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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	061240-8006.US06
First Named Inventor	Xiaodong Li
Title	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM
Priority Mail Express® Label No.	via EFS-Web

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO: **Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450**

1. [ ] **Fee Transmittal Form** (PTO/SB/17 or equivalent)
2. [✓] **Applicant asserts small entity status.** See 37 CFR 1.27
3. [ ] **Applicant certifies micro entity status.** See 37 CFR 1.29. Applicant must attach form PTO/SB/15A or B or equivalent.
4. [✓] **Specification** [*Total Pages* 21] Both the claims and abstract must start on a new page. *(See MPEP § 608.01(a) for information on the preferred arrangement)*
5. [✓] **Drawing(s)** (35 U.S.C. 113) [*Total Sheets* 18]
6. **Inventor's Oath or Declaration** [*Total Pages* 4] *(including substitute statements under 37 CFR 1.64 and assignments serving as an oath or declaration under 37 CFR 1.63(e))*
   a. [ ] Newly executed (original or copy)
   b. [✓] A copy from a prior application (37 CFR 1.63(d))
7. [✓] **Application Data Sheet** ** See note below.* See 37 CFR 1.76 (PTO/AIA/14 or equivalent)
8. **CD-ROM or CD-R** in duplicate, large table, or Computer Program (*Appendix*)
   [ ] Landscape Table on CD
9. **Nucleotide and/or Amino Acid Sequence Submission** (*if applicable, items a. – c. are required*)
   a. [ ] Computer Readable Form (CRF)
   b. [ ] Specification Sequence Listing on:
      i. [ ] CD-ROM or CD-R (2 copies); or
      ii. [ ] Paper
   c. [ ] Statements verifying identity of above copies

ACCOMPANYING APPLICATION PAPERS

10. [ ] **Assignment Papers** (cover sheet & document(s))
    Name of Assignee _____
11. [✓] **37 CFR 3.73(c) Statement** (*when there is an assignee*) [✓] **Power of Attorney**
12. [ ] **English Translation Document** (*if applicable*)
13. [ ] **Information Disclosure Statement** (PTO/SB/08 or PTO-1449)
    [ ] Copies of citations attached
14. [ ] **Preliminary Amendment**
15. [ ] **Return Receipt Postcard** (*MPEP § 503*) (*Should be specifically itemized*)
16. [ ] **Certified Copy of Priority Document(s)** (*if foreign priority is claimed*)
17. [ ] **Nonpublication Request** Under 35 U.S.C. 122(b)(2)(B)(i). Applicant must attach form PTO/SB/35 or equivalent.
18. [ ] **Other:** _____

*Note: (1) Benefit claims under 37 CFR 1.78 and foreign priority claims under 1.55 **must** be included in an Application Data Sheet (ADS).
(2) For applications filed under 35 U.S.C. 111, the application must contain an ADS specifying the applicant if the applicant is an assignee, person to whom the inventor is under an obligation to assign, or person who otherwise shows sufficient proprietary interest in the matter. See 37 CFR 1.46(b).

19. CORRESPONDENCE ADDRESS

[✓] The address associated with Customer Number: 25096 **OR** [ ] Correspondence address below

Name					
Address					
City		State		Zip Code	
Country		Telephone		Email	

Signature	/Stephen Bishop/	Date	16 April 2018
Name (Print/Type)	Stephen Bishop	Registration No. (Attorney/Agent)	38,829

This collection of information is required by 37 CFR 1.53(b). 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 12 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.**

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POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(b).

I hereby appoint:

[X] Practitioners associated with the Customer Number: 25096

OR

[ ] Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

Name	Registration Number		Name	Registration Number

as attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignment documents attached to this form in accordance with 37 CFR 3.73(b).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(b) to:

[X] The address associated with Customer Number: 25096

OR

[ ] Firm or Individual Name

Address					
City		State		Zip	
Country		Telephone		Email	

Assignee Name and Address:

Neocific, Inc.
13312 SE 43rd Street
Bellevue, Washington 98006

A copy of this form, together with a statement under 37 CFR 3.73(b) (Form PTO/SB/96 or equivalent) is required to be filed in each application in which this form is used. The statement under 37 CFR 3.73(b) may be completed by one of the practitioners appointed in this form if the appointed practitioner is authorized to act on behalf of the assignee, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record

The individual whose signature and title is supplied below is authorized to act on behalf of the assignee

Signature	[signature]	Date	1/3/2007
Name	XIAODONG LI	Telephone	425-445-2270
Title	PRESIDENT		

61240-8000/LEGAL12936537.1

PTO/AIA/96 (08-12)
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STATEMENT UNDER 37 CFR 3.73(c)

Applicant/Patent Owner: Neocific, Inc.

Application No./Patent No.: Not Yet Assigned Filed/Issue Date: Concurrently Herewith

Titled: CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM

Neocific, Inc., a corporation

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. ☑ The assignee of the entire right, title, and interest.

2. ☐ An assignee of less than the entire right, title, and interest (check applicable box):

   ☐ The extent (by percentage) of its ownership interest is _____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.

   ☐ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. ☐ The recipient, via a court proceeding or the like (*e.g.*, bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

A. ☐ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached.

B. ☑ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

   1. From: Inventors To: Waltical Solution, Inc.

      The document was recorded in the United States Patent and Trademark Office at Reel 023489, Frame 0816, or for which a copy thereof is attached.

   2. From: Inventors To: Waltical Solutions, Inc.

      The document was recorded in the United States Patent and Trademark Office at Reel 027104, Frame 0433, or for which a copy thereof is attached.

This collection of information is required by 37 CFR 3.73(b). 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 12 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.**

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STATEMENT UNDER 37 CFR 3.73(c)

3. From: Waltical Solutions, Inc. To: Neocific, Inc.

The document was recorded in the United States Patent and Trademark Office at
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4. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
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6. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☑ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Stephen Bishop/	16 April 2018
Signature	Date
Stephen Bishop	38,829
Printed or Typed Name	Title or Registration Number

DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	METHODS AND APPARATUS FOR SIGNAL TRANSMISSION AND RECEPTION IN A BROADBAND COMMUNICATION SYSTEM

As the below named inventor, I hereby declare that:

This declaration is directed to:

- [ ] The attached application, or
- [x] United States application or PCT international application number 13/861,942 filed on 04/12/2013 .

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

I hereby state that I have reviewed and understand the contents of the above identified application, including the claims, as amended by any amendment.

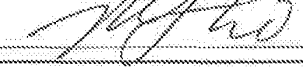
I acknowledge the duty to disclose information material to patentability as defined in 37 C.F.R. 1.56 including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

WARNING:

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LEGAL NAME OF INVENTOR

Inventor: Xiaodong Li Date: 8/5/2013

Signature: 

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

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LEGAL NAME OF INVENTOR

Inventor: Titus Lo Date: 4/12/2013

Signature:

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

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- ☐ The attached application, or
- ☒ United States application or PCT international application number 13/861,942 filed on 04/12/2013.

The above-identified application was made or authorized to be made by me.

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LEGAL NAME OF INVENTOR

Inventor: Kemin Li Date: 06/05/2013

Signature: 

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	METHODS AND APPARATUS FOR SIGNAL TRANSMISSION AND RECEPTION IN A BROADBAND COMMUNICATION SYSTEM

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- [ ] The attached application, or
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The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

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I hereby state that I have reviewed and understand the contents of the above identified application, including the claims, as amended by any amendment.

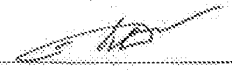
I acknowledge the duty to disclose information material to patentability as defined in 37 C.F.R. 1.56 including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

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LEGAL NAME OF INVENTOR

Inventor: Haiming Huang Date: 04/12/2013

Signature: 

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form or must have been previously filed. Use an additional PTO/AIA/01 form for each additional inventor.

CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM

CROSS-REFERENCE TO RELATED APPLICATION(S)

[0001] This application is a continuation of U.S. Patent Application No. 14/321,615, filed July 1, 2014, which is a continuation application of U.S. Patent Application No. 13/861,942 (now U.S. Patent No. 8,767,522), filed April 12, 2013, which is a continuation application of U.S. Patent Application No. 13/347,644 (now U.S. Patent No. 8,428,009), filed January 10, 2012, which is a continuation application of U.S. Patent Application No. 12/975,226 (now U.S. Patent No. 8,094,611), filed December 21, 2010, all of which are incorporated herein by reference. U.S. Patent Application No. 12/975,226 is a continuation application of U.S. Patent Application No. 10/583,229 (now U.S. Patent No. 7,864,725), filed August 27, 2008, which is the National Stage Application of International Application No. PCT/US2005/003518, filed January 27, 2005, which claims the benefit of U.S. Provisional Patent Application No. 60/540,586, filed on January 30, 2004, and of U.S. Provisional Patent Application No. 60/540,032, filed on January 29, 2004.

BACKGROUND

[0002] A direct Sequence Spread Spectrum (DSSS) system is inherently capable of supporting multi-cell and multi-user access applications through the use of orthogonal spreading codes. The initial access of the physical channel and frequency planning are relatively easier because of interference averaging in a DSSS system. It has been widely used in some existing wireless networks. However, a DSSS system using orthogonal spreading codes, may suffer severely from the loss of orthogonally in a broadband environment due to multi-path propagation effects, which results in low spectral efficiency.

[0003] In broadband wireless communications, Multi-Carrier (MC) technology is drawing more and more attention because of its capability. An MC system such as an Orthogonal Frequency Division Multiplexing (OFDM) system is capable of supporting broadband applications with higher spectral efficiency. An MC system mitigates the adverse effects of multi-path propagation in wireless environments by

using cyclic prefixes to extend the signal period as the data is multiplexed on orthogonal sub-carriers. In effect, it converts a frequency selective channel into a number of parallel flat fading channels which can be easily equalized with simple one-tap equalizers. The modulator and the demodulator can be executed efficiently via the fast Fourier transform (FFT) with much lower cost. However, MC systems are vulnerable while operating in multi-user and multi-cell environments.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] Figure 1 illustrates a basic structure of a multi-carrier signal in the frequency domain, made up of subcarriers.

[0005] Figure 2 illustrates a radio resource being divided into small units in both frequency and time domains.

[0006] Figure 3 illustrates a frame structure of an exemplary OFDM system.

[0007] Figure 4 illustrates three examples of a subframe structure in the exemplary OFDM system.

[0008] Figure 5 illustrates slot structure of the OFDM system and the overlay system.

[0009] Figure 6 is an illustration of MC signals overlaid with DSSS signals in the frequency domain where the power level of the DSSS signal is much lower than that of the MC signal.

[0010] Figure 7 is same as Figure 6 wherein not all MC subchannels are occupied.

[0011] Figure 8 illustrates a transmitter structure of MC and DSSS overlay system.

[0012] Figure 9 illustrates a receiver structure of MC and DSSS overlay system.

[0013] Figure 10 illustrates examples of communications between a base station and multiple mobile stations transmitting DSSS and MC signals.

[0014] Figure 11 illustrates a mobile station sending DSSS signals to its current serving base station, or other base stations.

[0015] Figure 12 illustrates using interference cancellation technique to cancel interfering DSSS signal in a composite signal to obtain a clearer MC signal.

[0016] Figure 13 illustrates a DSSS signal and a MC signal fully overlaid or partially overlaid at MC symbol or slot boundary in time domain.

[0017] Figure 14 illustrates a DSSS signal with a high Peak to Average Ratio in frequency domain causing strong interference to certain MC subcarriers.

[0018] Figure 15 illustrates using spectrum nulls in DSSS signal to protect an MC control subchannel.

[0019] Figure 16 illustrates spectrum control for DSSS signal using simple sub-sampling method.

[0020] Figure 17 illustrates examples of communications between a base station and multiple mobile stations transmitting both DSSS and MC signals.

[0021] Figure 18 illustrates a typical channel response in the time and frequency domains. By estimating the peaks of a channel response in the time domain, the channel profile in the frequency domain can be obtained.

DETAILED DESCRIPTION

[0022] A broadband wireless communication system where both the Multi-Carrier (MC) and direct Sequence Spread Spectrum (DSSS) signals are intentionally overlaid together in both time and frequency domains is described. The system takes advantage of both MC and DSSS techniques to mitigate their weaknesses. The MC signal is used to carry broadband data signal for its high spectral efficiency, while the DSSS signal is used for special purpose processing, such as initial random access, channel probing, and short messaging, in which signal properties such as simplicity, self synchronization, and performance under severe interference are of concern. In the embodiments of this invention both the MC and the DSSS signals are distinguishable in normal operations and the interference between the overlaid signals is insufficient to degrade the expected performance of either signal.

[0023] Unlike a typical CDMA system where the signals are designed to be orthogonal in the code domain or an OFDM system where the signals are designed to be orthogonal in frequency domain, the embodiments of this invention overlay the

MC signal, which is transmitted without or with very low spreading, and the DSSS signal, which is transmitted at a power level lower than that of the MC signal.

[0024] In accordance with aspects of certain embodiments of this invention, the MC signal is modulated on subcarriers in the frequency domain while the DSSS signal is modulated by the information bits or symbols in the time domain. In some cases the information bits modulating the DSSS sequence are always one.

[0025] This invention further provides apparatus and means to implement the mentioned processes and methods in a broadband wireless multi-access and/or multi-cell network, using advanced techniques such as transmit power control, spreading signal design, and iterative cancellation.

[0026] The mentioned MC system can be of any special format such as OFDM or Multi-Carrier Code Division Multiple Access (MC-CDMA). The presented methods and apparatus can be applied to downlink, uplink, or both, where the duplexing technique can be either Time Division Duplexing (TDD) or Frequency Division Duplexing (FDD).

[0027] Various embodiments of the invention are described to provide specific details for thorough understanding and enablement; however, the aspects of the invention may be practiced without such details. In some instances, well-known structures and functions have not been shown or described in detail to avoid unnecessarily obscuring the essential matters.

[0028] Unless the context clearly requires otherwise, throughout the description and the claims, the words “comprise,” “comprising,” and the like are to be construed in an inclusive sense as opposed to an exclusive or exhaustive sense; that is to say, in the sense of “including, but not limited to.” Words using the singular or plural number also include the plural or singular number respectively. Additionally, the words “herein,” “above,” "below" and words of similar import, when used in this application, shall refer to this application as a whole and not to any particular portions of this application. When the claims use the word "or" in reference to a list of two or more items, that word covers all of the following interpretations of the word: any of the items in the list, all of the items in the list and any combination of the items in the list.

MULTI-CARRIER COMMUNICATION SYSTEM

[0029] The physical media resource (e.g., radio or cable) in a multi-carrier communication system can be divided in both the frequency and time domains. This canonical division provides a high flexibility and fine granularity for resource sharing.

[0030] The basic structure of a multi-carrier signal in the frequency domain is made up of subcarriers. Within a particular spectral band or channel, there are a fixed number of subcarriers. There are three types of subcarriers:

1. Data subcarriers, which contain information data;
2. Pilot subcarriers, whose phases and amplitudes are predetermined and made known to all receivers and which are employed for assisting system functions such as estimation of system parameters; and
3. Silent subcarriers, which have no energy and are used for guard bands and DC carrier.

[0031] Figure 1 illustrates a basic structure of a multi-carrier signal in the frequency domain, made up of subcarriers. The data subcarriers can be arranged into groups called subchannels to support scalability and multiple-access. The carriers forming one subchannel are not necessarily adjacent to each other. As depicted in Figure 1, each user may use part or all of the subchannels.

[0032] Figure 2 illustrates a radio resource being divided into small units in both frequency (subchannels) and time domains (time slots). The basic structure of an MC signal in the time domain is made up of time slots to support multiple-access.

AN EXEMPLARY MC SYSTEM

[0033] An OFDM system is used in the system as a special case of an MC system. The system parameters for the uplink under consideration are listed in Table 1. Figure 3 illustrates a frame structure of a suitable OFDM system. In this system, a 20ms frame 310 is divided into four 5ms subframes 312. One subframe 312 consists of six time slots 314 and two special periods 316, which serve transition time from downlink to uplink and vise versa. The six time slots in one subframe can be configured as either uplink or downlink slots symmetrically or asymmetrically.

[0034] Figure 4 illustrates three examples of a subframe structure in an OFDM system: one symmetric configuration 412 and two asymmetric configurations 414, each with differing number of uplink (UL) and downlink (DL) slots. Figure 5 illustrates a slot structure of an OFDM system and an overlay system. One 800μs time slot 510 is comprised of 8 OFDM symbols 512, which are overlaid by DSSS signals 514 in the time domain. Two guard periods GP1 and GP2 are allocated for the DSSS signal 514.

Table 1: Uplink system parameters

Data Rate	**2, 4, 8, 16, 24 Mbps**
Modulation	**QPSK, 16-QAM**
Coding rate	**1/8, 1/4, 1/2, 3/4**
IFFT/FFT size	**1024**
OFDM symbol duration	**100 us**
Guard interval	**11.11 us**
Subcarrier spacing	**9.765625 kHz**
System sampling rate (fs)	**11.52 MHz**
Channel spacing	**10 MHz**

DETAILED DESCRIPTION OF A MC AND DSSS OVERLAY SYSTEM

[0035] Figure 5 illustrates the overlay of the MC and DSSS signals, where the DSSS signal overlaps with the MC signal in the time domain. The overlaid signal can be aligned at the boundary of MC slot or MC symbol when they are synchronized (for example, DSSS signal #k in Figure 5). It can also be not aligned when they are not synchronized (for example, DSSS signal #j in Figure 5). In one embodiment, the DSSS signal is placed at the period of cyclic prefix of the OFDM symbol.

[0036] Figure 6 is an illustration of MC signals overlaid with DSSS signals in the frequency domain where the power level of the DSSS signal is much lower than that of the MC signal. The subcarriers in a subchannel are not necessarily adjacent to each other in the frequency domain. Figure 7 is similar to Figure 6 wherein not all MC subchannels are occupied. It illustrates a scenario where some MC subchannels are not energized.

[0037] In another embodiment, the MC signal is modulated on subcarriers in the frequency domain while the DSSS signal is modulated in either the time domain or the frequency domain. In one embodiment the modulation symbol on the DSSS sequence is one and the sequence is unmodulated.

[0038] Figure 8 illustrates a transmitter structure 800 of an MC and DSSS overlay system, wherein the MC signal and DSSS signal are added together prior to Digital to Analog (D/A) conversion 830. In Figure 8, the top branch 810 is an OFDM transmitter and the bottom branch 820 is the spread spectrum transmitter. In the MC transmitter, the S/P buffer converts the sequential inputs into parallel outputs, which are in turn inputted to the inverse discrete Fourier transform (IDFT). The outputs from the IDFT are the time domain signals, which are converted from parallel to sequential signals after a cyclic prefix is added. Adding the prefix can also be performed after the P/S conversion. In the spread spectrum transmitter, the DSSS sequence is modulated by the information bits or symbols and the modulated signals will undergo pulse-shaping filtering so that the signal spectrum meets specified criteria.

[0039] A digital attenuator (G1) is used for the DSSS signal to adjust its transmitted signal level relative to the MC signal. The two signals are overlaid in the digital domain before converting to a composite analog signal. A second analog variable gain (G2) is used subsequent to the D/A converter 830 to further control the power level of the transmitted signal. When the MC signal is not present, both G1 and G2 will be applied to the DSSS signal to provide sufficient transmission dynamic range. G2 can be realized in multiple circuit stages.

[0040] Figure 9 illustrates a receiver structure 900 of an MC and DSSS overlay system. A composite signal is processed by a MC receiver 910 and DSSS receiver 920. At the receiver side, after automatic gain control (AGC), an Analog-to-Digital (A/D) converter 930 converts the received analog signal to digital signal. The MC receiver basically performs a reverse process of the MC transmitter. The MC synchronization circuit carries out the synchronization in both time and frequency for the receiver to function properly. The outputs of the P/S are information bits or symbols. To detect whether a DSSS signal is present, the signal is despread with a matched filter or a correlator, using the access sequence, to check if the correlation peak exceeds a predefined threshold. The information from the DSSS receiver 920

will then be used to decode the mobile station's signature in the case of initial random access; to derive the channel information in the case of channel probing; or to decode the information bit in the case of short messaging.

[0041] In one embodiment a rake receiver is used in the DSSS receiver 920 to improve its performance in a multi-path environment. In another embodiment, the MC signal is processed as if no DSSS signal is present. In yet another embodiment, advanced interference cancellation techniques can be applied to the composite signal to cancel the DSSS signal from the composite signal thus maintaining almost the same MC performance.

[0042] The transmitted composite signal for user i can be represented by:

$$s_i(t) = G_{i,2} * [G_{i,1} * s_{i,SS}(t) + b_i * s_{i,MC}(t)] \quad (1)$$

where bi is 0 when there is no MC signal and is 1 when an MC signal is present. Similarly, $G_{i,1}$ is 0 when there is no DSSS signal and varies depending on the power setting of the DSSS signal relative to the MC signal when a DSSS signal is present. $G_{i,2}$ is used to control the total transmission power for user i. The received signal can be represented by:

$$r(t) = \sum_{i=1}^{M} s_i(t) + N + I \quad (2)$$

where M is the total number of mobile station actively communicating with the current base station, N is the Gaussian noise, and I is the total interference from all the mobile stations in current and other base stations.

[0043] Denoting the received power of the MC signal as P_{MC} and the received power of the DSSS signal as P_{SS}, the signal to interference and noise ratio (SINR) for the MC signal is:

$$SINR_{MC} = P_{MC} / (N+I) \quad (3)$$

when the DSSS signal is not present; and is

$$SINR'_{MC} = P_{MC} / (N+I+P_{SS}) \quad (4)$$

when the DSSS signal is present. The system is designed such that the $SINR'_{MC}$ meets the SINR requirement for the MC signal and its performance is not compromised in spite of interference from the overlaid DSSS signal.

[0044] In one embodiment, the DSSS signal is power controlled such that P_{SS} is well below the noise level, N.

[0045] On the other hand, the SINR for the DSSS signal is

$$SINR_{SS} = P_{SS} / (N+I+P_{MC}) \quad (5)$$

[0046] Denoting the spreading factor for the DSSS signal as K_{SF}, the effective SINR for one symbol after despreading is:

$$SINR'_{SS} = P_{SS} * K_{SF} / (N+I+P_{MC}) \quad (6)$$

[0047] $SINR'_{SS}$ must be high enough to meet the performance requirement when detecting or decoding the information conveyed in the DSSS signal. In one embodiment, K_{SF} is chosen to be 1000, so that the DSSS signal is boosted with 30dB spreading gain after despreading.

[0048] Figure 11 illustrates a mobile station 1110 sending DSSS signals to its current serving base station or other base stations. The latter case is especially helpful in hand-off processes. In this Figure, a mobile station MS_k is communicating with a BS_i using an MC signal while transmitting a DSSS signal to BS_k.

POWER CONTROL

[0049] As discussed above, one design issue is to minimize the power of the DSSS signal to reduce its interference with the MC data signal. In one embodiment, the initial power setting of a mobile station, T_{MS_tx} (in dBm), is set based on path loss, L_{path} (in dB), and the desired received power level at the base station, $P_{BS\_rx\_des}$ (in dBm),

$$T_{MS\_tx} = P_{BS\_rx\_des} + L_{path} - C_1 - C_2 \quad (7)$$

[0050] C_1 (in dB) is set to a proper value so that the SINR of the MC as specified in equation (4) meets its requirement. C_2 (in dB) is an adjustment to compensate for the power control inaccuracy. Open loop power control inaccuracy is mainly caused by a discrepancy between an estimated path loss by the mobile station and the actual path loss.

[0051] In one embodiment, C_1 is set to 9dB for MC using QPSK modulation with ½ error control coding or 15dB for MC using 16QAM modulation with ½ error control coding. C_2 is set to 10dB or 2dB depending on whether the mobile station is under

open loop power control or closed loop power control. Power control for the DSSS signal also eases the spectrum mask requirement for the DSSS signal because the DSSS signal level is much lower than that of the MC signal.

[0052] With total power offset of $C_1 + C_2$ subtracted from an initial transmission power of the DSSS signal, the spreading factor of the DSSS signal needs to be set high enough (e.g., 512 (27dB) or higher) so that the DSSS signal can be detected in normal conditions. This requires a sufficient number of bits of the A/D converter at the base station, for example, 12 bits.

[0053] In one embodiment, the D/A converter at the mobile station uses 12 bits, among which 8 bits are targeted for the MC signal (assuming 3 bits are reserved for MC peak to average consideration). Thus, there are enough bits left for the DSSS signal even with significant attenuation relative to the MC signal.

CANCELING THE INTERFERENCE OF DSSS SIGNAL TO THE MC SIGNAL

[0054] In one embodiment, the base station employs interference cancellation techniques to cancel the DSSS interference to the MC signal. Figure 12 illustrates a system for using an interference cancellation technique to cancel an interfering DSSS signal in a composite signal to obtain a clearer MC signal. First, a DSSS signal is detected by the DSSS receiver 1220; then it is subtracted (decision directed) from the total received signal to obtain a cleaner MC data signal in the MC receiver 1210, as illustrated in Figure 12. In another embodiment, multiple step iterative cancellation can be applied to further improve the effectiveness of the interference cancellation. The MC receiver basically performs a reverse process of the MC transmitter mentioned above. The MC synchronization circuit carries out the synchronization in both time and frequency for the receiver to function properly. The outputs of the P/S are information bits or symbols.

DSSS SIGNAL DESIGN

[0055] DSSS sequences are chosen to have good autocorrelation and cross-correlation properties (i.e., with high peak to sidelobe ratio). In one embodiment, pulse-shaping is applied to restrict the spectrum mask of DSSS signals and to reduce impacts on the MC signals in the frequency domain. For example, the

transmitter pulse-shaping filter applied to the DSSS signal can be a root-raised cosine (RRC) with roll-off factor α in the frequency domain. The impulse response of the chip impulse filter $RC_0(t)$ is

$$RC_0(t) = \frac{\sin\left(\pi \frac{t}{T_C}(1-\alpha)\right) + 4\alpha \frac{t}{T_C}\cos\left(\pi \frac{t}{T_C}(1+\alpha)\right)}{\pi \frac{t}{T_C}\left(1-\left(4\alpha \frac{t}{T_C}\right)^2\right)} \quad (8)$$

where T_c is the chip duration.

[0056] Figure 13 illustrates a DSSS signal and a MC signal fully overlaid or partially overlaid with an MC symbol or slot boundary in the time domain. The DSSS and the MC signals may be aligned at the symbol (or slot) boundary when they are synchronized, or partially overlapped in the time domain when they are not synchronized, as shown in Figure 13, where a DSSS signal #m 1302 fully overlaps with a MC symbol (or slot) 1304 in time domain, while a DSSS signal #n 1306 overlaps with the MC symbol (or slot) only partially.

[0057] Figure 14 illustrates a DSSS signal with a high Peak to Average Ratio in the frequency domain causing strong interference to certain MC subcarriers. The sequence used to spread the DSSS signal has to be designed to avoid cases where the DSSS signal may have a high Peak to Average ratio (PAR) in the frequency domain and its spikes may cause severe interference with some MC subcarriers, as illustrated in Figure 14. In one embodiment, the DSSS sequence is designed so that, in partial or in full, it has low PAR in the frequency domain using signal processing techniques, such as a PAR reduction algorithm. Either binary or non binary sequences can be used.

[0058] In another embodiment, Golay complementary sequences, Reed-Muller codes, or the codes designed with similar construction methods may be used to control the PAR of DSSS sequences in the frequency domain, thereby limiting the interference of DSSS signals to MC signals, which are demodulated in the frequency domain. In one embodiment, guard periods are added to the DSSS signal which overlaps with one MC symbol, as shown by DSSS signal #p 1308 in Figure 13. The guard periods ensure that a well-designed DSSS sequence (with low PAR in

frequency domain) causes little interference with the MC subcarriers even when there is time misalignment in a DSSS signal relative to the OFDM symbol period.

[0059] Within MC subcarriers, the control subcarriers are more important than the data subcarriers and may need to have a better protection in the overlay system.

[0060] Figure 15 illustrates using spectrum nulls in the DSSS signal 1502 to protect an MC control subchannel. In one embodiment, the DSSS sequence is designed to have spectrum nulls at MC control subchannels to avoid excess interference with the uplink MC control signals 1504, as illustrated in Figure 15. One such scheme is to use sub-sampling such that the chip rate of the DSSS signal is 1/2 or 2/3 of the system sampling rate, which means the DSSS spectrum will only occupy the center portion with a width of 5.76MHz or 7.68MHz out of the 10MHz available spectrum 1506, as shown in Figure 16. Its interference with the MC sub-carriers over the rest of the spectrum will be much lower where the MC subchannels, carrying control information or using higher modulation subcarriers (such as 16QAM), are placed.

INITIAL RANDOM ACCESS USING THE OVERLAY SCHEME

[0061] Figure 10 illustrates a DSSS signal used as initial random access by the mobile station MS_j 1004, in an overlay system. In the mean time, MS_l and MS_k are transmitting MC signals to the base station BS_i 1002 . In one embodiment of the invention, the DSSS signal is used for initial random access and the MC signal is used by multiple mobile stations to transmit high rate data and related control information, as illustrated in Figure 10. In this arrangement the mobile station MS_j is transmitting its initial access DSSS signal simultaneously with the MC signals from other mobile stations (in this case, MS_l and MS_K) to the base station BS_i.

[0062] In the initial random access of a multi-carrier multiple access system, a mobile station cannot transmit directly onto the control subchannel because its transmission time and power have not been aligned with other mobile stations. When this mobile station powers up or wakes up from a sleep mode, it first listens to a base station broadcasting channel and finds an available random access DSSS channel. It then sends an initial random access signal over the DSSS channel with a certain

signature code or sequence that is designated to the corresponding base station and is broadcasted to all the mobile stations by each base station.

[0063] The initial access DSSS signal arrives at the base station together with MC signals from other mobile stations, each carrying data and control information. The initial power level of the DSSS signal is based on the open power loop control settings. A sufficient guard period is reserved in the DSSS signal to account for initial time alignment uncertainty, as shown in Figure 5.

[0064] If the base station successfully detects the DSSS signal, it sends the acknowledgement (ACK) carrying information such as a signature or other unique mobile station identifier and power and time adjustments of the mobile on the downlink control channel in the next available timeslot. The mobile station whose transmission signature matches that of the acknowledgement then moves to the designated uplink MC control channel using the assigned time and power values and further completes the message transmission.

[0065] If no feedback is received at the mobile station after a pre-defined number of slots, it assumes that the access slot was not detected by the base station, and will ramp up the transmission power of the DSSS signal by one step and re-transmit it, until it reaches the maximum allowable transmit signal power or the maximum retry times. In one embodiment, the power ramping step of the mobile station is set to be 1dB or 2dB which is configured by the base station on the downlink broadcasting channel. The maximum allowable transmit signal power and the retry times are also controlled by the base station depending on the uplink modulation/coding scheme and available access channels. During the initial random access, the DSSS signal can also be used for channel probing and short messaging.

CHANNEL PROBING USING DSSS IN THE OVERLAY SYSTEM

[0066] In one embodiment of the invention, the DSSS signal is used to assist estimation of channel characteristics. In this case, the mobile station is already synchronized in time and frequency with the base station, and its transmission of the MC signal is under closed-loop power control with the base station.

[0067] Figure 17 illustrates examples of communications between a base station 1702 and multiple mobile stations 1704 transmitting both DSSS and MC

signals. DSSS signal is used for channel probing or to carry short messages. In this case, MS_j 1704 is transmitting both an MC signal and a DSSS signal to the base station BS_i 1702. It is also under closed loop power control with the base station BS_i 1702. In Figure 17, the mobile station MS_j 1704 is transmitting its DSSS signal simultaneously with its own MC signal. Other mobile stations (in this case, MS_l 1704 and MS_K 1704) are transmitting either MC or DSSS signals to the base station BS_i 1702.

[0068] Figure 18 illustrates a typical channel response in the time domain 1802 and the frequency domain 1804. By estimating the peaks of a channel response in the time domain 1802, the channel profile in the frequency domain 1804 can be obtained. A typical channel response in the time domain and frequency domain for a broadband wireless system is shown in Figure 18. Using a matched filter in the DSSS receiver at the base station, the peaks of a channel response in time can be detected.

[0069] When closed loop power control is used, the initial power settings will be much more accurate than by using open loop power control alone. Thus, the margin reserved for power control inaccuracy can be reduced to a much smaller value. Furthermore, a bigger spreading factor can be used since no data information needs to be conveyed in the DSSS signal. This leaves a dynamic range large enough for detecting multi-path peaks from the output of the match filter or correlator, thereby generating a better channel profile. When and how often a mobile station should send the DSSS signal for channel probing is configurable by the network or the mobile station.

[0070] In one embodiment, the base station dictates the mobile station to transmit the channel probing DSSS when it needs an update of the mobile station's channel characteristics. In another embodiment, the base station polls the mobile station during its silent period and gets an update of the mobile station's information such as transmission timing and power from the probing DSSS signal. In yet another embodiment, the channel profile information is used by the base station to determine the proper modulation/coding and pilot pattern. In yet another embodiment, the channel profile information is used for advanced antenna techniques such as beamforming. In one embodiment, channel probing with the DSSS signaling is performed without close loop power control or time synchronization.

SHORT MESSAGE USING DSSS IN THE OVERLAY SYSTEM

[0071] In one embodiment of the invention, the DSSS signal is used to carry short messages. In this case, the mobile station is already synchronized in time and frequency with the base station, and its transmission of a MC signal is also under closed-loop power control with the base station. As shown in Figure 17, the mobile station MS_j is transmitting its DSSS signal carrying a short message simultaneously with its own MC signal. Other mobile stations (in this case, MS_I and MS_K) are transmitting either the MC signal or DSSS signal to the base station BS_i. In this case, the short message carried by the DSSS signal has a much lower data rate compared with that of the MC signal. In another embodiment, short messaging using the DSSS signaling is performed without close loop power control or time synchronization.

[0072] The above detailed description of the embodiments of the invention is not intended to be exhaustive or to limit the invention to the precise form disclosed above or to the particular field of usage mentioned in this disclosure. While specific embodiments of, and examples for, the invention are described above for illustrative purposes, various equivalent modifications are possible within the scope of the invention, as those skilled in the relevant art will recognize. Also, the teachings of the invention provided herein can be applied to other systems, not necessarily the system described above. The elements and acts of the various embodiments described above can be combined to provide further embodiments.

[0073] All of the above patents and applications and other references, including any that may be listed in accompanying filing papers, are incorporated herein by reference. Aspects of the invention can be modified, if necessary, to employ the systems, functions, and concepts of the various references described above to provide yet further embodiments of the invention.

[0074] Changes can be made to the invention in light of the above "Detailed Description." While the above description details certain embodiments of the invention and describes the best mode contemplated, no matter how detailed the above appears in text, the invention can be practiced in many ways. Therefore, implementation details may vary considerably while still being encompassed by the invention disclosed herein. As noted above, particular terminology used when describing certain features or aspects of the invention should not be taken to imply

that the terminology is being redefined herein to be restricted to any specific characteristics, features, or aspects of the invention with which that terminology is associated.

[0075] In general, the terms used in the following claims should not be construed to limit the invention to the specific embodiments disclosed in the specification, unless the above Detailed Description section explicitly defines such terms. Accordingly, the actual scope of the invention encompasses not only the disclosed embodiments, but also all equivalent ways of practicing or implementing the invention under the claims.

[0076] While certain aspects of the invention are presented below in certain claim forms, the inventors contemplate the various aspects of the invention in any number of claim forms. Accordingly, the inventors reserve the right to add additional claims after filing the application to pursue such additional claim forms for other aspects of the invention.

We claim:

1. A communication method for a mobile station operating in accordance with a time frame structure that includes a plurality of frames, each frame containing a plurality of subframes, each subframe containing a plurality of time slots, each time slot containing a plurality of Orthogonal Frequency Division Multiplexing (OFDM) symbols, the method comprising:

receiving from a base station information about availability of a random access channel;

transmitting a random access signal over the random access channel within an uplink frequency band, wherein

the random access signal contains a code sequence associated with a chip rate, the code sequence designated to the base station and the chip rate being a fraction of a system sampling rate; and

the random access signal has a time duration longer than multiple of the OFDM symbols;

receiving an acknowledgement to the random access signal from the base station, the acknowledgement carrying an identifier associated with the mobile station; and

transmitting an OFDM signal over a control channel at the system sampling rate and within the uplink frequency band.

2. The method of claim 1, wherein a guard period is added to the random access signal.

3. The method of claim 1, wherein the random access signal is generated from a binary or non-binary code sequence in the frequency domain or the time domain.

4. The method of claim 3, wherein the code sequence is a Golay complementary sequence, a Reed-Muller code, or a sequence constructed to reduce peak-to-average ratio.

5. The method of claim 3, wherein the code sequence has an autocorrelation with a high peak-to-sidelobe ratio.

6. The method of claim 1, wherein some frequency components within the random access channel are nulled.

7. The method of claim 1, wherein the random access signal is power controlled for transmission.

8. The method of claim 7, wherein an initial transmission power level of the random access signal is based on a path loss between the mobile station and the base station.

9. The method of claim 1, wherein the acknowledgement carries time adjustment for the mobile station.

10. The method of claim 1, wherein the acknowledgement carries power adjustment for the mobile station.

11. A mobile station operating in accordance with a time frame structure that includes a plurality of frames, each frame containing a plurality of subframes, each subframe containing a plurality of time slots, each time slot containing a plurality of Orthogonal Frequency Division Multiplexing (OFDM) symbols, the mobile station comprising:

a receiver configured to receive from a base station information about availability of a random access channel;

a transmitter configured to transmit a random access signal over the random access channel within an uplink frequency band, wherein the random access signal contains a code sequence associated with a chip rate, the code sequence designated to the base station and the chip rate being a fraction of a system sampling rate; and

the random access signal has a time duration longer than multiple of the OFDM symbols;

a receiver configured to receive an acknowledgement to the random access signal from the base station, the acknowledgement carrying an identifier associated with the mobile station; and

a transmitter configured to transmit an OFDM signal over a control channel at the system sampling rate and within the uplink frequency band.

12. The mobile station of claim 11, wherein a guard period is added to the random access signal.

13. The mobile station of claim 11, wherein the random access signal is generated from a binary or non-binary code sequence in the frequency domain or the time domain.

14. The mobile station of claim 13, wherein the code sequence is a Golay complementary sequence, a Reed-Muller code, or a sequence constructed to reduce peak-to-average ratio.

15. The mobile station of claim 13, wherein the code sequence has an autocorrelation with a high peak-to-sidelobe ratio.

16. The mobile station of claim 11, wherein some frequency components within the random access channel are nulled.

17. The mobile station of claim 11, wherein the random access signal is power controlled for transmission.

18. The mobile station of claim 17, wherein an initial transmission power level of the random access signal is based on a path loss between the mobile station and the base station.

19. The mobile station of claim 11, wherein the acknowledgement carries time adjustment for the mobile station.

20. The mobile station of claim 11, wherein the acknowledgement carries power adjustment for the mobile station.

ABSTRACT

In a broadband wireless communication system, a spread spectrum signal is intentionally overlapped with an OFDM signal, in a time domain, a frequency domain, or both. The OFDM signal, which inherently has a high spectral efficiency, is used for carrying broadband data or control information. The spread spectrum signal, which is designed to have a high spread gain for overcoming severe interference, is used for facilitating system functions such as initial random access, channel probing, or short messaging. Methods and techniques are devised to ensure that the mutual interference between the overlapped signals is minimized to have insignificant impact on either signal and that both signals are detectable with expected performance by a receiver.

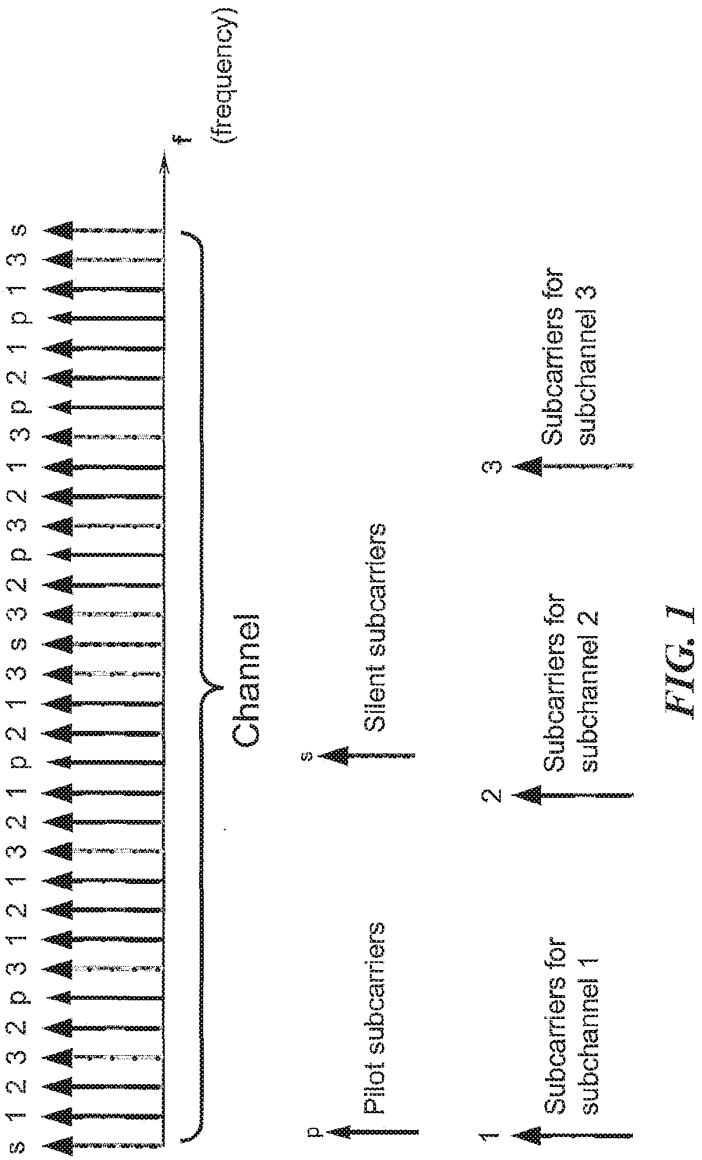

s 1 2 3 2 p 3 1 2 1 3 2 1 p 2 1 3 s 3 2 p 3 2 1 3 p 2 1 p 1 3 s
f
(frequency)
Channel
p
Pilot subcarriers
s
Silent subcarriers
1
Subcarriers for subchannel 1
2
Subcarriers for subchannel 2
3
Subcarriers for subchannel 3

FIG. 1



FIG. 2

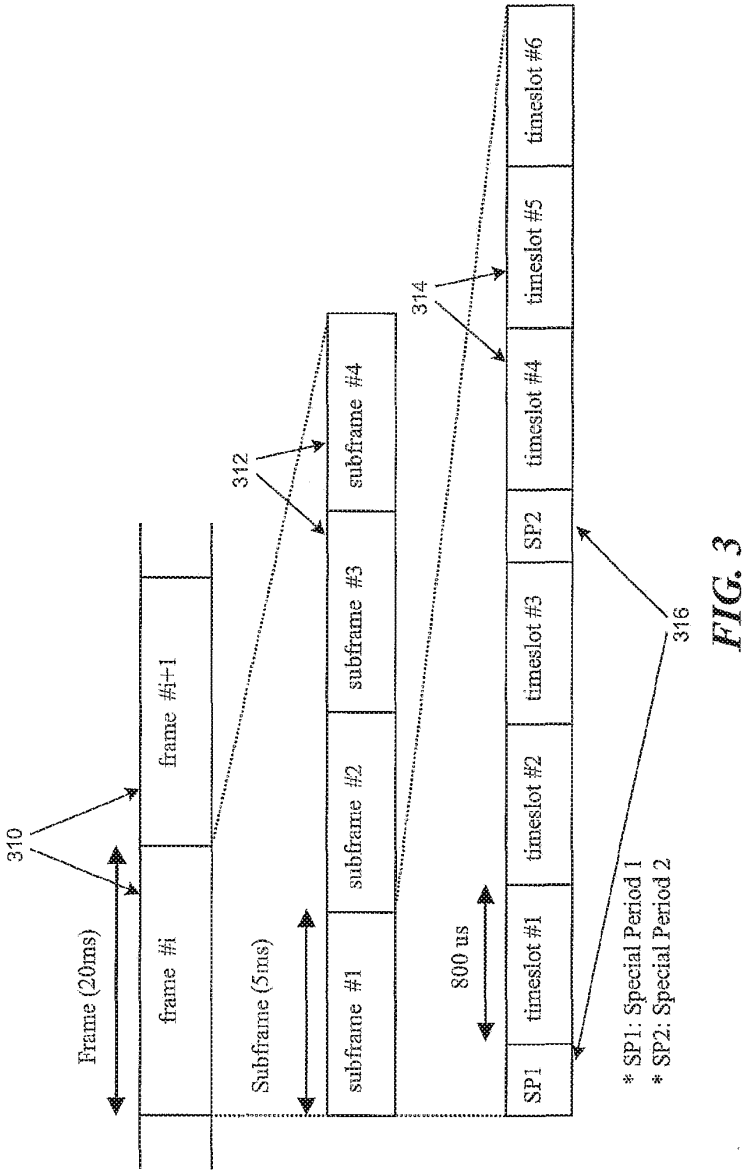

310
frame #i
frame #i+1
Frame (20ms)
312
subframe #1
subframe #2
subframe #3
subframe #4
Subframe (5ms)
314
800 us
SP1
timeslot #1
timeslot #2
timeslot #3
SP2
timeslot #4
timeslot #5
timeslot #6
316
* SP1: Special Period 1
* SP2: Special Period 2

