

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/AIA/82B identifies the application to which the Power of Attorney is directed, the Power of Attorney will not be recognized in the application.

Application Number	Not Yet Known
Filing Date	June 16, 2020
First Named Inventor	Li et al.
Title	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM
Art Unit	Not Yet Known
Examiner Name	Not Yet Known
Attorney Docket Number	NEO-PT012.7

SIGNATURE of Applicant or Patent Practitioner

Signature	/Christina R. Walsh/	Date (Optional)	June 16, 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.

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):

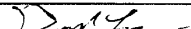
Neo Wireless LLC

- ☐ 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



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.

0002

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

First Named Inventor:	Li et al.	Nonprovisional Application Number (if known):	
Title of Invention:	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM		

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

1. The processing fee set forth in 37 CFR 1.17(i)(1) and the prioritized examination fee set forth in 37 CFR 1.17(c) have been filed with the request. The publication fee requirement is met because that fee, set forth in 37 CFR 1.18(d), is currently \$0. The basic filing fee, search fee, and examination fee are filed with the request or have been already been paid. I understand that any required excess claims fees or application size fee must be paid for the application.
2. I understand that the application may not contain, or be amended to contain, more than four independent claims, more than thirty total claims, or any multiple dependent claims, and that any request for an extension of time will cause an outstanding Track I request to be dismissed.
3. The applicable box is checked below:
 - I. ☒ **Original Application (Track One) - Prioritized Examination under § 1.102(e)(1)**
 - i. (a) The application is an original nonprovisional utility application filed under 35 U.S.C. 111(a). This certification and request is being filed with the utility application via EFS-Web.
---OR---
 - (b) The application is an original nonprovisional plant application filed under 35 U.S.C. 111(a). This certification and request is being filed with the plant application in paper.
 - ii. An executed inventor's oath or declaration under 37 CFR 1.63 or 37 CFR 1.64 for each inventor, or the application data sheet meeting the conditions specified in 37 CFR 1.53(f)(3)(i) is filed with the application.
 - II. ☐ **Request for Continued Examination - Prioritized Examination under § 1.102(e)(2)**
 - i. A request for continued examination has been filed with, or prior to, this form.
 - ii. If the application is a utility application, this certification and request is being filed via EFS-Web.
 - iii. The application is an original nonprovisional utility application filed under 35 U.S.C. 111(a), or is a national stage entry under 35 U.S.C. 371.
 - iv. This certification and request is being filed prior to the mailing of a first Office action responsive to the request for continued examination.
 - v. No prior request for continued examination has been granted prioritized examination status under 37 CFR 1.102(e)(2).

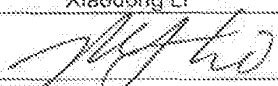
Signature	/Christina R. Walsh/	Date	June 16, 2020
Name (Print/Typed)	Christina R. Walsh	Practitioner Registration Number	61553
Note: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. Submit multiple forms if more than one signature is required.*			
☒ *Total of <u>1</u> forms are submitted.			

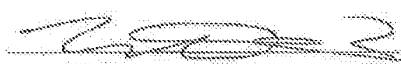
Privacy Act Statement

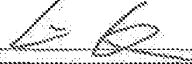
The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection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

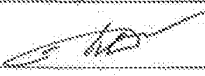
The information provided by you in this form will be subject to the following routine uses:

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

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 ☐ The attached application, or is directed to: ☒ United States application or PCT international application number <u>13/861,942</u> filed on <u>04/12/2013</u> 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: Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.	
LEGAL NAME OF INVENTOR Inventor: <u>Xiaodong Li</u> Date: <u>6/5/2013</u> 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: <u>Titus Lo</u> Date: <u>4/12/2013</u> 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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As the below named inventor, I hereby declare that: This declaration ☐ The attached application, or is directed to: ☒ United States application or PCT international application number <u>13/661,942</u> filed on <u>04/12/2013</u> 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: Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.	
LEGAL NAME OF INVENTOR Inventor: <u>Kemin Li</u> Date: <u>06/05/2013</u> 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.	

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Title of Invention	METHODS AND APPARATUS FOR SIGNAL TRANSMISSION AND RECEPTION IN A BROADBAND COMMUNICATION SYSTEM
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LEGAL NAME OF INVENTOR Inventor: <u>Haiming Huang</u> Date: <u>04/12/2013</u> 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.	

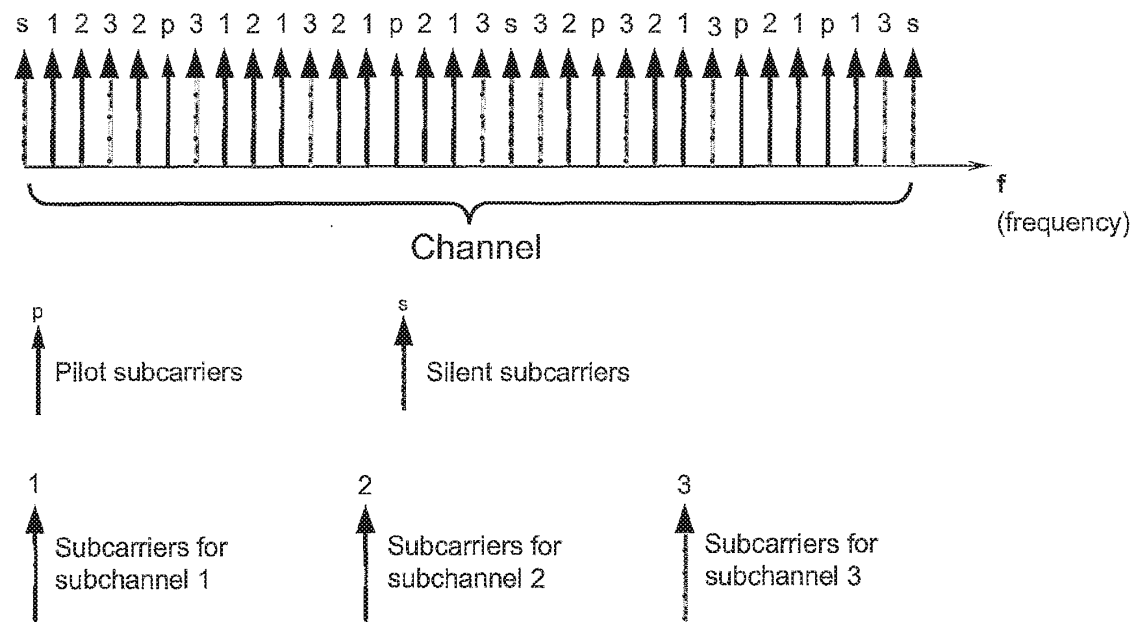


FIG. 1

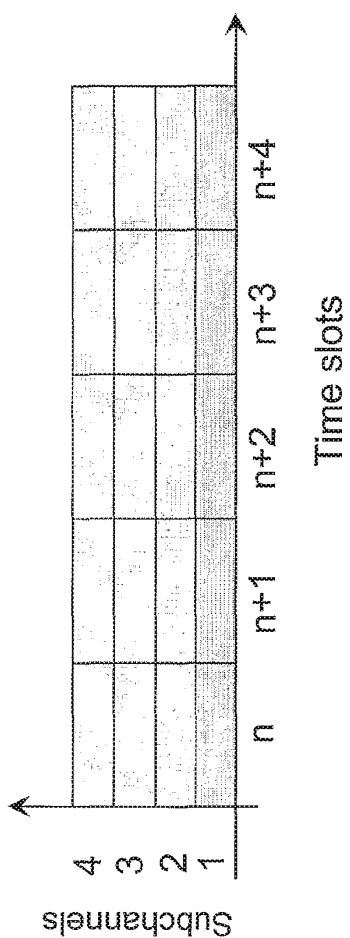


FIG. 2

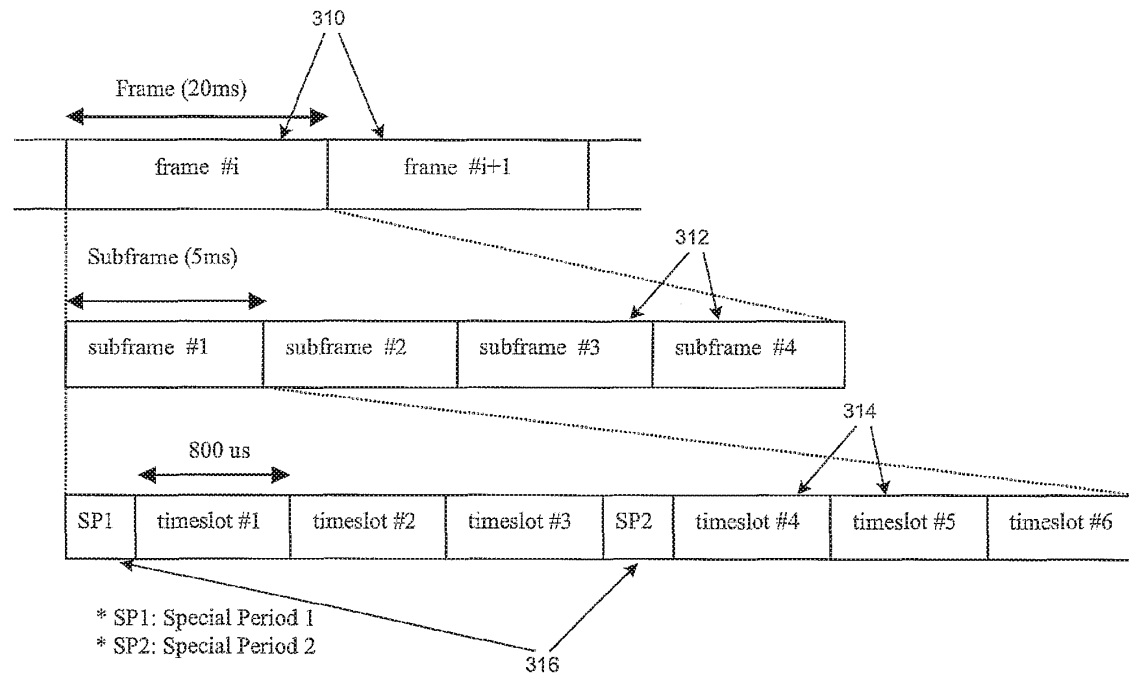


FIG. 3

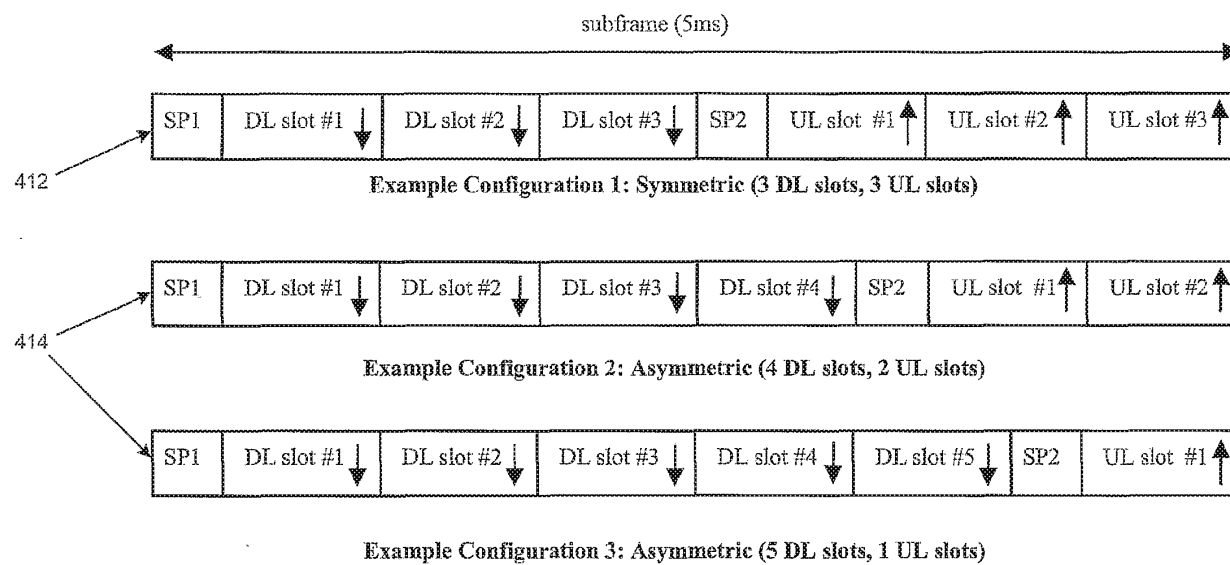


FIG. 4

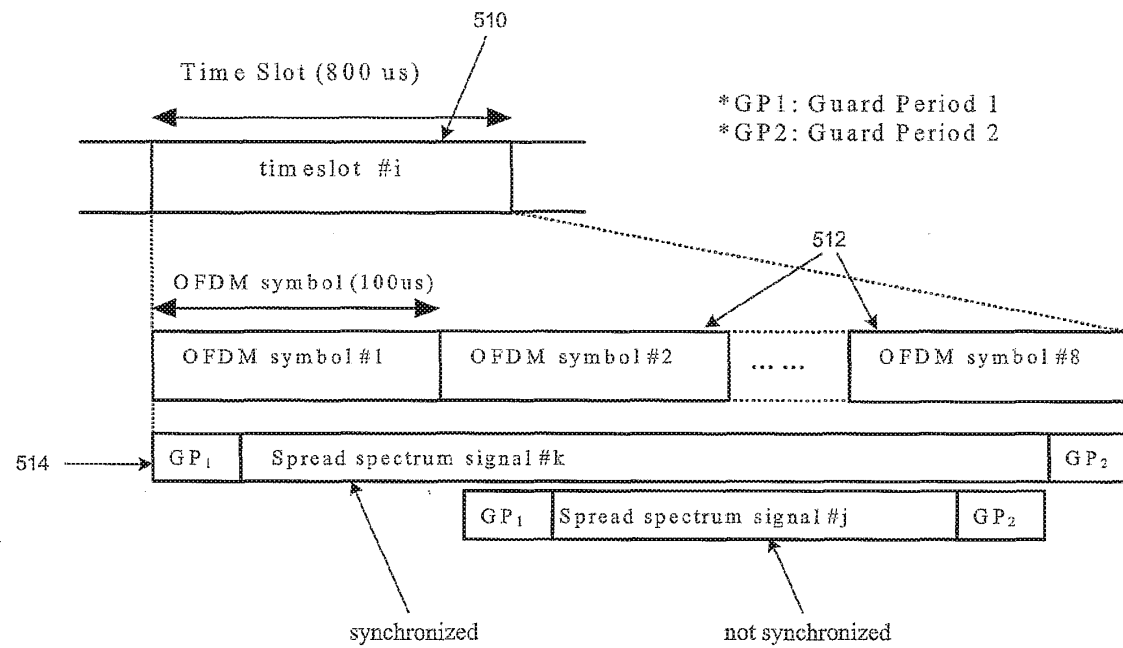
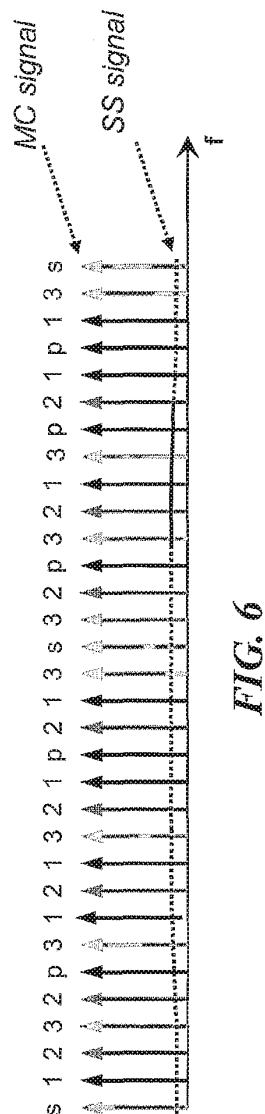
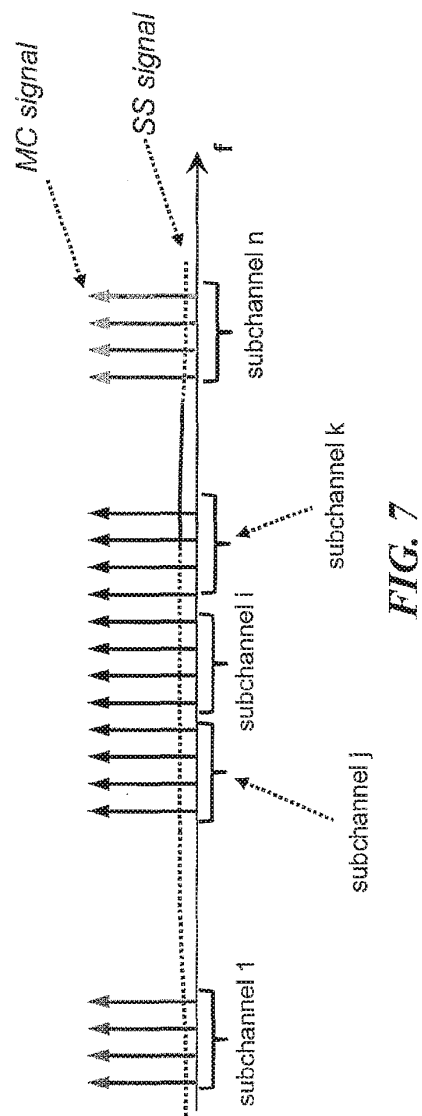


