UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ONEPLUS TECHNOLOGY (SHENZHEN) CO., LTD.,
Petitioner

v.

PANTECH CORPORATION,
Patent Owner

IPR2025-00887
U.S. Patent No. 8,995,372

DECLARATION OF DR. ROBERT AKL IN SUPPORT OF PETITION FOR *INTER PARTES REVIEW* OF U.S. PATENT 8,995,372

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IX. Ground 1: Tenny in view of Huawei renders obvious claims 1 and 8 58

A. Reasons to Combine Tenny and Huawei 58

1. The proposed modification is a simple substitution of Huawei's delegate CC setting mechanism with Tenny's to obtain predictable results. 59

2. A POSITA would also have a reasonable expectation of success in combining Tenny and Huawei. 60

3. The teaching, suggestion, and motivation in Tenny and Huawei would have led a POSITA to modify Tenny's delegate CC selection mechanism to choose a CC with lowest center frequency. 61

B. Independent Claim 1 62

[1.pre] A method of performing random access in a wireless communication system, the method comprising: 63

[1.a] configuring a[n] uplink (UL) timing group including at least one of CCs having a difference in center frequencies within a threshold range, CCs having the same beamforming scheme, CCs having the same timing advance (TA) value, and CCs having the same reference downlink (DL) CC for obtaining a TA value, from among a plurality of CCs; 64

[1.b] setting a CC satisfying at least one of a CC having a lowest center frequency value, a CC having a center frequency value that is closest to a mean value, a CC having a highest center frequency value, a CC having a broadest frequency band, and a CC in which a radio link monitoring (RLM) is defined, in the configured UL timing group as a delegate CC; and 66

(a) Coverage and Signal Quality: Usually, the PCell is selected as the TAC for the first user terminal group (UTG 0) because it has the strongest, most stable coverage and is used for control signaling. For additional UTGs, the eNB may choose a SCell with the most stable uplink path or one that has the most reliable uplink timing characteristics. See EX1019, pp. 49 (Sec. 7.5), 80-82 (Secs. 11.1 and 11.2). 68

(b) Uplink Frequency Band Characteristics: In inter-band carrier aggregation, carriers may operate in bands with different propagation delays. The eNB selects the TAC for each UTG to minimize delay mismatches and maintain reliable uplink timing. See EX1019, p. 37 (Sec. 5.2.7.3). 68

(c) Load Balancing and Scheduling Strategy: The eNB may select a carrier that is better suited for UL scheduling as the TAC. If an SCell is expected to handle more UL traffic, it may be selected as TAC to align TA with high-load carriers. See EX1019, pp. 107 (Sec. 16.1.6), 163-165 (Sec. 22.4.1). 68

(d) Hardware/UE Capability Constraints: Not all UEs support multiple TA groups. The eNB selects TACs based on UE capabilities, indicated in the UE Capability Information message. Some UEs may support only a single UTG, so only one TAC is used (usually the PCell). See EX1019, pp. 108-109 (Sec. 18)....68

[1.c] obtaining a TA value to be used for obtaining a[n] UL timing through the delegate CC; and [1.d] updating a TA value of the corresponding UL timing group based on the obtained TA value. 70

C. Independent Claim 8 71

[8.pre] An apparatus for performing random access in a wireless communication system, the apparatus comprising:....72

[8.a] a[n] uplink timing group configuring unit to configure a[n] uplink (UL) timing group including at least one of

component carriers (CCs) having a difference in center frequencies within a threshold range, CCs having the same beamforming scheme, CCs having the same timing advance (TA) value, and CCs having the same reference downlink (DL) CC to be used for obtaining a TA value, from among a plurality of CCs; 72

[8.b] a delegate CC setting unit to set a CC satisfying at least one of a CC having a lowest center frequency value, a CC having a center frequency value that is closest to a mean value, a CC having a highest center frequency, a CC having a broadest frequency band, a CC in which a radio link monitoring (RLM) is defined, in the configured UL timing group as a delegate CC; 74

[8.c] a TA value obtaining unit to obtain a TA value to be used for obtaining a UL timing through the delegate CC; and [8.d] a TA value updating unit to update a TA value of the corresponding UL timing group based on the obtained TA value. 75

X. Ground 2: Tenny in view of Huawei and further in view of Zhang renders obvious claims 2 and 9 76

A. Reasons to combine Tenny and Huawei with Zhang 76

B. Dependent Claim 2: *The method as claimed in claim 1, further comprising: determining whether a CC that is added or removed exists: and reconfiguring the UL timing group based on the determined CC."* 78

[2.a] determining whether a CC that is added or removed exists; 78

[2.b] reconfiguring the UL timing group based on the determined CC. 80

C. Dependent Claim 9: *The apparatus as claimed in claim 8, further comprising: a determining unit to determine whether a CC that is added or removed exists; and a timing group*

reconfiguring unit to reconfigure the UL timing group based on the determined CC. 82

[9.a] a determining unit to determine whether a CC that is added or removed exists; 82

[9.b] a timing group reconfiguring unit to reconfigure the UL timing group based on the determined CC. 83

XI. Ground 3: Tenny in view of Huawei and further in view of Wang renders obvious claims 3-4 and 10-11 83

A. Reasons to combine Tenny and Huawei with Wang 83

B. Dependent Claim 3: *The method as claimed in claim 1, wherein obtaining of the time alignment timer value comprises: obtaining the time alignment timer value by receiving, from an evolved NodeB (eNB), a random access response message including the TA value to be used for the UL timing.* 86

C. Dependent Claim 4: *The method as claimed in claim 1, further comprising: sensing occurrence of a condition for updating the TA value, wherein the condition for updating the TA value corresponds to at least one of: a case in which re-establishment of synchronization with respect to DL CCs is required; a case in which transmission of UL data is initialized; a case in which a UE-specific time alignment timer expires; and a case in which a time alignment timer set for each UL timing group expires.* 89

D. Dependent Claim 10: *The apparatus as claimed in claim 8, wherein the TA value obtaining unit receives a random access*

response message including the TA value to be used for obtaining the UL timing, from an evolved NodeB (eNB). 91

E. Dependent Claim 11: *The apparatus as claimed in claim 8, further comprising: a condition sensing unit to sense occurrence of a condition for updating the TA value, wherein the condition for updating the TA value corresponds to at least one of: a case in which re-establishment of synchronization with respect to DL CCs is required; a case in which transmission of UL data is initialized; a case in which a UE-specific time alignment timer expires; and a case in which a time alignment timer set for each UL timing group expires.* 92

XII. Ground 4: Tenny in view of Huawei and further in view of Nokia renders obvious claims 7 and 14.....93

A. Reasons to Combine Tenny and Huawei with Nokia 93

B. Dependent Claim 7: *The method as claimed in claim 1, wherein setting of the delegate CC comprises: wherein setting of the delegate CC comprises: setting a CC corresponding to a primary cell (PCell) in the UL timing group to be the delegate CC.* 95

C. Dependent Claim 14: *The apparatus as claimed in claim 8, wherein the delegate CC setting unit sets a CC corresponding to a primary service cell (PCell) in the UL timing group to be the delegate CC.* 97

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I, Robert Akl, D.Sc. of Dallas, Texas, declare that:

I. Introduction

1. My name is Robert Akl, and I have been retained by counsel for Petitioner OnePlus Technology (Shenzhen) Co., Ltd. ("OnePlus" or "Petitioner") as an expert witness to provide assistance regarding U.S. Patent No. 8,995,372 (also referred to herein as "the '372 Patent") currently assigned to Pantech Corporation ("Pantech" or "Patent Owner"). Specifically, I have been asked to consider the validity of claims 1-4, 7-11, and 14 of the '372 Patent (the "Challenged Claims") in view of prior art, anticipation, and obviousness considerations, and understanding of a person of ordinary skill in the art ("POSITA") at the time of the invention as it relates to the '372 Patent. I have personal knowledge of the facts and opinions set forth in this declaration and believe them to be true. If called upon to do so, I would testify competently thereto.

2. I am being compensated for my time at my standard consulting rate. I am also being reimbursed for expenses that I incur during the course of this work. My compensation is not contingent upon the results of my study, the substance of my opinions, or the outcome of any proceeding involving the challenged claims. I have no financial interest in the outcome of this matter.

3. My analysis here is based on my years of education, research, and

experience, as well as my investigation and study of relevant materials, including those cited herein.

4. I may rely upon these materials, my knowledge and experience, and/or additional materials to rebut arguments raised by the Patent Owner. Further, I may also consider additional documents and information in forming any necessary opinions, including documents that may not yet have been provided to me.

5. My analysis of the materials produced in this proceeding is ongoing, and I will continue to review any new material as it is provided. This declaration represents only those opinions I have formed to date. I reserve the right to revise, supplement, and/or amend my opinions stated herein based on new information and on my continuing analysis of the materials provided.

II. Background and Qualifications

6. I am an expert in the field of wireless communication systems. I have studied, taught, practiced, and researched this field for over 30 years. I have summarized in this section my educational background, work experience, and other relevant qualifications. Attached hereto as Appendix A is a true and correct copy of my *curriculum vitae* describing my background and experience.

7. I earned my Bachelor of Science degrees in Electrical Engineering and Computer Science *summa cum laude* with a grade point average of 4.0/4.0 and

a ranking of first in my undergraduate class from Washington University in St. Louis in 1994. In 1996, I earned my Master of Science degree in Electrical Engineering from Washington University in St. Louis with a grade point average of 4.0/4.0. I earned my Doctor of Science in Electrical Engineering from Washington University in St. Louis in 2000, again with a grade point average of 4.0/4.0, with my dissertation being on "Cell Design to Maximize Capacity in Cellular Code Division Multiple Access (CDMA) Networks."

8. While a graduate student, from 1997 through 1999, I worked at MinMax Corporation in St. Louis, where I designed software packages that provided tools to flexibly allocate capacity in a CDMA communications network and maximize the number of subscribers. I also validated the hardware architecture for an Asynchronous Transfer Mode (ATM) switch capable of channel group switching, as well as performed logical and timing simulations, and developed the hardware architecture for the ATM switch. I also worked with Teleware Corporation in Seoul, South Korea, where I designed and developed algorithms that were commercially deployed in a software package suite for analyzing the capacity in a CDMA network implementing the IS-95 standard to maximize the number of subscribers.

9. After obtaining my Doctor of Science degree, I worked as a Senior Systems Engineer at Comspace Corporation from October of 2000 to December of

2001. At Comspace, I designed and developed advanced data coding and modulation methods for improving the reliability and increasing the available data rates for cellular communications. I coded and simulated different encoding schemes (including Turbo coding, Viterbi decoding, trellis coded modulation, and Reed-Muller codes) and modulation techniques using amplitude and phase characteristics and multi-level star constellations. This work further entailed the optimization of soft decision parameters and interleavers for additive white Gaussian and Rayleigh faded channels. In addition, I also extended the control and trunking of Logic Trunked Radio (LTR) to include one-to-one and one-to-many voice and data messaging.

10. In January of 2002, I joined the faculty of the University of New Orleans in Louisiana as an Assistant Professor in the Department of Electrical Engineering. While in this position, I designed and taught two new courses called "Computer Systems Design I and II." I also developed a Computer Engineering Curriculum with a strong hardware-design emphasis, formed a wireless research group, and advised graduate and undergraduate students.

11. In September of 2002, I received an appointment as an Assistant Professor in the Department of Computer Science and Engineering at the University of North Texas (UNT), in Denton, Texas. In May of 2008, I earned tenure and was

promoted to the rank of Associate Professor. As a faculty member, I have taught courses and directed research in networking and telecommunications, including 2G, 3G, 4G, 5G, CDMA/WCDMA, GPS, GSM, UMTS, LTE, ad-hoc networks, antenna design and beamforming, Bluetooth, call admission control, channel coding, channel estimation, communication interfaces and standards, compression, computer architecture, fault recovery, link aggregation, Internet Protocols, MIMO systems, multi-cell network optimization, network routing, network security, network self-test, packet-networks, ring-networks, routing, telephony, VoIP, VPLS, Wi-Fi (802.11), 802.15.4, Zigbee, wireless communication, and wireless sensors. Between January of 2015 and August of 2022, I was appointed to Associate Chair of Graduate Studies in the Department of Computer Science and Engineering. In May of 2023, I was promoted to the rank of Professor.

12. I am also the director of the Wireless Sensor Lab ("WiSL") at UNT. I am a member of the Center for Information and Cyber Security (CICS). It is the only program in the U.S. to be federally certified by the National Security Agency as a Center of Academic Excellence in Information Assurance Education and Research and Cyber Defense Research. I was also a member of the NSF Net-Centric & Cloud Software & Systems: Industry-University Cooperative Research Center (I/UCRC). Several of my research projects are funded by industry and the National

Science Foundation and published in *IEEE* conference proceedings and journals.

13. In addition to advising and mentoring students at UNT, I was asked to join the faculty of the University of Arkansas in Little Rock as an Adjunct Assistant Professor from 2004 to 2008 in order to supervise the research of two Ph.D. graduate students who were doing research in wireless communications. At UNT, I have advised and supervised more than 250 undergraduate and graduate students, several of whom received a master's or doctorate degree under my guidance.

14. Further, between 2005 and 2017, I have received over a million dollars in funding from the State of Texas, Texas Higher Education Coordination Board, the National Science Foundation, and industry to design and conduct robotics, video, and mobile gaming (*e.g.*, Xbox, PC, mobile device) programming summer camps for middle and high school students at UNT. By using video and mobile gaming as the backdrop, participants have learned coding and programming principles and developed an understanding of the role of physics and mathematics in video game design. I have used competitive gaming projects in programming courses as a way to motivate and retain students in computer science.

15. Between 2011 and 2013, I was director of the Bio-Com Project that was funded by Raytheon. The project evaluated the feasibility study using Surface Electromyography (EMG) and bend resistive sensors, that are attached to each of

the five fingers of the hand, for hand gesture recognition. This approach is sometimes known as a "data glove." A prototype was developed and demonstrated at Raytheon, to help soldiers in close-combat situations communicate with hand gestures and hand signals that would be recognized and transmitted to other soldiers' Head Up Display (HUD) without breaking radio silence.

16. In addition to my academic work, I have remained active in the communication industry through my consulting work. In 2002, I consulted for Input/Output Inc. and designed and implemented algorithms for optimizing the frequency selection process used by sonar for scanning the bottom of the ocean. In 2004, I worked with Allegiant Integrated Solutions in Ft. Worth, Texas, to design and develop an integrated set of tools for fast deployment of wireless networks, using the IEEE 802.11 standard. Among other features, these tools optimize the placement of Access Points and determine their respective channel allocations to minimize interference and maximize capacity. I also assisted the Collin County Sheriff's Office (Texas) in a double homicide investigation, analyzing cellular record data to determine user location.

17. I have authored and co-authored over 100 journal publications, conference proceedings, technical papers, book chapters, and technical presentations in a broad array of communications-related technologies, including networking and

wireless communication. I have also developed and taught over 100 courses related to communications and computer systems, switches and routers, including several courses on signals and systems, 4G/LTE and 5G/NR, OFDM, Internet Protocols, VoIP, VPLS, Wi-Fi (802.11), 802.15.4, Zigbee, wireless communication, antenna design and beamforming, communications systems, communication interfaces and standards, channel estimation, fault recovery, link aggregation, location management, sensor networks, source coding and compression, network security, network self-test, computer systems design, game and app design, and computer architecture. These courses have included introductory courses on communication networks and signals and systems, as well as more advanced courses on wireless communications, networking and routing. A complete list of my publications and the courses I have developed and/or taught is also contained in my *curriculum vitae*.

18. My professional affiliations include services in various professional organizations and serving as a reviewer for a number of technical publications, journals, and conferences. I have also received a number of awards and recognitions, including the *IEEE* Professionalism Award (2008), UNT College of Engineering Outstanding Teacher Award (2008), and Tech Titan of the Future (2010), among others, which are listed in my *curriculum vitae*.

19. I have also served as an expert in certain legal proceedings. A list of

cases in which I have testified at trial, hearing, or by deposition (including those during the past five years) is provided in my *curriculum vitae*. Over the years, I have been retained by both patent owners and petitioners, as well as plaintiffs and defendants.

III. Level of Ordinary Skill in the Art

20. In rendering the opinions set forth in this declaration, I was asked to consider the patent claims and the prior art through the eyes of a POSITA at the time of the alleged invention. I understand that the factors considered in determining the ordinary level of skill in a field of art include the level of education and experience of persons working in the field, the types of problems encountered in the field, the teachings of the prior art, and the sophistication of the technology at the time of the alleged invention. I understand that a POSITA is not a specific real individual, but rather is a hypothetical individual having the qualities reflected by the factors above. I understand that a POSITA would also have knowledge from the teachings of the prior art, including the art cited below.

21. In general, my analyses and conclusions herein are from the perspective of a POSITA as of March 29, 2010—the claimed earliest priority date of the ’372 Patent. However, as discussed in Section VII.B, I have opined whether the Challenged Claims of the ’372 Patent satisfy the written description requirement,

and my opinion supports that the Challenged Claims are not entitled to the claimed foreign priority date of March 29, 2010. In this regard, my analyses and conclusions with respect to the Challenged Claims (using the perspective of a POSITA as of March 29, 2010) remain the same from the perspective of a POSITA as of March 29, 2011, the PCT filing date of the '372 Patent, should the Board agree that the Challenged Claims are not entitled to the foreign priority date.

22. Taking these factors into consideration, a POSITA at the time of the claimed invention would have had a Bachelor's degree in electrical engineering, computer engineering, computer science, or a related field, and two to three years of experience in the design or development of telecommunication systems, or the equivalent. Additional graduate education could substitute for professional experience, or significant professional experience in the field could substitute for formal education.

23. Before March 29, 2010, my level of skill in the art was at least that of a POSITA. I am qualified to provide opinions concerning what a POSITA would have known and understood at that time, and my analysis and conclusions herein are from the perspective of a POSITA as of that date. A different priority date would not change my opinions as long as the identified prior art were still prior art.

IV. Materials Considered and Relied Upon

24. In reaching the conclusions described in this declaration, I have relied on the documents and materials cited herein as well as those identified in this Declaration, including but not limited to, the '372 Patent, the prosecution history of the '372 Patent, and prior art references cited herein. These materials include patents, related documents, and printed publications. Each of these materials is a type of document that experts in my field would have reasonably relied upon when forming their opinions.

25. In the cited references, all emphasis is added unless otherwise noted.

26. I have also relied on my education, training, research, knowledge, and personal and professional experience in the relevant technologies and systems that were already in use prior to the claimed invention.

