

Exhibit 3



(12) **United States Patent**
Li et al.

(10) **Patent No.:** **US 10,833,908 B2**
(45) **Date of Patent:** ***Nov. 10, 2020**

(54) **CHANNEL PROBING SIGNAL FOR A BROADBAND COMMUNICATION SYSTEM**

(71) Applicant: **NEO WIRELESS LLC**, Wayne, PA (US)

(72) Inventors: **Xiaodong Li**, Kirkland, WA (US); **Titus Lo**, Bellevue, WA (US); **Kemin Li**, Bellevue, WA (US); **Haiming Huang**, Bellevue, WA (US)

(73) Assignee: **NEO WIRELESS LLC**, Wayne, PA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.
This patent is subject to a terminal disclaimer.

(21) Appl. No.: **16/902,740**

(22) Filed: **Jun. 16, 2020**

(65) **Prior Publication Data**
US 2020/0313948 A1 Oct. 1, 2020

Related U.S. Application Data

(63) Continuation of application No. 15/953,950, filed on Apr. 16, 2018, now Pat. No. 10,771,302, which is a (Continued)

(51) **Int. Cl.**
H04L 12/26 (2006.01)
H04L 27/26 (2006.01)
(Continued)

(52) **U.S. Cl.**
CPC **H04L 27/2626** (2013.01); **H04B 1/707** (2013.01); **H04B 1/711** (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC H04L 12/26; H04L 5/0007; H04L 5/0028; H04L 25/03834; H04L 27/0008; H04L 27/0012
(Continued)

(56) **References Cited**
U.S. PATENT DOCUMENTS

5,825,807 A 10/1998 Kumar
5,828,650 A * 10/1998 Malkamaki H04L 5/0007 370/203
(Continued)

FOREIGN PATENT DOCUMENTS

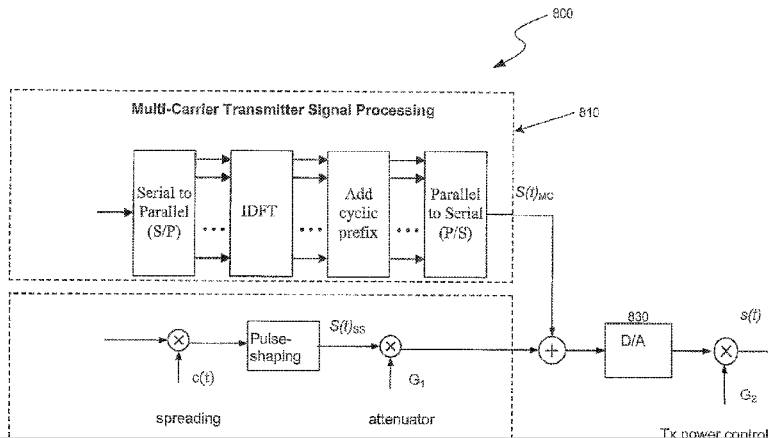
CN 1407745 4/2003
CN 1445949 10/2003
(Continued)

OTHER PUBLICATIONS

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 (Jun. 2004).
(Continued)

Primary Examiner — Dmitry Levitan
(74) *Attorney, Agent, or Firm* — Volpe Koenig

(57) **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
(Continued)



have insignificant impact on either signal and that both signals are detectable with expected performance by a receiver.

30 Claims, 18 Drawing Sheets

Related U.S. Application Data

continuation of application No. 14/321,615, filed on Jul. 1, 2014, now Pat. No. 9,948,488, which is a continuation of application No. 13/861,942, filed on Apr. 12, 2013, now Pat. No. 8,767,522, which is a continuation of application No. 13/347,644, filed on Jan. 10, 2012, now Pat. No. 8,428,009, which is a continuation of application No. 12/975,226, filed on Dec. 21, 2010, now Pat. No. 8,094,611, which is a continuation of application No. 10/583,229, filed as application No. PCT/US2005/003518 on Jan. 27, 2005, now Pat. No. 7,864,725.

(60) Provisional application No. 60/540,586, filed on Jan. 30, 2004, provisional application No. 60/540,032, filed on Jan. 29, 2004.

(51) **Int. Cl.**

- H04L 5/00* (2006.01)
- H04L 25/03* (2006.01)
- H04L 27/00* (2006.01)
- H04B 1/707* (2011.01)
- H04B 1/711* (2011.01)
- H04L 25/02* (2006.01)

(52) **U.S. Cl.**

- CPC *H04L 5/0007* (2013.01); *H04L 5/0028* (2013.01); *H04L 25/03834* (2013.01); *H04L 27/0008* (2013.01); *H04L 27/0012* (2013.01); *H04L 27/2602* (2013.01); *H04L 27/2647* (2013.01); *H04L 5/0016* (2013.01); *H04L 25/0228* (2013.01); *H04L 27/2607* (2013.01); *H04L 27/2655* (2013.01)

(58) **Field of Classification Search**

USPC 370/241, 252, 310, 328, 330, 464, 532
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