FIG. 5





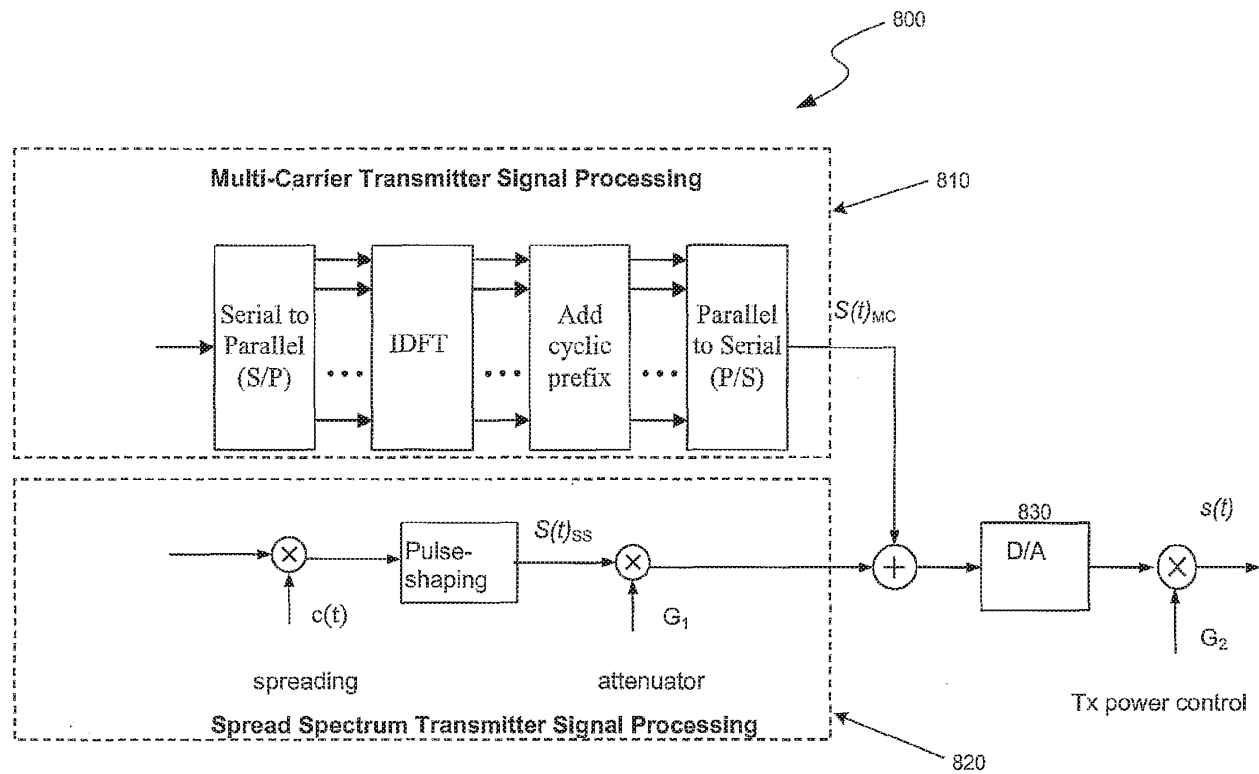


FIG. 8

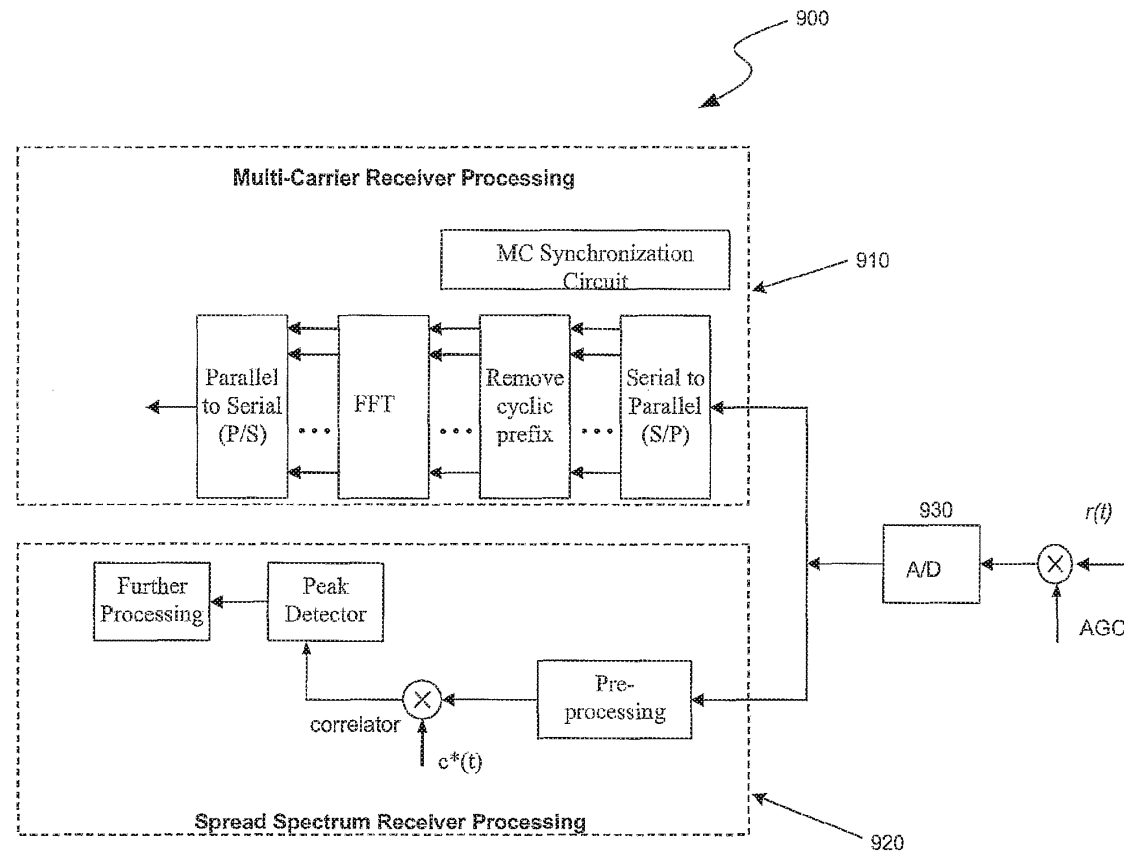
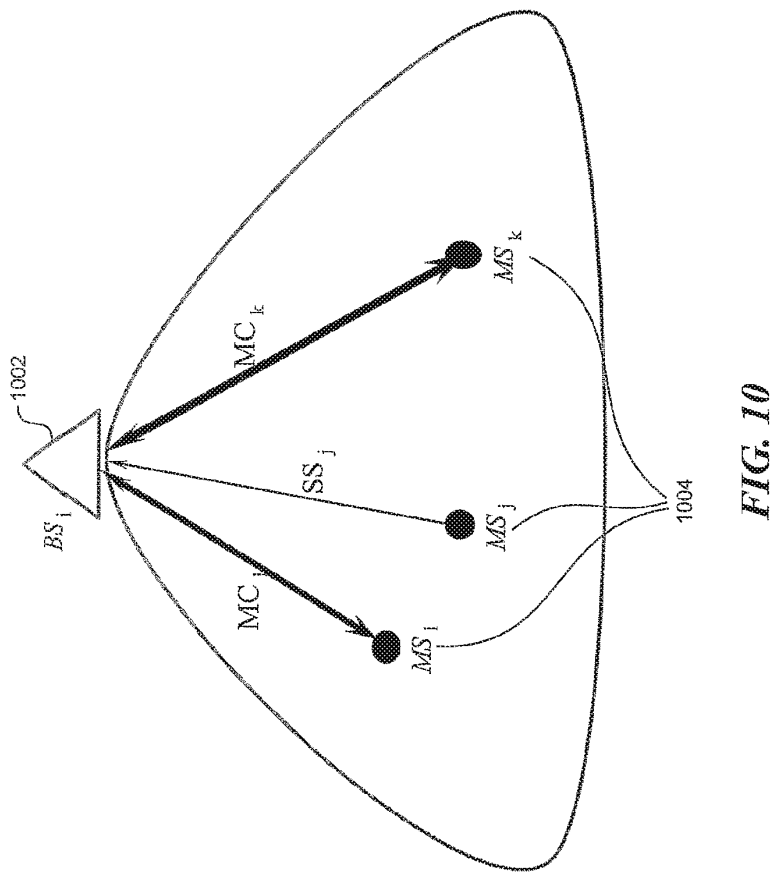


FIG. 9



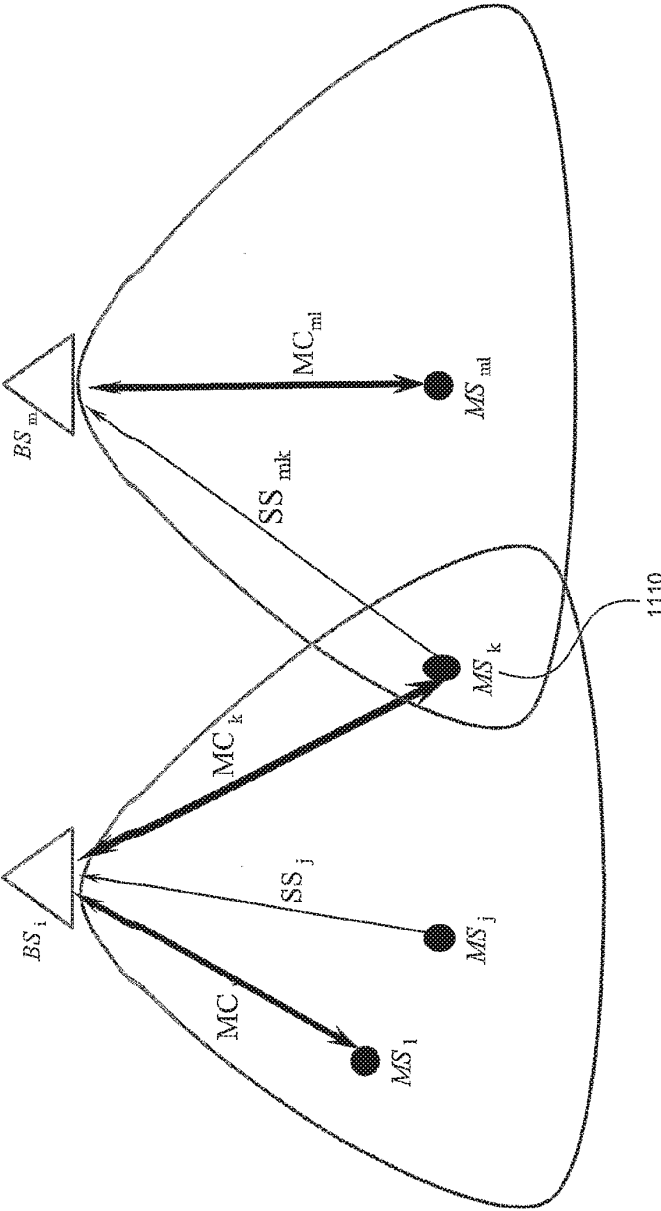


FIG. 11

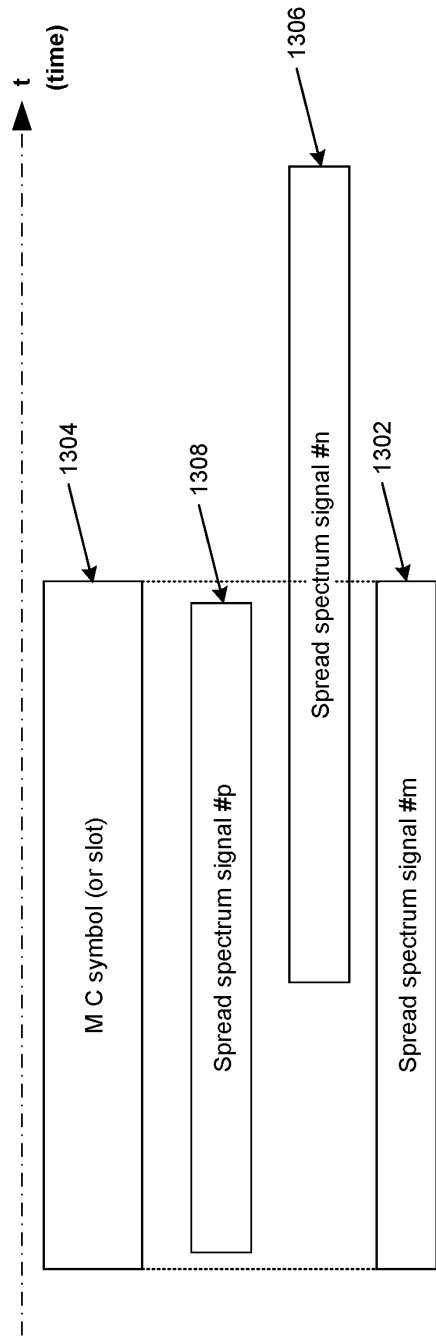


FIG. 13

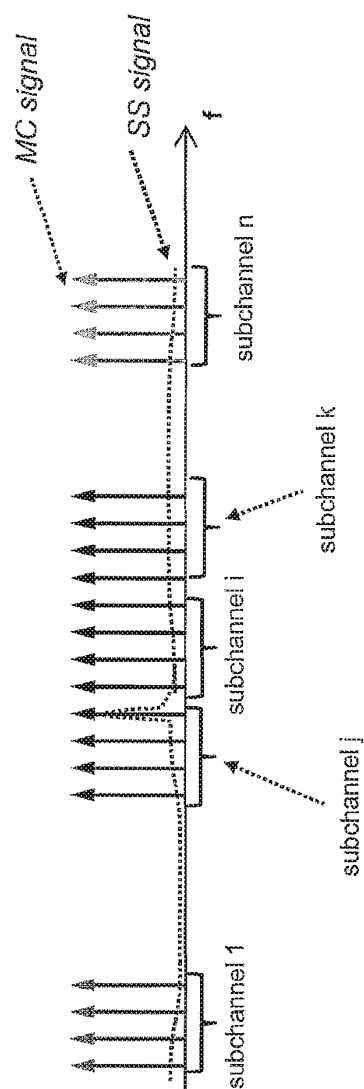
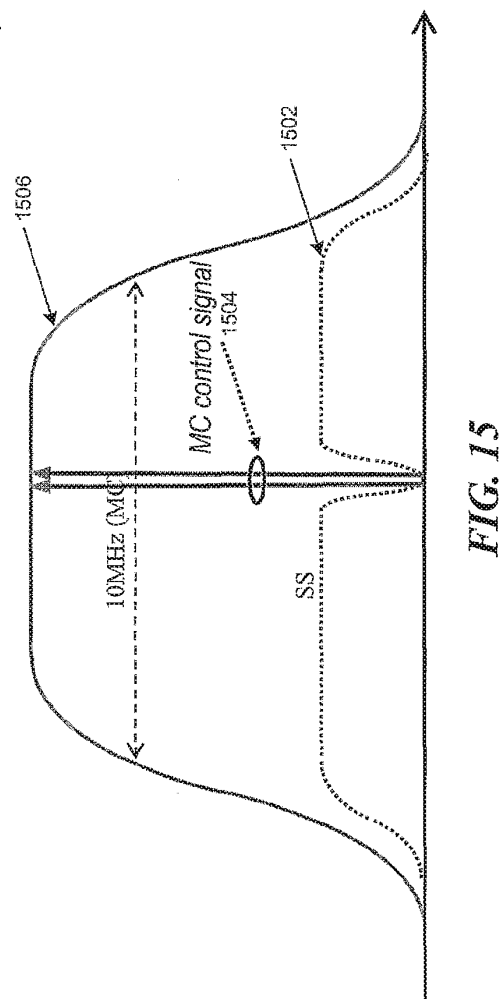
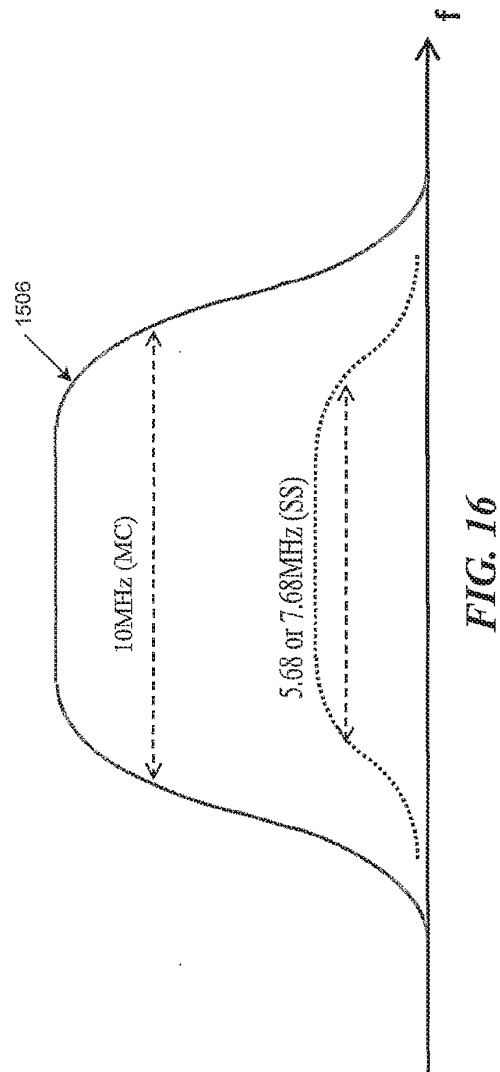