- EX1001: U.S. Patent No. 8,995,372 to Kwon *et al*. ("the '372 Patent")
- EX1002: Prosecution History of U.S. Patent No. 8,995,372 ("the '372 Prosecution History")
- EX1004: U.S. Patent Application Publication No. 2011/0158116 in the name of Tenny *et al.* ("Tenny '116")
- EX1005: U.S. Provisional Application No. 61/218,769 in the name of Tenny *et al*. ("Tenny-Prov")
- EX1006: "R2-100110, Multiple Timing Advance Impact on RAN2, Huawei (3GPP TSG RAN WG2 Meeting #68bis)," Valencia, SP, Jan 18–22, 2010 ("Huawei")

- EX1007: U.S. Patent Application Publication No. 2010/0303039 in the name of Zhang *et al.* ("Zhang")
- EX1008: U.S. Patent No. 9,426,765 in the name of Wang *et al.* ("Wang '765")
- EX1009: U.S. Provisional Application No. 61/293,871 in the name of Wang *et al*. ("Wang-Prov")
- EX1010: "R2-100372, RACH and carrier aggregation, Nokia (3GPP TSG RAN WG2 Meeting #68bis)," Valencia, SP, Jan 18–22, 2010 ("Nokia")
- EX1014: Machine Translation of KR20110108536A (Publication of KR Appl. No. 10-2010-0027782) by Google Patents
- EX1015: "R2-100054, Primary Component Carrier, Nokia (3GPP TSG-RAN WG2 Meeting #68bis)," Valencia, SP, Jan 18–22, 2010
- EX1016: "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA) Medium Access Control (MAC) Protocol Specification (Release 8)," 3GPP TS 36.321 V8.8.0 (2009-12) ("TS36321-V880")
- EX1017: "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall Description; Stage 2 (Release 9)," 3GPP TS 36.300 V9.2.0 (2009-12) ("TS36300-V920")
- EX1018: E. Dahlman *et al*., "3G Evolution: HSPA and LTE for Mobile Broadband," 1st ed. Elsevier, 2007 ("Dahlman")
- EX1019: "3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio

Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall Description; Stage 2 (Release 10)," 3GPP TS 36.300 V10.0.0 (2010-06) ("TS36300-Va00")

V. Legal Standards

27. I am not a lawyer and do not provide any legal opinions, but I have been advised that certain legal standards are to be applied by technical experts in forming opinions regarding the meaning and validity of patent claims. I have applied the legal standards described below, which were provided to me by counsel for the Petitioner.

28. It is my understanding that assessing the validity of a U.S. patent based on a prior art analysis requires two steps. First, one must construe the terms of the patent claims to understand what meaning a POSITA would have given the terms. Second, after the claim terms have been construed, one may then assess validity by comparing a patent claim to the "prior art." I understand that the teaching of the prior art is viewed through the eyes of a POSITA at the time the invention was made. My analysis as to what constitutes a POSITA is set forth above.

A. Claim Construction

29. I have been informed that patent claims are construed from the viewpoint of a POSITA of the patent at the time of the invention. I have been informed that patent claims generally should be interpreted consistent with their plain and ordinary meaning as understood by a POSITA in the relevant time period

(*i.e.*, at the time of the purported invention, or the so-called "effective filing date" of the patent application), after reviewing the patent claim language, the specification, and the prosecution history (collectively, the intrinsic record).

30. I have further been informed that a POSITA must read the claim terms in the context of the claim itself, as well as in the context of the entire patent specification. I understand that in the specification and prosecution history, the patentee may specifically define a claim term in a way that differs from the plain and ordinary meaning. I understand that the prosecution history of the patent is a record of the proceedings before the U.S. Patent and Trademark Office and may contain explicit representations or definitions made during prosecution that affect the scope of the patent claims. I understand that an applicant may, during the course of prosecuting the patent application, limit the scope of the claims to overcome prior art or to overcome an examiner's rejection, by clearly and unambiguously arguing to overcome or distinguish a prior art reference, or clearly and unambiguously disavowing claim coverage.

31. In interpreting the meaning of the claim language, I understand that a POSITA may also consider "extrinsic" evidence, including expert testimony, inventor testimony, dictionaries, technical treatises, other patents, and scholarly publications. I understand this evidence is considered to ensure that a claim is

construed in a way that is consistent with the understanding of a POSITA at the time of the invention. For example, this can be useful for a technical term whose meaning may differ from its ordinary English meaning. I understand that extrinsic evidence may not be relied on if it contradicts or varies the meaning of claim language provided by the intrinsic evidence, particularly if the applicant has explicitly defined a term in the intrinsic record.

32. I understand that when a claim uses the word "means" to describe a limitation, we presume that the limitation is a "means plus function" limitation. I understand that this presumption can be rebutted where the claim, in addition to the functional language, also recites structure, material, or acts sufficient to perform the claimed function in its entirety. When the presumption is not rebutted, I understand that a "means plus function" limitation must be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof.

33. I understand that the procedure for construing a "means plus function" claim limitation involves first defining the function of the limitation, and then identifying the corresponding structure for that function. I understand that the function of a means-plus-function limitation is construed to include the limitations contained in the claim language, and only those limitations. Further, I understand that the corresponding structure is identified by looking at the specification and

prosecution history of the patent. However, structure disclosed in the specification or the prosecution history is considered "corresponding" structure only if the specification or prosecution history clearly links or associates that structure to the function recited in the claim. I understand that it is well settled that if there is no structure in the specification corresponding to a means-plus-function limitation in the claims, the claim will be found invalid as indefinite. I understand that unless the corresponding structure of the "means plus function" limitation is disclosed in the specification in a way that one skilled in the art will understand what structure corresponds to and will perform the recited function, the claim is indefinite. I understand that a bare statement that known techniques or methods can be used does not disclose structure, even if a person of skill in the art would be capable of implementing a structure. I also understand that when a claim uses functional language but recites insufficient structure, such a claim may be subject to the same procedure as above despite the lack of the phrase "means for."

B. Priority Date

34. I understand that to obtain the priority benefit of an earlier-filed application, the claims must meet the written description requirement of 35 U.S.C. §112.

35. I also understand that to satisfy the written description requirement,

a patent specification must describe the claimed invention in sufficient detail that one skilled in the art can reasonably conclude that the inventor had possession of the claimed invention. An applicant shows that the inventor was in possession of the claimed invention by describing the claimed invention with all of its limitations using such descriptive means as words, structures, figures, diagrams, and formulas that fully set forth the claimed invention. I was informed that a prior application itself must describe an invention, and do so in sufficient detail that one skilled in the art can clearly conclude that the inventor invented the claimed invention as of the filing date sought.

C. Anticipation

36. I understand that a patent claim is invalid as "anticipated" if each and every limitation of the claim is found, either expressly or inherently, in a single device or method that predates the claimed invention or is described in a single previous publication or patent that predates the claimed invention. I understand that, in patent law, these previous devices, methods, publications, or patents are called "prior art." I understand that in order to anticipate a claim, a prior art reference must do more than merely disclose each element of the claim, but rather the prior art reference must disclose all of the elements of the claimed invention arranged as is recited by the claim. I also understand that in order for a prior art reference to

anticipate a claim of a patent, the reference must enable a POSITA at the time of the invention to practice the claim without undue experimentation.

37. I also understand that a prior art reference can disclose a claimed feature because the feature is expressly described or because the feature is inherent in the disclosure. I understand that something is inherent in a prior art reference if the missing descriptive matter must necessarily be present, not merely probably or possibly present, and it would be so recognized by a POSITA as of the priority date of the patent. I understand that it is acceptable to examine evidence outside of the prior art reference (*i.e.*, extrinsic evidence) in determining whether a feature, while not expressly discussed in the reference, is necessarily present in it.

38. I have further been informed that where a reference discloses multiple embodiments, the reference should not be limited to a preferred embodiment. Instead, each disclosed embodiment may anticipate.

39. Moreover, I have been informed that as part of an anticipation analysis, it is proper to take into account not only specific teachings of the reference, but also the inferences that a POSITA would reasonably be expected to draw therefrom. A reference can anticipate a claim even if it does not expressly spell out all the limitations arranged or combined as in the claim, if a POSITA, reading the reference, would envisage the claimed arrangement or combination.

D. Obviousness

40. I understand that a claim may be invalid if the subject matter described by the claim as a whole would have been obvious to a hypothetical POSITA in view of a prior art reference or in view of a combination of references at the time the claimed invention was made. Therefore, I understand that obviousness is determined from the perspective of a hypothetical POSITA and that the challenged claims of the patent should be read from the point of view of such a person at the time the claimed invention was made. I further understand that a hypothetical POSITA is assumed to know and to have all relevant prior art in the field of endeavor covered by the patent in suit.

41. I have been informed that there are two criteria for determining whether prior art is analogous and thus can be considered prior art: (1) whether the art is from the same field of endeavor, regardless of the problem addressed, and (2) if the reference is not within the field of the patentee's endeavor, whether the reference still is reasonably pertinent to the particular problem with which the patentee is involved. I have also been informed that the field of endeavor of a patent is not limited to the specific point of novelty, the narrowest possible conception of the field, or the particular focus within a given field. I have also been informed that a reference is reasonably pertinent if, even though it may be in a different field from that of the

patentee's endeavor, it is one which, because of the matter with which it deals, logically would have commended itself to a patentee's attention in considering their problem.

42. I have also been advised that an analysis of whether a claimed invention would have been obvious should be considered in light of the scope and content of the prior art, the differences (if any) between the prior art and the claimed invention, and the level of ordinary skill in the pertinent art involved. I understand as well that a prior art reference should be viewed as a whole.

43. I have also been advised that in considering whether a claimed invention would have been obvious over a combination of prior art references, I may assess whether there are apparent reasons to combine known elements in the prior art in the manner claimed in view of interrelated teachings of multiple prior art references, the effects of demands known to the design community or present in the marketplace, and/or the background knowledge possessed by a POSITA. I understand that other principles may be relied on in evaluating whether a claimed invention would have been obvious, and that these principles include the following:

- A combination of familiar elements according to known methods is likely to be obvious when it does no more than yielding predictable results;
- When a device or technology is available in one field of endeavor, design incentives and other market forces can prompt variations of it, either in the

same field or in a different one, so that if a POSITA can implement a predictable variation, the variation is likely obvious;

- If a technique has been used to improve one device, and a POSITA would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond their skill;
- An explicit or implicit teaching, suggestion, or motivation to combine two prior art references to form the claimed combination may demonstrate obviousness, but proof of obviousness does not depend on or require showing a teaching, suggestion, or motivation to combine;
- Market demand, rather than scientific literature, can drive design trends and may show obviousness;
- In determining whether the subject matter of a patent claim would have been obvious, neither the particular motivation nor the avowed purpose of the named inventor controls whether the claim is obvious;
- One of the ways in which a patent's subject can be proved obvious is by noting that there existed at the time of invention a known problem for which there was an obvious solution encompassed by the patent's claims;
- Any need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed;
- "Common sense" teaches that familiar items may have obvious uses beyond their primary purposes, and in many cases a POSITA will be able to fit the teachings of multiple patents together like pieces of a puzzle;
- A POSITA is also a person of ordinary creativity, and is not an automaton;
- A patent claim can be proved obvious by showing that the claimed combination of elements was "obvious to try," particularly when there is

a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions such that a POSITA would have had good reason to pursue the known options within his or her technical grasp; and

- One should be cautious of using hindsight in evaluating whether a claimed invention would have been obvious.

44. I further understand that, in making a determination as to whether the claimed invention would have been obvious to a POSITA, the Patent Trial and Appeal Board (PTAB) may consider certain objective factors if they are present, such as: commercial success of products practicing the claimed invention; long-felt but unsolved need; teaching away; unexpected results; copying; and praise by others in the field. These factors are generally referred to as "secondary considerations" or "objective indicia" of nonobviousness. I understand, however, that for such objective evidence to be relevant to the obviousness of a claim, there must be a causal relationship (called a "nexus") between the claim and the evidence, and that this nexus must be based on a novel element of the claim rather than something in the prior art. I also understand that even when they are present, secondary considerations may be unable to overcome primary evidence of obviousness (such as motivation to combine with predictable results) that is sufficiently strong.

VI. Technology Background

A. Random Access Procedure

45. The random access procedure is a fundamental process in wireless communication systems, *e.g.*, a Long-Term Evolution (LTE) system, which allows a User Equipment (UE) to establish or re-establish a connection with a base station, *e.g.*, an Evolved Universal Terrestrial Radio Access Network (E-UTRAN) NodeB (eNB) in the LTE system. EX1018, pp. 432-444 (Sec. 18.3). This procedure had already been defined in the 3rd Generation Partnership Project (3GPP) LTE standard and described in the textbook related to LTE before 2008. *See, e.g.*, EX1017, pp. 55-60 (Sec. 10.1.5); EX1018, pp. 432-444 (Sec. 18.3). The random access procedure serves two main purposes, namely establishment of uplink synchronization and establishment of a unique terminal identity known to both the base station and the UE. EX1018, pp. 432-444 (Sec. 18.3).

46. An overview of the random access procedure is shown in FIG. A (reproduction of Figure 10.1.5-1-1 of EX1017) below. The random access procedure includes four steps. The first step is the transmission of a random access preamble (RAP, a.k.a., message 1 or msg1) on the Random Access Channel (RACH) in uplink from the UE to the eNB. The main purpose of the random access preamble is to indicate to the eNB the presence of a random-access attempt and to obtain uplink

time synchronization. EX1018, pp. 432-434. The RACH is an uplink transport channel. EX1016, p. 10 (Sec. 4.5.1). Since the RACH is mapped to the Physical Random Access Channel (PRACH) that is transmitted via the actual antenna(s) of the UE, the random access preamble is transmitted from the UE to the eNB using the PRACH (*e.g.*, PRACH resources). EX1016, pp. 12-14 (Secs. 5.1.1 to 5.1.3).

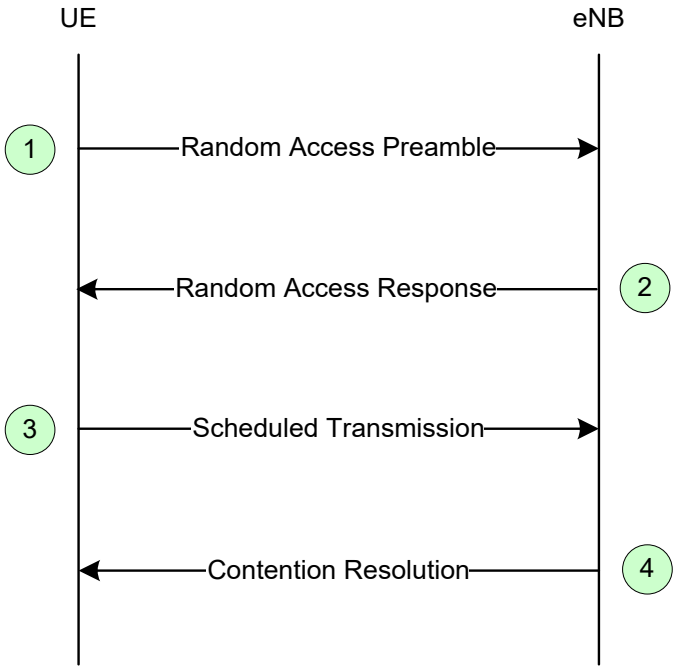


FIG. A – Figure 10.1.5.1-1: Contention based Random Access Procedure of EX1017 (TS36300-V920)

47. Referring to FIG. A above, the second step of the random access procedure is the eNB transmitting a random access response (RAR, a.k.a., message 2 or msg2) to the UE in the Downlink Shared Channel (DL-SCH), in response to the detected random access attempt. EX1017, p. 58; EX1018, pp. 441-442. The DL-

SCH is a downlink transport channel. EX1016, p. 9 (Sec. 4.5.1). The DL-SCH is mapped to the Physical Downlink Shared Channel (PDSCH). EX1018, pp. 304-305. The random access response is scheduled via the Physical Downlink Control Channel (PDCCH), which includes the DL-SCH resource allocation for the UE to receive the random access response on the PDSCH. EX1018, p. 313. After transmitting the random access preamble, the UE monitors the PDCCH for the random access response corresponding to the random access preamble. EX1016, p. 14 (Sec. 5.1.4); EX1018, pp. 441-442 (Sec. 18.3.2). Upon reception of the random-access response in the second step, the UE will adjust its uplink transmission timing and continue to the third step. EX1018, p. 442.

48. Also referring to FIG. A above, the third step of the random access procedure is first scheduled uplink transmission in the Uplink Shared Channel (UL-SCH) from the UE to the eNB. EX1017, p. 58. An important part of this uplink message (a.k.a., message 3 or msg3) is the inclusion of a terminal identity as this identity is used as part of the contention-resolution mechanism in the fourth step. EX1017, p. 58; EX1018, pp. 442-443. The fourth step of the random access procedure is the downlink transmission of a contention-resolution message (a.k.a., message 4 or msg4) in DL-SCH from the eNB to the UE. EX1017, pp. 58-59; EX1018, pp. 443-444.

B. Carrier Aggregation

49. Carrier Aggregation (CA) is a foundational technology developed to meet the growing demands for higher data rates and better spectrum efficiency in mobile communication systems, and is a central feature of LTE-Advanced, which was standardized in 3GPP Release 10. EX1019, p. 39 (Sec. 5.5); EX1018, pp. 543-544.

50. The basic idea of Carrier Aggregation is that, instead of using a single frequency band for transmission, a mobile device can simultaneously access multiple bands, *i.e.*, Component Carriers (CCs), to combine their bandwidths, effectively creating a much larger data pipeline. *See* EX1018, pp. 543-544. This aggregation allows networks to provide users with faster data speeds and higher system capacity without needing a brand-new spectrum allocation. EX1019, p. 39 (Sec. 5.5).

51. In CA, two to five CCs can be aggregated, with each carrier being up to 20 MHz wide, achieving a total bandwidth of up to 100 MHz. EX1019, p. 39 (Sec. 5.5). CCs can come from the same frequency band or from different bands. Depending on how they are combined, CA is classified into three types: intra-band contiguous, intra-band non-contiguous, and inter-band non-contiguous aggregation. Intra-band contiguous aggregation, which is technically simpler, involves

combining adjacent carriers within the same band. Intra-band non-contiguous aggregation, where carriers are separated within the same band, and inter-band non-contiguous aggregation, where carriers from entirely different bands are combined, both require more complex hardware, particularly at the device's radio front-end and baseband processing units. EX1019, p. 39 (Sec. 5.5); *see* EX1018, pp. 543-544.

