 during time slot 3, and is part of diversity cluster 4 during time slot 4. Thus, more interference diversity can be obtained through subcarrier hopping over time, with further interference diversity achieved by using different hopping patterns for different cells, as shown in Figure 10.

[0105] The manner in which the subscriber changes the subcarriers (hopping sequences) can be different for different cells in order to achieve better interference averaging through coding.

[0106] For static subscribers, such as in fixed wireless access, the channels change very little over time. Selective cluster allocation using the coherence clusters achieves good performance. On the other hand, for mobile subscribers, the channel time variance (the variance due to changes in the channel over time) can be very large. A high-gain cluster at one time can be in deep fade at another. Therefore, cluster allocation needs to be updated at a rapid rate, causing significant control overhead. In this case, diversity clusters can be used to provide extra robustness and to alleviate the overhead of frequent cluster reallocation. In one embodiment, cluster allocation is performed faster than the channel changing rate, which is often measured by the channel Doppler rate (in Hz), i.e. how many cycles the channel changes per second where the channel is completely different after

one cycle. Note that selective cluster allocation can be performed on both coherence and diversity clusters.

[0107] In one embodiment, for cells containing mixed mobile and fixed subscribers, a channel/interference variation detector can be implemented at either the subscriber or the base station, or both. Using the detection results, the subscriber and the base station intelligently selects diversity clusters to mobile subscribers or fixed subscribers at cell boundaries, and coherence clusters to fixed subscribers close to the base station. The channel/interference variation detector measures the channel (SINR) variation from time to time for each cluster. For example, in one embodiment, the channel/interference detector measures the power difference between pilot symbols for each cluster and averages the difference over a moving window (e.g., 4 time slots). A large difference indicates that channel/interference changes frequently and subcarrier allocation may be not reliable. In such a case, diversity clusters are more desirable for the subscriber.

[0108] Figure 11 is a flow diagram of one embodiment of a process for intelligent selection between diversity clusters and coherence clusters depending on subscribers mobility. The process is performed by processing logic that may comprise hardware (e.g., circuitry, dedicated logic, etc.), software (such as that which runs on, for example, a general purpose computer system or dedicated machine), or a combination of both.

[0109] Referring to Figure 11, processing logic in the base station performs channel/interference variation detection (processing block 1101). Processing logic then tests whether the results of the channel/interference variation detection indicate that the user is mobile or in a fixed position close to the edge of the cell (processing block 1102). If the user is not mobile or is not in a fixed position close to the edge of the cell, processing transitions to processing block 1103 where processing logic in the base station selects coherence clusters; otherwise, processing transitions to processing block 1104 in which processing logic in the base station selects diversity clusters.

[0110] In one embodiment, the base station determines whether a subscriber is mobile or fixed by detecting a rate of change of pilot signals, or the normalized channel variation, and determining that the rate of change is greater than a predetermined threshold. The normalized instantaneous difference between channels may be represented as $\frac{|H_i - H_{i-1}|^2}{|H_i|^2}$, where H_i represents the channel and i is the index to represent the individual channels.

[0111] The threshold is system dependent. For example, the rate of change is greater than 10% (although any precentage (e.g., 20%) could be used), then the base station concludes that the subscriber is mobile. In one embodiment, if the constant period in signaling is not greater than a multiple of the round trip delay (e.g., 5 times the round trip delay), then the base station determines that the subscriber is mobile and allocates diversity clusters; otherwise, the base station allocates coherence clusters.

[0112] The selection can be updated and intelligently switched during retraining.

[0113] The ratio/allocation of the numbers of coherence and diversity clusters in a cell depends on the ratio of the population of mobile and fixed subscribers. When the population changes as the system evolves, the allocation of coherence and diversity clusters can be reconfigured to accommodate the new system needs. Figure 12 illustrates a reconfiguration of cluster classification which can support more mobile subscribers than that in Figure 9.

[0114] Whereas many alterations and modifications of the present invention will no doubt become apparent to a person of ordinary skill in the art after having read the foregoing description, it is to be understood that any particular embodiment shown and described by way of illustration is in no way intended to be considered limiting. Therefore, references to details of various embodiments are not intended to limit the scope of the claims which in themselves recite only those features regarded as essential to the invention.