FIG. 3

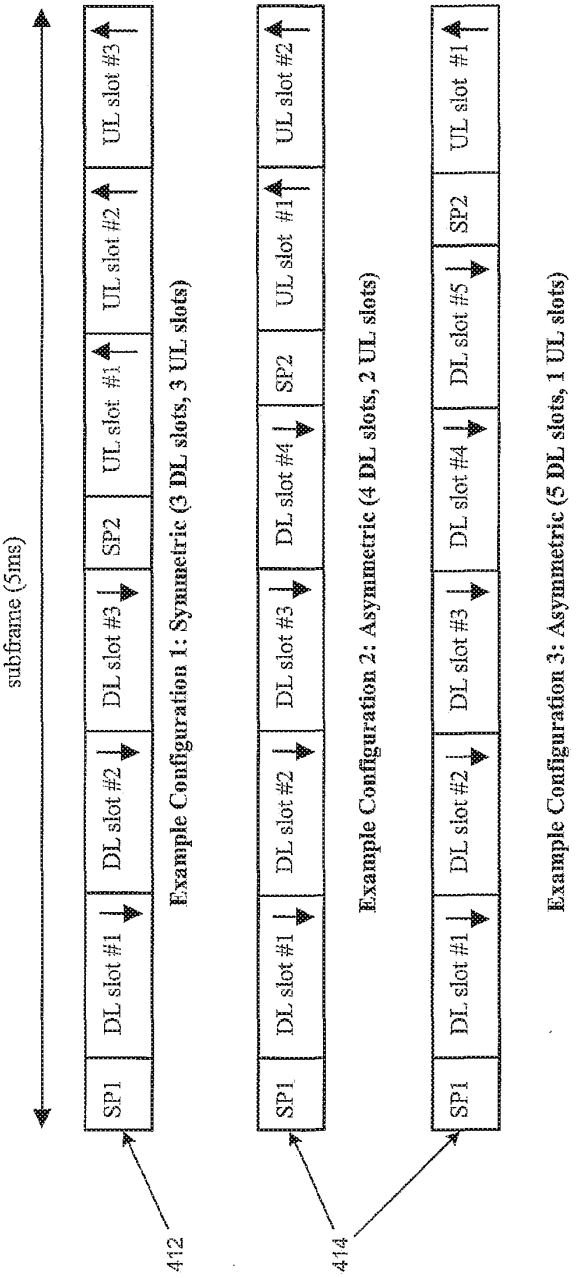

subframe (5ms)
SP1
DL slot #1
DL slot #2
DL slot #3
SP2
UL slot #1
UL slot #2
UL slot #3
Example Configuration 1: Symmetric (3 DL slots, 3 UL slots)
412
SP1
DL slot #1
DL slot #2
DL slot #3
DL slot #4
SP2
UL slot #1
UL slot #2
Example Configuration 2: Asymmetric (4 DL slots, 2 UL slots)
414
SP1
DL slot #1
DL slot #2
DL slot #3
DL slot #4
DL slot #5
SP2
UL slot #1
Example Configuration 3: Asymmetric (5 DL slots, 1 UL slots)

FIG. 4

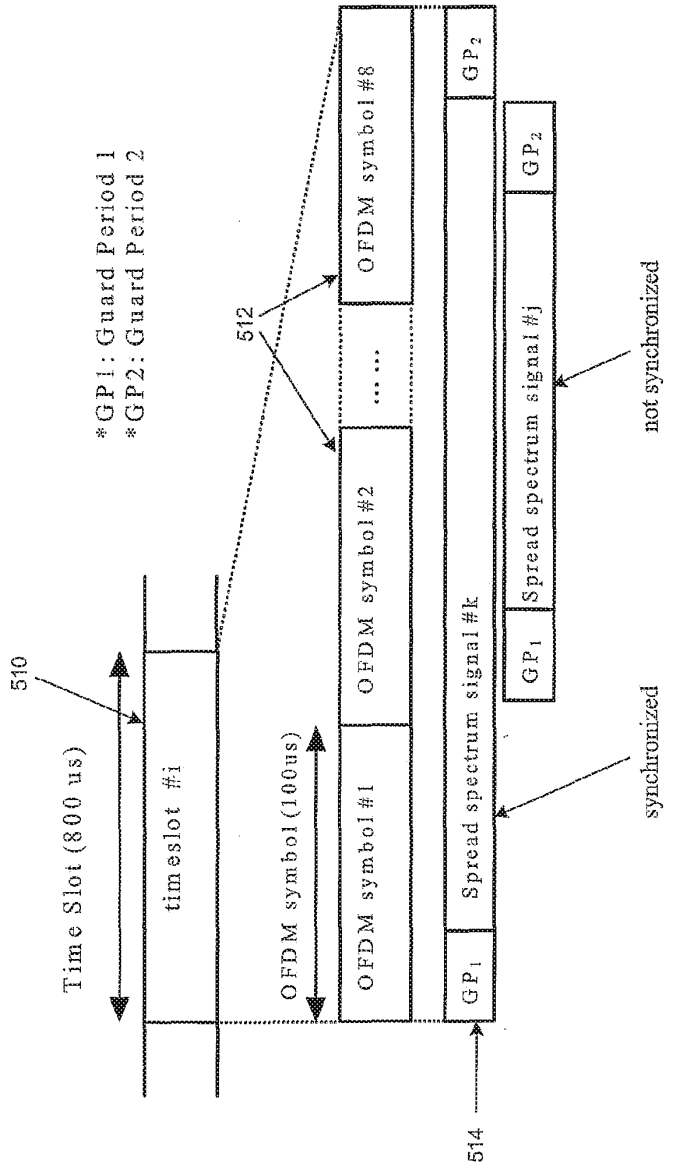

*GP1: Guard Period 1
*GP2: Guard Period 2
510
512
514
Time Slot (800 us)
timeslot #i
OFDM symbol (100us)
OFDM symbol #1
OFDM symbol #2
... ...
OFDM symbol #8
GP1
GP2
Spread spectrum signal #k
Spread spectrum signal #j
synchronized
not synchronized

FIG. 5

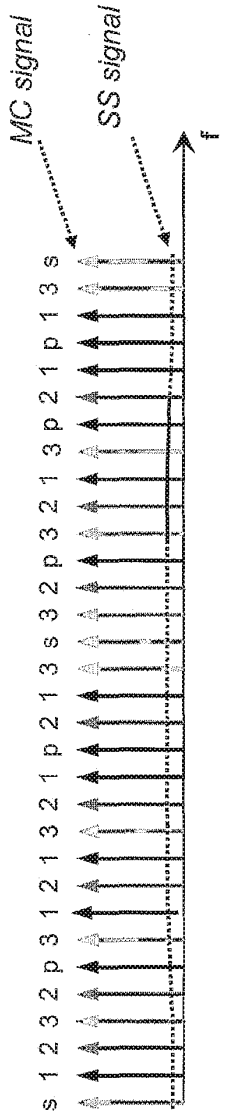


FIG. 6

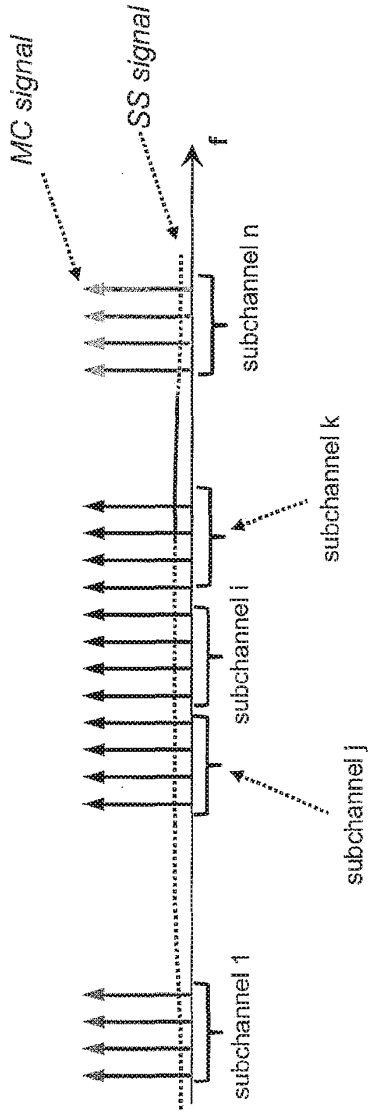

MC signal
SS signal
f
subchannel n
subchannel k
subchannel i
subchannel j
subchannel 1

FIG. 7

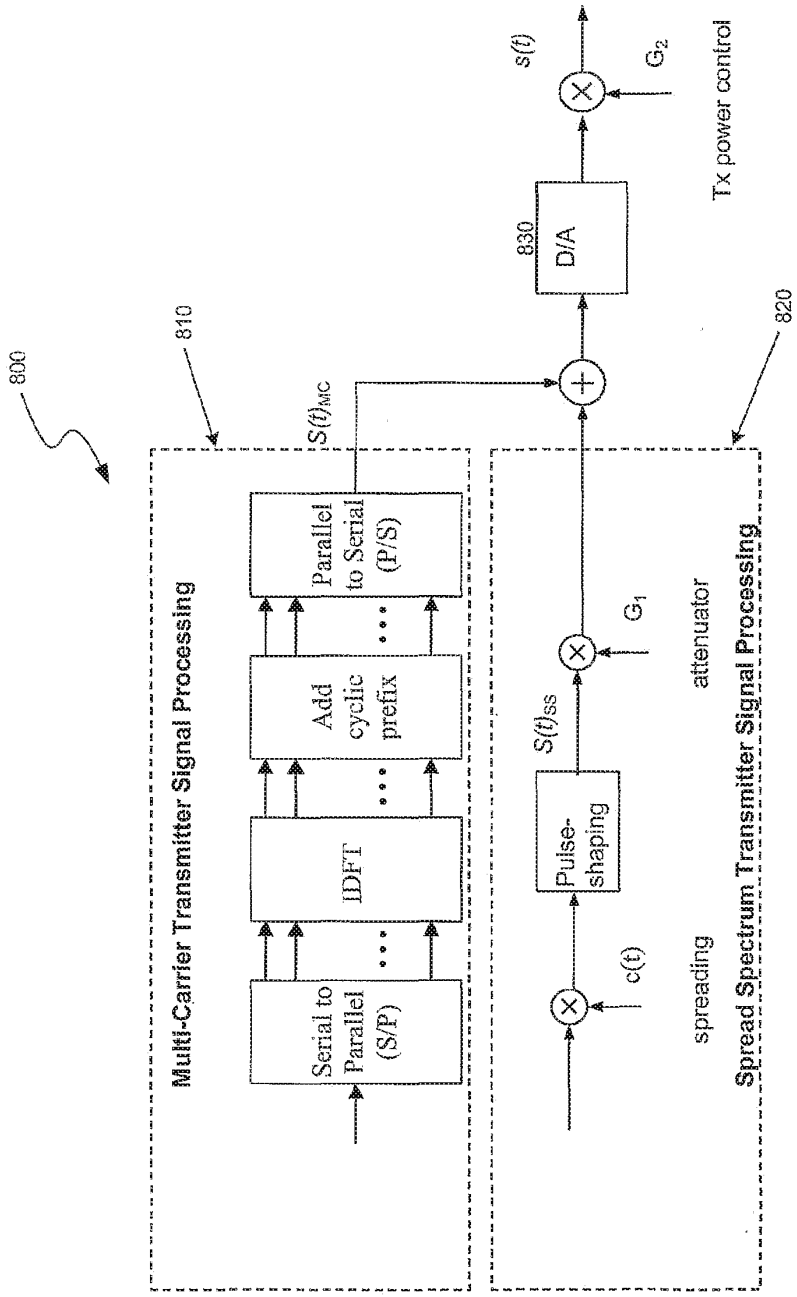

800
810
820
Multi-Carrier Transmitter Signal Processing
Spread Spectrum Transmitter Signal Processing
Serial to Parallel (S/P)
IDFT
Add cyclic prefix
Parallel to Serial (P/S)
S(t)MC
c(t)
spreading
Pulse-shaping
S(t)SS
G1
attenuator
830
D/A
s(t)
G2
Tx power control

FIG. 8

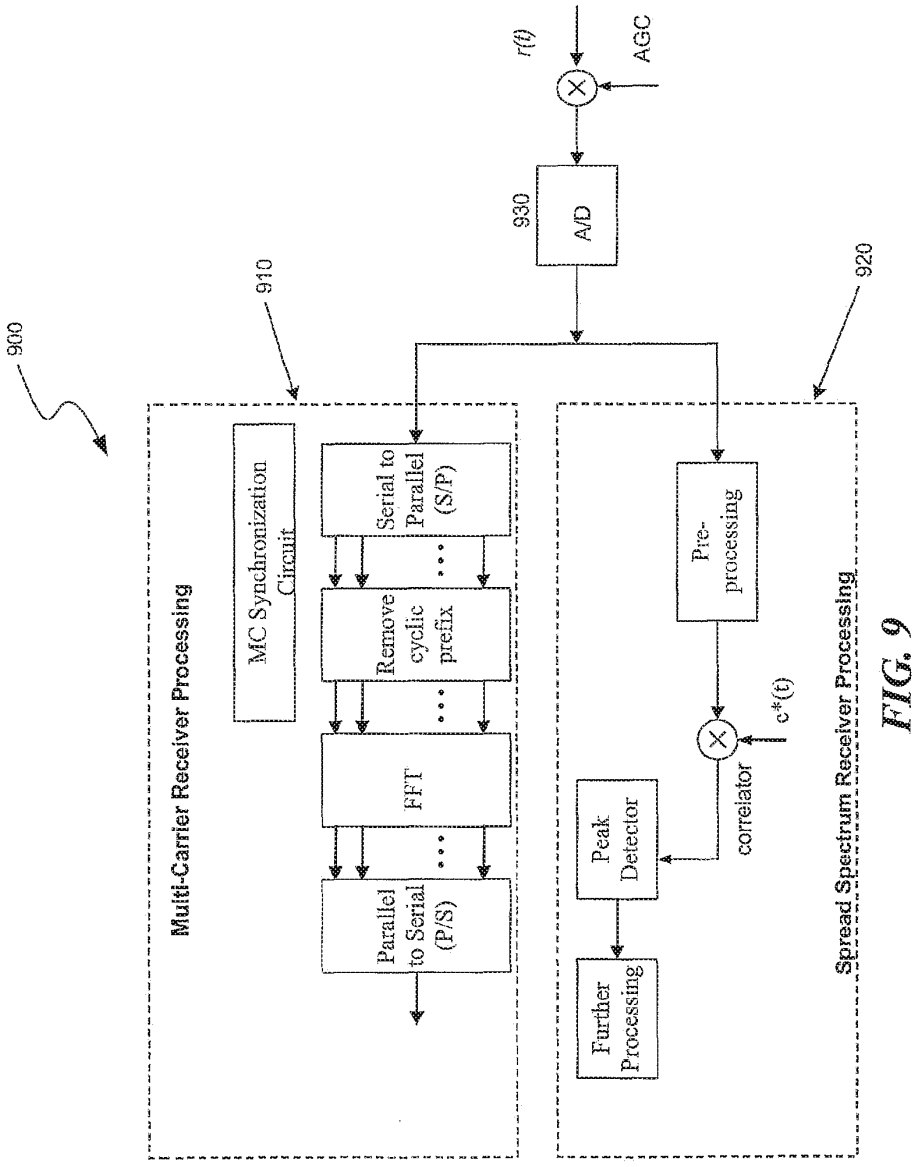

900
910
920
930
r(t)
AGC
A/D
Multi-Carrier Receiver Processing
MC Synchronization Circuit
Serial to Parallel (S/P)
Remove cyclic prefix
FFT
Parallel to Serial (P/S)
Spread Spectrum Receiver Processing
Pre-processing
c*(t)
correlator
Peak Detector
Further Processing

FIG. 9

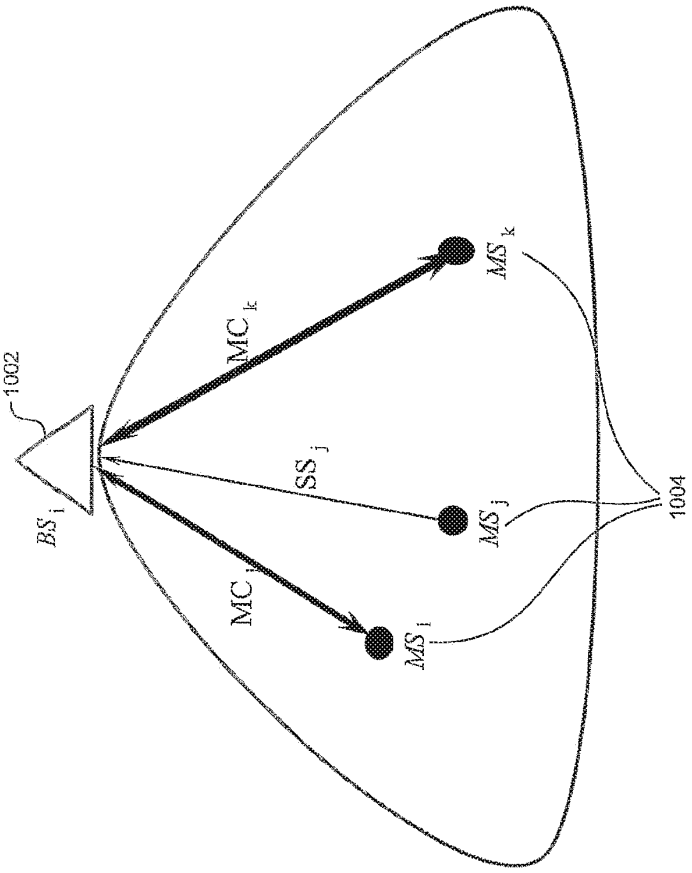


FIG. 10

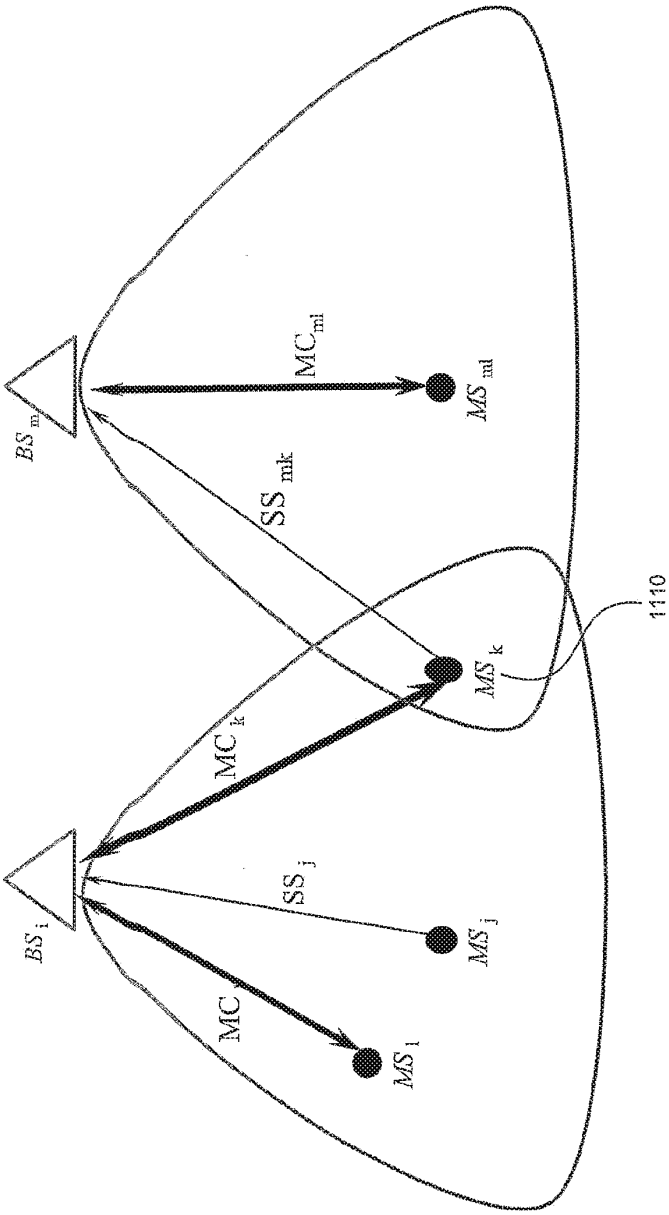


FIG. 11

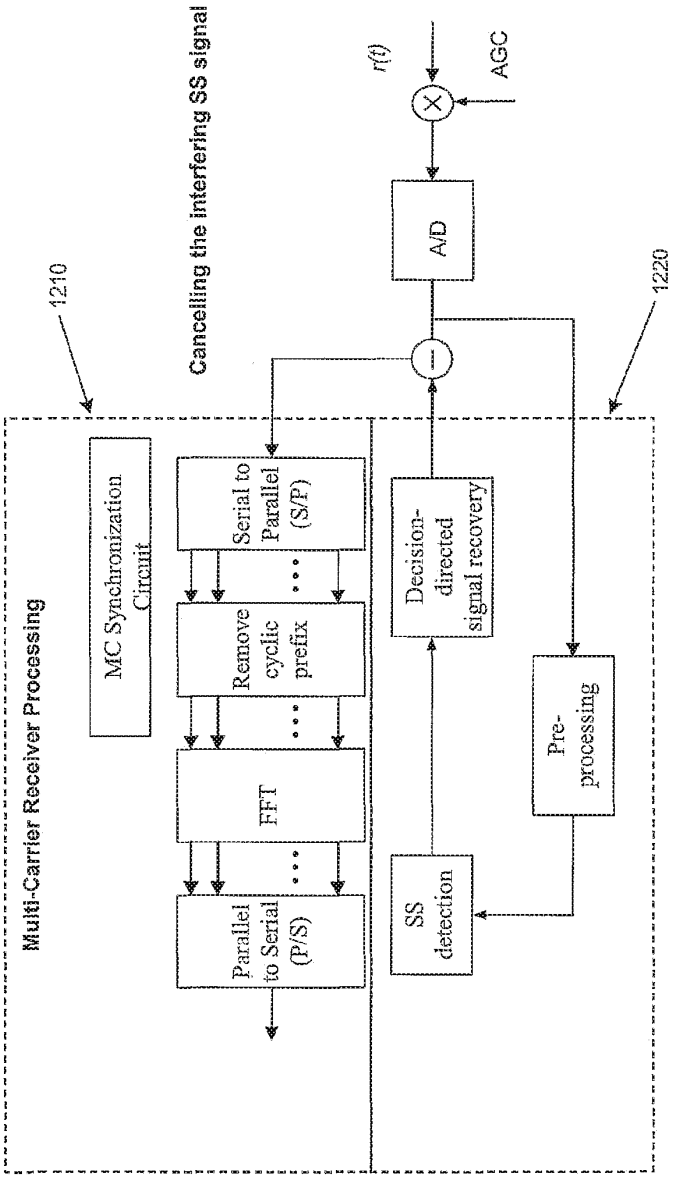

Cancelling the interfering SS signal
r(t)
AGC
A/D
1210
1220
Multi-Carrier Receiver Processing
MC Synchronization Circuit
Serial to Parallel (S/P)
Remove cyclic prefix
FFT
Parallel to Serial (P/S)
Decision-directed signal recovery
Pre-processing
SS detection

FIG. 12

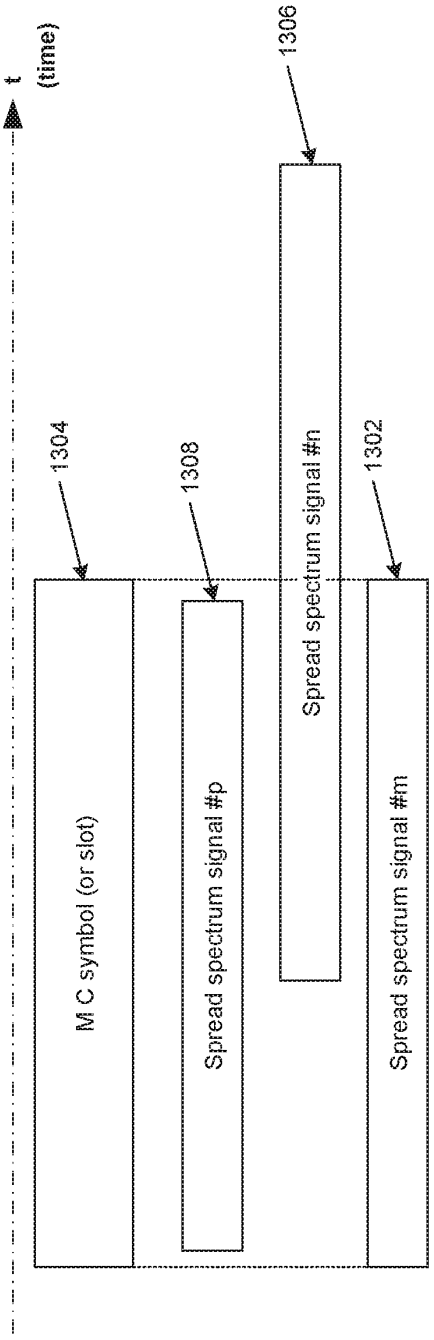

t
(time)
1306
1304
1308
1302
M C symbol (or slot)
Spread spectrum signal #p
Spread spectrum signal #n
Spread spectrum signal #m

FIG. 13

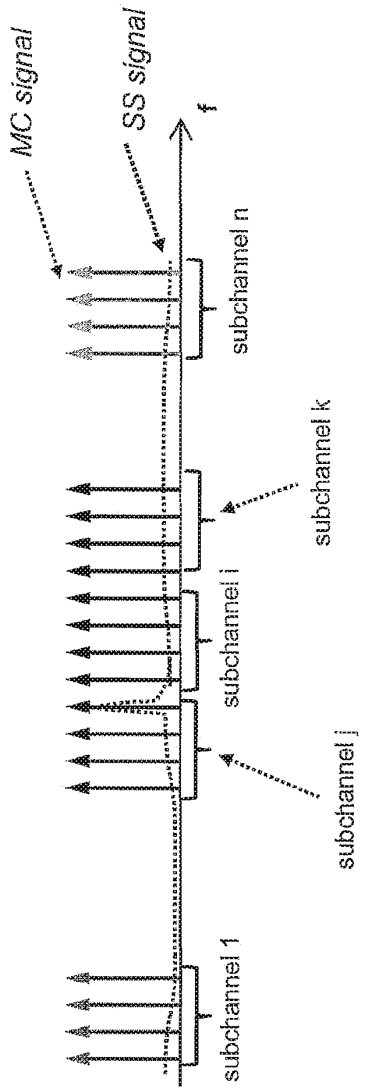

MC signal
SS signal
f
subchannel n
subchannel k
subchannel i
subchannel j
subchannel 1

FIG. 14

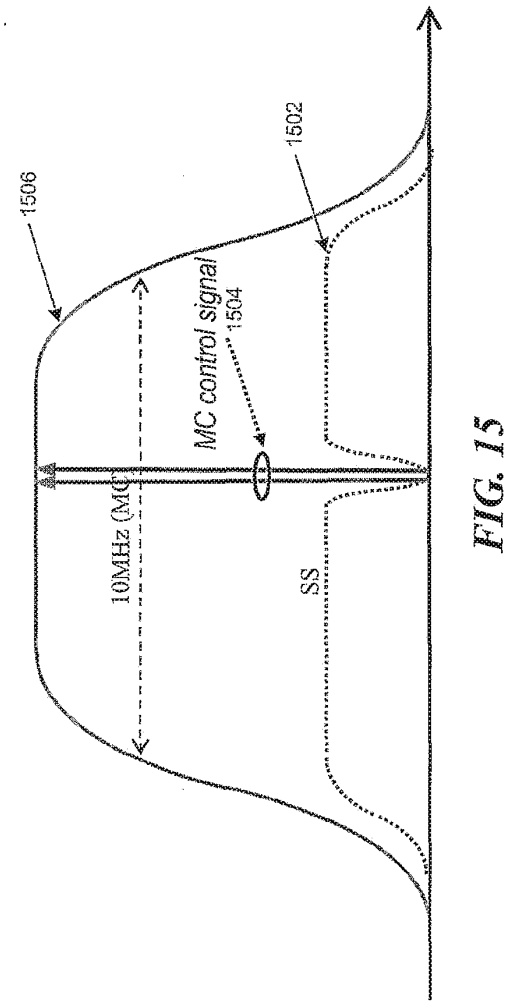


FIG. 15

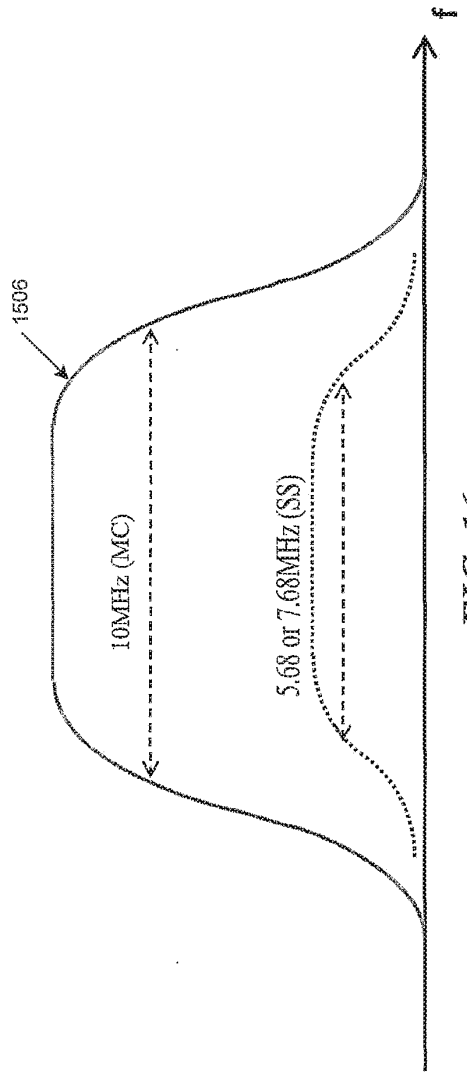


FIG. 16

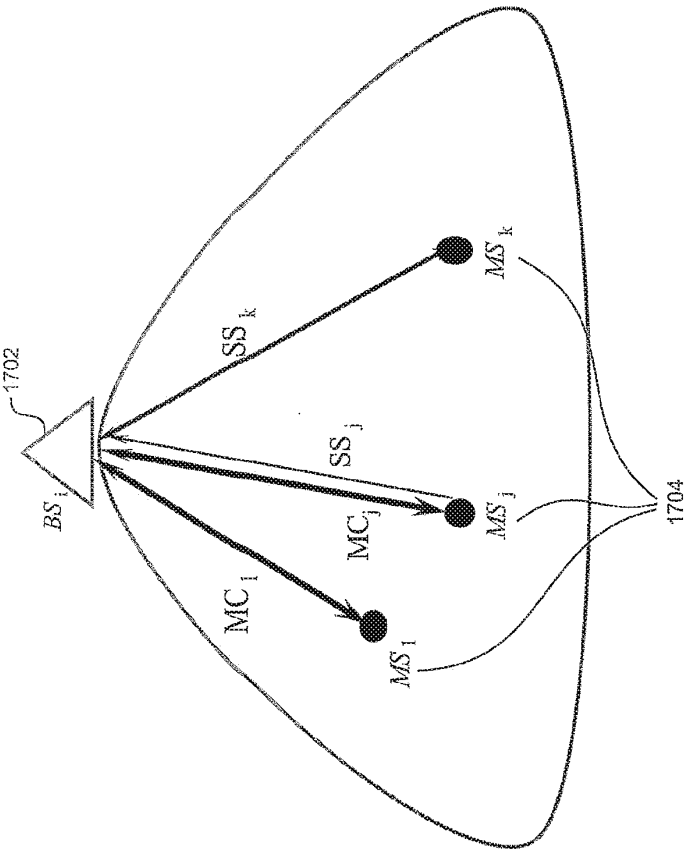


FIG. 17

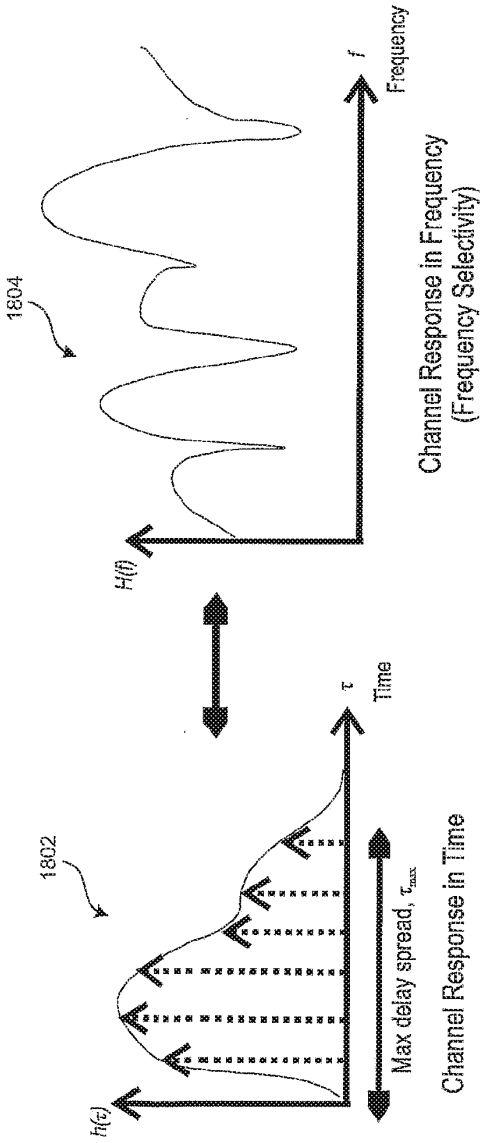

1804
H(f)
f
Frequency
Channel Response in Frequency
(Frequency Selectivity)
1802
h(τ)
τ
Time
Max delay spread, τ_{max}
Channel Response in Time

FIG. 18

Electronic Acknowledgement Receipt

EFS ID:	32349384
Application Number:	15953950
International Application Number:	
Confirmation Number:	1085
Title of Invention:	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Xiaodong Li
Customer Number:	25096
Filer:	Stephen C Bishop/Todd Nielsen
Filer Authorized By:	Stephen C Bishop
Attorney Docket Number:	061240-8006.US06
Receipt Date:	16-APR-2018
Filing Date:	
Time Stamp:	15:27:18
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet	0612408006US06_ADS_04_16_18.PDF	1256770 b5556844767aeaf3660d8a90dfc86b75ff737fff	no	10

Warnings:

Information:					
2		0612408006US06_Application_04_16_18.pdf	7990516 013a5806dc024191f52c5d0b5f6755314be090b1	yes	47

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Transmittal of New Application	1	1
	Power of Attorney	2	2
	Assignee showing of ownership per 37 CFR 3.73	3	4
	Oath or Declaration filed	5	8
	Specification	9	24
	Claims	25	28
	Abstract	29	29
	Drawings-only black and white line drawings	30	47

Warnings:	
Information:	
Total Files Size (in bytes):	9247286

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
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.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	061240-8006.US06
	Application Number	
Title of Invention	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM	

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	Kirkland	State/Province	WA	Country of Residence	US

Mailing Address of Inventor:

Address 1	9919 129th PL NE
Address 2	

City	Kirkland	State/Province	WA
Postal Code	98033	Country	US

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Titus		Lo	

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

City	Bellevue	State/Province	WA	Country of Residence	US

Mailing Address of Inventor:

Address 1	13312 SE 43rd ST
Address 2	

City	Bellevue	State/Province	WA
Postal Code	98006	Country	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

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	061240-8006.US06
	Application Number	
Title of Invention	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM	

City	Bellevue	State/Province	WA	Country of Residence	US

Mailing Address of Inventor:

Address 1	4228 144th Lane SE		
Address 2			
City	Bellevue	State/Province	WA
Postal Code	98006	Country	US

Inventor 4 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Haiming		Huang	

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

City	Bellevue	State/Province	WA	Country of Residence	US

Mailing Address of Inventor:

Address 1	605 141st CT SE #D203		
Address 2			
City	Bellevue	State/Province	WA
Postal Code	98007	Country	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	25096		
Email Address	patentprocurement@perkinscoie.com	Add Email	Remove Email

Application Information:

Title of the Invention	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM		
Attorney Docket Number	061240-8006.US06	Small Entity Status Claimed	☒
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	18	Suggested Figure for Publication (if any)	

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	061240-8006.US06
	Application Number	
Title of Invention	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM	

Filing By Reference:

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	25096		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim 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" field blank.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	Continuation of	14321615	2014-07-01

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	061240-8006.US06
	Application Number	
Title of Invention	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM	

Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
14321615	Continuation of	13861942	2013-04-12	8767522	2014-07-01
Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
13861942	Continuation of	13347644	2012-01-10	8428009	2013-04-23
Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
13347644	Continuation of	12975226	2010-12-21	8094611	2012-01-10
Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
12975226	Continuation of	10583229	2008-08-27	7864725	2011-01-04
Prior Application Status	Expired				Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)		
10583229	a 371 of international	PCT/US05/03518	2005-01-27		
Prior Application Status	Expired				Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)		
PCT/US05/03518	Claims benefit of provisional	60540586	2004-01-30		
Prior Application Status	Expired				Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)		
PCT/US05/03518	Claims benefit of provisional	60540032	2004-01-29		
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. 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(i)(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).

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	061240-8006.US06
	Application Number	
Title of Invention	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM	

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

Remove

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.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	061240-8006.US06
	Application Number	
Title of Invention	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM	

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is 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 State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	061240-8006.US06
	Application Number	
Title of Invention	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM	

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	Neocific, Inc.		
Mailing Address Information For Applicant:			
Address 1	1750 112th Ave. NE		
Address 2	Suite D159		
City	Bellevue	**State/Province**	WA
Country	US	Postal Code	98004
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 substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	061240-8006.US06
	Application Number	
Title of Invention	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM	

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

Signature:

Remove

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Stephen Bishop/			Date (YYYY-MM-DD)	2018-04-16
First Name	Stephen	Last Name	Bishop	Registration Number	38829

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

PTO/AIA/14 (02-18)
Approved for use through 11/30/2020. OMB 0651-0032
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 contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	061240-8006.US06
	Application Number	
Title of Invention	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM	

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 CooperationTreaty.

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.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/953,950	04/16/2018	Xiaodong Li	061240-8006.US06

CONFIRMATION NO. 1085

25096
PERKINS COIE LLP - SEA General
PATENT-SEA
P.O. BOX 1247
SEATTLE, WA 98111-1247

FORMALITIES LETTER

OC000000099405682

Date Mailed: 05/10/2018

NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION

FILED UNDER 37 CFR 1.53(b)

Filing Date Granted

Items Required To Avoid Abandonment:

An application number and filing date have been accorded to this application. The item(s) indicated below, however, are missing. Applicant is given **TWO MONTHS** from the date of this Notice within which to file all required items below to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

- The statutory basic filing fee is missing.
- The application search fee must be submitted.
- The application examination fee must be submitted.
- Surcharge as set forth in 37 CFR 1.16(f) must be submitted.
  The surcharge is due for any one of:
  - late submission of the basic filing fee, search fee, or examination fee,
  - late submission of inventor's oath or declaration,
  - filing an application that does not contain at least one claim on filing, or
  - submission of an application filed by reference to a previously filed application.

SUMMARY OF FEES DUE:

The fee(s) required within **TWO MONTHS** from the date of this Notice to avoid abandonment is/are itemized below. Small entity discount is in effect. If applicant is qualified for micro entity status, an acceptable Certification of Micro Entity Status must be submitted to establish micro entity status. (See 37 CFR 1.29 and forms PTO/SB/15A and 15B.)

- $ **75** basic filing fee.
- $ **80** surcharge.
- $ **330** search fee.
- $ **380** examination fee.
- $(**0**) previous unapplied payment amount.
- $ **865** TOTAL FEE BALANCE DUE.

Replies must be received in the USPTO within the set time period or must include a proper Certificate of Mailing or Transmission under 37 CFR 1.8 with a mailing or transmission date within the set time period. For more information and a suggested format, see Form PTO/SB/92 and MPEP 512.

Replies should be mailed to:

Mail Stop Missing Parts
Commissioner for Patents
P.O. Box 1450
Alexandria VA 22313-1450

Registered users of EFS-Web may alternatively submit their reply to this notice via EFS-Web, including a copy of this Notice and selecting the document description "Applicant response to Pre-Exam Formalities Notice". https://sportal.uspto.gov/authenticate/AuthenticateUserLocalEPF.html

For more information about EFS-Web please call the USPTO Electronic Business Center at 1-866-217-9197 or visit our website at http://www.uspto.gov/ebc.

If you are not using EFS-Web to submit your reply, you must include a copy of this notice.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/qnguyen/

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 15/953,950

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	75		N/A	
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	330		N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	380		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	20 minus 20 =	*	x 50 =	0.00	OR		
INDEPENDENT CLAIMS (37 CFR 1.16(h))	2 minus 3 =	*	x 230 =	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	785		TOTAL	

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($)	ADDITIONAL FEE($)	OR	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.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
15/953,950	04/16/2018	2827	0.00	061240-8006.US06	20	2

CONFIRMATION NO. 1085

FILING RECEIPT

25096
PERKINS COIE LLP - SEA General
PATENT-SEA
P.O. BOX 1247
SEATTLE, WA 98111-1247



Date Mailed: 05/10/2018

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, Kirkland, WA;
Titus Lo, Bellevue, WA;
Kemin Li, Bellevue, WA;
Haiming Huang, Bellevue, WA;

Applicant(s)

Neocific, Inc., Bellevue, WA;

Power of Attorney: The patent practitioners associated with Customer Number 25096

Domestic Priority data as claimed by applicant

This application is a CON of 14/321,615 07/01/2014 PAT 9948488
which is a CON of 13/861,942 04/12/2013 PAT 8767522
which is a CON of 13/347,644 01/10/2012 PAT 8428009
which is a CON of 12/975,226 12/21/2010 PAT 8094611
which is a CON of 10/583,229 08/27/2008 PAT 7864725
which is a 371 of PCT/US05/03518 01/27/2005
which claims benefit of 60/540,586 01/30/2004
and claims benefit of 60/540,032 01/29/2004

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.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 05/08/2018
The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 15/953,950**
Projected Publication Date: To Be Determined - pending completion of Missing Parts
Non-Publication Request: No
Early Publication Request: No
**** SMALL ENTITY ****
Title

CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM

Preliminary Class

365

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.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

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).

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The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop

technology, manufacture products, deliver services, and grow your business, visit http://www.SelectUSA.gov or call +1-202-482-6800.

Docket No.: 061240-8006.US06
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
Li et al.

Application No.: 15/953,950 Confirmation No.: 1085

Filed: April 16, 2018 Art Unit: 2827

For: CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM Examiner: Not Yet Assigned

RESPONSE TO NOTICE TO FILE MISSING PARTS OF APPLICATION

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

Sir:

In response to the Notice to File Missing Parts of Application – Filing Date Granted mailed May 10, 2018, Applicant respectfully submits the Filing Fee for the Application (as shown on accompanying Fee Transmittal), a Petition for Extension of Time, and a General Authorization for Extensions of Time under 37 C.F.R. § 1.136(A)(3) and Fees under 37 C.F.R. § 1.17.

Payment by Credit Card is submitted herewith in the amount of $2,365 covering the fees set forth in 37 C.F.R. § 1.16(f), 1.16(a), 1.16(k), 1.16(o), 1.16(h), and 1.17(a)(5). The Director is hereby authorized to charge any deficiency in the fees filed, asserted to be filed or which should have been filed herewith (or with any paper hereafter filed in this application by this firm) to our Deposit Account No. 50-0665, under Order No. 061240-8006.US06.

Dated: 10 December 2018

Respectfully submitted,

By /Stephen Bishop/
Stephen Bishop
Registration No.: 38,829
PERKINS COIE LLP
P.O. Box 1247
Seattle, Washington 98111-1247
(206) 359-8000
(206) 359-7198 (Fax)
Attorney for Applicant

Electronic Patent Application Fee Transmittal

Application Number:	15953950
Filing Date:	16-Apr-2018
Title of Invention:	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Xiaodong Li
Filer:	Stephen C Bishop/Todd Nielsen
Attorney Docket Number:	061240-8006.US06

Filed as Small Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
UTILITY FILING FEE (ELECTRONIC FILING)	4011	1	75	75
UTILITY SEARCH FEE	2111	1	330	330
UTILITY EXAMINATION FEE	2311	1	380	380
Pages:				
Claims:				
Miscellaneous-Filing:				
LATE FILING FEE FOR OATH OR DECLARATION	2051	1	80	80
Petition:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Extension - 5 months with $0 paid	2255	1	1500	1500
Miscellaneous:				
		Total in USD ($)		**2365**

Electronic Acknowledgement Receipt	
EFS ID:	34541273
Application Number:	15953950
International Application Number:	
Confirmation Number:	1085
Title of Invention:	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Xiaodong Li
Customer Number:	25096
Filer:	Stephen C Bishop/Todd Nielsen
Filer Authorized By:	Stephen C Bishop
Attorney Docket Number:	061240-8006.US06
Receipt Date:	10-DEC-2018
Filing Date:	16-APR-2018
Time Stamp:	19:24:47
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$2365
RAM confirmation Number	121118INTEFSW19260300
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		0612408006US06_MP_Response_12_10_18.pdf	413661 74b2cce0cfe2a9d8c3ae17cb15762b7ba2ce5b9f	yes	5

Multipart Description/PDF files in .zip description

Document Description	Start	End
Authorization for Extension of Time all replies	5	5
Extension of Time	4	4
Transmittal Letter	3	3
Applicant Response to Pre-Exam Formalities Notice	1	2

Warnings:

Information:

2	Fee Worksheet (SB06)	fee-info.pdf	38988 d576c15627384c2b3fe68c8faf3dddb130d4297d	no	2

Warnings:

Information:

Total Files Size (in bytes):	452649

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

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.

Docket No.: 061240-8006.US06
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
Li et al.

Application No.: 15/953,950 | Confirmation No.: 1085

Filed: April 16, 2018 | Art Unit: 2827

For: CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM | Examiner: Not Yet Assigned

AUTHORIZATION FOR: EXTENSIONS OF TIME UNDER 37 C.F.R. § 1.136(A)(3) AND FEES UNDER 37 C.F.R. § 1.17

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

Sir:

With respect to the above-identified application, the Commissioner is authorized to treat any concurrent or future reply requiring a petition for an extension of time under 37 C.F.R. § 1.136(a)(3) for its timely submission as incorporating a petition therefor for the appropriate length of time.

The Commissioner is also authorized to charge any extension of time fees or other fees that may be required under 37 C.F.R. § 1.17 for any paper filed concurrently herewith or in the future, or credit any overpayment, to Deposit Account No. 50-0665.

Dated: 10 December 2018

Respectfully submitted,

By /Stephen Bishop/
Stephen Bishop
Registration No.: 38,829
PERKINS COIE LLP
P.O. Box 1247
Seattle, Washington 98111-1247
(206) 359-8000
(206) 359-7198 (Fax)
Attorneys for Applicant

61240-8006.US06/142362714.1

PTO/AIA/22 (03-13)
Approved for use through 11/30/2020. OMB 0651-0031
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.

PETITION FOR EXTENSION OF TIME UNDER 37 CFR 1.136(a)	Docket Number (Optional) 061240-8006.US06
Application Number 15/953,950	Filed April 16, 2018
For CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM	
Art Unit 2827	Examiner Not Yet Assigned

This is a request under the provisions of 37 CFR 1.136(a) to extend the period for filing a reply in the above-identified application.