VII. Overview of the '372 Patent

A. Subject Matter Overview

52. The '372 Patent is titled "APPARATUS AND METHOD FOR PERFORMING RANDOM ACCESS IN A WIRELESS COMMUNICATION SYSTEM." EX1001, code (54). The '372 Patent was issued on March 31, 2015, from U.S. Application No. 13/638,507, which is a National Stage Entry of International Application No. PCT/KR2011/002159, filed on March 29, 2011. The '372 Patent claims priority to Korean Patent Application No. 10-2010-0027782 ("the '782 Korean Application"), filed on March 29, 2010. EX1001, code (30), 1:5-10.

53. The '372 Patent discloses "a method and apparatus for performing random access in a communication system that supports a plurality of component carriers (CCs)." EX1001, 1:15-19. The '372 Patent aims to address the issue of "[s]ynchronization between a user equipment (UE) and an evolved NodeB (eNB)"

when a plurality of CCs are used in the wireless communication system. EX1001, 1:21-35.

54. To achieve the purpose, the ’372 Patent proposes a method of configuring at least one of the multiple CCs into an uplink (UL) timing group, setting a delegate CC in the configured UL timing group, obtaining a TA value through the delegate CC, and updating the TA value of each group based on the obtained TA value. EX1001, 34:20-39 (claim 1).

55. The ’372 Patent illustrates a process of obtaining a UL synchronization between a UE and an eNB in FIG. 4 reproduced below, in which the UE configures UL timing groups and sets delegate CCs of each UL timing group at step 410 based on the information of multiple UE CCs received from the eNB at steps 400 and 405. EX1001, 7:24-9:12.

FIG.4

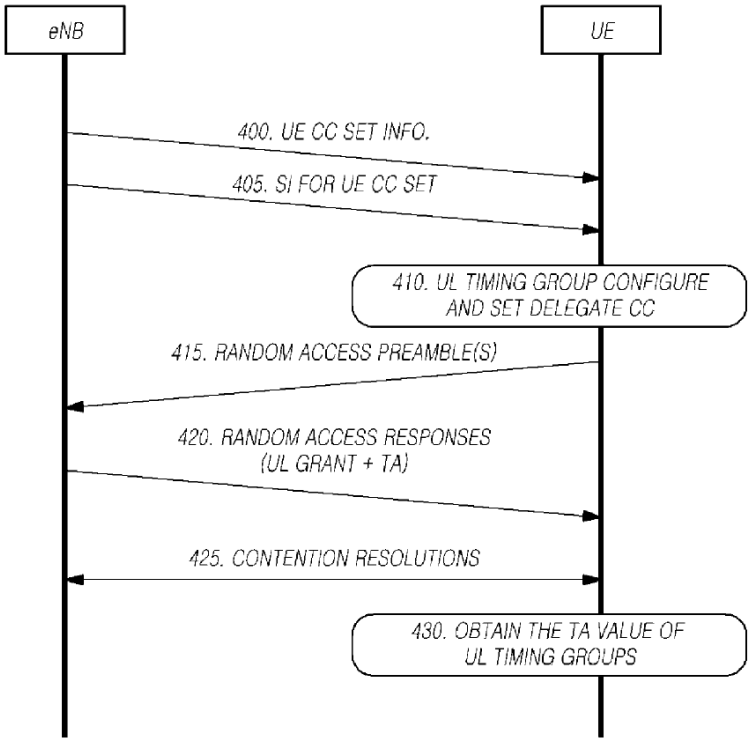


FIG. B – FIG. 4 of EX1001, the '372 Patent

56. I noticed that the '372 Patent specifically introduces the following conditions to be used by the UE to configure the UL timing groups: (i) CCs of which a difference in center frequency values is within a threshold range may have similar propagation characteristic and thus, the CCs may be configured to be a single group; (ii) CCs to which the same beamforming scheme is applied may be configured to be a single group; and (iii) CCs used in devices in the same radio network may be configured to be a single group. EX1001, 10:9-18.

57. I further noticed that the ’372 Patent also listed the following conditions for selecting the delegate CC in each group for performing a TA value obtaining procedure for obtaining a UL synchronization: (1) a CC having a lowest center frequency value, (2) a CC having a center frequency value that is closest to a mean value, (3) a CC having a highest center frequency value; (4) an SCC in which a radio link monitoring (RLM) is defined; (5) a CC having a broadest frequency band; and (6) a primary CC (PCC) in the group. EX1001, 10:19-31, 11:48-56.

58. Next, the ’372 Patent discloses that the UE can perform a random access process for obtaining TA values of UL timing groups based on the delegate CCs at steps 415-430 by receiving random access response (RAR) messages including the TA values from the eNB. EX1001, 11:57-63, 13:57-61, 13:66-14:14.

59. The ’372 Patent introduces the following situations of updating a TA value without reconfiguring of a UL timing group at step 435, as shown in FIG. 5 reproduced below. These include (a) a case in which the eNB requests the UE to re-establish synchronization with respect to all DL CCs, (b) a case in which the UE initializes and retries transmission of all UL data, (c) a case in which a UE-specific time alignment timer expires, (d) a case in which a time alignment timer set for each group expires; and (e) a case in which a new UL CC is added. EX1001, 14:36-59.

FIG.5

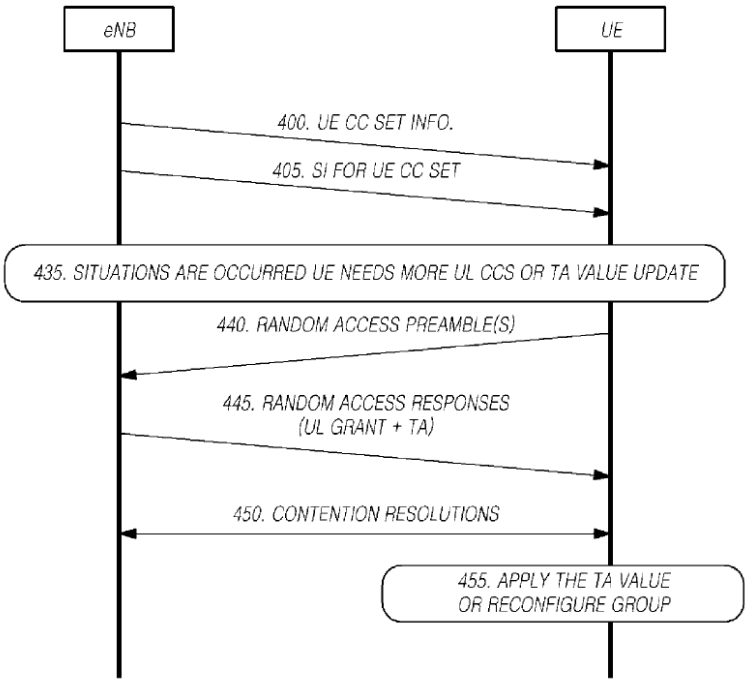


FIG. C – FIG. 5 of EX1001, the ’372 Patent

60. In addition, the ’372 Patent introduces the following situations of reconfiguration of UL timing groups at step 460, as shown in the FIG. 6 reproduced below. These include (I) a case in which a response is not obtained in response to UL transmission data transmitted through a few UL CCs of CCs in a group of the UE, (II) a case in which the eNB requests reconfiguration with respect to a few CCs in a group associated with a DL synchronization, (III) a case in which a CC time alignment timer set for each CC expires, (IV) a case in which a linkage set between a DL and a UL in the eNB is changed, (V) a case in which a UL timing group is

changed and a linkage between a DL and a UL in a group is changed; and (VI) all cases that require reorganization of a UL timing group. EX1001, 16:29-59.

FIG.6

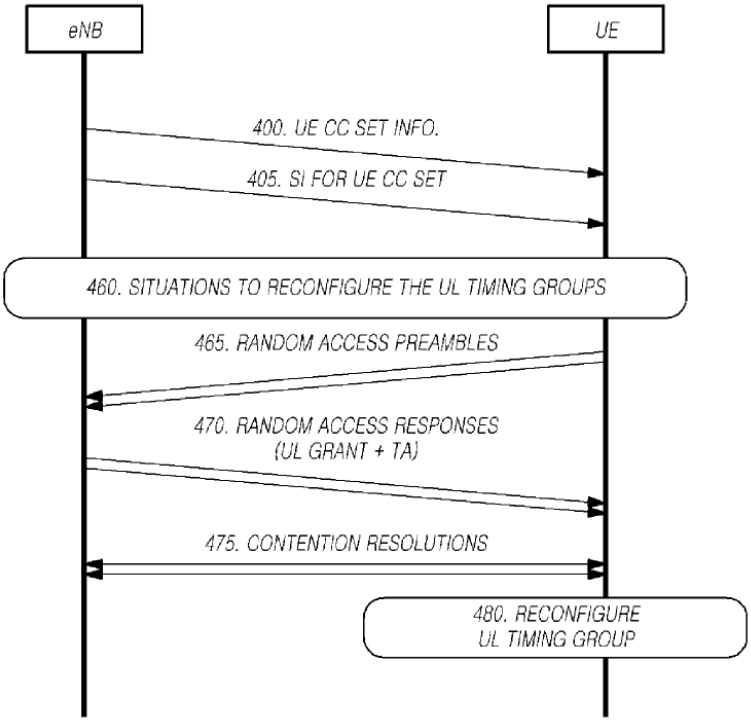


FIG. D – FIG. 6 of EX1001, the '372 Patent

61. The Challenged Claims are primarily directed to this CC grouping, which was a known method for establishing synchronization in wireless networks utilizing multiple CCs. For example, US2011/0158116 and its provisional (collectively, "Tenny," EX1004 and EX1005) discloses assigning a UE to at least one so-called timing group (*i.e.*, a group of carriers with uplink timings that are the same

or within some tolerance), uplink (UL) timing group configuration, selecting a "carrier candidate" for each timing group to request and obtain a single TA value for all CCs in the group TA, as well as value acquirement and update. EX1004, ¶¶55, 57, 59-61, 65-66, 70, FIG. 4; EX1005, Appx. A (1:17-19, 2:7-26, 3:26-4:8, 5:3-10, claim 6), ¶¶35-37, 39-40, Figure 2.

62. Moreover, the additional details recited in the claims were all standard techniques that were well-known to be applied when performing synchronization in LTE/LTE-A systems. For example, the delegate CC setting is disclosed by 3GPP TSG RAN WG2 proposal R2-100110 ("Huawei," EX1006); and the timing group reconfiguration is disclosed by US2010/0303039 ("Zhang," EX1007).

63. As I discuss below, the Challenged Claims are rendered obvious by the prior art. Further, there were no technological barriers to combining these elements to arrive at the claimed invention, and a POSITA would have been motivated to combine these elements and understood that the combination would yield predictable results.

B. Priority Date of the '372 Patent

64. The '372 Patent claims foreign priority to the '782 Korean application, filed on March 29, 2010. EX1001, code (30), 1:5-10. I reviewed EX1014 and found it does not provide enough written description support to at least the following claim

limitation of challenged claims 1 and 8—"*set[ting] a CC satisfying at least one of … a CC in which a radio link monitoring (RLM) is defined*." Since the other challenged claims all depend on claims 1 and 8, respectively, the '782 Korean application fails to provide written description support to them either.

65. Accordingly, it is my opinion that, based on the currently available information, the Challenged Claims of the '372 Patent are not entitled to the priority date of March 29, 2010. Thus, the '372 Patent may be entitled to a priority date no earlier than March 29, 2011. EX1001, code (22) (PCT filing date).

C. Prosecution History of the '372 Patent

66. I have reviewed the prosecution history of the '372 Patent (EX1002). During the prosecution of the U.S. Patent Application No. 13/638,507 that later issued as the '372 Patent, the Examiner allowed all claims 1-16 without issuing any Office Action. EX1002, 68-72. He did not give any reason for allowance. *Id*. The '372 Patent was issued on March 31, 2015. EX1002, 31.

D. Interpretation of the '372 Patent Challenged Claims

67. I have been instructed that the Challenged Claims of the '372 Patent are to be given their ordinary and customary meaning as understood by a POSITA at the time of the alleged invention in light of the specification and the prosecution history pertaining to the patent, except as provided below. I have followed these principles

in my analysis set forth in this document. I reserve the right to supplement my opinions in this declaration to the extent that any parties later propose claim constructions for any claim terms in the '372 Patent.

68. I understand that in a pending district court litigation between Pantech and OnePlus (No. 5:24-cv-00038-RWS-JBB (E.D. Tex.)), Petitioner proposes construing the following two claim terms as containing means-plus-function ("MPF") claim limitations under 35 U.S.C. § 112, paragraph 6. I also understand that Patent Owner asserts that these terms should be given their plain and ordinary meaning, without specifying what it believes the plain and ordinary meaning is. EX1012, 8-9.

69. For claim term #1: "a[n] uplink timing group configuring unit to configure a[n] uplink (UL) timing group including…from among a plurality of CCs," I think it should be construed as MPF claim limitation under 35 U.S.C § 112, paragraph 6. However, I have reviewed the specification of the '372 Patent but found no sufficient disclosure about the structure of the "uplink timing group configuring unit." For the purpose of analysis in my Declaration, I offer a possible corresponding construction of claim term #1, which is the hardware of the UE that implements the function of configuring an uplink (UL) timing group including … from among a plurality of CCs. *See* EX1001, 8:23-26, 14:20-23, 16:15-18, 17:52-55, 18:54-57,

32:31-37, 33:51-56, FIGs. 15-16.

70. For claim term #2: "a delegate CC setting unit to set a CC satisfying . . . in the configured UL timing group as a delegate CC," I think it should be construed as MPF claim limitation under 35 U.S.C § 112, paragraph 6. However, I have reviewed the specification of the '372 Patent but found no sufficient disclosure about the structure of the "delegate CC setting unit." For the purpose of analysis in my Declaration, I offer a possible corresponding construction of claim term #2, which is the hardware of the UE that implements the function of setting a CC satisfying … in the configured UL timing group as a delegate CC. *See* EX1001, 8:23-26, 14:20-23, 16:15-18, 17:52-55, 18:54-57.

71. I also notice that several other claim terms, such as "TA value obtaining unit" and "TA value updating unit" of claim 8, "determining unit" and "timing group reconfiguring unit" of claim 9, and "condition sensing unit" of claim 11, are not in dispute between the parties in the EDTX case. Therefore, these claim terms are construed according to their plain and ordinary meaning in my Declaration. To the extent that the Board invokes 35 U.S.C § 112, paragraph 6 to construe any of these terms, I propose to construe them similarly as claim terms #1 and #2 above with a structure represented by the hardware of the UE that implements the respective functions thereof.

72. As I explain below with respect to Grounds 1-4, the Challenged Claims are rendered obvious by the prior art under either party's construction.

VIII. Overview of the Cited References

73. General descriptions provided for the following references and combinations thereof are incorporated into each subsection and mapping of the claims that include citations to these references.

A. Tenny (EX1004, EX1005)

74. Tenny '116 (EX1004) claims priority to Tenny-Prov (EX1005) on its face. EX1004, code (60). For the purpose of this IPR, I was asked to determine from the perspective of a POSITA whether Tenny-Prov provides enabling written description support for (i) the subject matter in Tenny '116 that teaches or suggests features in the challenged claims, and (ii) at least claims 1 and 53 of Tenny '116. For condition (i), I will provide dual citations to both Tenny '116 and Tenny-Prov to demonstrate that the specific disclosures identified and relied upon from Tenny '116 in my declaration are supported by the written description in Tenny-Prov. For condition (ii), Table A below sets forth the disclosures from Tenny-Prov that support claims 1 and 53 of Tenny '116. Tenn-Prov includes an Appendix A (*see* Exhibit 1005 at 23), which is referred to as "EX1005, Appx. A" in my Declaration. Tenny '116 and Tenny-Prov are collectively referred to as "Tenny"

herein.

Tenny '116 Claims 1 and 53	Exemplary Disclosures from Tenny-Prov
[1.pre] A method that facilitates a timing alignment in a multicarrier system, the method comprising:	Appx. A (claim 1, 1:1-23), ¶¶34, 39, Figs. 3-4.
[1.a] determining at least one downlink timing associated with at least one downlink carrier;	Appx. A (Figs. 2-3, 3:19-4:13); ¶¶34, 37, claims 1, 7, 16.
[1.b] ascertaining an uplink timing associated with an uplink group of carriers, wherein the uplink timing is ascertained based on a processing of at least one downlink timing and a timing offset associated with the uplink group of carriers; and	Appx. A (3:19-4:13, Figs. 2-3); ¶¶33-34, 36, claims 1, 5.
[1.c] transmitting each of the uplink group of carriers within a threshold value of the uplink timing.	*See* [1.b]; *see also* Appx. A (1:17-21; 2:18-22, 3:19-4:13, Figs. 2-3, claim 1); ¶¶33-35, 37, 39, 40, claims 5, 14, 23, 32.
[53.pre] A method that facilitates a timing alignment in a multicarrier system, the method comprising:	*See* [1.pre].
[53.a] transmitting a downlink communication to a wireless terminal via at least one downlink carrier;	*See* [1.a]; *see also* ¶¶16, 33, 34, claim 1, Appx. A (3:19-4:13, Figs. 2-3).
[53.b] assigning a timing offset to an uplink group of carriers;	¶¶16, 33, 34, 36-40, claims 1, 8, 9, Appx. A (3:26-4:13, Figs. 2-3).

[53.c] providing the timing offset to the wireless terminal via the at least one downlink carrier; and	*See* [53.a]-[53.b]; *see also* ¶¶16, 33, 34, 36-40, claims 1, 8, 9, Appx. A (3:26-4:13, Figs. 2-3).
[53.d] receiving an uplink communication via the uplink group of carriers, wherein the uplink group of carriers are received according to the timing offset.	*See* [53.b]-[53.c], [1.a]-[1.b]; *see also* ¶¶13, 16, 33, 35, 39, Fig. 1; Appx. A (1:1-14, 3:26-4:13, Figs. 2-3).

Table A

75. Tenny, entitled "Method and Apparatus That Facilitates a Timing Alignment in A Multicarrier System," describes solutions to problems arising in "maintaining timing synchronisation for user equipment in a multicarrier Long Term Evolution-Advanced (LTE-A) system." EX1004, ¶3; EX1005, Appx. A (1:1-3). Like the '372 Patent, Tenny notes that different carriers have "some variation in timing for a number of reasons (*e.g.*, cable delays, distance between the base station site and a remote radio head)," which would make separate timing offsets per carrier beneficial or even necessary. EX1004, ¶9; EX1005, Appx. A (1:9-14).