FIG. 14





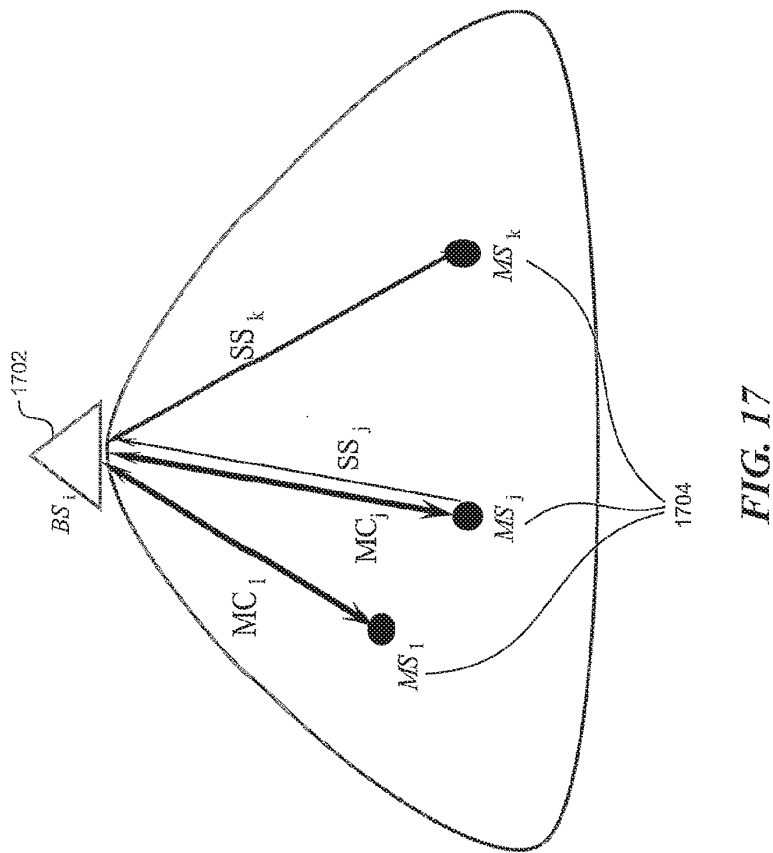


FIG. 17

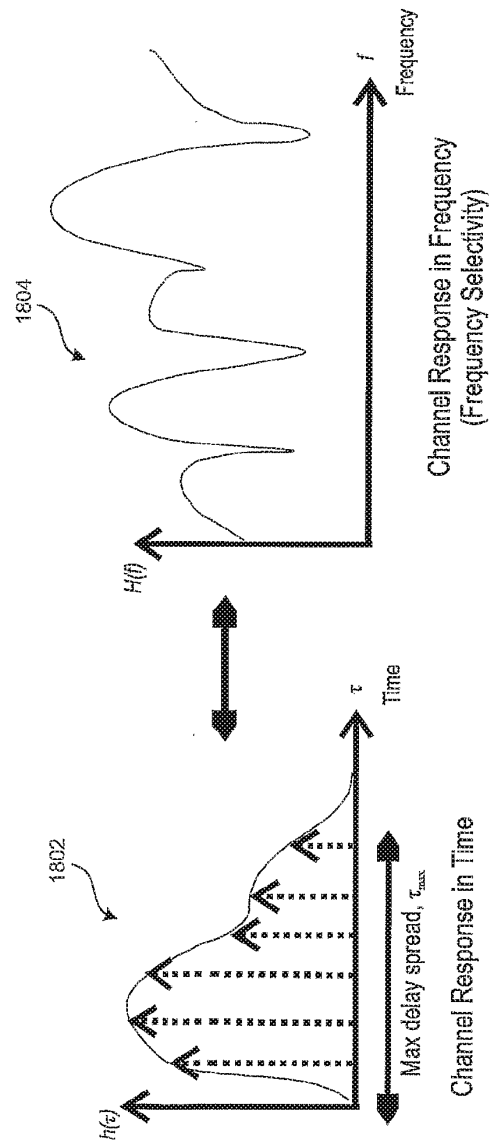


FIG. 18

Electronic Patent Application Fee Transmittal				
Application Number:				
Filing Date:				
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-PT012.7		
Filed as Large Entity				
Filing Fees for Track I Prioritized Examination - Nonprovisional Application under 35 USC 111(a)				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
UTILITY APPLICATION FILING	1011	1	300	300
UTILITY SEARCH FEE	1111	1	660	660
UTILITY EXAMINATION FEE	1311	1	760	760
REQUEST FOR PRIORITIZED EXAMINATION	1817	1	4000	4000
Pages:				
Claims:				
CLAIMS IN EXCESS OF 20	1202	10	100	1000
Miscellaneous-Filing:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
PUBL. FEE- EARLY, VOLUNTARY, OR NORMAL	1504	1	0	0
PROCESSING FEE, EXCEPT PROV. APPLS.	1830	1	140	140
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				6860

Electronic Acknowledgement Receipt	
EFS ID:	39730343
Application Number:	16902740
International Application Number:	
Confirmation Number:	1020
Title of Invention:	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM
First Named Inventor/Applicant Name:	Xiaodong Li
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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. 15/953,950, filed April 16, 2018, which is continuation of U.S. Patent Application No. 14/321,615, filed July 1, 2014, which issued on April 17, 2018 as U.S. Patent No. 9,948,488, which is a continuation application of U.S. Patent Application No. 13/861,942, filed April 12, 2013, which issued on July 1, 2014 as U.S. Patent No. 8,767,522, which is a continuation application of U.S. Patent Application No. 13/347,644, filed January 10, 2012, which issued on April 23, 2013 as U.S. Patent No. 8,428,009, which is a continuation application of U.S. Patent Application No. 12/975,226, filed December 21, 2010, which issued on January 10, 2012 as U.S. Patent No. 8,094,611, 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, filed August 27, 2008, which issued on January 4, 2011 as U.S. Patent No. 7,864,725, 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 orthogonality 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 vice 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 800 μ s 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 b_i 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 $\frac{1}{2}$ error control coding or 15dB for MC using 16QAM modulation with $\frac{1}{2}$ 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 subcarriers 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_i 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_i 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.

CLAIMS

What is claimed is:

1. A mobile station comprising:

a transmitter configured to:

transmit, to a base station, a first uplink signal within a frequency band, wherein the first uplink signal is an orthogonal frequency division multiplexing (OFDM) signal and utilizes a frame format comprising a plurality of timeslots, each timeslot comprising a plurality of OFDM symbols;

transmit, to the base station, an initial random access signal followed by a guard period in only a portion of the frequency band, wherein the initial random access signal includes a sequence associated with the base station and a time duration of the initial random access signal and the guard period is greater than a time duration of at least one of the plurality of OFDM symbols; and

a receiver configured to receive, from the base station, a response message.

2. The mobile station of claim 1, wherein:

the receiver is configured to determine if the response message identifies the sequence associated with the base station in the initial random access signal; and

on a condition that the response message identifies the sequence associated with the base station in the initial random access signal, the transmitter is configured to transmit a second uplink signal.

3. The mobile station of claim 2, wherein the response message includes power adjustment information and wherein the transmitter is configured to transmit the second uplink signal according to the power adjustment information.

4. The mobile station of claim 1, wherein the portion of the frequency band used for transmission of the initial random access signal does not include control channels.

5. The mobile station of claim 1, wherein the response message includes a mobile station identifier assigned to the mobile station.

6. The mobile station of claim 1, wherein the time duration of the initial random access signal and the guard period is greater than a time duration of at least two of the plurality of OFDM symbols.

7. The mobile station of claim 1, wherein the frequency band includes an outer portion and a center portion, wherein the portion of the frequency band for the initial random access signal is in the center portion and uplink control signals are sent in the outer portion.

8. The mobile station of claim 1, wherein the initial random access signal is a spread spectrum signal.

9. The mobile station of claim 1, wherein:
the receiver is further configured to receive broadcast information from the base station, the broadcast information indicating at least one sequence associated with the base station for use in producing the initial random access signal.

10. The mobile station of claim 1, wherein the transmitter includes an OFDM transmitter signal processing circuit comprising: a serial to parallel converter, an inverse Fourier transform, and a cyclic prefix addition circuit; and
the OFDM transmitter signal processing circuit outputs the first uplink signal.

11. A method performed by a mobile station, the method comprising:
transmitting, to a base station, a first uplink signal within a frequency band, wherein the first uplink signal is an orthogonal frequency division multiplexing (OFDM) signal and utilizes a frame format comprising a plurality of timeslots, each timeslot comprising a plurality of OFDM symbols;
transmitting, to the base station, an initial random access signal followed by a guard period in only a portion of the frequency band, wherein the initial random access signal includes a sequence associated with the base station and a time

duration of the initial random access signal and the guard period is greater than a time duration of at least one of the plurality of OFDM symbols; and
receiving, from the base station, a response message.

12. The method claim 11, further comprising:
determining if the response message identifies the sequence associated with the base station in the initial random access signal; and
on a condition that the response message identifies the sequence associated with the base station in the initial random access signal, transmitting a second uplink signal.

13. The method of claim 12, wherein the response message includes power adjustment information and wherein the second uplink signal is transmitted according to the power adjustment information.

14. The method of claim 11, wherein the portion of the frequency band used for transmission of the initial random access signal does not include control channels.

15. The method of claim 11, wherein the response message includes a mobile station identifier assigned to the mobile station.

16. The method of claim 11, wherein the time duration of the initial random access signal and the guard period is greater than a time duration of at least two of the plurality of OFDM symbols.

17. The method of claim 11, wherein the frequency band includes an outer portion and a center portion, wherein the portion of the frequency band for the initial random access signal is in the center portion and uplink control signals are sent in the outer portion.

18. The method of claim 11, wherein the initial random access signal is a spread spectrum signal.

19. The method of claim 11, further comprising:

receiving broadcast information from the base station, the broadcast information indicating at least one sequence associated with the base station for use in producing the initial random access signal.

20. The method of claim 11, wherein the first uplink signal is provided by an OFDM transmitter signal processing circuit comprising: a serial to parallel converter, an inverse Fourier transform, and a cyclic prefix addition circuit.

21. A mobile station comprising:

a first type of transmitter signal processing circuit configured to:

generate a first uplink signal, wherein the first uplink signal is an orthogonal frequency division multiplexing (OFDM) signal and utilizes a frame format comprising a plurality of timeslots, each timeslot comprising a plurality of OFDM symbols;

modulate the first uplink signal onto a first set of OFDM subcarriers;

a second type of transmitter signal processing circuit configured to generate an initial random access signal followed by a guard period, wherein the initial random access signal includes a sequence associated with a base station and a time duration of the initial random access signal and the guard period is greater than a time duration of least one of the plurality of OFDM symbols;

a circuit configured to provide at least the first uplink signal or the initial random access signal to output a digital signal;

a digital-to-analog (D/A) conversion circuit configured to convert the digital signal to an analog signal;

an antenna configured to transmit, to the base station, the analog signal in a frequency band, wherein the initial random access signal occupies in a frequency domain only a portion of the frequency band;

the antenna configured to receive, from the base station, a second analog signal;

an analog-to-digital (A/D) conversion circuit configured to convert the second analog signal to a second digital signal; and

a receiver circuit configured to receive, based on the second digital signal, a response message.

22. The mobile station of claim 21, wherein:

the receiver circuit is configured to determine if the response message identifies the sequence associated with the base station in the initial random access signal; and

on a condition that the response message identifies the sequence associated with the base station in the initial random access signal, the first type of transmitter signal processing circuit is configured to transmit a second uplink signal.

23. The mobile station of claim 22, wherein the response message includes power adjustment information and wherein the first type of transmitter signal processing circuit is configured to transmit the second uplink signal according to the power adjustment information.

24. The mobile station of claim 21, wherein the portion of the frequency band used for transmission of the initial random access signal does not include control channels.

25. The mobile station of claim 21, wherein the response message includes a mobile station identifier assigned to the mobile station.

26. The mobile station of claim 21, wherein time duration of the initial random access signal and the guard period is greater than a time duration of at least two of the plurality of OFDM symbols.

27. The mobile station of claim 21, wherein the frequency band includes an outer portion and a center portion, wherein the portion of the frequency band for the initial random access signal is in the center portion and uplink control signals are sent in the outer portion.

28. The mobile station of claim 21, wherein the initial random access signal is a spread spectrum signal.

29. The mobile station of claim 21, wherein:
the receiver circuit is further configured to receive broadcast information from the base station, the broadcast information indicating at least one sequence associated with the base station for use in producing the initial random access signal.

30. The mobile station of claim 21, wherein:
the first type of transmitter signal processing circuit is an OFDM transmitter signal processing circuit comprising: a serial to parallel converter, an inverse Fourier transform, and a cyclic prefix addition circuit; and
the OFDM transmitter signal processing circuit outputs the first uplink signal.

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.

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	NEO-PT012.7
		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						
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Inventor	2				Remove	
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	Titus		Lo			
Residence Information (Select One) ☒ US Residency ☐ Non US Residency ☐ Active US Military Service						
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Inventor	3				Remove	
Legal Name						
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	Kemin		Li			
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Title of Invention	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM		

City	Bellevue	State/Province	WA	Country of Residence	US
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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

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Postal Code	98007	Country i	US		

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button.**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	03624		
Email Address	eooffice@vklaw.com	Add Email	Remove Email

Application Information:

Title of the Invention	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM		
Attorney Docket Number	NEO-PT012.7	Small Entity Status Claimed	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	18	Suggested Figure for Publication (if any)	3

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	NEO-PT012.7
		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)
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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	15953950	2018-04-16

Application Data Sheet 37 CFR 1.76		Attorney Docket Number		NEO-PT012.7	
		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)
15953950	Continuation of	14321615	2014-07-01	9948488	2018-04-17
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/US2005/003518	2005-01-27		
Prior Application Status		Expired		Remove	
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)		
PCT/US2005/003518	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/US2005/003518	Claims benefit of provisional	60540032	2004-01-29		
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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	NEO-PT012.7
		Application Number	
Title of Invention	CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM		

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).

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

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

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

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	NEO-PT012.7
		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).

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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.

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	NEO-PT012.7
		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:			
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Mailing Address Information For Applicant:			
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Address 2	Floor 1		
City	Wayne	State/Province	PA
Country	US	Postal Code	19087
Phone Number		Fax Number	
Email Address			
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Assignee Information including Non-Applicant Assignee Information:

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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	NEO-PT012.7
		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.			
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Organization Name	NEO WIRELESS LLC		
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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	/Christina R. Walsh/		Date (YYYY-MM-DD)	2020-06-16	
First Name	Christina R.	Last Name	Walsh	Registration Number	61553
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Application Data Sheet 37 CFR 1.76		Attorney Docket Number	NEO-PT012.7
		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.**

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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:

NEO WIRELESS LLC

Application No.: 16/902,740

Confirmation No.: 1020

Filed: June 16, 2020

For: CHANNEL PROBING SIGNAL FOR A
BROADBAND COMMUNICATION SYSTEM

Group: 2827

Examiner: Not Yet Known

Our File: NEO-PT012.7

Date: June 19, 2020

PRELIMINARY AMENDMENT

Mail Stop Amendment (via EFS)
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Applicant respectfully request that the above-captioned application be amended prior to the initial office action as follows.

Electronic Acknowledgement Receipt	
EFS ID:	39774390
Application Number:	16902740
International Application Number:	
Confirmation Number:	1020
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-PT012.7
Receipt Date:	19-JUN-2020
Filing Date:	
Time Stamp:	17:21:03
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		NEO-PT012_7- PreliminaryAmendment_EFS-2 0200619.PDF	99116	yes	9
			10bffd7f9f9b4a0ef224e15b5fca4e3c4f422a89		

Multipart Description/PDF files in .zip description			
Document Description		Start	End
Applicant Arguments/Remarks Made in an Amendment		9	9
Claims		2	8
Preliminary Amendment		1	1

Warnings:

Information:

Total Files Size (in bytes):	99116
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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.

Applicant: NEO WIRELESS LLC
Application No.: 16/902,740

REMARKS

Pursuant to this Preliminary Amendment, claim 21 is amended.

Consideration and entry of this Preliminary Amendment is respectfully requested.

Respectfully submitted,

NEO WIRELESS LLC

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CRW/jrrs

Amendments to the Claims:

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

Listing of Claims:

1. (Original) A mobile station comprising:

a transmitter configured to:

transmit, to a base station, a first uplink signal within a frequency band, wherein the first uplink signal is an orthogonal frequency division multiplexing (OFDM) signal and utilizes a frame format comprising a plurality of timeslots, each timeslot comprising a plurality of OFDM symbols;

transmit, to the base station, an initial random access signal followed by a guard period in only a portion of the frequency band, wherein the initial random access signal includes a sequence associated with the base station and a time duration of the initial random access signal and the guard period is greater than a time duration of at least one of the plurality of OFDM symbols; and

a receiver configured to receive, from the base station, a response message.

2. (Original) The mobile station of claim 1, wherein:

the receiver is configured to determine if the response message identifies the sequence associated with the base station in the initial random access signal; and

on a condition that the response message identifies the sequence associated with the base station in the initial random access signal, the transmitter is configured to transmit a second uplink signal.

3. (Original) The mobile station of claim 2, wherein the response message includes power adjustment information and wherein the transmitter is configured to transmit the second uplink signal according to the power adjustment information.

4. (Original) The mobile station of claim 1, wherein the portion of the frequency band used for transmission of the initial random access signal does not include control channels.

5. (Original) The mobile station of claim 1, wherein the response message includes a mobile station identifier assigned to the mobile station.

6. (Original) The mobile station of claim 1, wherein the time duration of the initial random access signal and the guard period is greater than a time duration of at least two of the plurality of OFDM symbols.

7. (Original) The mobile station of claim 1, wherein the frequency band includes an outer portion and a center portion, wherein the portion of the frequency band for the initial random access signal is in the center portion and uplink control signals are sent in the outer portion.

8. (Original) The mobile station of claim 1, wherein the initial random access signal is a spread spectrum signal.

9. (Original) The mobile station of claim 1, wherein:
the receiver is further configured to receive broadcast information from the base station, the broadcast information indicating at least one sequence associated with the base station for use in producing the initial random access signal.

10. (Original) The mobile station of claim 1, wherein the transmitter includes an OFDM transmitter signal processing circuit comprising: a serial to parallel converter, an inverse Fourier transform, and a cyclic prefix addition circuit; and

the OFDM transmitter signal processing circuit outputs the first uplink signal.