WHAT IS CLAIMED IS:

1. A method for a wireless system employing orthogonal frequency division multiple access (OFDMA), the method comprising:

measuring, at a first time by a subscriber unit, channel information for a first plurality of subcarriers based on a first plurality of pilot symbols received from a base station;

providing, by the subscriber unit, feedback information relating to a plurality of feedback clusters based on at least the measuring of the channel information for the first plurality of subcarriers based on the first plurality of pilot symbols, each feedback cluster of the plurality of feedback clusters including a plurality of subcarriers, the feedback information relating to the plurality of feedback clusters based on the first plurality of pilot symbols includes an index corresponding to a first modulation and coding rate associated with each feedback cluster of the plurality of feedback clusters;

receiving, by the subscriber unit, a first allocation of OFDMA subcarriers selected by the base station for use by the subscriber unit, the first allocation of OFDMA subcarriers including an indication of a modulation and coding rate associated with the first allocation of OFDMA subcarriers;

measuring, at a second time by the subscriber unit, channel information for the first plurality of subcarriers based on a second plurality of pilot symbols received from the base station;

providing, by the subscriber unit, feedback information relating to the plurality of feedback clusters based on at least the measuring of the channel information for the first plurality of subcarriers based on the second plurality of pilot symbols, the feedback information relating to the plurality of feedback clusters based on the second plurality of pilot symbols includes an index corresponding to a second modulation and coding rate associated with each feedback cluster of the plurality of feedback clusters; and

receiving, by the subscriber unit, a second allocation of OFDMA subcarriers selected by the base station for use by the subscriber unit, the second

allocation of OFDMA subcarriers including an indication of a modulation and coding rate associated with the second allocation of OFDMA subcarriers.

2. The method of claim 1, wherein the plurality of feedback clusters at the second time is different than the plurality of feedback clusters at the first time.

3. The method of claim 1, wherein at least one subcarrier of the first allocation of OFDMA subcarriers is non-contiguous with other subcarriers of the first allocation of OFDMA subcarriers.

4. The method of claim 3, wherein the first allocation of OFDMA subcarriers includes a cluster identifier that identifies a first plurality of subcarriers in a first time slot and a second plurality of subcarriers in a second time slot, at least two subcarriers of the first plurality of subcarriers and of the second plurality of subcarriers being disjoint.

5. The method of claim 4, wherein at least one subcarrier of the first plurality of subcarriers in the first time slot is different than all of the subcarriers of the second plurality of subcarriers in the second time slot.

6. The method of claim 1, wherein the receiving of the first allocation of OFDMA subcarriers is receiving a first allocation of at least one diversity cluster.

7. The method of claim 6, wherein the at least one diversity cluster includes two or more subcarriers spread farther apart than a coherence bandwidth of a respective channel.

8. The method of claim 1, wherein the receiving of the first allocation of OFDMA subcarriers is receiving a first allocation of at least one coherence cluster.

9. The method of claim 1, wherein the receiving of the first allocation of OFDMA subcarriers includes receiving a first allocation of at least one group of clusters selected by the base station for use by the subscriber unit.

10. The method of claim 9, wherein at least one cluster of the first allocation of the at least one group of clusters is disjoint from at least one other cluster of the first allocation of the at least one group of clusters to obtain frequency diversity.

11. The method of claim 10, wherein disjoint clusters of the first allocation of the at least one group of clusters are spread farther apart than a coherence bandwidth of a respective channel.

12. The method of claim 9, wherein the receiving of the first allocation of the at least one group of clusters includes consecutive clusters.

13. The method of claim 9, wherein the receiving of the first allocation of the at least one group of clusters includes an indication of space between each cluster of the first allocation of the at least one group of clusters.

14. The method of claim 9, wherein the receiving of the first allocation of the at least one group of clusters includes receiving a group identifier that identifies one group of the first allocation of the at least one group of clusters.

15. The method of claim 1, wherein the measuring of the channel information for the first plurality of subcarriers based on the first plurality of pilot symbols includes measuring channel information for all available clusters allocable by the base station.

16. A subscriber unit in a wireless system employing orthogonal frequency division multiple access (OFDMA), the subscriber comprising:

a processor configured to:

measure, at a first time, channel information for a first plurality of subcarriers based on a first plurality of pilot symbols received from a base station;

provide feedback information relating to a plurality of feedback clusters based on at least a measurement of the channel information for the first plurality of subcarriers based on the first plurality of pilot symbols, each feedback cluster of the plurality of feedback clusters including a plurality of subcarriers, the feedback information relating to the plurality of feedback clusters based on the first plurality of pilot symbols includes an index corresponding to a first modulation and coding rate associated with each feedback cluster of the plurality of feedback clusters;

receive a first allocation of OFDMA subcarriers selected by the base station for use by the subscriber unit, the first allocation of OFDMA subcarriers including an indication of a modulation and coding rate associated with the first allocation of OFDMA subcarriers;

measure, at a second time, channel information for the first plurality of subcarriers based on a second plurality of pilot symbols received from the base station;

provide feedback information relating to the plurality of feedback clusters based on at least a measurement of the channel information for the first plurality of subcarriers based on the second plurality of pilot symbols, the feedback information relating to the plurality of feedback clusters based on the second plurality of pilot symbols includes an index corresponding to a second modulation and coding rate associated with each feedback cluster of the plurality of feedback clusters; and

receive a second allocation of OFDMA subcarriers selected by the base station for use by the subscriber unit, the second allocation of OFDMA subcarriers including an indication of a modulation and coding rate associated with the second allocation of OFDMA subcarriers.

