UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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SIEMENS MOBILITY, INC., GROUND TRANSPORTATION SYSTEMS USA, INC., HUMATICS CORP., and PIPER NETWORKS, INC.
Petitioners,

v.

METROM RAIL, LLC,
Patent Owner.

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Case Nos. IPR2023-00468 & IPR2023-00470

Patent Nos. 9,043,131 & 8,812,227

_____

DECLARATION OF TODOR COOKLEV, IN SUPPORT OF PATENT OWNER'S RESPONSE

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I, Todor Cooklev, declare as follows:

I. INTRODUCTION

1. I have been retained in this matter by McAndrews, Held & Malloy, Ltd. on behalf of Patent Owner Metrom Rail, LLC. to provide technical assistance in the *inter partes* review ("IPR") of the claims of U.S. Patent No. 9,043,131 ("the 131 patent") and U.S. Patent No. 8,812,227 ("the 227 patent"). I refer to the claims of the 131 patent and 227 patent collectively as the Challenged Claims. The 131 and 227 patents are generally directed to collision avoidance systems for rail vehicles that use time of flight of wideband signals for estimating separation distances between rail vehicles. The claimed systems also include global position system (GPS) receivers and other auxiliary detectors.

2. I understand that Petitioners Siemens Mobility, Inc., Ground Transportation Systems USA, Inc., Humatics Corp., and Piper Networks, Inc. ("Petitioner") petitions for *inter partes* review of the 131 and 227 patents and requests that the Patent Trial and Appeal Board ("Board") cancel the Challenged Claims.

3. For my work on this case, I am being compensated at my typical consulting rate of $650 per hour. I am also being reimbursed for reasonable expenses that I incur during the course of this work. My compensation does not depend on the substance of my opinions or the outcome of any issues in this case.

4. My analysis of the materials produced in this matter is ongoing and I will continue to review any new material as it is provided. This declaration represents only those opinions that relate to the patentability of the Challenged Claims that I have formed to date. I reserve the right to amend or supplement my opinions based on additional documents or evidence I am presented, including without limitation any arguments or expert declarations advanced by Petitioner in this case.

II. BACKGROUND AND QUALIFICATIONS

5. In forming my opinions, I relied upon my education, knowledge, and experience and considered the level of ordinary skill in the art as discussed below. A copy of my current *curriculum vitae* is attached to this Declaration, and it provides a comprehensive description of my academic and employment history along with papers and books that I have published and patent and patent applications of which I'm listed as an inventor.

6. I am currently Professor of Electrical and Computer Engineering at Purdue University in Fort Wayne, Indiana. At the same institution since 2008 I have served in several faculty and administrative positions, including as the Director of the Wireless Technology Center, ITT Associate Professor of Wireless Communication and Applied Research, and subsequently as Harris Professor of Wireless Communication and Applied Research.

7. I graduated from the Technical University of Sofia, Bulgaria in 1988 with a Diploma of Engineering in the field of Electrical Engineering. I graduated from Tokyo Institute of Technology in Tokyo, Japan in 1995 with a Doctor of Philosophy (Ph.D.) degree in Electrical Engineering.

8. I have received research funding from the National Science Foundation (NSF), the Defense Advanced Research Projects Agency (DARPA), the U.S. Air Force Research Laboratory, the Office of Naval Research, and a number of private companies, including major technology companies.

9. I have authored and co-authored more than 100 peer-reviewed articles. I am also a named inventor on 32 U.S. patents, most of which relate to the hardware or software aspects of communication systems. For part of this work in 2019, I was inducted into the Purdue Inventors Hall of Fame. A list of my publications and patents appears in my *curriculum vitae* attached as Exhibit 1.

10. Some of my publications relate to the technology at issue. For example, I presented a paper on UWB at the IEEE Global Communications Conference (Globecom) held in San Francisco in 2006. I also contributed to the paper "UWB-FSK: Performance tradeoffs for high-complexity receivers," published in the IEEE Transactions on Consumer Electronics in 2010.

11. Also, as part of my work on the Software-Defined Radio ontology and the VITA 49 standard, since about 2007 I have been investigating how to incorporate

position information from GPS and other methods providing location into software constructs describing wireless devices.

12. I have contributed to the development of several major standards for communication systems and numerous amendments. I have participated in many meetings of standards committees. I have prepared, submitted, and presented documents relating to technical matters considered by these committees. I have chaired some committee meetings and served in other leadership roles.

13. Between 2000-2002 and 2005-2008 I was a Voting Member of the IEEE 802.11 Working Group. Around 2005-2007 I was Chair or a Study Group within IEEE 802.11. For part of my work I received an award from IEEE Standards Association in 2012.

14. As part of my involvement with IEEE 802, in November 1999 I attended the first meeting of IEEE 802.15.3 and temporarily served as the first Vice-Chair. At that time this Task Group was beginning to work on high-rate wireless personal area networking and on Ultra-Wideband technology. Since 1999 I have reviewed most drafts produced by IEEE 802.15.3. Since about 1999 I have been familiar with government regulations, technology and business development related to UWB.

15. In 2020, I was elected to serve on the Board of Governors of the IEEE Standards Association for one term beginning January 2021. The Board of Governors provides overall leadership of the IEEE Standards Association.

16. Currently, I am a Series Editor for Wireless and Radio Communications of the IEEE Communications Standards Magazine (which is the premier journal in the field of communication standards) and have held that position since 2017. As a member of the Editorial Board I coordinate the review of scholarly manuscripts submitted to the wireless and radio communications series.