11. (Original) A method performed by a mobile station, the method comprising:

transmitting, to a base station, a first uplink signal within a frequency band, wherein the first uplink signal is an orthogonal frequency division multiplexing (OFDM) signal and utilizes a frame format comprising a plurality of timeslots, each timeslot comprising a plurality of OFDM symbols;

transmitting, to the base station, an initial random access signal followed by a guard period in only a portion of the frequency band, wherein the initial random access signal includes a sequence associated with the base station and a time duration of the initial random access signal and the guard period is greater than a time duration of at least one of the plurality of OFDM symbols; and

receiving, from the base station, a response message.

12. (Original) The method claim 11, further comprising:

determining if the response message identifies the sequence associated with the base station in the initial random access signal; and

on a condition that the response message identifies the sequence associated with the base station in the initial random access signal, transmitting a second uplink signal.

13. (Original) The method of claim 12, wherein the response message includes power adjustment information and wherein the second uplink signal is transmitted according to the power adjustment information.

14. (Original) The method of claim 11, wherein the portion of the frequency band used for transmission of the initial random access signal does not include control channels.

15. (Original) The method of claim 11, wherein the response message includes a mobile station identifier assigned to the mobile station.

16. (Original) The method of claim 11, wherein the time duration of the initial random access signal and the guard period is greater than a time duration of at least two of the plurality of OFDM symbols.

17. (Original) The method of claim 11, wherein the frequency band includes an outer portion and a center portion, wherein the portion of the frequency band for the initial random access signal is in the center portion and uplink control signals are sent in the outer portion.

18. (Original) The method of claim 11, wherein the initial random access signal is a spread spectrum signal.

19. (Original) The method of claim 11, further comprising:
receiving broadcast information from the base station, the broadcast information indicating at least one sequence associated with the base station for use in producing the initial random access signal.

20. (Original) The method of claim 11, wherein the first uplink signal is provided by an OFDM transmitter signal processing circuit comprising: a serial to parallel converter, an inverse Fourier transform, and a cyclic prefix addition circuit.

21. (Currently Amended) A mobile station comprising:

a first type of transmitter signal processing circuit configured to:

generate a first uplink signal, wherein the first uplink signal is an orthogonal frequency division multiplexing (OFDM) signal and utilizes a frame format comprising a plurality of timeslots, each timeslot comprising a plurality of OFDM symbols;

modulate the first uplink signal onto a first set of OFDM subcarriers;

a second type of transmitter signal processing circuit configured to generate an initial random access signal followed by a guard period, wherein the initial random access signal includes a sequence associated with a base station and a time duration of the initial random access signal and the guard period is greater than a time duration of at least one of the plurality of OFDM symbols;

a circuit configured to provide at least the first uplink signal or the initial random access signal to output a digital signal;

a digital-to-analog (D/A) conversion circuit configured to convert the digital signal to an analog signal;

~~an antenna~~ wherein the mobile station is configured to transmit, to the base station, the analog signal in a frequency band, wherein the initial random access signal occupies in a frequency domain only a portion of the frequency band;

~~the antenna~~ wherein the mobile station is further configured to receive, from the base station, a second analog signal; and

wherein the mobile station further comprises:

an analog-to-digital (A/D) conversion circuit configured to convert the second analog signal to a second digital signal; and

a receiver circuit configured to receive, based on the second digital signal, a response message.

22. (Original) The mobile station of claim 21, wherein:

the receiver circuit is configured to determine if the response message identifies the sequence associated with the base station in the initial random access signal; and

on a condition that the response message identifies the sequence associated with the base station in the initial random access signal, the first type of transmitter signal processing circuit is configured to transmit a second uplink signal.

23. (Original) The mobile station of claim 22, wherein the response message includes power adjustment information and wherein the first type of transmitter signal processing circuit is configured to transmit the second uplink signal according to the power adjustment information.

24. (Original) The mobile station of claim 21, wherein the portion of the frequency band used for transmission of the initial random access signal does not include control channels.

25. (Original) The mobile station of claim 21, wherein the response message includes a mobile station identifier assigned to the mobile station.

26. (Original) The mobile station of claim 21, wherein time duration of the initial random access signal and the guard period is greater than a time duration of at least two of the plurality of OFDM symbols.

27. (Original) The mobile station of claim 21, wherein the frequency band includes an outer portion and a center portion, wherein the portion of the frequency band for the initial random access signal is in the center portion and uplink control signals are sent in the outer portion.

28. (Original) The mobile station of claim 21, wherein the initial random access signal is a spread spectrum signal.

29. (Original) The mobile station of claim 21, wherein:
the receiver circuit is further configured to receive broadcast information from the base station, the broadcast information indicating at least one sequence associated with the base station for use in producing the initial random access signal.

30. (Original) The mobile station of claim 21, wherein:
the first type of transmitter signal processing circuit is an OFDM transmitter signal processing circuit comprising: a serial to parallel converter, an inverse Fourier transform, and a cyclic prefix addition circuit; and
the OFDM transmitter signal processing circuit outputs the first uplink signal.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	16/902,740
	Filing Date	2020-06-16
	First Named Inventor	Li et al.
	Art Unit	2827
	Examiner Name	Not Yet Known
	Attorney Docket Number	NEO-PT012.7

U.S. PATENT DOCUMENTS							
EXAMINER INITIAL		DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
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		5,867,478	02/1999	Baum et al.			
		5,909,436	06/1999	Engstrom et al.			
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1 Corresponds to KR 2003-0085040

2 Corresponds to WO 02/073831

3 Corresponds to CN 1432245

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	16/902,740
	Filing Date	2020-06-16
	First Named Inventor	Li et al.
	Art Unit	2827
	Examiner Name	Not Yet Known
	Attorney Docket Number	NEO-PT012.7

EXAMINER INITIAL		DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE
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⁴ Corresponds to US 2002/0159430

⁵ Corresponds to CN 1465150

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	16/902,740
	Filing Date	2020-06-16
	First Named Inventor	Li et al.
	Art Unit	2827
	Examiner Name	Not Yet Known
	Attorney Docket Number	NEO-PT012.7

EXAMINER INITIAL		DOCUMENT NUMBER	DATE	NAME	CLASS	SUBCLASS	FILING DATE IF APPROPRIATE	
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EXAMINER INITIAL		DOCUMENT NUMBER	DATE	COUNTRY	CLASS	SUBCLASS	TRANSLATION	
							YES	NO
	*	1407745	04/2003	CN				
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⁶ Corresponds to WO 2003/058887

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	16/902,740
	Filing Date	2020-06-16
	First Named Inventor	Li et al.
	Art Unit	2827
	Examiner Name	Not Yet Known
	Attorney Docket Number	NEO-PT012.7

OTHER DOCUMENTS		
EXAMINER INITIAL		DESCRIPTION (Including Author, Title, Date, Pertinent Pages, Etc.)
	*	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).
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		Examination Report, European Application No. 05712825.8, Mail Date August 16, 2012, 6 pages.
		Extended European Search Report received for counterpart European Patent Application No. 18196596.3, mailing date February 20, 2019 (8 pages).
	*	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).
		International Search Report and Written Opinion for International Application No. PCT/US05/01939, Mail Date 4/26/2005, 7 pages.
		International Search Report and Written Opinion; International Patent Application No. PCT/US05/03518; Filed January 27, 2005; Applicant: Waltical Solutions, Inc.; Mailed: May 23, 2005; 8 pages.
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		Notice of Allowance, U.S. Patent Application No. 13/861,942, Examiner Dmitry H. Levitan, Mail Date 5/16/14, 14 pages.
		Supplementary European Search Report, European Application No. 05711777, May 7, 2012, 6 pages.
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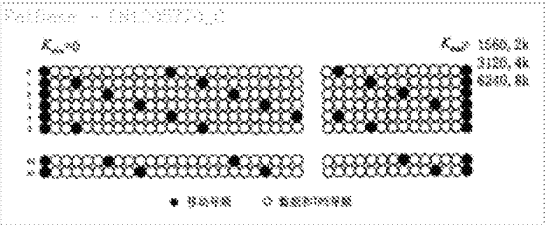
1) Family number: 28418857 (CN1205770C)

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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
CN1407745 A	20030402	CN20011030988	20010829

Priority:

CN20011030988 20010829

Probable Assignee: XI AN ELECTRONIC SCIENCE AND TEC

Assignee(s): (std): SHANGHAI JIAO TONG UNIV ; XI AN ELECTRONIC SCIENCE AND TEC ; XIDIAN UNIV ; ZHEJIANG UNIV

Assignee(s): XI AN ELECTRONIC SCIENCE AND TECHNOLOGY UNIV

Inventor(s): (std): GE JIANHUA ; LI BINGBING ; ZHANG WENJUN ; BINGBING LI ; WENJUN ZHANG ; JIANHUA GE

[19] 中华人民共和国国家知识产权局

[51] Int. Cl⁷

H04H 1/00

H04J 11/00



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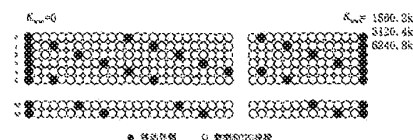
代理人 李 直

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 T_s 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 T_s 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 T_s 包括持续期为 T_u 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:

$$S_i = \{k = K_{\min} + 3 \times (i \bmod 4) + 12p \mid p > 0 \text{ 整数}, k \in [K_{\min}, K_{\max}]\}, \text{ 式中 } K_{\min} = 0;$$

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; T_u 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; T_u 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; T_u 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 $E(CC^*)=1$; 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 111111111111, 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 T_s 的多个载波信号组成。符号持续期 T_s 包括持续期为 T_u 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 $E(C/C^*)=16/9$ 。

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 T_s 的多个载波信号组成。符号持续期 T_s 包括持续期为 T_u 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，它有多值可以选取，如可选取 $T_u/4$ 、 $T_u/8$ 、 $T_u/16$ 、 $T_u/32$ ，但不限于此几值。8K 工作模式 T_u 为 819.2 微秒，4K 工作模式 T_u 为 409.6 微秒，2K 工作模式 T_u 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111111111111,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:

$S_i = \{k = K_{min} + 3 \times (i \bmod 4) + 12p \mid p > 0 \text{ 整数}, k \in [K_{min}, K_{max}]\}$, 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:

$$\text{Re}(C_{m,k})=4/3(1-2w_k)$$

$$\text{Im}(C_{m,k})=0$$

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价值相同。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
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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
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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
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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

$$\text{Re}(C_{m,k})=4/3(1-2w_k)$$

$$\text{Im}(C_{m,k})=0$$

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 W_k 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
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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,
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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 $\alpha=1$
011	分层 $\alpha=2$
100	分层 $\alpha=4$
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 $S_{36}, S_{37}, S_{38}, S_{39}, S_{40}$	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

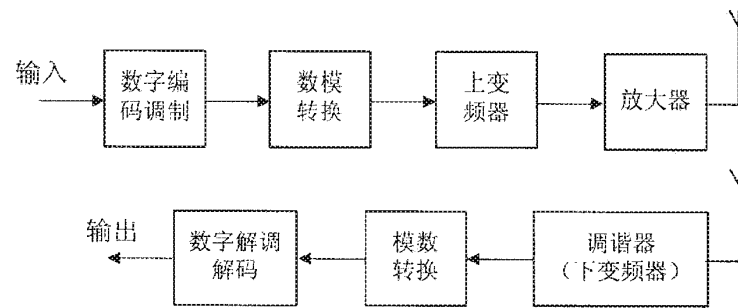


图 1

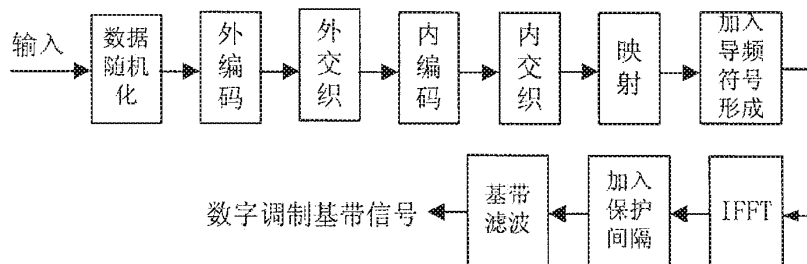


图 2

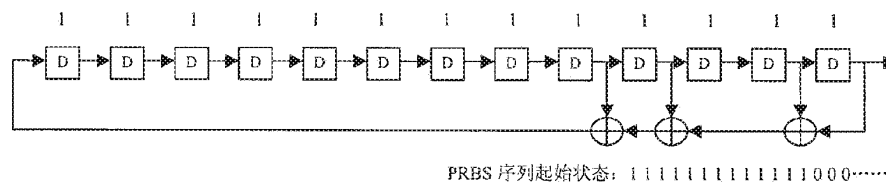


图 3

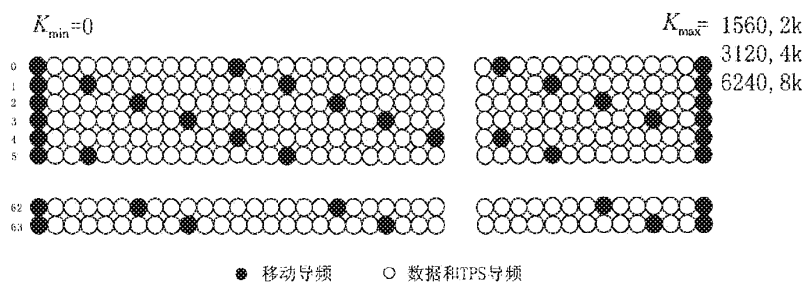


图 4

1) Family number: 29073631 (CN1445949A)

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Title: NEW COMMUNICATION METHOD OF COMBINED SPREAD SPECTRUM

Abstract: The present invention uses discrete multicarrier spread spectrum, direct sequential spread spectrum and inverse discrete 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 despread spectrum and discrete Fourier transformation are used to form a two-dimensional despread spectrum module and two-dimensional despread 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**Family:**

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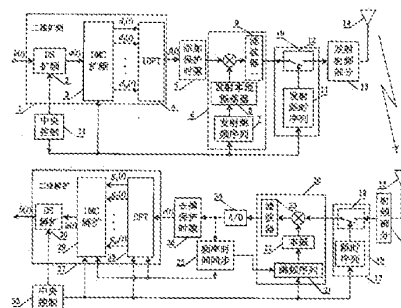
[72] 发明人 唐友喜

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： $f(t) = s\beta U\alpha p\sqrt{2P_r}b(t)$ ，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： $\hat{b}(t) = NMT_c\sqrt{\frac{P_r}{2}}b(t) + (\beta U\alpha p)^T \int_0^T s^T n(t)dt$ ，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；意味着对抗信道畸变的能力增强。

现有的主要扩展频谱的方法（技术）有：

（1）直接序列扩展频谱（DS-SS）（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 $\alpha: \alpha_1, \alpha_2, \dots, \alpha_N$ 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-SS）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 Magazine, 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 $\beta U \alpha p$ 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: $f(t) = s \beta U \alpha p \sqrt{2P_r} b(t)$,其中, α 是对应直接序列扩频的扩频序列, $\alpha = \text{diag}(\alpha_1, \alpha_2, \dots, \alpha_N)$, β 为离散多载波扩频的扩频序列矩阵, $\beta_j = (\beta_{j,1}, \beta_{j,2}, \dots, \beta_{j,M})^T \quad j=1, 2, \dots, N$, $\beta = (\beta_1, \beta_2, \dots, \beta_N)$, $p = (p(t), p(t-T_c), \dots, p(t-(N-1)T_c))^T$, $s = (\cos(2\pi\Delta f t), \cos(2\pi 2\Delta f t), \dots, \cos(2\pi M\Delta f t))$, $U = \text{diag}\{p(t), p(t-T_c), \dots, p(t-(N-1)T_c)\}$ 。

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 Fourier Transform)。 $b(t)$ 为原始输入信息,经直接序列扩频2扩频后,输出 $d(t)$:

$$d(t) = \sum_{j=1}^N b(t) \alpha_j p(t - (j-1)T_c) \quad (1)$$

其中 α_j 为对应直接序列扩频的扩频序列 $\alpha: \alpha_1, \alpha_2, \dots, \alpha_N$ 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:

$$p(t) = \begin{cases} 1, & t \in [0, T_c] \\ 0, & \text{其它} \end{cases} \quad (2)$$

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。

$$d_i(t) = d(t)\beta_{j,i}p(t - (j-1)T_c) \quad i=1, 2, \dots, M; j=1, 2, \dots, N \quad (3)$$

其中：

$$\beta_j = (\beta_{j,1}, \beta_{j,2}, \dots, \beta_{j,M})^T \quad j=1, 2, \dots, N \quad (4)$$

$$\beta = (\beta_1, \beta_2, \dots, \beta_N) \quad (5)$$

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：

$$f(t) = s\beta U \alpha p \sqrt{2P_T} b(t) \quad (6)$$

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：

$$f(t) = \sum_{j=1}^N \sum_{i=1}^M \sqrt{2P_T} b(t) \alpha_j \beta_{j,i} p(t - (j-1)T_c) \cos(2\pi i \Delta f t) \quad (7)$$

$f(t)$ 的矩阵表达式为：

$$f(t) = s\beta U \alpha p \sqrt{2P_T} b(t) \quad (8)$$

其中，

$$s = (\cos(2\pi \Delta f t), \cos(2\pi 2 \Delta f t), \dots, \cos(2\pi M \Delta f t)) \quad (9)$$

$$U = \text{diag}\{p(t), p(t-T_c), \dots, p(t-(N-1)T_c)\} \quad (10)$$

$$\alpha = \text{diag}(\alpha_1, \alpha_2, \dots, \alpha_N) \quad (11)$$

$$p = (p(t), p(t-T_c), \dots, p(t-(N-1)T_c))^T \quad (12)$$

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：

$$\begin{aligned} r(t) &= f(t) + n(t) \\ &= s\beta U\alpha p\sqrt{2P_T}b(t) + n(t) \end{aligned} \quad (13)$$