The requested extension and fee are as follows (check time period desired and enter the appropriate fee below):

		Fee	Small Entity Fee	Micro Entity Fee	
☐	One month (37 CFR 1.17(a)(1))	$200	$100	$50	$
☐	Two months (37 CFR 1.17(a)(2))	$600	$300	$150	$
☐	Three months (37 CFR 1.17(a)(3))	$1,400	$700	$350	$
☐	Four months (37 CFR 1.17(a)(4))	$2,200	$1,100	$550	$
☑	Five months (37 CFR 1.17(a)(5))	$3,000	$1,500	$750	$ 1,500

☑ Applicant asserts small entity status. See 37 CFR 1.27.

☐ Applicant certifies micro entity status. See 37 CFR 1.29.
Form PTO/SB/15A or B or equivalent must either be enclosed or have been submitted previously.

☐ A check in the amount of the fee is enclosed.

☑ Payment by credit card.

☐ The Director has already been authorized to charge fees in this application to a Deposit Account.

☑ The Director is hereby authorized to charge any fees which may be required, or credit any overpayment, to Deposit Account Number _____.

☐ Payment made via EFS-Web.

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

I am the

☐ applicant.

☑ attorney or agent of record. Registration number 38,829.

☐ attorney or agent acting under 37 CFR 1.34. Registration number _____.

/Stephen Bishop/ — Signature

10 December 2018 — Date

Stephen Bishop — Typed or printed name

(206) 359-8000 — Telephone Number

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. Submit multiple forms if more than one signature is required, see below*.

☐ * Total of _____ forms are submitted.

This collection of information is required by 37 CFR 1.136(a). 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 6 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: Mail Stop PCT, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

PTO/SB/17 (01-18)
Approved for use through 11/30/2020. OMB 0651-0032
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

FEE TRANSMITTAL

Complete if known	
Application Number	15/953,950
Filing Date	April 16, 2018
First Named Inventor	Xiaodong Li
Examiner Name	Not Yet Assigned
Art Unit	2827
Practitioner Docket No.	061240-8006.US06

[■] Applicant asserts small entity status. See 37 CFR 1.27.

[ ] Applicant certifies micro entity status. See 37 CFR 1.29. Form PTO/SB/15A or B or equivalent must either be enclosed or have been submitted previously.

TOTAL AMOUNT OF PAYMENT ($) 2,365

METHOD OF PAYMENT (check all that apply)

[ ] Check [■] Credit Card [ ] Money Order [ ] None [ ] Other (please identify): _____

[■] Deposit Account Deposit Account Number: 50-0665 Deposit Account Name: Perkins Coie LLP

For the above-identified deposit account, the Director is hereby authorized to (check all that apply):

[ ] Charge fee(s) indicated below [ ] Charge fee(s) indicated below, **except for the filing fee**

[■] Charge any additional fee(s) or underpayment of fee(s) under 37 CFR 1.16 and 1.17 [■] Credit any overpayment of fee(s)

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

FEE CALCULATION

1. BASIC FILING, SEARCH, AND EXAMINATION FEES (U = undiscounted fee; S = small entity fee; M = micro entity fee)

	FILING FEES			SEARCH FEES			EXAMINATION FEES			
Application Type	U ($)	S ($)	M ($)	U ($)	S ($)	M ($)	U ($)	S ($)	M ($)	Fees Paid ($)
Utility	300	150*	75	660	330	165	760	380	190	785
Design	200	100	50	160	80	40	600	300	150	
Plant	200	100	50	420	210	105	620	310	155	
Reissue	300	150	75	660	330	165	2,200	1,100	550	
Provisional	280	140	70	0	0	0	0	0	0	

* The $150 small entity status filing fee for a utility application is further reduced to $75 for a small entity status applicant who files the application via EFS-Web.

2. EXCESS CLAIM FEES

Fee Description	Undiscounted Fee ($)	Small Entity Fee ($)	Micro Entity Fee ($)
Each claim over 20 (including Reissues)	100	50	25
Each independent claim over 3 (including Reissues)	460	230	115
Multiple dependent claims	820	410	205

Total Claims		Extra Claims		Fee ($)		Fee Paid ($)
20	-20 or HP =	_____	x	_____	=	_____

HP = highest number of total claims paid for, if greater than 20.

Indep. Claims		Extra Claims		Fee ($)		Fee Paid ($)
2	-3 or HP =	_____	x	_____	=	_____

HP = highest number of independent claims paid for, if greater than 3.

Multiple Dependent Claims		
	Fee ($)	Fee Paid ($)
	_____	_____

3. APPLICATION SIZE FEE

If the specification and drawings exceed 100 sheets of paper (excluding electronically filed sequence or computer listings under 37 CFR 1.52(e)), the application size fee due is $400 ($200 for small entity) ($100 for micro entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).

Total Sheets		Extra Sheets		Number of each additional 50 or fraction thereof		Fee ($)		Fee Paid ($)
39	- 100 =	_____	/ 50 =	_____ (round **up** to a whole number)	x	_____	=	_____

4. OTHER FEE(S) Fees Paid ($)

Non-English specification, $130 fee (no small or micro entity discount) _____

Non-electronic filing fee under 37 CFR 1.16(t) for a utility application, $400 fee ($200 small or micro entity) _____

Other (e.g., late filing surcharge): Surcharge - Late filing fee ($80) and Petition for Extension of Time - 5-mo ($1,500) $1,580

SUBMITTED BY

Signature	/Stephen Bishop/	Registration No. (Attorney/Agent) 38,829	Telephone (206) 359-8000
Name (Print/Type)	Stephen Bishop		Date 10 December 2018

This collection of information is required by 37 CFR 1.136. 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 30 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.

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 15/953,950

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	75		N/A	
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	330		N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	380		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	20 minus 20 =	*	x 50 =	0.00	OR		
INDEPENDENT CLAIMS (37 CFR 1.16(h))	2 minus 3 =	*	x 230 =	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	785		TOTAL	

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($)	ADDITIONAL FEE($)	OR	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.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
15/953,950	04/16/2018	2827	865	061240-8006.US06	20	2

CONFIRMATION NO. 1085

UPDATED FILING RECEIPT

25096
PERKINS COIE LLP - SEA General
PATENT-SEA
P.O. BOX 1247
SEATTLE, WA 98111-1247

OC000000104403159

Date Mailed: 12/13/2018

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, Kirkland, WA;
Titus Lo, Bellevue, WA;
Kemin Li, Bellevue, WA;
Haiming Huang, Bellevue, WA;

Applicant(s)

Neocific, Inc., Bellevue, WA;

Power of Attorney: The patent practitioners associated with Customer Number 25096

Domestic Priority data as claimed by applicant

This application is a CON of 14/321,615 07/01/2014 PAT 9948488
which is a CON of 13/861,942 04/12/2013 PAT 8767522
which is a CON of 13/347,644 01/10/2012 PAT 8428009
which is a CON of 12/975,226 12/21/2010 PAT 8094611
which is a CON of 10/583,229 08/27/2008 PAT 7864725
which is a 371 of PCT/US05/03518 01/27/2005
which claims benefit of 60/540,586 01/30/2004
and claims benefit of 60/540,032 01/29/2004

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.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 05/08/2018
The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 15/953,950**
Projected Publication Date: 03/21/2019
Non-Publication Request: No
Early Publication Request: No
**** SMALL ENTITY ****
Title

CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM

Preliminary Class

365

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.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

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).

SelectUSA

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop

technology, manufacture products, deliver services, and grow your business, visit http://www.SelectUSA.gov or call +1-202-482-6800.

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
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.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 15/953,950	Filing Date 04/16/2018	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $460 =	
☐ 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).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	12/21/2018	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 20	Minus	** 20	= 0		x $100 =	0
	Independent (37 CFR 1.16(h))	* 4	Minus	*** 3	= 1		x $460 =	460
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	460

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/SHERRY A DAVIS/
*** 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 number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. 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 12 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.

Docket No.: 061240-8006.US06
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
Li et al.

Application No.: 15/953,950 Confirmation No.: 1085

Filed: April 16, 2018 Art Unit: 2827

For: CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM Examiner: Not Yet Assinged

PRELIMINARY AMENDMENT UNDER 37 CFR 1.115

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

Sir:

Prior to examination on the merits, please amend the above-identified U.S. patent application as follows:

INTRODUCTORY COMMENTS

Amendments to the Specification begin on page 2 of this paper.

Amendments to the Claims are reflected in the listing of claims which begins on page 3 of this paper.

Remarks/Arguments begin on page 8 of this paper.

Electronic Patent Application Fee Transmittal				
Application Number:	15953950			
Filing Date:	16-Apr-2018			
Title of Invention:	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM			
First Named Inventor/Applicant Name:	Xiaodong Li			
Filer:	Stephen C Bishop/Todd Nielsen			
Attorney Docket Number:	061240-8006.US06			
Filed as Small Entity				
Filing Fees for Utility under 35 USC 111(a)				
Description	**Fee Code**	**Quantity**	**Amount**	**Sub-Total in USD($)**
Basic Filing:				
Pages:				
Claims:				
INDEPENDENT CLAIMS IN EXCESS OF 3	2201	1	230	230
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**230**

Electronic Acknowledgement Receipt	
EFS ID:	34680341
Application Number:	15953950
International Application Number:	
Confirmation Number:	1085
Title of Invention:	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Xiaodong Li
Customer Number:	25096
Filer:	Stephen C Bishop/Todd Nielsen
Filer Authorized By:	Stephen C Bishop
Attorney Docket Number:	061240-8006.US06
Receipt Date:	21-DEC-2018
Filing Date:	16-APR-2018
Time Stamp:	17:47:40
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$230
RAM confirmation Number	122618INTEFSW17481900
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		0612408006US06_PA_12_21_18.pdf	106632 2fae901918d0078de116c3093cd3b0c6777cdade	yes	8

Multipart Description/PDF files in .zip description

Document Description	Start	End
Applicant Arguments/Remarks Made in an Amendment	8	8
Claims	3	7
Specification	2	2
Preliminary Amendment	1	1

Warnings:

Information:

2	Fee Worksheet (SB06)	fee-info.pdf	30480 88decd9d760aa5231860ad28543ec423c8ebd0cf	no	2

Warnings:

Information:

Total Files Size (in bytes):	137112

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New Applications Under 35 U.S.C. 111

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REMARKS

Claims 1-20 were pending prior to the present filing. Claims 1-20 have been canceled and new claims 21-40 have been added. Support for the new claims may be found, for example, in at least paragraph(s) [0038], [0040], and [0055]-[0060], and accompanying figures, including Figure 16. Applicant respectfully requests examination of the newly-added claims.

Please charge any underpayment or credit any overpayment to our Deposit Account No. 50-0665 under Order No. 061240-8006.US06, from which the undersigned is authorized to draw.

Dated: 21 December 2018

Respectfully submitted,

By /Stephen Bishop/
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Attorneys for Applicant

AMENDMENTS TO THE CLAIMS

Please amend the claims as follows:

1-20. (Canceled)

21. (New) A communication method for a mobile device in an Orthogonal Frequency Division Multiplexing (OFDM) communication system, the method comprising:

receiving a request for an uplink probing signal from a base station in the system; and

transmitting, in response to the received request, the probing signal with a code sequence modulated in the frequency domain, wherein:

the probing signal is configured to overlap, in the time domain, with uplink signals transmitted over an uplink frequency band by other mobile devices in the system; and

the probing signal is configured to occupy a portion of spectrum in between OFDM subcarriers designated for transmission of uplink control information in the system at both ends of the uplink frequency band.

22. (New) The method of claim 21, wherein the probing signal enables the base station to estimate a channel profile in the frequency domain.

23. (New) The method of claim 22, wherein the channel profile is used by the base station to determine a transmission format for a subsequent transmission over the channel.

24. (New) The method of claim 23, wherein the transmission format comprises a modulation/coding or pilot pattern.

25. (New) The method of claim 22, wherein the channel profile is used for beamforming in a subsequent transmission by the base station.

26. (New) The method of claim 21, wherein the portion of spectrum is available for transmission of uplink data signals by other mobile devices in the system.

27. (New) A communication method for a base station in an Orthogonal Frequency Division Multiplexing (OFDM) communication system, the method comprising:

transmitting a request for an uplink probing signal to a mobile device in the system; and

receiving the probing signal from the mobile device, wherein:

the probing signal contains a code sequence modulated in the frequency domain;

the probing signal overlaps, in the time domain, with uplink signals transmitted over an uplink frequency band by other mobile devices in the system; and

the probing signal occupies a portion of spectrum in between OFDM subcarriers designated for transmission of uplink control information in the system at both ends of the uplink frequency band.

28. (New) The method of claim 27, further comprising estimating, based on the received probing signal, a channel profile in the frequency domain.

29. (New) The method of claim 28, further comprising using the channel profile to determine a transmission format for a subsequent transmission over the channel.

30. (New) The method of claim 29, wherein the transmission format comprises a modulation/coding or pilot pattern.

31. (New) The method of claim 28, further comprising using the channel profile for beamforming in a subsequent transmission.

32. (New) The method of claim 27, wherein the portion of spectrum is available for transmission of uplink data signals by other mobile devices in the system.

33. (New) A communication method for an Orthogonal Frequency Division Multiplexing (OFDM) communication system, the method comprising:

sending a request for an uplink probing signal to a mobile device from a base station in the system; and

responding by the mobile device to the request by transmitting the probing signal with a code sequence modulated in the frequency domain, wherein:

the probing signal is configured to overlap, in the time domain, with uplink signals transmitted over an uplink frequency band by other mobile devices in the system; and

the probing signal is configured to occupy a portion of spectrum in between OFDM subcarriers designated for transmission of uplink control information in the system at both ends of the uplink frequency band.

34. (New) The method of claim 33, wherein transmission power of the probing signal is under power control.

35. (New) The method of claim 33, wherein the probing signal enables the base station to estimate a channel profile in the frequency domain.

36. (New) The method of claim 35, wherein the channel profile is used by the base station to determine a transmission format for a subsequent transmission over the channel.

37. (New) The method of claim 36, wherein the transmission format comprises a modulation/coding or pilot pattern.

38. (New) The method of claim 35, wherein the channel profile is used for beamforming in a subsequent transmission by the base station.

39. (New) The method of claim 33, wherein the portion of spectrum is available for transmission of uplink data signals by other mobile devices in the system.

40. (New) A mobile device in an Orthogonal Frequency Division Multiplexing (OFDM) communication system, the mobile device comprising:

a receiver configured to receive a request for an uplink probing signal from a base station in the system;

a transmitter configured to form and transmit, in response to the received request, the probing signal with a code sequence modulated in the frequency domain, wherein:

the probing signal is configured to overlap, in the time domain, with uplink signals transmitted over an uplink frequency band by other mobile devices in the system; and

the probing signal is configured to occupy a portion of spectrum in between OFDM subcarriers designated for transmission of uplink control information in the system at both ends of the uplink frequency band.

AMENDMENTS TO THE SPECIFICATION

Please amend the specification on page 1 as follows under the section heading CROSS-REFERENCE TO RELATED APPLICATION(S):

[0001] This application is a continuation of U.S. Patent Application No. 14/321,615 (now U.S. Patent No. 9,948,488), filed July 1, 2014, which is a continuation application of U.S. Patent Application No. 13/861,942 (now U.S. Patent No. 8,767,522), filed April 12, 2013, which is a continuation application of U.S. Patent Application No. 13/347,644 (now U.S. Patent No. 8,428,009), filed January 10, 2012, which is a continuation application of U.S. Patent Application No. 12/975,226 (now U.S. Patent No. 8,094,611), filed December 21, 2010, all of which are incorporated herein by reference. U.S. Patent Application No. 12/975,226 is a continuation application of U.S. Patent Application No. 10/583,229 (now U.S. Patent No. 7,864,725), filed August 27, 2008, which is the National Stage Application of International Application No. PCT/US2005/003518, filed January 27, 2005, which claims the benefit of U.S. Provisional Patent Application No. 60/540,586, filed on January 30, 2004, and of U.S. Provisional Patent Application No. 60/540,032, filed on January 29, 2004.

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
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(Not for submission under 37 CFR 1.99)

Application Number	15953950
Filing Date	2018-04-16
First Named Inventor	Xiaodong Li
Art Unit	2461
Examiner Name	Dmitry Levitan
Attorney Docket Number	061240-8006.US06

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	15953950
	Filing Date	2018-04-16
	First Named Inventor	Xiaodong Li
	Art Unit	2461
	Examiner Name	Dmitry Levitan
	Attorney Docket Number	061240-8006.US06

	1	Extended European Search Report received for counterpart European Patent Application No. 18196596.3, mailing date February 20, 2019 (8 pages).

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EXAMINER SIGNATURE

Examiner Signature		Date Considered	

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

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	15953950
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	First Named Inventor	Xiaodong Li
	Art Unit	2461
	Examiner Name	Dmitry Levitan
	Attorney Docket Number	061240-8006.US06

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

X That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

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X See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Stephen Bishop/	Date (YYYY-MM-DD)	2019-03-12
Name/Print	Stephen Bishop	Registration Number	38829

This collection of information is required by 37 CFR 1.97 and 1.98. 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 1 hour 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.**

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EP1443720 III English Translation of 3

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This invention has offered inserting and synchronous method of movable termination of a wireless LAN system, adopt the spread spectrum technique of the direct sequence (DSSS) in the wireless local area network, among them the spectrum spreading code which passes a kind of high spectrum effectiveness is a synchronizing code of large area (LAS) as sector heading code, synchronizing code, access code, spectrum spreading code, can overcome the frequency spectrum in the present wireless local area network standard unefficiently, such shortcomings as the scheduling of resource is not flexible. LAS yard includes LA code block and LS code block. LAS yard that this invention adopt have zero characteristic to interfere with window, multiple access interference and interfere with being very much low while being multipath. After adopting DSSS technology, the adjacent district / sector can adopt the same carrier frequency, spectrum effectiveness is higher than the existing wireless LAN system.This invention adopts the access method that dynamic CDMA combines with TDMA, under moving the work terminally and counting more situations like this, the deployment operation of AP will be simpler.

The movable termination of the wireless LAN system inserts and synchronous method

Technical field

This invention involves the construction method of wireless LAN system in mobile communication, especially involve inserting and synchronous method of movable termination of the wireless LAN system.

Background technology

The standard of the wireless local area network is mainly divided into two major agreement systems: IEEE 802.11 agreement standard systems and HiperLAN agreement systems made of the European Telecommunication Standards Institute (ETSI). Among them 802.11 systems mainly include 802.11a and 802.11b, these two kinds of agreements both face the connectionless standard, have stipulated the norms of WLAN physical layer (PHY, Physical Layer) and media access control (MAC, Medium Access Control). Employ the most extensive one to be IEEE 802.11b in WLAN at present, it works in 2.4GHz frequency band, the highest speed supports 11Mbps. 802.11a work, in 5GHz frequency band, physical layer speed reachable 54Mbps.HiperLAN is a wireless local area network technology system of European ETSI, including HipreLAN1, HiperLAN2 and HiperLink and the open air in order to be used for fixing used for wireless backbone network in the indoor employ visiting HiperAccess four kinds of standards of the wired infrastructure, among them HiperLAN2 is electric to work in 5GHz frequency band, the speed of physical layer can reach as high as 54Mbps, it is a connection-oriented protocol standard, there are certain advantages more than 802.11a in supporting real-time business, Qos to support. The electricity of this invention adopts the connection-oriented protocol, it is HiperLAN2 that it mainly consults the target.

The physical layer of HiperLAN2 adopts the technology of orthogonal frequency-division multiplexing (OFDM), and adopt the time division multiple access way (TDMA) and distinguish different movable terminations. Control channel and traffic channel are distinguished by TDMA way, Fig. 1 is the typical MAC frame format of HiperLAN2.

MAC agreement of HiperLAN2 is TDMA/TDD scheme, every MAC frame length 2ms, divided into descenting, up run two stages, each stages are divided into a plurality of time slots. An access point (AP) can include n ' n=1-8)The sector, the forward control channel of different sectors (broadcast channel BCH1-BCHn, frame control channel FCH1-FCHn, data packet unit on insert and confirm signal channel ACH1-ACHn) send at different time slots through the

time division way, leading symbol that the unit of these data packets combined with certain length while mapping to the physical layer, then modulate and send out through OFDM. After the forward control channel is downstream business channel time slot DL1-DLp of corresponding to different movable terminations, peer mode Business channel time slot DiL1-DiLm, upstream business channel time slot UL1-ULq, inserting channel time slot RCHS1-RCHSn backward under (two terminal station direct communication modes).Can be found out from the picture, TDMA is a multiple address way of only HiperLAN2.
802.11a and frame format of HiperLAN2 have certain differences, but only distinguish different movable terminations by TDMA way too.
So, the shortcoming that wireless local area network has in the prior art is, common channel and traffic channel of the forward direction adopt the time division way, especially the public control channel between different sectors can't be sent at the same time, this causes certain wasteful use of resources, has influenced spectrum effectiveness to a certain extent; In this way flexibility of the resource scheduling modes is not enough to only adopt TDMA way to distinguish different movable terminations, especially the district supports it under (greater heavier situation such as more or general data rate of the quantity of movable termination of low speed), the computation complexity of scheduling of resource is relatively big;OFDM son, the wave number can't be flexible to change in year, when the signal channel condition is changed, hope to change the transmission rate accordingly, only realized by changing the modulation mode, changing the encoder mode of signal channel to come; Adjacent district can only distinguish by different carrier frequencies at the network connection, frequency that take up at the network connection resource more.
Invention content
In the wireless local area network structure of this invention, the physical layer does not adopt OFDM technology of the prior art, but has adopted the spread spectrum technique of the direct sequence (DSSS), and pass and use the spectrum spreading code of a kind of high spectrum effectiveness in DSSS ---The synchronizing code of large area (LAS), come to overcome the shortcoming in the present wireless local area network standard.
The wireless LAN system of this invention adopts LAS yard on the physical layer as sector heading code, synchronizing code, access code, spectrum spreading code, LAS yard includes LA code block and LS code block, distinguishes different sector districts with LA yard, distinguishes different movable terminations in the same district with LS yard.
The wireless local area network of this invention further includes the following technical feature.
In the access point that the movable termination can insert the wireless LAN system through the multiple address way that TDMA/CDMA combine together. If a certain sector adopts a series of LA yards as heading code of the sector in the wireless LAN system, public control channels of this sector will all pass the modulation of LA yard of this group.
The wireless LAN system of this invention passes and closes the cyclic(al) delay control method, guarantee the synchronous relation between movable termination and access point. The concrete course of closing the cyclic(al) delay control method is, when the movable termination inserts, the concrete method to close cyclic(al) delayed control is, the movable termination is received fashionably, the access point analyzes by inserting and leading the way the movable termination sends machine format moment, then will delay news for the movable termination through inserting and responding to the signal channel (ACH), the movable termination adjusts and inserts the sending moment when leads the way according to this information, every frame of control process of whole closed circuit is

repeated once, until finishing synchronously.In data transmission of the business, the concrete method to close cyclic(al) delayed control analyzes by guide on the upstream traffic channel the movable termination sends machine format moment for the access point, the control box on the downstream special channel (DL-DCH) adjusts information of time delay and sends, the movable termination adjusts one's own business data transmission moment according to this information, once of every frame of course of whole closed circuit or many framing control.

The wireless LAN system of this invention adopts a series of LS and one yard of access as the movable termination and leads the way, have stipulated in LS yard a series of inserts synchronous time slot, the movable termination, through deriving and catching to and inserting the synchronous time slot in the code block in traverse way in predefined LS, one random choice inserts synchronous time slot to insert. The concrete step of access course of the movable termination is:

A, movable termination catch the picture synchronization time slot of the wireless LAN system in LS yard through DL-SCH signal channel;

B, movable termination got a series of idle LS yards on the broadcast channel (BCH) as inserting leading the way, lead the way on the reverse synchronisation channel (UL-SCH) according to the moment sending of the picture synchronization time slot that is caught;

C, access point receive after inserting and leading the way, if there is no access conflict of a plurality of movable terminations, analyze this leading arrival time, feedback for the movable termination to delay adjusting information through inserting ACH signal channel, and enter step d; If there are conflicts, then the time slot of the picture synchronization keeps the idle attitude, and get back to step a;

D, movable termination adjust message change message send the moment leading the way according to delay that receive, and onward transmission inserts leading the way on the same synchronous time slot;

F, repeating the above-mentioned step c and step d, is in pace with system until the movable termination sends the moment leading the way;

G, access point send the confirmed message to the movable termination through ACH signal channel, the movable termination sends to inserting news after receiving the confirmed message, the access point will insert the result to send to the movable termination through ACH signal channel after dealing with these and inserting news.

LAS yard adopted in this invention has zero to interfere with the window property, meet certain in-step condition between the movable terminations, and multipath delay go beyond zero interfere with window, multiple access interference and interfere with being very much low while being multipath, it interferes with to be zero in theory, transmit into the influence of the bandwidth in the physical system, zero is interfered with there are certain interference levels in the window, but the order of magnitude is very low, therefore spectrum effectiveness is very high. After adopting DSSS technology, the adjacent district / sector can adopt the same carrier frequency, spectrum effectiveness is higher than the existing wireless LAN system.This invention adopts the access method that dynamic CDMA combines with TDMA, under simplifying the situation, also can be the same as existing standard to only adopt TDMA way, the public control channels of different sectors can adopt the code division way to send at the same time, can adopt the spectrum spreading code of the spreading factor of the great to insert to the short rate movable termination, a business subchannel can convey a plurality of movable terminations at the same time, as to the high speed movable termination, can adopt the polygram way to use a plurality of code

resources of a time slot, can also use the minor spreading factor at the same time. So, this invention is that a kind of TDMA/CDMA was combined, but the flexible wireless local area network that disposes inserts the scheme.
Because TDMA/CDMA combines together, under the circumstances that the movable termination counts more situations, the deployment operation of AP will be simpler.
Because only adopt CDMA way while overcoming at present systematically, under inserting movable termination more situations, it is more difficult to manage because of complicatedness of the dispatch algorithm. And because of DSSS technical use, when the propagation channel condition change and change the transmission rate needing adaptation, besides alterable modulation mode, signal channel code rate, can also change the spreading factor in a flexible way. After adopting CDMA way, the business datum of different movable terminations can be sent at the same time, AP can meet more movable terminations and insert the service quality after the LAN while adopting the simpler dispatch algorithm.
Because of adopting the code multiple-address as the sector heading code of the public control channel, different public control channels can be with sending to each sector constantly, the crossover question that no longer worries between the sector, so public control channel relatively reduces to taking up the proportion of system resource, relatively increase for the system resource in the traffic channel, has raised spectrum effectiveness.
Adjacent sectors, districts can all adopt the identical carrier frequency.
The definition graph 1 of figure: Format graph 2 of MAC frame of HiperLAN2: The structural representation 3 of signal channel of physical frame of this invention LAS-WLAN: The structural representation 4 of frame time for this invention: The downstream special channel DL-DCH structural representation 5: Reverse synchronisation channel UL-SCH and reverse access channel RCH structural representation 6: The upstream special channel UL-DCH structural representation 7: The movable termination inserts the synoptic diagram of the course
Concrete mode of execution
Now combine figure and embodiment to further explain this invention. This embodiment passes the physical frame stucture of this invention, adjustment and modification that did to each signal channel of wireless local area network in the prior art, the movable termination inserts four parts of course, delayed control to explain the wireless local area network how to realize this invention.
1, Physical frame stucture of this invention
The physical frame signal channel structural representation of this invention LAS-WLAN is shown as in Fig. 2.
Set length of the physical frame as 2ms, code rate 20Mbps.
If there are a plurality of sectors in a district, different from Fig. 1 (Fig. 1 is MAC frame stucture, its correspondent physical layer frame of structural every-channel is the time's too, here is a concept which benefits introduction CDMA, it was physical frame that was adopted), public control channel can be with sending constantly that it descents, different sectors adopt one yard of spread spectrum of different LA, the LA yard becomes the heading code of the sector.
The frame time structural representation of this invention is shown as in Fig. 3. A frame length is 2ms, are divided into 17 stature frames. Each signal channel going in the picture can occupy one or many stature frames, a plurality of signal channels can pass code division, occupy the same stature frame. Downstream subframe and upstream subframe in a frame

can be allocated to count dynamically according to the present business state, it is 6us to receive and dispatch the guard band (GAP part in the picture). In a frame, the 0th stature frame length is 544 chips, other subframes are all 2451 chips.
Having represented 17 stature frame SF0-SF16 of a frame in Fig. 3, among them insert the guard band of receiving and dispatching of 120 chips in some stature frame (SFi, 1<i<16) of the middle above, insert the guard band of receiving and dispatching of 120 chips behind the 16th work song frame too, namely represent SF0-SFi-1 subframe as descenting in the picture, SFi-SF16 is a upstream subframe.

The length of other subframes is 2451 chips, every stature frame includes 16 time slots (TS0-TS15). These 16 time slots have adopted LA yard to modulate the position, the length of each time slots has nothing in common with each other, the minimum length is 140. The length of time slot deducts LS chip remaining in code length and is divided into two parts are inserted in C yard and in front of S yard. LS code length is 128, so the minimum interval is 6 chips.
Table 1 is the main span length of LA yard.

Time slot	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Length	140	142	144	146	148	150	152	154	156	158	160	162	164	168	176	141

Table 1
C yard and S one yard of GAP length ahead of each time slot are shown in Table 2.

Time slot	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
C yard	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	6
S yard	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	7

Table 2
Exchange through doing the position of interval of different length of LA yard, can derive out other LA yard, different districts can adopt identical LS yard, modulate through different LA yard. Different sectors of the same district can adopt same LA yard, and can adopt different LS code blocks.
The length is LS yard of 128, its spreading factor can be from 16-128 changes. As to the high-speed movable termination, try hard to adopt the minor spreading factor and the transmissive number of code channel reduces to run side by side.
2, Adjustment and modification done to each signal channel of wireless local area network in the prior art in this invention
1)_SCH,DownLink Synchronization CHannel)

The signal channel of this physical layer, once of every frame transmission, the position is the 0th stature frame of every frame, the length is 544 chips. The synchronisation channel contains 8 time slots, each time slots are made up for LS yard and three sections of GAP of 32 long by one, a portable symbol. Adopt different modulation modes, numbers of bits of data that these 8 symbols can transmit are different. The movable termination can obtain synchronism of the periodic line of forward direction through catching the special code message transmitted in synchronisation channel of the forward direction.
Choose a LS yard A0 (C yard and S code length are 16 respectively) that length is 32, can derive out a series of code words through orthogonal rotation transformation:
Have A 0 ={a0,a1,a2, ...,a31), changes and changes through fastening orthogonality, the code block received is [image]◆ among them i =2π i/31, i=0-31.
Rotate the code word that is derive, produce through orthogonality, may be with not keeping orthogonal relation revolutionary LS yard at other subframes. Above-mentioned 32 code word can distribute different district into, movable termination select a code word to make moving ahead simultaneously sequentially in here code block, until catching to the frame home positions of the present district.
The information that carries of the synchronisation channel can also be divided into different data domain, except the special sign used for moving ahead simultaneously is overseas, can also carry LA yard, LS code block information of this district. Can obtain the information after at the movable termination moves ahead simultaneously.
2)Broadcast channel (BCH, Broadcasting CHannel)
Send the shared information of the district.
3)Control channel of frame (FCH, Frame control CHannel)
This inserts the system resource of dot pair and carries on managing and assigned instruction signal channel. The behavior in service of subframe of ascending-descending data in a frame is sent out on this signal channel.
4)Insert and respond to the signal channel (ACH, Access indicator CHannel)
It conveys the treatment state asked in access of the movable termination in the previous frame, it is the information of Access grant that the movable termination can obtain oneself on this signal channel. Usually, this signal channel contains access delay and adjusts information, adjust it and send and insert the moment when leads the way with the movable termination of the notice.
5)Public pilot channel (CPICH, Common Pilot CHannel)
The movable termination can use the public pilot channel to do channel estimation, can also use the break pilot frequency on the traffic channel.
Above-mentioned BCH, FCH, ACH, CPICH signal channel adopt one yard of spread spectrum of different LS, adopts the code division way to send out on the same stature frame. And through certain allocation of resources of code word, can realize different sectors are adopted different LS yard, the common channels of all sectors are sent out at the same time.
6)Downstream special channel (DL-DCH, DownLink Dedicate CHannel)
The number of subframe that is taken up can distinguish the movable termination with method that TDMA/CDMA two kinds of multiple address way combines by the dynamic deployment of access point. Descenting has no business, there is no DL-DCH signal channel. Special channel include control and data division, control box include disconnected pilot frequency, delayed control, power control, automatic retransmission person who ask part among them. Can already utilize descenting in the public pilot channel to do channel

estimation with movable termination, also can utilize break pilot frequency channel estimation of every stature frame, or the two combine.
Fig. 4 is a DL-DCH structural representation. In 4 Fig., every stature 0th time slot of frame used for, spread delay and control information of power, the first time slot is used for transmitting disconnected pilot frequency, the postern time slot is used for transmitting the data packet that the mapping of transmission channel comes over. It delay, pilot frequency some and behind use to be same LS yards of spread spectrum data division, so different movable terminations can have one's own break pilot frequency and delay the control information.
7)Reverse synchronisation channel (UL-SCH, UpLink Synchronization CHannel)
UL-SCH is used in the reverse link and move ahead simultaneously, mainly inserts the synchronism in the course backward. The movable termination utilized the reverse synchronisation channel to transmit and lead the way (Preamble) synchronously, the access point obtained synchronizing information of the movable termination through the fact that these are leading in demodulation.
8)Reverse access channel (RCH, Random access Channel)
The opposite direction used in the movable termination inserts the course, convey and insert information. The movable termination always just sent to inserting information on ACH signal channel after finishing reversely synchronously. Fig. 5 is one UL-SCH and RCH structural representation.
UL-SCH and RCH take up the last stature frame SF15 of a frame through the time division way. Among them UL-SCH contains 8 and inserts the time slot (RSS0-RSS7) backward, its length is like downstream synchronisation channel DL-SCH. The remaining part of the subframe is used for transmitting ACH and inserting news.
UL-SCH and RCH place on the end of a frame, the purpose is to make the positions of these two signal channels fix, it is convenient for access point to punish information at the two signal channel these.
9)Upstream special channel (UL-DCH, UpLink Dedicate Channel)
Used for transmitting the reverse business datum, this signal channel is divided into data division and control box too, with descenting specializedly similarly, containing power control, automatic retransmission in the signal channel heading asks (ARQ), disconnected pilot frequency part, but without control box of delay, because the access point can not be adjusted the launching time of the downstream special channel of a certain movable termination alone. Control box and data division of the business adopt one yard of spread spectrum of same LS. The design example of UL-DCH is shown as in Fig. 6.
When different movable terminations use the identical subframe to convey the business, rely on different LS yard to distinguish between them.
3.The movable termination inserts the course
Before the movable termination hopes for the access system, must catch to the systematic picture synchronization through DL-SCH signal channel, the reference of the periodic line of the forward direction has already been got constantly. As the access system of the movable termination, send and insert leading the way on UL-SCH signal channel at first, the present and idle guide can get from broadcast channel. It sends to and inserts the time slot position that leads the way stipulating by the system parameter. In this embodiment, there are 8 time slots in all on UL-SCH signal channel, and both sides leave the time of 16 chips to adjust excess. And is sent to all movable terminations of this district by BCH signal channel.

The access point receives after this is inserted and led the way, without the conflict, analyze this leading arrival time, feedback the delay and adjust information through ACH signal channel. According to receive delay, adjust message change message send the moment when leads the way movable termination, and onward transmission inserts leading the way on the same synchronous time slot. Only pass the adjustment of several frames continuously, and after the access point thinks it accords with and in pace with system promptly constantly that the movable termination sends the moment when leads the way, just let the movable termination be sent and inserted news through ACH signal channel sending acknowledgement. Having inserted and included the information of resource request in news, the access point will insert the result to send in ACH signal channel to the movable termination after dealing with the information.

If two movable terminations send on the same synchronous time slot to inserting leading the way, conflict, both movable terminations are unable to insert, this synchronous time slot continues being in idle state. The general movable termination will look for another synchronous time slot or wait to go after the next frame to try new access according to certain algorithm.

Insert the course entirely and is shown as in Fig. 7. The guide that the movable termination sent, be received in the ability of the next frame by the access point, then adjust information of time delay to send on ACH signal channel. Only pass time delay and adjust, the movable termination sends the moment leading the way and meets system requirement promptly, so send the news of finishing synchronously on ACH signal channel, the movable termination will insert message delivery to go out on RCH signal channel.

4.Delayed control is when the movable termination inserts, the access point analyzes by inserting and leading the way the movable termination sends machine format moment, then will delay the control information for the movable termination through ACH signal channel, the movable termination adjusts and inserts the sending moment when leads the way according to this information. Every frame of this closed circuit course is repeated once, until finish synchronously, then send and insert news.

When in the transmission course of the business datum, the access point analyzes the transmission data of the movable termination by guide on the upstream traffic channel, the control box on DL-DCH signal channel adjusts information of time delay to send, the movable termination adjusts one's own business data transmission moment according to this information. This pieces of closed circuit course can by every framing control one time,also can framing control eaches much.

The above-mentioned embodiment of this invention can be realized by various other ways. For example, can only transmit the downstream control channel with LS yard, and other signal channels all adopt OFDM to modulate. So the public control channels of different sectors have adopted the code division way, but the business still adopts TDMA way. So can avoid upstream requiring synchronously, on the basis of keeping the existing HiperLAN2 basic structure, have reduced the resources in the public control channel and taken up the proportion through the code division way.

Also needn't use LA yard, only spend LS yard, can reduce GAP length in the the time slots so, the duty ratio is higher, so the spectrum effectiveness in a district is higher. But the adjacent district can only adopt the frequency division multiplexing way at the network connection. Can also use shorter LS yard, form shorter time slot and shorter subframe. The number of subframe in such frame can increase, make the system suitable for the data traffic of

shorter burst. Also can construct the more long physical frame, such as 10ms frame, the schedulable subframe counts more in such frame.
In addition, from reduce complicate angle, set out, can these system simplification, let it approach the present HiperLAN2 standard even more. For example each sectors only adopt one LS yard, adapt to different signal channel environments by adjusting his spreading factor. Totally adopt TDMA way to distinguish with the sector movable termination, and different sectors / movable terminations of the district are distinguished through different LS/LA yard.

[Claims]
1, The movable termination of a wireless LAN system inserts and synchronous method, characterized by, the stated wireless LAN system adopts the synchronizing code of large area (LAS) on the physical layer as sector heading code, synchronizing code, access code, spectrum spreading code, stated LAS yard includes LA code block and LS code block, distinguishes different sector districts with LA yard, distinguish different movable terminations in the same district with LS yard.
2, The movable termination of a wireless LAN system inserts as Claim 1 states and synchronous method, characterized by, in the access point that the movable termination inserts the stated wireless LAN system through the multiple address way that TDMA/CDMA combines together.
3, The movable termination of a wireless LAN system inserts as Claim 1 states and synchronous method, characterized by, the stated wireless LAN system passes and closes the cyclic(al) delay control method, guarantee the synchronous relation between movable termination and access point.
4, The movable termination of a wireless LAN system inserts as Claim 3 states and synchronous method, characterized by, when the movable termination insert, the stated concrete method to close cyclic(al) delayed control is, the access point analyzes by inserting and leading the way the movable termination sends machine format moment, then will delay news for the movable termination through inserting and responding to the signal channel (ACH), the movable termination adjusts and inserts the sending moment when leads the way according to this information, every frame of control process of whole closed circuit is repeated once, until finishing synchronously.
5, The movable termination of a wireless LAN system inserts as Claim 3 states and synchronous method, characterized in that, in data transmission of the business, the stated concrete method to close cyclic(al) delayed control analyzes by guide on the upstream traffic channel the movable termination sends machine format moment for the access point, the control box on the downstream special channel (DL-DCH) adjusts information of time delay and sends, the movable termination adjusts one's own business data transmission moment according to this information, once of every frame of course of whole closed circuit or many framing control.
6, The movable termination of a wireless LAN system inserts as Claim 1 states and synchronous method, characterized by, if a certain sector adopts a series of LA yards as heading code of the sector in the stated wireless LAN system, public control channels of this sector will all pass the modulation of LA yard of this group.

7, The movable termination of a wireless LAN system inserts as Claim 1 states and synchronous method, characterized by, the stated wireless LAN system adopts a series of LS and one yard of access as the movable termination and leads the way, have stipulated in stated LS yard a series of inserts synchronous time slot, the movable termination, through deriving and catching to and inserting the synchronous time slot in the code block in traverse way in stated LS, one random choice inserts access point that synchronous time slot inserted the wireless LAN system.

8, The movable termination of a wireless LAN system inserts as Claim 7 states and synchronous method, characterized by, the concrete step of access course of the stated movable termination is:

A, movable termination catch the picture synchronization time slot of the wireless LAN system in LS yard through the downstream synchronisation channel (DL-SCH);

B, movable termination got a series of idle LS yards on the broadcast channel (BCH) as inserting leading the way, stated leading according to the moment sending of the picture synchronization time slot that is caught on the reverse synchronisation channel (UL-SCH);

C, after access point receive insert, lead the way while being stated, have a plurality of access conflict of movable termination, analyze this leading arrival time, respond to the signal channel (ACH) to feedback for the movable termination to delay adjusting information through inserting, and enter step d; If there are conflicts, the stated picture synchronization time slot keeps the idle attitude, and get back to step a;

D, movable termination adjust message change message send the moment leading the way according to delay that receive, and onward transmission inserts leading the way on the same synchronous time slot;

F, repeating the above-mentioned step c and step d, is in pace with system until the movable termination sends the moment leading the way;

G, access point respond to the signal channel (ACH) to the movable termination to send to the confirmed message through inserting, the movable termination sends to inserting news after receiving the confirmed message, the access point responds to the signal channel (ACH) and inserts the result to send to the movable termination through inserting after dealing with these and inserting news.