17. I am qualified by education and experience to testify as an expert with respect to subject matter in the fields of wireless communications, wireless communications protocols, and hardware and software for wireless devices.

18. My qualifications are stated more fully in my *curriculum vitae*, a copy of which is attached hereto as Exhibit 1.

III. MATERIALS CONSIDERED

19. In preparing this Declaration, I have considered the documents tabulated below. I have also relied on my conversations with Mr. Karl Gunther and Mr. James Marchi. Finally, I have relied on my extensive knowledge of UWB and GPS. I have supported my opinions with inline citations to publicly accessible publications and articles.

Exhibit	Description
1001	U.S. Patent No. 9,043,131 to Carlson et al.
2009	Declaration of Mr. Kurt Gunther
2008	Declaration of James Marchi
2016	https://web.archive.org/web/20130602090958/http://metrom-rail.com/aura-collision-avoidance-system and attachment
2017	https://web.archive.org/web/20210805044759/https://www.pipernetworks.com/asset-tracking-rtls-solutions/
2018	https://web.archive.org/web/20211026212904/https://www.pipernetworks.com/asset-tracking-rtls-solutions/
2019	AURA MOW Product Specification
2020	HELIX MOW Limits Compliance & Collision Avoidance System (LCCAS) Product Specification
2021	AURA-Helix Comparison Chart
2022	Helix Claim Chart
2023	AURA Claim Chart
2027	Declaration of Nathaniel E Frank-White and Ex. A[1]

IV. LEGAL UNDERSTANDING

20. I am not an attorney, and I render no opinions on the law itself. My opinions are informed by my understanding of the relevant law as has been provided to me by counsel. I understand that the patentability analysis is conducted on a claim-by-claim and element-by-element basis.

A. OBVIOUSNESS

21. I further understand that a patent claim is unpatentable and invalid if the subject matter of the claim as a whole would have been obvious to a person of

[1] Authenticated copies of Ex. 2016, Ex. 2017 and Ex. 2018.

ordinary skill in the art ("POSITA") of the claimed subject matter as of the time of the invention at issue. I understand that obviousness may be shown by considering more than one item of prior art or the knowledge of a POSITA.

22. I understand that the following factors should be evaluated to determine whether the claimed subject matter is obvious: (1) the scope and content of the prior art; (2) the difference or differences, if any, between each claim of the patent and the prior art; (3) the level of ordinary skill in the art at the time the patent was filed; and 4) the objective evidence of non-obviousness, also referred to as secondary considerations (described below).

23. I understand that so-called "objective indicia of non-obviousness," also known as "secondary considerations," are also to be considered when assessing obviousness if present. These include commercial success; long-felt but unresolved need; failure of others to solve the problem that the inventor solved; unexpected results; copying of the invention by others; and industry recognition or expressions of disbelief by experts in the field of the claimed invention. I also understand that a nexus, *i.e.*, a tie, must exist between objective indicia of non-obviousness and the novel aspects of the claimed subject matter.

24. For objective evidence of secondary considerations to be relevant, there must be a nexus between the merits of the claimed invention and the objective evidence. A nexus can be established in two ways: (1) via a presumption of nexus,

or (2) via a showing that the evidence is a direct result of the unique characteristics of the claimed invention.

25. The law presumes a nexus when it shows that the asserted objective evidence is tied to a specific product that embodies the claimed features, and is coextensive with them.

26. Even if there is a failure to establish nexus, the patent owner is still afforded an opportunity to prove nexus by showing that the evidence of secondary considerations is the direct result of the unique characteristics of the claimed invention.

27. I understand that the test of obviousness is whether the claimed invention, as a whole, would have been obvious to one of ordinary skill in the art as of the date of the invention in light of the prior art. I understand that the use of hindsight must be avoided when considering whether the alleged invention would have been obvious to the POSITA.

28. I understand that in determining obviousness, the POSITA is a person of ordinary creativity, not an automaton. I understand that, when there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a POSITA has good reason to pursue the known options within his or her technical grasp.

29. I understand that a dependent claim incorporates each and every limitation of the independent claim from which it depends. Thus, I understand that if a prior art reference fails to anticipate an independent claim, then that prior art also necessarily fails to anticipate all dependent claims that depend from the independent claim. Similarly, I understand that if a prior art reference or combination of prior art reference fails to render obvious an independent claim, then that prior art reference or combination of prior art references also necessarily fails to render obvious all dependent claims that depend from that independent claim.

V. LEVEL OF ORDINARY SKILL IN THE ART

30. I have been asked to analyze the 131 and 227 patent specification and claims. I have also been asked to review the specific features of the collision avoidance systems (CAS) designed by Patent Owner and Petitioner, Piper Networks.

31. I am qualified to render the opinions herein because I have sufficient training and experience to read and understand the patent claims in the 131 patent. I am not opining on what the ordinary skill level in the railway industry for wireless safety devices is, but my skill level in wireless technology specifically and systems engineering generally is likely significantly higher than the ordinary skill level in the railroad industry.

VI. OPINIONS

32. I have been asked to determine if Petitioner Piper Networks had sufficient access to the AURA CAS system to allow it to copy the patented features of the AURA CAS and the similarity of Petitioner's Helix CAS to Patent Owner's AURA CAS. Relatedly, I have been asked to identify evidence that would indicate that Piper Networks copied the AURA CAS.