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：

$$\begin{aligned} \mathbf{g} &= \int_0^{T_c} \left(s^T s\beta U\alpha p\sqrt{2P_T}b(t) + s^T n(t) \right) dt \\ &= \mathbf{I}_{M \times M} \frac{T_c}{2} \beta U\alpha p\sqrt{2P_T}b(t) + \int_0^{T_c} s^T n(t) dt \\ &= \beta U\alpha p \frac{T_c\sqrt{P_T}}{\sqrt{2}} b(t) + \int_0^{T_c} s^T n(t) dt \end{aligned} \quad (14)$$

其中 $\mathbf{I}_{M \times M}$ 为 $M \times M$ 单位矩阵， $\mathbf{g} = (g_1, g_2, \dots, g_M)^T$ 。 $\mathbf{g}$ 送至 DMC 解扩 29 进行处理，对 $\mathbf{g}$ 左乘 $(\beta U)^T$ ，得 DMC 解扩 29 的输出 $\mathbf{h}(t)$ ：

$$\mathbf{h}(t) = (\beta U)^T \beta U\alpha p \frac{T_c\sqrt{P_T}}{\sqrt{2}} b(t) + (\beta U)^T \int_0^{T_c} s^T n(t) dt \quad (15)$$

据式 (2) 中定义的 $\mathbf{p}$ 在时间轴上的性质，式 (14) 可以化简为：

$$\mathbf{h}(t) = \Omega\alpha p \frac{T_c\sqrt{P_T}}{\sqrt{2}} b(t) + (\beta U)^T \int_0^{T_c} s^T n(t) dt \quad (16)$$

其中 Ω 为:

$$\Omega = \text{diag}\{|\beta_1|^2 p(t), |\beta_2|^2 p(t-T_c), \dots, |\beta_N|^2 p(t-(N-1)T_c)\} \quad (17)$$

其中 $|\beta_j|^2 = \beta_j^T \beta_j, j=1, 2, \dots, N$ 。

$\mathbf{h}(t)$ 送至 DS 解扩单元 30, 输出 $\hat{b}(t)$:

$$\begin{aligned} \hat{b}(t) &= (\alpha \mathbf{p})^T \mathbf{h}(t) \\ &= \mathbf{p}^T \alpha^T \Omega \alpha \mathbf{p} \frac{T_c \sqrt{P_T}}{\sqrt{2}} b(t) + (\beta \mathbf{U} \alpha \mathbf{p})^T \int_0^{T_c} \mathbf{s}^T n(t) dt \\ &= \frac{T_c \sqrt{P_T}}{\sqrt{2}} b(t) \sum_{j=1}^N \alpha_j^2 |\beta_j|^2 p(t-(j-1)T_c) + (\beta \mathbf{U} \alpha \mathbf{p})^T \int_0^{T_c} \mathbf{s}^T n(t) dt \end{aligned} \quad (18)$$

将式(2)代入式(18), 不失一般性, 设 $\alpha_i = \pm 1, \beta_{ji} = \pm 1, j=1, 2, \dots, M, i=1, 2, \dots, N$, 则有:

$$\hat{b}(t) = NMT_c \sqrt{\frac{P_T}{2}} b(t) + (\beta \mathbf{U} \alpha \mathbf{p})^T \int_0^{T_c} \mathbf{s}^T n(t) dt \quad (19)$$

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 $(\beta \mathbf{U} \alpha \mathbf{p})^T \int_0^{T_c} \mathbf{s}^T n(t) dt$ 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， $\alpha_1, \alpha_2, \dots, \alpha_N$ 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； g 是离散富里叶变换（20）后的输出信号； $h(t)$ 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_i 是对应直接序列扩频的扩频序列 $\alpha = (\alpha_1, \alpha_2, \dots, \alpha_N)^T$ 中的元素， N 为直接序列扩频的处理增益， $\beta_j = (\beta_{j,1}, \beta_{j,2}, \dots, \beta_{j,M})^T$ ， $j=1, 2, \dots, N$ ； $\beta = (\beta_1, \beta_2, \dots, \beta_N)$ ， 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 $i=1, 2, \dots, M$ ， $j=1, 2, \dots, N$ 。

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， $d_i(t) = d(t) \beta_{j,i} p(t - (j-1)T_c)$ $i=1, 2, \dots, M; j=1, 2, \dots, N$ ，其中： $\beta_j = (\beta_{j,1}, \beta_{j,2}, \dots, \beta_{j,M})^T$ $j=1, 2, \dots, N$ ， $\beta = (\beta_1, \beta_2, \dots, \beta_N)$ ， 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 $M\Delta f$ 。逆离散傅里叶变换单元的输出为： $f(t) = \sum_{i=1}^M \sqrt{2P_T} d_i(t) \cos(2\pi i \Delta f t)$ ， 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：

$$f(t) = s \beta U \alpha p \sqrt{2P_T} b(t) \quad (8)$$

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），

$$\hat{b}(t) = NMT_c \sqrt{\frac{P_r}{2}} b(t) + (\beta \mathbf{U} \alpha \mathbf{p})^T \int_0^{T_c} \mathbf{s}^T n(t) dt \quad (19)$$

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。

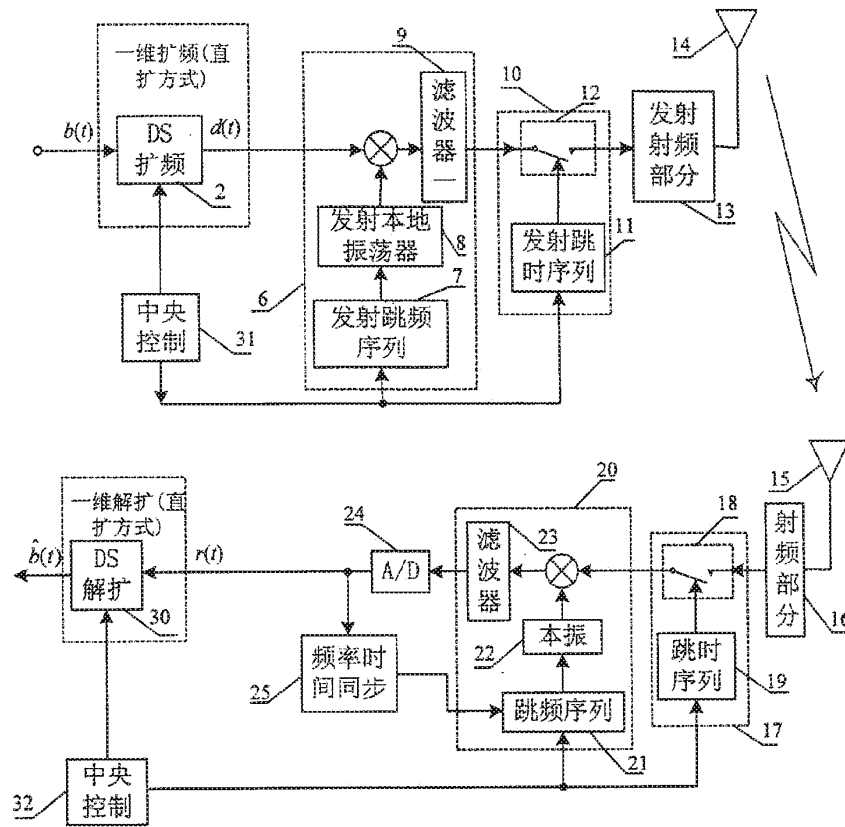


图 1

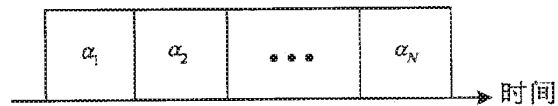


图 2

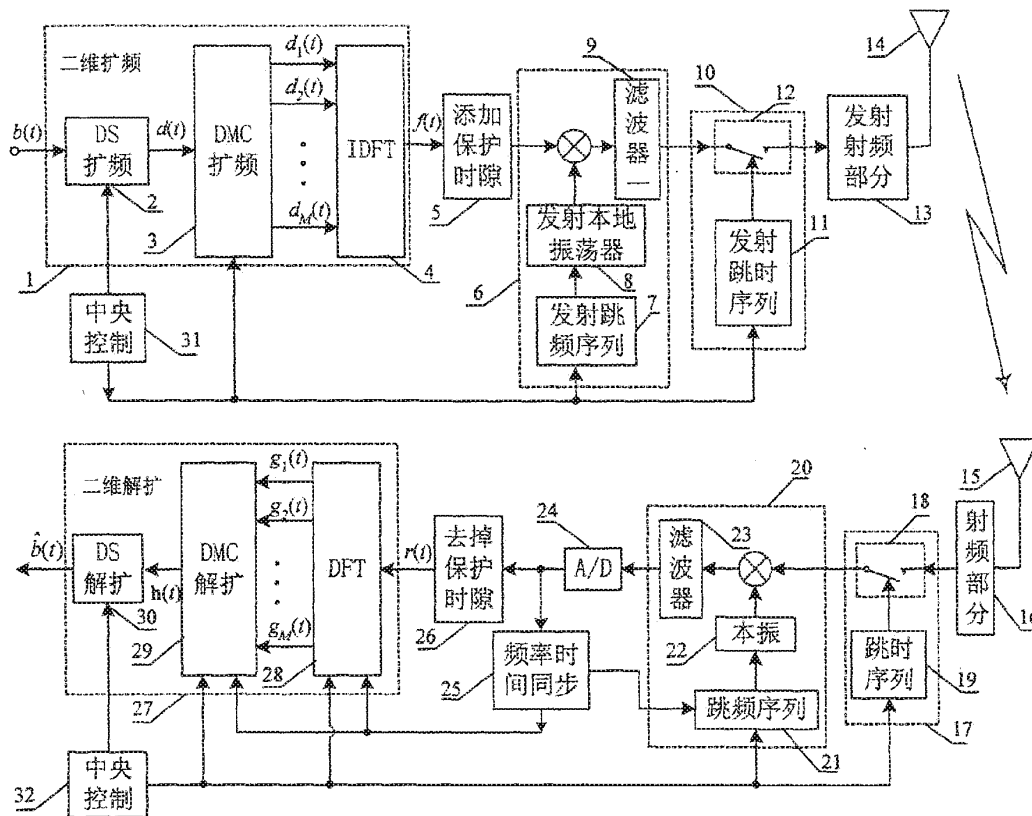


图 3

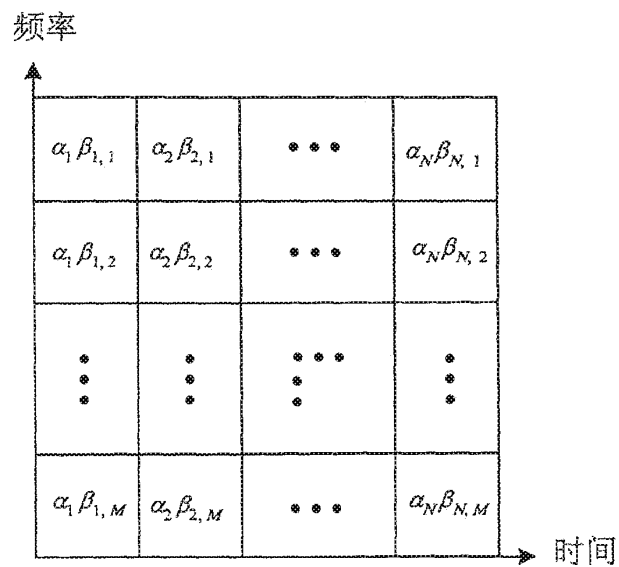


图 4

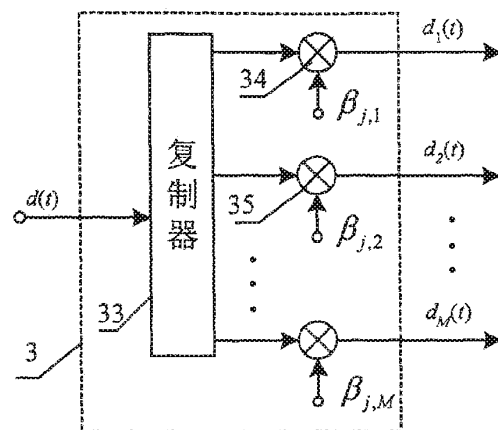


图 5

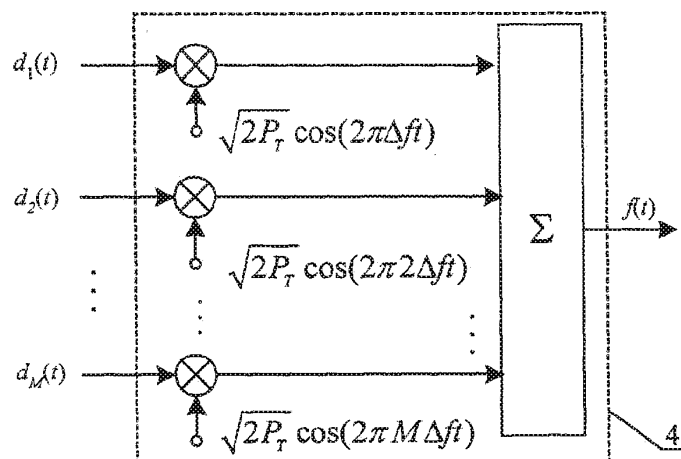


图 6

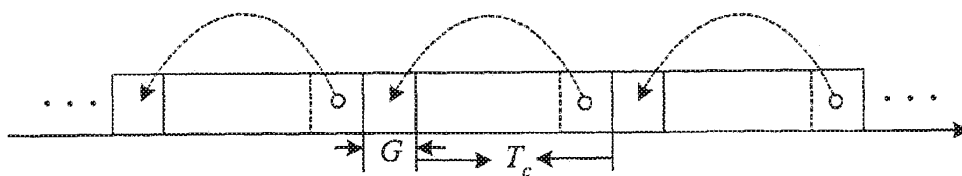


图 7

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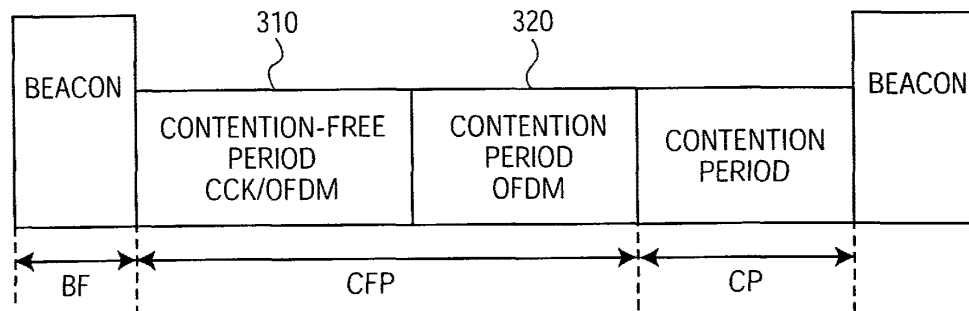
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[Continued on next page]

(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 operate 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.



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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COEXISTENCE OF MODULATION SCHEMES IN A WLAN**FIELD OF THE INVENTION**

The invention pertains to wireless local area networks and to the coexistence of
5 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

10 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 6Mbps to
54Mbps. IEEE 802.11a defines a physical layer based on the orthogonal frequency division
15 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 11Mbps. The direct sequence spread
spectrum/complementary code keying (DSSS/CCK) physical layer is one of the three
20 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
25 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
30 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.

5 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.

10 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
15 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
20 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
25 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
30 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
5 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
10 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
15 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.

20 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
25 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
30 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

5 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;

10 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.

15 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
20 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
25 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
30 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

5 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 STA1-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.

- 5 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.
- 10
15
20

- 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.
- 25

- 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
- 30

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.

5 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
10 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
15 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
20 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.

25 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
30 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.

5

CLAIMS

What is claimed is:

1. A system comprising:
 - a first station capable of transmitting and receiving data modulated using a
 - 5 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,
 - 10 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.
- 15 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
- 20 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
- 25 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.

5 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 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.