17. The subscriber unit of claim 16, wherein the plurality of feedback clusters at the second time is different than the plurality of feedback clusters at the first time.

18. The subscriber unit of claim 16, wherein at least one subcarrier of the first allocation of OFDMA subcarriers is non-contiguous with other subcarriers of the first allocation of OFDMA subcarriers.

19. The subscriber unit of claim 18, wherein the first allocation of OFDMA subcarriers includes a cluster identifier that identifies a first plurality of subcarriers in a first time slot and a second plurality of subcarriers in a second time slot, at least two subcarriers of the first plurality of subcarriers and of the second plurality of subcarriers being disjoint.

20. The subscriber unit of claim 19, wherein at least one subcarrier of the first plurality of subcarriers in the first time slot is different than all of the subcarriers of the second plurality of subcarriers in the second time slot.

21. The subscriber unit of claim 16, wherein receipt of the first allocation of OFDMA subcarriers is receipt of a first allocation of at least one diversity cluster.

22. The subscriber unit of claim 21, wherein the at least one diversity cluster includes two or more subcarriers spread farther apart than a coherence bandwidth of a respective channel.

23. The subscriber unit of claim 16, wherein receipt of the first allocation of OFDMA subcarriers is receipt of a first allocation of at least one coherence cluster.

24. The subscriber unit of claim 16, wherein receipt of the first allocation of OFDMA subcarriers includes receipt of a first allocation of at least one group of clusters selected by the base station for use by the subscriber unit.

25. The subscriber unit of claim 24, wherein at least one cluster of the first allocation of the at least one group of clusters is disjoint from at least one other cluster of the first allocation of the at least one group of clusters to obtain frequency diversity.

26. The subscriber unit of claim 25, wherein disjoint clusters of the first allocation of the at least one group of clusters are spread farther apart than a coherence bandwidth of a respective channel.

27. The subscriber unit of claim 24, wherein receipt of the first allocation of the at least one group of clusters includes consecutive clusters.

28. The subscriber unit of claim 24, wherein receipt of the first allocation of the at least one group of clusters includes an indication of space between each cluster of the first allocation of the at least one group of clusters.

29. The subscriber unit of claim 24, wherein receipt of the first allocation of the at least one group of clusters includes receipt of a group identifier that identifies one group of the first allocation of the at least one group of clusters.

30. The subscriber unit of claim 16, wherein the measurement of the channel information for the first plurality of subcarriers based on the first plurality of pilot symbols includes measurement of channel information for all available clusters allocable by the base station.

ABSTRACT

A method and apparatus for allocating subcarriers in an orthogonal frequency division multiple access (OFDMA) system is described. In one embodiment, the method comprises allocating at least one diversity cluster of subcarriers to a first subscriber and allocating at least one coherence cluster to a second subscriber.

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	OFDMA WITH ADAPTIVE SUBCARRIER-CLUSTER CONFIGURATION AND SELECTIVE LOADING
First Named Inventor/Applicant Name:	Xiaodong Li
Filer:	Alfred Young Chu/Chloe Hong
Attorney Docket Number:	176.0003-06000

Filed as Large Entity

Track I Prioritized Examination - Nonprovisional Application under 35 USC 111(a) Filing Fees