33. I have also been asked to compare the Challenged Claims with Patent Owner's AURA CAS and determine if the AURA CAS embodies the features of one or more of the Challenged Claims. Relatedly, I have been asked to evaluate if the AURA CAS includes any non-insignificant unclaimed features, *i.e.*, the degree of correspondence between the AURA CAS and one or more of the Challenged Claims.

A. COPYING

34. I have concluded the Piper Networks copied the patented features of the AURA CAS to arrive at their Helix CAS. I base this conclusion on information regarding when details of the AURA CAS was first publicly available, information about Piper Network products and services offering at different times in the past, and my comparison of the AURA CAS to the Helix CAS.

35. I used the Way Back Machine to determine approximately when features of the AURA CAS were first publicly available. Features of the AURA CAS and specifically the various claimed features were publicly accessible *via*

Patent Owner's website at least since June 2, 2013. *See* Ex. 2016; see also https://web.archive.org/web/20130602090958/http://metrom-rail.com/aura-collision-avoidance-system.

36. I used the Way Back Machine to determine approximately when Piper Networks first offered its Helix CAS for sale. As recently as August 5, 2021, Piper Networks' product offerings did not include a the Helix CAS. *See* Ex. 2017. Sometime between August 5, 2021 and October 2, 2022, for the first time, Piper Networks website disclosed a version of its Helix CAS for MOWs. *See* Ex. 2018. From this I conclude that earliest availability of the Helix CAS based on public representation made on their website was August 6, 2021.

37. Finally, my comparison of the features of the Helix CAS with the AURA CAS show that the Helix CAS includes the patented features of the AURA CAS. *See* Ex. 2021 (chart comparing the AURA CAS with the Helix CAS, hereinafter AURA-Helix Chart.) The information for the Helix CAS was obtained from public sources including Piper Networks website (https://www.pipernetworks.com/maintenance-of-way-safety/) and product specification. Ex. 2020. The information for the AURA CAS was derived from its product specification. See Ex. 2019.

38. Based on my analysis, I conclude that there is substantial similarity between the AURA CAS and HELIX CAS. Further, because the AURA CAS was

publicly available at least five years before the Helix CAS, it is very likely that the Piper Networks' Helix CAS was copied from Patent Owner's AURA CAS.

39. Separately, I compared claim 1 and 7 of the 131 and 227 patents to the features of the Helix CAS. There is a high degree of correspondence between the claims and the Helix CAS. *See* Ex. 2022.

B. NEXUS

40. I was asked to compare one or more of the Challenged Claims with the AURA CAS and determine if AURA CAS embodies the claimed features and ascertain the degree of correspondence between the AURA CAS and one or more of the Challenged Claims.

41. To perform my comparison, I relied on publicly available product specification for the AURA CAS. See Ex. 2019. My comparison of the features of the AURA CAS with certain Challenged Claims show that the AURA CAS embodies the patented features. Ex. 2023 is a chart comparing the Challenged Claims 1 and 7 of the 131 patent (pp. 1-6) and separately, claims 1 and 7 of the 227 patent (pp. 7-12) with the AURA CAS. I have also concluded that there is a high degree of correspondence between the AURA CAS and claims 1 and 7 of the 131 and 227 patents. Based on my discussions with Mr. James Marchi, I understand that the claimed features of the AURA CAS are the features that drive demand for the

AURA CAS. From my conversations with Mr. Kurt Gunther, I have concluded that there are no unclaimed significant features in the AURA CAS.

VII. CONCLUSION

42. 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 are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

September 15, 2023

Todor Cooklev

EXHIBIT 1

Todor Cooklev, PhD.

Curriculum Vitae

Personal

1336 Sycamore Hills Parkway, Fort Wayne, IN 46814
Contact e-mail: tcooklev@gmail.com
Cell: 925-984-5283

Citizenship: United States (by naturalization)

Professional experience

2016 – **Professor of Electrical and Computer Engineering**
2101 E Coliseum Blvd., ETCS 349
Purdue University Fort Wayne, Indiana 46805

- Research on most aspects of wireless systems, including hardware, signal processing, and software techniques, in particular for software-defined radios.
- Courses:
  ECE 428 Communication Systems
  ECE 549 Software-Defined Radio
  ECE 543 Wireless Communications and Networks

2013 – 2017 **Co-founder and CEO, Adaptive RF, Fort Wayne, IN**

- Developed innovative RF technology and served as co-founder of a company that received funding from the Department of Defense

2018 – 2019 **Chief Technology Officer, Stryke Industries LLC**

- CTO of a company receiving a grant from the Air Force Research Laboratory, Rome, NY

2010 – 2016 **ITT Associate Professor of Wireless Communication and Applied Research,** *Purdue University Fort Wayne*

2008 – 2022 **Director, Wireless Technology Center**
Purdue University Fort Wayne

2005 – 2008 **Consultant, Hitachi America Ltd., San Jose, California**

- Voting Member, IEEE 802.11 WG; participated in the work on several 802.11 amendments
- Chair, IEEE 802.11 VTS Study Group; responsible for the proposal and approval to create a Task Group that lead to the IEEE 802.11aa standard

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2011 – 2012 **Consultant, Hitachi America Ltd., San Jose, California**

- Attended meetings of the 3GPP RAN1 standardization committee in Dresden, Germany, Jeju Island, Korea, Prague, Czech Republic, and Qindao, China, 2012.
- Contributed to several documents submitted to 3GPP