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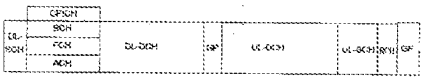
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权利要求书 2 页 说明书 9 页 附图 4 页

[54] 发明名称 无线局域网系统的移动终端接入和同步方法

[57] 摘要

本发明提供了一种无线局域网系统的移动终端接入和同步方法，在无线局域网采用直接序列扩频技术(DSSS)，其中通过一种高频谱效率的扩频码即大区域同步码(LAS)作为扇区识别码、同步码、接入码、扩频码，可以克服当前无线局域网标准中频谱效率不高、资源调度不灵活等缺点。 LAS 码包含 LA 码组和 LS 码组。 本发明采用的 LAS 码具有零干扰窗的特性，多址干扰和多径干扰都非常低。 采用 DSSS 技术后，相邻小区/扇区可以采用同一载波频率，频谱效率高于现有无线局域网系统。 本发明采用动态的 CDMA 与 TDMA 相结合的接入方法，这样在移功终端数较多的情况下，AP 的调度运算会更简单。



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1、一种无线局域网系统的移动终端接入和同步方法，其特征在于，所述无线局域网系统在物理层采用大区域同步码(LAS)作为扇区识别码、同步码、接入码、扩频码，所述 LAS 码包含 LA 码组和 LS 码组，用 LA 码区分不同的扇区小区，用 LS 码区分同一小区中不同的移动终端。

2、如权利要求 1 所述的一种无线局域网系统的移动终端接入和同步方法，其特征在于，移动终端通过 TDMA/CDMA 相结合的多址方式接入到所述无线局域网系统的接入点中。

3、如权利要求 1 所述的一种无线局域网系统的移动终端接入和同步方法，其特征在于，所述无线局域网系统通过闭环的延迟控制方法，保证移动终端和接入点的同步关系。

4、如权利要求 3 所述的一种无线局域网系统的移动终端接入和同步方法，其特征在于，在移动终端接入时，所述闭环的延迟控制的具体方法为，接入点通过接入前导来分析移动终端发送数据的时刻，然后通过接入响应信道(ACH)将延迟消息发给移动终端，移动终端根据该信息调整接入前导的发送时刻，整个闭环控制过程每帧重复一次，直至同步完成。

5、如权利要求 3 所述的一种无线局域网系统的移动终端接入和同步方法，其特征在于，在业务数据传输过程中，所述闭环的延迟控制的具体方法为接入点通过上行业务信道上的前导来分析移动终端发送数据的时刻，在下行专用信道(DL-DCH)的控制部分将时延调整信息发送下去，移动终端根据该信息调整自己的业务数据发送时刻，整个闭环过程每一帧或者多帧调整一次。

6、如权利要求 1 所述的一种无线局域网系统的移动终端接入和同步方法，其特征在于，如所述无线局域网系统中某一扇区采用一组 LA 码作为扇区识别码，则该扇区的公共控制信道都要经过这组 LA 码的调制。

7、如权利要求 1 所述的一种无线局域网系统的移动终端接入和同步方法，其特征在于，所述无线局域网系统采用一组 LS 码作为移动终端的接入前导，在所述 LS 码中规定了一组接入同步时隙，移动终端通过在所述 LS 派生码组中用遍历的方式捕获到接入同步时隙，随机选择一个接入同步时隙接入无线局域网系统的接入点。

8、如权利要求 7 所述的一种无线局域网系统的移动终端接入和同步方法，其特征在于，所述移动终端的接入过程具体步骤为：

a、移动终端通过下行同步信道(DL-SCH)在 LS 码中捕获无线局域网系统的帧同步时隙；

b、移动终端在广播信道(BCH)上获得空闲的一组 LS 码作为接入前导，在反向同步信道(UL-SCH)上按照捕获到的帧同步时隙的时刻发送所述前导；

c、接入点接收到所述接入前导后，如没有多个移动终端的接入冲突，则分析该前导的到达时间，通过接入响应信道(ACH)反馈给移动终端延迟调整信息，并进入步骤 d；如有冲突，则所述帧同步时隙继续处于空闲态，并回到步骤 a；

d、移动终端根据接收到的延迟调整信息调整自己发送前导的时刻，并在同一个同步时隙上继续发送接入前导；

f、重复上述步骤 c 和步骤 d，直到移动终端发送前导的时刻与系统同步；

g、接入点通过接入响应信道(ACH)向移动终端发送确认消息，移动终端在收到确认消息后发送接入消息，接入点在处理这些接入消息后通过接入响应信道(ACH)将接入结果发送给移动终端。

无线局域网系统的移动终端接入和同步方法

技术领域

本发明涉及移动通信中的无线局域网系统的构造方法，尤其涉及无线局域网系统的移动终端接入和同步方法。

背景技术

无线局域网标准主要分为两大协议体系：IEEE 802.11协议标准体系和欧洲电信标准协会（ETSI）制定的HiperLAN协议体系。其中802.11体系主要包括802.11a 和802.11b，这两种协议都是面向无连接的标准，规定了WLAN物理层(PHY，Physical Layer)和介质访问控制(MAC，Medium Access Control)的规范。目前WLAN中应用最广泛的是IEEE 802.11b，它工作在2.4GHz频段，最高速率支持11Mbps。802.11a工作在5GHz频段，物理层速率可达54Mbps。HiperLAN是欧洲ETSI的无线局域网技术体系，包括HipreLAN1、HiperLAN2以及用于户内无线骨干网的HiperLink和为用于固定户外应用访问有线基础设施的HiperAccess四种标准，其中HiperLAN2也工作在5GHz频段，物理层速率最高可达54Mbps，它是面向连接的协议标准，在支持实时业务、Qos支持方面比802.11a有一定优势。本发明也采用面向连接的协议，其主要参照对象为HiperLAN2。

HiperLAN2的物理层采用正交频分复用（OFDM）技术，并采用时分多址方式（TDMA）区分不同移动终端。控制信道和业务信道也通过TDMA方式来区分，图1是HiperLAN2的典型MAC帧格式。

HiperLAN2的MAC协议为TDMA/TDD方案，每一个MAC帧长度2ms，分为下行、上行两个阶段，每个阶段又被分为多个时隙。一个接入点（AP）可包含n个（n=1~8）扇区，不同扇区的前向控制信道（广播信道BCH1~BCHn、帧控制信道FCH1~FCHn，接入确认信道ACH1~ACHn）的数据包单元都是通过时分方式在不同时隙上发送的，这些数据包单元映射到物理层上时再加上一定长度的前导符号，然后通过OFDM调制发送出去。前向控制信道之后是对应不同移动终端的下行业务信道时隙DL1～DLp、对等模式（两个终端直接通信的模式）下

的业务信道时隙DiL1～DiLm、上行业务信道时隙UL1～ULq、反向接入信道时隙RCHS1~RCHSn。从图中可以看出，TDMA是HiperLAN2唯一的多址方式。

802.11a与HiperLAN2的帧格式有一定差别，但是也只采用TDMA方式来区分不同移动终端。

所以，现有技术中的无线局域网所具有的缺点是，前向公共信道和业务信道采用时分方式，尤其是不同扇区之间的公共控制信道不能同时发送，这造成一定的资源浪费，在一定程度上影响了频谱效率；只采用TDMA方式区分不同移动终端，这样资源调度方式的灵活性不够，尤其是小区负载较重的情况下（如低速移动终端数量较多或者总的数据率较大），资源调度的计算复杂度较大；OFDM子载波数不能灵活改变，当信道条件变化，希望相应地改变传输速率时，只有通过更改调制方式、改变信道编码方式来实现；组网时相邻小区只能通过不同载波频率来区分，组网时占用的频率资源较多。

发明内容

本发明的无线局域网结构中，物理层不采用现有技术的 OFDM 技术，而是采用了直接序列扩频技术（DSSS），并通过运用 DSSS 中的一种高频谱效率的扩频码---大区域同步码(LAS)，来克服当前无线局域网标准中的缺点。

本发明的无线局域网系统在物理层采用 LAS 码作为扇区识别码、同步码、接入码、扩频码，LAS 码包含 LA 码组和 LS 码组，用 LA 码区分不同的扇区小区，用 LS 码区分同一小区中不同的移动终端。

本发明的无线局域网进一步包括如下技术特征。

移动终端可以通过 TDMA/CDMA 相结合的多址方式接入到无线局域网系统的接入点中。如无线局域网系统中某一扇区采用一组 LA 码作为扇区识别码，则该扇区的公共控制信道都要经过这组 LA 码的调制。

本发明的无线局域网系统通过闭环的延迟控制方法，保证移动终端和接入点的同步关系。闭环的延迟控制方法的具体过程为，在移动终端接入时，闭环的延迟控制的具体方法为，移动终端接入时，接入点通过接入前导来分析移动终端发送数据的时刻，然后通过接入响应信道(ACH)将延迟消息发给移动终端，移动终端根据该信息调整接入前导的发送时刻，整个闭环控制过程每帧重复一次，直至同步完成。在业务数据传输过程中，闭环的延迟控制的具体方法

为接入点通过上行业务信道上的前导来分析移动终端发送数据的时刻，在下行专用信道(DL-DCH)的控制部分将时延调整信息发送下去，移动终端根据该信息调整自己的业务数据发送时刻，整个闭环过程每一帧或者多帧调整一次。

本发明的无线局域网系统采用一组 LS 码作为移动终端的接入前导，在 LS 码中规定了一组接入同步时隙，移动终端通过在预定义的 LS 派生码组中用遍历的方式捕获到接入同步时隙，随机选择一个接入同步时隙接入。移动终端的接入过程具体步骤为：

a、移动终端通过 DL-SCH 信道在 LS 码中捕获无线局域网系统的帧同步时隙；

b、移动终端在广播信道(BCH)上获得空闲的一组 LS 码作为接入前导，在反向同步信道(UL-SCH)上按照捕获到的帧同步时隙的时刻发送前导；

c、接入点接收到接入前导后，如没有多个移动终端的接入冲突，则分析该前导的到达时间，通过接入 ACH 信道反馈给移动终端延迟调整信息，并进入步骤 d；如有冲突，则帧同步时隙继续处于空闲态，并回到步骤 a；

d、移动终端根据接收到的延迟调整信息调整自己发送前导的时刻，并在同一个同步时隙上继续发送接入前导；

f、重复上述步骤 c 和步骤 d，直到移动终端发送前导的时刻与系统同步；

g、接入点通过 ACH 信道向移动终端发送确认消息，移动终端在收到确认消息后发送接入消息，接入点在处理这些接入消息后通过 ACH 信道将接入结果发送给移动终端。

本发明采用的LAS码具有零干扰窗特性，当移动终端之间满足一定的同步条件，且多径时延不超出零干扰窗时，多址干扰和多径干扰都非常低，在理论上干扰是零，因为实际系统中受传输带宽的影响，零干扰窗内存在一定的干扰水平，但量级非常低，因而频谱效率非常高。采用DSSS技术后，相邻小区/扇区可以采用同一载波频率，频谱效率高于现有无线局域网系统。本发明采用动态的CDMA与TDMA相结合的接入方法，在简化情况下，也可以与现有标准相同只采用TDMA方式，不同扇区的公共控制信道可以采用码分方式同时发送，对低速率移动终端可以采用较高扩频因子的扩频码接入，一个业务子信道可以同时传送多个移动终端，对于高速率移动终端，可以采用多码方式使用一个时隙的多个码资源，同时还可以使用较小扩频因子。因此，本发明是一种TDMA/CDMA结合的，可灵活配置的无线局域网接入方案。

由于TDMA/CDMA相结合，在移动终端数较多的情况下，AP的调度运算会更简单。克服了目前系统中因为只采用CDMA方式，在接入移动终端较多的情况下，因为调度算法复杂而调

度比较困难。且由于DSSS技术的使用，当传播信道条件发生变化而需要自适应地改变传输速率时，除了可改变调制方式、信道编码速率外，还可以灵活地改变扩频因子。采用CDMA方式后，不同移动终端的业务数据可以同时发送，AP采用较简单的调度算法可以满足较多移动终端接入局域网后的服务质量。

由于采用了多址码作为公共控制信道的扇区识别码，不同公共控制信道可以在同时刻发送到各个扇区，不再担心扇区之间的交叠问题，这样公共控制信道对系统资源的占用比例相对减少，留给业务信道的系统资源相对增加，提高了频谱效率。相邻扇区、小区都可以采用相同的载波频率。

附图说明

图 1：HiperLAN2 的 MAC 帧格式

图 2：本发明 LAS-WLAN 的物理帧信道结构示意图

图 3：本发明的帧时间结构示意图

图 4：下行专用信道 DL-DCH 结构示意图

图 5：反向同步信道 UL-SCH 和反向接入信道 RCH 结构示意图

图 6：上行专用信道 UL-DCH 结构示意图

图 7：移动终端接入过程示意图

具体实施方式

下面结合附图和实施例来进一步说明本发明。本实施例通过本发明的物理帧结构、对现有技术中无线局域网的各个信道所作的调整和修改、移动终端接入过程、延迟控制四个部分来说明如何实现本发明的无线局域网。

1、本发明的物理帧结构

本发明LAS-WLAN的物理帧信道结构示意图如图2所示。

设物理帧长度为2ms，码片速率20Mbps。

如果一个小区有多个扇区，则与图1不同（图1是MAC帧结构，其对应的物理层帧结构的各信道也是时分的，这里为便于介绍CDMA的概念，采用的是物理帧），其下行公共控制信道可

以在同时刻发送，不同扇区采用不同的LA码扩频，这些LA码就成为了扇区识别码。

本发明的帧时间结构示意图如图3所示。一帧长度为2ms，分成17个子帧。上图中的各个信道可以占据一个或多个子帧，多个信道又可以通过码分，占据同一个子帧。一帧中的下行子帧和上行子帧数可以根据当前业务状况进行动态调配，收发保护带(图中的GAP部分)为6us。在一帧中，第0个子帧长度为544码片，其它子帧都为2451码片。

图3中表示了一帧的17个子帧SF0～SF16，其中在中间某个子帧（SFi，1<i<16）前面插入120码片的收发保护带，在第16号子帧后面也插入120码片的收发保护带，即图中表示SF0～SFi-1为下行子帧，SFi～SF16为上行子帧。

SF0长度为544码片。SF0用于传送DL_SCH信道，内部包含8个同步时隙SS0～SS7，每个时隙长度是64码片，在SF0的开始和末尾都插入16码片的保护带。每个同步时隙由长度为32的LS码组成，LS码的C码、S码之间插入了16个码片的保护带，前后各插入8码片的保护带。

其它子帧的长度为2451码片，每个子帧包含16个时隙（TS0～TS15）。这16个时隙采用了LA码进行位置调制，每个时隙的长度各不相同，最小长度是140。时隙长度减去LS码长度余下的码片分成两部分插入到C码和S码的前面。LS码长度是128，因此最小间隔是6码片。

表1是主LA码的间隔长度。

时隙	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
长度	140	142	144	146	148	150	152	154	156	158	160	162	164	168	176	141

表1

各个时隙的C码和S码前面的GAP长度如表2所示。

时隙	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
C码	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	6
S码	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	7

表2

通过将LA码的不同长度的间隔位置做前后交换，即可派生出其它LA码，不同小区可以采

用相同的LS码，通过不同的LA码调制即可。同一小区的不同扇区可以采用同一个LA码，而可采用不同的LS码组。

长度为128的LS码，其扩频因子可以从16～128变化。对于高速移动终端，尽量采用较小的扩频因子而减少并行传输的码道数目。

2、本发明对现有技术中无线局域网的各个信道所作的调整和修改

1）下行同步信道（DL_SCH，DownLink Synchronization CHannel)

这一个物理层的信道，每帧发送一次，位置为每帧的第0个子帧，长度是544个码片。同步信道含有8个时隙，每个时隙由一个长为32的LS码和三段GAP组成，可携带一个符号。采用不同的调制方式，则这8个符号可传递的数据比特量就不同。移动终端通过捕获前向同步信道传递的特殊编码信息可以获得前向链路的同步。

选择一个长度为32个的LS码A0（C码和S码长度各为16），经过正交旋转变换即可派生出一组码字：

设 $A_0=(a0,a1,a2,...,a31)$，通过旋正交转变换，得到的码组为 $Ai=(a0,a1\cdot e^{j\varphi_i},a2\cdot e^{j\varphi 2i},...,a31\cdot e^{j\varphi 31i})$。其中 $\varphi_i=2\pi i/31$，i=0~31。

通过正交旋转派生出的码字，可以与其它子帧上的未经过旋转的LS码保持正交关系。上述32个码字可以分配到不同的小区中，移动终端从这里码组里依次挑选一个码字用来做同步，直到捕获到当前小区的帧起始位置为止。

同步信道的携带的信息还可以分成不同的数据域，除了用于同步的特殊标志域外，还可以携带本小区的LA码、LS码组信息。移动终端同步上后即可获得这些信息。

2）广播信道(BCH，Broadcasting CHannel）

发送小区共享信息。

3）帧控制信道(FCH，Frame control CHannel）

这是接入点对系统资源进行调度和分配的指示信道。一帧中的上下行数据子帧使用状况都在此信道上发送出来。

4) 接入响应信道（ACH，Access indicator CHannel）

它传送上一帧中移动终端的接入请求的处理状况，移动终端可以在该信道上获得自己是否允许接入的信息。通常，该信道含有接入延迟调整信息，以通知移动终端调整其发送接入前导

的时刻。

5）公共导频信道（CPICH，Common PIlot CHannel）

移动终端可使用公共导频信道做信道估计，也可使用业务信道上的间断导频。

上述BCH、FCH、ACH、CPICH信道采用不同的LS码扩频，采用码分方式在同一个子帧上发送出去。而且通过一定的码字资源分配，可以实现不同扇区采用不同的LS码，所有扇区的公共信道同时发送出去。

6）下行专用信道（DL-DCH，DownLink Dedicate CHannel）

占用的子帧数目由接入点动态的调度，可以用TDMA/CDMA两种多址方式结合的方法来区分移动终端。如果下行没有业务，则没有DL-DCH信道。专用信道包含控制和数据部分，其中控制部分包含间断导频、延迟控制、功率控制、自动重传请求（ARQ）等部分。移动终端既可利用下行公共导频信道做信道估计，也可以利用每个子帧的间断导频信道估计，或二者结合。

图4是一个DL-DCH结构示意图。在图4中，每个子帧的第0个时隙用来传第延迟和功率控制信息，第1个时隙用来传递间断导频，后面的时隙用来传递传输信道映射过来的数据包。延迟、导频部分与后面数据部分使用同一个LS码扩频，这样不同移动终端则可以有自己的间断导频和延迟控制信息。

7) 反向同步信道(UL-SCH，UpLink Synchronization CHannel)

UL-SCH用于反向链路同步，主要是反向接入过程中的同步。移动终端利用反向同步信道传递同步前导（Preamble），接入点通过解调这些前导而获得移动终端的同步信息。

8）反向接入信道（RCH，Random access Channel）

用于移动终端的反向接入过程，传送接入信息。移动终端总是在反向同步完成后，才在ACH信道上发送接入信息。图5是一个UL-SCH和RCH结构示意图。

UL-SCH和RCH通过时分方式占用一帧的最后一个子帧SF15。其中UL-SCH含有8个反向接入时隙（RSS0～RSS7），其长度与下行同步信道DL-SCH一样。子帧余下的部分用来传递ACH接入消息。

UL-SCH和RCH放在一帧的末尾，目的是使这两个信道的位置固定，便于接入点处理这两个信道上的信息。

9) 上行专用信道（UL-DCH，UpLink Dedicate Channel）

用于传递反向业务数据，该信道也分为数据部分和控制部分，与下行专用类似，在信道首部含有功率控制、自动重传请求（ARQ）、间断导频部分，但没有延迟控制部分，因为接入点不可能单独调整某一个移动终端的下行专用信道的发射时刻。控制部分和业务数据部分采用同一个LS码扩频。UL-DCH的设计例子如图6所示。

当不同移动终端使用相同的子帧传送业务时，他们之间依靠不同的LS码区分。

3. 移动终端接入过程

当移动终端希望接入系统之前，必须通过DL-SCH信道捕获到系统的帧同步，前向链路的参考时刻已经获得。当移动终端接入系统时，首先在UL-SCH信道上发送接入前导，当前空闲的前导可以从广播信道上获得。其发送接入前导的时隙位置由系统参数规定。在本实施例中，UL-SCH信道上一共有8个时隙，且两边都留有16个码片的时间调整余量。并由BCH信道发送给本小区所有移动终端。

接入点接收到该接入前导后，如果没有冲突，则分析该前导的到达时间，通过ACH信道反馈延迟调整信息。移动终端将根据接收到延迟调整信息调整自己发送前导的时刻，并在同一个同步时隙上继续发送接入前导。只有通过连续几帧的调整，且接入点认为移动终端发送前导的时刻时刻符合即与系统同步后，才通过ACH信道发送确认信息，让移动终端发送接入消息。接入消息里包含了资源请求信息，接入点处理这些信息后将在ACH信道中将接入结果发送给移动终端。

如果有两个移动终端在同一个同步时隙上发送接入前导，则出现冲突，两个移动终端都无法接入，该同步时隙继续处于空闲状态。一般移动终端会根据一定的算法寻找另一个同步时隙或者等待到下一帧后再尝试新的接入。

整个接入过程如图7所示。移动终端发送的前导，要在下一帧的才能被接入点接收到，然后在ACH信道上将时延调整信息发送下去。只经过一次时延调整，移动终端发送前导的时刻即满足系统要求，因此ACH信道上发送同步完成的消息，移动终端则在RCH信道上将接入消息发送出去。

4. 延迟控制

在移动终端接入时，接入点通过接入前导来分析移动终端发送数据的时刻，然后通过ACH

信道将延迟控制信息发给移动终端，移动终端根据该信息调整接入前导的发送时刻。这个闭环过程每帧重复一次，直至同步完成为止，然后发送接入消息。

在业务数据传输过程中，接入点通过上行业务信道上的前导来分析移动终端发送数据的时刻，在DL-DCH信道的控制部分将时延调整信息发送下去，移动终端根据该信息调整自己的业务数据发送时刻。这个闭环过程可以每一帧调整一次，也可以多帧调整一次。

本发明的上述实施例，可以用其他各种方式实现。例如，可以仅仅用LS码来传递下行控制信道，而其它信道全部采用OFDM调制。这样不同扇区的公共控制信道采用了码分方式，但是业务仍然采用TDMA方式。这样可避免上行的同步要求，在保留现有HiperLAN2基本结构的基础上，又通过码分方式降低了公共控制信道的资源占用比例。

还可以不使用LA码，而只用LS码，这样可减小时隙中的GAP长度，占空比更高，因此一个小区中的频谱效率更高。但组网时相邻小区只能采用频分复用方式了。

还可以使用较短的LS码，构成较短的时隙和较短的子帧。这样一帧中的子帧数目可以增多，使系统更适合于较短的突发数据业务。也可以构造更长的物理帧，如10ms帧，这样一帧中可调度的子帧数更多。

另外，从减少复杂性的角度出发，可以将该系统简化，让它更接近于当前的HiperLAN2标准。比如每个扇区只采用一个LS码，通过调整其扩频因子来适应不同的信道环境。同扇区移动终端完全采用TDMA方式区分，而不同扇区/小区的移动终端通过不同的LS/LA码区分。

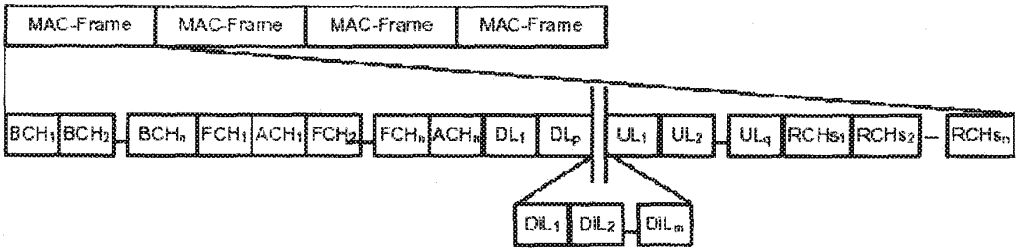

MAC-Frame
MAC-Frame
MAC-Frame
MAC-Frame
BCH1
BCH2
BCHn
FCH1
ACH1
FCH2
FCHn
ACHn
DL1
DLp
UL1
UL2
ULq
RCHs1
RCHs2
RCHsm
DiL1
DiL2
DiLm

图 1

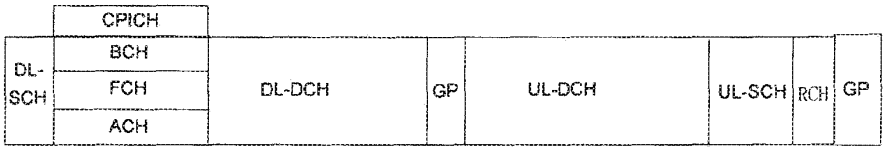

CPICH
DL-SCH
BCH
FCH
ACH
DL-DCH
GP
UL-DCH
UL-SCH
RCH
GP

图 2

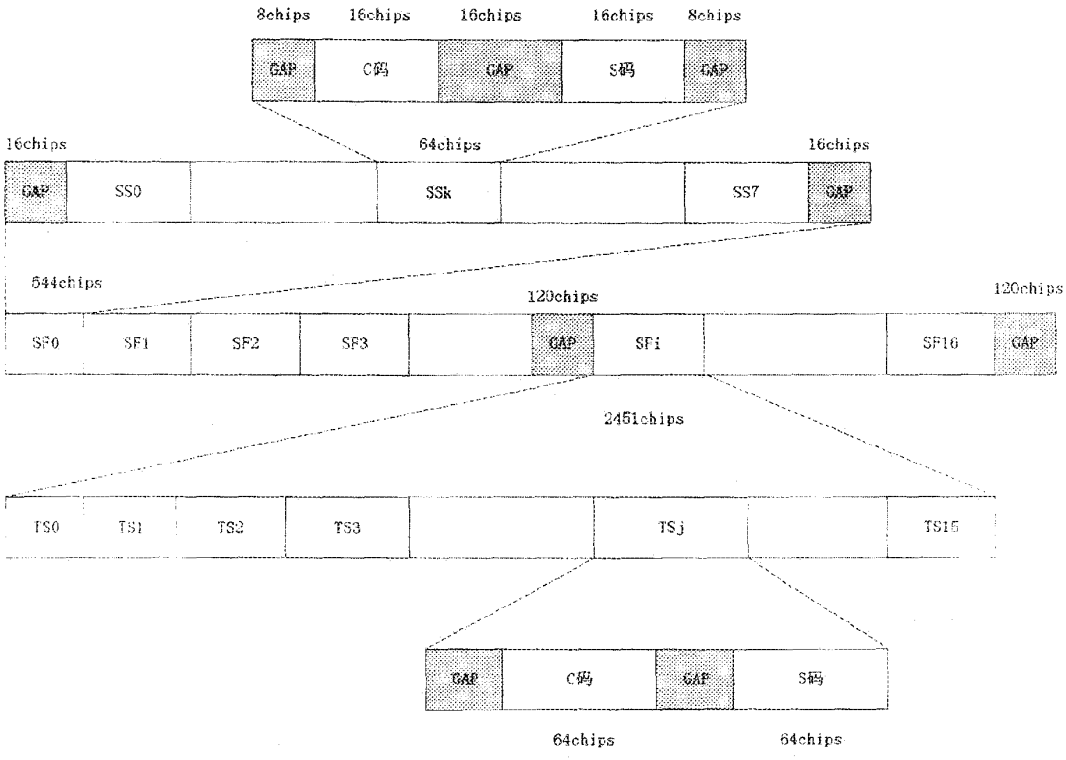

8chips
16chips
16chips
16chips
8chips
GAP
C码
GAP
S码
GAP
16chips
64chips
16chips
GAP
SS0
SSk
SS7
GAP
544chips
120chips
120chips
SF0
SF1
SF2
SF3
GAP
SFi
SF16
GAP
2451chips
TS0
TS1
TS2
TS3
TSj
TS15
GAP
C码
GAP
S码
64chips
64chips

图 3

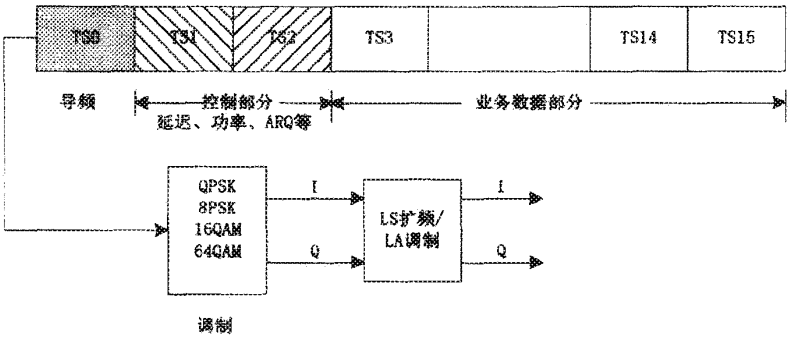

TS0
TS1
TS2
TS3
TS14
TS15
导频
控制部分
延迟、功率、ARQ等
业务数据部分
QPSK
8PSK
16QAM
64QAM
I
Q
LS扩频/
LA调制
I
Q
调制

图 4

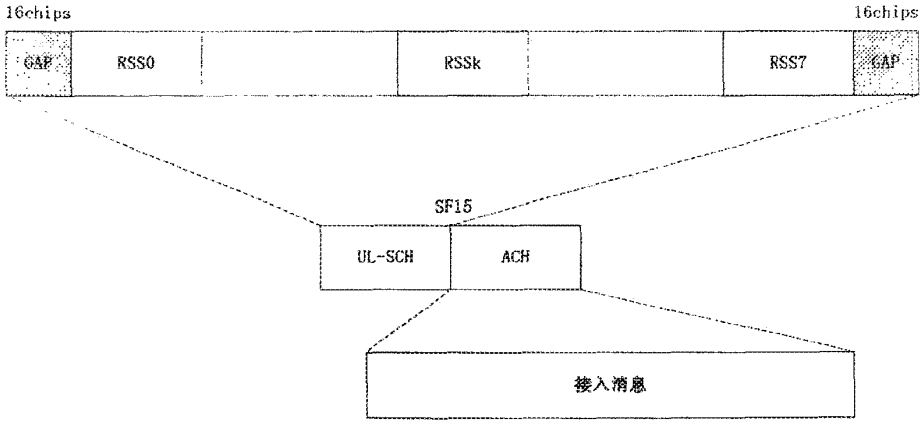

16chips
16chips
GAP
RSS0
RSSk
RSS7
GAP
SF15
UL-SCH
ACH
接入消息

图 5

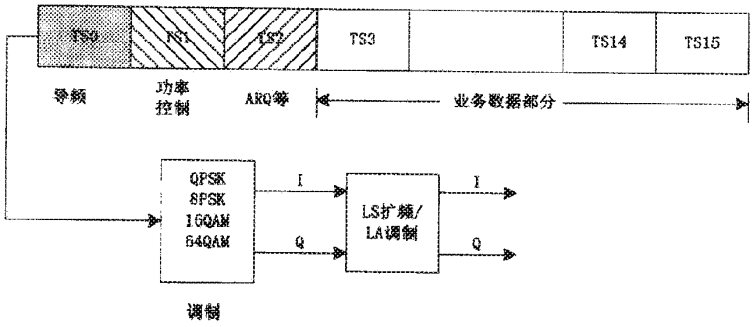

TS0
TS1
TS2
TS3
TS14
TS15
导频
功率控制
ARQ等
业务数据部分
QPSK
8PSK
16QAM
64QAM
I
Q
LS扩频/LA调制
I
Q
调制

图 6

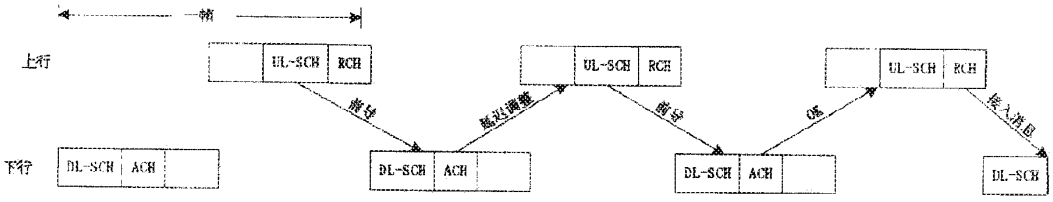

一帧
上行
UL-SCH
RCH
下行
DL-SCH
ACH
断开
随机接入
断开
OK
接入消息
DL-SCH

图 7

Electronic Acknowledgement Receipt

EFS ID:	35402508
Application Number:	15953950
International Application Number:	
Confirmation Number:	1085
Title of Invention:	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Xiaodong Li
Customer Number:	25096
Filer:	Stephen C Bishop/Todd Nielsen
Filer Authorized By:	Stephen C Bishop
Attorney Docket Number:	061240-8006.US06
Receipt Date:	12-MAR-2019
Filing Date:	16-APR-2018
Time Stamp:	18:30:21
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	0612408006US06_IDS_03_12_19.PDF	1034481 244b8c316ca45dc1663c5e0fd9406740d8564fe9	no	4

Warnings:

Information:					
2	Non Patent Literature	EESR.pdf	366325 de05eed829ee42c42056c3ff1a464af1d1007d2b	no	8
Warnings:					
Information:					
3	Foreign Reference	CN1452326A.pdf	15844113 1f5c07fd96a4809e3cf4965976ed0d0db363176b	no	26
Warnings:					
Information:					
			Total Files Size (in bytes):	17244919	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

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.

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United States Patent and Trademark Office
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/953,950	04/16/2018	Xiaodong Li	061240-8006.US06

CONFIRMATION NO. 1085

25096
PERKINS COIE LLP - SEA General
PATENT-SEA
P.O. BOX 1247
SEATTLE, WA 98111-1247

PUBLICATION NOTICE

OC000000106766176

Title:CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM

Publication No.US-2019-0089566-A1
Publication Date:03/21/2019

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently http://www.uspto.gov/patft/.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Public Records Division. The Public Records Division can be reached by telephone at (571) 272-3150 or (800) 972-6382, by facsimile at (571) 273-3250, by mail addressed to the United States Patent and Trademark Office, Public Records Division, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently https://portal.uspto.gov/pair/PublicPair. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Office of Data Managment, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

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www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/953,950	04/16/2018	Xiaodong Li	061240-8006.US06	1085

25096 7590 05/07/2019

PERKINS COIE LLP - SEA General
PATENT-SEA
P.O. BOX 1247
SEATTLE, WA 98111-1247

EXAMINER	
LEVITAN, DMITRY	

ART UNIT	PAPER NUMBER
2461	

NOTIFICATION DATE	DELIVERY MODE
05/07/2019	ELECTRONIC

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.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

patentprocurement@perkinscoie.com

Office Action Summary	**Application No.** 15/953,950	**Applicant(s)** Li et al.	
	Examiner DMITRY LEVITAN	**Art Unit** 2461	**AIA (FITF) 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 12/21/18.

☐ 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) 21-40 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) 21-40 is/are rejected.

8) ☐ Claim(s) _____ 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 4/16/18 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: _____.

Notice of Pre-AIA or AIA Status

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

2. Preliminary amendment, filed 12/21/18, has been entered. Claims 21-40 remain pending.

Claim Rejections - 35 USC § 112

3. Claims 21-40 are rejected under 35 U.S.C. 112(a) or 35 U.S.C. 112 (pre-AIA), first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor or a joint inventor, or for pre-AIA the inventor(s), at the time the application was filed, had possession of the claimed invention.

Claims 21, 27, 33 and 40 limitations, directed to "the probing signal occupies a portion of spectrum in between OFDM subcarriers designated for transmission of uplink control information in the system at both ends of the uplink frequency band" are not supported by the disclosure, as filed.

The preliminary amendment on page 8 cites paragraphs [0038], [0040] and [0055]-[0060] with Fig. 16 as the support for the new claims 21-40. The cited text and figures fail to support the limitations of the claims indicated above.

Therefore, the limitations of claims 21, 27, 33 and 40, directed to "the probing signal occupies a portion of spectrum in between OFDM subcarriers designated for transmission of uplink control information in the system at both ends of the uplink frequency band" are identified as NEW MATTER.

Other claims are rejected, as the claims depending on the claims rejected above.

Conclusion

4. Any inquiry concerning this communication or earlier communications from the examiner should be directed to DMITRY LEVITAN whose telephone number is (571)272-3093. The examiner can normally be reached on 8:30-4:30.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Huy Vu can be reached on 5712723155. 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.

DMITRY LEVITAN
Primary Examiner
Art Unit 2461

/DMITRY LEVITAN/
Primary Examiner, Art Unit 2461

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/953,950	Li et al.
	Examiner	**Art Unit**
	DMITRY LEVITAN	2461

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

CLAIMS

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

CLAIM		DATE								
Final	Original	05/02/2019								
	21	✓								
	22	✓								
	23	✓								
	24	✓								
	25	✓								
	26	✓								
	27	✓								
	28	✓								
	29	✓								
	30	✓								
	31	✓								
	32	✓								
	33	✓								
	34	✓								
	35	✓								
	36	✓								
	37	✓								
	38	✓								
	39	✓								
	40	✓								

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/953,950	Li et al.
	Examiner	Art Unit
	DMITRY LEVITAN	2461

CPC - Searched*		
Symbol	Date	Examiner
H04L 12/26	05/02/2019	DL

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner
370	241, 252, 310, 328, 330, 464, 532	05/02/2019	DL

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
IEEE, EAST	05/02/2019	DL

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

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	15953950
Filing Date	2018-04-16
First Named Inventor	Xiaodong Li
Art Unit	2461
Examiner Name	Dmitry Levitan
Attorney Docket Number	061240-8006.US06

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	5909436		1999-06-01	Engstrom et al.	

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20010021182		2001-09-13	Wakutsu Takashi	

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	1452326	CN		2003-10-29	Huawei Tech Co. Ltd		X

If you wish to add additional Foreign Patent Document citation information please click the Add button Add

NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /D.L/

EFS Web 2.1.18

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	15953950
	Filing Date	2018-04-16
	First Named Inventor	Xiaodong Li
	Art Unit	2461
	Examiner Name	Dmitry Levitan
	Attorney Docket Number	061240-8006.US06

	1	Extended European Search Report received for counterpart European Patent Application No. 18196596.3, mailing date February 20, 2019 (8 pages).

If you wish to add additional non-patent literature document citation information please click the Add button Add

EXAMINER SIGNATURE

Examiner Signature	/DMITRY LEVITAN/	Date Considered	05/02/2019

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

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /D.L/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	15953950
	Filing Date	2018-04-16
	First Named Inventor	Xiaodong Li
	Art Unit	2461
	Examiner Name	Dmitry Levitan
	Attorney Docket Number	061240-8006.US06

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

X That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

X See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Stephen Bishop/	Date (YYYY-MM-DD)	2019-03-12
Name/Print	Stephen Bishop	Registration Number	38829

This collection of information is required by 37 CFR 1.97 and 1.98. 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 1 hour 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.**

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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.

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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.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /D.L/

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L5	26	(uplink) with ((combin$5 or multiplex$5 or configur$5 or allocat$4) near4 ((prob$4 or test$4) near3 (between or middle or center)))	US-PGPUB; USPAT	OR	ON	2019/05/02 14:48
L6	50	(uplink or UL) with ((combin$5 or multiplex$5 or configur$5 or allocat$4 or insert$4 or position$6 or locat$6) near3 ((prob$4 or test$4) near5 (between or middle or center)))	US-PGPUB; USPAT	OR	ON	2019/05/02 14:52
L8	5	(uplink or UL) with ((combin$5 or multiplex$5 or configur$5 or allocat$4 or insert$4 or position$6 or locat$6) near3 ((prob$4 or test$4 or signal) near5 (between or middle or center))) and ((uplink or UL) adj3 control) and @ay<"2005"	US-PGPUB; USPAT	OR	ON	2019/05/02 14:59

5/ 2/ 2019 3:04:17 PM
C:\ Users\ dlevitan\ Documents\ EAST\ Workspaces\ 15953950.wsp

Docket No.: 061240-8006.US06
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
Li et al.

Application No.: 15/953,950 | Confirmation No.: 1085

Filed: April 16, 2018 | Art Unit: 2461

For: CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM | Examiner: Dmitry Levitan

AMENDMENT AND RESPONSE TO NON-FINAL OFFICE ACTION UNDER 37 CFR 1.111

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

Sir:

In response to the Final Office Action mailed on May 7, 2019, please amend the above-identified U.S. patent application as follows:

INTRODUCTORY COMMENTS

Amendments to the Claims are reflected in the listing of claims which begins on page 2 of this paper.

Remarks/Arguments begin on page 7 of this paper.

AMENDMENTS TO THE CLAIMS

Please amend the claims as follows:

1-20. (Canceled)

21. (Previously Presented) A communication method for a mobile device in an Orthogonal Frequency Division Multiplexing (OFDM) communication system, the method comprising:

receiving a request for an uplink probing signal from a base station in the system; and

transmitting, in response to the received request, the probing signal with a code sequence modulated in the frequency domain, wherein:

the probing signal is configured to overlap, in the time domain, with uplink signals transmitted over an uplink frequency band by other mobile devices in the system; and

the probing signal is configured to occupy a portion of spectrum in between OFDM subcarriers designated for transmission of uplink control information in the system at both ends of the uplink frequency band.

22. (Previously Presented) The method of claim 21, wherein the probing signal enables the base station to estimate a channel profile in the frequency domain.

23. (Previously Presented) The method of claim 22, wherein the channel profile is used by the base station to determine a transmission format for a subsequent transmission over the channel.

24. (Previously Presented) The method of claim 23, wherein the transmission format comprises a modulation/coding or pilot pattern.

25. (Previously Presented) The method of claim 22, wherein the channel profile is used for beamforming in a subsequent transmission by the base station.

26. (Previously Presented) The method of claim 21, wherein the portion of spectrum is available for transmission of uplink data signals by other mobile devices in the system.

27. (Previously Presented) A communication method for a base station in an Orthogonal Frequency Division Multiplexing (OFDM) communication system, the method comprising:

transmitting a request for an uplink probing signal to a mobile device in the system; and

receiving the probing signal from the mobile device, wherein:

the probing signal contains a code sequence modulated in the frequency domain;

the probing signal overlaps, in the time domain, with uplink signals transmitted over an uplink frequency band by other mobile devices in the system; and

the probing signal occupies a portion of spectrum in between OFDM subcarriers designated for transmission of uplink control information in the system at both ends of the uplink frequency band.

28. (Previously Presented) The method of claim 27, further comprising estimating, based on the received probing signal, a channel profile in the frequency domain.

29. (Previously Presented) The method of claim 28, further comprising using the channel profile to determine a transmission format for a subsequent transmission over the channel.

30. (Previously Presented) The method of claim 29, wherein the transmission format comprises a modulation/coding or pilot pattern.

31. (Previously Presented) The method of claim 28, further comprising using the channel profile for beamforming in a subsequent transmission.

32. (Previously Presented) The method of claim 27, wherein the portion of spectrum is available for transmission of uplink data signals by other mobile devices in the system.

33. (Previously Presented) A communication method for an Orthogonal Frequency Division Multiplexing (OFDM) communication system, the method comprising:

sending a request for an uplink probing signal to a mobile device from a base station in the system; and

responding by the mobile device to the request by transmitting the probing signal with a code sequence modulated in the frequency domain, wherein:

the probing signal is configured to overlap, in the time domain, with uplink signals transmitted over an uplink frequency band by other mobile devices in the system; and

the probing signal is configured to occupy a portion of spectrum in between OFDM subcarriers designated for transmission of uplink control information in the system at both ends of the uplink frequency band.

34. (Previously Presented) The method of claim 33, wherein transmission power of the probing signal is under power control.

35. (Previously Presented) The method of claim 33, wherein the probing signal enables the base station to estimate a channel profile in the frequency domain.

36. (Previously Presented) The method of claim 35, wherein the channel profile is used by the base station to determine a transmission format for a subsequent transmission over the channel.

37. (Previously Presented) The method of claim 36, wherein the transmission format comprises a modulation/coding or pilot pattern.

38. (Previously Presented) The method of claim 35, wherein the channel profile is used for beamforming in a subsequent transmission by the base station.

39. (Previously Presented) The method of claim 33, wherein the portion of spectrum is available for transmission of uplink data signals by other mobile devices in the system.

40. (Previously Presented) A mobile device in an Orthogonal Frequency Division Multiplexing (OFDM) communication system, the mobile device comprising:

a receiver configured to receive a request for an uplink probing signal from a base station in the system;

a transmitter configured to form and transmit, in response to the received request, the probing signal with a code sequence modulated in the frequency domain, wherein:

the probing signal is configured to overlap, in the time domain, with uplink signals transmitted over an uplink frequency band by other mobile devices in the system; and

the probing signal is configured to occupy a portion of spectrum in between OFDM subcarriers designated for transmission of uplink control information in the system at both ends of the uplink frequency band.

REMARKS

Based on the following remarks, the applicant respectfully requests that the rejections set forth in the Office Action mailed May 7, 2019 (the "Office Action") be withdrawn.

The applicant has reviewed the Office Action and submits that all objections and rejections raised in the Office Action have been appropriately resolved herein. Each objection and rejection is addressed below, preceded by a heading similar to that found in the Office Action.[1]

Claims 21-40 were pending when the present Office Action was mailed. By this response, no claims have been amended, cancelled, or added. Accordingly, claims 21-40 are currently pending.

I. Response to the 112 Rejection

Claims 21-40 were rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the written description requirement. Specifically, the Office argues that the limitation "the probing signal is configured to occupy a portion of spectrum in between OFDM subcarriers designated for transmission of uplink control information in the system at both ends of the uplink frequency band" is not supported by the specification as filed. (Office Action, p. 2.) Applicant respectfully disagrees, and specifically directs the Office's attention to paragraphs [0059] and [0060] of the specification as filed, as well as associated Figures 15 and 16, in conjunction with the following arguments.

[1] Silence regarding a position taken, or argument made, by the Office does not indicate any acquiescence to that position or argument. Furthermore, arguments made by the applicant with respect to a particular claim or claims apply only to those claim or claims, and not to other claims or patents/applications, unless specifically noted herein.

As has previously been described, the claimed system is directed to a method of transmitting a probing signal with a code sequence modulated in the frequency domain. The probing signal can be used, for example, to assist estimation of channel characteristics. (*See, e.g.,* Specification at ¶¶ [0022] and [0066].) In the section of the specification entitled "DSSS Signal Design," the specification describes various schemes that may be used to minimize interference between the DSSS (probing) signal and the MC (Multi-Carrier) signal. (*Id.,* ¶¶ [0055]-[0060].) In particular, paragraph [0059] notes that "within MC subcarriers, the control subcarriers are more important than the data subcarriers and may need to have a better protection in the overlay system." (*Id.,* at ¶ [0059], emphasis added.) In other words, the specification specifically calls out the importance in probing signal design of better protecting MC control information from interference with the probing signal.

After noting the importance of protecting the control information, the specification describes two schemes that can help minimize interference. Figure 15 describes one of those schemes, namely a DSSS sequence that is designed to have spectrum nulls at the uplink MC control subchannels to avoid excess interference with those control signals. (*Id.,* at ¶ [0060] and Figure 15.) In contrast, Figure 16 describes a different scheme, namely one in which the DSSS signal is designed such that it "only occup[ies] the center portion…of the available spectrum." (*Id., at* ¶ [0060].) As shown in Figure 16, the DSSS signal occupies a portion of the overall 10MHz available spectrum, with the spectrum on either side of the DSSS signal spectrum available for the MC signal. As noted in the specification, that means that "its [i.e., the DSSS signal] interference with the MC sub-carriers [sic] over the rest of the spectrum will be much lower where the MC subcarriers, carrying control information or using higher modulation subcarriers…are placed." (*Id.*)

Applicant's pending claims are specifically directed to the second scheme described in paragraph [0060] and depicted in Figure 16. In particular, two aspects of the probing signal and interference mitigation scheme are characterized in the pending claims. First, "the probing signal is configured to overlap, in the time domain, with uplink signals transmitted over an uplink frequency band by other mobile devices in the system," which the Office agrees is supported by applicant's specification. Second, "the probing signal is configured to occupy a portion of spectrum in between OFDM subcarriers designated for transmission of uplink control information in the system at both ends of the uplink frequency band." This second limitation, which is the subject of the 112 rejection, directly corresponds to the aforementioned disclosure in the specification. That is, as is depicted in Figure 16 and accompanying text, the probing signal occupies the center portion of the spectrum with both ends of the uplink frequency band (i.e., the portion outside the center portion of the spectrum), available for uplink control information. The claim construction is further supported by the disclosure in paragraph [0059], which spells out the impetus behind such a construction and the need to further protect the control subcarriers.

For at least the aforementioned reasons, the applicant submits that the specification as filed clearly meets the written description requirement. Applicant therefore respectfully requests that the Section 112 rejection be withdrawn.

II. Conclusion

In view of the foregoing, the applicant accordingly requests reconsideration of the application and respectfully submit that the application is in condition for allowance. If the Examiner has any questions or believes a telephone conference would expedite prosecution of this application, the Examiner is encouraged to contact the undersigned at (206) 359-8000.

The applicant reserves the right to later pursue any previously pending or other broader or narrow claims that capture any subject matter supported by the present disclosure, including subject matter that might be found disclaimed herein or by any prior prosecution. Accordingly, reviewers of this or any parent, child or related prosecution history shall not reasonably infer that the applicant has made any disclaimers or disavowals of any subject matter supported by the present application.

Please charge any underpayment or credit any overpayment to our Deposit Account No. 50-0665 under Order No. 061240-8006.US06, from which the undersigned is authorized to draw.

Dated: __7 November 2019_____ Respectfully submitted,

By __/Stephen Bishop/_____
Stephen Bishop
Registration No.: 38,829

Perkins Coie LLP
P.O. Box 1247
Seattle, WA 98111-1247
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Fax: (206) 359-7198

Attorneys for Applicant

Electronic Patent Application Fee Transmittal					
Application Number:	15953950				
Filing Date:	16-Apr-2018				
Title of Invention:	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM				
First Named Inventor/Applicant Name:	Xiaodong Li				
Filer:	Stephen C Bishop/Jayme Jones				
Attorney Docket Number:	061240-8006.US06				
Filed as Small Entity					
Filing Fees for Utility under 35 USC 111(a)					
Description		**Fee Code**	**Quantity**	**Amount**	**Sub-Total in USD($)**
Basic Filing:					
Pages:					
Claims:					
Miscellaneous-Filing:					
Petition:					
Patent-Appeals-and-Interference:					
Post-Allowance-and-Post-Issuance:					
Extension-of-Time:					

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension - 3 months with $0 paid	2253	1	700	700
Miscellaneous:				
			Total in USD ($)	**700**

Electronic Acknowledgement Receipt	
EFS ID:	37684070
Application Number:	15953950
International Application Number:	
Confirmation Number:	1085
Title of Invention:	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Xiaodong Li
Customer Number:	25096
Filer:	Stephen C Bishop/Jayme Jones
Filer Authorized By:	Stephen C Bishop
Attorney Docket Number:	061240-8006.US06
Receipt Date:	07-NOV-2019
Filing Date:	16-APR-2018
Time Stamp:	12:53:05
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$700
RAM confirmation Number	E2019A7C53315110
Deposit Account	
Authorized User	
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		2019-11-7_ResponseToNFOA_asfiled_061240-8006US06.pdf	126301 293af00997905d66ca1e476d4062c6872f5e784c	yes	10
	Multipart Description/PDF files in .zip description				
	Document Description		**Start**	**End**	
	Amendment/Req. Reconsideration-After Non-Final Reject		1	1	
	Claims		2	6	
	Applicant Arguments/Remarks Made in an Amendment		7	10	
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30888 dd1f43869796bd8d4223067e8fc51001662ef880	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	157189		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

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.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/953,950	04/16/2018	Xiaodong Li	061240-8006.US06	1085

25096 7590 11/20/2019

PERKINS COIE LLP - SEA General
PATENT-SEA
P.O. BOX 1247
SEATTLE, WA 98111-1247

EXAMINER	
LEVITAN, DMITRY	

ART UNIT	PAPER NUMBER
2461	

NOTIFICATION DATE	DELIVERY MODE
11/20/2019	ELECTRONIC

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.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

patentprocurement@perkinscoie.com

Office Action Summary	**Application No.** 15/953,950	**Applicant(s)** Li et al.	
	Examiner DMITRY LEVITAN	**Art Unit** 2461	**AIA (FITF) 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 11/07/19.