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Utility application filing	1011	1	280	280
Utility Search Fee	1111	1	600	600
Utility Examination Fee	1311	1	720	720
Request for Prioritized Examination	1817	1	4000	4000
Pages:				
Claims:				
Claims in Excess of 20	1202	10	80	800
Miscellaneous-Filing:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Publ. Fee- Early, Voluntary, or Normal	1504	1	0	0
PROCESSING FEE, EXCEPT PROV. APPLS.	1830	1	140	140
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal Letter	Transmittal.pdf	89777 92923194e7956595ff269d6e18db0d4c97297fb6	no	2
Warnings:					
Information:					
2	TrackOne Request	aia0424_Track1_Request.pdf	152808 c1d9dc35bef884c31737b858eebb75b9c6b56933	no	2
Warnings:					
Information:					
3	Application Data Sheet	ADS.pdf	1561715 2dd2f356d37f997ec681700b0bee42e77e4e95b8	no	8
Warnings:					
Information:					
4	Oath or Declaration filed	Declaration_from_Prev_Case.pdf	454544 c65775ee3b363ba8bb9583a75795874093 2da546	no	5
Warnings:					
Information:					
5	Drawings-only black and white line drawings	Drawings.pdf	368004 4d10b52c9462062f5903368607466b4a369aa60b	no	7
Warnings:					
Information:					
6	Power of Attorney	PoA.pdf	634902 f331f97cd7a304fa7d3ea2ce2cea65329c5171b1	no	2
Warnings:					
Information:					
7	Transmittal Letter	IDS.pdf	112907 7e24d6f5d7a7fa795c86c9a5d9ef1583f5049029	no	6
Warnings:					
Information:					
8	Information Disclosure Statement (IDS) Form (SB08)	SB08.pdf	553741 a006c018ac165d07d4034432be1ea7f0d278b519	no	48
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					

9		Specification.pdf	4382296 0c5ab32ed281cb0a0e0573bcef2cdf42e15a9ceb	yes	33

Multipart Description/PDF files in .zip description		
Document Description	**Start**	**End**
Specification	1	26
Claims	27	32
Abstract	33	33

Warnings:

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10	Fee Worksheet (SB06)	fee-info.pdf	41822 71576ff519fd5f43377757d7238e0a630f26cdda	no	2

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New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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For: OFDMA WITH ADAPTIVE SUBCARRIER-CLUSTER CONFIGURATION AND SELECTIVE LOADING

Prior Application Information:

Group Art Unit: (2643)

Examiner: (Meless Nmn Zewdu)

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Sir:

CONTINUING APPLICATION TRANSMITTAL

Transmitted herewith for filing is a ☒ Continuation ☐ Divisional ☐ Continuation-In-Part application under 37 C.F.R. § 1.53(b) of prior patent Application No. 13/230,625, filed September 12, 2011.

☐ Applicant claims small entity status under 37 C.F.R. §§ 1.9 and 1.27.

☒ A Certification and Request for Prioritized Examination (TRACK I) (Form PTO/SB/424) is enclosed.

☒ Application Data Sheet 37 CFR 1.76 is enclosed.

☒ 33 total application pages including specification, claims (30 total and 2 independent), and abstract are enclosed.

☐ A newly executed Declaration ☐ is enclosed ☒ will follow.

☒ A copy of the Declaration from the prior application is enclosed.

The entire disclosure of the prior application, from which an oath or declaration is supplied, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference.

☒ 7 sheets of drawings (8.5 x 11; Figs. 1A-13) are enclosed.

☒ The power of attorney in the prior application is to at least one of the following: MARTIN & FERRARO, LLP; Thomas H. Martin, Reg. No. 34,383; and Amedeo F. Ferraro, Reg. No. 37,129.

☒ A new Power of Attorney along with the requisite Transmittal is enclosed.

☐ A copy of the Power of Attorney in the prior application is enclosed along with the requisite Transmittal.

☐ A certified copy of _____ Patent Application No. _____ filed _____ from which priority is claimed under 35 U.S.C. § 119 is enclosed.

☒ Information Disclosure Statement (IDS) with Form PTO/SB/08 is enclosed (☒ with references).

☐ Amend the specification by rewriting paragraph 1 on page 1 to read as follows:
--This is a ☐ continuation ☐ divisional of application Serial No. _____, filed _____, and claims benefit of U.S. Provisional application No. _____, filed _____, all of which are incorporated herein by reference.--.

☐ Cancel Claims _____.

☐ An Amendment is enclosed.

☒ Correspondence Address: Customer No. 22882
Martin & Ferraro, LLP
1557 Lake O'Pines Street, NE
Hartville, Ohio 44632
Telephone: (330) 877-0700
Facsimile: (330) 877-2030