2006 – 2008 **Consultant,** *Datamars, Lugano, Switzerland*

- Evaluated and produced reports on certain wireless technologies and standards
- Participated in the IEEE 802.15.4f committee

2004 – 2006 **Consultant,** *Leica Geosystems, Switzerland*

- IEEE 802.16 (WiMAX) and related technologies

2005 – 2007 **Technical Advisory Board Member***, Doceotech, San Ramon, CA*

2002 – 2008 **Assistant Professor** with tenure (2008), *San Francisco State University.*

2000 – 2002 **Member of the Technical Staff***, Aware, Inc., Bedford, MA and Lafayette, CA*

- Worked on DSL standards. Participated in the International Telecommunications Union, Study Group 15, Question 4. Chaired the session on coding for DSL at the session in Antwerp, Belgium, June 2000. Participated in the Telecommunications Industry Association T1E1 Committee on DSL
- Developed advanced coding and decoding methods for DSL
- Worked on the design of an IEEE 802.11a chipset.
- Voting member, IEEE 802.15; Co-Founder and First Vice-Chair of IEEE 802.15.3 (High-data rate wireless personal area networking

1998-1999 **Consultant***, Quantronix, Framingham, Utah*

- Image processing; developed software for edge detection and wrote a report

1996-1997 **Consultant,** *Communications Research Center, Government of Canada.*

- Designed digital filter banks for communication systems and wrote two technical reports

1997-1999 **Senior Engineer,** *3Com Corporation*

- Worked on V.90 voice-band modems
- Implemented data compression and other signal processing algorithms V.42 and V.42bis
- Worked on the Bluetooth Standard, one of the first contributors to the Host Controller Interface of Bluetooth.
- Participated in the Bluetooth/IEEE group, which drafted the license agreement between Bluetooth and the IEEE 802, which in turn led to the establishment of the IEEE 802.15 Working Group.

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Grants Awarded

1. Office of Naval Research Summer Fellow 2020, Naval Surface Warfare Center Crane

2. National Science Foundation S^2ERC I/UCRC, "FPGA implementation of shared-memory middleware", 2017-2019, PI

3. National Science Foundation S^2ERC I/UCRC, "Shared-memory middleware", 2016-2017, PI

4. City of Fort Wayne, Economic Development Fund, 2013-15, co-PI.

5. Allen County Capital Improvement Board (CIB), 2013-15, co-PI

6. U.S. Defense Advanced Research Projects Agency (DARPA) Small Business Technology Transfer (STTR) Phase I "A flexible and extensible solution to incorporating new RF devices and capabilities into EW/ISR networks, co-PI, August 2013 – February 2014.

7. National Science Foundation S^2ERC I/UCRC, "The performance of middleware solutions for SDR", 2013-2014, PI

8. National Science Foundation S^2ERC I/UCRC, "Cognitive decision applications for embedded use," 2011-2012, PI

9. Visiting Fellowship, National Institute of Communication Technology (Japan), 2011

10. National Science Foundation S^2ERC I/UCRC, "Signal processing techniques for multicarrier modulation," 2009-2011, PI

11. NMDG, Belgium, laboratory grant 2010, PI

12. National Science Foundation, Professional Science Master's Program, MS in engineering, with concentration in wireless and systems engineering, 2010-2013, Co-PI.

13. Emona Instruments, Sydney, Australia, Laboratory exercises in communications, Principal Investigator, 2008.

14. Lilly Endowment, wireless laboratory grant, 2010, PI.

15. ITT (now Harris) Communications Systems, 2007-2011, PI.

16. State of Indiana, workforce development, 2008-2010, PI

17. National Science Foundation DUE-0442313, "Standards in Education for Product, Process, and Service Design and Development: A Proof-of-Concept Project," 2005-2008, PI.

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18. France Telecom, Paris, France, "New methods for multicarrier modulation for high data-rate wireless systems," Principal Investigator, 2006.

19. Agilent Technologies/Sun Microsystems, Palo Alto, CA, "Distributed wireless sensor network for environmental monitoring," Co-principal Investigator, 2005.

20. CSU summer research grant, 2004.

21. U.S. Air-Force Research Laboratory, Wright-Patterson AFB, "Data over voice communications," Principal Investigator, 2004.

Honors and Awards

2012	IEEE Standards Association, "for outstanding contributions to the development of IEEE 802.11aa"
2006	Wireless Educator of the Year Award with the citation "In recognition of the pivotal role of educators in preparing tomorrow's wireless technology leaders".
2005	Duke's Choice Award, Sun Microsystems, (group award)
2003	IEEE Communications Society Oakland/East Bay Chapter Achievement Award, (group award)
1999	3Com Inventor Award
1995-1997	NATO Science Fellowship
1994	IEEE Asia - Pacific Conference on Circuits and Systems Best Paper Award for the paper "Theory of filter banks over finite fields"

Education

1995 *Tokyo Institute of Technology, Tokyo, Japan,*
Doctor of Philosophy in Electrical Engineering
Dissertation: Regular Perfect-Reconstruction Filter Banks and Wavelet Bases

1988 *Technical University of Sofia, Bulgaria,* Dipl. Eng. in Electrical Engineering

Professional Activities

Board Membership:
Board of Governors, IEEE Standards Association, 2021-2022

Committee/Editorial Board Membership:
IEEE Communications Standards Magazine, Series Editor, Wireless and Radio Communications, 2017-

Committee Membership:
- IEEE 802.11 Working Group Voting Member, 2001-2003, 2006-present

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- IEEE 802.15 Working Group Voting Member 1999-2001
- Chairman, IEEE Standards in Education Committee, 2006 – present
- Member of the Editorial Board, Journal of Networks.
- 2004-2005 Chairman and 2003-2004 Secretary of the Oakland/East Bay Chapter of the IEEE Communication Society.