76. To address the variations in timing, Tenny proposes grouping carriers with similar "uplink timings" ("same to within some tolerance") to the same "timing group." EX1004, ¶55; EX1005, Appx. A (1:17-23). For example, as illustrated in FIG. 3 of Tenny '116 below, a "UE" (*e.g.*, mobile phone) can be "assigned carriers from multiple timing groups" (*e.g.*, groups A and B). EX1004, ¶57, FIG. 3; EX1005,

Appx. A (1:24-2:6, Fig. 1). Tenny discloses that, although these groups "originat[e] from the same cell site," the carriers in these groups come from network components that are distanced from each other, such as the "remote radio head 320 belonging to main base station site 310" ("eNB"), which causes some carriers to have different timing from others, which justifies "maintain[ing] timing separately for each group." *Id*.

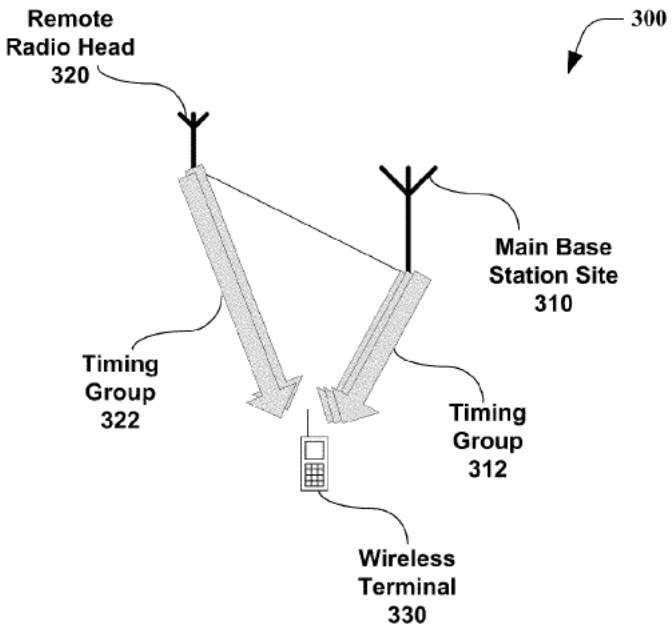


FIG. E – Tenny '116, FIG. 3

77. Tenny teaches "assigning a UE to at least one 'timing group,'" which "refers to a group of carriers with uplink timings that are the same to within some tolerance." EX1004, ¶55; EX1005, Appx. A (1:17-19). Tenny teaches that the assignment can be made by the network and sent to the UE via "group identifier[s],"

each consisting of "a small number of bits (*e.g.*, as an index into the set of timing groups with which the UE was configured)." EX1004, ¶70; EX1005, Appx. A (5:3-8). This "mapping could be established by explicit signaling (in higher layers such as the Radio Resource Control) at the time the UE is configured with particular carriers." *Id*.

78. Tenny discloses, "within each timing group, the UE may need to occasionally perform random access to update its timing," where the UE "interact[s] with the base station" (*i.e.* eNB) to receive "timing adjustments" for each group. EX1004, ¶58; EX1005, Appx. A (2:7-17, 4:15-20).

79. Figure 3 of Tenny-Prov, highlighted below depicts a wireless device "that facilitates carrier grouping and updating timing for carrier groups," including a "carrier grouping component," a "carrier candidate selection component," "a timing offset component," and a "timing update component." EX1005, ¶¶8, 34, Figure 3.

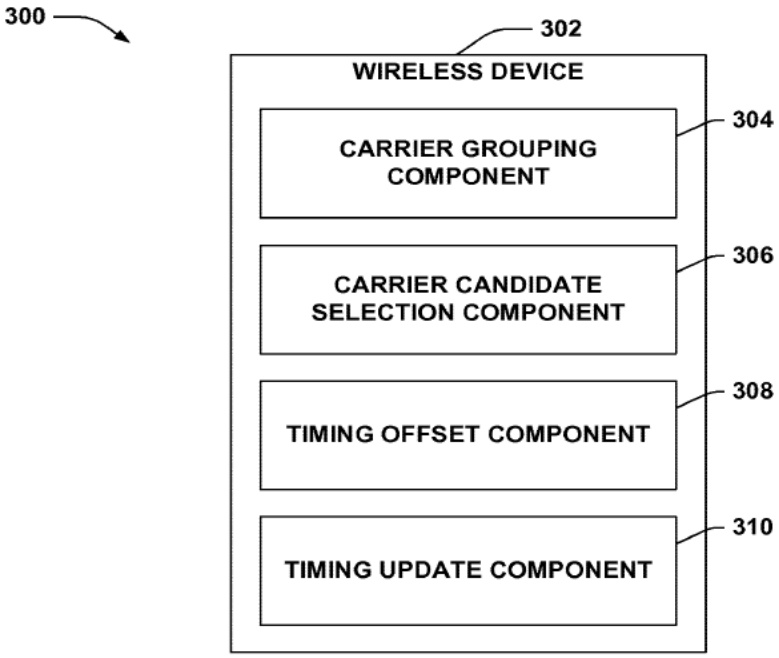


Fig. 3

FIG. F – Tenny-Prov, Fig. 3

80. The **carrier grouping component 304** "receive[s] one or more groupings" from the "wireless network," such as the "group identifier[s]" included in the RRC signaling sent by the eNB. EX1005, ¶35, Figures 3, 4, Appx. A (5:5-10). Tenny discloses that the wireless device configures UL timing groups in two steps: (1) by "generat[ing] the association of the plurality of carriers into one or more timing groups according to [the] grouping receiv[ed] from the base station associated with a subset of the plurality of carriers" and (2) by "choos[ing] a carrier in the group from which to acquire timing updates" using the **carrier selection component 306**. EX1005, ¶36, p. 17 (claim 15).

81. Upon configuring the timing groups, the "UE performs random access

for timing synchronisation" on the "single carrier of [each] timing group" selected by the **carrier selection component 306** to "acquire timing updates." EX1005, ¶36, Figure 3, Appx. A (2:7-26, claim 6).

82. In particular, a timing update is acquired by **timing offset component 308** as a "timing offset" on "candidate carrier" selected by the **carrier selection component 306** for "a given group." EX1005, ¶¶36-37, 40, Figure 3. As such, the "timing offset" serves "a single timing advance value" that is "indicated to the UE for use with all carriers in the group." EX1005, Appx. A (2:8-10, claim 1).

83. Finally, the **timing update component 310** "updat[es] timing for the group of carriers based on the offset" received from the "candidate carrier" chosen for the respective timing group. EX1005, ¶37, Figure 3, Appx. A (3:26-4:8, claim 1).

84. Tenny further discloses a vector timing adjustment command in which a UE assigned to several timing groups can "receive timing adjustments for all groups with a single interaction with the base station." EX1004, ¶68; EX1005, Appx. A (4:14-17). The network in Tenny knows "the timing groups in which the UE is assigned to at least one carrier." EX1004, ¶69; EX1005, Appx. A (4:21-22).

B. Huawei (EX1006)

85. Huawei proposes supporting multiple timing advance (TA) values in

uplink carrier aggregation (CA) scenarios, specifically focusing on inter-band aggregation where different uplink component carriers (CCs) operate on separate frequency bands. EX1006, 1 (§1). To reduce "unnecessary RACH operation and TA maintenance overhead" where one separate TA is maintained for each band in the UL aggregate CCs, Huawei suggests a method that would "allow sharing a TA for inter-band aggregated CCs to support multiple TA." EX1006, 2 (§2.1).

86. Huawei considered potential random access channel (RACH) impact caused by multiple TA from four aspects, including RRC connection establishment/reestablishment, inter-eNB handover, UL/DL data arrival requiring RACH, and radio link failure (RLF). EX1006, 2-4 (§2.2). When UL CCs in the different bands are out of synchronization, Huawei discloses that "eNB can send the PDCCH order for each CC group with the identical TA value, and UE can perform the contention-free RACH simultaneously." EX1006, 3 (§2.2.3). Since UE only performs RACH on one UL CC in Rel-8, for inter-band aggregated CCs, the UL CC with the lowest frequency is chosen among the multiple CCs with the identical TA value, so that RACH is performed on the chosen UL CC. EX1006, 4 (§2.2.4).

87. Huawei discloses that, regarding maintenance of uplink time alignment, one timing advance command for the CCs with identical TA is sufficient, resulting in simplified signaling and UE operations. EX1006, 4 (§2.3)

C. Zhang (EX1007)

88. Zhang is also in the field of wireless communication. EX1007, ¶2. Zhang identifies a problem in the conventional LTE handover procedure where the measurements defined to support a single-carrier system are insufficient to support handover in a multicarrier system. EX1007, ¶21. In response, Zhang proposes a component carrier-specific (CC-specific) reconfiguration mechanism that allows a wireless transmit/receive unit (WTRU), which includes a user equipment (UE), a mobile station, a cellular phone, etc., to add, remove, or replace one or more CCs. EX1007, ¶¶22, 40.

89. For example, FIG. 3 of Zhang (reproduced below) shows an LTE wireless communication system/access network 200 that includes several eNBs 220 and a WTRU 210, which is in communication with one eNB 220. EX1007, ¶46. Each eNB 220 "interfaces with a Mobility Management Entity (MME)/Serving GateWay (S-GW) 230 through an S1 interface." *Id*. "The WTRU 210, the eNB 220, and the MWE/S-GW 230 are configured to perform" a CC-specific reconfiguration, which includes "adding, removing, or replacing a component carrier on a component carrier basis." EX1007, ¶¶47, 49.

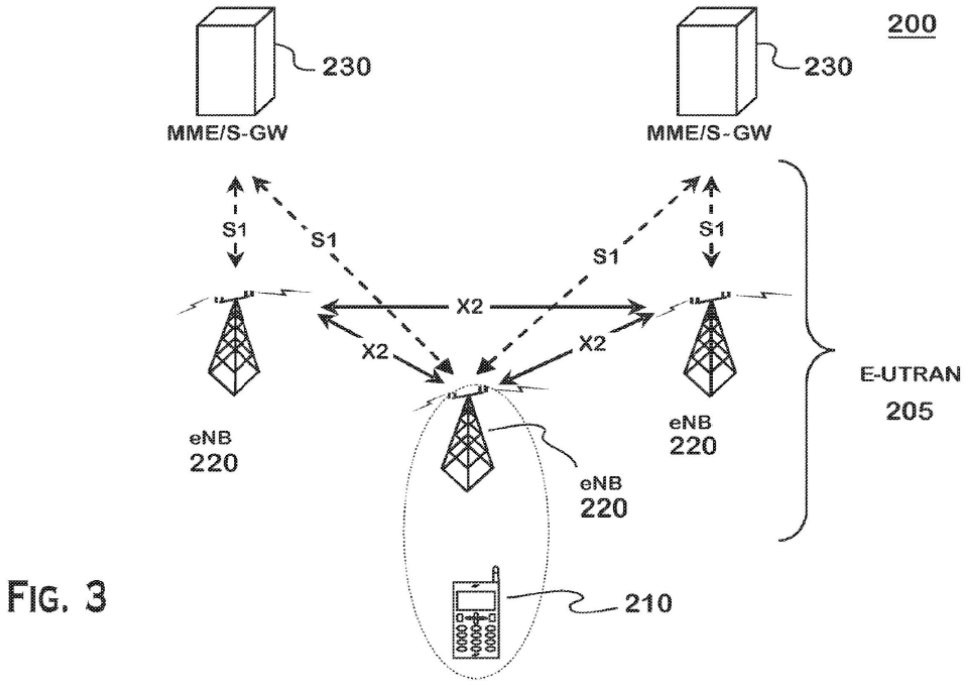


FIG. 3

FIG. G – Zhang, Fig. 3

90. FIG. 5 of Zhang (reproduced below) further illustrates an example of CC reconfiguration. EX1007, ¶¶49-50, FIG. 5. When a WTRU moves from position P1 to position P2, thus leaving the boundary of CC2A and entering into the boundary of CC2B, it may remove CC2A and add CC2B to have better overall achievable data rates. EX1007, ¶50. Such a mechanism of changing a subset of CC(s) while maintaining a connection for at least one CC is referred to by Zhang as CC-specific reconfiguration. *Id*.

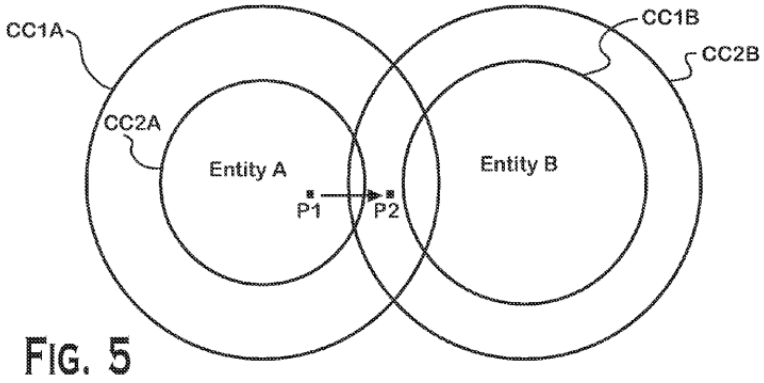


FIG. H – Zhang, Fig. 5

91. The CC-specific reconfiguration may be performed for unlink (UL) and downlink (DL) independently, and may or may not comprise a handover procedure. EX1007, ¶52, FIGs. 7A-7B. When the CC-specific reconfiguration is performed during a handover, the WTRU can perform a random access on one or several of UL CCs in the target cell while continuing its normal operation in the source cell. EX1007, ¶80. The WTRU may receive a radio source control (RRC) Connection Reconfiguration message from the target cell to reconfigure the CCs that are still configured with the source cell, which may not be performed through a RACH procedure. EX1007, ¶84. The WTRU in Zhang may maintain subsets of CCs, each configured with different cells. EX1007, ¶85.

D. Wang (EX1008, EX1009)

92. Wang '765 (EX1008) claims priority to Wang-Prov (EX1009) on its

face. EX1008, code (60). For the purpose of this IPR, I was asked to determine from the perspective of a POSITA whether Wang-Prov provides enabling written description support for (i) the subject matter in Wang '765 that teaches or suggests features in the challenged claims, and (ii) at least claims 1, 9, 10, and 12 of Wang '765. For condition (i), I will provide dual citations to both Wang '765 and Wang-Prov to demonstrate that the specific disclosures identified and relied upon from Wang '765 in my declaration are supported by the written description in Wang-Prov. For condition (ii), Table B below sets forth the disclosures from Wang-Prov that support claims 1, 9, 10, and 12 of Wang '765. Wang '765 and Wang-Prov are collectively referred to as "Wang" herein.

Wang '765 Claim 1	**Exemplary Disclosures from Wang-Prov**
[1.pre] A method of handling uplink synchronization for a mobile device capable of receiving and transmitting on a plurality of component carriers in a wireless communication system, the method comprising:	p. 1 (Title; Introduction); at pp.26-28 (Title; Introduction; Background)
[1.a] performing a first random access procedure on a first component carrier of the plurality of component carriers to establish uplink synchronization on the first component carrier; and	pp. 5-6 (*e.g.*, Exemplary embodiment #2-1, Steps 1-3); pp. 39-40 (Embodiment #2-1, and Procedure for the Embodiment #2-1)

[1.b] performing a second random access procedure on at least a component carrier of the plurality of component carriers to establish uplink synchronization on the at least a component carrier, which comprises:	pp. 5-6 (*e.g.*, Exemplary embodiment #2-1, Steps 4-5); pp. 39-40 (Embodiment #2-1, and Procedure for the Embodiment #2-1)
[1.c] receiving at least a random access preamble assigned by a network of the wireless communication system for the at least a component carrier;	pp. 5-6 (*e.g.*, Exemplary embodiment #2-1, Step 4); pp. 39-40 (Embodiment #2-1, and Procedure for the Embodiment #2-1)
[1.d] sending at least a random access preamble message including the at least a random access preamble to the network; and	pp. 5-6 (*e.g.*, Exemplary embodiment #2-1, Step 5); pp. 39-40 (Embodiment #2-1, and Procedure for the Embodiment #2-1)
[1.e] receiving a random access response message on the first component carrier corresponding to the at least a random access preamble message from the network, wherein the random access response message includes at least a timing advance value determined by the network according to the at least a random access preamble message.	pp. 5-6 (*e.g.*, Exemplary embodiment #2-1, Step 6); p. 8 (*e.g.*, Exemplary embodiment #3-5); pp. 9-11 (*e.g.*, The design of Timing Alignment Timer) pp. 33-34 (Contention/Non-Contention based Random Access Channel) pp. 39-40 (Embodiment #2-1, and Procedure for the Embodiment #2-1); p. 49 (Embodiment #3-5)
Wang '765 Claim 9	**Exemplary disclosures from Wang-Prov**
[9.pre] A mobile device of a wireless communication system for handling uplink synchronization, the mobile device	p. 1 (Title; Introduction); at pp.26-28 (Title; Introduction; Background)

capable of receiving and transmitting on a plurality of component carriers, the mobile device comprising:	
[9.a] a processor for executing a program; and a storage unit coupled to the processor for storing the program; wherein the program instructs the processor to perform the following steps:	pp. 24-25
[9.b] performing a first random access procedure on a first component carrier of the plurality of component carriers to establish uplink synchronization on the first component carrier; and	pp. 5-6 (*e.g.*, Exemplary embodiment #2-1, Steps 1-3); pp. 39-40 (Embodiment #2-1, and Procedure for the Embodiment #2-1)
[9.c] performing a second random access procedure on at least a component carrier of the plurality of component carriers to establish uplink synchronization on the at least a component carrier, which comprises:	pp. 5-6 (*e.g.*, Exemplary embodiment #2-1, Steps 4-5); pp. 39-40 (Embodiment #2-1, and Procedure for the Embodiment #2-1)
[9.d] receiving at least a random access preamble assigned by a network of the wireless communication system for the at least a component carrier;	pp. 5-6 (*e.g.*, Exemplary embodiment #2-1, Step 4); pp. 39-40 (Embodiment #2-1, and Procedure for the Embodiment #2-1)
[9.e] sending at least a random access preamble message including the at least a random access preamble to the network; and	pp. 5-6 (*e.g.*, Exemplary embodiment #2-1, Step 5); pp. 39-40 (Embodiment #2-1, and Procedure for the Embodiment #2-1)