CALCULATION OF FEES								
ITEM		TOTAL NO. OF CLAIMS		NO. OF CLAIMS OVER BASE	LG/SM $ ENTITY FEE			$ FEE
A	TOTAL CLAIMS FEE	30	-20	10	LG=$80 SM=$40	$80	$ 800	
B	INDEPENDENT CLAIMS FEE*	2	-3	0	LG=$420 SM=$210	$420	$ 0	
C	SUBTOTAL - ADDITIONAL CLAIMS FEE (ADD FINAL COLUMN IN LINES A + B)							$ 800.00
D	MULTIPLE-DEPENDENT CLAIMS FEE				LARGE ENTITY FEE = $780 SMALL ENTITY FEE = $390		$ 0	
E	BASIC FEE				LARGE ENTITY FEE = $280 SMALL ENTITY FEE = $140 EFS SMALL ENTITY FEE = $70		$ 280	
F	SEARCH FEE				LARGE ENTITY FEE = $600 SMALL ENTITY FEE = $300		$ 600	
G	EXAMINATION FEE				LARGE ENTITY FEE = $720 SMALL ENTITY FEE = $360		$ 720	
H	TOTAL BASIC, SEARCH & EXAMINATION FEES (ADD TOTALS FOR LINES D-G)							$ 1,600.00

ITEM		TOTAL SHEETS Application and Drawings	Disc. for Filing Via EFS	TOTAL EXTRA SHEETS	NO. OF ADDT'L 50 OR FRACTION THEREOF	LG/SM $ ENTITY FEE		
I	APPLICATION SIZE	40	*.75	0	0	LG=$400 SM=$200	$400	$ 0
J	NON-ELECTRONIC FILING FEE (additional fee for applications filed in paper)					LG=$400 SM=$200	$400	$ 0
K	PUBLICATION FEE						$0	$ 0
L	PROCESSING FEE (TRACK I)						$140	$ 140.00
M	PRIORITIZED EXAMINATION FEE (TRACK I)						LG=$4000 SM=$2000	$ 4,000.00
N	TOTAL FILING FEES (ADD TOTALS FOR LINES C, H, I, J, K, L and M)							$ 6,540.00

☒ The total amount of $6,540 to cover the above fees is to be charged to Deposit Account No. 50-1068.

☒ The Commissioner is hereby authorized to charge any deficiency for additional fees associated with this communication or credit any overpayment to Deposit Account No. 50-1068.

PETITION FOR EXTENSION. If any extension of time is necessary for the filing of this application, including any extension in the parent application, Serial No. 13/230,625, filed September 12, 2011, for the purpose of maintaining copendency between the parent application and this application, and such extension has not otherwise been requested, such an extension is hereby requested, and the Commissioner is authorized to charge necessary fees for such an extension to our Deposit Account No. 50-1068.

Respectfully submitted,

MARTIN & FERRARO, LLP

Date: June 2, 2014

By: /Alfred Y. Chu/
Alfred Y. Chu
Registration No. 62,317

1557 Lake O'Pines Street, NE
Hartville, Ohio 44632
Telephone: (330) 877-0700
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PTO/AIA/82A (07-13)
Approved for use through 11/30/2014. OMB 0651-0051
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

TRANSMITTAL FOR POWER OF ATTORNEY TO ONE OR MORE REGISTERED PRACTITIONERS

NOTE: This form is to be submitted with the Power of Attorney by Applicant form (PTO/AIA/82B) to identify the application to which the Power of Attorney is directed, in accordance with 37 CFR 1.5, unless the application number and filing date are identified in the Power of Attorney by Applicant form. If neither form PTO/AIA/82A nor form PTO/AIA82B identifies the application to which the Power of Attorney is directed, the Power of Attorney will not be recognized in the application.

Application Number	(Cont. of 13/230,625)
Filing Date	June 2, 2014
First Named Inventor	Xiaodong Li
Title	OFDMA WITH ADAPTIVE SUBCARRIER-CLUSTER CONFIGURATION AND SELECTIVE LOADING
Art Unit	(2643)
Examiner Name	(Meless Nmn Zewdu)
Attorney Docket Number	176.0003-06000

SIGNATURE of Applicant or Patent Practitioner

Signature	/Alfred Y. Chu/	Date (Optional)	June 2, 2014
Name	Alfred Y. Chu	Registration Number	62,317
Title (if Applicant is a juristic entity)			
Applicant Name (if Applicant is a juristic entity)			

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. If more than one applicant, use multiple forms.

☑ *Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Doc Code: PA..

Document Description: Power of Attorney

PTO/AIA/82B(07-13)

Approved for use through 1/31/2014 OMB 0651-0035

U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in the attached transmittal letter.

☒ I hereby appoint Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A or equivalent).

22882

OR

☐ I hereby appoint Practitioner(s) named below as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A or equivalent).

Name	Registration Number	Name	Registration Number

Please recognize or change the correspondence address for the application identified in the attached transmittal letter to:

☒ The address associated with the above-mentioned Customer Number.