Program Committee Membership:

- General Chair, Tactical Communications and Interoperability Conference, 2011
- General Chair, Fort Wayne Wireless Summer School 2009 and 2010
- Program Committee Member, Int. Conf. on Wireless Applications and Computing, 2007.
- Program Committee Member, Int. Conference on WLAN, WPAN, and WMAN, Hawaii, Aug. 2007.
- Program Committee Member, Int. Joint Conf. e-Business and Telecommunications, Barcelona, Spain, 2007.
- Program Committee Member, Int. Conf. Wireless Information Networks and Systems, Lisbon, Portugal, 2006.
- Technical Program Committee Member, Int. Conf. Networking and Services, ICNS 2006, Santa Clara, CA.
- Technical Program Committee Member, Advanced Int. Conference on Telecommunications, AICT, Guadeloupe, French Caribbean 2006.
- Program Committee Member, Int. Joint Conf. e-Business and Telecommunications, Reading, UK, 2005.
- Technical Program Committee Member, Int. Conf. Convergent Services and Next-Generation Networks, June 2005, Chicago, IL.
- Technical Program Committee Member, Int. Conference on Service Assurance with Partial and Intermittent Resources, Lisbon, Portugal, July 2005.
- Technical Program Committee Member, Int. Conf. Telecommunications, 2004, Brazil.
- 3rd Int. Workshop on Signal and Image Processing, Manchester, UK, Special session on wavelets in communication systems, signal and image processing, special session co-organizer, Nov. 1996.

Tutorials at International Conferences

1) T. Cooklev, "The analog RF-digital interface: the VITA 49 standard and evolution roadmap," First IEEE Next G Summit, Johns Hopkins University, June 14, 2022.
2) T. Cooklev, "Open RF-digital interfaces and wireless ontologies," IEEE BlackSeaCom, 4th International Black Sea Conference on Communications and Networking, Varna, Bulgaria, June 2016.
3) M. Cummings, T. Cooklev, "Software Defined Radio Technology", Tutorial at the 2008 Symposium System on Chip, Tampere, Finland, Nov. 2008.
4) M. Cummings, T. Cooklev, "Software Defined Radio Technology", Tutorial at the IASTED Int. Conference Computer Communications, Palma de Mallorca, Spain, Sept. 2008.
5) M. Cummings, T. Cooklev, "Software Defined Radio Technology", Tutorial at the 2007 International Conference on Computer Design, Squaw Creek, CA 2007.
6) T. Cooklev, "Wireless communication standards: 802.11, 802.15, and 802.16," Int. Conference Telecommunications, Fortaleza, Brazil, Aug. 2004, tutorial.
7) T. Cooklev, "Wireless data communication standards, IEEE Globecom 2003, Dec. 2003, San Francisco, CA, tutorial.

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Short Courses and Invited Talks excluding conferences:

1) T. Cooklev, "Open RAN", Technical University of Sofia, Bulgaria, November 2019.
2) T. Cooklev, "Software-defined radio technology," Oulu University, Finland, Oct. 2017.
3) T. Cooklev, "Software-defined radio technology," Aarhus University, Denmark, Oct. 2017.
4) T. Cooklev, "Modern wireless systems," Technical University of Sofia, Bulgaria, 2014.
5) T. Cooklev, "Modern Wireless Systems," Featured faculty presentation, Feb. 2012, IPFW.
6) T. Cooklev, "Software-defined radio technology," Tokyo Institute of Technology, Dec. 2011.
7) T. Cooklev, "Software-defined radio technology," University of Akron, OH, 2010.
8) T. Cooklev, "Modern wireless systems," Catholic University of Leuven, Leuven. Belgium, 2010
9) T. Cooklev, "Modern wireless systems," University of Qatar, Doha, Qatar, 2009.
10) T. Cooklev, "Modern wireless systems," Technical University of Sofia, Bulgaria, 2009.
11) T. Cooklev, "Modern wireless systems: from Marconi's radio to cognitive radio," Sigma Xi presentation, February 2009, IPFW.
12) T. Cooklev "Software-Defined Radio Technology," Talk at IPFW, Oct. 2008.
13) M. Cummings, T. Cooklev, "Software Defined Radio Technology", IEEE Communication Society, Oakland/East Bay Chapter, presentation, Oct. 2007, San Ramon, CA.
14) T. Cooklev, "Engineering Standards in Engineering Education," presentation and a panel participant, Standards Engineering Society Annual Conference, San Francisco, CA, August. 2007. (panelist and presenter)
15) T. Cooklev, "Vector transform for multicarrier modulation", France Telecom, June 2007, Rennes, France.
16) T. Cooklev, "Wireless Communication Standards," Distinguished Lecture, IEEE Communication Society, Oct. 2006, University of Maine.
17) T. Cooklev, "The IEEE 802.11, 802.15, and 802.16 Families of Standards," Short Course, April 2006, Lietuvos Telekomas, Vilnius, Lithuania,
18) T. Cooklev, "The IEEE 802.11, 802.15, and 802.16 Families of Standards," Short Course, Feb. 2006, Austin, TX.
19) T. Cooklev, "The IEEE 802.11, 802.15, and 802.16 Families of Standards," Invited Talk, Dec. 2005, Cisco Systems, San Jose, CA.
20) Wireless local area networks, Hitachi Ltd., Brisbane, CA, June 2005.
21) T. Cooklev, "The IEEE 802.11, 802.15, and 802.16 Families of Standards," Invited Talk, May 2005, Texas Instruments, Dallas, TX.
22) T. Cooklev, "Standards for the Wireless Internet", IEEE Communication Society, Oakland/East Bay Chapter, presentation, January 2005. Freemont, CA.
23) T. Cooklev, "Wireless data communication standards, IEEE Wescon, Aug. 2003, San Francisco, CA, tutorial.
24) Short Course on 802.11, 802.15, 802.16, West Long Branch, NJ, August 2003
25) Wireless data communication standards, Lockheed Palo Alto Research Center, June 5, 2003.
26) Short Course on IEEE 802.11, 802.15, and 802.16, San Francisco, CA, Dec. 2002.
27) Standards for wireless data communications, University of Utah, Salt Lake City, UT, 1999
28) OFDM for wireless communications, 3Com Technology Forum, Boston, MA, Nov. 1998.
29) Filter banks and wavelets: a modern applied mathematics tool, Invited Lecture at the Analysis Day, Department of Mathematics and Statistics, Carleton University, Ottawa, Canada, 1997
30) Filter banks and wavelets for video signal processing, Genesis Microchip Inc, Markham, Ontario, Canada, July 1996.