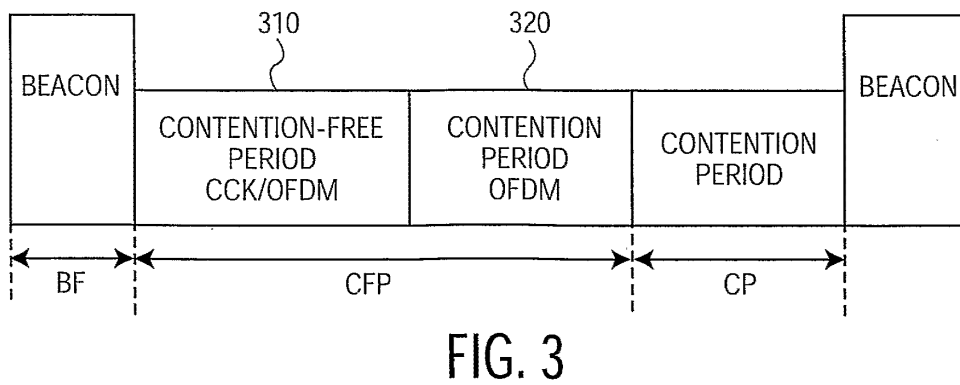
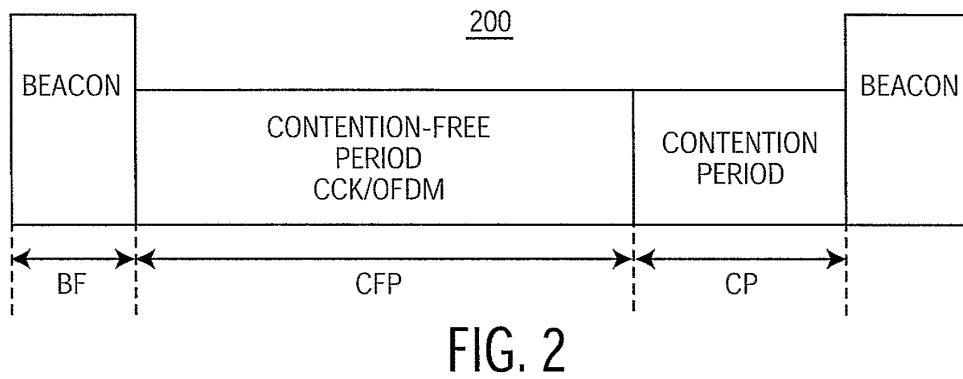
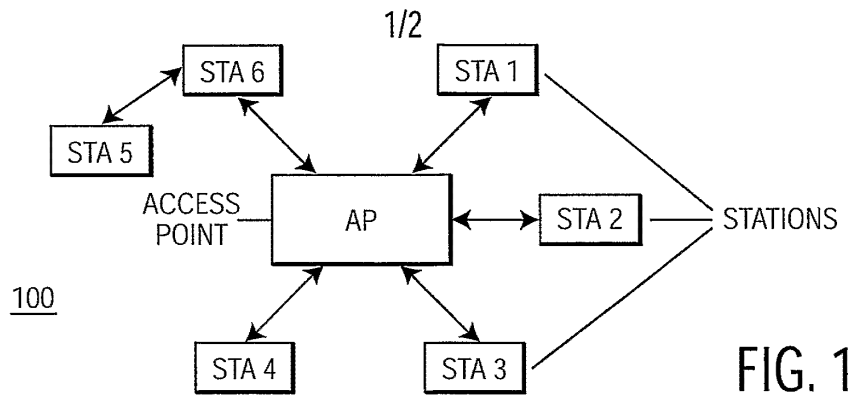
16. The access point of Claim 12, wherein during the contention period, the access point sends a request-to-send frame comprising information representative of the second modulation scheme.

17. The access point of Claim 12, wherein during the sub-contention period,
5 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
10 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
15 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
20 data according to the first modulation scheme and following a distributed coordination function access mechanism.



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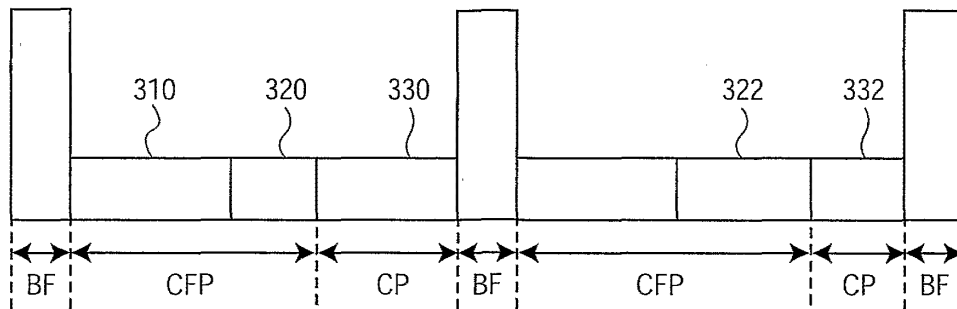


FIG. 4

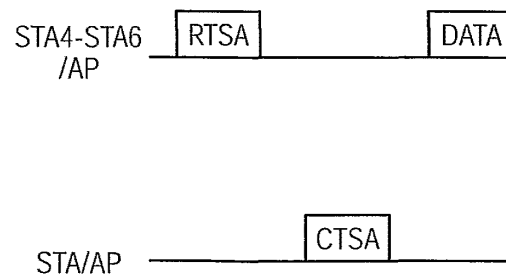


FIG. 5

Electronic Acknowledgement Receipt	
EFS ID:	39817726
Application Number:	16902740
International Application Number:	
Confirmation Number:	1020
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-PT012.7
Receipt Date:	24-JUN-2020
Filing Date:	16-JUN-2020
Time Stamp:	22:17:00
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	Transmittal Letter	NEO-PT012_7-IDS_transmittal-EFS.pdf	61105	no	3
			08b83c041c0f04455782f0d9cb44248042914491		

Warnings:

Information:					
2	Information Disclosure Statement (IDS) Form (SB08)	NEO-PT012_7-Master_List-EFS.pdf	91856	no	4
			26230c2dd9f9b64790b86f89a1844ececbe7d0d		
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					
3	Non Patent Literature	802_16a_2003.PDF	3354632	no	323
			a71a466f18d0233692bb8b226ed191271ba2d1fa		
Warnings:					
Information:					
4	Foreign Reference	CN1407745.pdf	13923217	no	15
			a219e7f278eb3c22b22a28e76e8a537adc168e43		
Warnings:					
Information:					
5	Foreign Reference	CN1445949.pdf	15635182	no	17
			68e54b1bc52eb657f216d68b6c5d1c29b3a7960e		
Warnings:					
Information:					
6	Non Patent Literature	ETSI_EN_300_744_V1_5_1.pdf	2610707	no	64
			2223a1ce2653d3bb4d3882303976757d4ffd6cab		
Warnings:					
Information:					
7	Foreign Reference	wo03058881.pdf	724700	no	16
			c9820f829611de00d8e14e43815148a6f2ed1f18		
Warnings:					
Information:					
Total Files Size (in bytes):			36401399		

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.

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the **PATENT APPLICATION** of:

Li et al.

Application No.: 16/902,740

Confirmation No.: 1020

Filed: June 16, 2020

For: CHANNEL PROBING SIGNAL FOR A
BROADBAND COMMUNICATION SYSTEM

Group: 2827

Examiner: Not Yet Known

Our File: NEO-PT012.7

Date: June 24, 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 Information Disclosure Statement Form.

This Application is a continuation of U.S. Patent Application No. 15/953,950, filed April 16, 2018, which 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, 6334531-1

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. 16/908,067, filed June 22, 2020, is also a continuation of U.S. Patent Application No. 15/953,950.

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. Documents that were not cited in the parent application are indicated by an asterisk (*) on the enclosed Information Disclosure Statement Form. Copies of the cited 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.

Applicant: Neo Wireless LLC
Application No.: 16/902,740

It is respectfully requested that the Examiner consider these documents and return an initialed copy of the Information Disclosure Statement Form indicating consideration of the cited materials.

Respectfully submitted,

Neo Wireless LLC

By /Christina R. Walsh/
Christina R. Walsh
Registration No.
(215) 568-6400

Volpe and Koenig, P.C.
United Plaza
30 South 17th Street
Philadelphia, PA 19103

CRW/PCK
Enclosures



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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY. DOCKET NO	TOT CLAIMS	IND CLAIMS
16/902,740	06/16/2020	2827	2720	NEO-PT012.7	30	3

CONFIRMATION NO. 1020

FILING RECEIPT



0000000117973606

3624

VOLPE AND KOENIG, P.C.
30 SOUTH 17TH STREET, 18TH FLOOR
PHILADELPHIA, PA 19103

Date Mailed: 06/25/2020

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 15/953,950 04/16/2018
which 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/US2005/003518 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: 06/23/2020

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 16/902,740**

Projected Publication Date: 10/01/2020

Non-Publication Request: No

Early Publication Request: No

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 Assets Control, 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.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875						Application or Docket Number 16/902,740				
APPLICATION AS FILED - PART I										
(Column 1)		(Column 2)		SMALL ENTITY		OTHER THAN SMALL ENTITY				
FOR	NUMBER FILED	NUMBER EXTRA	RATE(\$)	FEE(\$)		RATE(\$)	FEE(\$)			
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	300			
SEARCH FEE (37 CFR 1.16(k), (l), or (m))	N/A	N/A	N/A			N/A	660			
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	760			
TOTAL CLAIMS (37 CFR 1.16(j))	30	minus 20 = 10				x 100 =	1000			
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3	minus 3 = 0				x 460 =	0.00			
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$310 (\$155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0.00			
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00			
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL		TOTAL	2720			
APPLICATION AS AMENDED - PART II										
(Column 1)		(Column 2)		(Column 3)		SMALL ENTITY		OTHER THAN SMALL ENTITY		
AMENDMENT A		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)	ADDITIONAL FEE(\$)
	Total (37 CFR 1.16(i))	*	Minus	**	=	x	=		x	=
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x	=		x	=
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))									
TOTAL ADD'L FEE								TOTAL ADD'L FEE		
AMENDMENT B		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)		RATE(\$)	ADDITIONAL FEE(\$)
	Total (37 CFR 1.16(i))	*	Minus	**	=	x	=		x	=
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x	=		x	=
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))									
TOTAL ADD'L FEE								TOTAL ADD'L FEE		
* If the entry in column 1 is less than the entry in column 2, write "0" in column 3. ** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20". *** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3". The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.										



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/902,740	06/16/2020	Xiaodong Li	NEO-PT012.7	1020
3624	7590	06/30/2020	EXAMINER	
VOLPE AND KOENIG, P.C. 30 SOUTH 17TH STREET, 18TH FLOOR PHILADELPHIA, PA 19103			ART UNIT	
			2461	
			PAPER NUMBER	
			2461	
			NOTIFICATION DATE	
			06/30/2020	
			DELIVERY MODE	
			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

<i>Decision Granting Request for Prioritized Examination (Track I)</i>	Application No. 16/902,740	Applicant(s) Li et al.	
	Examiner CHERYL P GIBSON BAYLOR	Art Unit OPET	AIA (FITF) Status No
1. THE REQUEST FILED <u>16 June 2020</u> IS GRANTED . The above-identified application has met the requirements for prioritized examination A. ☒ for an original nonprovisional application (Track I). B. ☐ for an application undergoing continued examination (RCE). 2. The above-identified application will undergo prioritized examination. The application will be accorded special status throughout its entire course of prosecution until one of the following occurs: A. filing a <u>petition for extension of time</u> to extend the time period for filing a reply; B. filing an <u>amendment to amend the application to contain more than four independent claims, more than thirty total claims</u>, or a multiple dependent claim; C. filing a <u>request for continued examination</u> ; D. filing a notice of appeal; E. filing a request for suspension of action; F. mailing of a notice of allowance; G. mailing of a final Office action; H. completion of examination as defined in 37 CFR 41.102; or I. abandonment of the application. Telephone inquiries with regard to this decision should be directed to CHERYL GIBSON BAYLOR at (571)272-3213. In his/her absence, calls may be directed to Petition Help Desk at (571) 272-3282.			
/CHERYL GIBSON BAYLOR/ Paralegal Specialist, OPET			



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/902,740	06/16/2020	Xiaodong Li	NEO-PT012.7	1020
3624	7590	08/31/2020	EXAMINER	
Volpe Koenig 30 SOUTH 17TH STREET, 18TH FLOOR PHILADELPHIA, PA 19103			LEVITAN, DMITRY	
			ART UNIT	PAPER NUMBER
			2461	
			NOTIFICATION DATE	DELIVERY MODE
			08/31/2020	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. 16/902,740	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 6/16/20.
☐ 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) 1-30 is/are pending in the application.
 5a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 6) ☐ Claim(s) ____ is/are allowed.
- 7) ☒ Claim(s) 1-30 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 6/16/20 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) | 3) ☐ Interview Summary (PTO-413) |
| | Paper No(s)/Mail Date ____. |
| 2) ☒ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) | 4) ☐ Other: ____. |
| Paper No(s)/Mail Date ____. | |

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 6/19/20, has been entered. Claims 1-30 remain ending.

Claim Rejections - 35 USC § 112

3. Claims 1-30 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 1, 11 and 21 limitations, directed to "the initial random access signal includes a sequence associated with the base station and a time duration of the initial random access signal and a guard period is greater than a time duration of at least one of the plurality of the OFDM symbols" are not supported by the disclosure, as filed, and are identified as NEW MATTER. The corresponding portions of the disclosure do not comprise the claimed particulars of the initial random access signal, like its own time duration, and comparing the guard period length with the OFDM symbols duration.

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

4. Claims 1-20 are rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which the inventor or a joint inventor, or for pre-AIA the applicant regards as the invention.

Claims 1 and 11 limitations, directed to transmitting to the base station “first uplink signal” and “an initial access signal” are unclear, because the priority or order of the signal transmission it is not understood, which of the signals is transmitted first: “first” or “initial”.

In addition, it is unclear, if the terms “first” and “initial” are associated with the sequences of each of the two transmissions or with the mobile station transmitter.

Claims 2-10 and 12-20 are rejected as the claims depending on the claims rejected above.

Conclusion

5. 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

Notice of References Cited	Application/Control No. 16/902,740		Applicant(s)/Patent Under Reexamination Li et al.	
	Examiner DMITRY LEVITAN		Art Unit 2461	Page 1 of 1

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*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
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*	B	US-6175550-B1	01-2001	van Nee; Richard D. J.	H04L1/0002	370/206
*	C	US-6567383-B1	05-2003	Bohnke; Ralf	H04L5/005	370/280
*	D	US-6922388-B1	07-2005	Laroia; Rajiv	H04J3/0682	370/208
*	E	US-7411897-B2	08-2008	Yoo; Hwa-sun	H04L27/2605	370/208
*	F	US-5828650-A	10-1998	Malkamaki; Esa	H04L5/0007	370/203
	G					
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	I					
	J					
	K					
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	M					

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*		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)
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	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.

U.S. Patent and Trademark Office
PTO-892 (Rev. 01-2001)

Notice of References Cited

Part of Paper No. 20200826

<i>Search Notes</i> 	Application/Control No. 16/902,740	Applicant(s)/Patent Under Reexamination Li et al.
	Examiner DMITRY LEVITAN	Art Unit 2461

CPC - Searched*		
Symbol	Date	Examiner
H04L 12/26, 5/0007, 5/0028, 25/03834, 27/0008, 27/0012, 27/26/02	08/26/2020	DL

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner
370	241, 252, 310, 328, 330, 464, 532	08/26/2020	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	08/26/2020	DL

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

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<i>Index of Claims</i> 	Application/Control No. 16/902,740	Applicant(s)/Patent Under Reexamination Li et al.
	Examiner DMITRY LEVITAN	Art Unit 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	08/26/2020								
	1	✓								
	2	✓								
	3	✓								
	4	✓								
	5	✓								
	6	✓								
	7	✓								
	8	✓								
	9	✓								
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	29	✓								
	30	✓								



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BIB DATA SHEET

CONFIRMATION NO. 1020

SERIAL NUMBER	FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.		
16/902,740	06/16/2020 RULE	370	2461	NEO-PT012.7		
APPLICANTS NEO WIRELESS LLC, Wayne, PA; INVENTORS Xiaodong Li, Kirkland, WA; Titus Lo, Bellevue, WA; Kemin Li, Bellevue, WA; Haiming Huang, Bellevue, WA; ** CONTINUING DATA ***** This application is a CON of 15/953,950 04/16/2018 PAT 10771302 which 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/US2005/003518 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 ***** ** IF REQUIRED, FOREIGN FILING LICENSE GRANTED ** 06/23/2020						
Foreign Priority claimed ☐ Yes ☒ No 35 USC 119(a-d) conditions met ☐ Yes ☒ No Verified and /DMITRY LEVITAN/ Acknowledged Examiner's Signature		☐ Met after Allowance Initials	STATE OR COUNTRY WA	SHEETS DRAWINGS 18	TOTAL CLAIMS 30	INDEPENDENT CLAIMS 3
ADDRESS Volpe Koenig 30 SOUTH 17TH STREET, 18TH FLOOR PHILADELPHIA, PA 19103 UNITED STATES						
TITLE CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM						
FILING FEE RECEIVED 2720	FEES: Authority has been given in Paper No. _____ to charge/credit DEPOSIT ACCOUNT No. _____ for following:			☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit		

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	16/902,740
	Filing Date	2020-06-16
	First Named Inventor	Li et al.
	Art Unit	2827
	Examiner Name	Not Yet Known
	Attorney Docket Number	NEO-PT012.7

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1 Corresponds to KR 2003-0085040

2 Corresponds to WO 02/073831

3 Corresponds to CN 1432245

/DMITRY LEVITAN/

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	16/902,740
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	Examiner Name	Not Yet Known
	Attorney Docket Number	NEO-PT012.7

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	16/902,740
	Filing Date	2020-06-16
	First Named Inventor	Li et al.
	Art Unit	2827
	Examiner Name	Not Yet Known
	Attorney Docket Number	NEO-PT012.7

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6 Corresponds to WO 2003/058887

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	16/902,740
	Filing Date	2020-06-16
	First Named Inventor	Li et al.
	Art Unit	2827
	Examiner Name	Not Yet Known
	Attorney Docket Number	NEO-PT012.7

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		Examination Report, European Application No. 05712825.8, Mail Date August 16, 2012, 6 pages.
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/DMITRY LEVITAN/

08/26/2020

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

Ford Motor Co.
Exhibit 1002
Page 152

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L9	9	(coexistence adj2 modulation) and OFDM and WLAN	US-PGPUB; USPAT	OR	ON	2020/08/26 14:41
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L17	76	((base adj2 station) or enb or BS or enodeB or AP or (access adj2 point)) and (OFDM near4 (slot)) and (UP or uplink) and ((OFDM) near4 (length or period or duration or size)) and @ay<"2004"	US-PGPUB; USPAT	OR	ON	2020/08/26 15:14
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8/26/2020 3:20:03 PM

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	16902740
	Filing Date	2020-06-16
	First Named Inventor	Li et al.
	Art Unit	2461
	Examiner Name	Dmitry Levitan
	Attorney Docket Number	NEO-PT012.7

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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
	1	7873009	B2	2011-01-18	Larsson et al.	
	2	8102832	B2	2012-01-24	Agrawal et al.	
	3	8363691	B2	2013-01-29	Hasegawa et al.	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		16902740
	Filing Date		2020-06-16
	First Named Inventor	Li et al.	
	Art Unit	2461	
	Examiner Name	Dmitry Levitan	
	Attorney Docket Number	NEO-PT012.7	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	16902740
	Filing Date	2020-06-16
	First Named Inventor	Li et al.
	Art Unit	2461
	Examiner Name	Dmitry Levitan
	Attorney Docket Number	NEO-PT012.7

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)	2020-09-01
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.**

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Electronic Patent Application Fee Transmittal				
Application Number:		16902740		
Filing Date:		16-Jun-2020		
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-PT012.7		
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:	40439539
Application Number:	16902740
International Application Number:	
Confirmation Number:	1020
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-PT012.7
Receipt Date:	01-SEP-2020
Filing Date:	16-JUN-2020
Time Stamp:	13:36:13
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	\$240
RAM confirmation Number	E202091D36305038
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	Transmittal Letter	NEO-PT012_7-IDS_transmittal-EFS.pdf	90065	no	3
			312dc7429e9fae0e1163679958ee3e0a3b258e51		
Warnings:					
Information:					
2	Information Disclosure Statement (IDS) Form (SB08)	NEO-PT012_7-SB08-20200831.pdf	1077972	no	4
			6dc2bffa7408cf97c173087f387f2ef82d5207be		
Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	30558	no	2
			165f9abc97a223c6993310764319c2339b0dd6b		
Warnings:					
Information:					
Total Files Size (in bytes):			1198595		
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.					