OR

☐ The address associated with Customer Number:

OR

☐ Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the Applicant:

☐ Inventor or Joint Inventor

☐ Legal Representative of a Deceased or Legally Incapacitated Inventor

☒ Assignee or Person to Whom the Inventor is Under an Obligation to Assign

☐ Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document)

SIGNATURE of Applicant for Patent

Signature		Date	3/7/2013
Name	Mary Kay	Telephone	972.456.9120
Title and Company	CEO Adeptive Inc		

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. Submit multiple forms for more than one signature, see below *.

☒ *Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.31, 1.32 and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	)	Confirmation No.: (Not Yet Assigned)
Xiaodong Li et al.	)	
Serial No.: (Cont. of 13/230,625)	)	Group Art Unit: (2643)
Filed: June 2, 2014	)	Examiner: (Meless Nmn Zewdu)
For: OFDMA WITH ADAPTIVE SUBCARRIER-CLUSTER CONFIGURATION AND SELECTIVE LOADING	)	

Mail Stop AMENDMENT
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

INFORMATION DISCLOSURE STATEMENT UNDER 37 C.F.R. § 1.97(b)

Pursuant to 37 C.F.R. §§ 1.56 and 1.97(b), Applicant brings to the attention of the Examiner the documents listed on the attached Form PTO/SB/08. This Information Disclosure Statement is being filed within three months of the filing date of the above-referenced application.

The present application is a continuation of U.S. Application No. 13/230,625, filed September 12, 2011 (Publication No. 2012/0069755), which is pending; which is a continuation of U.S. Application No. 12/748,781, filed March 29, 2010, now U.S. Patent No. 8,036,199; which is a continuation of U.S. Application No. 11/931,926, filed October 31, 2007, now U.S. Patent No. 7,715,358; which is a continuation of U.S. Application No. 11/199,586, filed August 8, 2005, now U.S. Patent No. 7,454,212 ("'212 patent"); which is a continuation of U.S. Application No. 09/738,086, filed December 15, 2000, now U.S. Patent No. 6,947,748 ("'748 patent"); upon which Applicant relies for the benefits provided in 35 U.S.C. § 120.

Applicant brings to the Examiner's attention Application Nos. 09/898,163, filed July 2, 2001, now U.S. Patent No. 6,751,444; 09/692,681, filed October 18, 2000, now U.S. Patent No. 6,870,808 ("'808 patent"); 09/837,337, filed April 17, 2001, now U.S. Patent No. 6,904,283 ("'283 patent"); 09/685,977, filed October 10, 2000, now U.S.

Patent No. 7,072,315 ("'315 patent"); 09/837,701, filed April 17, 2001, now U.S. Patent No. 7,146,172 ("'172 patent"); 11/085,826, filed March 21, 2005, now U.S. Patent No. 7,355,962; 11/592,084, filed November 2, 2006, now U.S. Patent No. 7,379,742 ("'742 patent"); 11/931,759, filed October 31, 2007, now U.S. Patent No. 7,489,934 ("'934 patent"); 11/925,229, filed October 26, 2007, now U.S. Patent No. 7,573,850 ("'850 patent"); 11/007,064, filed December 7, 2004, now U.S. Patent No. 7,573,851("'851 patent"); 11/931,385, filed October 31, 2007, now U.S. Patent No. 7,650,152; 12/470,922, filed May 22, 2009, now U.S. Patent No. 7,933,244; 10/534,200, filed January 18, 2006, now U.S. Patent No. 8,005,479; 12/399,624, filed March 6, 2009, now U.S. Patent No. 8,738,020; 12/498,924, filed July 7, 2009 (Publication No. 2009/0274059), which is pending; 13/053,111, filed March 21, 2011 (Publication No. 2011/0170446), which is pending; 13/053,091, filed March 21, 2011 (Publication No. 2011/0222420), which is pending; 13/053,127, filed March 21, 2011 (Publication No. 2011/0222495), which is pending; 13/186,221, filed July 19, 2011 (Publication No. 2011/0312367), which is pending; 13/731,825, filed December 31, 2012 (Publication No. 2013/0121199), which is pending; 13/731,832, filed December 31, 2012 (Publication No. 2013/0121200), which is pending; 13/756,957, filed February 1, 2013 (Publication No. 2013/0142069), which is pending; 13/801,788, filed March 13, 2013 (Publication No. 2013/0195061), which is pending; 13/801,846, filed March 13, 2013 (Publication No. 2013/0195062), which is pending; 14/286,780, filed May 23, 2014, which is pending; and 14/286,884, filed May 23, 2014, which is pending.

Applicant also brings to the attention of the Examiner the file history (the Office Actions and responses) of each of the above-referenced patents and applications. While the individual Office Actions and responses are not attached hereto, they are available in each of the file wrappers in the Patent Office, through PAIR, or will be provided by Applicant at the Examiner's request.