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31) Advanced topics in filter banks, wavelets, and their applications in modern communications systems, CRC, Ottawa, March and August 1996.
32) Digital filter banks and wavelets, Dept. Elect. Eng., University of Ottawa, March 1996.
33) Digital filter banks and wavelets, Dept. Elect. Eng., Queen's University, Kingston, March 1996.
34) Perfect-reconstruction filter banks and wavelet bases and their applications in digital communications, Fujitsu Laboratories, Kawasaki, Japan, July 1994.
35) Fast algorithms for signal processing, Istanbul University, Istanbul, Turkey, Jan. 1994.

Publications

Books and Monographs

1) T. Cooklev and A. Yagle, *Modern Communication Systems: A first course*, Michigan Publishing, 2023 (in preparation).
2) T. Cooklev, W*ireless communications standards: A Study of IEEE 802.11, 802.15, 802.16*, IEEE Press, New York, NY. 2004.

Chapters in Books

1) A. Vlahov, D. Elkova, V. Poulkov, T. Cooklev, Virtualized, open, and intelligent: the evolution of the Radio Access Network," River Publishers, 2021.

2) Subbu Ponnuswamy, Todor Cooklev, Yang Xiao, and Krishna Sumanth Velidi, "Security in fixed and mobile IEEE 802.16 networks," Chapter 4, *WiMAX/MobileFi: Advanced Research and Technology*, edited by Yang Xiao, Taylor and Francis, January 2008.

3) T. Cooklev and A. Hristozov, "The Software Communications Architecture," in *Resource Management in Future Internet*, edited by Ramjee Prasad, River Publishers, Denmark, 2015.

Journal Papers

1) V. Kolev, T. Cooklev, F. Keinert, *Design of a Simple Orthogonal Multiwavelet Filter by Matrix Spectral Factorization*, Circuits, Systems, and Signal Processing, 2019.

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11) C. Tavares, T. Cooklev, S. Gaur, "On video over 802.11," doc. 802.11-06/0039, Jan. 2006. (on behalf of Hitachi America Ltd)

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12) C. Tavares, T. Cooklev, “MAC extensions for HDTV,” doc. 802.11-05/0632, July 2005. (on behalf of Hitachi America Ltd)
13) M. Tzannes, T. Cooklev, D. Lee, C. Lanzl, “Extended data rate 802.11a”, doc. 802.11-02/232, March 2002. (on behalf of Aware, Inc.)
14) S. Prestwich, D. Ostermiller, K. Dobson, T. Cooklev, “Dynamic frequency hopping,” IEEE 802.15, Tel Aviv, Israel, January 2000. (on behalf of Aware, Inc.)

Contributions to ITU-T SG15 Q4 on DSL technology

15) T. Cooklev, A. Freedman, and M. Tzannes, “Low-density parity check codes (LDPC) for ADSL,” ITU-T SG15 Q4 BI-068, Bangalore, India, Nov. 2000. (on behalf of Aware, Inc.)
16) T. Cooklev, M. Tzannes, A. Freedman, “Low-density parity check coded modulation for ADSL,” ITU-T SG15 Q4 BI-081, Bangalore, India, 2000. (on behalf of Aware, Inc.)
17) T. Cooklev, “Error-correcting codes for ADSL,” ITU-T SG15 Q4, BA-108, Antwerp, Belgium, June 2000. (on behalf of Aware, Inc.)