☐ 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) 21-40 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) 21-40 is/are rejected.

8) ☐ Claim(s) _____ 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 _____ 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: _____.

Notice of Pre-AIA or AIA Status

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

2. Amendment, filed 11/07/19, has been entered. Claims 21-40 remain pending.

Claim Rejections - 35 USC § 112

3. Claims 21-40 are rejected under 35 U.S.C. 112(a) or 35 U.S.C. 112 (pre-AIA), first paragraph, as failing to comply with the written description requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor or a joint inventor, or for pre-AIA the inventor(s), at the time the application was filed, had possession of the claimed invention.

Claims 21, 27, 33 and 40 limitations, directed to "the probing signal occupies a portion of spectrum in between OFDM subcarriers designated for transmission of uplink control information in the system at both ends of the uplink frequency band" are not supported by the disclosure, as filed.

The amendment on page 7 cites paragraphs [0059] and [0060] of the specification as filed, corresponding to [0063] and [0064] of the published version, with Fig. 15 and 16, as the support for the new claims 21-40. The cited text and figures fail to support the limitations of the claims indicated above.

Therefore, the limitations of claims 21, 27, 33 and 40, directed to "the probing signal occupies a portion of spectrum in between OFDM subcarriers designated for transmission of uplink control information in the system at both ends of the uplink frequency band" are identified as NEW MATTER.

Other claims are rejected, as the claims depending on the claims rejected above.

Response to Arguments

1. Applicant's arguments filed 11/07/19 have been fully considered but they are not persuasive.

On pages 8 and 9 of the Response, Applicant argues that limitations, directed to "the probing signal occupies a portion of spectrum in between OFDM subcarriers designated for transmission of uplink control information in the system at both ends of the uplink frequency band" are supported by the cited portions of the specification.

Examiner respectfully disagrees.

Fig 16 and text on [0064] position the probing signal DSSS/SS located in the middle of the frequency band. The corresponding Multi-Carrier/MC signal 1506 occupies all the spectrum of the frequency band. However, nowhere in the disclosure the MC subcarriers for the control signals are located at both sides of the uplink frequency band.

Applicant's arguments, directed to protecting the control subcarriers over the data subcarriers of the MC and using the central portion of the frequency band for the probe/DSSS to reduce interference between the probe and the control subcarriers of the MC, are incorrect, because these arguments do not support the essential step of positioning the control carriers at both ends of the uplink frequency band, as claimed.

Particularly, according to the arguments logic, the control carriers could be positioned at one/single end of the frequency band.

Therefore, the claims limitations, directed to "the probing signal occupies a portion of spectrum in between OFDM subcarriers designated for transmission of uplink control information in the system at both ends of the uplink frequency band" are identified as NEW MATTER.

Conclusion

2. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

4. Any inquiry concerning this communication or earlier communications from the examiner should be directed to DMITRY LEVITAN whose telephone number is (571)272-3093. The examiner can normally be reached on 8:30-4:30.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Huy Vu can be reached on 5712723155. 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.

DMITRY LEVITAN
Primary Examiner
Art Unit 2461

/DMITRY LEVITAN/
Primary Examiner, Art Unit 2461

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/953,950	Li et al.
	Examiner	**Art Unit**
	DMITRY LEVITAN	2461

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

CLAIMS

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

CLAIM		DATE								
Final	Original	05/02/2019	11/14/2019							
	21	✓	✓							
	22	✓	✓							
	23	✓	✓							
	24	✓	✓							
	25	✓	✓							
	26	✓	✓							
	27	✓	✓							
	28	✓	✓							
	29	✓	✓							
	30	✓	✓							
	31	✓	✓							
	32	✓	✓							
	33	✓	✓							
	34	✓	✓							
	35	✓	✓							
	36	✓	✓							
	37	✓	✓							
	38	✓	✓							
	39	✓	✓							
	40	✓	✓							

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/953,950	Li et al.
	Examiner	Art Unit
	DMITRY LEVITAN	2461

CPC - Searched*		
Symbol	Date	Examiner
H04L 12/26	11/14/2019	DL

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner
370	241, 252, 310, 328, 330, 464, 532	11/14/2019	DL

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
IEEE, EAST	11/14/2019	DL

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

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the **PATENT APPLICATION** of: Neocific, Inc.	
Application No.: 15/953,950	Our File: NEO-PT012.6
Confirmation No.: 1085	Date: February 14, 2020
Filed: April 16, 2018	
For: CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM	
Group: 2461	
Examiner: Dmitry Levitan	

RESPONSE PURSUANT TO 37 C.F.R. §1.114

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

This Response is being timely filed in response to the Final Office Action dated November 20, 2019. A Request for Continued Examination (RCE) is filed concurrently herewith.

Please amend the application without prejudice or disclaimer as follows:

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
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.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 15/953,950	Filing Date 04/16/2018	☐ To be Mailed

ENTITY: ☐ LARGE ☑ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $50 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $230 =	
☐ 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).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	02/14/2020	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 20	Minus	** 20	= 0		x $50 =	0
	Independent (37 CFR 1.16(h))	* 4	Minus	*** 4	= 0		x $230 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/VANESSA D HODGES/
*** 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 number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. 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 12 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: RCEX
Doc description: Request for Continued Examination (RCE)

PTO/SB/30EFS (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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REQUEST FOR CONTINUED EXAMINATION(RCE)TRANSMITTAL
(Submitted Only via EFS-Web)

Application Number	15/953,950	Filing Date	2018-04-16	Docket Number (if applicable)	NEO-PT012.6	Art Unit	2461
First Named Inventor	Xiaodong Li			Examiner Name	Dmitry Levitan		

This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.
Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. The Instruction Sheet for this form is located at WWW.USPTO.GOV

SUBMISSION REQUIRED UNDER 37 CFR 1.114

Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

☐ Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.

☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on _____

☐ Other _____

☒ Enclosed

☒ Amendment/Reply

☐ Information Disclosure Statement (IDS)

☐ Affidavit(s)/ Declaration(s)

☐ Other _____

MISCELLANEOUS

☐ Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of months _____
(Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)

☐ Other _____

FEES

The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.

☒ The Director is hereby authorized to charge any underpayment of fees, or credit any overpayments, to Deposit Account No 220493

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

X Patent Practitioner Signature

Applicant Signature

PTO/SB/30EFS (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
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 contains a valid OMB control number.

Signature of Registered U.S. Patent Practitioner			
Signature	/John D. Wilt/	Date (YYYY-MM-DD)	2020-02-14
Name	John D. Wilt	Registration Number	76110

This collection of information is required by 37 CFR 1.114. 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 12 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.

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

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.

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the **PATENT APPLICATION** of: Neocific, Inc.	
Application No.: 15/953,950	Our File: NEO-PT012.6
Confirmation No.: 1085	Date: February 14, 2020
Filed: April 16, 2018	
For: CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM	
Group: 2461	
Examiner: Dmitry Levitan	

RESPONSE PURSUANT TO 37 C.F.R. §1.114

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

This Response is being timely filed in response to the Final Office Action dated November 20, 2019. A Request for Continued Examination (RCE) is filed concurrently herewith.

Please amend the application without prejudice or disclaimer as follows:

Amendments to the Claims:

This listing of the claims will replace all prior versions of the claims in the application:

1-20. (Canceled)

21. (Currently Amended) A communication method for a mobile device in an Orthogonal Frequency Division Multiplexing (OFDM) communication system, the method comprising:

receiving a request for an uplink probing signal from a base station in the system; and

transmitting, in response to the received request, the probing signal with a code sequence modulated in the frequency domain, wherein:

the probing signal is configured to overlap, in the time domain, with uplink signals transmitted over an uplink frequency band by other mobile devices in the system; and

the probing signal is configured to occupy a portion of spectrum in ~~between~~ OFDM subcarriers not designated for transmission of uplink control ~~information~~ signals in the system ~~at both ends of~~ in the uplink frequency band.

22. (Previously Presented) The method of claim 21, wherein the probing signal enables the base station to estimate a channel profile in the frequency domain.

23. (Previously Presented) The method of claim 22, wherein the channel profile is used by the base station to determine a transmission format for a subsequent transmission over the channel.

24. (Previously Presented) The method of claim 23, wherein the transmission format comprises a modulation/coding or pilot pattern.

25. (Previously Presented) The method of claim 22, wherein the channel profile is used for beamforming in a subsequent transmission by the base station.

26. (Previously Presented) The method of claim 21, wherein the portion of spectrum is available for transmission of uplink data signals by other mobile devices in the system.

27. (Currently Amended) A communication method for a base station in an Orthogonal Frequency Division Multiplexing (OFDM) communication system, the method comprising:

transmitting a request for an uplink probing signal to a mobile device in the system; and

receiving the probing signal from the mobile device, wherein:

the probing signal contains a code sequence modulated in the frequency domain;

the probing signal overlaps, in the time domain, with uplink signals transmitted over an uplink frequency band by other mobile devices in the system; and

the probing signal occupies a portion of spectrum in ~~between~~ OFDM subcarriers not designated for transmission of uplink control ~~information~~ signals in the system ~~at both ends of~~ in the uplink frequency band.

28. (Previously Presented) The method of claim 27, further comprising estimating, based on the received probing signal, a channel profile in the frequency domain.

29. (Previously Presented) The method of claim 28, further comprising using the channel profile to determine a transmission format for a subsequent transmission over the channel.

30. (Previously Presented) The method of claim 29, wherein the transmission format comprises a modulation/coding or pilot pattern.

31. (Previously Presented) The method of claim 28, further comprising using the channel profile for beamforming in a subsequent transmission.

32. (Previously Presented) The method of claim 27, wherein the portion of spectrum is available for transmission of uplink data signals by other mobile devices in the system.

33. (Currently Amended) A communication method for an Orthogonal Frequency Division Multiplexing (OFDM) communication system, the method comprising:

sending a request for an uplink probing signal to a mobile device from a base station in the system; and

responding by the mobile device to the request by transmitting the probing signal with a code sequence modulated in the frequency domain, wherein:
the probing signal is configured to overlap, in the time domain, with uplink signals transmitted over an uplink frequency band by other mobile devices in the system; and

the probing signal is configured to occupy a portion of spectrum in ~~between~~ OFDM subcarriers not designated for transmission of uplink control ~~information~~ signals in the system ~~at both ends of~~ in the uplink frequency band.

34. (Previously Presented) The method of claim 33, wherein transmission power of the probing signal is under power control.

35. (Previously Presented) The method of claim 33, wherein the probing signal enables the base station to estimate a channel profile in the frequency domain.

36. (Previously Presented) The method of claim 35, wherein the channel profile is used by the base station to determine a transmission format for a subsequent transmission over the channel.

37. (Previously Presented) The method of claim 36, wherein the transmission format comprises a modulation/coding or pilot pattern.

38. (Previously Presented) The method of claim 35, wherein the channel profile is used for beamforming in a subsequent transmission by the base station.

39. (Previously Presented) The method of claim 33, wherein the portion of spectrum is available for transmission of uplink data signals by other mobile devices in the system.

40. (Currently Amended) A mobile device in an Orthogonal Frequency Division Multiplexing (OFDM) communication system, the mobile device comprising:

a receiver configured to receive a request for an uplink probing signal from a base station in the system;

a transmitter configured to form and transmit, in response to the received request, the probing signal with a code sequence modulated in the frequency domain, wherein:

the probing signal is configured to overlap, in the time domain, with uplink signals transmitted over an uplink frequency band by other mobile devices in the system; and

the probing signal is configured to occupy a portion of spectrum in ~~between~~ OFDM subcarriers not designated for transmission of uplink control ~~information~~ signals in the system ~~at both ends of~~ in the uplink frequency band.

REMARKS/ARGUMENTS

Upon entry of this Amendment, Claims 21-40 will be pending in this application. Claims 21, 27, 33, and 40 have been amended. Support for the amendments can be found throughout the U.S. Patent Application Publication 2019/0089566, and in particular, paragraph [0064] and Figure 15 (shown below). No new matter has been added.

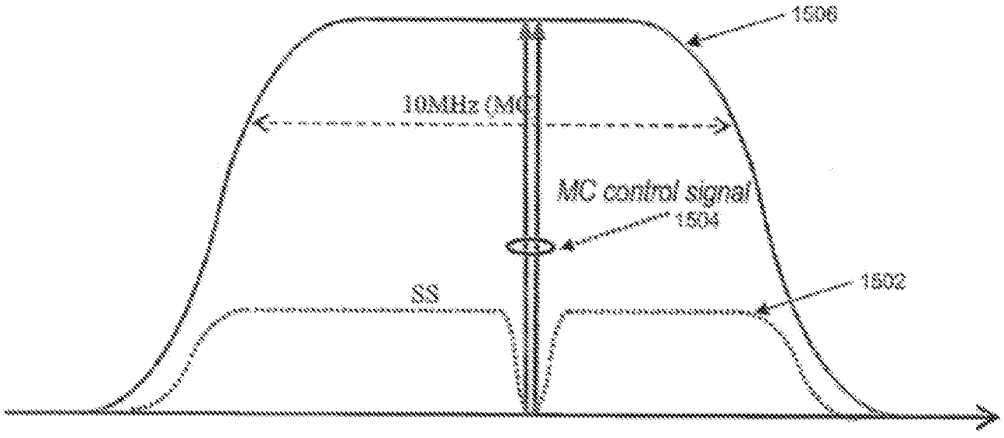


FIG. 15

Applicant respectfully requests the entry of the amendments and reconsideration of the application in view of the amendments and the remarks below.

Request for an Interview

If any of the claims submitted herewith will be rejected by the Examiner, the Applicant respectfully requests a telephonic interview.

Claim Rejections - 35 U.S.C. §112

Claims 21-40 are rejected under 35 U.S.C. §112(a) or 35 U.S.C. §112 (pre-AIA), first paragraph, as allegedly failing to comply with the written description requirement. The claims contain subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the pre-AIA the inventors, at the time the application was filed, had possession of the claimed invention.

Although Applicant respectfully disagrees with the rejection, to advance prosecution, the current claims do not refer to "transmission of uplink control information... at both ends of the frequency band." The amended pending claims 21, 27, 33 and 40 have language, such as "the probing signal is configured to occupy a portion of spectrum in OFDM subcarriers not designated for transmission of uplink control signals in the system in the uplink frequency band." The amended language is at least supported by paragraph [0064] and Figure 15 of the application.

In view of the foregoing, Applicant respectfully requests withdrawal of the rejection under 35 U.S.C. 112.

Conclusion

If the Examiner believes that any additional minor formal matters need to be addressed in order to place this application in condition for allowance, or that a telephonic interview will help to materially advance the prosecution of this application, the Examiner is invited to contact the undersigned by telephone at the Examiner's convenience.

In view of the foregoing, Applicant respectfully submits that the present application, including claims 21-40, is in condition for allowance and a notice to that effect is respectfully requested.

Respectfully submitted,

Neocific, Inc.

By /John D. Wilt/
John D. Wilt
Registration No. 76,110

Volpe and Koenig, P.C.
30 South 17th Street
Philadelphia, PA 19103-4009
Telephone: (215) 568-6400
Facsimile: (215) 568-6499

JDW/cb
Enclosure – Request for Continued Examination (RCE)

Electronic Patent Application Fee Transmittal	
Application Number:	15953950
Filing Date:	16-Apr-2018
Title of Invention:	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Xiaodong Li
Filer:	John D. Wilt/Caren Burgoon
Attorney Docket Number:	061240-8006.US06
Filed as Large Entity	
Filing Fees for Utility under 35 USC 111(a)	

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
RCE- 1ST REQUEST	1801	1	1300	1300
		Total in USD ($)		**1300**

Electronic Acknowledgement Receipt	
EFS ID:	38594956
Application Number:	15953950
International Application Number:	
Confirmation Number:	1085
Title of Invention:	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Xiaodong Li
Customer Number:	25096
Filer:	John D. Wilt/Caren Burgoon
Filer Authorized By:	John D. Wilt
Attorney Docket Number:	061240-8006.US06
Receipt Date:	14-FEB-2020
Filing Date:	16-APR-2018
Time Stamp:	15:50:45
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$1300
RAM confirmation Number	E20202DF51425384
Deposit Account	220493
Authorized User	Caren Burgoon
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.16 (National application filing, search, and examination fees) 37 CFR 1.17 (Patent application and reexamination processing fees)	

37 CFR 1.19 (Document supply fees)

37 CFR 1.20 (Post Issuance fees)

37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Request for Continued Examination (RCE)	NEO_PT012_6_RCE_20200214.PDF	1350117 8fdf125498435f2da189dc0104d956a20493dc72	no	3
Warnings:					
Information:					
2		NEO_PT012_6_FOAReply_20200214.PDF	127425 5c162c56f939d10409391d2507a6646662dbbcad	yes	9

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Response After Final Action	1	1
	Claims	2	6
	Applicant Arguments/Remarks Made in an Amendment	7	9

Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	30605 d2574f3e2d000d6aadb5e2687b43ace75ab2d3db	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	1508147		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

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.

Doc Code: PA..
Document Description: Power of Attorney

PTO/AIA/82A (07-13)
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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	15/953,950
Filing Date	April 16, 2018
First Named Inventor	Li et al.
Title	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM
Art Unit	2461
Examiner Name	LEVITAN, DMITRY
Attorney Docket Number	NEO-PT012.6

SIGNATURE of Applicant or Patent Practitioner

Signature	/Christina R. Walsh/	Date (Optional)	March 3, 2020
Name	Christina R. Walsh	Registration Number	61553
Title (if Applicant is a juristic entity)			
Applicant Name (if Applicant is a juristic entity)	Neo Wireless LLC		

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 03/31/2021. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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POWER OF ATTORNEY BY APPLICANT

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

Application Number	Filing Date

(Note: The boxes above may be left blank if information is provided on form PTO/AIA/82A.)

☑ I hereby appoint the Patent 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 identified above: 03624

OR

☐ I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) 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 patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note: Complete form PTO/AIA/82C.)

Please recognize or change the correspondence address for the application identified in the attached transmittal letter or the boxes above 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 (if the Applicant is a juristic entity, list the Applicant name in the box):

Neo Wireless LLC

☐ Inventor or Joint Inventor (title not required below)

☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)

☑ Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)

☐ 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) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature	David Loo	Date (Optional)	
Name	David Loo		
Title	C.E.O., Neo Wireless LLC		

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. 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.

Electronic Acknowledgement Receipt

EFS ID:	38749940
Application Number:	15953950
International Application Number:	
Confirmation Number:	1085
Title of Invention:	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Xiaodong Li
Customer Number:	25096
Filer:	Christina R. Walsh/Justin Slater
Filer Authorized By:	Christina R. Walsh
Attorney Docket Number:	061240-8006.US06
Receipt Date:	03-MAR-2020
Filing Date:	16-APR-2018
Time Stamp:	11:39:57
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Power of Attorney	NEO-PT012_6-Executed_POA_ByApplicant_aia0082_EFS-20200302.PDF	349259 5dce287c9196e8b001bacef75a289e1eeed811ce	no	2

Warnings:

Information:	
Total Files Size (in bytes):	349259

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
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.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/953,950	04/16/2018	Xiaodong Li	061240-8006.US06

CONFIRMATION NO. 1085

IMPROPER CPOA LETTER

25096
PERKINS COIE LLP - SEA General
PATENT-SEA
P.O. BOX 1247
SEATTLE, WA 98111-1247



Date Mailed: 03/06/2020

NOTICE REGARDING POWER OF ATTORNEY

This is in response to the power of attorney filed 03/03/2020. The power of attorney in this application is not accepted for the reason(s) listed below:

- The power of attorney has not been accepted because the party who is giving power has not been identified. Power of attorney may only be signed by the applicant for patent (37 CFR 1.42) or the patent owner. A party who is not the applicant must become the applicant in accordance with 37 CFR 1.46(c) and appoint any power of attorney in compliance with 37 CFR 3.71 and 3.73. For a reissue application, reexamination proceeding, or supplemental examination proceeding, a patent owner who was not the applicant under 37 CFR 1.46 must appoint any power of attorney in compliance with 37 CFR 3.71 and 3.73. See 37 CFR 1.32(b)(4).

/mteklemichael/

Office of Data Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

03624
VOLPE AND KOENIG, P.C.
30 SOUTH 17TH STREET, 18th Floor
PHILADELPHIA, PA 19103
UNITED STATES

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/953,950	04/16/2018	Xiaodong Li	061240-8006.US06

CONFIRMATION NO. 1085

25096
PERKINS COIE LLP - SEA General
PATENT-SEA
P.O. BOX 1247
SEATTLE, WA 98111-1247

IMPROPER CFR REQUEST

OC000000115195402

Date Mailed: 03/06/2020

RESPONSE TO REQUEST FOR CORRECTED FILING RECEIPT

Power of Attorney, Claims, Fees, System Limitations, and Miscellaneous

In response to your request for a corrected Filing Receipt, the Office is unable to comply with your request because:

- Any request to correct or update the name of the applicant must include an application data sheet (ADS) in compliance with 37 CFR 1.76 specifying the correct or updated name of the applicant in the applicant information section. Any request to change the applicant after an original applicant has been specified under 37 CFR 1.46(b) must include a new ADS in compliance with 37 CFR 1.76 specifying the applicant in the applicant information section and comply with 37 CFR 3.71 and 3.73. See 37 CFR 1.46(c).

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/mteklemichael/

Doc Code: PA..
Document Description: Power of Attorney

PTO/AIA/82A (07-13)
Approved for use through 03/31/2021. 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.

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	15/953,950
Filing Date	April 16, 2018
First Named Inventor	Li et al.
Title	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM
Art Unit	2461
Examiner Name	LEVITAN, DMITRY
Attorney Docket Number	NEO-PT012.6

SIGNATURE of Applicant or Patent Practitioner

Signature	/Christina R. Walsh/	Date (Optional)	March 11, 2020
Name	Christina R. Walsh	Registration Number	61553
Title (if Applicant is a juristic entity)			
Applicant Name (if Applicant is a juristic entity)	Neo Wireless LLC		

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 03/31/2021. 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 either the attached transmittal letter or the boxes below.

Application Number	Filing Date

(Note: The boxes above may be left blank if information is provided on form PTO/AIA/82A.)

☑ I hereby appoint the Patent 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 identified above: 03624

OR

☐ I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) 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 patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note: Complete form PTO/AIA/82C.)

Please recognize or change the correspondence address for the application identified in the attached transmittal letter or the boxes above 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 (if the Applicant is a juristic entity, list the Applicant name in the box):

Neo Wireless LLC

☐ Inventor or Joint Inventor (title not required below)

☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)

☑ Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)

☐ 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) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature	David Loo	Date (Optional)	
Name	David Loo		
Title	C.E.O., Neo Wireless LLC		

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. 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.

Electronic Acknowledgement Receipt	
EFS ID:	38830473
Application Number:	15953950
International Application Number:	
Confirmation Number:	1085
Title of Invention:	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Xiaodong Li
Customer Number:	25096
Filer:	Christina R. Walsh/Justin Slater
Filer Authorized By:	Christina R. Walsh
Attorney Docket Number:	061240-8006.US06
Receipt Date:	11-MAR-2020
Filing Date:	16-APR-2018
Time Stamp:	14:53:27
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet	NEO-PT012_6-Supplemental_ADS_EFS-20200311.PDF	823609 d1bc5541cb993568998c7f3019a9d4d8eaf1f20e	no	10

Warnings:

Information:					
This is not an USPTO supplied ADS fillable form					
2	Assignee showing of ownership per 37 CFR 3.73	NEO-PT012_6-373c_aia96_EFS-20200311.PDF	122794 5c3131203b73612b642302552b9e6010fad75ae3	no	3
Warnings:					
Information:					
3	Req to correct/update/change appl name until pay issue fee	NEO-PT012_6-RequestForChangeOfApplicant_EFS-20200311.PDF	213829 489fb9eed4aec9cb79f64d8f49ad62c59085154a	no	2
Warnings:					
Information:					
4	Power of Attorney	NEO-PT012_6-Executed_POA_ByApplicant_aia0082_EFS-20200311.PDF	353727 3d1efe7919b6a96de9fe1f8a4ac1e0f2f7610341	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	1513959		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

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.

SUPPLEMENTAL APPLICATION DATA SHEET

PTO/AIA/14 (02-18)
Approved for use through 11/30/2020. OMB 0651-0032
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 contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	~~061240-8006.US06~~ NEO-PT012.6
	Application Number	15/953,950
Title of Invention	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM	

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	Kirkland	State/Province	WA	Country of Residence	US

Mailing Address of Inventor:

Address 1	9919 129th PL NE		
Address 2			
City	Kirkland	State/Province	WA
Postal Code	98033	Country i	US

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Titus		Lo	

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

City	Bellevue	State/Province	WA	Country of Residence	US

Mailing Address of Inventor:

Address 1	13312 SE 43rd ST		
Address 2			
City	Bellevue	State/Province	WA
Postal Code	98006	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

SUPPLEMENTAL APPLICATION DATA SHEET

PTO/AIA/14 (02-18)
Approved for use through 11/30/2020. OMB 0651-0032
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 contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	~~061240-8006.US06~~ NEO-PT012.6
	Application Number	15/953,950
Title of Invention	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM	

City	Bellevue	State/Province	WA	Country of Residence	US

Mailing Address of Inventor:

Address 1	4228 144th Lane SE		
Address 2			
City	Bellevue	State/Province	WA
Postal Code	98006	Country	US

Inventor 4 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Haiming		Huang	

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

City	Bellevue	State/Province	WA	Country of Residence	US

Mailing Address of Inventor:

Address 1	605 141st CT SE #D203		
Address 2			
City	Bellevue	State/Province	WA
Postal Code	98007	Country	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	~~25096~~ 03624
Email Address	~~patentprocurement@perkinscoie.com~~ eoffice@vklaw.com Add Email Remove Email

Application Information:

Title of the Invention	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM		
Attorney Docket Number	~~061240-8006.US06~~ NEO-PT012.6 **Small Entity Status Claimed** ☒		
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	18	Suggested Figure for Publication (if any)	

PTO/AIA/14 (02-18)
Approved for use through 11/30/2020. OMB 0651-0032
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 contains a valid OMB control number.

SUPPLEMENTAL APPLICATION DATA SHEET

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	~~061240-8006.US06~~ NEO-PT012.6
	Application Number	15/953,950
Title of Invention	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM	

Filing By Reference:

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	~~25006~~ 03624		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim 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" field blank.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
15/953,950	Continuation of	14321615	2014-07-01

SUPPLEMENTAL APPLICATION DATA SHEET

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	~~061240-8006.US06~~ NEO-PT012.6
	Application Number	15/953,950
Title of Invention	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM	

Prior Application Status	Patented			Remove	
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
14321615	Continuation of	13861942	2013-04-12	8767522	2014-07-01
Prior Application Status	Patented			Remove	
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
13861942	Continuation of	13347644	2012-01-10	8428009	2013-04-23
Prior Application Status	Patented			Remove	
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
13347644	Continuation of	12975226	2010-12-21	8094611	2012-01-10
Prior Application Status	Patented			Remove	
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
12975226	Continuation of	10583229	2008-08-27	7864725	2011-01-04
Prior Application Status	Expired			Remove	
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)		
10583229	a 371 of international	PCT/US05/03518	2005-01-27		
Prior Application Status	Expired			Remove	
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)		
PCT/US05/03518	Claims benefit of provisional	60540586	2004-01-30		
Prior Application Status	Expired			Remove	
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)		
PCT/US05/03518	Claims benefit of provisional	60540032	2004-01-29		

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

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. 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(i)(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).

SUPPLEMENTAL APPLICATION DATA SHEET

PTO/AIA/14 (02-18)
Approved for use through 11/30/2020. OMB 0651-0032
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 contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	~~061240-8006.US06~~ NEO-PT012.6
	Application Number	15/953,950
Title of Invention	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM	

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

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

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.

SUPPLEMENTAL APPLICATION DATA SHEET

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

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	~~061240-8006.US06~~ NEO-PT012.6
	Application Number	15/953,950
Title of Invention	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM	

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is 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 State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

SUPPLEMENTAL APPLICATION DATA SHEET

PTO/AIA/14 (02-18)
Approved for use through 11/30/2020. OMB 0651-0032
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 contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	~~061240-8006.US06~~ NEO-PT012.6
	Application Number	15/953,950
Title of Invention	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM	

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

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	~~Neocific, Inc.~~ Neo Wireless LLC		
Mailing Address Information For Applicant:			
Address 1	~~1750 112th Ave. NE~~ 123 West Wayne Avenue, Floor 1		
Address 2	~~Suite D159~~		
City	~~Bellevue~~ Wayne	**State/Province**	~~WA~~ PA
Country US		Postal Code	~~98004~~ 19087
Phone Number		Fax Number	
Email Address			

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

Assignee Information including Non-Applicant Assignee 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.

SUPPLEMENTAL APPLICATION DATA SHEET

PTO/AIA/14 (02-18)
Approved for use through 11/30/2020. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	~~061240-8006.US06~~ NEO-PT012.6
	Application Number	
Title of Invention	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM	

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.

If the Assignee or Non-Applicant Assignee is an Organization check here. Neo Wireless LLC X

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

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1	123 West Wayne Avenue, Floor 1		
Address 2			
City	Wayne	**State/Province**	PA
Country i	US	Postal Code	19087
Phone Number		Fax Number	
Email Address			

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

Signature:

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	~~/Stephen Bishop/~~ /Christina R. Walsh/			Date (YYYY-MM-DD)	2020-03-11 ~~2018-04-16~~
First Name	~~Stephen~~ Christina R.	Last Name	~~Bishop~~ Walsh	Registration Number	~~38829~~ 61553

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

PTO/AIA/14 (02-18)

SUPPLEMENTAL APPLICATION DATA SHEET

Approved for use through 11/30/2020. OMB 0651-0032
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 contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	~~061240-8006.US06~~ NEO-PT012.6
	Application Number	
Title of Invention	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM	

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 CooperationTreaty.

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.

PTO/AIA/96 (08-12)
Approved for use through 01/31/2013. OMB 0651-0031
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.

STATEMENT UNDER 37 CFR 3.73(c)

Applicant/Patent Owner: Neo Wireless LLC

Application No./Patent No.: 15/953,950 Filed/Issue Date: April 16, 2018

Titled: CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM

Neo Wireless LLC, a corporation

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. ☑ The assignee of the entire right, title, and interest.

2. ☐ An assignee of less than the entire right, title, and interest (check applicable box):

   ☐ The extent (by percentage) of its ownership interest is _____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.

   ☐ There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. ☐ The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. ☐ The recipient, via a court proceeding or the like (*e.g.*, bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

A. ☐ An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel _____, Frame _____, or for which a copy thereof is attached.

B. ☑ A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

1. From: INVENTORS To: WALTICAL SOLUTIONS, INC.

   The document was recorded in the United States Patent and Trademark Office at
   Reel 051266, Frame 0634, or for which a copy thereof is attached.

2. From: WALTICAL SOLUTIONS, INC. To: NEOCIFIC, INC.

   The document was recorded in the United States Patent and Trademark Office at
   Reel 051266, Frame 0900, or for which a copy thereof is attached.

This collection of information is required by 37 CFR 3.73(b). 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 12 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.

PTO/AIA/96 (08-12)
Approved for use through 01/31/2013. OMB 0651-0031
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.

STATEMENT UNDER 37 CFR 3.73(c)

3. From: NEOCIFIC, INC. To: CFIP NCF LLC

The document was recorded in the United States Patent and Trademark Office at
Reel 051116, Frame 0396, or for which a copy thereof is attached.

4. From: CFIP NCF LLC To: NEO WIRELESS LLC

The document was recorded in the United States Patent and Trademark Office at
Reel 051971, Frame 0226, or for which a copy thereof is attached.

5. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

6. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at
Reel _____, Frame _____, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☑ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Christina R. Walsh/	March 11, 2020
Signature	Date
Christina R. Walsh	61553
Printed or Typed Name	Title or Registration Number

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.

Doc Code: R46C.REQ
Document Description: Request under 37 CFR 1.46(c) to correct, update or change the applicant.

PTO/AIA/41 (04-15)
Approved for use through 11/30/2020. OMB 0651-0031
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.

REQUEST TO CORRECT OR UPDATE THE NAME OF THE APPLICANT UNDER 37 CFR 1.46(c)(1), OR CHANGE THE APPLICANT UNDER 37 CFR 1.46(c)(2)
(FOR USE ONLY IN APPLICATIONS FILED ON OR AFTER SEPTEMBER 16, 2012)

Application Number	15/953,950
Filing Date	April 16, 2018
First Named Inventor	Li et al.
Art Unit	2461
Examiner Name	LEVITAN, DMITRY
Practitioner Docket Number	NEO-PT012.6

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

Applicant hereby **requests that the name of the applicant be corrected or updated under 37 CFR 1.46(c)(1), or that the applicant be changed under 37 CFR 1.46(c)(2),** in the above-identified application. **Requests under 37 CFR 1.46(c)(1) or (c)(2) cannot be submitted after payment of the issue fee or if the application has been patented.**

Please check the applicable box(es) below.

☐ 1. This request is to **correct or update the name of the applicant** (**under 37 CFR 1.46(c)(1)**) and includes:

☐ An application data sheet (ADS) in accordance with 37 CFR 1.76(c) with the corrected or updated information shown with markings (*e.g.*, underlining for insertions, strikethrough for deletions). A Corrected Web-based ADS may be used.

Note: Requests under 37 CFR 1.46(c)(1) may be filed to correct typographical errors in the name of the § 1.46 applicant, or for updating the name of the § 1.46 applicant (*i.e.*, where there is no change in the applicant itself but just in the applicant's name). See the Manual of Patent Examining Procedure (MPEP) section 605.01.

☒ 2. This request is to **change the applicant** (**under 37 CFR 1.46(c)(2)**) and includes:

☒ An application data sheet (ADS) in accordance with 37 CFR 1.76(c) that identifies the changes with proper markings (underlining for insertions and strikethrough for deletions). A Corrected Web-based ADS may be used.

☒ A Statement Under 37 CFR 3.73(c) (Form PTO/AIA/96 or equivalent). See MPEP 325.

I am the

☐ applicant* ☒ attorney or agent of record Registration number 61553 ☐ attorney or agent acting under 37 CFR 1.34 Registration number _____

Signature /Christina R. Walsh/
Typed or printed name Christina R. Walsh
Date March 11, 2020

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. *Juristic entities must be represented by a patent practitioner (See 37 CFR 1.31, applicable to any paper filed on or after September 16, 2012 that is presented on behalf of a juristic entity, regardless of application filing date). Submit multiple forms if more than one signature is required, see below**.

☐ ** Total of _____ forms are submitted.

This collection of information is required by 37 CFR 1.36. 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 12 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.

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.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/953,950	04/16/2018	Xiaodong Li	061240-8006.US06

CONFIRMATION NO. 1085

25096
PERKINS COIE LLP - SEA General
PATENT-SEA
P.O. BOX 1247
SEATTLE, WA 98111-1247

POWER OF ATTORNEY NOTICE

OC000000115457386

Date Mailed: 03/17/2020

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 03/11/2020.

- The Power of Attorney to you in this application has been revoked by the applicant. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/atesfai/

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/953,950	04/16/2018	Xiaodong Li	NEO-PT012.6

CONFIRMATION NO. 1085

3624
VOLPE AND KOENIG, P.C.
30 SOUTH 17TH STREET, 18th Floor
PHILADELPHIA, PA 19103

POA ACCEPTANCE LETTER

OC000000115457406

Date Mailed: 03/17/2020

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 03/11/2020.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/atesfai/

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
15/953,950	04/16/2018	2461	1095	NEO-PT012.6	20	2

CONFIRMATION NO. 1085

REPLACEMENT FILING RECEIPT

3624
VOLPE AND KOENIG, P.C.
30 SOUTH 17TH STREET, 18th Floor
PHILADELPHIA, PA 19103

OC000000119457450

Date Mailed: 03/17/2020

Receipt is acknowledged of this non-provisional utility 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 FIRST INVENTOR, 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 corrected Filing Receipt, including a properly marked-up ADS showing the changes with strike-through for deletions and underlining for additions. If you received a "Notice to File Missing Parts" or other Notice requiring a response for this application, please submit any request for correction 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 provided that the request is grantable.

Inventor(s)

Xiaodong Li, Kirkland, WA;
Titus Lo, Bellevue, WA;
Kemin Li, Bellevue, WA;
Haiming Huang, Bellevue, WA;

Applicant(s)

Neo Wireless LLC, Wayne, PA;

Assignment For Published Patent Application

Neo Wireless LLC, Wayne, PA

Power of Attorney: The patent practitioners associated with Customer Number 03624

Domestic Priority data as claimed by applicant

This application is a CON of 14/321,615 07/01/2014 PAT 9948488
which is a CON of 13/861,942 04/12/2013 PAT 8767522
which is a CON of 13/347,644 01/10/2012 PAT 8428009
which is a CON of 12/975,226 12/21/2010 PAT 8094611
which is a CON of 10/583,229 08/27/2008 PAT 7864725
which is a 371 of PCT/US05/03518 01/27/2005
which claims benefit of 60/540,586 01/30/2004
and claims benefit of 60/540,032 01/29/2004

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.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 05/08/2018
The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 15/953,950**
Projected Publication Date: Not Applicable
Non-Publication Request: No
Early Publication Request: No
**** SMALL ENTITY ****
Title

CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM

Preliminary Class

370

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.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

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).

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www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/953,950	04/16/2018	Xiaodong Li	NEO-PT012.6	1085

3624 7590 03/20/2020

VOLPE AND KOENIG, P.C.
30 SOUTH 17TH STREET, 18th Floor
PHILADELPHIA, PA 19103

EXAMINER	
LEVITAN, DMITRY	

ART UNIT	PAPER NUMBER
2461	

NOTIFICATION DATE	DELIVERY MODE
03/20/2020	ELECTRONIC

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.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

eoffice@volpe-koenig.com

Office Action Summary	**Application No.** 15/953,950	**Applicant(s)** Li et al.	
	Examiner DMITRY LEVITAN	**Art Unit** 2461	**AIA (FITF) 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 2/14/20.

☐ 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) 21-40 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) 21-40 is/are rejected.

8) ☐ Claim(s) _____ 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 _____ 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: _____.

Notice of Pre-AIA or AIA Status

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

2. Amendment, filed 2/14/20, has been entered. Claims 21-40 remain pending.

Double Patenting

3. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on nonstatutory double patenting provided the reference application or patent either is shown to be commonly owned with the examined application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement. See MPEP § 717.02 for applications subject to examination under the first inventor to file provisions of the AIA as explained in MPEP § 2159. See MPEP

§§ 706.02(l)(1) - 706.02(l)(3) for applications not subject to examination under the first inventor to file provisions of the AIA. A terminal disclaimer must be signed in compliance with 37 CFR 1.321(b).

The USPTO Internet website contains terminal disclaimer forms which may be used. Please visit www.uspto.gov/patent/patents-forms. The filing date of the application in which the form is filed determines what form (e.g., PTO/SB/25, PTO/SB/26, PTO/AIA/25, or PTO/AIA/26) should be used. A web-based eTerminal Disclaimer may be filled out completely online using web-screens. An eTerminal Disclaimer that meets all requirements is auto-processed and approved immediately upon submission. For more information about eTerminal Disclaimers, refer to www.uspto.gov/patents/process/file/efs/guidance/eTD-info-I.jsp.

4. Claim 21 rejected on the ground of nonstatutory double patenting as being unpatentable over claim 1 of U.S. Patent No. 9,948,488. Although the claims at issue are not identical, they are not patentably distinct from each other because both claims are directed to the same method with minor obvious modifications, as the claim 21 limitations, directed to the step of "the probing signal is configured to occupy a portion of spectrum in OFDM subcarriers not designated for transmission of uplink control signals in the system in the uplink frequency band" have similar meaning as the claim 1 limitations of the patent, directed to the step "the probing signal is configured to overlap, in the time domain, with uplink signals transmitted over uplink frequency band of the communication system, and the probing signal is configured to overlap, in the frequency domain, with the data subcarriers but to avoid the control subcarriers in the uplink frequency band of the communication system".

As the limitations, directed to the data subcarriers of the patent claim are omitted for an obvious reason to simplify the claim. Other differences are insignificant, as the claims use different but similar terms, directed to the same subject matter.

Response to Arguments

5. Applicant's arguments with respect to claims 21, 27, 33 and 40 have been considered but are moot because the arguments do not apply to any of the references being used in the current rejection.

Conclusion

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to DMITRY LEVITAN whose telephone number is (571)272-3093. The examiner can normally be reached on 8:30-4:30.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Huy Vu can be reached on 5712723155. 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 https://ppair-my.uspto.gov/pair/PrivatePair. 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.

DMITRY LEVITAN
Primary Examiner
Art Unit 2461

/DMITRY LEVITAN/
Primary Examiner, Art Unit 2461

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/953,950	Li et al.
	Examiner	**Art Unit**
	DMITRY LEVITAN	2461

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

CLAIMS

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

CLAIM		DATE								
Final	Original	05/02/2019	11/14/2019	03/16/2020						
	21	✓	✓	✓						
	22	✓	✓	✓						
	23	✓	✓	✓						
	24	✓	✓	✓						
	25	✓	✓	✓						
	26	✓	✓	✓						
	27	✓	✓	✓						
	28	✓	✓	✓						
	29	✓	✓	✓						
	30	✓	✓	✓						
	31	✓	✓	✓						
	32	✓	✓	✓						
	33	✓	✓	✓						
	34	✓	✓	✓						
	35	✓	✓	✓						
	36	✓	✓	✓						
	37	✓	✓	✓						
	38	✓	✓	✓						
	39	✓	✓	✓						
	40	✓	✓	✓						

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/953,950	Li et al.
	Examiner	Art Unit
	DMITRY LEVITAN	2461

CPC - Searched*		
Symbol	Date	Examiner
H04L 12/26	03/16/2020	DL

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner
370	241, 252, 310, 328, 330, 464, 532	03/16/2020	DL

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
IEEE, EAST	03/16/2020	DL

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

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	19	(OFDM with ((TDM or time$domain) with (combin$5 or multiplex$5 or overlap$5 or simultaneus$5 or aggreg$7))) and (align47 or synchron$5) and (interferen$5 with (OFDM near5 (TDM or time$domain)))	US-PGPUB; USPAT	OR	ON	2020/03/16 11:02
L2	7	(OFDM with ((TDM or time$domain) with (combin$5 or multiplex$5 or overlap$5 or simultaneus$5 or aggreg$7))) and ((prob$3 near4 (UL or uplink)) near5 (avoid or between or exclud$3 or designat$4))	US-PGPUB; USPAT	OR	ON	2020/03/16 11:07
L4	6	(OFDM with ((TDM or time$domain) with (combin$5 or multiplex$5 or overlap$5 or simultaneus$5 or aggreg$7))) and ((prob$3 near4 (UL or uplink)) near8 (spectrum or bandwidth or band or frequency))	US-PGPUB; USPAT	OR	ON	2020/03/16 11:10
L5	5	(OFDM with ((TDM or time$domain) with (combin$5 or multiplex$5 or overlap$5 or simultaneus$5 or aggreg$7))) and ((prob$3 near4 (control)) near8 (spectrum or bandwidth or band or frequency or subcarriers))	US-PGPUB; USPAT	OR	ON	2020/03/16 11:11

3/16/2020 11:13:10 AM
C:\Users\dlevitan\Documents\EAST\Workspaces\15953950.wsp

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.: 15/953,950

Filed: April 16, 2018 FILE: NEO-PT012.6

DATE: March 30, 2020

DECLARATION OF LARGE ENTITY STATUS
PURSUANT TO 37 C.F.R. §1.27 (c)(1)

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

Sir:

The above-identified patent is no longer entitled to small entity status and should be considered a large entity for all further payments.

Respectfully submitted,

NEO WIRELESS LLC

By /John C. Donch Jr./
John C. Donch Jr., Esquire
Registration No. 43,593
(215) 568-6400

Volpe and Koenig, P.C.
United Plaza
30 South 17th Street
Philadelphia, PA 19103-4009

JCD/dt

5670574-1

Electronic Acknowledgement Receipt	
EFS ID:	39010814
Application Number:	15953950
International Application Number:	
Confirmation Number:	1085
Title of Invention:	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Xiaodong Li
Customer Number:	3624
Filer:	John C. Donch/Diane Thatcher
Filer Authorized By:	John C. Donch
Attorney Docket Number:	NEO-PT012.6
Receipt Date:	30-MAR-2020
Filing Date:	16-APR-2018
Time Stamp:	17:07:41
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Notification of loss of entitlement to small entity status	NEO_PT012.pdf	47794 30fa6b71efd7a9cfb080cc88b9641683bd86ad89	no	1

Warnings:

Information:	
Total Files Size (in bytes):	47794

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
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.

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
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.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 15/953,950	Filing Date 04/16/2018	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $460 =	
☐ 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).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	06/22/2020	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 20	Minus	** 20	= 0		x $100 =	0
	Independent (37 CFR 1.16(h))	* 4	Minus	*** 4	= 0		x $460 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/SHERRY A DAVIS/
*** 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 number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. 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 12 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.**

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PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 15/953,950	Filing Date 04/16/2018	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $460 =	
☐ 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).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	06/22/2020	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 36	Minus	** 20	= 16		x $100 =	1600
	Independent (37 CFR 1.16(h))	* 5	Minus	*** 4	= 1		x $460 =	460
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	2060

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/SHERRY A DAVIS/
*** 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 number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. 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 12 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.**

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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the **PATENT APPLICATION** of:	
Neo Wireless LLC	
Application No.: 15/953,950	
Confirmation No.: 1085	
Filed: April 16, 2018	
For: CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM	
Group: 2461	
Examiner: LEVITAN, DMITRY	

Our File: NEO-PT012.6

Date: June 22, 2020

RESPONSE PURSUANT TO 37 C.F.R. §1.111

Mail Stop Amendment (via EFS)
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

This Response and Terminal Disclaimer are being timely filed in response to the Non-Final Office Action dated March 20, 2020.