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the **PATENT APPLICATION** of:

Li et al.

Application No.: 16/902,740

Confirmation No.: 1020

Filed: June 16, 2020

For: CHANNEL PROBING SIGNAL FOR A
BROADBAND COMMUNICATION SYSTEM

Group: 2461

Examiner: Dmitry Levitan

Our File: NEO-PT012.7

Date: September 1, 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. 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.

This Application is a continuation of U.S. Patent Application No. 15/953,950, filed April 16, 2018, which 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
6432936.1

Applicant: Neo Wireless LLC
Application No.: 16/902,740

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. 16/908,067, filed June 22, 2020, is also a continuation of U.S. Patent Application No. 15/953,950.

Applicant: Neo Wireless LLC
Application No.: 16/902,740

It is respectfully requested that the Examiner consider these documents and return an initialed copy of the Information Disclosure Statement Form indicating consideration of the cited materials.

Respectfully submitted,

Neo Wireless LLC

By /Christina R. Walsh/
Christina R. Walsh
Registration No.
(215) 568-6400

Volpe and Koenig, P.C.
United Plaza
30 South 17th Street
Philadelphia, PA 19103

CRW/PCK
Enclosure

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875				Application or Docket Number 16/902,740		Filing Date 06/16/2020		☐ To be Mailed		
ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO										
APPLICATION AS FILED - PART I										
		(Column 1)	(Column 2)							
FOR		NUMBER FILED	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), (l), 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(j))		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	09/11/2020	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)		ADDITIONAL FEE (\$)			
	Total (37 CFR 1.16(i))	* 30	Minus	** 30	= 0	x \$100 =		0		
	Independent (37 CFR 1.16(h))	* 3	Minus	*** 3	= 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			
AMENDMENT		(Column 1)	(Column 2)	(Column 3)						
		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".					/JACQUELYN L WILLIAMS/					
*** 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: DIST.E.FILE Document Description: Electronic Terminal Disclaimer - Filed		PTO/SB/25 U.S. Patent and Trademark Office Department of Commerce	
Electronic Petition Request	TERMINAL DISCLAIMER TO OBVIATE A PROVISIONAL DOUBLE PATENTING REJECTION OVER A PENDING "REFERENCE" APPLICATION		
Application Number	16902740		
Filing Date	16-Jun-2020		
First Named Inventor	Xiaodong Li		
Attorney Docket Number	NEO-PT012.7		
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) of 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 any patent granted on pending reference Application Number(s)			
16908067 filed on 06/22/2020 as the term of any patent granted on said reference application may be shortened by any terminal disclaimer filed prior to the grant of any patent on the pending reference application. 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 any patent granted on the reference application 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 any patent granted on the instant application that would extend to the expiration date of the full statutory term of any patent granted on said reference application, "as the term of any patent granted on said reference application may be shortened by any terminal disclaimer filed prior to the grant of any patent on the pending reference application," in the event that any such patent granted on the pending reference application: 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 shortened by any terminal disclaimer filed prior to its grant.			
☒ 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.	
Applicant claims the following fee status:	
☐ Small Entity ☐ Micro Entity ☒ Regular Undiscounted	
I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.	
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 <u>61553</u>	
☐ 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.

Electronic Patent Application Fee Transmittal				
Application Number:		16902740		
Filing Date:		16-Jun-2020		
Title of Invention:		CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM		
First Named Inventor/Applicant Name:		Xiaodong Li		
Filer:		Christina R. Walsh/Joann Miceli		
Attorney Docket Number:		NEO-PT012.7		
Filed as Large Entity				
Filing Fees for Utility under 35 USC 111(a)				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
STATUTORY OR TERMINAL DISCLAIMER	1814	1	160	160
Pages:				
Claims:				
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 (\$)				160

Doc Code: DISQ.E.FILE

Document Description: Electronic Terminal Disclaimer – Approved

Application No.: 16902740

Filing Date: 16-Jun-2020

Applicant/Patent under Reexamination: Li

Electronic Terminal Disclaimer filed on September 11, 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:	40533136
Application Number:	16902740
International Application Number:	
Confirmation Number:	1020
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/Joann Miceli
Filer Authorized By:	Christina R. Walsh
Attorney Docket Number:	NEO-PT012.7
Receipt Date:	11-SEP-2020
Filing Date:	16-JUN-2020
Time Stamp:	15:52:30
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	\$160
RAM confirmation Number	E20209AF52278160
Deposit Account	220493
Authorized User	Joann Miceli
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	Terminal Disclaimer-Filed (Electronic)	eTerminal-Disclaimer.pdf	34091	no	2
			f9caa55035c73a3771ad399319867992e6ca c9f1		

Warnings:

Information:

2	Fee Worksheet (SB06)	fee-info.pdf	30469	no	2
			d27cdaf10ae4009d27bdcbb419b3af50a6 28a0f		

Warnings:

Information:

Total Files Size (in bytes):	64560
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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.

Amendments to the Claims:

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

1. (Currently Amended) A mobile station comprising:

a transmitter configured to:

transmit, to a base station, a first uplink signal within a frequency band, wherein the first uplink signal is an orthogonal frequency division multiplexing (OFDM) signal and utilizes a frame format comprising a plurality of timeslots, each timeslot comprising a plurality of OFDM symbols;

transmit, to the base station, ~~an initial~~ a random access signal followed by a guard period in only a portion of the frequency band, wherein the ~~initial~~ random access signal includes a sequence associated with the base station, ~~[[and]]~~ wherein a time duration of a combination of the ~~initial~~ random access signal and the guard period is greater than a time duration of at least one of the plurality of OFDM symbols; and

a receiver configured to receive, from the base station, a response message.

2. (Currently Amended) The mobile station of claim 1, wherein:

the receiver is configured to determine if the response message identifies the sequence associated with the base station in the ~~initial~~ random access signal; and

on a condition that the response message identifies the sequence associated with the base station in the ~~initial~~ random access signal, the transmitter is configured to transmit a second uplink signal.

3. (Original) The mobile station of claim 2, wherein the response message includes power adjustment information and wherein the transmitter is configured

- 2 -

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to transmit the second uplink signal according to the power adjustment information.

4. (Currently Amended) The mobile station of claim 1, wherein the portion of the frequency band used for transmission of the ~~initial~~ random access signal does not include control channels.

5. (Original) The mobile station of claim 1, wherein the response message includes a mobile station identifier assigned to the mobile station.

6. (Currently Amended) The mobile station of claim 1, wherein the time duration of the combination of the ~~initial~~ random access signal and the guard period is greater than a time duration of at least two of the plurality of OFDM symbols.

7. (Currently Amended) The mobile station of claim 1, wherein the frequency band includes an outer portion and a center portion, wherein the portion of the frequency band for the ~~initial~~ random access signal is in the center portion and uplink control signals are sent in the outer portion.

8. (Currently Amended) The mobile station of claim 1, wherein the ~~initial~~ random access signal is a spread spectrum signal.

9. (Currently Amended) The mobile station of claim 1, wherein:
the receiver is further configured to receive broadcast information from the base station, the broadcast information indicating at least one sequence associated with the base station for use in producing the ~~initial~~ random access signal.

10. (Original) The mobile station of claim 1, wherein the transmitter includes an OFDM transmitter signal processing circuit comprising: a serial to parallel converter, an inverse Fourier transform, and a cyclic prefix addition circuit; and

the OFDM transmitter signal processing circuit outputs the first uplink signal.

11. (Currently Amended) A method performed by a mobile station, the method comprising:

transmitting, to a base station, a first uplink signal within a frequency band, wherein the first uplink signal is an orthogonal frequency division multiplexing (OFDM) signal and utilizes a frame format comprising a plurality of timeslots, each timeslot comprising a plurality of OFDM symbols;

transmitting, to the base station, an ~~initial~~ random access signal followed by a guard period in only a portion of the frequency band, wherein the ~~initial~~ random access signal includes a sequence associated with the base station, ~~[[and]]~~ wherein a time duration of a combination of the ~~initial~~ random access signal and the guard period is greater than a time duration of at least one of the plurality of OFDM symbols; and

receiving, from the base station, a response message.

12. (Currently Amended) The method claim 11, further comprising:

determining if the response message identifies the sequence associated with the base station in the ~~initial~~ random access signal; and

on a condition that the response message identifies the sequence associated with the base station in the ~~initial~~ random access signal, transmitting a second uplink signal.

13. (Original) The method of claim 12, wherein the response message includes power adjustment information and wherein the second uplink signal is transmitted according to the power adjustment information.

14. (Currently Amended) The method of claim 11, wherein the portion of the frequency band used for transmission of the ~~initial~~ random access signal does not include control channels.

15. (Original) The method of claim 11, wherein the response message includes a mobile station identifier assigned to the mobile station.

16. (Currently Amended) The method of claim 11, wherein the time duration of the combination of the ~~initial~~ random access signal and the guard period is greater than a time duration of at least two of the plurality of OFDM symbols.

17. (Currently Amended) The method of claim 11, wherein the frequency band includes an outer portion and a center portion, wherein the portion of the frequency band for the ~~initial~~ random access signal is in the center portion and uplink control signals are sent in the outer portion.

18. (Currently Amended) The method of claim 11, wherein the ~~initial~~ random access signal is a spread spectrum signal.

19. (Currently Amended) The method of claim 11, further comprising:
receiving broadcast information from the base station, the broadcast information indicating at least one sequence associated with the base station for use in producing the ~~initial~~ random access signal.

20. (Original) The method of claim 11, wherein the first uplink signal is provided by an OFDM transmitter signal processing circuit comprising: a serial to parallel converter, an inverse Fourier transform, and a cyclic prefix addition circuit.

21. (Currently Amended) A mobile station comprising:
a first type of transmitter signal processing circuit configured to:
generate a first uplink signal, wherein the first uplink signal is an orthogonal frequency division multiplexing (OFDM) signal and utilizes a frame format comprising a plurality of timeslots, each timeslot comprising a plurality of OFDM symbols;
modulate the first uplink signal onto a first set of OFDM subcarriers;
a second type of transmitter signal processing circuit configured to generate an ~~initial~~ random access signal followed by a guard period, wherein the ~~initial~~ random access signal includes a sequence associated with a base station, ~~[[and]]~~ wherein a time duration of a combination of the ~~initial~~ random access signal and the guard period is greater than a time duration of at least one of the plurality of OFDM symbols;
a circuit configured to provide at least the first uplink signal or the ~~initial~~ random access signal to output a digital signal;
a digital-to-analog (D/A) conversion circuit configured to convert the digital signal to an analog signal;
wherein the mobile station is configured to transmit, to the base station, the analog signal in a frequency band, wherein the ~~initial~~ random access signal occupies in a frequency domain only a portion of the frequency band;
wherein the mobile station is further configured to receive, from the base station, a second analog signal; and
wherein the mobile station further comprises:

an analog-to-digital (A/D) conversion circuit configured to convert the second analog signal to a second digital signal; and
a receiver circuit configured to receive, based on the second digital signal, a response message.

22. (Currently Amended) The mobile station of claim 21, wherein:

the receiver circuit is configured to determine if the response message identifies the sequence associated with the base station in the ~~initial~~ random access signal; and

on a condition that the response message identifies the sequence associated with the base station in the ~~initial~~ random access signal, the first type of transmitter signal processing circuit is configured to transmit a second uplink signal.

23. (Original) The mobile station of claim 22, wherein the response message includes power adjustment information and wherein the first type of transmitter signal processing circuit is configured to transmit the second uplink signal according to the power adjustment information.

24. (Currently Amended) The mobile station of claim 21, wherein the portion of the frequency band used for transmission of the ~~initial~~ random access signal does not include control channels.

25. (Original) The mobile station of claim 21, wherein the response message includes a mobile station identifier assigned to the mobile station.

26. (Currently Amended) The mobile station of claim 21, wherein the time duration of the combination of the ~~initial~~ random access signal and the guard period is greater than a time duration of at least two of the plurality of OFDM symbols.

27. (Currently Amended) The mobile station of claim 21, wherein the frequency band includes an outer portion and a center portion, wherein the portion of the frequency band for the ~~initial~~ random access signal is in the center portion and uplink control signals are sent in the outer portion.

28. (Currently Amended) The mobile station of claim 21, wherein the ~~initial~~ random access signal is a spread spectrum signal.

29. (Currently Amended) The mobile station of claim 21, wherein:
the receiver circuit is further configured to receive broadcast information from the base station, the broadcast information indicating at least one sequence associated with the base station for use in producing the ~~initial~~ random access signal.

30. (Original) The mobile station of claim 21, wherein:
the first type of transmitter signal processing circuit is an OFDM transmitter signal processing circuit comprising: a serial to parallel converter, an inverse Fourier transform, and a cyclic prefix addition circuit; and
the OFDM transmitter signal processing circuit outputs the first uplink signal.

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the **PATENT APPLICATION** of:

NEO WIRELESS LLC

Application No.: 16/902,740

Confirmation No.: 1020

Filed: 06/16/2020

For: CHANNEL PROBING
SIGNAL FOR A BROADBAND
COMMUNICATION SYSTEM

Group: 2461

Examiner: Dmitry Levitan

Our File: NEO-PT012.7

Date: September 11, 2020

RESPONSE PURSUANT TO 37 C.F.R. §1.111

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

This Response and an e-Terminal Disclaimer is being timely filed in response to the Non-Final Office Action dated August 31, 2020.

Please amend the application without prejudice or disclaimer as follows:

Electronic Acknowledgement Receipt	
EFS ID:	40536311
Application Number:	16902740
International Application Number:	
Confirmation Number:	1020
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/Joann Miceli
Filer Authorized By:	Christina R. Walsh
Attorney Docket Number:	NEO-PT012.7
Receipt Date:	11-SEP-2020
Filing Date:	16-JUN-2020
Time Stamp:	16:54:32
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		NEO_PT0012_7_Response_NF OA_EFS.pdf	158170 2db22674f9a0b7597fe1a032a0bc2ac06871a255	yes	11

	Multipart Description/PDF files in .zip description		
	Document Description	Start	End
	Applicant Arguments/Remarks Made in an Amendment	9	11
	Amendment Copy Claims/Response to Suggested Claims	2	8
	Amendment/Req. Reconsideration-After Non-Final Reject	1	1
Warnings:			
Information:			
Total Files Size (in bytes):		158170	
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.			

REMARKS/ARGUMENTS

After the foregoing Amendment, claims 1-30 are currently pending in this application. Claims 1, 2, 4, 6-9, 11, 12, 14, 16-19, 21, 22, 24, and 26-29 are amended.

Examiner Interview

Applicant thanks the Examiner for granting a telephonic interview with the Applicant's representative on September 10, 2020.

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 1-30 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. with regard to the claim element of “*a time duration of a the initial random access signal and the guard period...*”.

Claims 1, 11 and 21 have been accordingly amended, to clarify the meaning of the element, to recite “*wherein the random access signal includes a sequence associated with the base station, wherein a time duration of a combination of the random access signal and the guard period is greater than a time duration of at*

least one of the plurality of OFDM symbols". (Emphasis added) This feature is illustrated at least in FIG. 5 and described in paragraphs [0034]-[0035] and [0063] of the present Application.

Claims 1-20 are rejected under 35 U.S.C. 112(b) or 35 U.S.C. 112 (pre-AIA), second paragraph, as being, with reference to the "first uplink signal" and the "initial random access signal". To improve clarity, the term "initial" has been removed from the claims.

Accordingly, at least for the reasons given above, withdrawal of the §112 rejections of the claims is respectfully requested.

Applicant: NEO WIRELESS LLC
Application No.: 16/902,740

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/jmm



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
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Alexandria, Virginia 22313-1450
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NOTICE OF ALLOWANCE AND FEE(S) DUE

3624 7590 09/22/2020
Volpe Koenig
30 SOUTH 17TH STREET, 18TH FLOOR
PHILADELPHIA, PA 19103

EXAMINER

LEVITAN, DMITRY

ART UNIT

PAPER NUMBER

2461

DATE MAILED: 09/22/2020

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/902,740	06/16/2020	Xiaodong Li	NEO-PT012.7	1020

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	12/22/2020

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.