Other non-referred publications and technical reports

18) T. Cooklev, “Standards, regulation, and compliance,” IEEE Standards University, [online] https://www.standardsuniversity.org/e-magazine/september-2017/standards-regulation-compliance/
19) T. Cooklev A wavelet transform approach to the design of sequences for communications, Communications Research Centre, Ottawa, Tech. Report U6800-6-2438, 1997.
20) I. Rabinovitch, A. N. Venetsanopoulos, and T. Cooklev, ``Perceptually lossless still image compression using the wavelet transform, considering the properties of the Human Visual System," ITRC, Kingston, Ontario, 1996.
21) T. Cooklev, On the design and implementation of filter banks and filter bank trees with finite wordlength, Communications Research Centre, Ottawa, Tech. Report 67CRC-5-3315, 1996.
22) T. Cooklev, M. Kato, A. Nishihara, M. Sablatash ``Multifilter banks and multiwavelets," IEICE Tech. Report, Tokyo, Japan, May 1995.
23) T. Cooklev, A. Nishihara, ``Regular biorthogonal filter banks and wavelet bases: new design and implementation," IEICE Tech. Report, presented at KDD Research Institute, Kamifukuoka, Saitama, Japan, April 1995.
24) V. Dimitrov and T. Cooklev, ``Two algorithms for modular exponentiation using non-standard arithmetics,'' IEICE Tech. Report, ISEC93-98, 1994. (in Japanese), presented at the IEICE meeting on information security and cryptography, Osaka, Japan, March 1994.
25) T. Cooklev and A. Nishihara, ``Pruning the real-valued FFT algorithms for efficient time-domain interpolation and linear convolution,'' IEICE Tech. Report, CAS93-14, VLD93-14, DSP93-24, May 1993.
26) T. Cooklev and A. Nishihara, ``Band pass maximally flat FIR filters and Hilbert transformers," IEICE Tech. Report, CS92-88, DSP92-88, Jan. 1993.

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Expert Testimony (last four years)

2023 – Expert for Metrom Rail LLC

- Law firm: McAndrews, Held & Malloy, Chicago, IL
- Case name: *Siemens Mobility, Inc., Ground Transportation Systems USA, Inc., Humatics Corp., and Piper Networks, Inc., v. Metrom Rail LLC*
- Case Nos. IPR2023-00468 & IPR2023-00470
- Submitted declaration
- Technology at issue: ultra-wideband (UWB) sensing for collision avoidance

2023 – Expert for Mitsubishi Electric Corporation

- Law firm: Xsensus LLP, Alexandria, VA
- Case name: *TCL Communication Technology Holdings Limited, TCT Mobile International Limited, TCT Mobile, Inc., TCT Mobile (US) Inc., TCT Mobile (US) Holdings Inc.* v. *Mitsubishi Electric Corp.*
- PTAB Case Nos. IPR2023-00957, IPR2023-00997
- Submitted declarations
- Technology at issue: cellular communications

2022 – Expert for XR Communications, LLC d/b/a Vivato Technologies

- Law firm: Russ August Kabat, Los Angeles, CA
- Case name: *XR Communications, LLC, dba Vivato Technologies v. Asustek Computer, Inc.*
- Case No. 6:21-cv-00622-ADA (*W. D. Texas*)
- Reports on infringement and technical scope of license
- Testified at a deposition
- Technology at issue: beamforming in wireless communications

2023 – Expert for Pantech Corporation

- Law firm: Mayer Brown LLP
- Case names: *Pantech Corporation and Pantech Wireless LLC v. LG Electronics Inc., and LG Electronics U.S.A., Inc.* and *Pantech Corporation and Pantech Wireless LLC v. OnePlus Technology (Shenzhen) Co. Ltd.*
- Civil Action Nos. *5:22-cv-00113-RWS-JBB, 5:22-cv-00069-RWS (E. D. Tex.)*
- Submitted report in connection with claim construction
- Testified at a deposition
- Technology at issue: cellular communications

2023 – Expert for WSOU Investments, LLC d/b/a Brazos Licensing and Development

- Law firm: Folio Law Group
- Case name: *WSOU Investments, LLC d/b/a Brazos Licensing and Development v. Google, LLC.*,
- Case No. *6:20-cv-00585-ADA (W.D. Tex.)*
- Submitted a validity report

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- Testified at a deposition
- Technology at issue: determining a location of a mobile device and location-based services

2023 – Expert for Lemko Corp.
- Law firm: Kramer Levin, New York, NY
- Case name: *Microsoft Corporation and Affirmed Networks, Inc. v. Lemko Corporation*
- PTAB Case No. IPR2023-00530
- Technology at issue: implementation of cellular networks
- Submitted a declaration

2022 – Expert for Ford Motor Company
- Law firm: Latham and Watkins (2022-2023); Brooks Cushman P.C. (2023-)
- Case name: Neo Wireless v. Ford
- Submitted declarations in support of petitions for *Inter Partes* review
- Technology at issue: wireless communications

2021 – Expert for Flexiworld Technologies
- Law firm: Nelson Bumgardner Conroy, Dallas, TX
- Case name: *Roku, Inc.* v. *Flexiworld Technologies*
- PTAB Case Nos. IPR2021-00713, IPR2021-00714, IPR2021-00715, PGR2021-00112, IPR2022-00775
- Submitted multiple declarations
- Testified at multiple depositions

2020 – Expert for Smart Mobile Technologies LLC
- Law firm: Hagens Berman Sobol Shapiro, Pasadena, CA (2020-2022); Graves and Shaw LLP (2022 – present).
- Case names: *Smart Mobile Technologies LLC v. Apple Inc., and Smart Mobile Technologies LLC v. Samsung Electronics Co. Ltd. and Samsung Electronics America, Inc.*
- Case Nos: *6:21-cv-00603, 6:21-cv-00701 (W.D. Tex.)*
- PTAB case Nos. IPR2022-00766, IPR2022-00807, IPR2022-00808, IPR2022-01002, IPR2022-01003, IPR2022-01004, IPR2022-01005, IPR2022-00979, IPR2022-00980, IPR2022-00981, IPR2022-00982, IPR2022-01222, IPR2022-01223, IPR2022-01248, IPR2022-01249
- Submitted multiple declarations
- Testified at multiple depositions