Applicant notes that copies of the other listed non-U.S. patent documents were previously submitted in one of the prior applications listed above, upon which the present application relies for the benefits provided in 35 U.S.C. § 120. Applicant respectfully requests that the Examiner consider the documents upon which Applicant

relies for the benefits provided in 35 U.S.C. § 120 and indicate that they were considered by making appropriate notations on the attached form.

The '742 patent (which is a continuation of the '172 patent), the '934 patent (which is a continuation of the '212 patent), as well as the '283, '315, '172, '748, and '212 patents were the subject of litigation in the United States District Court for the Eastern District of Texas, Civil Action No. 6:08-cv-00460, hereinafter referred to as Litigation 1. Litigation 1 was dismissed without prejudice pursuant to stipulation of dismissal.

The '212 and '748 patents are the subject of several litigations in the United States District Court for the Eastern District of Texas, Civil Action Nos. 6:12-cv-00016, 6:12-cv-00020, 6:12-cv-00120, 6:12-cv-00121, 6:12-cv-00124, 6:12-cv-00125, 6:12-cv-00017, 6:12-cv-00019, 6:13-cv-00028, 6:13-cv-00296, 6:13-cv-00424, 6:13-cv-00432, 6:13-cv-00433, 6:13-cv-00434, 6:13-cv-00435, 6:13-cv-00436, 6:13-cv-00437, 6:13-cv-00438, 6:13-cv-00439, 6:13-cv-00440, 6:13-cv-00441, 6:13-cv-00442, 6:13-cv-00443, 6:13-cv-00444, 6:13-cv-00445, 6:13-cv-00446, 6:13-cv-00585, 6:13-cv-00778, 6:13-cv-00853, 6:13-cv-00854, and 6:13-cv-00922, hereinafter referred to as Litigations 2, 3, 5, 6, 9-12, 16, and 30-51, respectively.

The '212 and '748 patents are also the subject of several litigations in the United States District Court for the Northern District of California, Civil Action Nos. 3:13-cv-04468, 3:13-cv-04469, 5:13-cv-01774, 5:13-cv-01776, 5:13-cv-01777, 5:13-cv-01778, 5:13-cv-01844, and 5:13-cv-02023, hereinafter referred to as Litigations 21-28, respectively.

The '808, '283, '315, '172, and '851 patents are the subject of several litigations in the United States District Court for the Eastern District of Texas, Civil Action Nos. 6:12-cv-00022, 6:12-cv-00122, 6:12-cv-00123, 6:12-cv-00021, 6:12-cv-00318, and 6:12-cv-00369, hereinafter referred to as Litigations 4, 7, 8, 13, 14, and 15, respectively. Litigations 13 and 14 have been voluntarily dismissed without prejudice.

The '283, '315, '172, and '851 patents are the subject of litigation in the United States District Court for the Eastern District of Texas, Civil Action No. 6:13-cv-00049, hereinafter referred to as Litigation 17.

The '808 patent is the subject of litigation in the United States District Court for the Eastern District of Texas, Civil Action No. 6:13-cv-00050, hereinafter referred to as Litigation 18.

The '808 patent is also the subject of several litigations in the United States District Court for the District of Columbia, Civil Action Nos. 1:13-mc-00497 and 1:13-mc-00498, hereinafter referred to as Litigations 19 and 20, respectively.

The '850 patent is also the subject of litigation in the United States District Court for the Eastern District of Texas, Civil Action No. 6:09-cv-00562, hereinafter referred to as Litigation 29.

In Litigations 1-12, 15, 17, 18, 21-28, and 30, the defendants asserted that various references were pertinent to the issue of validity of at least one of the '212, '748, '808, '283, '315, '172, '851, '742, and '934 patents under 35 U.S.C. §§ 102 and 103. Applicant notes for the Examiner on the attached Form PTO/SB/08 in the column for the Examiner's initials the various references from Litigations 1-18, 21-28, and 30. Any references associated with Litigations 1-51 are identified by the designation "Lit. 1-51."

The '808 patent is also the subject of an investigation pursuant to Section 337 of Tariff Act 1930, as amended, before the U.S. International Trade Commission, Investigation No. 337-TA-871, hereinafter referred to as "ITC 1."