5,867,478 A	2/1999	Baum et al.	
5,909,436 A	6/1999	Engstrom et al.	
6,141,546 A	10/2000	Thomas	
6,175,550 B1*	1/2001	van Nee	H04L 1/0002 370/206
6,434,364 B1	8/2002	O'Riordain	
6,480,558 B1	11/2002	Ottosson et al.	
6,515,960 B1	2/2003	Usui et al.	
6,567,383 B1*	5/2003	Bohnke	H04L 5/005 370/280
6,643,281 B1	11/2003	Ryan	
6,731,673 B1	5/2004	Kotov et al.	
6,741,578 B1	5/2004	Moon et al.	
6,771,706 B2	8/2004	Ling et al.	
6,847,678 B2	1/2005	Berezdivin et al.	
6,922,388 B1*	7/2005	Laroia	H04J 3/0682 370/208
6,940,827 B2	9/2005	Li et al.	
7,035,663 B1	4/2006	Linebarger et al.	

7,123,934 B1	10/2006	Linebarger et al.	
7,149,239 B2	12/2006	Hudson	
7,161,985 B2	1/2007	Dostert et al.	
7,161,987 B2	1/2007	Webster et al.	
7,218,666 B2	5/2007	Baum et al.	
7,260,054 B2	8/2007	Olszewski	
7,274,652 B1	9/2007	Webster et al.	
7,317,931 B2	1/2008	Guo	
7,342,974 B2	3/2008	Chiou	
7,386,055 B2	6/2008	Morita et al.	
7,403,556 B2	7/2008	Kao et al.	
7,411,897 B2*	8/2008	Yoo	H04L 27/2605 370/208
7,418,042 B2	8/2008	Choi et al.	
7,443,829 B2	10/2008	Rizvi et al.	
7,471,667 B2*	12/2008	Hirsch	H04L 5/1453 370/312
7,548,506 B2	6/2009	Ma et al.	
7,555,268 B2	6/2009	Trachewsky et al.	
7,567,624 B1	7/2009	Schmidl et al.	
7,646,747 B2	1/2010	Atarashi et al.	
7,693,032 B2	4/2010	Li et al.	
7,724,720 B2	5/2010	Korpela et al.	
7,738,437 B2	6/2010	Ma et al.	
7,864,725 B2	1/2011	Li et al.	
7,873,009 B2	1/2011	Larsson et al.	
7,907,592 B2	3/2011	Han et al.	
8,009,660 B2	8/2011	Li et al.	
8,089,887 B2	1/2012	Lippman et al.	
8,094,611 B2	1/2012	Li et al.	
8,102,832 B2	1/2012	Agrawal et al.	
8,363,691 B2	1/2013	Hasegawa et al.	
8,428,009 B2	4/2013	Li et al.	
8,432,891 B2	4/2013	Li et al.	
8,767,522 B2	7/2014	Li et al.	
2001/0021182 A1	9/2001	Wakutsu	
2002/0141483 A1	10/2002	Doetsch et al.	
2002/0159422 A1	10/2002	Li et al.	
2003/0072255 A1	4/2003	Ma et al.	
2003/0081538 A1	5/2003	Walton et al.	
2003/0179776 A1	9/2003	Sumasu et al.	
2004/0085946 A1	5/2004	Morita et al.	
2004/0171357 A1	9/2004	Lobinger	
2004/0264600 A1	12/2004	Kao et al.	
2005/0111397 A1	5/2005	Attar et al.	
2006/0114815 A1	6/2006	Hasegawa	
2006/0245409 A1	11/2006	Korpela	
2008/0304551 A1	12/2008	Li et al.	
2011/0211617 A1	9/2011	Li et al.	
2011/0299474 A1	12/2011	Li et al.	
2012/0106513 A1	5/2012	Li et al.	
2013/0242937 A1	9/2013	Li et al.	

FOREIGN PATENT DOCUMENTS

CN	1452326	10/2003
EP	1650891	4/2006
JP	09-233047	9/1997
JP	10-210002	8/1998
KR	2001-0083789	9/2001
KR	2003-0060892	7/2003
KR	2009-0040929	4/2009
WO	2003/058881	7/2003

OTHER PUBLICATIONS

Examination Report, European Application No. 05711777.2, dated Oct. 29, 2012, 6 pages.
Examination Report, European Application No. 05712825.8, dated Aug. 16, 2012, 6 pages.
Extended European Search Report received for counterpart European Patent Application No. 18196596.3, dated Feb. 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 Addi-

(56)

References Cited

OTHER PUBLICATIONS

International Search Report and Written Opinion for International Application No. PCT/US05/01939, dated Apr. 26, 2005, 7 pages.
International Search Report and Written Opinion; International Patent Application No. PCT/US05/03518; Filed Jan. 27, 2005; Applicant: Waltical Solutions, Inc.; dated May 23, 2005; 8 pages.
Notice of Allowance, U.S. Appl. No. 13/347,644, filed Mar. 7, 2013, 17 pages.