2014 – Expert for TQ Delta, Austin, TX
- Law firm: McAndrews, Chicago, IL
- Case name: TQ Delta, LLC v. Adtran
  Civil Action *No. 14-cv-00954-RGA (D-Del.)*, Civil Action *No. 15-cv-00121-RGA* (*D-Del.*)

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- Case name: TQ Delta, LLC v. 2Wire
  Civil Action *No. 13-cv-1835-RGA (D-Del.)*
- Case name: TQ Delta, LLC v. Zhone Technologies, Inc.
  Civil Action *No. 13-cv-1836-RGA (D-Del.)*
- Case name: TQ Delta, LLC v. Zyxel Communications, Inc. and Zyxel Communications Corporation
  Civil Action *No. 13-cv-2013-RGA (D-Del.)*
- Submitted product testing reports, computer simulation reports, a report on the terms of a license agreement, a report on standards essentiality, infringement reports, validity reports
- Testified at depositions and trials
- Technology at issue: Digital signal processing in Digital Subscriber Line communication systems

2021 – 2023 Expert for TQ Delta, Austin, TX

- Law firm: Davis Law Firm, P.C., Longview TX, and McAndrews, Chicago, IL
- Case name: TQ Delta, LLC, v. Commscope Holding Company, Inc., Commscope Inc., Arris International Limited, Arris Global Ltd, Arris US Holdings, Inc., Arris Solutions, Inc., Arris Technology, Inc., and Arris Enterprises, LLC
- Civil Action No: 2:21-cv-310-JRG, 2:21-cv-309-JRG (*E.D. Tex*.)
- Submitted a declaration in connection with claim construction, infringement report, validity report, and reports on testing and simulation
- Testified at two depositions and at trial

2021 – 2023 Expert for WSOU Investments, LLC d/b/a Brazos Licensing and Development

- Law firm: Kasowitz Benson Torres LLP
- Case name: *WSOU Investments, LLC d/b/a Brazos Licensing and Development v. Canon, Inc*.,
- Case Nos. *6:20-cv-00980-ADA, 6:20-cv-00981-ADA (W.D. Tex.)*
- Submitted a declaration in connection with claim construction.
- Testified at a deposition
- Technology at issue: frequency-hopping wireless communication

2021 – 2022 Expert for NXP

- Law firm: Jones Day, Washington, DC
- Case name: Certain Integrated Circuits, Chipsets, and Electronic Devices, and Products Containing the Same, ITC 337-TA-1287
- Technology at issue: IEEE 802.11
- Submitted a validity report
- Deposition

2021 – 2022 Expert for Barkan Wireless IP Holdings, L.P.

- Law firm: Heim, Payne & Chorush, LLP, Houston, TX

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- Case name: *Barkan Wireless* v. *T-Mobile, Inc. and Nokia of America Corp.*
- Civil Action No. *2:21-CV-00034-JRG (E. D. Tex.)*
- Submitted a validity report
- Testified at a deposition
- Technology at issue: cellular network architecture involving home base stations (femtocells)

2021 – 2022 Expert for 3G Licensing

- Law firm: Devlin Law Firm LLC
- Case name: *Cradlepoint, Inc., Dell Inc., Honeywell International, Inc., Sierra Wireless, Inc., TCL Communication Technology Holdings Limited, TCT Mobile International Limited, TCT Mobile, Inc., TCT Mobile (US) Inc., TCT Mobile (US) Holdings Inc., Thales DIS AIS Deutschland Gmbh, ZTE Corporation, and ZTE (USA) Inc.* v. *3G Licensing, S.A.*
- PTAB Case Nos. IPR2021-00640, IPR2021-01141
- Technology at issue: cellular communications
- Submitted declarations
- Testified at a deposition

2019 – 2022 Expert for Evolved Wireless LLC, Austin, TX

- Law firm: Nelson Bumgardner Albritton P.C., Fort Worth, TX (2019–22); Bruster PLLC, Southlake, TX (2022–present)
- Patent portfolio review
- IPR2021-00943
- Technology at issue: 4G cellular communications

2020 – 2021 Expert for General Access Solutions, Dallas, TX

- Law firm: Bartlit Beck, Denver, CO
- Case name*: General Access Solutions, LTD. v. Virgin Mobile USA, L.P., Boost Mobile, LLC, and Sprint Spectrum L.P.*
- Civil Action *No. 2:20-cv-00007-RWS (E. D. Tex.)*
- Submitted a report on standards essentiality
- Testified at a deposition
- Technology at issue: protocol architecture to support beamforming in 4G and 5G cellular standards

2015 – 2019 Expert for Evolved Wireless, Austin, TX

- Law firm: Robins Kaplan, Minneapolis, MN
- Civil Actions *No. 15-cv-542-SLR-SRF, No. 15-cv-543-SLR-SRF, No. 15-cv-544-SLR-SRF, No. 15-cv-545-SLR-SRF, No. 15-cv-546-SLR-SRF*, and *No. 15-cv-547-SLR-SRF (D-Del.)* brought against Apple, HTC, Lenovo, Samsung, ZTE, and Microsoft.
- Submitted infringement and validity reports
- Testified at deposition and trial
- Technologies at issue: 4G cellular communications

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