Applicant brings to the Examiner's attention that Applicant's Japanese Patent Nos. JP 3980478 (which corresponds to International Application No. PCT/US01/31766, filed October 10, 2001, which claims priority to U.S. Patent No. 7,072,315) and JP 4213466 (which corresponds to International Application No. PCT/US01/48701, filed December 13, 2001, which claims priority to U.S. Patent No. 7,146,172) are currently the subject of several litigations in Japan, Civil Action No. 28418 entitled "Adaptix, Inc. v. Huawei Japan," Civil Action No. 31440 entitled "Adaptix, Inc. v. ZTE Japan," and Civil Action No. 1149 entitled "Adaptix, Inc. v. Ericsson Japan," hereinafter referred to as "JP Lits. 1, 2, and 3," respectively.

Applicant also brings to the Examiner's attention that Applicant's Japanese Patent No. JP 4201595 (which corresponds to International Application No. PCT/US01/48421, filed December 13, 2001, which claims priority to U.S. Patent No.

6,947,748) is currently the subject of several litigations in Japan, Civil Action No. 17915 entitled "Adaptix, Inc. v. Huawei Japan," Civil Action No. 19919 entitled "Adaptix, Inc. v. ZTE Japan," and Civil Action No. 23278 entitled "Adaptix, Inc. v. LG Electronics Japan," hereinafter referred to as "JP Lits. 4, 5, and 7," respectively.

Applicant brings to the Examiner's attention that Applicant's Japanese Patent Nos. JP 4201595 and JP 5119070 (which claims priority to U.S. Patent No. 6,947,748) are currently the subject of litigations in Japan, Civil Action No. 22141 entitled "Adaptix, Inc. v. Kyocera," Civil Action No. 10769 entitled "Adaptix, Inc. v. LG Electronics Japan," Civil Action No. 12187 entitled "Adaptix, Inc. v. ZTE Japan," Civil Action No. 12188 entitled "Adaptix, Inc. v. Huawei Japan," Civil Action No. 12198 entitled "Adaptix, Inc. v. Apple Japan," and Civil Action No. 12199 entitled "Adaptix, Inc. v. Kyocera," hereinafter referred to as "JP Lits. 6 and 8-12," respectively.

Applicant brings to the Examiner's attention that Applicant's Japanese Patent No. JP 3980478 is currently the subject of several Invalidation Trials in Japan, Trial No. 2013-800082 entitled "ZTE Japan v. Adaptix, Inc.," Trial No. 2013-800141 entitled "Huawei v. Adaptix, Inc.," and Trial No. 2013-800235 entitled "ZTE Japan v. Adaptix, Inc.," hereinafter referred to as "JP Trials 1, 3, and 5," respectively.

Applicant brings to the Examiner's attention that Applicant's Japanese Patent No. JP 4213466 is currently the subject of several Invalidation Trials in Japan, Trial No. 2013-800083 entitled "ZTE Japan v. Adaptix, Inc." and Trial No. 2013-800147 entitled "Huawei v. Adaptix, Inc.," hereinafter referred to as "JP Trials 2 and 4," respectively.

Applicant brings to the Examiner's attention that Applicant's Japanese Patent No. JP 4201595 is currently the subject of Invalidation Trial in Japan, Trial No. 2014-800008 entitled "ZTE Japan v. Adaptix, Inc.," hereinafter referred to as "JP Trial 6."

Applicant notes for the Examiner on the attached Form PTO/SB/08 in the column for the Examiner's initials the references from ITC 1, JP Lits. 1-12, and JP Trials 1-6. References from ITC 1, JP Lits. 1-12, and JP Trials 1-6 are identified by the designation "ITC 1," "JP Lit. 1-12," and "JP Trial 1-6," respectively. Copies of the Japanese documents as provided to Applicant by the defendants in JP Lits. 1-12 and JP Trials 1-6 are being submitted and include a translation when provided by the defendants or when an English abstract is readily available.

Applicant hereby respectfully requests the Examiner to advise Applicant of any additional types of litigation documents beyond those already provided that the Examiner may desire in association with the present application.

This submission does not represent that a search has been made or that no better art exists and does not constitute an admission that each or all of the listed documents are material or constitute "prior art." If the Examiner applies any of the documents as prior art against any claims in the application and Applicant determines that the cited documents do not constitute "prior art" under United States law, Applicant reserves the right to present to the office the relevant facts and law regarding the appropriate status of such documents.

Applicant further reserves the right to take appropriate action to establish the patentability of the disclosed invention over the listed documents, should one or more of the documents be applied against the claims of the present application.

If there is any fee due in connection with the filing of this Statement, please charge the fee to our Deposit Account No. 50-1068.

Respectfully submitted,

MARTIN & FERRARO, LLP

Date: June 2, 2014

By: /Alfred Y. Chu/
Alfred Y. Chu
Registration No. 62,317

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Hartville, Ohio 44632
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