[9.f] receiving a random access response message on the first component carrier corresponding to the at least a random access preamble message from the network, wherein the random access response message includes at least a timing advance value determined by the network according to the at least a random access preamble message.	pp. 5-6 (*e.g.*, Exemplary embodiment #2-1, Step 6); p. 8 (*e.g.*, Exemplary embodiment #3-5); pp. 9-11 (*e.g.*, The design of Timing Alignment Timer) pp. 33-34 (Contention/Non-Contention based Random Access Channel) pp. 39-40 (Embodiment #2-1, and Procedure for the Embodiment #2-1); p. 49 (Embodiment #3-5)
Wang '765 Claim 10	**Exemplary disclosures from Wang-Prov**
[10.pre] A method of handling uplink synchronization for a mobile device capable of receiving and transmitting on a plurality of component carriers in a wireless communication system, the method comprising:	p. 1 (Title; Introduction); pp. 26-28 (Title; Introduction; Background)
[10.a] performing a random access procedure on a first component carrier of component carriers with the same timing advance value to obtain a timing advance value; and	p. 9 (*e.g.*, The design of Timing Alignment Timer)
[10.b] managing a plurality of time alignment timers each corresponding to some of the plurality of component carriers for indicating a synchronization state on the component carriers with the same timing advance value, wherein the managing step comprises:	p. 9 (*e.g.*, The design of Timing Alignment Timer)

[10.c] starting or restarting the time alignment timer when a timing advance command in a random access response message of the random access procedure is received for the first component carrier, and a random access preamble of the random access procedure is not selected by the mobile device or the time alignment timer is not running.	p. 11 (Fig. 5 and accompanying descriptions) p. 58 (Time Alignment Timer in LTE)
Wang '765 Claim 12	**Exemplary disclosures from Wang-Prov**
[12.pre] A mobile device of a wireless communication system for handling uplink synchronization, the mobile device capable of receiving and transmitting on a plurality of component carriers, the mobile device comprising:	p. 1 (Title; Introduction); pp. 26-28 (Title; Introduction; Background)
[12.a] a processor for executing a program; and a storage unit coupled to the processor for storing the program; wherein the program instructs the processor to perform the following steps:	pp. 24-25
[12.b] performing a random access procedure on a first component carrier of component carriers with the same timing advance value to obtain the timing advance value; and	p. 9 (*e.g.*, The design of Timing Alignment Timer)
[12.c] managing a plurality of time alignment timers each corresponding to some of the	p. 9 (*e.g.*, The design of Timing Alignment Timer)

plurality of component carriers for indicating a synchronization state on the component carriers with the same timing advance value, wherein the managing step comprises:	
[12.d] starting or restarting the time alignment timer when a timing advance command in a random access response message of the random access procedure is received for the first component carrier, and a random access preamble of the random access procedure is not selected by the mobile device or the time alignment timer is not running.	p. 11 (Fig. 5 and accompanying descriptions) p. 58 (Time Alignment Timer in LTE)

Table B

93. Wang, entitled "Method of Handling Uplink Synchronization and Related Communication Device," describes a method and a mobile device for "handling uplink synchronization" in a wireless communication system with a plurality of component carriers (CCs). EX1008, Abstract; EX1009, 1-2 (Introduction). Wang identified certain scenarios where different CCs from the same eNB may have separate timing advances (TAs) that need to be synchronized. EX1008, 2:25-36; EX1009, 1-2.

94. Wang proposes three functions to be applied to the wireless communication system with multiple CCs and uplink (UL) timing advances.

EX1008, 4:61-65; EX1009, 3. Regarding the first function of achieving UL timing synchronization on multiple CCs, Wang discloses various exemplary embodiments. For example, as shown below in the reproduced figure of Wang, the UE in Wang may perform contention-based random access procedure on some CCs, and non-contention based random access procedure on some other CCs. EX1008, 7:8-29; EX1009, 5, 34.

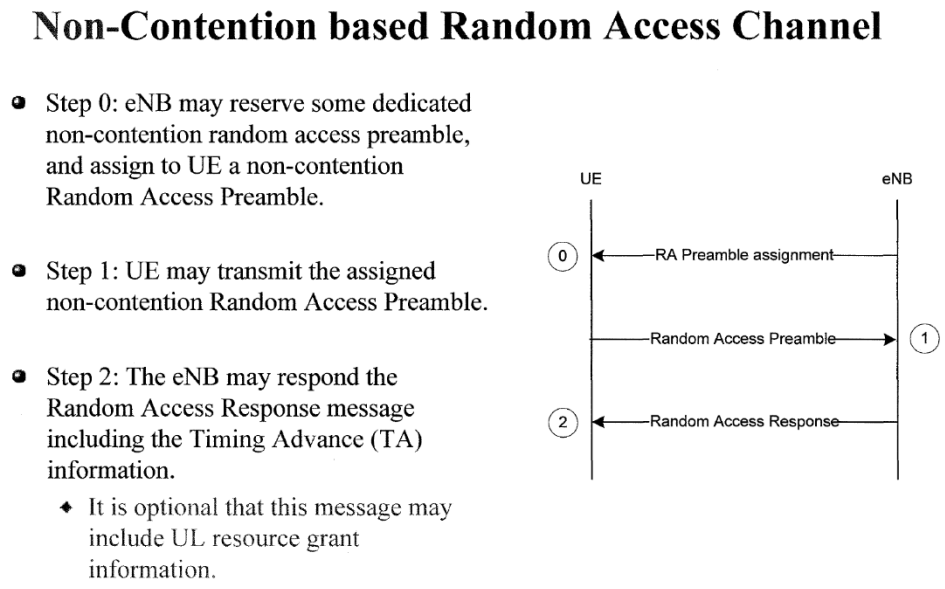


FIG. I1 – *Wang-Prov at p.34 (Non-Contention based Random Access Channel)*

95. To increase the number of CCs, the network may send a message (*e.g.*, RRC Connection Reconfiguration message) to the UE. EX1008, 8:42-53; EX1009, 54. Upon the addition, the eNB "may transmit a message" that includes dedicated non-contention random access preamble (RAP). EX1008, 6:40-67, FIGs. 6-7; EX1009, 5-6 (Embodiment #2-1), 39-40 (Embodiment #2-1 and Procedure for the

Embodiment #2-1). Subsequently, such dedicated non-contention RAP may be transmitted by the UE to the eNB, which replies "a message with the Timing Advance (TA) information" for the group of CCs based on the dedicated RAP associated with the CCs. *Id*. Wang also teaches that the RAP message may be replied from the eNB "through the same or different CCs, where the UE sends the [RAP]," including the CC via which the RRC message is transmitted. EX1009, 43 (Embodiment #2-4) (figure reproduced below).

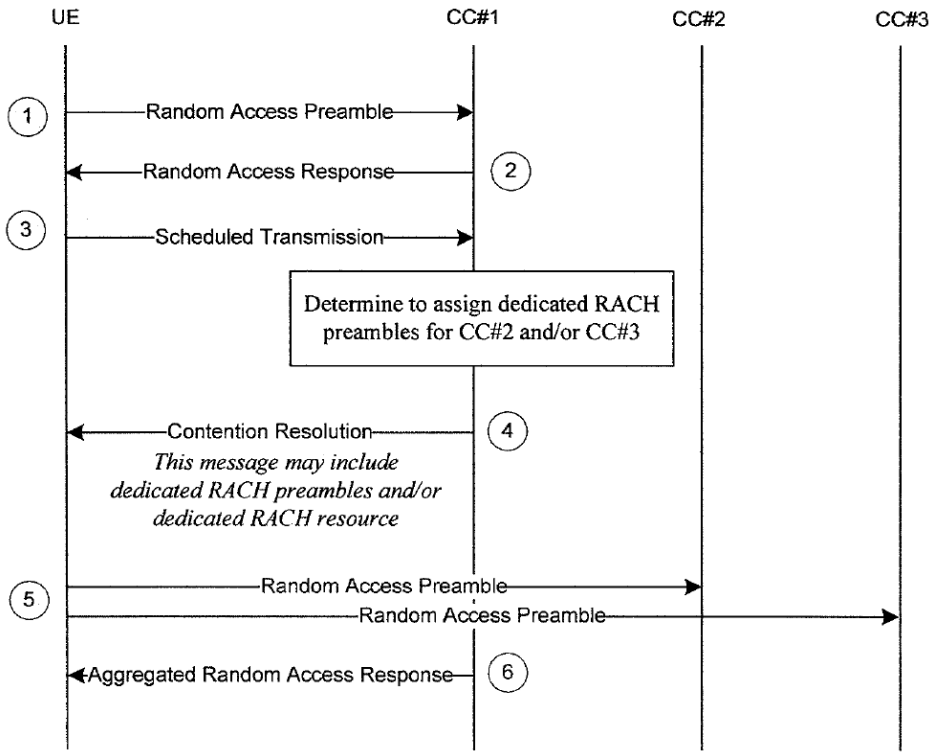


FIG. I2 – *Wang-Prov at p.34 (Embodiment #2-4)*

96. Regarding the second function of maintaining Time Alignment Timer (TAT) validity, Wang describes three embodiments.

> "1. *One TAT per UL CC:* A UE maintains one TAT per UL CC. The update of a TAT (start, restart or stop) follows LTE procedure.
>
> 2. *One TAT per TA group:* A UE maintains one TAT per TA group, i.e., the UL CCs in the same TA group share the same TAT. The update of TAT in a TA group may follow LTE procedure.
>
> 3. *One common TAT:* All UL CCs share a common TAT.
>
> The update of a TAT in LTE system could be triggered by Timing Advance Command received in Random Access Response (RAR) or in MAC Control Element (MAC CE)."

EX1009, 9, 59; EX1008, 9:59-10:3, 10:61-11:3. According to the second embodiment, applying a TA value of the delegate UL CC in a TA group can be an update for the TA values of all the UL CCs in that group. *Id*.

97. Regarding the third function of updating the TA, Wang discloses applying the Timing Advance Command (TAC) to the corresponding UL CCs or TA group, with the TA values determined by the eNB. EX1008, 11:44-60, FIG. 17; EX1009, 14 (figure reproduced below).

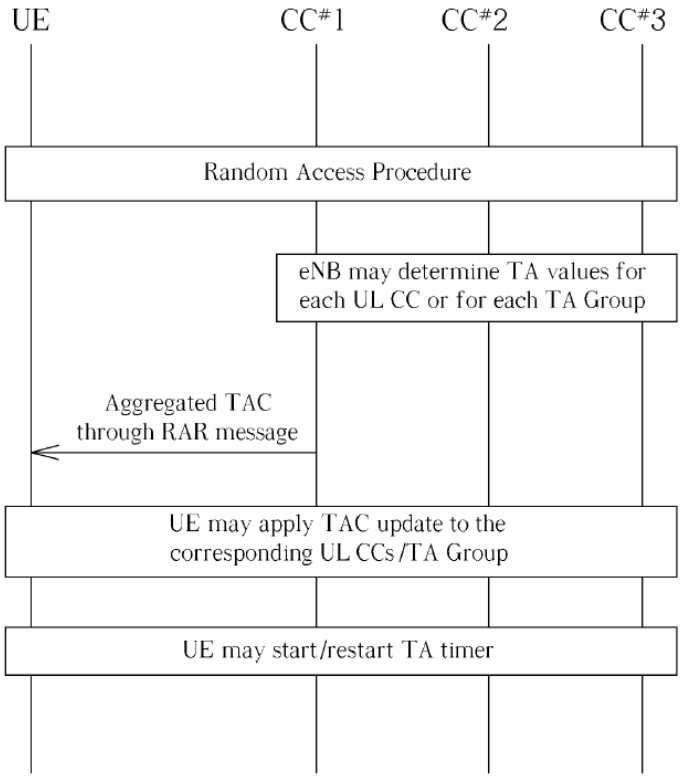


FIG. J – *Wang '765, Fig. 17*

98. Wang further describes that "[t]he UE adjusts the uplink timing of all the UL CCs in the same TA group according to the received TAC." EX1009, 9, 12; EX1008, FIGs. 18A-18C. In some cases, the RAR message transmitted from the eNB includes "UL resource grant information," in addition to the TA information. EX1009, 15-16 (figures), 34; EX1008, FIGs. 18A-18C.

E. Nokia (EX1010)

99. Nokia proposes two options in response to the question of whether the UE should support multiple RACH procedures as a result of carrier aggregation

(CA). EX1010, 2. One option is for the UE to "support a single RACH (per group of UL CCs that share a common timing advance)." EX1010, 3. The other option is for the UE to "support multiple RACH (per group of UL CCs that share a common timing advance)." *Id*. In either case, the RACH is "associated with the 'special cell' or primary carrier … if the carrier is part of the group of CCs that apply the same timing advance." *Id*.

100. Nokia further proposes that if a UE operates with multiple timing advance groups, then it should have at least one RACH per group to enable correct timing alignment. EX1010, 1.

IX. Ground 1: Tenny in view of Huawei renders obvious claims 1 and 8

A. Reasons to Combine Tenny and Huawei

101. In my opinion, a POSITA would have been motivated, for the reasons stated in detail below, to combine Tenny's random access performance in a multicarrier wireless communication system with Huawei's delegate CC setting mechanism, which selects a CC having a lowest center frequency value, to modify Tenny's delegate CC setting mechanism to also select a CC having a lowest center frequency value.

1. The proposed modification is a simple substitution of Huawei's delegate CC setting mechanism with Tenny's to obtain predictable results.

102. As I discussed in Section IX.B, *infra*, other than the conditions for selecting the delegate CC in limitation [1.b], Tenny discloses all limitations of claim 1 of the '372 Patent. Tenny itself discloses several alternative delegate CC selection methods, such as using a hash function, a pseudorandom function, a time-based function, etc. EX1004, ¶¶61-62; EX1005, ¶¶36, 39.

103. Tenny and Huawei are analogous art in the same field as the '372 Patent, which relates to performing random access in a multicarrier wireless communication system. EX1001, 1:15-19. Tenny and Huawei both disclose grouping multiple CCs into timing groups according to the TA value of these CCs, and the timing for each group is separately maintained. EX1004, ¶57, FIG. 3; EX1005, Appx. A (1:24-2:6, Fig. 1); EX1006, 4 (§2.2.4). Further, both Tenny and Huawei teach the notion of updating the timing for the group of CCs based on a TA command. EX1005, ¶37, Fig. 3, Appx. A (3:26-4:8, claim 1); EX1006, 4 (§2.3).

104. Given the similarity between Tenny and Huawei, the proposed modification is nothing more than a simple substitution of one known element (delegate CC selection mechanism in Tenny) with another (delegate CC selection mechanism in Huawei) to obtain predictable results—consistency in the delegate CC selection process to minimize the overhead of signaling.

105. Thus, it is my opinion that a POSITA would have been motivated to implement Huawei's delegate CC selection method to Tenny's carrier candidate selection by selecting a CC having a lowest center frequency from a UL timing group as the carrier candidate for acquiring timing updates for the entire group.

2. A POSITA would also have a reasonable expectation of success in combining Tenny and Huawei.

106. A POSITA would also have a reasonable expectation of success in combining Tenny and Huawei as the proposed combination would yield predictable results.

107. Both Tenny and Huawei relate to performing random access in a multicarrier wireless communication system. They are both pertinent to the problem addressed by the '372 Patent, *i.e.*, synchronization between a UE and an eNB in such a multicarrier system. EX1001, 1:21-35; EX1004, ¶¶3, 9; EX1005, Appx. A (1:1-3, 1:9-14); EX1006, 3 (§2.2.3). Moreover, both Tenny and Huawei use delegate CC (or carrier candidate) to update TA values in the timing group represented by the delegate CC. EX1004, ¶57, FIG. 3; EX1005, Appx. A (1:24-2:6, Fig. 1); EX1006, 4 (§2.2.4).

108. Therefore, a POSITA would have found it routine, straightforward, and advantageous to substitute Huawei's delegate CC selection mechanism (selecting a CC having a lowest center frequency) in place of Tenny's (using a hash function,

a pseudorandom function, a time-based function, etc.). I noticed that Huawei called its CC selection the "simplest way" in the inter-band aggregated CCs with identical TA value. EX1006, 4 (§2.2.4). This further indicates that a POSITA would have known such a modification would predictably work and provide the expected successful result.

3. The teaching, suggestion, and motivation in Tenny and Huawei would have led a POSITA to modify Tenny's delegate CC selection mechanism to choose a CC with lowest center frequency.

109. Tenny recognizes that in a multicarrier environment, timing synchronization for UE is more complex than that in a single-carrier environment. EX1004, ¶9; EX1005, Appx. (1:24-29). As a result, Tenny proposes to group multiple carriers into "timing groups" with the similar timing information (within a tolerance). EX1004, ¶34; EX1005, Appx. (1:17-19). To avoid performing unnecessary timing updates through random process procedures, Tenny discloses multiple embodiments directed towards selecting one carrier of each timing group, so that the timing update through that selected carrier would lead to the timing updates of all carriers in the timing group. EX1004, ¶58; EX1005, Appx. (2:8-13).

110. In my opinion, a POSITA would have been motivated by the above teaching from Tenny to explore designs that could efficiently perform timing updates on the timing groups in a multicarrier environment, each of which may be

represented by a selected carrier.

111. Huawei also aims to address the same problem—TA maintenance for UL aggregated CCs could cause a lot of unnecessary RACH and maintenance overhead. EX1006, 2 (§2.1). Huawei explicitly states that "if the inter-band aggregated CCs can share identical TA," RACH can be performed via a CC "with lowest frequency," as well as "the simplest way is to choose one with lowest frequency to perform RACH if the inter-band aggregated CCs can share identical TA." EX1006, 4 (§2.2.4). A POSITA would have understood that Huawei presents an alternative and simpler mechanism for delegate CC selection, a key component in the improvement of the multicarrier system also taught and suggested by Tenny. EX1004, ¶58; EX1005, Appx. (2:8-13).

112. Further, as I discussed above in Section IX.A.2, the modification of Tenny by Huawei could lead to a reasonable expectation of success. In sum, it is my opinion that a POSITA would have been motivated to combine Tenny's disclosure with Huawei's delegate CC selection mechanism to arrive at the claimed invention in the '372 Patent.

B. Independent Claim 1

113. Claim 1 is reproduced below. For ease of discussion, I have included a label for each claim limitation.

[1.pre] A method of performing random access in a wireless communication system, the method comprising:

[1.a] configuring a[n] uplink (UL) timing group including at least one of CCs having a difference in center frequencies within a threshold range, CCs having the same beamforming scheme, CCs having the same timing advance (TA) value, and CCs having the same reference downlink (DL) CC for obtaining a TA value, from among a plurality of CCs;

[1.b] setting a CC satisfying at least one of a CC having a lowest center frequency value, a CC having a center frequency value that is closest to a mean value, a CC having a highest center frequency value, a CC having a broadest frequency band, and a CC in which a radio link monitoring (RLM) is defined, in the configured UL timing group as a delegate CC;

[1.c] obtaining a TA value to be used for obtaining a UL timing through the delegate CC; and

[1.d] updating a TA value of the corresponding UL timing group based on the obtained TA value.