Please amend the application without prejudice or disclaimer as follows:

6331883-1

Amendments to the Claims:

This listing of the claims will replace all prior versions of the claims in the application:

1-20. (Canceled)

21. (Currently Amended) A communication method for a mobile device in an Orthogonal Frequency Division Multiplexing (OFDM) communication system, the method comprising:

receiving a request for a ~~an uplink~~ probing signal from a base station in the system; and

transmitting, in response to the received request, the probing signal with a code sequence modulated in the frequency domain, wherein:

the probing signal is configured to overlap, in the time domain, with uplink signals transmitted over an uplink frequency band by other mobile devices in the system; and

the probing signal is configured to occupy a portion of spectrum in the uplink frequency band ~~in OFDM subcarriers~~ not designated for transmission of uplink control signals in the system ~~in the uplink frequency band~~.

22. (Currently Amended) The method of claim 21, wherein the probing signal ~~enables~~ provides information for the base station to estimate a channel profile in the frequency domain.

23. (Currently Amended) The method of claim [[22]] 21, wherein the probing signal provides information for ~~channel profile is used by~~ the base station to determine a transmission format for a subsequent transmission ~~over the channel~~.

24. (Previously Presented) The method of claim 23, wherein the transmission format comprises a modulation/coding or pilot pattern.

25. (Currently Amended) The method of claim 22, wherein the mobile device receives ~~channel profile is used for beamforming in~~ a subsequent transmission [[by]]

from the base station that has been beamformed using the estimated channel profile.

26. (Currently Amended) The method of claim 21, wherein the portion of spectrum is available for transmission of uplink data signals by other mobile devices in the system during a time period when the portion of the spectrum is not occupied by the probing signal.

27. (Currently Amended) A communication method for a base station in an Orthogonal Frequency Division Multiplexing (OFDM) communication system, the method comprising:

transmitting a request for a ~~an uplink~~ probing signal to a mobile device in the system; and

receiving the probing signal from the mobile device, wherein:

the probing signal contains a code sequence modulated in the frequency domain;

the probing signal overlaps, in the time domain, with uplink signals transmitted over an uplink frequency band by other mobile devices in the system; and

the probing signal occupies a portion of spectrum in the uplink frequency band ~~in OFDM subcarriers~~ not designated for transmission of uplink control signals in the system ~~in the uplink frequency band~~.

28. (Previously Presented) The method of claim 27, further comprising estimating, based on the received probing signal, a channel profile in the frequency domain.

29. (Previously Presented) The method of claim 28, further comprising using the channel profile to determine a transmission format for a subsequent transmission over the channel.

30. (Previously Presented) The method of claim 29, wherein the transmission format comprises a modulation/coding or pilot pattern.

31. (Currently Amended) The method of claim 28, further comprising using the channel profile for beamforming in a subsequent transmission to the mobile device.

32. (Currently Amended) The method of claim 27, wherein the portion of spectrum is available for transmission of uplink data signals by other mobile devices in the system during a time period when the portion of the spectrum is not occupied by the probing signal.

33. (Currently Amended) A communication method for an Orthogonal Frequency Division Multiplexing (OFDM) communication system, the method comprising:

sending a request for a ~~an uplink~~ probing signal to a mobile device from a base station in the system; and

responding by the mobile device to the request by transmitting the probing signal with a code sequence modulated in the frequency domain, wherein:

the probing signal is configured to overlap, in the time domain, with uplink signals transmitted over an uplink frequency band by other mobile devices in the system; and

the probing signal is configured to occupy a portion of spectrum in the uplink frequency band ~~in OFDM subcarriers~~ not designated for transmission of uplink control signals in the system ~~in the uplink frequency band~~.

34. (Previously Presented) The method of claim 33, wherein transmission power of the probing signal is under power control.

35. (Previously Presented) The method of claim 33, wherein the probing signal enables the base station to estimate a channel profile in the frequency domain.

36. (Currently Amended) The method of claim 35, wherein the channel profile is used by the base station to determine a transmission format for a subsequent transmission ~~over the channel~~.

37. (Previously Presented) The method of claim 36, wherein the transmission format comprises a modulation/coding or pilot pattern.

38. (Currently Amended) The method of claim 35, wherein the channel profile is used for beamforming in a subsequent transmission by the base station to the mobile device.

39. (Currently Amended) The method of claim 33, wherein the portion of spectrum is available for transmission of uplink data signals by other mobile devices in the system during a time period when the portion of the spectrum is not occupied by the probing signal.

40. (Currently Amended) A mobile device in an Orthogonal Frequency Division Multiplexing (OFDM) communication system, the mobile device comprising:

a receiver configured to receive a request for a ~~an uplink~~ probing signal from a base station in the system;

a transmitter configured to form and transmit, in response to the received request, the probing signal with a code sequence modulated in the frequency domain, wherein:

the probing signal is configured to overlap, in the time domain, with uplink signals transmitted over an uplink frequency band by other mobile devices in the system; and

the probing signal is configured to occupy a portion of spectrum in the uplink frequency band ~~in OFDM subcarriers~~ not designated for transmission of uplink control signals in the system ~~in the uplink frequency band~~.

41. (New) The mobile device of claim 40, wherein the probing signal provides information for the base station to estimate a channel profile in the frequency domain.

42. (New) The mobile device of claim 40, wherein the probing signal provides information for the base station to determine a transmission format for a subsequent transmission.

43. (New) The mobile device of claim 42, wherein the transmission format comprises a modulation/coding or pilot pattern.

44. (New) The mobile device of claim 41, wherein the mobile device is configured to receive a subsequent transmission from the base station that has been beamformed using the estimated channel profile.

45. (New) The mobile device of claim 40, wherein the portion of spectrum is available for transmission of uplink data signals by other mobile devices in the system during a time period when the portion of the spectrum is not occupied by the probing signal.

46. (New) The mobile device of claim 40, wherein the portion of spectrum is within a center portion of the uplink frequency band and subcarriers for the transmission of uplink control signals are within an outer portion of the uplink frequency band.

47. (New) The method of claim 21, wherein the portion of spectrum is within a center portion of the uplink frequency band and subcarriers for the transmission of uplink control signals are within an outer portion of the uplink frequency band.

48. (New) The method of claim 27, wherein the portion of spectrum is within a center portion of the uplink frequency band and subcarriers for the transmission of uplink control signals are within an outer portion of the uplink frequency band.

49. (New) The method of claim 33, wherein the portion of spectrum is within a center portion of the uplink frequency band and subcarriers for the transmission of uplink control signals are within an outer portion of the uplink frequency band.

50. (New) A base station in an Orthogonal Frequency Division Multiplexing (OFDM) communication system, the base station comprising:

a transmitter configured to transmit a request for a probing signal to a mobile device in the system; and

a receiver configured to receive the probing signal from the mobile device, wherein:

the probing signal contains a code sequence modulated in the frequency domain;

the probing signal overlaps, in the time domain, with uplink signals transmitted over an uplink frequency band by other mobile devices in the system; and

the probing signal occupies a portion of spectrum in the uplink frequency band not designated for transmission of uplink control signals in the system.

51. (New) The base station of claim 50, wherein the receiver is further configured to estimate, based on the received probing signal, a channel profile in the frequency domain.

52. (New) The base station of claim 51, further comprising using the channel profile to determine a transmission format for a subsequent transmission over the channel.

53. (New) The base station of claim 52, wherein the transmission format comprises a modulation/coding or pilot pattern.

54. (New) The base station of claim 51, further comprising using the channel profile for beamforming in a subsequent transmission to the mobile device.

55. (New) The base station of claim 50, wherein the portion of spectrum is available for transmission of uplink data signals by other mobile devices in the system during a time period when the portion of the spectrum is not occupied by the probing signal.

56. (New) The base station of claim 50, wherein the portion of spectrum is within a center portion of the uplink frequency band and subcarriers for the

transmission of uplink control signals are within an outer portion of the uplink frequency band.

REMARKS/ARGUMENTS

After the foregoing Amendment, claims 21-56 are currently pending in this application. Claims 1-20 are previously canceled. Claims 21-23, 25-27, 31-33, 36, and 38-40 are amended. Claims 41-56 are added. No new subject matter has been added by way of this Amendment.

Request for an Interview

If any of the claims submitted herewith will be rejected by the Examiner, the Applicant respectfully requests a telephonic interview.

Double Patenting Rejection

Claim 21 is rejected under the judicially created doctrine of nonstatutory double patenting as being unpatentable over claim 1 of U.S. Patent No. 9,948,488. A Terminal Disclaimer is submitted herewith to overcome the nonstatutory double patenting rejection. Accordingly, withdrawal of the nonstatutory double patenting rejection is respectfully requested.

Conclusion

If the Examiner believes that any additional minor formal matters need to be addressed in order to place this application in condition for allowance, or that a telephonic interview will help to materially advance the prosecution of this

application, the Examiner is invited to contact the undersigned by telephone at the Examiner's convenience.

In view of the foregoing, Applicant respectfully submits that the present application is in condition for allowance and a notice to that effect is respectfully requested.

Respectfully submitted,

Neo Wireless LLC

By /Christina R. Walsh/
Christina R. Walsh
Registration No. 61,553

Volpe and Koenig, P.C.
30 South 17th Street
Philadelphia, PA 19103-4009
Telephone: (215) 568-6400
Facsimile: (215) 568-6499

CRW/jrrs
Enclosure

Electronic Patent Application Fee Transmittal

Application Number:	15953950
Filing Date:	16-Apr-2018
Title of Invention:	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Xiaodong Li
Filer:	Christina R. Walsh/Justin Slater
Attorney Docket Number:	NEO-PT012.6

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
CLAIMS IN EXCESS OF 20	1202	16	100	1600
INDEPENDENT CLAIMS IN EXCESS OF 3	1201	1	460	460
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
STATUTORY OR TERMINAL DISCLAIMER	1814	1	160	160
		Total in USD ($)		**2220**

Electronic Acknowledgement Receipt	
EFS ID:	39788433
Application Number:	15953950
International Application Number:	
Confirmation Number:	1085
Title of Invention:	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Xiaodong Li
Customer Number:	3624
Filer:	Christina R. Walsh/Justin Slater
Filer Authorized By:	Christina R. Walsh
Attorney Docket Number:	NEO-PT012.6
Receipt Date:	22-JUN-2020
Filing Date:	16-APR-2018
Time Stamp:	16:06:57
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$2220
RAM confirmation Number	E20206LG07289210
Deposit Account	220493
Authorized User	Justin Slater
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.21 (Miscellaneous fees and charges) 37 CFR 1.19 (Document supply fees)	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		NEO-PT012_6-Reply_EFS-20200622.PDF	123780 4d8407cc9f158a186b7f3084fa8890ef15e75577	yes	10

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Amendment/Req. Reconsideration-After Non-Final Reject	1	1
	Amendment Copy Claims/Response to Suggested Claims	2	8
	Applicant Arguments/Remarks Made in an Amendment	9	10

Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	33690 a100206aef2b1861fcd45296ea821f7ad6b13c4f	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	157470		

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If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

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.

Doc Code: DIST.E.FILE **Document Description: Electronic Terminal Disclaimer - Filed**	PTO/SB/26 U.S. Patent and Trademark Office Department of Commerce

Electronic Petition Request	**TERMINAL DISCLAIMER TO OBVIATE A DOUBLE PATENTING REJECTION OVER A "PRIOR" PATENT**
Application Number	15953950
Filing Date	16-Apr-2018
First Named Inventor	Xiaodong Li
Attorney Docket Number	NEO-PT012.6
Title of Invention	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM

☒ Filing of terminal disclaimer does not obviate requirement for response under 37 CFR 1.111 to outstanding Office Action

☒ This electronic Terminal Disclaimer is not being used for a Joint Research Agreement.

Owner	Percent Interest
Neo Wireless LLC	100%

The owner(s) with percent interest listed above in the instant application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the instant application which would extend beyond the expiration date of the full statutory term of prior patent number(s)

9948488

as the term of said prior patent is presently shortened by any terminal disclaimer. The owner hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and the prior patent are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns.

In making the above disclaimer, the owner does not disclaim the terminal part of the term of any patent granted on the instant application that would extend to the expiration date of the full statutory term of the prior patent, "as the term of said prior patent is presently shortened by any terminal disclaimer," in the event that said prior patent later:
- expires for failure to pay a maintenance fee;
- is held unenforceable;
- is found invalid by a court of competent jurisdiction;
- is statutorily disclaimed in whole or terminally disclaimed under 37 CFR 1.321;
- has all claims canceled by a reexamination certificate;
- is reissued; or
- is in any manner terminated prior to the expiration of its full statutory term as presently shortened by any terminal disclaimer.

◯ Terminal disclaimer fee under 37 CFR 1.20(d) is included with Electronic Terminal Disclaimer request.

◉ I certify, in accordance with 37 CFR 1.4(d)(4), that the terminal disclaimer fee under 37 CFR 1.20(d) required for this terminal disclaimer has already been paid in the above-identified application.	
THIS PORTION MUST BE COMPLETED BY THE SIGNATORY OR SIGNATORIES I certify, in accordance with 37 CFR 1.4(d)(4) that I am: ◉ An attorney or agent registered to practice before the Patent and Trademark Office who is of record in this application Registration Number 61553 ◯ A sole inventor ◯ A joint inventor; I certify that I am authorized to sign this submission on behalf of all of the inventors as evidenced by the power of attorney in the application ◯ A joint inventor; all of whom are signing this request	
Signature	/Christina R. Walsh/
Name	Christina R. Walsh

*Statement under 37 CFR 3.73(b) is required if terminal disclaimer is signed by the assignee (owner).
Form PTO/SB/96 may be used for making this certification. See MPEP § 324.

Doc Code: DISQ.E.FILE
Document Description: Electronic Terminal Disclaimer – Approved

Application No.: 15953950

Filing Date: 16-Apr-2018

Applicant/Patent under Reexamination: Li

Electronic Terminal Disclaimer filed on June 22, 2020

☒ APPROVED

This patent is subject to a terminal disclaimer

☐ DISAPPROVED

Approved/Disapproved by: Electronic Terminal Disclaimer automatically approved by EFS-Web

U.S. Patent and Trademark Office

Electronic Acknowledgement Receipt

EFS ID:	39788502
Application Number:	15953950
International Application Number:	
Confirmation Number:	1085
Title of Invention:	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Xiaodong Li
Customer Number:	3624
Filer:	Christina R. Walsh/Justin Slater
Filer Authorized By:	Christina R. Walsh
Attorney Docket Number:	NEO-PT012.6
Receipt Date:	22-JUN-2020
Filing Date:	16-APR-2018
Time Stamp:	16:08:37
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Terminal Disclaimer-Filed (Electronic)	eTerminal-Disclaimer.pdf	32106 43b916b55e020c45c42235ca732f32a75cb159c1	no	2

Warnings:

Information:	
Total Files Size (in bytes):	32106

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New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
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If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
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.

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	15953950
Filing Date	2018-04-16
First Named Inventor	Li et al.
Art Unit	2461
Examiner Name	Dmitry Levitan
Attorney Docket Number	NEO-PT012.6

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	6771706	B2	2004-08-03	Ling et al.	* Corresponds to KR 2003-0085040
	2	7274652	B1	2007-09-25	Webster et al.	* Corresponds to CN 1432245

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20020159422	A1	2002-10-31	Li et al.	
	2	20030072255	A1	2003-04-17	Ma et al.	
	3	20030179776	A1	2003-09-25	Sumasu et al.	* Corresponds to CN 1465150
	4	20040085946	A1	2004-05-06	Morita et al.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	15953950
	Filing Date	2018-04-16
	First Named Inventor	Li et al.
	Art Unit	2461
	Examiner Name	Dmitry Levitan
	Attorney Docket Number	NEO-PT012.6

	5	20040171357	A1	2004-09-02	Lobinger et al.	
	6	20040264600	A1	2004-12-30	Kao et al.	
	7	20060114815	A1	2006-06-01	Hasegawa et al.	
	8	20060245409	A1	2006-11-02	Korpela et al.	
	9	20080304551	A1	2008-12-11	Li et al.	
	10	20110211617	A1	2011-09-01	Li et al.	
	11	20110299474	A1	2011-12-08	Li et al.	
	12	20120106513	A1	2012-05-03	Li et al.	

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FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	1407745	CN	A	2003-04-02	XI AN ELECTRONIC SCIENCE AND TEC		

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	15953950
	Filing Date	2018-04-16
	First Named Inventor	Li et al.
	Art Unit	2461
	Examiner Name	Dmitry Levitan
	Attorney Docket Number	NEO-PT012.6

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	3	2003058881	WO	A2	2003-07-17	NXP SEMICONDUCTORS NV	* Corresponds to WO 2003/058887	

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	EUROPEAN TELECOMMUNICATIONS STANDARDS INSTITUTE, Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for digital terrestrial television, ETSI EN 300 744 V1.5.1 (June 2004).	
	2	IEEE Standard for Local and metropolitan area networks; Part 16: Air Interface for Fixed Broadband Wireless Access Systems — Amendment 2: Medium Access Control Modifications and Additional Physical Layer Specifications for 2–11 GHz, IEEE Std. 802.16a-2003 (April 1, 2003).	

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That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

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☒ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

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A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Christina R. Walsh/	Date (YYYY-MM-DD)	2020-06-23
Name/Print	Christina R. Walsh	Registration Number	61,553

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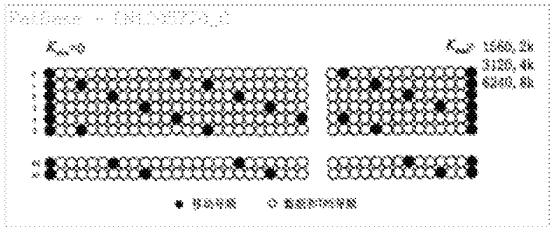
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1) Family number: 28418857 (CN1205770C) © PatBase

Title: Orthogonal frequency division multiplex transmission system for digital ground broadcasting



Abstract: Signal transmission for digital surface broadcasting COFDM transmission system has a baseband digital modifying signal with 10MHz sampling rate, a frame of 64 OFDM signals, each OFDM consisting of multiple carrier signals with Ts duration, which includes several sub-carrier for data signals, shift pilot frequency continuous pilot frequency and TPS pilot frequency in an order. The reference signals for shift and continuous pilot frequencies are generated by a pseudo random binary sequence. They are also used to perform ZDPSK modification ignition of the TPS pilot frequency sub-carrier. The TPSblock consists of 1 bit for ignition, 16 bits for synchronization, 34 data bits and 13 bits for error protection.

Classifications:

International (IPC 8-9): H04H20/65 H04J11/00 (Advanced/Invention)

International (IPC 1-7): H04H1/00 H04J11/00

Family:

Publication number	Publication date	Application number	Application date
CN1205770 C	20050608	CN20011030988	20010829
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Probable Assignee: XI AN ELECTRONIC SCIENCE AND TEC

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Assignee(s): XI AN ELECTRONIC SCIENCE AND TECHNOLOGY UNIV

Inventor(s): (std): GE JIANHUA ; LI BINGBING ; ZHANG WENJUN ; BINGBING LI ; WENJUN ZHANG ; JIANHUA GE

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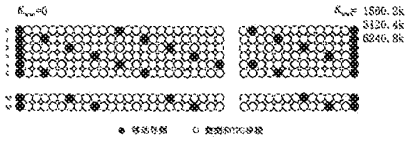
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代理人 李 直
权利要求书 2 页 说明书 9 页 附图 2 页

[54] 发明名称 数字地面广播 COFDM 传输系统中的信号传输方法

[57] 摘要

本发明公开了一种数字地面广播 COFDM 传输系统中的信号传输方法。基带数字调制信号采样率为 10MHz，一帧 OFDM 信号由 64 个 OFDM 符号组成，每个 OFDM 符号由持续期为 Ts 的多个载波信号组成，其中包括若干个数据信号子载波、移动导频子载波、连续导频子载波和 TPS 导频子载波，各类载波有规律地排列。连续导频和移动导频子载波基准信号由一个伪随机二进制序列获得，该序列也用于对 TPS 导频子载波进行 2DPSK 调制初始化。每个 TPS 块的 64 个比特包括 1 个初始化比特、16 个同步比特、34 个信息比特和 13 个用于误码保护的冗余比特。本发明设计的信号传输方法显著提高了 COFDM 传输系统的性能，同时使得接收机可以更简单地实现。



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1．一种适于数字地面广播的编码正交频分复用传输系统，其特征在于：基带数字调制信号采样率为 10MHz，OFDM 信号占用信号带宽为 7.62MHz；

一帧 OFDM 信号由 64 个 OFDM 符号组成，每个 OFDM 符号由持续期为 Ts 的 M 个载波信号组成，其中包括 N_1 个数据信号子载波、N_2 个移动导频子载波、N_3 个连续导频子载波和 N_4 个 TPS 导频子载波；

符号持续期 Ts 包括持续期为 Tu 的有用部分和持续期为 ΔT 的保护间隔部分，保护间隔插在有用部分之前；

对于第 i 个 OFDM 符号，移动导频子载波位置集合 S_i 为：

$S_i = \{k = K_{\min} + 3 \times (i \bmod 4) + 12p \mid p > 0$整数，$k \in [K_{\min}, K_{\max}]\}$，式中 $K_{\min}$=0；

连续导频子载波的位置关于中心频率位置对称，OFDM 传输信号帧中 64 个 OFDM 符号的连续导频子载波位置和值相同；

连续导频和移动导频子载波基准信号由一个伪随机二进制序列获得，该伪随机二进制序列也用于对 TPS 导频子载波进行 2DPSK 调制初始化；

每个 OFDM 符号传送一个 TPS 比特，同一符号中的每个 TPS 载波传送相同的差分编码的信息比特，对应于一个 OFDM 帧，每个 TPS 块由 64 个比特组成，包括 1 个初始化比特、16 个同步比特、34 个信息比特和 13 个用于误码保护的冗余比特；

2．根据权利要求 1 所述的编码正交频分复用传输系统，其特征在于：在 2K 工作模式下，每个 OFDM 符号的载波信号数 M 等于 1561，数据信号子载波数 N_1 等于 1392，移动导频子载波数 N_2 等于 130，连续导频子载波数 N_3 等于 41，TPS 导频子载波数 N_4 等于 8；Tu 为 204.8 微秒；$K_{\max}$ 等于 1560。

3．根据权利要求 1 所述的编码正交频分复用传输系统，其特征在于：在 4K 工作模式下，每个 OFDM 符号的载波信号数 M 等于 3121，数据信号子载波数 N_1 等于 2784，移动导频子载波数 N_2 等于 260，连续导频子载波数 N_3 等

于 81，TPS 导频子载波数 N_4 等于 16；Tu 为 409.6 微秒；K_{max} 等于 3120。

4．根据权利要求 1 所述的编码正交频分复用传输系统，其特征在于：在 8K 工作模式下，每个 OFDM 符号的载波信号数 M 等于 6241，数据信号子载波数 N_1 等于 5568，移动导频子载波数 N_2 等于 520，连续导频子载波数 N_3 等于 161，TPS 导频子载波数 N_4 等于 32；Tu 为 819.2 微秒；K_{max} 等于 6240。

5．根据权利要求 1 至 4 中任意一项所述的编码正交频分复用传输系统，其特征在于：所有的数据单元的调制经归一化，使 E(C C*)=1；连续、移动和 TPS 导频均在提升的功率上发射，使 E(CC*)=16/9。

6．根据权利要求 1 至 4 中任意一项所述的编码正交频分复用传输系统，其特征在于：伪随机二进制序列发生器用的连接多项式为：$x^{13}+x^4+x^3+x+1$，预置 11111111111，使该伪随机二进制序列的第一输出比特与第一个有效载波重合，在每个使用的载波上由该序列产生一个新的数值。

7．根据权利要求 1 至 4 中任意一项所述的编码正交频分复用传输系统，其特征在于：TPS 中的第 2~17 比特是一个同步字，每帧依次取 0011010111101110 和 1100101000010001。

8．根据权利要求 1 至 4 中任意一项所述的编码正交频分复用传输系统，其特征在于：TPS 误码保护采用（63，50，t=3）本原 BCH 码，码生成多项式为：$g(x)= x^{13}+x^{12}+x^{11}+x^{10}+ x^9+x^8+x^6+x^3+x+1$。

一种适于数字地面广播的编码正交频分复用传输系统

本发明属于信号传输领域，特别涉及采用正交频分复用调制模式（OFDM）的数字地面广播系统中的信号传输方法。

典型的数字地面广播传输系统包括发射机和接收机。数字调制技术往往对数字信号进行信道编码后进行调制，再加入必要的辅助信息如导频信号，然后经过信道频谱形成滤波成为基带数字调制信号。该数字信号经过数模转换器、上变频器被调制到相应的频带发送。在接收端，下变频器将射频信号变为基带信号，再经过模数转换器以得到数字信号。该数字信号经数字解调、信道解码后被恢复成与发端一致的信息。图 1 给出了典型的数字地面广播传输系统框图。

数字地面广播 COFDM 传输系统的数字编码调制单元对输入数据进行一系列的数字处理。它包括数据随机化、外编码（通常为 Reed-Solomon 码）、外交织（通常为卷积交织）、内编码（通常为卷积或网格码）、内交织（通常为时间和频率二维交织）、映射、加入导频信号、系统信息、正交频分复用（通常用 IFFT 实现）、加保护间隔（通常为循环扩展）、成形滤波等。其处理模块流程见图 2。

在数字地面广播 COFDM 传输系统中，传输信号除数据信号之外，还包括用于信道估计、同步捕获和跟踪的移动导频信号和连续导频信号，以及用于传递业务类型系统信息的传输信令（TPS）导频信号。各导频子载波在数据子载波中的比例以及位置安排，对 COFDM 传输系统的性能有重要影响。

本发明的目的是为数字地面广播 COFDM 传输系统提供一种信号传输方法，该方法通过合理地安排数据子载波与各导频子载波的结构以提高 COFDM 传输系统的性能，同时可降低接收机的复杂度。

本发明设计的信号传输方法是这样的：在数字地面广播 COFDM 传输系

统中，基带数字调制信号采样率为 10MHz，OFDM 信号占用信号带宽为 7.62MHz。OFDM 传输信号由帧组成，一帧 OFDM 信号由 64 个 OFDM 符号组成。每个 OFDM 符号由持续期为 Ts 的多个载波信号组成。符号持续期 Ts 包括持续期为 Tu 的有用部分和持续期为△T 的保护间隔部分。每个 OFDM 符号由多个子载波信号组成。在 2K 工作模式中，子载波数为 1561；在 4K 工作模式，子载波数为 3121；在 8K 工作模式，子载波数为 6241。每个 OFDM 符号除载有数据的子载波信号外，还含有用于信道估计、同步捕获和跟踪的移动导频和连续导频，以及用于传递业务类型系统信息的 TPS 导频。对于 2K 工作模式，数据信号子载波数目为 1392，移动导频子载波数目为 130 个，连续导频子载波数为 41 个，TPS 导频子载波数为 8 个。对于 4K 工作模式，数据子载波数为 2784，移动导频子载波数为 260，连续导频子载波数为 81，TPS 导频子载波数为 16。对于 8K 工作模式，数据子载波数为 5568，移动导频子载波数为 520，连续导频子载波数为 161，TPS 导频子载波数为 32。

数据子载波采用多电平正交振幅(MQAM)调制或相移键控(MPSK)调制，连续导频和移动导频子载波采用二进制相移键控(BPSK)调制，TPS 导频子载波采用二进制差分相移键控(2DPSK)调制。

连续导频和移动导频子载波基准信号由一个伪随机二进制序列获得。伪随机二进制序列也用于对传输信令导频子载波进行 2DPSK 调制初始化。

所有的数据单元的调制经归一化，使 E(C C*)=1。所有导频（连续、移动和 TPS）在提升的功率上发射，使 E(CC*)=16/9。

传输参数信令（TPS）定义在一个 OFDM 信号帧的连续 64 个 OFDM 符号上。每个 OFDM 符号传送一个 TPS 比特。每个 TPS 块（对应于一个 OFDM 帧）由 64 个比特组成，包括：1 个初始化比特、16 个同步比特、34 个信息比特和 13 个用于误码保护的冗余比特。对于 34 个信息比特，可以只使用其中的一部分，而将其余部分作为备用。每个 OFDM 帧第一个符号的 TPS 载波位

置相对应的参考符号序列应用于该位置 TPS 导频载波信号的 DBPSK 调制初始化。

本发明设计的信号传输方法具有以下诸多有益效果：OFDM 信号占用信号带宽为 7.62MHz，采样率为 10MHz 有利于频域滤波与频谱成形；OFDM 帧信号由 64 个 OFDM 符号组成，采用（63，50）本原 BCH 码用于传输信令导频信号误码保护，更适宜差分二相调制；连续导频相对与中心对称配置，可简化接收机实现；传输信令参数含有多种信息，可灵活实现混合、单一、分层工作模式，用于移动接收和固定接收业务；各导频功率均大于信号功率 3dB，可实现多种同步及信道估计功能；基准信号由一个 13 阶伪随机序列发生器产生，对 2K、4K、8K 模式不会出现周期性重复。

以下结合附图进一步描述本发明的实施例。

图 1 为典型的数字地面广播传输系统框图。

图 2 为数字地面广播 COFDM 传输系统数字编码调制功能模块流程图。

图 3 为 PRBS 序列发生器。

图 4 为 OFDM 传输信号的帧结构示意图。

在数字地面广播 COFDM 传输系统中，基带数字调制信号采样率为 10MHz，OFDM 信号占用信号带宽为 7.62MHz。OFDM 传输信号由帧组成，每个帧信号包含 64 个 OFDM 符号。每个 OFDM 符号由持续期为 Ts 的多个载波信号组成。符号持续期 Ts 包括持续期为 Tu 的有用部分和持续期为。T 的保护间隔部分。保护间隔插在有用部分之前，它有多个值可以选取，如可选取 Tu/4、Tu/8、Tu/16、Tu/32，但不限于此几种值。8K 工作模式 Tu 为 819.2 微秒，4K 工作模式 Tu 为 409.6 微秒，2K 工作模式 Tu 为 204.8 微秒。每个 OFDM 符号除载有数据的子载波信号外，还含有用于信道估计、同步捕获和跟踪的移动导频和连续导频，以及用于系统传输业务类型（如单一、混合和分层调制）信息的 TPS 导频。数据子载波信号采用多电平振幅调制(MQAM)或相移

键控(MPSK)调制，连续导频和移动导频子载波信号采用二进制相移键控（BPSK）调制，TPS 导频子载波信号采用二进制相移键控(2DPSK)调制。

连续导频和移动导频子载波基准信号由一个伪随机二进制序列获得。伪随机二进制序列按照图 3 产生，产生该伪随机二进制序列的发生器用的连接多项式为：$x^{13}+x^4+x^3+x+1$。将其初始化为 11111111111，使该伪随机二进制序列的第一输出比特与第一个有效载波重合。在每个使用的载波上（无论是否导频）由该序列产生一个新的数值。该伪随机二进制序列也用于对传输信令导频子载波进行 2DPSK 调制初始化。

将构成一帧的 64 个 OFDM 符号依次规定为第 0 个、第 1 个、…、第 63 个 OFDM 符号。这 64 个 OFDM 符号的移动导频子载波的位置有所不同，其分布与符号指数 i（0~63）有关。第 i 个 OFDM 符号，移动导频子载波位置集合 S_i 为：

$S_i = \left(k = K_{\min} + 3\times(i \bmod 4) + 12p \middle| p>0\text{整数},\ k \in [K_{\min}, K_{\max}]\right)$，其中，$K_{\min}$=0，对于 2K 工作模式，$K_{\max}$=1560；对于 4K 工作模式，$K_{\max}$=3120；对于 8K 工作模式，$K_{\max}$=6240。

移动导频子载波位置如图 4 所示。由伪随机二进制序列获得的参考信息在每个符号内散布的移动导频单元中传输。移动的导频单元总在“提升后”的功率电平上发射，相应的调制为：

$$\mathrm{Re}(C_{m,k})=4/3(1-2w_k)$$

$$\mathrm{Im}(C_{m,k})=0$$

式中，m 为符号时间指示，k 为载波频率指示。

连续导频子载波的数目随系统工作模式而变化。在 2K 工作模式，连续导频子载波数为 41 个；在 4K 工作模式，连续导频子载波数为 81 个；而在 8K 工作模式，连续导频子载波数为 161 个。OFDM 传输信号帧中 64 个 OFDM 符号的连续导频子载波位置和值相同。连续导频子载波的位置关于中心频率位置对称（相对于中心位置之和为 0）。表 1、2、3 给出一种关于中心频率位

置对称的连续导频子载波位置集。

表 1 2K 工作模式连续导频子载波位置集

0，15，69，162，177，216，270，351，375，414，429，480，516，537，594，603，639，666，741，768，780，792，831，852，882，921,966，1023，1050，1095，1146，1185，1200，1209，1278，1344，1383，1437，1479，1545，1560

表 2 4K 工作模式连续导频子载波位置集

0，15，69，162，177，216，270，351，375，414，429，480，516，537， 594，603，639，666，741，768，780，792，831，852，882，921,966，1023，1050，1095，1146，1185，1200，1209，1278，1344，1383，1437，1479，1545，1560，1575，1629，1722，1737，1776，1830，1911，1935，1974，1989，2040，2076，2097，2154，2163，2199，2226，2301，2328，2340，2352，2391，2412，2442，2481，2526，2583，2610，2655，2706，2745，2760，2769，2838，2904，2943，2997，3039，3105，3120

表 3 8K 工作模式连续导频子载波位置集

0，15，69，162，177，216，270，351，375，414，429，480，516，537，594，603，639，666，741，768，780，792，831，852，882，921,966，1023，1050，1095，1146，1185，1200，1209，1278，1344，1383，1437，1479，1545，1560，1575，1629，1722，1737，1776，1830，1911，1935，1974，1989，2040，2076，2097，2154，2163，2199，2226，2301，2328，2340，2352，2391，2412，2442，2481，2526，2583，2610，2655，2706，2745，2760，2769，2838，2904，2943，2997，3039，3105，3120，3135，3189，3282 ，3297，3336，3390，3471，3495，3534，3549，3600，3636，3657 3714，3723，3759，3786，3861，3888，3900，3912，3951，3972，4002，4041，4086，4143，4170，4215，4266，4305，4320，4329，4398，4464，4503，4557，4599，4665，4680，4695，4749，4842，

4857，4896，4950，5031，5055，5094，5109，5160，5196，5217，5274，5283，5319，5346，5421，5448，5460，5472，5511，5532，5562，5601，5646， 5703，5730，5775，5826，5865，5880，5889 ，5958，6024，6063，6117，6159，6225，6240

所有连续导频按伪随机二进制序列给出的参考序列进行调制。连续导频单元总在“提升后”的功率电平上发射，相应的调制为

$$Re(C_{m,k})=4/3(1-2w_k)$$

$$Im(C_{m,k})=0$$

式中，m 为符号时间指示，k 为载波频率指示。

TPS 载波用于给出与传输方案有关的参数，即信道编码和调制参数及系统信息。对于 2K 工作模式，TPS 信令在 8 个载波上并行传输；对于工作 4K 模式，在 16 个载波上并行传输；对于 8K 工作模式，在 32 个载波上并行传输。同一符号中的每个 TPS 载波传送相同的差分编码的信息比特。表 4、5、6 给出了一种 TPS 载波的载波位置集。

TPS 导频单元在“提升后”功率电平上发射。每个 TPS 载波用 DBPSK 调制传送相同的信息。DBPSK 在每个 TPS 块的开始时由伪随机二进制序列提供基准序列 Wk 进行初始化。

表 4 2K 工作模式 TPS 载波的载波位置集

40， 346，569，700，790，1155，1219，1469

表 5 4K 工作模式 TPS 载波的载波位置集

40， 346，569，700，790，1155，1219，1469，1600，1906，2129，2260，2350，2715，2779，3029

表 6 8K 工作模式 TPS 载波的载波位置集

40， 346，569，700，790，1155，1219，1469，1600，1906，2129，2260，2350，2715，2779，3029，3160，3466，3689，3820，3910，

4275，4339，4589，4720，5026，5249，5380，5470，5835，5899，6149

每个 OFDM 符号传送一个 TPS 比特，每个 TPS 块（对应于一个 OFDM 帧）由 64 个比特组成，包括：1 个初始化比特、16 个同步比特、34 个信息比特和 13 个用于误码保护的冗余比特。对于 34 个信息比特，可以只使用其中的一部分，而将其余部分作为备用。如使用 27 个，其余 7 个作为备用，置为“1010101”。每个 OFDM 帧第一个符号的 TPS 载波位置相对应的参考符号序列用于该位置 TPS 导频载波信号的 DBPSK 调制初始化。

传输信息按表 7 进行传输。2DPSK 调制的第一个比特 S_0 是一个初始化比特。TPS 初始化比特 S_0 从伪随机二进制序列得出。

TPS 中的第 1—16 比特是一个同步字，每帧依次取 sw_0 和 sw_1，这里 sw_0 为 0011010111101110，sw_1 为 1100101000010001

TPS 误码保护采用（63，50，t=3）本原 BCH 码。码生成多项式为：$g(x)=x^{13}+x^{12}+x^{11}+x^{10}+x^9+x^8+x^6+x^3+x+1$

表 7 TPS 信令信息及格式

比特数	格式	目的/内容
S_0	w_k	DBPSK 调制初始化
S_1-S_{16}	0011010111101110，	同步字
S_{17}-S_{18}	见表 8	工作模式
S_{19}-S_{21}	见表 9	传输模式
S_{22}-S_{24}	见表 10	非分层单一或分层 HP 码流或混合模式第一路内编码速率
S_{25}-S_{27}	见表 10	分层 LP 码流或混合模式第二路内编码速率
S_{28}-S_{29}	见表 11	非分层单一或分层 HP 码流或混合模式第一路外交织深度
S_{30}-S_{31}	见表 11	分层 LP 码流或混合模式第二路外交织深度
S_{32}-S_{33}	见表 12	单一或混合模式第一路信号星座
S_{34}-S_{35}	见表 12	混合模式第二路信号星座
S_{36}	见表 13	当前帧混合工作模式

S_{37}	见表 13	下一帧混合工作模式
S_{38}	见表 13	下下帧混合工作模式
S_{39}	见表 13	下下下帧混合工作模式
S_{40}	见表 13	下下下下帧混合工作模式
S_{41}-S_{43}	见表 14	保护间隙
S_{44}-S_{50}	设置为“1010101”	将来预留
S_{51}-S_{63}	BCH 码	误码保护

表 8 工作模式的信令格式

比特 S_{17}-S_{18}	工作模式
00	2K
01	4K
10	8K
11	备用

表 9 传输模式的信令格式

比特 S_{19}-S_{21}	传输模式
000	非分层单一
001	非分层混合
010	分层α=1
011	分层α=2
100	分层α=4
101	备用
110	备用
111	备用

表 10 码率的信令格式

比特 S_{22}-S_{24}, S_{25}-S_{27}	码率
000	1/2 卷积码
001	2/3 卷积码
010	3/4 卷积码
011	5/6 卷积码
100	7/8 卷积码
101	1/2turbo 码

110	备用
111	备用

表 11 外交织器交织深度的信令格式

比特 S_{28}-S_{29}, S_{30}-S_{31}	卷积交织器参数
00	4
01	32
10	64
11	192

表 12 星座可能类型的信令格式

比特 S_{32}-S_{33}, S_{34}-S_{35}	星座图特性
00	DQPSK
01	QPSK
10	16QAM
11	64QAM

表 13 混合工作模式信令格式

比特 S36, S37, S38, S39, S40	混合工作模式
0	第一路
1	第二路

表 14 保护间隔的信令格式

比特 S_{41}-S_{43}	保护间隔值
000	1/32
001	1/16
010	1/8
011	1/4
100	备用
101	备用
110	备用
111	备用

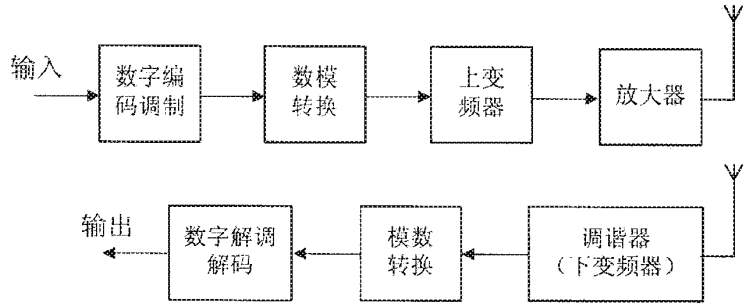

输入
数字编码调制
数模转换
上变频器
放大器
输出
数字解调解码
模数转换
调谐器（下变频器）

图 1

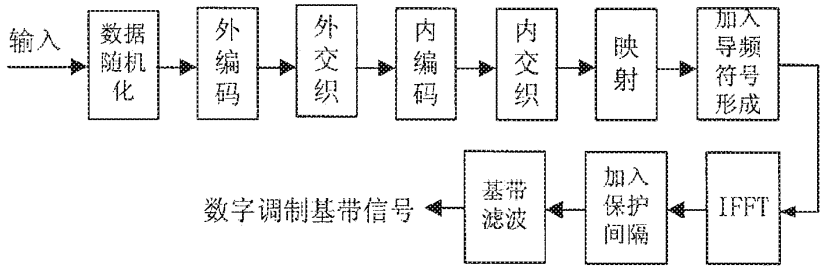

输入
数据随机化
外编码
外交织
内编码
内交织
映射
加入导频符号形成
IFFT
加入保护间隔
基带滤波
数字调制基带信号

图 2

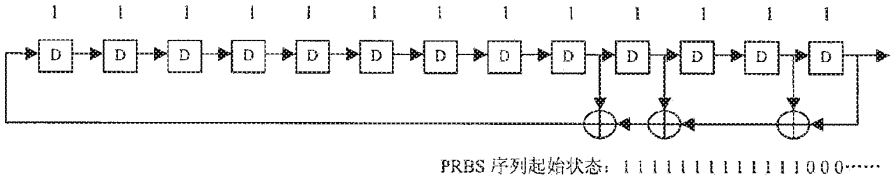

1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
D D D D D D D D D D D D D D D
PRBS 序列起始状态：1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 0 0 0……

图 3

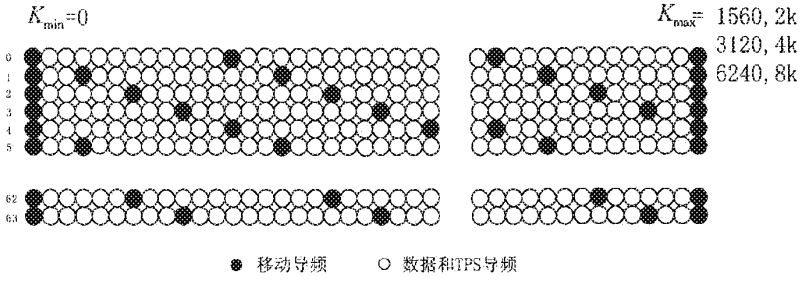

K_{min}=0
K_{max}= 1560, 2k
3120, 4k
6240, 8k
0
1
2
3
4
5
62
63
移动导频
数据和TPS导频

图 4

1) Family number: 29073631 (CN1445949A) © PatBase

Title: NEW COMMUNICATION METHOD OF COMBINED SPREAD SPECTRUM

Abstract: The present invention uses discrete multicarrier spread spectrum, direct sequential spread spectrum and inverse dicrete Fourier transformation to form a two-dimensional spread spectrum module, and the two-dimensional spread spectrum module, frequency hopping and time hopping spread spectrum are used to form the emission part of the united extending spectrum communication method. The inverse discrete multicarrier, direct sequential despreading spectrum and discrete Fourier transformation are used to form a two-dimensional despreading spectrum module and two-dimensional despreading spectrum module, time dehopping and frequency dehopping unit are used to form the receiving part of the united extending spectrum communication method.