HOW TO REPLY TO THIS NOTICE:

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 09/22/2020
Volpe Koenig
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.
16/902,740	06/16/2020	Xiaodong Li	NEO-PT012.7	1020

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	12/22/2020

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, 1 _____
- (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. 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. _____



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/902,740	06/16/2020	Xiaodong Li	NEO-PT012.7	1020
3624	7590	09/22/2020	EXAMINER	
Volpe Koenig			LEVITAN, DMITRY	
30 SOUTH 17TH STREET, 18TH FLOOR				
PHILADELPHIA, PA 19103			ART UNIT	PAPER NUMBER
			2461	
DATE MAILED: 09/22/2020				

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. 16/902,740	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 9/11/20.
☐ 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 1-30 . 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)	5. ☐ Examiner's Amendment/Comment
2. ☒ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.	6. ☐ Examiner's Statement of Reasons for Allowance
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.	7. ☐ Other _____.
4. ☒ Interview Summary (PTO-413), Paper No./Mail Date. _____.	

/DMITRY LEVITAN/ Primary Examiner, Art Unit 2461	
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<i>Applicant-Initiated Interview Summary</i>	Application No. 16/902,740	Applicant(s) Li et al.	
	Examiner DMITRY LEVITAN	Art Unit 2461	AIA (FITF) Status No

All participants (applicant, applicants representative, PTO personnel):

(1) DMITRY LEVITAN. (3) ____.

(2) Christina R. Walsh. (4) ____.

Date of Interview: 10 September 2020.

Type: ☒ Telephonic ☐ Video Conference
☐ Personal [copy given to: ☐ applicant ☐ applicant's representative]

Exhibit shown or demonstration conducted: ☐ Yes ☒ No.
If Yes, brief description: ____.

Issues Discussed ☐101 ☒112 ☐102 ☐103 ☐Others
(For each of the checked box(es) above, please describe below the issue and detailed description of the discussion)

Claim(s) discussed: 1.

Identification of prior art discussed: N/A.

Substance of Interview
(For each issue discussed, provide a detailed description and indicate if agreement was reached. Some topics may include: identification or clarification of a reference or a portion thereof, claim interpretation, proposed amendments, arguments of any applied references etc...)

Applicant and Examiner discussed the issue of the support for the claim 1 limitations, which were rejected in the Office action as NEW MATTER. Applicant indicated the particulars of Fig. 5, which show the relative durations of the OFDM symbols and the guard period, as the support for the claim 1 limitations..

Applicant recordation instructions: The formal written reply to the last Office action must include the substance of the interview. (See MPEP section 713.04). If a reply to the last Office action has already been filed, applicant is given a non-extendable period of the longer of one month or thirty days from this interview date, or the mailing date of this interview summary form, whichever is later, to file a statement of the substance of the interview.

Examiner recordation instructions: Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

☐ Attachment

/DMITRY LEVITAN/ Primary Examiner, Art Unit 2461	
---	--

Summary of Record of Interview Requirements

Manual of Patent Examining Procedure (MPEP), Section 713.04, Substance of Interview Must be Made of Record

A complete written statement as to the substance of any face-to-face, video conference, or telephone interview with regard to an application must be made of record in the application whether or not an agreement with the examiner was reached at the interview.

Title 37 Code of Federal Regulations (CFR) 1.133 Interviews

Paragraph (b)

In every instance where reconsideration is requested in view of an interview with an examiner, a complete written statement of the reasons presented at the interview as warranting favorable action must be filed by the applicant. An interview does not remove the necessity for reply to Office action as specified in §§ 1.111, 1.135. (35 U.S.C. 132)

37 CFR §1.2 Business to be transacted in writing.

All business with the Patent or Trademark Office should be transacted in writing. The personal attendance of applicants or their attorneys or agents at the Patent and Trademark Office is unnecessary. The action of the Patent and Trademark Office will be based exclusively on the written record in the Office. No attention will be paid to any alleged oral promise, stipulation, or understanding in relation to which there is disagreement or doubt.

The action of the Patent and Trademark Office cannot be based exclusively on the written record in the Office if that record is itself incomplete through the failure to record the substance of interviews.

It is the responsibility of the applicant or the attorney or agent to make the substance of an interview of record in the application file, unless the examiner indicates he or she will do so. It is the examiners responsibility to see that such a record is made and to correct material inaccuracies which bear directly on the question of patentability.

Examiners must complete an Interview Summary Form for each interview held where a matter of substance has been discussed during the interview by checking the appropriate boxes and filling in the blanks. Discussions regarding only procedural matters, directed solely to restriction requirements for which interview recordation is otherwise provided for in Section 812.01 of the Manual of Patent Examining Procedure, or pointing out typographical errors or unreadable script in Office actions or the like, are excluded from the interview recordation procedures below. Where the substance of an interview is completely recorded in an Examiners Amendment, no separate Interview Summary Record is required.

The Interview Summary Form shall be given an appropriate Paper No., placed in the right hand portion of the file, and listed on the "Contents" section of the file wrapper. In a personal interview, a duplicate of the Form is given to the applicant (or attorney or agent) at the conclusion of the interview. In the case of a telephone or video-conference interview, the copy is mailed to the applicants correspondence address either with or prior to the next official communication. If additional correspondence from the examiner is not likely before an allowance or if other circumstances dictate, the Form should be mailed promptly after the interview rather than with the next official communication.

The Form provides for recordation of the following information:

- Application Number (Series Code and Serial Number)
- Name of applicant
- Name of examiner
- Date of interview
- Type of interview (telephonic, video-conference, or personal)
- Name of participant(s) (applicant, attorney or agent, examiner, other PTO personnel, etc.)
- An indication whether or not an exhibit was shown or a demonstration conducted
- An identification of the specific prior art discussed
- An indication whether an agreement was reached and if so, a description of the general nature of the agreement (may be by attachment of a copy of amendments or claims agreed as being allowable). Note: Agreement as to allowability is tentative and does not restrict further action by the examiner to the contrary.
- The signature of the examiner who conducted the interview (if Form is not an attachment to a signed Office action)

It is desirable that the examiner orally remind the applicant of his or her obligation to record the substance of the interview of each case. It should be noted, however, that the Interview Summary Form will not normally be considered a complete and proper recordation of the interview unless it includes, or is supplemented by the applicant or the examiner to include, all of the applicable items required below concerning the substance of the interview.

A complete and proper recordation of the substance of any interview should include at least the following applicable items:

- 1) A brief description of the nature of any exhibit shown or any demonstration conducted, -
- 2) an identification of the claims discussed,
- 3) an identification of the specific prior art discussed,
- 4) an identification of the principal proposed amendments of a substantive nature discussed, unless these are already described on the Interview Summary Form completed by the Examiner,
- 5) a brief identification of the general thrust of the principal arguments presented to the examiner,
(The identification of arguments need not be lengthy or elaborate. A verbatim or highly detailed description of the arguments is not required. The identification of the arguments is sufficient if the general nature or thrust of the principal arguments made to the examiner can be understood in the context of the application file. Of course, the applicant may desire to emphasize and fully describe those arguments which he or she feels were or might be persuasive to the examiner.)
- 6) a general indication of any other pertinent matters discussed, and
- 7) if appropriate, the general results or outcome of the interview unless already described in the Interview Summary Form completed by the examiner.

Examiners are expected to carefully review the applicants record of the substance of an interview. If the record is not complete and accurate, the examiner will give the applicant an extendable one month time period to correct the record.

Examiner to Check for Accuracy

If the claims are allowable for other reasons of record, the examiner should send a letter setting forth the examiners version of the statement attributed to him or her. If the record is complete and accurate, the examiner should place the indication, Interview Record OK on the paper recording the substance of the interview along with the date and the examiners initials.

<i>Search Notes</i> 	Application/Control No. 16/902,740	Applicant(s)/Patent Under Reexamination Li et al.
	Examiner DMITRY LEVITAN	Art Unit 2461

CPC - Searched*		
Symbol	Date	Examiner
H04L 12/26, 5/0007, 5/0028, 25/03834, 27/0008, 27/0012, 27/26/02	09/17/2020	DL

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner
370	241, 252, 310, 328, 330, 464, 532	09/17/2020	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	09/17/2020	DL

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
370	241	09/17/2020	DL

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<i>Index of Claims</i> 	Application/Control No. 16/902,740	Applicant(s)/Patent Under Reexamination Li et al.
	Examiner DMITRY LEVITAN	Art Unit 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	08/26/2020	09/17/2020						
	1	✓	=						
	2	✓	=						
	3	✓	=						
	4	✓	=						
	5	✓	=						
	6	✓	=						
	7	✓	=						
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	10	✓	=						
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	25	✓	=						
	26	✓	=						
	27	✓	=						
	28	✓	=						
	29	✓	=						
	30	✓	=						

Issue Classification 	Application/Control No. 16/902,740	Applicant(s)/Patent Under Reexamination Li et al.	
	Examiner DMITRY LEVITAN	Art Unit 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
H04B	/	1	/	707	I	2013-01-01
H04B	/	1	/	711	I	2013-01-01
H04L	/	27	/	2647	I	2013-01-01
H04L	/	27	/	2602	I	2013-01-01
H04L	/	27	/	2655	A	2013-01-01
H04L	/	5	/	0016	A	2013-01-01
H04L	/	25	/	0228	A	2013-01-01
H04L	/	27	/	2607	A	2013-01-01

CPC Combination Sets				
Symbol	Type	Set	Ranking	Version
/				

NONE (Assistant Examiner) (Date)		Total Claims Allowed: 30	
/DMITRY LEVITAN/ Primary Examiner, Art Unit 2461 (Primary Examiner) (Date)		17 September 2020 O.G. Print Claim(s) 1	O.G. Print Figure 8

U.S. Patent and Trademark Office

Part of Paper No.: 20200917

Issue Classification 	Application/Control No. 16/902,740	Applicant(s)/Patent Under Reexamination Li et al.
	Examiner DMITRY LEVITAN	Art Unit 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		Total Claims Allowed:	
(Assistant Examiner)	(Date)	30	
/DMITRY LEVITAN/ Primary Examiner, Art Unit 2461	17 September 2020	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	8

Issue Classification 	Application/Control No. 16/902,740	Applicant(s)/Patent Under Reexamination Li et al.
	Examiner DMITRY LEVITAN	Art Unit 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
	1		10		19		28								
	2		11		20		29								
	3		12		21		30								
	4		13		22										
	5		14		23										
	6		15		24										
	7		16		25										
	8		17		26										
	9		18		27										

NONE (Assistant Examiner) _____ (Date) _____		Total Claims Allowed: 30	
/DMITRY LEVITAN/ Primary Examiner, Art Unit 2461 (Primary Examiner) _____ (Date) 17 September 2020		O.G. Print Claim(s) 1	O.G. Print Figure 8

U.S. Patent and Trademark Office

Part of Paper No.: 20200917

EAST Search History

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	4	((wireless or radio or cellular) and (guard) and OFDM and (chip near2 (interval or duration or rate))).clm.	US-PGPUB; USPAT	OR	ON	2020/09/17 10:38
L3	11	((radio or wireless or LTE) and (frequency adj2 (range or portion or band)) and OFDM and (Base\$station or BST or BS or enb or enodeB) and (guard)).clm.	US-PGPUB; USPAT	OR	ON	2020/09/17 10:41
L4	9	((radio or wireless or LTE) and (random adj2 access) and OFDM and (Base\$station or BST or BS or enb or enodeB) and (guard)).clm.	US-PGPUB; USPAT	OR	ON	2020/09/17 10:42

9/17/2020 10:43:39 AM

C:\Users\dlevitan\Documents\EAST\Workspaces\16902740.wsp

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number	16902740
	Filing Date	2020-06-16
	First Named Inventor	Li et al.
	Art Unit	2461
	Examiner Name	Dmitry Levitan
	Attorney Docket Number	NEO-PT012.7

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	7873009	B2	2011-01-18	Larsson et al.		
	2	8102832	B2	2012-01-24	Agrawal et al.		
	3	8363691	B2	2013-01-29	Hasegawa et al.		

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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							

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)	Application Number		16902740
	Filing Date		2020-06-16
	First Named Inventor	Li et al.	
	Art Unit	2461	
	Examiner Name	Dmitry Levitan	
	Attorney Docket Number	NEO-PT012.7	

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NON-PATENT LITERATURE DOCUMENTS

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		

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EXAMINER SIGNATURE

Examiner Signature	/DMITRY LEVITAN/	Date Considered	09/17/2020
--------------------	------------------	-----------------	------------

*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.

**INFORMATION DISCLOSURE
STATEMENT BY APPLICANT**
(Not for submission under 37 CFR 1.99)

Application Number	16902740
Filing Date	2020-06-16
First Named Inventor	Li et al.
Art Unit	2461
Examiner Name	Dmitry Levitan
Attorney Docket Number	NEO-PT012.7

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)	2020-09-01
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.**

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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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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)).
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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.

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

By fax, send to: (571)-273-2885

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3624 7590 09/22/2020
Volpe Koenig
30 SOUTH 17TH STREET, 18TH FLOOR
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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.
16/902,740	06/16/2020	Xiaodong Li	NEO-PT012.7	1020

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	12/22/2020

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 Koenig

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, PENNSYLVANIA

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 _____

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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.

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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 September 25, 2020

Typed or printed name Christina R. Walsh

Registration No. 61,553

Electronic Patent Application Fee Transmittal				
Application Number:		16902740		
Filing Date:		16-Jun-2020		
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-PT012.7		
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:	40674257
Application Number:	16902740
International Application Number:	
Confirmation Number:	1020
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-PT012.7
Receipt Date:	25-SEP-2020
Filing Date:	16-JUN-2020
Time Stamp:	16:27:23
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	E20209OG27477068
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 1.19 (Document supply fees) 37 CFR 1.20 (Post Issuance fees)	

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_7-IssueFee_PTOL85_EFS-20200925.pdf	85364	no	1
			ed77a58b6ebcf6071d56f3da3ae4f89d2610d2b		

Warnings:**Information:**

2	Fee Worksheet (SB06)	fee-info.pdf	30235	no	2
			1e24f7220f5d309bbc9d0a7f2dba6d7b7c2f44fd		

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New Applications Under 35 U.S.C. 111

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New International Application Filed with the USPTO as a Receiving Office

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/902,740	06/16/2020	Xiaodong Li	NEO-PT012.7

CONFIRMATION NO. 1020

3624

Volpe Koenig

30 SOUTH 17TH STREET, 18TH FLOOR
PHILADELPHIA, PA 19103

PUBLICATION NOTICE



OC000000120335218

Title:CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM

Publication No.US-2020-0313948-A1

Publication Date:10/01/2020

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 Management, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101



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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.
16/902,740	11/10/2020	10833908	NEO-PT012.7	1020

3624 7590 10/21/2020
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.

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
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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 Western District of Texas Waco Division on the following

☐ Trademarks or ☒ Patents. (☐ the patent action involves 35 U.S.C. § 292.);

DOCKET NO. 6:21-cv-00025	DATE FILED 4/28/2021	U.S. DISTRICT COURT Western District of Texas Waco Division
PLAINTIFF Neo Wireless LLC		DEPENDANT LG Electronics Inc., LG Electronics U.S.A., 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 10,044,517	8/7/2018	Neo Wireless LLC
3 10,833,908	4/17/2018	Neo Wireless LLC
4 10,075,941	9/11/2018	Neo Wireless LLC
5 10,447,450	10/15/2019	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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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
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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 Western District of Texas Waco Division on the following

☐ Trademarks or ☒ Patents. (☐ the patent action involves 35 U.S.C. § 292.);

DOCKET NO. 6:21-cv-00026	DATE FILED 4/28/2021	U.S. DISTRICT COURT Western District of Texas Waco Division
PLAINTIFF Neo Wireless LLC		DEPENDANT Apple 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 10,044,517	8/7/2018	Neo Wireless LLC
3 10,833,908	4/17/2018	Neo Wireless LLC
4 10,075,941	9/11/2018	Neo Wireless LLC
5 10,447,450	10/15/2019	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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DECISION/JUDGEMENT		
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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. 2:22-cv-00093	DATE FILED 3/29/2022	U.S. DISTRICT COURT Eastern District of Texas, Marshall Division
PLAINTIFF Neo Wireless LLC		DEPENDANT 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
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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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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
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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. 2:22-cv-00094	DATE FILED 3/29/2022	U.S. DISTRICT COURT Eastern District of Texas, Marshall Division
PLAINTIFF Neo Wireless LLC		DEPENDANT 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
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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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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
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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. 2:22-cv-00095	DATE FILED 3/29/2022	U.S. DISTRICT COURT Eastern District of Texas, Marshall Division
PLAINTIFF Neo Wireless LLC		DEPENDANT 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
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DECISION/JUDGEMENT		
CLERK	(BY) DEPUTY CLERK	DATE

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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

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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 3/29/2022	U.S. DISTRICT COURT Eastern District of Tennessee
PLAINTIFF Neo Wireless LLC		DEFENDANT 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	
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DECISION/JUDGEMENT		
CLERK	(BY) DEPUTY CLERK	DATE

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Case 1:22-cv-00076-TAV-SKL Document 2 Filed 03/29/22 Page 1 of 2 PageID #: 314

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
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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. 3:22-cv-01252	DATE FILED 7/15/2022	U.S. DISTRICT COURT Northern District of Ohio
PLAINTIFF Neo Wireless LLC		DEFENDANT 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

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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)

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
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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. 3:22-cv-780-J-MMHJBT	DATE FILED July 15, 2022	U.S. DISTRICT COURT Middle District of Florida
PLAINTIFF NEO WIRELESS, LLC		DEFENDANT 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 ELIZABETH M. WARREN	(BY) DEPUTY CLERK Amy Thomas	DATE July 20, 2022
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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
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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. 3:22-cv-01252	DATE FILED 7/15/2022	U.S. DISTRICT COURT Northern District of Ohio
PLAINTIFF Neo Wireless LLC		DEFENDANT 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 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 Sandy Opacich	(BY) DEPUTY CLERK /s/Natalie Wlotzko	DATE 8/15/2022
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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