[1.pre] A method of performing random access in a wireless communication system, the method comprising:

114. Tenny discloses [1.pre] by teaching a method of performing a random access procedure by an access terminal (also known as "user equipment (UE)") in a wireless communication system. EX1004, ¶¶41-42, 58-61, FIGs. 1, 3; EX1005, ¶13, Fig. 1, Appx. A (2:8-9, Fig. 1).

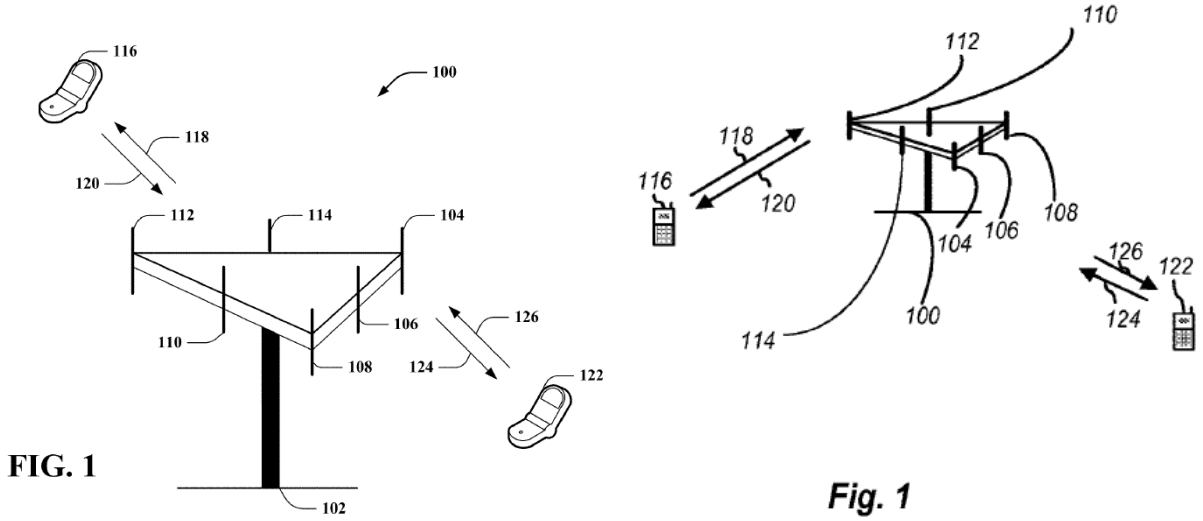


FIG. K – Tenny '116, Fig. 1 and Tenny-Prov, Fig. 1

115. Both FIG. 1 of Tenny '116 and Fig. 1 of Tenny-Prov disclose a wireless communication system comprising a base station (access point 110, base station 102) and UEs (access terminals 116 and 122). EX1004, ¶¶41-42; EX1005, ¶13. Tenny further discloses a method of performing random access procedure by the access terminals. EX1004, ¶¶41-42; EX1005, Appx. A (2:8-9).

> ***[1.a] configuring a[n] uplink (UL) timing group including at least one of CCs having a difference in center frequencies within a threshold range, CCs having the same beamforming scheme, CCs having the same timing advance (TA) value, and CCs having the same reference downlink (DL) CC for obtaining a TA value, from among a plurality of CCs;***

116. I notice that claim limitation [1.a] requires "***at least one of***" the following four conditions: **[i]** "*component carriers (CCs) having a difference in center frequencies within a threshold range*," **[ii]** "*CCs having the same*

beamforming scheme," **[iii]** "*CCs having the same timing advance (TA) value*," and **[iv]** "*CCs having the same reference downlink (DL) CC to be used for obtaining a TA value*." I understand that satisfying any one of the four conditions meets the requirement of [1.a].

117. In my opinion, Tenny discloses [8.a] by disclosing condition **[iii]**: "*configuring a[n] uplink (UL) timing group including CCs having the same timing advance (TA) value*."

118. Tenny discloses that CCs with the same or similar uplink timings ("timings that are the same to within some tolerance" or "within a threshold difference") are grouped into the same "timing group." EX1004, ¶55; EX1005, ¶¶33-34, Appx. A (5:18-22). If "timing offsets" or "timing differences" of a set of CCs are within a threshold range, which means that the uplink timings of the CCs in each group are "close enough," the set of CCs can be configured into the same "timing group" that shares "a single timing advance value." EX1004, ¶¶65, 70; EX1005, Appx. A (5:3-5).

119. For example, Tenny '116 states that "the network could opt to send only a single timing advance command per MAC element, but indicate which timing group the value is associated with." EX1004, ¶70; EX1005, Appx. A (5:3-5). A POSITA would have understood that a single TA command will inform the UE

of a single TA value, because the TA command contains a single index TA value (*e.g.*, how many units of advance) and the target TA Group ID to which the command applies. EX1017, 34 (§6.1.3.5) and 38 (§6.2.3).

120. Such an understanding is also confirmed by Huawei. For example, Huawei states that "[i]f all UL CCs in the different bands are out of synchronization, eNB can send the PDCCH order for **each CC group with the identical TA value**, and UE can perform the contention-free RACH simultaneously," and "[i]f identical TA cannot be shared among the inter-band aggregated CCs, RACH should be performed separately at least for **each group of CCs with identical TA value**." EX1006, 3-4 (§§2.2.3 and 2.2.4).

> ***[1.b] setting a CC satisfying at least one of a CC having a lowest center frequency value, a CC having a center frequency value that is closest to a mean value, a CC having a highest center frequency value, a CC having a broadest frequency band, and a CC in which a radio link monitoring (RLM) is defined, in the configured UL timing group as a delegate CC; and***

121. I notice that claim limitation [1.b] requires "***at least one of***" the following five conditions: **[i]** "*a CC having a lowest center frequency value*," **[ii]** "*a CC having a center frequency value that is closest to a mean value*," **[iii]** "*a CC having a highest center frequency*," and **[iv]** "*a CC having a broadest frequency band*," and **[v]** "*a CC in which a radio link monitoring (RLM) is defined*." I understand that satisfying any one of the five conditions meets the requirement of

[1.b].

122. In my opinion, Tenny in view of Huawei renders obvious [1.b] by rendering obvious condition **[i]**: "*setting a CC satisfying a CC having a lowest center frequency value in the configured UL timing group as a delegate CC*."

123. Tenny discloses selecting a carrier candidate from a timing group ("*to set a CC ... in the configured UL timing group as a delegate CC*") for acquiring timing updates for the entire group, and further discloses that the selection can be based on multiple methods, such as using a hash function, a pseudorandom function, a time-based function, etc. EX1004, ¶¶61-62; EX1005, ¶¶36, 39. Huawei discloses another selection method—choosing one CC with a lowest frequency from a group of CCs sharing identical TA value as the one uplink CC (UL CC) for Random Access Channel (RACH). EX1006, 4 (§2.2.4).

124. A POSITA would have understood that, the eNB selects a Timing Advance Command (TAC) based on several factors, such as:

(a) Coverage and Signal Quality: Usually, the PCell is selected as the TAC for the first user terminal group (UTG 0) because it has the strongest, most stable coverage and is used for control signaling. For additional UTGs, the eNB may choose a SCell with the most stable uplink path or one that has the most reliable uplink timing characteristics. *See* EX1019, pp. 49 (Sec. 7.5), 80-82 (Secs. 11.1 and 11.2).

(b) Uplink Frequency Band Characteristics: In inter-band carrier aggregation, carriers may operate in bands with different propagation delays. The eNB selects the TAC for each UTG to minimize delay mismatches and maintain reliable uplink timing. *See* EX1019, p. 37 (Sec. 5.2.7.3).

(c) Load Balancing and Scheduling Strategy: The eNB may select a carrier that is better suited for UL scheduling as the TAC. If an SCell is expected to handle more UL traffic, it may be selected as TAC to align TA with high-load carriers. *See* EX1019, pp. 107 (Sec. 16.1.6), 163-165 (Sec. 22.4.1).

(d) Hardware/UE Capability Constraints: Not all UEs support multiple TA groups. The eNB selects TACs based on UE capabilities, indicated in the UE Capability Information message. Some UEs may support only a single UTG, so only one TAC is used (usually the PCell). *See* EX1019, pp. 108-109 (Sec. 18)

125. Therefore, if a PCell is picked as the TAC, the PCell is always picked as the delegate CC. If it is not the PCell but an SCell chosen as the delegate CC, the selection criterion can be any one of the conditions under limitation [1.b]. Thus, the

different delegate CC selection criteria do not generate a different result in terms of keeping consistency in the delegate CC selection process to minimize the overhead of signaling.

126. As I discussed above in Section IX.A, a POSITA would have been motivated to implement Huawei's delegate CC selection method to Tenny's carrier candidate selection by selecting a CC having a lowest frequency from a UL timing group as the carrier candidate for acquiring timing updates for the entire group.

127. Further, as I discussed above in Section VI.B, a POSITA would have understood that there are two types of CC in LTE: (A) intra-band CCs that are in the same band (including intra-band contiguous and intra-band non-contiguous); (B) inter-band CCs that are in different frequency bands. I note that the plain and ordinary meaning of claim 1 of the '372 Patent does not limit its scope to either one of intra-band or inter-band CCs. Thus, Huawei's disclosure about inter-band CCs sharing the same TA falls within the scope of claim 1 of the '372 Patent. EX1006, 4 (§2.2.4).

128. Because "carrier frequency" is typically defined as the center frequency of the cell, a POSITA would have understood that Huawei's choice of CC with the "lowest frequency" would mean CC with the lowest center frequency. EX1017, 14 (§3.1); EX1006, 4 (§2.2.4). Therefore, it is my opinion that Tenny in view of Huawei

renders obvious [1.b], since a POSITA would have been motivated to implement Huawei's delegate CC selection method—selecting a CC having a lowest center frequency from a UL timing group as the carrier candidate—to Tenny's carrier candidate selection for acquiring timing updates for the entire group.

[1.c] obtaining a TA value to be used for obtaining a[n] UL timing through the delegate CC; and [1.d] updating a TA value of the corresponding UL timing group based on the obtained TA value.

129. In my opinion, Tenny discloses [1.c] and [1.d] by obtaining a timing message including a timing offset (also known as "timing advance") used for determining the uplink timing through the carrier candidate of a group, and updating the uplink timing for the group based on the obtained timing offset.

130. Both Tenny '116 and Tenny-Prov disclose that for each timing group, a timing message encoded with a timing offset of the carrier candidate of the timing group can be acquired by performing a random access procedure, and the uplink timing is determined. EX1004, ¶¶58, 77, 81; EX1005, ¶¶34-37, Fig. 3. More specifically, both Tenny '116 and Tenny-Prov disclose that the timing message is a Timing Advance Command (TAC), and only a single TAC is used to update the TA value for all carriers in the group. EX1004, ¶¶70, 77; EX1005, Appx. A (5:3-5, 7:3).

131. The exact same teaching is also confirmed by Huawei. For example,

Huawei states that "the UE adjusts its uplink time alignment based on Timing Advance Command MAC PDU. From UE point of view, one timing advance command for the CCs with identical TA is [sic] enough." EX1006, §2.3 at p.4.

132. Thus, Tenny discloses [1.c] and [1.d].

133. From the foregoing, it is my opinion that Tenny in view of Huawei renders obvious claim 1.

C. Independent Claim 8

134. Claim 8 is reproduced below. For ease of discussion, I have included a label for each claim limitation.

> **[8.pre]** An apparatus for performing random access in a wireless communication system, the apparatus comprising:
> **[8.a]** a[n] uplink timing group configuring unit to configure a[n] uplink (UL) timing group including at least one of component carriers (CCs) having a difference in center frequencies within a threshold range, CCs having the same beamforming scheme, CCs having the same timing advance (TA) value, and CCs having the same reference downlink (DL) CC to be used for obtaining a TA value, from among a plurality of CCs;
> **[8.b]** a delegate CC setting unit to set a CC satisfying at least one of a CC having a lowest center frequency value, a CC having a center frequency value that is closest to a mean value, a CC having a highest center frequency, a CC having a broadest frequency band, a CC in which a radio link monitoring (RLM) is defined, in the configured UL timing group as a delegate CC;

[8.c] a TA value obtaining unit to obtain a TA value to be used for obtaining a UL timing through the delegate CC; and

[8.d] a TA value updating unit to update a TA value of the corresponding UL timing group based on the obtained TA value.

[8.pre] An apparatus for performing random access in a wireless communication system, the apparatus comprising:

135. As I discussed above in Sections IX.B, Tenny discloses that the wireless communication system includes an access terminal ("*an apparatus… in a wireless communication system*") that performs the random access procedure ("*for performing random access*"). EX1004, ¶¶41-42, 58-61, FIGs. 1, 3; EX1005, ¶13, Fig. 1, Appx. A (2:8-9, Fig. 1). Thus, Tenny also discloses [8.pre].

[8.a] a[n] uplink timing group configuring unit to configure a[n] uplink (UL) timing group including at least one of component carriers (CCs) having a difference in center frequencies within a threshold range, CCs having the same beamforming scheme, CCs having the same timing advance (TA) value, and CCs having the same reference downlink (DL) CC to be used for obtaining a TA value, from among a plurality of CCs;

136. As I discussed above in Section IX.B, Tenny discloses "*configuring a[n] uplink (UL) timing group including at least one of CCs having a difference in center frequencies within a threshold range, CCs having the same beamforming scheme, CCs having the same timing advance (TA) value, and CCs having the same reference downlink (DL) CC for obtaining a TA value, from among a plurality of*

CCs." FIG. 3 of Tenny-Prov (reproduced below) further discloses that wireless device 302 includes a carrier grouping component 304 configured to perform the function of grouping CCs. EX1005, ¶34; EX1004, ¶¶13, 16, 93-94, 120-121, 123.

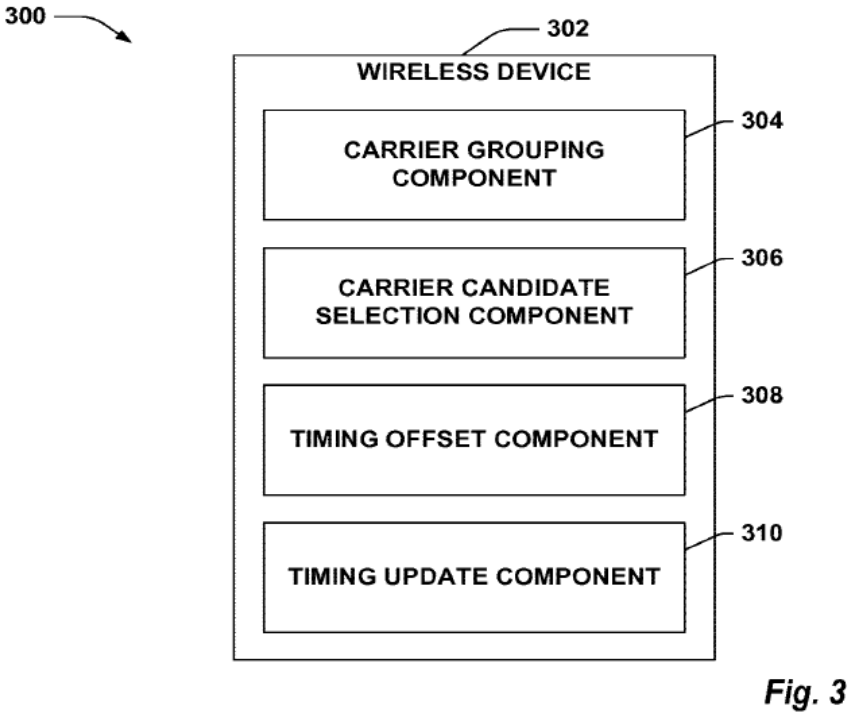


FIG. L – Tenny-Prov, Fig. 3

137. Under the Patent Owner's construction of plain and ordinary meaning, the wireless device 302 of Tenny discloses the claimed "uplink timing group configuring unit."

138. Under the Petitioner's proposal to construe this limitation to be a means-plus-function term, Tenny still discloses this limitation. A POSITA would have understood that wireless device 302 in Tenny is equivalent to the UE in the '372

Patent, and that carrier grouping component 304 configures an UL timing group including CCs with the same or similar uplink timings, which is also the function of the "uplink timing group configuring unit" of this limitation. Further, the hardware of wireless device 302 that implements carrier grouping component 304 is also taught by Tenny, thereby disclosing the corresponding structure of this limitation as well. EX1004, ¶¶120-121, 123; EX1005, ¶¶44-47.

139. Therefore, it is my opinion that Tenny discloses [8.a].

> ***[8.b] a delegate CC setting unit to set a CC satisfying at least one of a CC having a lowest center frequency value, a CC having a center frequency value that is closest to a mean value, a CC having a highest center frequency, a CC having a broadest frequency band, a CC in which a radio link monitoring (RLM) is defined, in the configured UL timing group as a delegate CC;***

140. As I discussed above in Sections IX.B, Tenny in view of Huawei renders obvious "*set[ting] a CC satisfying at least one of a CC having a lowest center frequency value, a CC having a center frequency value that is closest to a mean value, a CC having a highest center frequency, a CC having a broadest frequency band, and a CC in which a radio link monitoring (RLM) is defined, in the configured UL timing group as a delegate CC*."

141. FIG. 3 of Tenny-Prov (reproduced above) further discloses that wireless device 302 includes a carrier candidate selection component 306 configured to perform the function of selecting a carrier candidate of a timing group. EX1005,

¶36; EX1004, ¶¶13, 16, 93-94, 120-121, 123. Thus, modified Tenny's carrier candidate selection component 306 based on the teachings of Huawei renders obvious the claimed "delegate CC setting unit."

142. Under the Patent Owner's construction of plain and ordinary meaning, the limitation is rendered obvious by Tenny in view of Huawei.

143. Under the Petitioner's proposal to construe this limitation to be a means-plus-function term, Tenny still discloses this limitation.

144. A POSITA would have understood that wireless device 302 in Tenny is equivalent to the UE in the '372 Patent, and that Huawei's disclosure of choosing one CC with a lowest frequency from a group of CCs as the UL CC for RACH is also the function of the "delegate CC setting unit" of this limitation. Further, the hardware of wireless device 302 that implements carrier candidate selection component 306 is also taught by Tenny, thereby disclosing the corresponding structure of this limitation as well. EX1004, ¶¶120-121, 123; EX1005, ¶¶44-47.

145. Therefore, it is my opinion that Tenny in view of Huawei renders obvious [8.b].

[8.c] a TA value obtaining unit to obtain a TA value to be used for obtaining a UL timing through the delegate CC; and [8.d] a TA value updating unit to update a TA value of the corresponding UL timing group based on the obtained TA value.