Notice of Allowance, U.S. Appl. No. 13/861,942, filed May 16, 2014, 14 pages.

Supplementary European Search Report, European Application No. 05711777, dated May 7, 2012, 6 pages.

Supplementary European Search Report, European Application No. 05712825, dated Mar. 26, 2012, 4 pages.

Tufvesson et al. "OFDM Time and Frequency Synchronization by Spread Spectrum Pilot Technique;" Communication Theory Mini-Conference, Vancouver, B.C., Canada, Jun. 6-10, 1999, pp. 115-119.

* cited by examiner

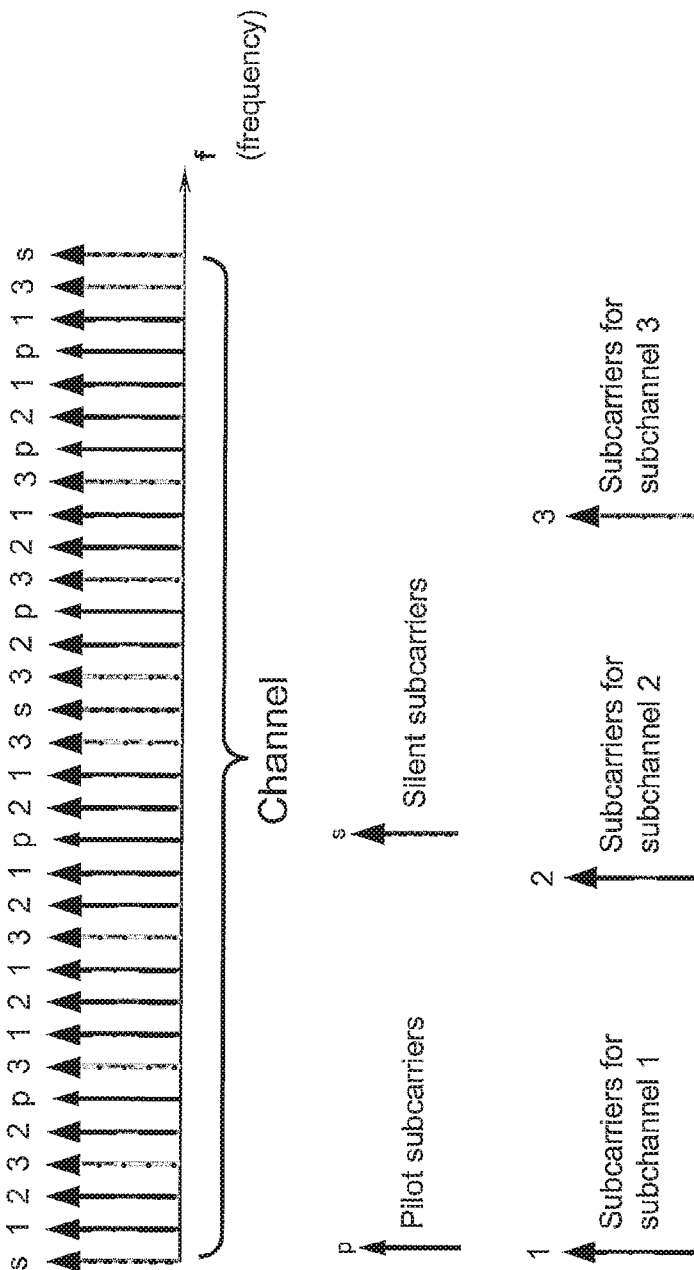


FIG. 1

Explore Litigation Insights

Docket Alarm provides insights to develop a more informed litigation strategy and the peace of mind of knowing you're on top of things.

Real-Time Litigation Alerts



Keep your litigation team up-to-date with **real-time alerts** and advanced team management tools built for the enterprise, all while greatly reducing PACER spend.

Our comprehensive service means we can handle Federal, State, and Administrative courts across the country.

Advanced Docket Research



With over 230 million records, Docket Alarm's cloud-native docket research platform finds what other services can't. Coverage includes Federal, State, plus PTAB, TTAB, ITC and NLRB decisions, all in one place.

Identify arguments that have been successful in the past with full text, pinpoint searching. Link to case law cited within any court document via Fastcase.

Analytics At Your Fingertips



Learn what happened the last time a particular judge, opposing counsel or company faced cases similar to yours.

Advanced out-of-the-box PTAB and TTAB analytics are always at your fingertips.

API

Docket Alarm offers a powerful API (application programming interface) to developers that want to integrate case filings into their apps.

LAW FIRMS

Build custom dashboards for your attorneys and clients with live data direct from the court.

Automate many repetitive legal tasks like conflict checks, document management, and marketing.

FINANCIAL INSTITUTIONS

Litigation and bankruptcy checks for companies and debtors.

E-DISCOVERY AND LEGAL VENDORS

Sync your system to PACER to automate legal marketing.