Classifications:

International (IPC 8-9): H04B1/707 H04J13/02 H04L27/26 (Advanced/Invention); H04J13/02 (Core/Invention)

International (IPC 1-7): H04J13/02

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Probable Assignee: UNIV ELECTRONIC SCIENCE AND TECH

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Inventor(s): (std): TANG YOUXI ; YOUXI TANG

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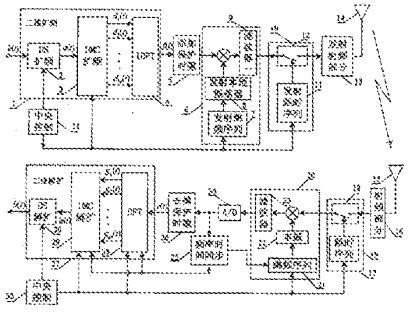
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权利要求书 1 页 说明书 11 页 附图 3 页

[54] 发明名称 一种新的联合扩展频谱的通信方法

[57] 摘要

本发明公开了一种新的联合扩展频谱通信方法，它是由离散多载波扩频 3 与直接序列扩频 2 和逆离散富立叶变换 4 一起组成二维扩频模块 1，二维扩频模块 1 与跳频扩频 6、跳时扩频 10 一起组成联合扩展频谱通信方法的发射部分；由逆离散多载波 29 与直接序列解扩频 30、离散富立叶变换 28 一起组成二维解扩频模块 27，二维解扩频模块 27 与解跳时扩频单元 17、解跳频扩频单元 20 一起组成联合扩展频谱通信方法的接收部分。采用本发明的通信方法，信息在无线信道上的随机性更强，使得非法用户(如敌方、故意破坏者)更难截获合法用户的信息。



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1. 一种新的联合扩展频谱通信方法，包括发射部分和接收部分，发射部分包括直接序列扩频单元（2）、逆离散富立叶变换（4）、跳频扩频单元（6）、跳时扩频单元（10）；接收部分包括解跳时扩频单元（17）、解跳频扩频单元（20）、离散富立叶变换（28）、直接序列解扩频单元（30）；其特征在于是发射部分还包括离散多载波扩频单元（3），离散多载波扩频单元（3）与直接序列扩频单元（2）和逆离散富立叶变换（4）一起组成二维扩频模块（1），二维扩频过程的矩阵表达式是：$f(t)=\mathbf{s}\beta\mathbf{U}\alpha\mathbf{p}\sqrt{2P_T}b(t)$，二维扩频模块（1）与跳频扩频单元（6）、跳时扩频单元（10）一起组成联合扩展频谱通信方法的发射部分；接收部分还包括逆离散多载波单元（29），逆离散多载波单元（29）与直接序列解扩频单元（30）、离散富立叶变换（28）一起组成二维解扩频模块（27），二维解扩频过程的矩阵表达式是$\hat{b}(t)=NMT_c\sqrt{\frac{P_T}{2}}b(t)+(\beta\mathbf{U}\alpha\mathbf{p})^{\mathrm{T}}\int_0^{T_c}\mathbf{s}^{\mathrm{T}}n(t)\mathrm{d}t$，二维解扩频模块（27）与解跳时扩频单元（17）、解跳频扩频单元（20）一起组成联合扩展频谱通信方法的接收部分。

2. 根据权利要求 1 所述的一种新的联合扩展频谱通信方法，其特征是所述的二维扩频模块（1）对用户信息扩频操作的顺序，可以是先进行直接序列扩频（2），再进行离散多载波扩频（3）；也可以先进行离散多载波扩频（3），再进行直接序列扩频（2）。

3. 根据权利要求 1 所述的一种新的联合扩展频谱通信方法，其特征是所述的跳时扩频（6）、跳频扩频（10）、二维扩频（1）三者的扩频操作顺序是可变的。

4. 根据权利要求 1 所述的一种新的联合扩展频谱通信方法，其特征是所述的离散多载波扩频（3）所用的扩频序列矩阵的每一列，可以是不同的伪随机序列，也可以是相同的伪随机序列；所述的直接序列扩频（2）所用的扩频序列，是一种伪随机序列。

5. 根据权利要求 1 所述的一种新的联合扩展频谱通信方法，其特征是所述的逆离散富立叶变换（4）可以采用逆离散富立叶变换技术，也可以采用快速富立叶变换技术。

6. 根据权利要求 1 所述的一种新的联合扩展频谱通信方法，其特征是所述的离散富立叶变换（4）可以采用离散富立叶变换技术，也可以采用快速富立叶变换技术。

一种新的联合扩展频谱的通信方法

技术领域

本发明属于电磁波技术的领域，如无线通信、光通信、超声波通信、有线通信等有关数据传输、处理技术，特别涉及采用扩展频谱的通信方法。

背景技术

众所周知，在现有的通信技术中，广泛地采用扩展频谱的通信方法。传统扩展频谱采用扩频码与原始信号相乘的方法，达到对原始信号的频谱的扩展。因此采用扩展频谱的通信方法具有的优点是：频谱的扩宽，意味着截获原始信号的概率降低；意味着抗干扰性能的增强；意味着通信误码率的降低；意味着对抗信道奇变的能力增强。

现有的主要扩展频谱的方法（技术）有：

（1）直接序列扩展频频谱（DS-CDMA）（又称时域扩频方法）：如图 1 中模块 2，它是通过使用一相对于原始数据较高速率的扩频序列与原始数据相乘，从而扩展原始数据的频谱。其工作原理请见：《数字通信原理》第三版，J. G. Proakis 著，电子工业出版社，1998 年 9 月出版。直接序列扩频（直扩）的工作原理可简述为：$b(t)$为原始输入信息，经直接序列扩频 2 扩频后，输出 $d(t)=\sum_{j=1}^{N} b(t)\alpha_j p(t-(j-1)T_c)$，其中 α_j 为对应直接序列扩频的扩频序列α: $\alpha_1, \alpha_2, \ldots, \alpha_N$ 中的元素，N 为直接序列扩频的处理增益，$p(t)$为宽度等于 T_c 的单位幅度脉冲，$p(t)=\begin{cases}1, & t\in[0,T_c]\\ 0, & \text{其它}\end{cases}$，扩频序列如图 2 所示。

（2）多载波扩展频谱（MC-CDMA）的工作原理是：将原始数据的每一比特，分别用多载波系统中的不同子载波传输，再用一扩频序列加扰。详细内容见：Shinsuke Hara and Ramjee Prasad, "Overview of Multicarrier CDMA," IEEE Communications Magzine, pp.126-133, Dec. 1997。

（3）跳时扩展频谱（TH-SS）的工作原理是：通信中不同的时间段，使用不同的载波中心频率，载波中心频率受跳频序列的控制。详细内容见：《扩频通信》，查光明、熊贤祚著，西安电子科技大学出版社，1990 年出版。

（4）跳频扩展频谱（FH-SS）的工作原理是：通信中处于连接的时间段、连接的时刻，

受跳时序列的控制。详细内容见：《扩频通信》，查光明、熊贤祚著，西安电子科技大学出版社，1990 年出版。

现有的扩展频频谱的通信方法均为一维扩频，如 DS-CDMA、MC-CDMA 等，它存在的缺点是：

（1） 扩展后的频谱不均匀，容易被敌方检测到某些调制参数的具体值；（2）高扩频增益时实现比较困难；（3）扩频增益的设计不灵活；（4）数字化接收时采样速率太高；（5）自适应干扰抑制实现起来复杂。

发明内容

本发明的任务是提供一种信息被截获概率更低的通信方法，即采用本发明的通信方法，信息在无线信道上的随机性更强，使得非法用户（如敌方、故意破坏者）更难截获合法用户的信息。

本发明由发射和接收两部分组成。

本发明发射机部分组成：本发明的发射部分包括由直接序列（Direct Sequence，简称 DS）扩频单元 2、离散多载波(Discrete MultiCarrier，简称 DMC)扩频单元 3、逆离散富里叶变换（Inverse Discrete Forierr Transform，简称 IDFT）4 组成二维扩频模块 1，完成二维扩频的功能，二维扩频模块 1 与跳频扩频单元 6、跳时扩频单元 10 一起组成联合扩展频谱的通信方法。发射机中还包括添加保护时隙单元 5、跳频序列 7、本地振荡器 8、跳时序列 11 跳时开关 12、射频部分 13、天线 14、中央控制单元 31 等单元，如图 3 所示。

本发明发射机部分工作过程：本发明的发射部分首先由 DS 直接序列扩频（Direct Sequence）单元 2、DMC 离散多载波(Discrete MultiCarrier) 单元 3、IDFT 为逆离散富里叶变换（Inverse Discrete Forierr Transform）4 组成完成二维扩频功能的模块 1，这是本发明的主要创新内容；然后通过添加保护时隙单元 5 的输出，送至跳频单元 6；发射跳频序列 7 控制发射本地振荡器 8 的输出频率，与添加保护时隙 5 的输出混频、滤波后送至跳时扩频单元 10，其中发射跳时开关 12 由发射跳时序列 11 控制。中央控制单元 31 通过控制整个系统中时序、频率等分别控制 DS 扩频单元 2、DMC 扩频单元 3、发射跳频序列 7、发射跳时序列 11。发射跳时开关 12 的输出送至发射射频部分 13，经天线 10 辐射至电磁波传输介质中。如图 3 所示。

二维扩频模块（1）对用户信息扩频操作，可以是先进行直接序列扩频（2），再进行

离散多载波扩频（3）；也可以先进行离散多载波扩频（3），再进行直接序列扩频（2）；本发明中跳时扩频（6）、跳频扩频（10）、二维扩频（1）三者的扩频操作顺序是可变的，即可根据具体的要求来确定三者的扩频操作顺序。逆离散富立叶变换（4）可以采用逆离散富立叶变换技术，也可以采用快速富立叶变换技术。

二维扩展频谱的方法可以先用图 4 来简单说明。将原始数据的每一比特 $b(t)$，与图 4 所示的二维扩频矩阵 $\beta\mathbf{U}\alpha\mathbf{p}$ 相乘，完成二维扩频，图 4 中横轴为时间，纵轴为频率，二维扩频模块 1 的二维扩频输出的数学表达式为：$f(t)=\mathbf{s}\beta\mathbf{U}\alpha\mathbf{p}\sqrt{2P_c}b(t)$，其中，$\alpha$是对应直接序列扩频的扩频序列，$\alpha=\mathrm{diag}(\alpha_1,\ \alpha_2,\ \ldots,\ \alpha_N)$，$\beta$为离散多载波扩频的扩频序列矩阵，$\boldsymbol{\beta}_j=(\beta_{j,1},\beta_{j,2},\ldots,\beta_{j,M})^{\mathrm{T}}$ $j=1,\ 2,\ \ldots,\ N$，$\boldsymbol{\beta}=(\boldsymbol{\beta}_1,\boldsymbol{\beta}_2,\ldots,\boldsymbol{\beta}_N)$，$\mathbf{p}=\left(p(t),p(t-T_c),\ldots,p\left(t-(N-1)T_c\right)\right)^{\mathrm{T}}$，$\mathbf{s}=\left(\cos(2\pi\Delta ft),\cos(2\pi 2\Delta ft),\ldots,\cos(2\pi M\Delta ft)\right)$，$\mathbf{U}=\mathrm{diag}\left\{p(t),p(t-T_c),\ldots,p\left(t-(N-1)T_c\right)\right\}$。

离散多载波扩频（3）所用的扩频序列矩阵中的每一列，可以是不同的伪随机序列，也可以是相同的伪随机序列；所述的直接序列扩频（2）所用的扩频序列，是一种伪随机序列。

添加保护时隙单元 5 的的功能是为了减轻信道多径引起的码间干扰，保护时隙的添加原理如图 7 所示，其中 G 表示保护时隙的长度。

本发明发射机部分的原理（二维扩频功能的模块 1 的工作过程）：

这里以 BPSK 调制为例，说明本发明的思想，这样设定并不影响本发明的思想应用于其它调制方式的系统中。本发明采用二维扩频联合跳频、跳时扩频组成的一种新的联合扩展频谱的通信方法，其工作原理，如图 3 所示。在图 3 中，模块 1 完成二维扩频的功能，其中 DS 为直接序列扩频（Direct Sequence），DMC 为离散多载波(Discrete MultiCarrier)，IDFT 为逆离散富里叶变换（Inverse Discrete Forierr Transform）。$b(t)$为原始输入信息，经直接序列扩频 2 扩频后，输出 $d(t)$:

$$d(t)=\sum_{j=1}^{N}b(t)\alpha_j p\left(t-(j-1)T_c\right) \tag{1}$$

其中 α_j 为对应直接序列扩频的扩频序列α：$\alpha_1,\ \alpha_2,\ \ldots,\ \alpha_N$，中的元素，$N$ 为直接序列扩频的处理增益，$p(t)$为宽度等于 T_c 的单位幅度脉冲:

$$p(t)=\begin{cases}1, & t\in[0,T_c]\\ 0, & \text{其它}\end{cases} \tag{2}$$

当然，$p(t)$也可以为其它形式的脉冲形状，式（2）的假定不影响本发明的一般性。

直接序列扩频单元（DS）2 扩频后的信号送到离散多载波扩频单元（DMC）3，离散多载波扩频单元 3 中的复制器 33 输入 1 个码元（chip），如图 5 所示，输出 M 路相同的 1 个码元宽度的信号，每路信号再分别与频域扩频序列$\beta_{j,i}$相乘，其工作原理如图 5 所示。

$$d_i(t)=d(t)\beta_{j,i}p\left(t-(j-1)T_c\right) \qquad i=1,2,...,M;\ j=1,2,...,N \tag{3}$$

其中：

$$\boldsymbol{\beta}_j=(\beta_{j,1},\beta_{j,2},...,\beta_{j,M})^{\mathrm{T}} \qquad j=1,2,...,N \tag{4}$$

$$\boldsymbol{\beta}=(\boldsymbol{\beta}_1,\boldsymbol{\beta}_2,...,\boldsymbol{\beta}_N) \tag{5}$$

β为离散多载波扩频的扩频序列矩阵，其列向量分别对应于一扩频序列，$\beta_{j,i}$为频域扩频序列，$d_i(t)$为 DMC 扩频 3 输出的信号。

DMC 扩频 3 输出的信号 $d_i(t)$，送至逆离散富里叶变换（IDFT）模块 4，IDFT 4 的模型如图 6 所示。实际工程中，IDFT 4 一般使用快速富里叶变换（IFFT）算法；这里为了说明本发明的思想，只用了 IDTF 来描述；但不论是 IDFT，还是 FFT，均不影响本发明的一般性。在图 6 中，Δf为多载波中任意的最近两个子载波的间距，共有 M 个子载波，所以总的频带宽度为 $M\Delta f$。逆离散富里叶变换单元的输出 $f(t)$为：

$$f(t)=\mathbf{s}\boldsymbol{\beta}\mathbf{U}\boldsymbol{\alpha}\mathbf{p}\sqrt{2P_T}b(t) \tag{6}$$

其中 P_T为任一子载波的发射功率。将式(1)、(3)~(5)代入式(6)，则逆离散富里叶变换单元的输出为：

$$f(t)=\sum_{j=1}^{N}\sum_{i=1}^{M}\sqrt{2P_T}b(t)\alpha_j\beta_{j,i}p\left(t-(j-1)T_c\right)\cos(2\pi i\Delta ft) \tag{7}$$

$f(t)$的矩阵表达式为：

$$f(t)=\mathbf{s}\boldsymbol{\beta}\mathbf{U}\boldsymbol{\alpha}\mathbf{p}\sqrt{2P_T}b(t) \tag{8}$$

其中，

$$\mathbf{s}=\left(\cos(2\pi\Delta ft),\cos(2\pi 2\Delta ft),...,\cos(2\pi M\Delta ft)\right) \tag{9}$$

$$\mathbf{U}=\mathrm{diag}\left\{p(t),p(t-T_c),...,p(t-(N-1)T_c)\right\} \tag{10}$$

$$\alpha=\mathrm{diag}(\alpha_1,\ \alpha_2,\ ...,\ \alpha_N) \tag{11}$$

$$\mathbf{p}=\left(p(t),p(t-T_c),...,p(t-(N-1)T_c)\right)^{\mathrm{T}} \tag{12}$$

结论：上面从理论讨论由 DS2、DMC3、IDFT4 组成完成二维扩频功能的模块 1 的工作原理，而跳频扩频单元（6）、跳时扩频单元（10）两种扩频方法均为现有技术，因此，本发明提出的通信方法可以通过二维扩频联合跳频、跳时扩频对原始数据的频谱进行联合扩展，使得通信信息被截获率比现有技术更低。其原因从上面很容易看出：要截获采用本发明方法传送的通信信息，不仅需要截获跳频规律、跳时规律，还需进一步在二维空间中寻找检测方法。

本发明发射机部分创新点：（1）现有的扩展频频谱的通信方法中，其扩频均为一维扩频，例如采用直接序列扩展频谱（DS-CDMA）、多载波扩展频谱（MC-CDMA）等方法。本发明是在直接序列扩展频谱（DS-CDMA）基础上，采用全新的 DMC 离散多载波(Discrete MultiCarrier)扩频，它的特点是扩频序列在相邻时间段多载波扩频序列不同，即由 DS2、DMC3、IDFT4 组成完成二维扩频功能的模块 1，实现二维扩频的目的。（2）二维扩频与跳频、跳时两种扩频方法结果结合，组成本发明的联合扩展频谱通信方法。

本发明发射机部分的实质：相对于传统的跳时、跳频、多载波扩频、直接序列扩频等方法，本发明的核心思想是：在跳时跳频过程中的每一跳的时间宽度内，采用二维扩频（Two Dimension Spread Spectrum）的方法，对信息进行扩展频谱，信息在无线信道上的随机性更强，使得非法用户（如敌方、故意坏者等）更难截获合法用户的信息。

本发明接收机部分：

本发明接收机部分组成：包括：接收天线 15、射频部分 16、解跳时单元 17、解跳频单元 20、A/D 变换器 24、跳时序列 19、跳时开关 18、跳频序列 21、频率、时间同步 25、中央控制单元 31、保护时隙模块 26，它还包括：二维解调部分 27，它由离散富里叶变换（DFT）单元 28、DMC 解扩单元 29、DS 解扩单元 30 组成。如图 3 所示。

本发明接收机部分工作过程：

工作过程：接收机中接收天线 15 接收到发射的信号，经过解跳时单元 17、解跳频单元 20 后送至 A/D 24；其中跳时序列 19 受中央控制单元 31 的控制，跳时序列 19 控制跳时

开关 18 的开关；跳频序列 21 受频率、时间同步 25 及中央控制单元 31 的控制。A/D 变换器 24 的输出在去掉保护时隙模块 26 中去掉保护时隙，送至二维解扩模块 27 中的离散富里叶变换（DFT）单元 28。A/D 变换器 24 输出的另一路信号送至频率时间同步单元 25，得到时间频率同步信息，用于二维解扩及通过跳频序列控制本振的频率精度。如图 3 所示。

二维扩频解扩的工作原理（二维扩频解扩 27 的工作过程）：

在接收机中，频率时间同步单元25的时间、频率同步的传统方法有多种方式，这里就不再说明了。解调方式可以是非相干解调、差分相干解调、导引符号辅助的相干解调、相干解调等多种方式。不论何种解调方法，本发明中的时频二维扩频方法均可以使用。这里只描述BPSK相干解调时的时频二维解扩方法。为了突出二维扩频解扩的原理，这里假设时间、频率已同步，射频信号经过的是加性白高斯噪声信道，系统中没有采用添加保护时隙、去掉保护时隙单元，射频发射部分、跳频及解跳频、跳时及解跳时、射频部分对$f(t)$影响可以忽略。这种假设不影响本发明的一般性。则有：

$$\begin{aligned} r(t) &= f(t) + n(t) \\ &= \mathbf{s}\beta\mathbf{U}\alpha\mathbf{p}\sqrt{2P_T}\,b(t) + n(t) \end{aligned} \tag{13}$$

其中 $r(t)$是去掉保护时隙模块 26 的输出，$f(t)$为二维扩频模块 1 的输出，$n(t)$为功率谱密度为 N_0 的加性白高斯噪声。根据图 3 所示模型，$r(t)$经过离散富里叶变换（DFT）28 后的信号为：

$$\begin{aligned} \mathbf{g} &= \int_0^{T_c}\left(\mathbf{s}^{\mathrm{T}}\mathbf{s}\beta\mathbf{U}\alpha\mathbf{p}\sqrt{2P_T}\,b(t) + \mathbf{s}^{\mathrm{T}}n(t)\right)\mathrm{d}t \\ &= \mathbf{I}_{M\times M}\frac{T_c}{2}\beta\mathbf{U}\alpha\mathbf{p}\sqrt{2P_T}\,b(t) + \int_0^{T_c}\mathbf{s}^{\mathrm{T}}n(t)\mathrm{d}t \\ &= \beta\mathbf{U}\alpha\mathbf{p}\frac{T_c\sqrt{P_T}}{\sqrt{2}}b(t) + \int_0^{T_c}\mathbf{s}^{\mathrm{T}}n(t)\mathrm{d}t \end{aligned} \tag{14}$$

其中 $\mathbf{I}_{M\times M}$为 $M\times M$ 单位矩阵，$\mathbf{g}=(g_1, g_2, \ldots, g_M)^{\mathrm{T}}$。$\mathbf{g}$ 送至 DMC 解扩 29 进行处理，对 $\mathbf{g}$ 左乘 $(\beta\mathbf{U})^{\mathrm{T}}$，得 DMC 解扩 29 的输出 $\mathbf{h}(t)$：

$$\mathbf{h}(t) = (\beta\mathbf{U})^{\mathrm{T}}\beta\mathbf{U}\alpha\mathbf{p}\frac{T_c\sqrt{P_T}}{\sqrt{2}}b(t) + (\beta\mathbf{U})^{\mathrm{T}}\int_0^{T_c}\mathbf{s}^{\mathrm{T}}n(t)\mathrm{d}t \tag{15}$$

据式（2）中定义的 $\mathbf{p}$ 在时间轴上的性质，式（14）可以化简为：

$$\mathbf{h}(t) = \mathbf{\Omega}\alpha\mathbf{p}\frac{T_c\sqrt{P_T}}{\sqrt{2}}b(t) + (\beta\mathbf{U})^{\mathrm{T}}\int_0^{T_c}\mathbf{s}^{\mathrm{T}}n(t)\mathrm{d}t \tag{16}$$

其中Ω为：

$$\Omega = \mathrm{diag}\left\{ |\beta_1|^2 p(t), |\beta_2|^2 p(t-T_c), ..., |\beta_N|^2 p\left(t-(N-1)T_c\right)\right\} \tag{17}$$

其中$|\beta_j|^2 = \beta_j^{\mathrm{T}}\beta_j$, j =1, 2, …, N。

$\mathbf{h}(t)$送至 DS 解扩单元 30，输出$\hat{b}(t)$：

$$\begin{aligned}\hat{b}(t) &= (\alpha\mathbf{p})^{\mathrm{T}}\mathbf{h}(t) \\ &= \mathbf{p}^{\mathrm{T}}\alpha^{\mathrm{T}}\Omega\alpha\mathbf{p}\frac{T_c\sqrt{P_T}}{\sqrt{2}}b(t) + (\beta\mathbf{U}\alpha\mathbf{p})^{\mathrm{T}}\int_0^{T_c}\mathbf{s}^{\mathrm{T}}n(t)\mathrm{d}t \\ &= \frac{T_c\sqrt{P_T}}{\sqrt{2}}b(t)\sum_{j=1}^{N}\alpha_j^2|\beta_j|^2 p\left(t-(j-1)T_c\right) + (\beta\mathbf{U}\alpha\mathbf{p})^{\mathrm{T}}\int_0^{T_c}\mathbf{s}^{\mathrm{T}}n(t)\mathrm{d}t\end{aligned} \tag{18}$$

将式(2)代入式（18），不失一般性，设α_i=±1, $\beta_{j,i}$=±1, j=1, 2, ..., M, i=1, 2, ..., N，则有：

$$\hat{b}(t) = NMT_c\sqrt{\frac{P_T}{2}}b(t) + (\beta\mathbf{U}\alpha\mathbf{p})^{\mathrm{T}}\int_0^{T_c}\mathbf{s}^{\mathrm{T}}n(t)\mathrm{d}t \tag{19}$$

从上面理论上讨论了由 DFT28、DMC 解扩 29、DS 解扩组成的二维解扩模块 27 的工作原理，而解跳频 20、解跳时 17 两种解扩频方法为传统技术，因此，本发明提出的接收机通过对联合扩频后的信息进行二维解扩频、解跳频、解跳时的联合解扩展频谱方法，对经过联合扩频后的原始信息进行联合解扩是可行的。由式(18)，由于$(\beta\mathbf{U}\alpha\mathbf{p})^{\mathrm{T}}\int_0^{T_c}\mathbf{s}^{\mathrm{T}}n(t)\mathrm{d}t$是均值为零的高斯噪声过程，显然检测的结果$\hat{b}(t)$是$b(t)$无偏估计，说明本发明中接收机结构是一种最优的方法。

需要说明的是，根据系统指标等的要求，本发明系统中可以不使用添加保护时隙单元 5 及去掉保护时隙单元 26 两个单元。用不用添加保护时隙单元 5 及去掉保护时隙单元 26 两个单元均不影响本发明的一般性。

另外本发明系统中的时间、频率同步信息，用于直接序列扩频解扩、离散多载波扩频解扩的时间、频率基准。

本发明接收机部分创新点：在 DS 解扩基础上，增加 DMC 解扩，并联合了解跳频、解跳时方法,对经过本发明联合扩频后的原始信息进行联合解扩频。

本发明接收机部分的实质：对应于本发明发射机的 DMC 扩频信号，进行 DMC 解扩，同时联合了直接序列扩频解扩、解跳频、解跳时。

在图 3 中，二维扩频是先 DS 扩频，再 DMC 扩频。由于 DS 扩频和 DMC 扩频均是线性操作，因此，先后顺序是可以交换的。所以，是先 DS 扩频再 DMC 扩频，还是先 DMC 扩频再 DS 扩频，均不影响本发明的一般性。

离散富立叶变换 4 可以采用离散富立叶变换技术（如图 3 所示），也可以采用快速富立叶变换技术。

本发明的工程实现与传统的一维扩频联合跳频、跳时的低截获无线通信系统相比，具有如下特点：

(1)本发明被截获率比现有技术更低，这是因为要截获本发明方法的无线通信信息，不仅需要截获跳频规律、跳时规律，还需进一步在二维空间中寻找检测方法；而传统的跳时跳频直接序列扩频无线通信信息的截获，是在解跳时解跳频后在一维空间中寻找检测方法。显然，截获本发明的方法的无线通信信息，要困难的多。

(2)本发明跳频的每一跳涉及的频带上更均匀。传统的跳频直接序列扩频无线通信，其频谱是 $\sin(2\pi\Delta f)/(2\pi\Delta f)$函数，在每一跳载波中心点（$\Delta f=0$ 时）附近信号，能量最强，离载波中心点越远的信号，能量越弱，因而造成扩展后的频谱不均匀，容易被敌方检测到某些调制参数的具体值，而本发明在每一跳由多个频谱宽度相同的子载波在频域的移位共同组成一个总的信号，所以探测本发明的无线通信系统每一跳的载波中心频率要困难的多。

(3)由于采用了 DFT 进行解调，因此不需要自适应干扰抑制，只需减单的限幅算法，即可达到很好的抗多频点阻塞干扰的能力。

(4)便于数字化无线通信的实现。本发明的 IDFT、DFT 可以使用工程中已十分成熟的 IFFT、FFT 来实施，与传统的直接序列扩频低截获无线通信相比，使用本发明方法实现的低截获无线通信接收机实现成本低，性能更稳定。

(5)抑制衰落信道影响的能力更强。在满足一定误码率要求的前提下，说明了本发明方法实现的低截获无线通信接收机，不需要发射机发射更多的能量，从而进一步增加了抗截获能力。

(6)采用本发明的无线通信系统的接收机具体实现更简单，在相同的扩频增益前提下，实现成本比跳时跳频直接序列扩频（FT-FH-DS-SS）的无线通信系统低。

纵上所述，采用本发明的通信方法，信息在无线信道上的随机性更强，使得非法用户（如敌方、故意破坏者）更难截获合法用户的信息，它可用于无线通信、光通信、超声波

通信、有线通信等有关信息（数据）传输的技术中，为信息（数据）传输的安全提供了技术保证。

附图说明：

图 1 是传统的直接序列扩频联合跳频、跳时的低截获无线通信系统工作原理图

其中，发射机部分：2 是直接序列（DS）扩频单元，6 是发射跳频扩频单元，7 是发射跳频序列，8 是发射本地振荡器，9 是滤波器一，10 是发射跳时扩频单元，11 是发射跳时序列，12 是发射开关，13 是发射射频部分，14 是天线；15 是接收天线；接收机部分：16 是射频部分，17 是解跳时扩频单元，18 跳时接收开关，19 是跳时序列，20 是接收机混频及解跳频部分，21 是跳频序列，22 是本地振荡器，23 是滤波器，24 是 A/D 转换，25 是频率时间同步单元，30 是 DS 解扩单元。

$b(t)$是 原始输入信息， $d(t)$ 是直接序列扩频 2 扩频后的输出信息， $\hat{b}(t)$ 是二维解扩频模块 30 的输出。

图 2 是直接序列扩频的扩频序列示意图

其中，横轴为时间轴，α_1，α_2，…，α_N是直接序列扩频序列的具体值。

图 3 是本发明通信方法原理的示意图

其中，发射机部分：1 是二维扩频模块，2 是直接序列（DS）扩频单元，3 是离散多载波（DMC）扩频单元，4 是逆离散富里叶变换（IDFT）模块，5 是添加保护时隙单元，6 是发射跳频扩频单元，7 是发射跳频序列，8 是发射本地振荡器，9 是滤波器一，10 是跳时扩频单元，11 是发射跳时序列，12 是发射开关，13 是发射射频部分，14 是天线；接收机部分：15 是接收天线，16 是射频部分，17 是解跳时扩频单元，18 接收跳时开关，19 是跳时序列，20 是混频及解跳频部分，21 是跳频序列，22 是本地振荡器，23 是滤波器，24 是 A/D 转换，25 是频率时间同步单元，26 是去掉保护时隙单元，27 是二维解扩频单元，28 是 DFT 模块，29 是 DMC 扩频单元，30 是 DS 解扩单元。

$b(t)$是 原始输入信息；$d(t)$是直接序列扩频 2 扩频后的输出信息；$f(t)$是逆离散富里叶变换单元（4）的输出，即二维扩频模块 1 的输出；$r(t)$是二维解扩频模块（27）的输入；$\mathbf{g}$ 是离散富里叶变换（20）后的输出信号；$\mathbf{h}(t)$是逆离散多载波（29）的输出； $\hat{b}(t)$ 是二维解扩频模块（27）的输出。

图 4 为二维扩频矩阵对应的元素示意图

其中，横轴为时间轴，纵轴为频率，α_j 是对应直接序列扩频的扩频序列$\alpha=(\alpha_1, \alpha_2, \ldots, \alpha_N)^T$中的元素，$N$ 为直接序列扩频的处理增益，$\boldsymbol{\beta}_j=(\beta_{j,1},\beta_{j,2},\ldots,\beta_{j,M})^T$，$j$=1, 2, ..., N；$\boldsymbol{\beta}=(\boldsymbol{\beta}_1,\boldsymbol{\beta}_2,\ldots,\boldsymbol{\beta}_N)$，β是对应离散多载波扩频的扩频序列矩阵，其不同的列向量分别对应于频域扩频不同数据（chip）的一频域扩频序列，$\alpha_j\beta_{j,i}$ 为二维扩频矩阵的元素，其中 i=1, 2, ..., M，j=1, 2, ..., N。

图 5 是离散多载波扩频 3 的扩频原理示意图

其中，33 是复制器，离散多载波扩频单元 3 中的复制器 33 输入 1 个码元（chip），输出 M 路相同的 1 个码元宽度的信号，每路信号再分别与频域扩频序列$\beta_{j,i}$ 相乘，$d_i(t)=d(t)\beta_{j,i}p(t-(j-1)T_c)$　　i=1, 2, ..., M; j=1, 2, ..., N，其中：$\boldsymbol{\beta}_j=(\beta_{j,1},\beta_{j,2},\ldots,\beta_{j,M})^T$ j=1, 2, ..., N，$\boldsymbol{\beta}=(\boldsymbol{\beta}_1,\boldsymbol{\beta}_2,\ldots,\boldsymbol{\beta}_N)$，β为离散多载波扩频的扩频序列矩阵，其不同的列向量分别对应于频域扩频不同数据（chip）的一频域扩频序列。

图 6 是逆离散傅立叶变换模块（IDFT）4 工作原理示意图

其中，Δf 为多载波中任意的最近两个子载波的间距，共有 M 个子载波，所以总的频带宽度为 $M\Delta f$。逆离散富里叶变换单元的输出为：$f(t)=\sum_{i=1}^{M}\sqrt{2P_T}d_i(t)\cos(2\pi i\Delta ft)$，$P_T$ 为任一子载波的发射功率，$d_i(t)$为从 DMC3 扩频后输出的第 M 路信号。

图 7 是保护时隙 5 的添加原理图

其中，G 是保护时隙的宽度，T_c 是符号的有效长度。保护时隙是为了对抗多径时引起的码间串扰。

具体实施方式：

本发明发射部分的主要创新是通过联合二维扩频、跳频、跳时三种扩频方法组成的联合扩频通信系统，其中跳频扩频、跳时扩频都是现有的扩频方法，二维扩频方法的矩阵表达式（8）是：

$$f(t)=\mathbf{s}\boldsymbol{\beta}\mathbf{U}\boldsymbol{\alpha}\mathbf{p}\sqrt{2P_T}b(t) \tag{8}$$

式（8）可以通过编程的方法实现，利用现有技术可以制作成相应的硬件，实现二维扩频的

过程；然后，联合跳频扩频、跳时扩频的现有扩频技术，组成本发明的发射机系统。

本发明接收部分的主要创新是解二维扩频、解跳频、解跳时三种扩频方法组成的通信系统，其中解跳频、解跳时都为现有的扩频方法，二维解扩频的原理由式（13）、（13）、（14）、（15）、（18）表示，最后的检测结果为式（19），

$$\hat{b}(t) = NMT_c\sqrt{\frac{P_T}{2}}b(t) + (\beta \mathbf{U} \alpha \mathbf{p})^T \int_0^{T_c} \mathbf{s}^T n(t)\mathrm{d}t \tag{19}$$

可以按上述公式所表示的方法，通过编程来实现本发明提出的通信方法，然后利用现有技术可以制作成相应的硬件，组成本发明的接收机系统，实现二维解扩频的过程。

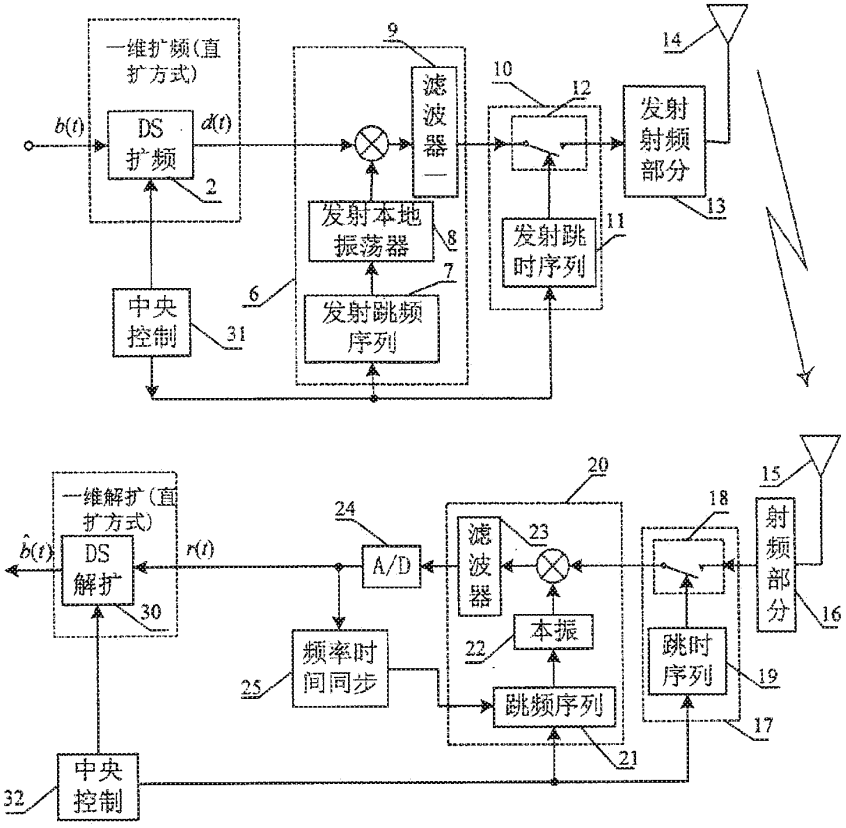

一维扩频(直扩方式)
b(t)
DS扩频
d(t)
2
9
滤波器一
发射本地振荡器
8
7
发射跳频序列
6
中央控制
31
10
12
发射跳时序列
11
14
发射射频部分
13
一维解扩(直扩方式)
DS解扩
30
r(t)
24
A/D
20
滤波器
23
本振
22
频率时间同步
25
跳频序列
21
18
跳时序列
19
17
15
射频部分
16
32
中央控制

图 1


α_1
α_2
• • •
α_N
时间

图 2

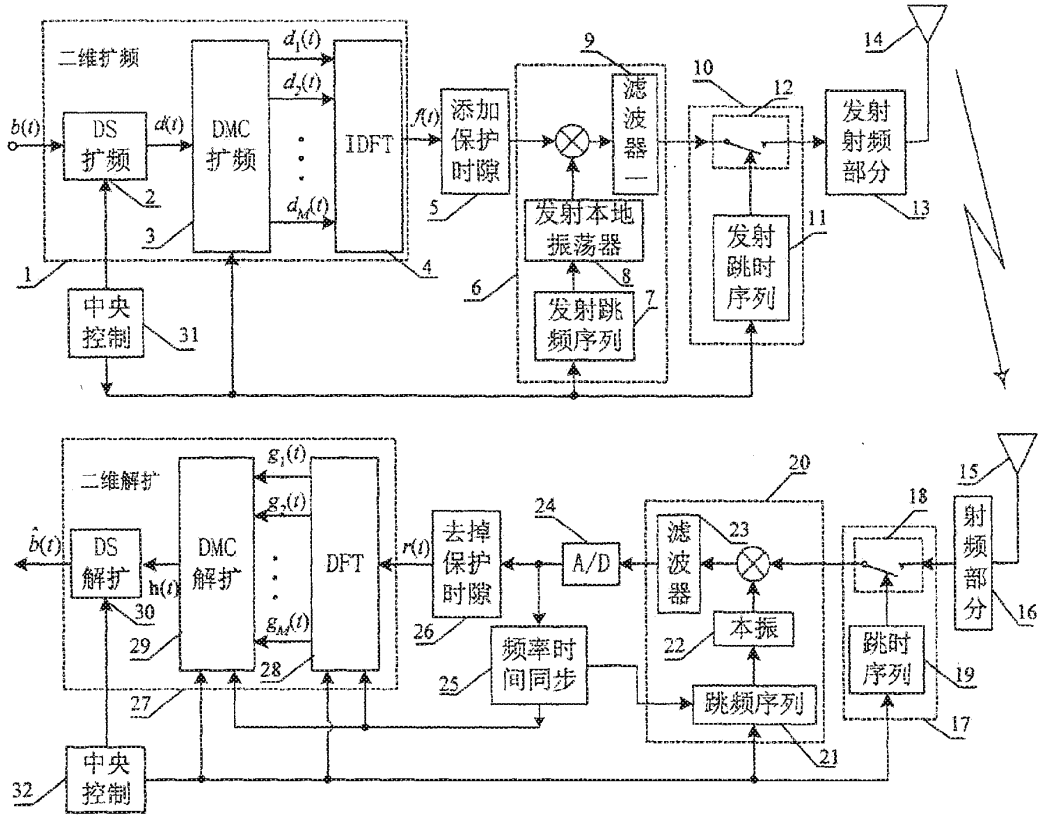

二维扩频
DS 扩频
DMC 扩频
IDFT
添加保护时隙
滤波器
发射本地振荡器
发射跳频序列
发射跳时序列
发射射频部分
中央控制
二维解扩
DS 解扩
DMC 解扩
DFT
去掉保护时隙
A/D
滤波器
本振
频率时间同步
跳频序列
跳时序列
射频部分
中央控制

图 3

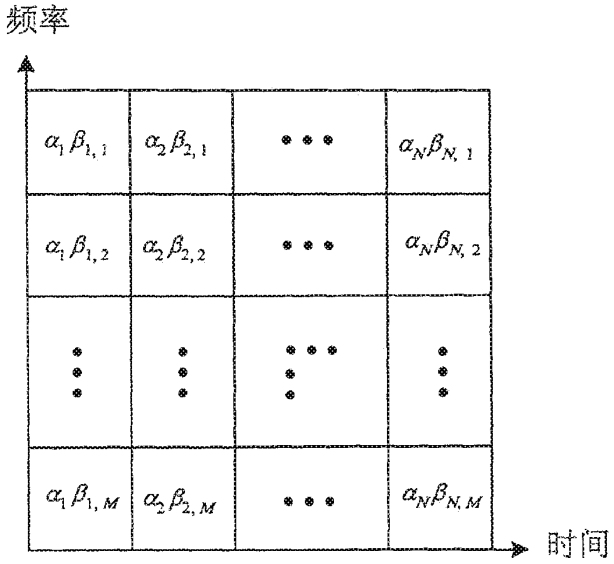

频率
时间

图 4

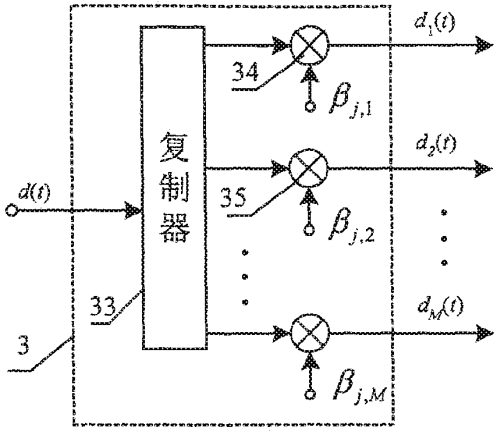

复制器
d(t)
3
33
34
35
$d_1(t)$
$d_2(t)$
$d_M(t)$
$\beta_{j,1}$
$\beta_{j,2}$
$\beta_{j,M}$

图 5

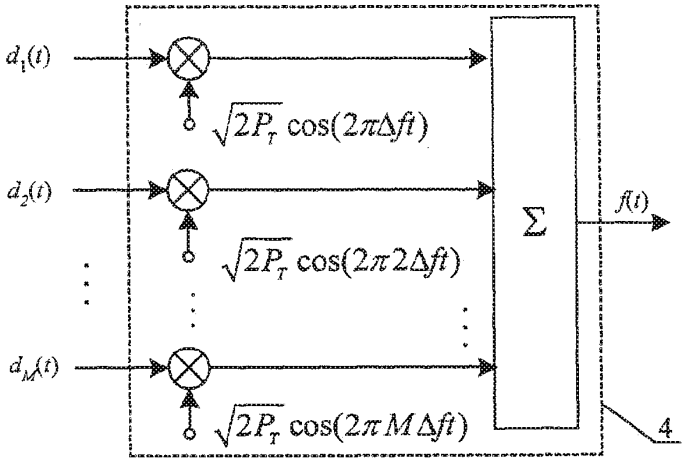

$d_1(t)$
$d_2(t)$
$d_M(t)$
$\sqrt{2P_T}\cos(2\pi\Delta ft)$
$\sqrt{2P_T}\cos(2\pi 2\Delta ft)$
$\sqrt{2P_T}\cos(2\pi M\Delta ft)$
Σ
$f(t)$
4

图 6

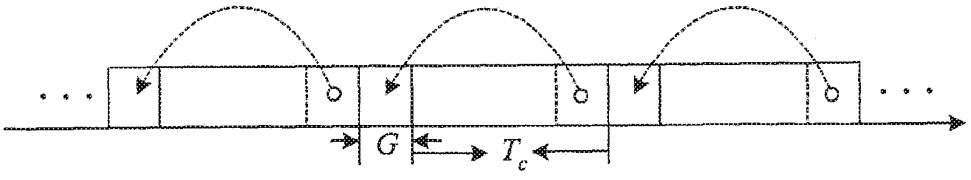

G
T_c

图 7

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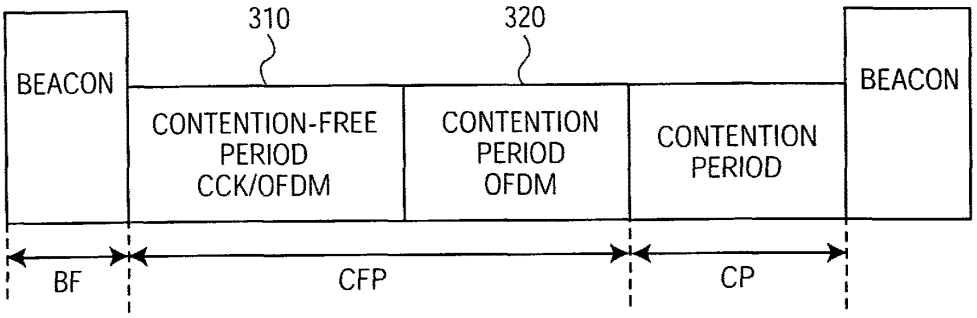
Declarations under Rule 4.17:

— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii)) for the following designations AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, YU, ZA, ZM, ZW, ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG)*

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[Continued on next page]

(54) Title: COEXISTENCE OF MODULATION SCHEMES IN A WLAN



(57) Abstract: A local area network is provided where an OFDM station and DSSS/CCK station coexist. During a contention-free period both stations oeprate under the point coordination function rules as defined in the IEEE 802.11 specification. Both stations transmit data when polled by the access point. The contention-free period comprises a sub-contention period of the OFDM station operates under the distributed coordination function while the DSSS/CCK station waits to be polled by the access point before starting to communicate.

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COEXISTENCE OF MODULATION SCHEMES IN A WLAN

FIELD OF THE INVENTION

The invention pertains to wireless local area networks and to the coexistence of stations capable of different modulation schemes. The invention is particularly relevant to the coexistence and interoperability in a WLAN of stations capable of transmitting and receiving OFDM modulated data and stations capable of transmitting and receiving DSSS/CCK modulated data.

BACKGROUND ART

The IEEE 802.11 WLAN standard provides a number of physical layer options in terms of data rates, modulation types and spreading spectrum technologies. An extension of the IEEE 802.11 standard, namely IEEE 802.11a, defines requirements for a physical layer operating in the 5 GHz U-NII frequency and data rates ranging from 6Mps to 54Mps. IEEE 802.11a defines a physical layer based on the orthogonal frequency division multiplexing (OFDM). This physical layer is similar to the one defined by the European ETSI-HIPERLAN II (European Telecommunications Standards Institute-HiperLAN2). A second extension, IEEE 802.11b, defines a set of physical layers' specifications operating in the 2.4GHz ISM frequency band up to 11Mps. The direct sequence spread spectrum/complementary code keying (DSSS/CCK) physical layer is one of the three physical layers supported in the IEEE 802.11 standard and uses the 2.4GHz frequency band as the RF transmission media.

The IEEE standard committee has created a working group TGg with the mission of developing a higher speed PHY extension to the 802.11b standard. The 802.11g standard will be compatible with the IEEE 802.11 MAC and will implement all mandatory portions of the IEEE 802.11b PHY standard. A scope of TGg is to provide a wireless LAN standard where stations communicating in OFDM modulation and legacy stations communicating in DSSS/CCK modulation coexist and communicate with each other.

Another extension IEEE 802.11e enhances the current 802.11 MAC to expand support for LAN applications with Quality of Service requirements. IEEE 802.11e enables

direct communications from one station to another. Example applications include transport of voice, audio and video over 802.11 wireless networks, video conferencing, media stream distribution, enhanced security applications, and mobile and nomadic access applications.

SUMMARY OF THE INVENTION

It is an object of the invention to enable the interoperability of stations communicating in different modulations in a WLAN.

It is an object of the invention to enable the coexistence of OFDM stations and legacy DSSS/CCK stations in a IEEE 802.11 WLAN.

It is yet another object of the invention to provide a new timing structure for communications over a WLAN.

It is yet another object of the invention to allow OFDM stations to communicate according to a distributed coordination function during a contention-free period.