146. As I discussed above in Section IX.B, Tenny discloses "*obtaining a TA*

value to be used for obtaining a UL timing through the delegate CC," and "*updating a TA value of the corresponding UL timing group based on the obtained TA value*."

147. FIG. 3 of Tenny-Prov (reproduced above) further discloses that wireless device 302 includes a timing offset component 308 configured to perform the function of obtaining a TA value of the carrier candidate of the group, which corresponds to the claimed "TA value obtaining unit". FIG. 3 of Tenny-Prov (reproduced above) further discloses that wireless device 302 includes a timing update component 310 configured to perform the function of updating the TA value of the group, which corresponds to the claimed "TA value updating unit." EX1005, ¶¶34, 37, Fig. 3; EX1004, ¶¶13, 16, 93-94, 120-121, 123.

148. Therefore, Tenny discloses both [8.c] and [8.d].

149. From the foregoing, it is my opinion that Tenny in view of Huawei renders obvious claim 8.

X. Ground 2: Tenny in view of Huawei and further in view of Zhang renders obvious claims 2 and 9

A. Reasons to combine Tenny and Huawei with Zhang

150. I have discussed the reasons to combine Tenny and Huawei extensively in Section IX.A above. In the following of my declaration, I will further explain why a POSITA would have been motivated to combine Tenny and Huawei's random access performance in a wireless communication system with Zhang's timing group

reconfiguration scheme.

151. First, Zhang, Tenny, and Huawei are analogous art in the same field as the '372 Patent, which relates to multicarrier wireless communication. EX1001, 1:15-19; EX1004, ¶3; EX1005, Appx. A (1:1-3); EX1006, 1 (§1); EX1007, ¶¶2, 42. In particular, Zhang identifies a problem in the conventional LTE handover procedure where the measurements defined to support a single-carrier system are insufficient to support handover in a multicarrier system. EX1007, ¶21. This handover difficulty is also explored by Huawei; that is, to support multiple TA, one RACH per CC could cause a lot of system complexity and burden. EX1006, 3 (§2.2.2). Tenny also suggests that the complexity in the multicarrier system arises along with a hard handover where multiple timing groups each have independent timing. EX1004, ¶56.

152. Moreover, while Tenny and Huawei are largely silent on the solution to the above difficulty, Zhang has proposed a CC-specific configuration scheme that allows a WTRU to add, remove, or replace one or more CCs. EX1007, ¶¶22, 40. A POSITA, with the suggestion of Tenny and Huawei, would be motivated to find solutions to the issues identified therein by, for example, consulting the proposal by Zhang. A POSITA would have been motivated to implement Zhang's teaching of CC-specific configuration scheme to the performance of random access in a wireless

communication system disclosed by Tenny and Huawei, because it directly resolves the problem by increasing the data rate and spectrum efficiency of the system, which is a predictable result of the implementation. EX1007, ¶2.

153. Further, a POSITA would have had a reasonable expectation of success in applying these teachings in Zhang, given that Tenny and Huawei's system was explicitly designed to provide solutions to several issues arising in an LTE-A system, and doing so would have been straightforward and would have required minimal disruption to the existing LTE infrastructure.

B. Dependent Claim 2: *The method as claimed in claim 1, further comprising: determining whether a CC that is added or removed exists: and reconfiguring the UL timing group based on the determined CC."*

154. As I discussed above in Section IX.B, Tenny in view of Huawei renders obvious claim 1. In my opinion, the additional limitations of claim 2 are also disclosed by Huawei and Zhang as follows.

[2.a] determining whether a CC that is added or removed exists;

155. First, I understand that [2.a] is satisfied when either one of "*determining whether a CC that is added exists*" or "*determining whether a CC that is removed exists*" is met.

156. As shown in Fig. 3 below, Huawei discloses that, during an inter-eNB handover, multiple CCs for the target cell requiring different TAs are added by

performing RACH on those CCs to acquire their respective TAs. EX1006, 3 (§2.2.2). A POSITA would have understood that, the subsequent performance of RACH on the newly added CCs inherently indicates that the addition of the CCs is determined; otherwise, no RACH needs to be carried out, and the UE can simply use the CCs from the source cell.

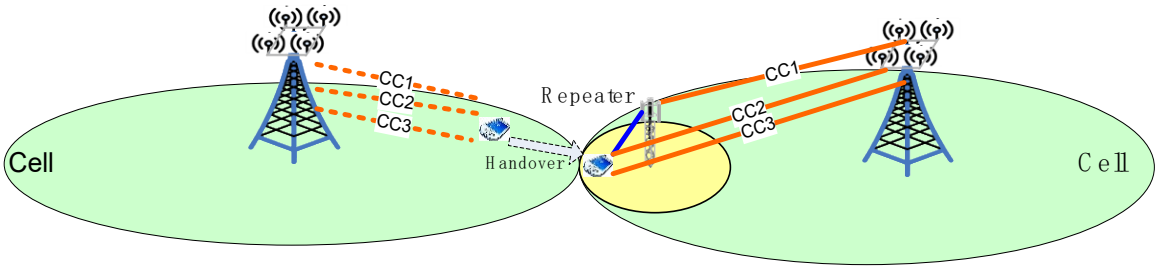


FIG. M – Fig. 3 of Huawei, Multiple TA impact in the case of handover

157. To the extent that [2.a] requires both of "*determining whether a CC that is added exists*" and "*determining whether a CC that is removed exists*" to be met, Zhang fills the gap left by Huawei.

158. As I discussed above in Section VIII.C, Zhang proposes a CC-specific reconfiguration mechanism that allows addition, removal, or replacement of one or more CCs in a multicarrier wireless communication system. EX1007, ¶22. FIG. 5 of Zhang reproduced below illustrates an example of Zhang's CC-specific reconfiguration.

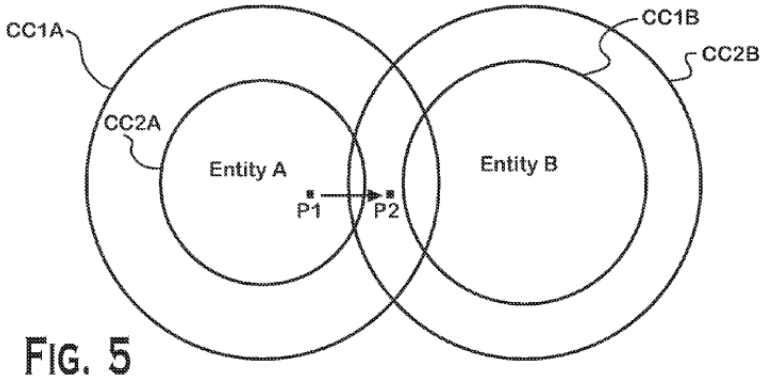


FIG. N – Fig. 5 of Huawei

159. In one example of Zhang, when a WTRU (*i.e.*, UE) moves from position P1 to position P2, thus leaving the boundary of CC2A and entering into the boundary of CC2B, it may remove CC2A and add CC2B to have better overall achievable data rates. EX1007, ¶50. That is, the WTRU has reconfigured its CCs from a group of CC1A and CC2A to a group of CC1A and CC2B.

160. Therefore, a POSITA would have understood that, as a precursor step to such reconfiguration, determination of whether a CC is added or removed is necessary for the subsequent reconfiguration; otherwise, the system in Zhang would not recognize which group of CCs are reconfigured for UL and DL transmission.

161. Therefore, it is my opinion that Huawei in view of Zhang discloses [2.a].

[2.b] reconfiguring the UL timing group based on the determined CC.

162. Huawei does not explicitly disclose that the UL timing group is

reconfigured based on the added CC, but Zhang does. Zhang discloses performing a carrier reconfiguration in response to determining that a CC is added or removed.

163. As I discussed above in Section X.B, in one example of Zhang, the WTRU reconfigures its CCs from a group of CC1A and CC2A to a group of CC1A and CC2B, by determining the removal of CC2A and addition of CC2B, when the WTRU moves outside of the boundary of CC2A while entering into the boundary of CC2B. EX1007, ¶50. Since Zhang also discloses that the reconfiguration may be applicable to both UL and DL transmission, a POSITA would have understood from Zhang's teaching that the CCs being reconfigured in the example above may constitute a UL timing group. EX1007, ¶52.

164. Thus, Zhang discloses [2.b].

165. As discussed above in Section X.A, a POSITA would have been motivated to implement Zhang's teaching of CC-specific reconfiguration to the performance of random access in a wireless communication system disclosed by Tenny and Huawei.

166. Therefore, it is my opinion that Tenny in view of Huawei and further in view of Zhang renders obvious claim 2.

C. Dependent Claim 9: *The apparatus as claimed in claim 8, further comprising: a determining unit to determine whether a CC that is added or removed exists; and a timing group reconfiguring unit to reconfigure the UL timing group based on the determined CC.*

167. As I discussed above in Section IX.C, Tenny in view of Huawei renders obvious claim 8. In my opinion, the additional limitations of claim 9 are also disclosed by Zhang as follows.

[9.a] a determining unit to determine whether a CC that is added or removed exists;

168. As I discussed above in Section X.B, Zhang discloses [2.a]. The difference of [9.a] over [2.a] is a general-purpose hardware/software component—"*a determining unit*"—that carries out the determining step, which is also disclosed by Zhang.

169. Zhang discloses that the WTRU can be implemented by a processor in association with software. EX1007, ¶91. The features and elements described in Zhang, in conjunction with the WTRU, can also be implemented "in a computer program, software, or firmware incorporated in a computer-readable storage medium for execution by a general purpose computer or a processor." EX1007, ¶89. Thus, a POSITA would have understood from Zhang's teaching that a general-purpose hardware/software component is included in Zhang's WTRU to perform the determining step. Thus, Zhang discloses [9.a].

[9.b] a timing group reconfiguring unit to reconfigure the UL timing group based on the determined CC.

170. As I discussed above in Section X.B, Zhang discloses [2.b]. The difference of [9.b] over [2.b] is a general-purpose hardware/software component—"*a timing group reconfiguring unit*"—that carries out the reconfiguring step, which is also disclosed by Zhang.

171. With Zhang's teaching described above in Section X.B, a POSITA would have understood that a general-purpose hardware/software component is included in Zhang's WTRU to perform the reconfiguring step.

172. Thus, Zhang discloses [9.b].

173. As I discussed above in Section X.A, a POSITA would have been motivated to implement Zhang's teaching of CC-specific reconfiguration to the performance of random access in a wireless communication system disclosed by Tenny and Huawei.

174. Therefore, it is my opinion that Tenny in view of Huawei and further in view of Zhang renders obvious claim 9.

XI. Ground 3: Tenny in view of Huawei and further in view of Wang renders obvious claims 3-4 and 10-11

A. Reasons to combine Tenny and Huawei with Wang

175. I have discussed the reasons to combine Tenny and Huawei extensively

in Section IX.A above. In the following of my declaration, I will further explain why a POSITA would have been motivated to combine Tenny and Huawei's random access performance in a wireless communication system with Wang's teaching of (i) obtaining the TA value via a RAR message from the eNB ("TA acquirement element"); and (ii) updating the TA value in case a UE-specific TAT expires ("TA update element").

176. First, Wang, Tenny, and Huawei are analogous art in the same field as the '372 Patent, which relates to multicarrier wireless communication. EX1001, 1:15-19; EX1004, ¶3; EX1005, Appx. A (1:1-3); EX1006, 1 (§1); EX1008, Abstract; EX1009, 1-2 (Introduction). In particular, Wang identified certain scenarios where different CCs from the same eNB may have separate timing advances (TAs) that need to be synchronized. EX1008, 2:25-36; EX1009, 1-2. This synchronization issue is also recognized by Tenny and Huawei. EX1004, ¶9; EX1005, Appx. (1:24-29); EX1006, 3 (§2.2.3). To address this issue, Tenny proposes a timing alignment method for the multicarrier system that focuses on transmission of uplink group of CCs within a threshold value of uplink timing. EX1004, Abstract, claim 1. Wang's improvement is similarly related to uplink CC synchronization, which performs two separate random access procedures on two CCs separately. EX1008, Abstract, 13:24-48 (claim 1).

177. Second, Tenny discloses or at least suggests the two claim features of the ’372 Patent that Wang improves upon. Regarding the TA acquirement element, Tenny states that updating the timing of a timing group is by “performing a random access procedure.” EX1004, ¶58; EX1005, ¶37. Although Tenny does not explicitly describe the details of the random access procedure, a POSITA, upon consideration of Tenny’s disclosure, would be motivated to find further details as to the performance of the random access procedure. The POSITA would have relied on Wang, which identifies that the RAR message is part of the random access procedure and that the RAR message includes the TA value, to supplement Tenny, because Wang provides the relevant details. EX1008, 1:48-56, 9:20-29; EX1009, 9, 12, 33-34.

178. Third, regarding the TA update element, Tenny at least suggests one of the conditions that trigger the TA update—re-establishment of downlink (DL) CCs is needed when the uplink transmissions are not aligned with the received downlink timing, so that DL CC synchronization is regained. EX1004, ¶10. A POSITA would have understood that there are alternative ways to trigger the TA update, especially in view of the five different conditions claimed in the ’372 Patent, and would search for a known, alternative method that would also trigger the TA update. Wang provides such an alternative method by relying on a case in which a UE-specific

time alignment timer expires. EX1008, 1:32-47; EX1009, 9-10. Wang's method brings about the same predictable results as Tenny's, *i.e.*, updating the TA value during the random access procedure in a multicarrier wireless communication system.

B. Dependent Claim 3: ***The method as claimed in claim 1, wherein obtaining of the time alignment timer value comprises: obtaining the time alignment timer value by receiving, from an evolved NodeB (eNB), a random access response message including the TA value to be used for the UL timing.***

179. First, I have noticed that the term "*time alignment timer value*" in claim 3 lacks an antecedent basis. For the purpose of analysis in my Declaration, I consider this term to refer to "timing advance (TA) value" recited in claim 1.

180. As I discussed above in Section IX.B, Tenny in view of Huawei renders obvious claim 1. In my opinion, the additional limitations of claim 3 are also disclosed by Tenny or Wang as follows.

181. Tenny discloses updating the timing of a timing group by "performing a random access procedure." EX1004, ¶58; EX1005, ¶37. A POSITA would have understood the random access procedure to include a random response message. In the network-based solution proposed by Tenny, the network (such as the eNB) assigns the UE to a particular group of CCs, and instructs the UE regarding which delegate CC to use for random access. EX1004, ¶60; EX1005, Appx. A (2:18-20).

With the above teaching by Tenny, a POSITA would have understood that the timing advance value for update is received from the eNB in the form of a random response message.

182. Thus, it is my opinion that Tenny discloses the additional limitations of claim 3.

183. To the extent that Tenny's disclosure is found insufficient as to the feature that the TA value is included in an RAR message transmitted from the eNB, Wang provides such teaching. Wang discloses in the "Description of the Prior Art" section that an RAR message is used to transmit the TA value, via a timing alignment command (TAC), from the eNB to the UE. EX1008, 1:48-56, 9:20-29; EX1009, 9, 12, 33-34. Additionally, as shown in the figure of Wang-Prov (reproduced below), step 2 teaches that the eNB transmits an RAR message to the UE, which includes the Timing Advance (TA) information. EX1009, 33.

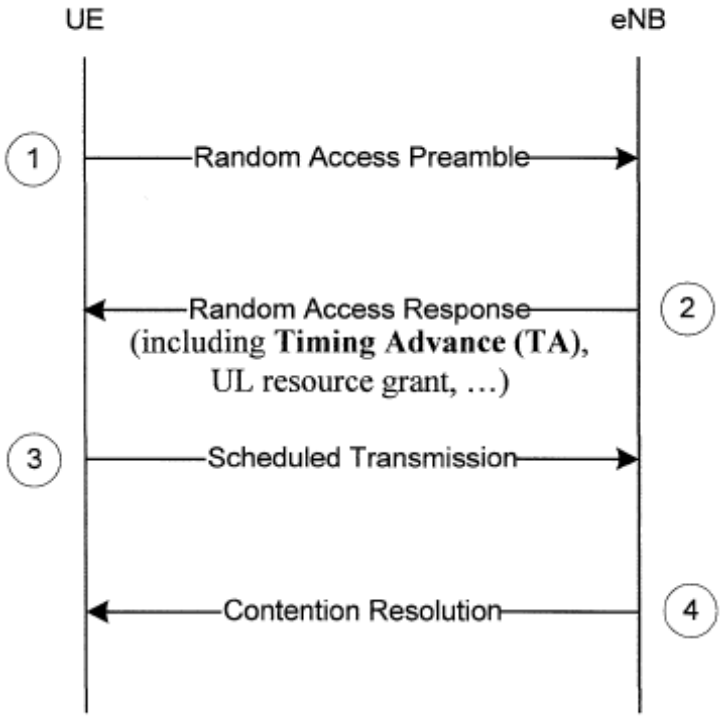


FIG. O – A figure of Wang-Prov

184. Thus, Wang discloses the additional limitations of claim 3.

185. As I discussed above in Section XI.B, it would have been obvious for a POSITA to implement Wang's teaching of obtaining the TA value via an RAR message from the eNB to the performance of random access in a wireless communication system disclosed by Tenny and Huawei.

186. Therefore, it is my opinion that Tenny in view of Huawei and further in view of Wang renders obvious claim 3.

C. Dependent Claim 4: ***The method as claimed in claim 1, further comprising: sensing occurrence of a condition for updating the TA value, wherein the condition for updating the TA value corresponds to at least one of: a case in which re-establishment of synchronization with respect to DL CCs is required; a case in which transmission of UL data is initialized; a case in which a UE-specific time alignment timer expires; and a case in which a time alignment timer set for each UL timing group expires.***

187. As I discussed above in Section IX.B, Tenny in view of Huawei renders obvious claim 1. It is my opinion that the additional limitations of claim 4 are also disclosed by Tenny and Wang as follows.

188. As an initial matter, I noticed that that claim 4 requires "***at least one of***" the following four conditions: **[i]** "*a case in which re-establishment of synchronization with respect to DL CCs is required*"; **[ii]** "*a case in which transmission of UL data is initialized*"; **[iii]** "*a case in which a UE-specific time alignment timer expires*"; and **[iv]** "*a case in which a time alignment timer set for each UL timing group expires*." Therefore, I understand that satisfying any one of the four conditions would disclose this entire limitation of claim 4.