To this end, a system of the invention comprises a first and second stations capable of transmitting and receiving data modulated using respective first and modulation schemes. The first modulation scheme may be a DSSS/CCK modulation and the second scheme may be an OFDM modulation. The system also comprises an access point for communicating with the first and the second stations. The access point transmits a beacon frame indicating a beginning of a contention-free period followed by a contention period. In the invention, the contention-free period comprises a sub-contention period. During this sub-contention period, the second station transmits data modulated using the second modulation scheme, according to a distributed coordination function access mechanism.

Legacy station using the DSSS/CCK modulation in an 802.11 WLAN may not be configured to communicate correctly with other OFDM stations. Legacy stations may not detect OFDM communications during the contention period. Thus, legacy DSSS/CCK devices, which cannot decode OFDM modulated data, may not be able to follow the collision avoidance mechanism as defined in IEEE 802.11. Therefore the invention provides a solution to enable the coexistence, within the same WLAN, of legacy stations and OFDM stations. During the contention-free period, both first and second stations may communicate using the point coordination function rules defined in the 802.11 standard

and both stations communicate when polled by the access point. The invention introduces a sub-contention period in the contention-free period. This sub-contention period is such that the second station may gain access to the medium according to the distributed coordination function access mechanism while the first station is still operating according to the point coordination function rules, i.e. the first station may communicate when polled by the access point. In one or more embodiments of the invention, the access point may decide not to poll the first station during the sub-contention period. The medium may thus be reserved for communications with the second station and other stations capable of communicating using the second modulation scheme only. The second station gains access to the medium by listening to it and competing for it with other stations using the second modulation scheme. An advantage of one or more embodiments of the invention is to enable OFDM modulated communications during the sub-contention period thereby achieving pure OFDM data traffic and high bit rates communications. Another advantage of one or more embodiments of the invention is that a receiving station, e.g. the access point, knows which modulation scheme is being used during the sub-contention period. Thus, a receiving station knows it will receive data according to the second modulation scheme. Such knowledge may allow to reduce data overhead and permits lowering the costs and power saving. Another advantage of a system of the invention is bandwidth efficiency.

In an embodiment of the invention, the sub-contention period occurs at the end of the contention-free period. Thus, during a first portion of the contention-free period, the first and the second stations operate according to the rules of the point coordination function. During the second and last portion of the contention-free period, i.e. the sub-contention period, the second station operates according to the rules of the distributed coordination function while the first station is still operating according to the rules of the point coordination function. The access point may be configured not to poll the first station during the sub-contention period.

In a further embodiment of the invention, the access point dynamically adjusts the duration of the sub-contention period. The adjustment may be done based on respective bandwidth requirements of both stations or the adjustment may be done based on a

number of stations respectively communicating using the first or the second modulation scheme.

The invention also relates to an access point and a station in such a system.

BRIEF DESCRIPTION OF THE DRAWING

The invention is explained in further details, by way of examples, and with reference to the accompanying drawing wherein:

Fig.1 shows a wireless local area network of the invention;

Fig.2 is a timing diagram showing communication periods in a wireless local area network;

Fig.3 is a timing diagram showing communication periods of the invention;

Fig.4 shows request-to-send and clear-to-send frames of the invention; and,

Fig.5 shows dynamic adjustments of the sub-contention period and of the contention period.

Elements within the drawing having similar or corresponding features are identified by like reference numerals.

DETAILED DESCRIPTION

An 802.11 wireless local area network 100 of the invention as shown in Fig.1 comprises an access point AP and a plurality of stations STA1-STA6. A station STA may communicate with another station directly as described in the IEEE 802.11e extension or a station STA may communicate with another station STA via the access point AP or the station STA may communicate with the access point AP only. The IEEE 802.11 specification describes two access mechanisms to the medium by the stations STA1-STA6: the distributed coordination function and the point coordination function.

The point coordination function is a centrally controlled access mechanism and a point coordinator located in the access point AP controls the access of the stations STA1-STA6 to the medium. The stations STA1-STA6 request that the point coordinator or access point AP registers them on a polling list. The access point AP regularly polls the stations STA1-STA6 for traffic information and data to be transmitted while also transmitting data to the stations STA1-STA6. The access point AP begins a period of operation called the contention-free period CFP, as shown in Fig.2, during which the

point coordination function is operating. During this contention-free period CFP, access to the medium is completely controlled by the access point AP. The contention-free period CFP occurs periodically to provide a near-isochronous service to the stations STA1-STA6. The IEEE 802.11 specification also defines a contention period CP alternating with the contention-free period CFP during which the distributed coordination function rules operate and all stations may compete for access to the medium as will be explained hereinafter.

Fig.2 is a timing diagram 200 showing a contention-free period CFP followed by a contention period CP. The contention-free period CFP begins when the access point AP gains access to the medium during a previous contention period CP using the distributed coordination function procedures. Upon gaining access to the medium, the access point AP transmits a beacon frame BF. The transmission of the beacon frame BF may be periodical, however the transmission of the beacon frame BF may be slightly delayed from an ideal start instant since the access point AP must compete for the medium according to the distributed coordination function rules.

During the contention-free period CFP, the access point AP has control of the medium and delivers traffic to stations STA1-STA6 and may poll stations STA1-STA6 that have requested content-free service for them to deliver traffic to the access point AP. As a result, the traffic in the contention-free period CFP comprises frames sent from the access point AP to one or more of the stations STA1-STA6 followed by the acknowledgment from those stations. Every station STA may receive frames addressed to it by the access point AP and return an acknowledgment. The access point AP sends a contention-free poll (CF-Poll) frame to those stations STA1-STA6 that have requested contention-free service. If the station STA polled has traffic to send, it may transmit one frame for each contention-free poll CF-Poll received. If the station STA has no traffic to send, it may decide not to respond to the contention-free poll CF-Poll. The access point AP may send the contention-free poll CF-Poll addressed to a station together with data to be transmitted to that station.

The primary mechanism for preventing stations from accessing the medium during the contention-free period CFP is the network allocation vector (NAV) implemented by the IEEE 802.11 MAC. The NAV is a value that indicates to a station STA the amount of

time that remains before the medium will become available. The NAV may be kept current in a station through duration values that are transmitted in all frames. The beacon frame BF sent by the access point AP at the beginning of the contention-free period CFP may contain information from the access point AP about the maximum expected length of the contention-free period CFP. A station STA receiving the beacon frame BF will enter this information into its NAV and is thus prevented from independently accessing the medium until the contention-free period CFP concludes or until the access point AP specifies otherwise to the station STA.

During the contention period CP, the basic access mechanism is the distributed coordination function, which uses carrier sense multiple access with collision avoidance. The stations STA1-STA6 sense the medium to see if it is already carrying a transmission. A station STA having its NAV set at zero waits until the medium is idle to start transmitting. The station STA can also do virtual carrier sensing by transmitting a request-to-send frame RTS to the intended receiver, the access point AP or another station STA, and by waiting for a clear-to-send frame CTS from the intended receiver. The RTS frame advertises the duration of the intended transmission and the duration may also be transmitted in the CTS frame. In some embodiments, the use of the RTS-CTS frames entails extra overhead and the mechanism may be dropped for smaller packets communication, using them only for larger packets.

In an embodiment of the invention, the system 100 comprises a first group of stations ST1-STA3 capable of transmitting and receiving DSSS/CCK modulated data and a second group of stations STA4-STA6 capable of transmitting and receiving OFDM modulated data. A station STA1-STA3 cannot understand OFDM modulated data received from/transmitted to one of the stations STA4-STA6. Thus, stations STA1-STA3, which cannot decode OFDM modulated data, may not be able to follow collision avoidance mechanism.

In order to provide high data throughput, the system 100 allocates a period of time to OFDM data transfer only.

A timing diagram of how the system 100 operates is given in Fig.3. The access point AP initiates a contention-free period CFP by transmitting a beacon frame BF to the stations STA1-STA6. The contention-free period CFP is followed by a contention period

CP. The contention-free period CFP consists of a first sub-part, a CCK/OFDM contention-free period 310 and a second sub-part, an OFDM contention period 320. In this embodiment, the CCK/OFDM contention-free period 310 occurs before the OFDM contention period 320 however this order may be inversed.

The location and/or duration of the OFDM contention period 320 may be transmitted in an information element of the beacon frame BF.

During the period 310, the CCK stations STA1-STA3 and the OFDM stations STA4-STA6 communicate with the access point AP when polled by the access point AP as mentioned above. In this embodiment, the access point AP may have been made aware of the OFDM capability of the stations STA4-STA6. To this end, an information field indicating the OFDM capability may be exchanged when the station STA4-STA6 joins the network, e.g. during authentication. An OFDM bit of the information field may be reserved for indicating OFDM capability of the station STA4-ST6. Thus, when the access point AP polls or needs to access to a station STA during the contention-free period 310, it will access it using DSSS/CCK or OFDM modulation based on the known capabilities of the station STA. The station STA may then respond to the access point AP using the same modulation as it was addressed with. In one embodiment of the invention, the access point AP converts received OFDM (or DSSS/CCK) modulated data into DSSS/CCK (OFDM) modulated data for transmission to the receiving station based on respective capabilities of the transmitting and receiving stations.

During the period 320, a CCK station STA1-STA3 communicates with the access point AP when polled by the access point AP. In this embodiment, the access point AP is configured not to poll the stations STA1-STA3 during the period 320 and as a result, the stations STA1-STA3 may not transmit data during the period 320. During this period 320, the OFDM stations STA4-STA6 communicate with each other or with the access point AP based on a distributed coordination function. Such an OFDM contention period 320 enables to load the medium with pure OFDM data traffic and thereby enables high data throughput.

As mentioned above, a station STA4-STA6 gains access to the medium during the period 320 by sending a request-to-send RTS frame to the intended receiver and waits to receive a clear-to-send CTS frame from the intended receiver to start transmitting. In this

embodiment, only OFDM stations may communicate during the period 320. As a result, the RTS and CTS frames are not necessarily modulated using DSSS/CCK modulation and may instead be OFDM modulated thereby enabling to reduce the data overhead and to improve the bandwidth efficiency.

The contention-free period CFP is then followed by the contention period 330. During period 330, both the legacy devices STA1-STA3 and the OFDM devices STA4-STA6 may compete for the medium and transmit data. Alternatively, only the legacy devices STA1-STA3 may communicate during the contention period 330.

In one embodiment of the invention, the stations STA1-STA6 may transmit DSSS/CCK modulated data only. The stations STA4-STA6 then need to send DSSS/CCK modulated RTS and CTS frames.

In another embodiment, the stations STA4-STA6 may communicate using either the CCK modulation or the OFDM modulation. Thus, alternative RTSA and CTSA frames are introduced as shown in Fig.4. If one of the OFDM station STA4-STA6 or the access point AP desires to transmit OFDM data during the contention period 330, it may transmit such alternative RTSA frame that comprises a field indicating that OFDM modulated data is or will be transmitted. This alternative RTSA frame informs the receiving station that OFDM modulation will be used. For example, one of the OFDM stations STA4-STA6 or the access point AP sends a request-to-send frame RTSA including an element which requests the receiving station to use either OFDM or DSSS/CCK modulation for the data. The RTSA frame is modulated in DSSS/CCK. The receiving station then in its clear-to-send CTSA frame indicates whether it accepts or refuses the OFDM modulation. If the receiving station refuses the OFDM modulation, the station STA4-STA6 uses the DSSS/CCK modulation.

In another embodiment of the invention, the access point AP dynamically adjusts the duration of the contention period 320 based on the respective bandwidth requirements of the OFDM stations STA4-STA6. Thus, the more bandwidth is required from the stations STA4-STA6 relative to the stations STA1-STA3, the longest the contention period 320 will be. Alternately, the access point AP may also adjust the duration of the contention period 320 based on the number of stations capable of OFDM modulation. In case the proportion of OFDM stations STA is high relative to the total number of stations

in the network, the access point AP will increase the duration of the contention period 320. Fig.5 shows a dynamic adjustment of the sub-contention period 320 to the sub-contention period 322 and a dynamic adjustment of the contention period 330 to the contention period 332.

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CLAIMS

What is claimed is:

1. A system comprising:

a first station capable of transmitting and receiving data modulated using a first modulation scheme;

a second station capable of transmitting and receiving data modulated using a second modulation scheme;

an access point for communicating with the first and the second stations; and wherein,

the access point transmits a beacon frame indicating a beginning of a contention-free period followed by a contention period, and, the contention-free period comprises a sub-contention period during which the second station is enabled to transmit data modulated according to the second modulation scheme following a distributed coordination function access mechanism.

2. The system of Claim 1, wherein the first modulation scheme is a DSSS/CCK modulation scheme.

3. The system of Claim 1, wherein the second modulation scheme is an OFDM modulation scheme.

4. The system of Claim 1, wherein the sub-contention period occurs at the end of the contention-free period.

5. The system of Claim 1, wherein the access point dynamically adjusts the duration of the sub-contention period.

6. The system of Claim 5, wherein the access point further adjusts the duration of the sub-contention period based on respective bandwidth requirements of the first and second stations.

7. The system of Claim 5, wherein the access point further adjusts the duration of the sub-contention period based on respective numbers of devices using the first and the second modulation schemes.

8. The system of Claim 1, wherein during the contention period, the second station sends a request-to-send frame comprising information representative of the second modulation scheme.

9. The system of Claim 1, wherein during the sub-contention period, the second station transmits request-to-send and clear-to-send frames modulated according to the second modulation scheme.

10. The system of Claim 1, wherein the second station sends an information field representative of the second modulation capability when joining the system.

11. The system of Claim 1, wherein the system operates under the IEEE 802.11 specification.

12. An access point for communicating over a local area network with a first station capable of transmitting and receiving data modulated according to a first modulation scheme and with a second station capable of transmitting and receiving data modulated according to a second modulation scheme, wherein the access point transmits a beacon frame indicating a beginning of a contention-free period followed by a contention period, and, the contention-free period comprises a sub-contention period during which the second station is enabled to transmit data modulated according to the second modulation scheme following a distributed coordination function access mechanism.

13. The access point of Claim 12, wherein the first modulation scheme is a DSSS/CKK modulation scheme.

14. The access point of Claim 12, wherein the second modulation scheme is an OFDM modulation scheme.

15. The access point of Claim 12, wherein the access point dynamically adjusts the duration of the sub-contention period.

16. The access point of Claim 12, wherein during the contention period, the access point sends a request-to-send frame comprising information representative of the second modulation scheme.

17. The access point of Claim 12, wherein during the sub-contention period, the access point transmits request-to-send and clear-to-send frames modulated according to the second modulation scheme.

18. The access point of Claim 12, wherein during the contention period, the access point receives from the second station a request-to-send frame comprising information representative of the second modulation scheme.

19. The access point of Claim 12, wherein the access point received from the second station an information field representative of the second modulation capability when the second station joins the local area network.

20. A station in a local area network, the station being capable of transmitting and receiving data using a first modulation scheme, the local area network further comprising a second station capable of transmitting and receiving data using a second modulation scheme and an access point for communicating with both stations, wherein the station receives a beacon frame transmitted by the access point indicating a beginning of a contention-free period followed by a contention period, and, the contention-free period comprises a sub-contention period during which the station is enabled to transmit data according to the first modulation scheme and following a distributed coordination function access mechanism.

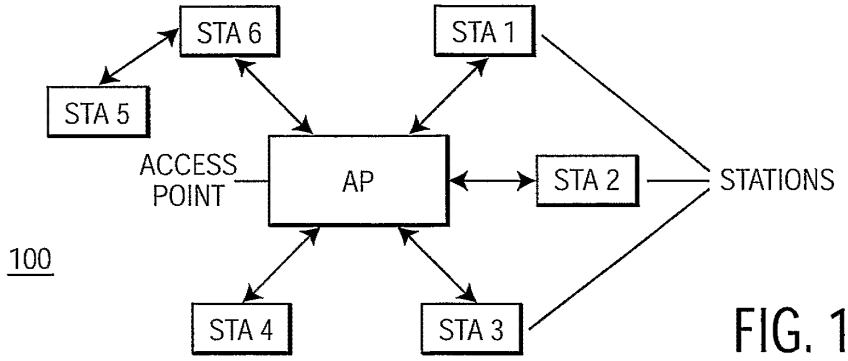


FIG. 1

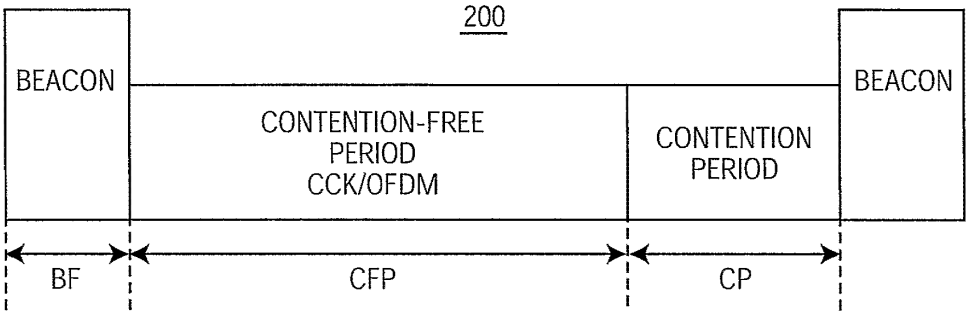


FIG. 2

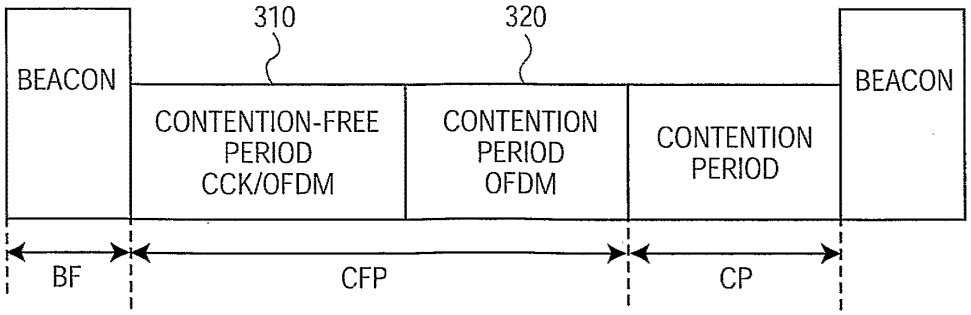


FIG. 3

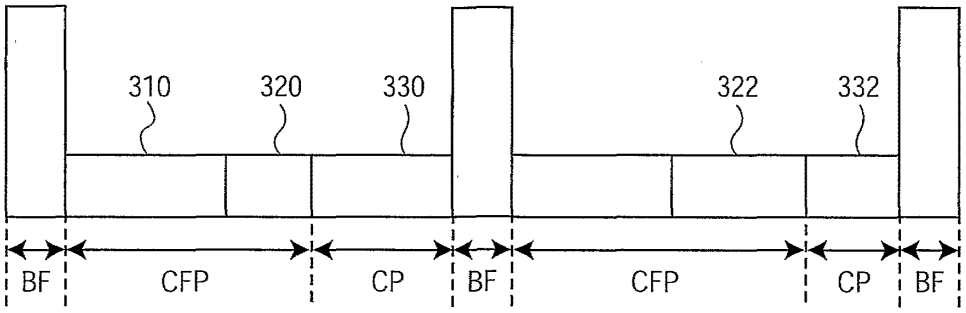

310
320
330
322
332
BF
CFP
CP
BF
CFP
CP
BF

FIG. 4

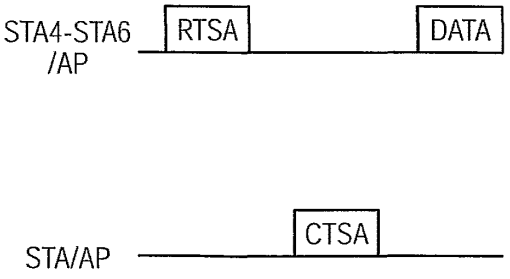

STA4-STA6
/AP
RTSA
DATA
STA/AP
CTSA

FIG. 5

Electronic Patent Application Fee Transmittal					
Application Number:	15953950				
Filing Date:	16-Apr-2018				
Title of Invention:	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM				
First Named Inventor/Applicant Name:	Xiaodong Li				
Filer:	Christina R. Walsh/Carey Kulp				
Attorney Docket Number:	NEO-PT012.6				
Filed as Large Entity					
Filing Fees for Utility under 35 USC 111(a)					
Description		**Fee Code**	**Quantity**	**Amount**	**Sub-Total in USD($)**
Basic Filing:					
Pages:					
Claims:					
Miscellaneous-Filing:					
Petition:					
Patent-Appeals-and-Interference:					
Post-Allowance-and-Post-Issuance:					
Extension-of-Time:					

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
SUBMISSION- INFORMATION DISCLOSURE STMT	1806	1	240	240
		Total in USD ($)		**240**

Electronic Acknowledgement Receipt	
EFS ID:	39803672
Application Number:	15953950
International Application Number:	
Confirmation Number:	1085
Title of Invention:	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Xiaodong Li
Customer Number:	3624
Filer:	Christina R. Walsh/Carey Kulp
Filer Authorized By:	Christina R. Walsh
Attorney Docket Number:	NEO-PT012.6
Receipt Date:	23-JUN-2020
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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	NEO-PT012_6-IDS_transmittal-EFS.pdf	60321 191107da9852093d876b3e166b59651dceae58e1	no	3
Warnings:					
Information:					
2	Information Disclosure Statement (IDS) Form (SB08)	NEO-PT012_6-SB08-EFS.pdf	1054528 10fed1cdbb66ac44126aad6e50ab9e6ec87a4c2b	no	5
Warnings:					
Information:					
3	Foreign Reference	CN1407745.pdf	13923217 a219e7f278eb3c22b22a28e76e8a537adc168e43	no	15
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Information:					
4	Foreign Reference	CN1445949.pdf	15635182 68e54b1bc52eb657f216d68b6c5d1c29b3a7960e	no	17
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5	Foreign Reference	wo03058881.pdf	724700 c9820f829611de00d8e14e43815148a6f2ed1f18	no	16
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Information:					
6	Non Patent Literature	802_16a_2003.PDF	3354632 a71a466f18d0233692bb8b226ed191271ba2d1fa	no	323
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Information:					

7	Non Patent Literature	ETSI_EN_300_744_V1_5_1.pdf	2610707 2223a1ce2653d3bb4d3882303976757d4ffd6cab	no	64
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8	Fee Worksheet (SB06)	fee-info.pdf	30673 7c0488fd2a62baa22e07af739e8d4208b6d492c3	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	37393960		

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If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
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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.

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the **PATENT APPLICATION** of:	
Li et al.	
Application No.: 15/953,950	
Confirmation No.: 1085	
Filed: April 16, 2018	
For: CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM	
Group: 2461	
Examiner: Dmitry Levitan	

Our File: NEO-PT012.6
Date: June 23, 2020

INFORMATION DISCLOSURE STATEMENT

Mail Stop Amendment (via EFS)
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Further to Applicant's Duty of Disclosure pursuant to 37 C.F.R. §1.56, Applicant wishes to bring to the Examiner's attention the material cited on the enclosed PTO Form SB-08.

References cited in the parent application are cited on the PTO Form SB-08. Pursuant to 37 C.F.R. §1.98(d) copies of documents cited in the parent application are not enclosed, but copies will be provided upon request. Copies of the newly cited foreign patents and non-patent literature references are enclosed. Pursuant to 37 C.F.R. §1.98(a)(2)(ii), copies of the cited U.S. publications and/or patent documents have not been included.

6333797-1

This Application is a continuation of U.S. Patent Application No. 14/321,615, filed July 1, 2014, which issued April 17, 2018 as U.S. Patent No. 9,948,488, which is a continuation of U.S. Patent Application No. 13/861,942, filed April 12, 2013, which issued July 1, 2014 as U.S. Patent No. 8,767,522, which is a continuation of U.S. Patent Application No. 13/347,644, filed January 10, 2012, which issued April 23, 2013 as U.S. Patent No. 8,428,009, which is a continuation of U.S. Patent Application No. 12/975,226, filed December 21, 2010, which issued January 10, 2012 as U.S. Patent No. 8,094,611, which is a continuation of U.S. Patent Application No. 10/583,229, filed August 27, 2008, which issued January 4, 2011 as U.S. Patent No. 7,864,725, which is the U.S. National Stage, under 35 U.S.C. §371, of International Application No. PCT/US05/03518, filed January 27, 2005, which claims the benefit of Provisional Application No. 60/540,586, filed January 30, 2004 and Provisional Application No. 60/540,032, filed January 29, 2004.

U.S. Patent Application No. 16/902,740, filed June 16, 2020 and U.S. Patent Application No. 16/908,067, filed June 22, 2020, claim the benefit of this Application.

It is respectfully requested that the Examiner consider these documents and return an initialed copy of the PTO Form SB-08 indicating consideration of the cited materials.

Respectfully submitted,

Neo Wireless LLC

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CRW/PCK
Enclosures

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3624 7590 07/13/2020

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PHILADELPHIA, PA 19103

EXAMINER
LEVITAN, DMITRY

ART UNIT	PAPER NUMBER
2461	

DATE MAILED: 07/13/2020

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15/953,950	04/16/2018	Xiaodong Li	NEO-PT012.6	1085

TITLE OF INVENTION: CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1000	$0.00	$0.00	$1000	10/13/2020

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

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I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

3624 7590 07/13/2020
VOLPE AND KOENIG, P.C.
30 SOUTH 17TH STREET, 18TH FLOOR
PHILADELPHIA, PA 19103

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/953,950	04/16/2018	Xiaodong Li	NEO-PT012.6	1085

TITLE OF INVENTION: CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1000	$0.00	$0.00	$1000	10/13/2020

EXAMINER	ART UNIT	CLASS-SUBCLASS
LEVITAN, DMITRY	2461	370-241000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1_____
2_____
3_____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. Fees submitted: ❑Issue Fee ❑Publication Fee (if required) ❑Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❑ Electronic Payment via EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/953,950	04/16/2018	Xiaodong Li	NEO-PT012.6	1085

3624 7590 07/13/2020

VOLPE AND KOENIG, P.C.
30 SOUTH 17TH STREET, 18TH FLOOR
PHILADELPHIA, PA 19103

EXAMINER	
LEVITAN, DMITRY	
ART UNIT	PAPER NUMBER
2461	

DATE MAILED: 07/13/2020

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. 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 30 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, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. 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.

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.

Notice of Allowability	Application No. 15/953,950	Applicant(s) Li et al.	
	Examiner DMITRY LEVITAN	Art Unit 2461	AIA (FITF) Status No

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

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to 6/23/20.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ 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.

3. ☑ The allowed claim(s) is/are 21-56 . As a result of the allowed claim(s), 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.**

4. ☐ 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)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☑ Notice of References Cited (PTO-892)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☐ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/DMITRY LEVITAN/
Primary Examiner, Art Unit 2461

Notice of References Cited	Application/Control No. 15/953,950	Applicant(s)/Patent Under Reexamination Li et al.	
	Examiner DMITRY LEVITAN	Art Unit 2461	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-8363691-B2	01-2013	Hasegawa; Tsuyoshi	H04B1/707	370/335
*	B	US-8102832-B2	01-2012	Agrawal; Avneesh	H04B1/713	370/342
*	C	US-7873009-B2	01-2011	Larsson; Peter	H04W28/18	370/330
	D					
	E					
	F					
	G					
	H					
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC 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.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/953,950	Li et al.
	Examiner	Art Unit
	DMITRY LEVITAN	2461

CPC - Searched*		
Symbol	Date	Examiner
H04L 12/26	07/02/2020	DL

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner
370	241, 252, 310, 328, 330, 464, 532	07/02/2020	DL

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
IEEE, EAST	07/02/2020	DL

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
370	241	07/02/2020	DL

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/953,950	Li et al.
	Examiner	**Art Unit**
	DMITRY LEVITAN	2461

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

CLAIMS

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

CLAIM		DATE								
Final	Original	05/02/2019	11/14/2019	03/16/2020	07/02/2020					
1	21	✓	✓	✓	=					
2	22	✓	✓	✓	=					
4	23	✓	✓	✓	=					
5	24	✓	✓	✓	=					
3	25	✓	✓	✓	=					
6	26	✓	✓	✓	=					
8	27	✓	✓	✓	=					
9	28	✓	✓	✓	=					
10	29	✓	✓	✓	=					
11	30	✓	✓	✓	=					
12	31	✓	✓	✓	=					
13	32	✓	✓	✓	=					
15	33	✓	✓	✓	=					
16	34	✓	✓	✓	=					
17	35	✓	✓	✓	=					
18	36	✓	✓	✓	=					
19	37	✓	✓	✓	=					
20	38	✓	✓	✓	=					
21	39	✓	✓	✓	=					
23	40	✓	✓	✓	=					
24	41				=					
26	42				=					
27	43				=					
25	44				=					
28	45				=					
29	46				=					
7	47				=					
14	48				=					
22	49				=					
30	50				=					
31	51				=					
32	52				=					
33	53				=					
34	54				=					
35	55				=					
36	56				=					

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/953,950	Li et al.
	Examiner	**Art Unit**
	DMITRY LEVITAN	2461

CPC							
Symbol						**Type**	**Version**
H04L	/	27	/	2626		F	2013-01-01
H04L	/	5	/	0007		I	2013-01-01
H04L	/	5	/	0028		I	2013-01-01
H04L	/	25	/	03834		I	2013-01-01
H04L	/	27	/	0008		I	2013-01-01
H04L	/	27	/	0012		I	2013-01-01
H04L	/	27	/	2602		I	2013-01-01
H04B	/	1	/	707		I	2013-01-01
H04B	/	1	/	711		I	2013-01-01
H04L	/	27	/	2647		I	2013-01-01
H04L	/	5	/	0016		A	2013-01-01
H04L	/	25	/	0228		A	2013-01-01
H04L	/	27	/	2607		A	2013-01-01
H04L	/	27	/	2655		A	2013-01-01

CPC Combination Sets								
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	36	
/DMITRY LEVITAN/ Primary Examiner, Art Unit 2461	02 July 2020	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	10

U.S. Patent and Trademark Office — Part of Paper No.: 20200702

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/953,950	Li et al.
	Examiner	**Art Unit**
	DMITRY LEVITAN	2461

INTERNATIONAL CLASSIFICATION				
CLAIMED				
H04L	/	12	/	26

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**
370	241

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

NONE (Assistant Examiner)	(Date)	**Total Claims Allowed:** 36	
/DMITRY LEVITAN/ Primary Examiner, Art Unit 2461 (Primary Examiner)	02 July 2020 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 10

U.S. Patent and Trademark Office — Part of Paper No.: 20200702

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/953,950	Li et al.
	Examiner	Art Unit
	DMITRY LEVITAN	2461

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

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
	21		30		39		48								
	22		31		40		49								
	23		32		41		50								
	24		33		42		51								
	25		34		43		52								
	26		35		44		53								
	27		36		45		54								
	28		37		46		55								
	29		38		47		56								

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	36	
/DMITRY LEVITAN/ Primary Examiner, Art Unit 2461	02 July 2020	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	10

U.S. Patent and Trademark Office — Part of Paper No.: 20200702

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
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 contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	15953950
Filing Date	2018-04-16
First Named Inventor	Li et al.
Art Unit	2461
Examiner Name	Dmitry Levitan
Attorney Docket Number	NEO-PT012.6

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	6771706	B2	2004-08-03	Ling et al.	* Corresponds to KR 2003-0085040
	2	7274652	B1	2007-09-25	Webster et al.	* Corresponds to CN 1432245

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20020159422	A1	2002-10-31	Li et al.	
	2	20030072255	A1	2003-04-17	Ma et al.	
	3	20030179776	A1	2003-09-25	Sumasu et al.	* Corresponds to CN 1465150
	4	20040085946	A1	2004-05-06	Morita et al.	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /D.L/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	15953950
	Filing Date	2018-04-16
	First Named Inventor	Li et al.
	Art Unit	2461
	Examiner Name	Dmitry Levitan
	Attorney Docket Number	NEO-PT012.6

	5	20040171357	A1	2004-09-02	Lobinger et al.	
	6	20040264600	A1	2004-12-30	Kao et al.	
	7	20060114815	A1	2006-06-01	Hasegawa et al.	
	8	20060245409	A1	2006-11-02	Korpela et al.	
	9	20080304551	A1	2008-12-11	Li et al.	
	10	20110211617	A1	2011-09-01	Li et al.	
	11	20110299474	A1	2011-12-08	Li et al.	
	12	20120106513	A1	2012-05-03	Li et al.	

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2]	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	1407745	CN	A	2003-04-02	XI AN ELECTRONIC SCIENCE AND TEC		

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /D.L/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	15953950
	Filing Date	2018-04-16
	First Named Inventor	Li et al.
	Art Unit	2461
	Examiner Name	Dmitry Levitan
	Attorney Docket Number	NEO-PT012.6

	2	1445949	CN	A	2003-10-01	UNIV ELECTRONIC SCIENCE AND TECH		
	3	2003058881	WO	A2	2003-07-17	NXP SEMICONDUCTORS NV	* Corresponds to WO 2003/058887	

If you wish to add additional Foreign Patent Document citation information please click the Add button [Add]

NON-PATENT LITERATURE DOCUMENTS [Remove]

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	EUROPEAN TELECOMMUNICATIONS STANDARDS INSTITUTE, Digital Video Broadcasting (DVB); Framing structure, channel coding and modulation for digital terrestrial television, ETSI EN 300 744 V1.5.1 (June 2004).	
	2	IEEE Standard for Local and metropolitan area networks; Part 16: Air Interface for Fixed Broadband Wireless Access Systems — Amendment 2: Medium Access Control Modifications and Additional Physical Layer Specifications for 2–11 GHz, IEEE Std. 802.16a-2003 (April 1, 2003).	

If you wish to add additional non-patent literature document citation information please click the Add button [Add]

EXAMINER SIGNATURE

Examiner Signature	/DMITRY LEVITAN/	Date Considered	07/02/2020

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

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /D.L/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	15953950
	Filing Date	2018-04-16
	First Named Inventor	Li et al.
	Art Unit	2461
	Examiner Name	Dmitry Levitan
	Attorney Docket Number	NEO-PT012.6

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

☒ The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Christina R. Walsh/	Date (YYYY-MM-DD)	2020-06-23
Name/Print	Christina R. Walsh	Registration Number	61,553

This collection of information is required by 37 CFR 1.97 and 1.98. 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 1 hour 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.**

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /D.L/

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 record s.

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.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /D.L/

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L5	12	(radio or wireless) and ((frequency near3 domain) near4 (prob$3 or test$3)) and (Base$station or BST or BS or enb or enodeB) and ((time near2 domain) near3 (overlap$3 or "same" or shar$4)) and @ay<"2005"	US-PGPUB; USPAT	OR	ON	2020/07/02 15:04
L6	22	(LTE or radio or wireless) and ((frequency near3 domain) with (prob$3 or test$3)) and ((time near2 domain) near3 (overlap$3 or "same" or shar$4)) and @ay<"2005"	US-PGPUB; USPAT	OR	ON	2020/07/02 15:06
L9	29	(LTE or radio or wireless) and ((frequency near3 domain) near5 (code)) and ((time near2 domain) near3 (overlap$3 or "same" or shar$4)) and (prob$3 or test$3) and @ay<"2005"	US-PGPUB; USPAT	OR	ON	2020/07/02 16:10

7/2/2020 4:13:36 PM
C:\Users\dlevitan\Documents\EAST\Workspaces\15953950.wsp

EAST Search History

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L13	45	((LTE or radio or wireless) and ((frequency near5 domain)) and ((time near2 domain) near7 (prob$3 or test$3))).clm.	US-PGPUB; USPAT	OR	ON	2020/07/02 16:29
L14	6	((LTE or radio or wireless) and OFDM and ((frequency near5 domain)) and ((time near2 domain) near7 (prob$3 or test$3))).clm.	US-PGPUB; USPAT	OR	ON	2020/07/02 16:30
L17	9	((LTE or radio or wireless) and OFDM and ((time near2 domain) near7 (prob$3 or test$3))).clm.	US-PGPUB; USPAT	OR	ON	2020/07/02 16:33

7/2/2020 4:34:25 PM
C:\Users\dlevitan\Documents\EAST\Workspaces\15953950.wsp

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

3624 7590 07/13/2020
VOLPE AND KOENIG, P.C.
30 SOUTH 17TH STREET, 18TH FLOOR
PHILADELPHIA, PA 19103

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

Christina R. Walsh	(Typed or printed name)
/Christina R. Walsh/	(Signature)
July 31, 2020	(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/953,950	04/16/2018	Xiaodong Li	NEO-PT012.6	1085

TITLE OF INVENTION: CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1000	$0.00	$0.00	$1000	10/13/2020

EXAMINER	ART UNIT	CLASS-SUBCLASS
LEVITAN, DMITRY	2461	370-241000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 Volpe and Koenig, P.C.
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: Neo Wireless LLC

(B) RESIDENCE: (CITY and STATE OR COUNTRY): Wayne, PA

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ☒ Corporation or other private group entity ❑ Government

4a. Fees submitted: ☒ Issue Fee ❑ Publication Fee (if required) ❑ Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

☒ Electronic Payment via EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

☒ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. 220493

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /Christina R. Walsh/ Date July 31, 2020

Typed or printed name Christina R. Walsh Registration No. 61,553

Electronic Patent Application Fee Transmittal

Application Number:	15953950
Filing Date:	16-Apr-2018
Title of Invention:	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Xiaodong Li
Filer:	Christina R. Walsh/Shaylynn McNally
Attorney Docket Number:	NEO-PT012.6

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
UTILITY APPL ISSUE FEE	1501	1	1000	1000

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**1000**

Electronic Acknowledgement Receipt	
EFS ID:	40163060
Application Number:	15953950
International Application Number:	
Confirmation Number:	1085
Title of Invention:	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Xiaodong Li
Customer Number:	3624
Filer:	Christina R. Walsh/Shaylynn McNally
Filer Authorized By:	Christina R. Walsh
Attorney Docket Number:	NEO-PT012.6
Receipt Date:	31-JUL-2020
Filing Date:	16-APR-2018
Time Stamp:	14:53:57
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$1000
RAM confirmation Number	E20207UE54431821
Deposit Account	220493
Authorized User	Shaylynn McNally
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.16 (National application filing, search, and examination fees) 37 CFR 1.17 (Patent application and reexamination processing fees)	

37 CFR 1.19 (Document supply fees)

37 CFR 1.20 (Post Issuance fees)

37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Issue Fee Payment (PTO-85B)	NEO-PT012_6_Issue-Fee-efs.pdf	163636 215cf5a4c41c2a035c6e7de2832f93f741f5ef94	no	1
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30416 e834b06daf85107bb1e3bf3f7a705864e8a27564	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	194052		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

<u>New Applications Under 35 U.S.C. 111</u>
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
<u>National Stage of an International Application under 35 U.S.C. 371</u>
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
<u>New International Application Filed with the USPTO as a Receiving Office</u>
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.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/953,950	09/08/2020	10771302	NEO-PT012.6	1085

3624 7590 08/19/2020

Volpe Koenig
30 SOUTH 17TH STREET, 18TH FLOOR
PHILADELPHIA, PA 19103

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 0 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

Xiaodong Li, Kirkland, WA;
Neo Wireless LLC, Wayne, PA;
Titus Lo, Bellevue, WA;
Kemin Li, Bellevue, WA;
Haiming Huang, Bellevue, WA;

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The USA offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to encourage and facilitate business investment. To learn more about why the USA is the best country in the world to develop technology, manufacture products, and grow your business, visit SelectUSA.gov.

IR103 (Rev. 10/09)

AO 120 (Rev. 08/10)

TO:	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK
Mail Stop 8 **Director of the U.S. Patent and Trademark Office** **P.O. Box 1450** **Alexandria, VA 22313-1450**	

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Eastern District of Texas, Marshall Division on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
2:22-cv-00093	3/29/2022	Eastern District of Texas, Marshall Division

PLAINTIFF	DEFENDANT
Neo Wireless LLC	Toyota Motor North America, Inc., Toyota Motor Sales, U.S.A., Inc., & Toyota Motor Engineering & Manufacturing North America, Inc.

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	8,467,366	6/18/2013	Neo Wireless LLC
2	10,075,941	9/11/2018	Neo Wireless LLC
3	10,447,450	10/15/2019	Neo Wireless LLC
4	10,771,302	9/8/2020	Neo Wireless LLC
5	10,833,908	4/17/2018	Neo Wireless LLC

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
2		
3		
4		
5		

In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE

Copy 1—Upon initiation of action, mail this copy to Director Copy 3—Upon termination of action, mail this copy to Director
Copy 2—Upon filing document adding patent(s), mail this copy to Director Copy 4—Case file copy

REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK

Page 2 of 2

PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
6 10,965,512	3/30/2021	Neo Wireless LLC

AO 120 (Rev. 08/10)

TO:	Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Eastern District of Texas, Marshall Division on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
2:22-cv-00094	3/29/2022	Eastern District of Texas, Marshall Division

PLAINTIFF	DEFENDANT
Neo Wireless LLC	General Motors Company and General Motors LLC

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	8,467,366	6/18/2013	Neo Wireless LLC
2	10,075,941	9/11/2018	Neo Wireless LLC
3	10,447,450	10/15/2019	Neo Wireless LLC
4	10,771,302	9/8/2020	Neo Wireless LLC
5	10,833,908	4/17/2018	Neo Wireless LLC

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
2		
3		
4		
5		

In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE

Copy 1—Upon initiation of action, mail this copy to Director Copy 3—Upon termination of action, mail this copy to Director
Copy 2—Upon filing document adding patent(s), mail this copy to Director Copy 4—Case file copy

REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK

Page 2 of 2

PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
6 10,965,512	3/30/2021	Neo Wireless LLC

AO 120 (Rev. 08/10)

TO:	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK
Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Eastern District of Texas, Marshall Division on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
2:22-cv-00095	3/29/2022	Eastern District of Texas, Marshall Division

PLAINTIFF	DEFENDANT
Neo Wireless LLC	Tesla Inc.

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	8,467,366	6/18/2013	Neo Wireless LLC
2	10,075,941	9/11/2018	Neo Wireless LLC
3	10,447,450	10/15/2019	Neo Wireless LLC
4	10,771,302	9/8/2020	Neo Wireless LLC
5	10,833,908	4/17/2018	Neo Wireless LLC

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
2		
3		
4		
5		

In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE

Copy 1—Upon initiation of action, mail this copy to Director Copy 3—Upon termination of action, mail this copy to Director
Copy 2—Upon filing document adding patent(s), mail this copy to Director Copy 4—Case file copy

REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK

Page 2 of 2

PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
6 10,965,512	3/30/2021	Neo Wireless LLC

To Be Filed in CM/ECF

AO 120 (Rev. 08/10)

TO:	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK
Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Eastern District of Tennessee on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
	3/29/2022	Eastern District of Tennessee

PLAINTIFF	DEFENDANT
Neo Wireless LLC	Volkswagen Group of America, Inc. & Volkswagen Group of America Chattanooga Operations, LLC

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	8,467,366	6/18/2013	Neo Wireless LLC
2	10,075,941	9/11/2018	Neo Wireless LLC
3	10,447,450	10/15/2019	Neo Wireless LLC
4	10,771,302	9/8/2020	Neo Wireless LLC
5	10,833,908	4/17/2018	Neo Wireless LLC

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
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In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE

Copy 1—Upon initiation of action, mail this copy to Director Copy 3—Upon termination of action, mail this copy to Director
Copy 2—Upon filing document adding patent(s), mail this copy to Director Copy 4—Case file copy

REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK

PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
6 10,965,512	3/30/2021	Neo Wireless LLC

AO 120 (Rev. 08/10)

TO:	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK
Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court for the Middle District of Tennessee on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
3:22-cv-00220	3/29/2022	for the Middle District of Tennessee

PLAINTIFF	DEFENDANT
NEO Wireless, LLC	Nissan North America Inc.

PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1 8467366		See attached complaint
2 10833908		
3 10075941		
4 10447450		
5 10965512		

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☑ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1 10771302		
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In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE
LYNDA M. HILL	VANESSA HAINES	4/4/2022

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AO 120 (Rev. 08/10)

TO:	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK
Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Northern District of Ohio on the following

☑ Trademarks or ☐ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
3:22-cv-01252	7/15/2022	Northern District of Ohio

PLAINTIFF	DEFENDANT
Neo Wireless LLC	FCA US, LLC

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	8,467,366	6/18/2013	Neo Wireless LLC
2	10,075,941	9/11/2018	Neo Wireless LLC
3	10,447,450	10/15/2019	Neo Wireless LLC
4	10,771,302	9/8/2020	Neo Wireless LLC
5	10,833,908	4/17/2018	Neo Wireless LLC

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
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In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE

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Copy 2—Upon filing document adding patent(s), mail this copy to Director Copy 4—Case file copy

REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK

PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
6 10,965,512	3/30/2021	Neo Wireless LLC

AO 120 (Rev. 08/10)

TO:	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK
Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Middle District of Florida on the following

☐ Trademarks or ☒ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
3:22-cv-780-J-MMHJBT	July 15, 2022	Middle District of Florida

PLAINTIFF	DEFENDANT
NEO WIRELESS, LLC	MERCEDES-BENZ USA, LLC

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	8,467,366	January 23, 2020	Neo Wireless LLC
2	10,833,908	June 16, 2020	Neo Wireless LLC
3	10,075,941	January 23, 2020	Neo Wireless LLC
4	10,447,450	January 23, 2020	Neo Wireless LLC
5	10,965,512	September 4, 2020	Neo Wireless
6	10,771,302	January 23, 2020	Neo Wireless LLC

CLERK	(BY) DEPUTY CLERK	DATE
ELIZABETH M. WARREN	Amy Thomas	July 20, 2022

Copy 1—Upon initiation of action, mail this copy to Director **Copy 3—Upon termination of action, mail this copy to Director**
Copy 2—Upon filing document adding patent(s), mail this copy to Director **Copy 4—Case file copy**

AO 120 (Rev. 08/10)

TO:	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK
Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Northern District of Ohio on the following

☑ Trademarks or ☐ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
3:22-cv-01252	7/15/2022	Northern District of Ohio

PLAINTIFF	DEFENDANT
Neo Wireless LLC	FCA US, LLC

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	8,467,366	6/18/2013	Neo Wireless LLC
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5	10,833,908	4/17/2018	Neo Wireless LLC

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PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
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In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT
Conditional Transfer Order (CTO 1) by the Judicial Panel on Multidistrict Litigation. In re: MDL 3034 Neo Wireless, LLC, Patent Litigation. Case Transferred to Eastern District of Michigan and assigned to the Honorable Terrence G. Berg.

CLERK	(BY) DEPUTY CLERK	DATE
Sandy Opacich	/s/Natalie Wlotzko	8/15/2022

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Page 2 of 2

PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
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