189. In my opinion, Tenny discloses the limitation of claim 4 by satisfying condition **[i]**. Specifically, Tenny discloses that, for maintaining timing synchronization in a single-carrier environment, the downlink offset needs to be updated to align its uplink transmissions in relation to the received downlink timing.

EX1004, ¶9; EX1005, Appx. A (1:5-8). The same would be true for such timing synchronization in a multicarrier environment where timing variation "make[s] separate timing offsets per carrier beneficial or even necessary." EX1004, ¶10. Thus, a POSITA would have understood that, when the uplink transmissions are not aligned with the received downlink timing, the timing synchronization with respect to DL CCs in a multicarrier system needs to be re-established by updating the offset(s) of the DL CCs.

190. To the extent that Tenny's disclosure is found insufficient as to the case of requiring re-establishment of synchronization with respect to DL CCs, Wang fills the gap. In my opinion, Wang discloses the limitation of claim 4 by satisfying condition **[iii]**. Specifically, Wang discloses that the UE maintains a time alignment timer (TAT) indicating whether the UE is synchronized with the eNB on uplink timing, and when the TAT expires, the UE performs a random access procedure to update the TA value. EX1008, 1:32-47; EX1009, 9-10.

191. As discussed above in Section XI.A, POSITA would have been motivated to implement Wang's teaching of updating the TA value in case a UE-specific TAT expires to the performance of random access in a wireless communication system disclosed by Tenny and Huawei.

192. Therefore, it is my opinion that Tenny in view of Huawei and further

in view of Wang renders obvious claim 4.

D. Dependent Claim 10: ***The apparatus as claimed in claim 8, wherein the TA value obtaining unit receives a random access response message including the TA value to be used for obtaining the UL timing, from an evolved NodeB (eNB).***

193. As discussed above in Section IX.C, Tenny in view of Huawei renders obvious claim 8. In my opinion, the additional limitations of claim 10 are also disclosed by Tenny or Wang as follows.

194. As I discussed above in Section XI.B, Tenny discloses claim 3 by satisfying condition **[i]**. Moreover, as I discussed above in Section IX.C, Tenny further discloses the TA value obtaining unit. Therefore, Tenny discloses the additional limitations of claim 10.

195. Alternatively, as discussed in Section XI.B, Wang also discloses claim 3 by satisfying condition **[iii]**. The difference of claim 10 over claim 3 is a general-purpose hardware/software component—"*the TA value obtaining unit*"—that carries out the receiving step, which is already disclosed by Tenny, as I discussed above in Section IX.C. Therefore, Tenny in view of Wang discloses the additional limitations of claim 10.

196. As discussed above in Section XI.A, a POSITA would have been motivated to implement Wang's teaching of obtaining the TA value via an RAR

message from the eNB to the performance of random access in a wireless communication system disclosed by Tenny and Huawei.

197. Therefore, it is my opinion that Tenny in view of Huawei and further in view of Wang renders obvious claim 10.

E. Dependent Claim 11: ***The apparatus as claimed in claim 8, further comprising: a condition sensing unit to sense occurrence of a condition for updating the TA value, wherein the condition for updating the TA value corresponds to at least one of: a case in which re-establishment of synchronization with respect to DL CCs is required; a case in which transmission of UL data is initialized; a case in which a UE-specific time alignment timer expires; and a case in which a time alignment timer set for each UL timing group expires.***

198. As I discussed above in Section IX.C, Tenny in view of Huawei renders obvious claim 8. In my opinion, the additional limitations of claim 11 are also disclosed by Tenny or Wang as follows.

199. As I discussed above in Section XI.C, Tenny discloses claim 4. The difference of claim 11 over claim 4 is a general-purpose hardware/software component—"*a condition sensing unit*"—that carries out the sensing step, which is also disclosed by Tenny.

200. Tenny discloses that software functions can be implemented with modules (e.g., procedures, functions, and so on) that perform the functions, and hardware components can be implemented by, *e.g.*, processors, controllers, micro-

controllers, microprocessors, other electronic units designed to perform the functions. EX1004, ¶¶122-123. Thus, a POSITA would have understood from Tenny's teaching that a general-purpose hardware/software component is included in Tenny's UE to perform the sensing step. Thus, Tenny discloses the additional limitations of claim 11.

201. Alternatively, as I discussed above in Section XI.C, Wang also discloses claim 4. The general-purpose hardware/software component—"*a condition sensing unit*"—that carries out the sensing step, which is already disclosed by Tenny, as discussed immediately above. Thus, Tenny in view of Wang discloses the additional limitations of claim 11.

202. As discussed above in Section XI.A, a POSITA would have been motivated to implement Wang's teaching of updating the TA value in case a UE-specific TAT expires to the performance of random access in a wireless communication system disclosed by Tenny and Huawei.

203. Therefore, it is my opinion that Tenny in view of Huawei and further in view of Wang renders obvious claim 11.

XII. Ground 4: Tenny in view of Huawei and further in view of Nokia renders obvious claims 7 and 14

A. Reasons to Combine Tenny and Huawei with Nokia

204. I have discussed the reasons to combine Tenny and Huawei extensively

in Section IX.A above. In the following of my Declaration, I will further explain why a POSITA would have been motivated to combine Tenny and Huawei's random access performance in a wireless communication system with Nokia's delegate CC setting mechanism, which sets a CC corresponding to a primary cell in the UL timing group.

205. First, Nokia, Tenny, and Huawei are analogous art in the same field as the '372 Patent, which relates to multicarrier wireless communication. EX1001, 1:15-19; EX1004, ¶3; EX1005, Appx. A (1:1-3); EX1006, 1 (§1); EX1010, 2. I have noticed that, Nokia and Huawei are both 3GPP TSG-RAN WG2 proposals disclosed publicly around the same time (no later than January 12, 2010), discussed at the same working group meeting (Meeting #68bis held at Valencia, Spain on January 18-22, 2010), and presented in short order (Agenda Item #7.1.1 for Huawei and #7.1.8 for Nokia). EX1006, 1; EX1010, 1. This significantly increases the chance that a POSITA in the field will have access to and consult both references at about the same time.

206. Second, as I discussed above in Section IX.A, it would have been obvious to supplement Tenny with Huawei's delegate CC selection mechanism—selecting a CC having a lowest center frequency from a UL timing group as the carrier candidate. Similarly, a POSITA would have supplemented Tenny with

Nokia's alternative CC selection mechanism—selecting a PCell CC for random access procedure. Since it would have been obvious for a POSITA to substitute Tenny's delegate CC setting mechanism with Huawei's, as I discussed above in Section IX.A, and given the proximity between Huawei and Nokia, as discussed above, it would be similarly obvious for a POSITA to substitute Tenny and Huawei's delegate CC setting mechanism with Nokia's. The substitution would yield predictable results—primary CC being always activated, and thus having better coverage than secondary CC. S*ee* EX1001, 7:66-67.

B. Dependent Claim 7: *The method as claimed in claim 1, wherein setting of the delegate CC comprises: wherein setting of the delegate CC comprises: setting a CC corresponding to a primary cell (PCell) in the UL timing group to be the delegate CC.*

207. As I discussed above in Section IX.B, Tenny in view of Huawei renders obvious claim 1. In my opinion, the additional limitations of claim 7 are also disclosed by Nokia as follows.

208. As I discussed above in Section VIII.E, in a multicarrier (*i.e.*, carrier aggregation) system, Nokia discloses two options for supporting RACH procedures, and under either option, the RACH is "associated with the 'special cell' or primary carrier … if the carrier is part of the group of CCs that apply the same timing advance." EX1010, 2-3; *see also* EX1015, 3 (teaching that "[t]he PCC corresponds

to the 'special' cell" which "conveys SR, offers a RACH and governs RLF"). Nokia further proposes that at least one RACH per timing advance group is needed to enable correct timing alignment. EX1010, 1. In view of the above teachings of Nokia, a POSITA would have understood that the RACH uses a CC selected from the group of CCs, which corresponds to the primary component carrier (PCC). The PCC was later officially named as Primary Cell (PCell) in the context of carrier aggregation in Rel-10. EX1010, 1; EX1019, 49 (Sec. 7.5).

209. Further, as I discussed above in Section IX.B, the eNB selects the Timing Advance Command (TAC) based on several factors, including coverage and signal quality. A POSITA would have further understood that, the PCell is selected as the TAC for the first UTG (UTG 0) because it has the strongest, most stable coverage and is used for control signaling.

210. As I discussed above in Section XII.A, a POSITA would have been motivated to implement Nokia's teaching of setting a CC corresponding to the primary service cell to the performance of random access in a wireless communication system disclosed by Tenny and Huawei.

211. Therefore, it is my opinion that Tenny in view of Huawei and further in view of Nokia renders obvious claim 7.

C. Dependent Claim 14: ***The apparatus as claimed in claim 8, wherein the delegate CC setting unit sets a CC corresponding to a primary service cell (PCell) in the UL timing group to be the delegate CC.***

212. As I discussed above in Section IX.C, Tenny in view of Huawei renders obvious claim 8. In my opinion, the additional limitations of claim 14 are also disclosed by Nokia as follows.

213. As I discussed in Section XII.B, Nokia discloses claim 7. Moreover, as I discussed above in Section IX.C, Tenny discloses the delegate CC setting unit. Thus, Tenny in view of Nokia discloses the additional limitations of claim 14.

214. As I discussed above in Section XII.A, a POSITA would have been motivated to implement Nokia's teaching of setting a CC corresponding to the primary service cell to the performance of random access in a wireless communication system disclosed by Tenny and Huawei.

215. Therefore, it is my opinion that Tenny in view of Huawei and further in view of Nokia renders obvious claim 14.

XIII. Secondary Considerations

216. I have seen no evidence in the '372 Patent's prosecution history or elsewhere supporting any secondary considerations arguments, or evidence of nexus to any of the Challenged Claims. *See* generally EX1002. Indeed, per my discussion of the prior art referenced herein, any purported solutions to problems or unexpected

results in the ’372 Patent were already well known. To the extent the Patent Owner asserts the existence of any secondary considerations in its responses, I reserve my right to address any such evidence.

XIV. Additional Remarks

217. I currently hold the opinions expressed in this declaration. But my analysis may continue, and I may acquire additional information and/or attain supplemental insights that may result in added observations.

218. In signing this declaration, I recognize that the declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also recognize that I may be subject to cross-examination in the case and that cross-examination will take place within the United States. If cross-examination is required of me, I will appear for cross-examination within the United States during the time allotted for cross-examination.

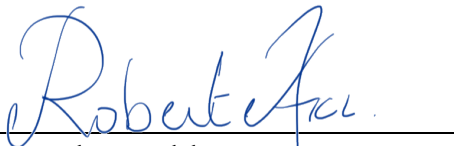
219. I have reviewed the accompanying Petition for *Inter Partes* Review of the ’372 Patent and, given the information set forth in this declaration, I agree with the reasoning and conclusions of the grounds of challenge in the Petition. Based on my own analysis, I agree that: (1) Tenny in view of Huawei renders obvious claims 1 and 8, (2) Tenny in view of Huawei and further in view of Zhang renders obvious claims 2 and 9, (3) Tenny in view of Huawei and further in view of Wang renders

obvious claims 3-4 and 10-11, and (4) Tenny in view of Huawei and further in view of Nokia renders obvious claims 7 and 14.

* * *

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. I further declare 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 the Title 18 of the United States Code and that such willful false statements may jeopardize the validity of this proceeding.

Dated: May 6, 2025

By: 

Dr. Robert Akl, D.Sc.
Dallas, Texas

APPENDIX A

Professor Robert Akl, D.Sc.



Professional Summary

Dr. Akl has over three decades of industry and academic experience. He is currently a Tenured Professor at the University of North Texas and a Senior Member of *IEEE*. He has designed, implemented, and optimized both hardware and software aspects of several wireless communication systems for CDMA, Wi-Fi, and sensor networks. Dr. Akl has broad expertise in wireless communication, Bluetooth, CDMA/WCDMA network optimization, GSM, LTE, VoIP, telephony, computer architecture, and computer networks. He is a very active researcher and is well published and cited. He has been awarded many research grants by leading companies in the industry and the National Science Foundation. He has developed and taught over 100 courses in his field. Dr. Akl has received several awards and commendations for his work, including the 2008 *IEEE* Professionalism Award and was the winner of the 2010 Tech Titan of the Future Award.

Dr. Akl has extensive experience with patents in the wireless and networking industry. In the past ten years, he has worked as a technical expert in dozens of patent related matters, involving thousands of hours of research, investigation, and study. He has repeatedly been qualified as an expert by Courts, and has provided numerous technology tutorials to Courts, and given testimony by deposition and at trial. He has worked with companies large and small, both for and against the validity and infringement of patents, and has also helped counsel and Courts to understand technology that often seems complex. In doing so, he has become familiar with, and actively worked with, the legal principles that underlie patentability and validity and claim interpretation in the wireless and networking industries.

Areas of Expertise

2G, 3G, 4G, 5G, 6G, CDMA/WCDMA, GPS, GSM, UMTS, LTE, Ad-hoc Networks, Antenna Design, Bluetooth, Call Admission Control, Channel Coding, Channel Estimation, Communication Interfaces and Standards, Compression, Computer Architecture, Internet protocols, MIMO Systems, Multi-cell Network Optimization, Network Security, Packet-networks, Ring-networks, Switches and Routers, Telephony, VoIP, VPLS, Wi-Fi, Wireless Communication, Wireless Sensors.

Education

Year	College/University	Degree	GPA
2000	Washington University in Saint Louis	D.Sc. in Electrical Engineering	**4.0 / 4.0**
1996	Washington University in Saint Louis	M.Sc. in Electrical Engineering	**4.0 / 4.0**
1994	Washington University in Saint Louis	B.Sc. in Electrical Engineering	**4.0 / 4.0**
1994	Washington University in Saint Louis	B.Sc. in Computer Science	**4.0 / 4.0**

Graduated *summa cum laude* and ranked first in undergraduate class.

Dissertation: "Cell Design to Maximize Capacity in Cellular Code Division Multiple Access (CDMA) Networks." Advisors: Dr. Manju Hegde and Dr. Paul Min.

Litigation Support and Expert Witness Experience

L1. 2025 **Fish & Richardson, P.C.**
Case: Apple Inc. v. Apex Beam Technologies LLC
IPR2025-00895; IPR2025-00896; IPR2025-00898; IPR2025-00900; IPR2025-00901;IPR2025-00904; IPR2025-00909; IPR2025-00910; IPR2025-00911; IPR2025-00921; IPR2025-00922; IPR2025-00923
Matter: *Inter Partes* Review, multi-antenna transmission
Project: Twelve declarations to support twelve IPR Petitions

L2. 2025 **Milbank LLP**
Case: Samsung Electronics Co, LTD., Samsung Electronics America, Inc v. Empire Technology Development LLC
IPR2024-00896
Matter: *Inter Partes* Review, MIMO wireless communication, energy consumption
Project: Declaration to support Patent Owner's response

L3. 2025 **Bayes PLLC**
Case: OnePlus Technology (Shenzhen) Co. Ltd. v. Pantech Corporation
IPR2025-00637; IPR2025-00783; IPR2025-00887
Matter: *Inter Partes* Review, radio link failure
Project: Three declarations to support three IPR Petitions

L4. 2025 **Folio Law Group PLLP**
Case: K.Mizra LLC v. Ciena Corporation
Northern district of Georgia, Atlanta division, Case No. 1:24-cv-05442-SDG
Matter: Patent infringement, telecommunication systems, switches and routers
Project: Declaration in support of plaintiff's amended complaint

L5. 2025 **Carter Arnett**
Case: Katana Silicon Technologies, LLC v. GlobalFoundries, Inc, et al.
Western district of Texas, Austin division, Case No. 1:22-cv-00852-RP
Matter: Patent infringement, telecommunication systems
Project: Declaration

L6. 2025 **Bunsow De Mory LLP**
Case: Secure Wi-Fi, LLC v. Samsung Electronics Co, LTD., Samsung Electronics America, Inc.
Eastern district of Texas, Marshall division, Case No. 2:24-cv-00047-JRG-RSP
Matter: Patent infringement, Wi-Fi access and security
Project: Declaration regarding claim construction

L7. 2024 **Steptoe LLP**
Case: Corrigent Corporation and Nahum Communication NTB LTD v. Dell Technologies Inc. and Dell Inc.; Corrigent Corporation and Nahum Communication NTB LTD v. Arista Networks Inc.
District of Delaware, Case No. 1:22-cv-496-RGA; Case No. 1:22-cv-497-RGA
Matter: Patent infringement, telecommunication systems, switches and routers
Project: Source code review, two expert reports regarding infringement, two rebuttal expert reports regarding validity, two reply expert reports, two supplemental rebuttal expert reports, two depositions

L8. 2024 **Kilpatrick Townsend & Stockton LLP**
Case: Intellectual Ventures I LLC and Intellectual Ventures II LLC v. Lenovo Group Limited; Intellectual Ventures I LLC and Intellectual Ventures II LLC v. Zebra Technologies Corporation
Western district of Texas, Waco division, Case No. 6:23-cv-000307-ADA; Case No. 6:23-cv-00292-ADA
Matter: Patent infringement, cyclic diversity methods
Project: Source code review, expert report regarding invalidity

L9. 2024 **Perkins Coie LLP**
Case: ParkerVision, Inc. v. MediaTek Inc and MediaTek USA Inc.
Western district of Texas, Waco division, Case No. 6:22-cv-01163-ADA
Matter: Patent infringement, frequency translation
Project: Non-infringement consulting

L10. 2024 **Steptoe LLP**
Case: Stingray IP Solutions v. Leedarson IOT Technology, Inc. et al.
Eastern district of Texas, Marshall division, Case No. 2:23-cv-00499-JRG-RSP
Matter: Patent infringement, mobile ad-hoc networks
Project: Declaration regarding claim construction

L11. 2024 **Milbank LLP**
Case: Empire Technology Development LLC v. Samsung Electronics Co, LTD., Samsung Electronics America, Inc.
Eastern district of Texas, Marshall division, Case No. 2:23-cv-00427-JRG-RSP
Matter: Patent infringement, MIMO wireless communication, energy consumption
Project: Source code review, declaration regarding claim construction, expert report regarding infringement, expert report regarding validity, deposition

L12. 2024 **Folio Law Group PLLP**
Case: Valve Corporation v. Immersion Corporation
IPR2024-00477; IPR2024-00478; IPR2024-00557; IPR2024-00582; IPR2024-00714
Matter: *Inter Partes* Review, virtual reality and augmented reality
Project: Five declarations to support five Patent Owner's responses, deposition

L13. 2024 **Hicks Johnson PLLC**
Case: Cardtek International, Inc. v. The Kroger Co.
Eastern district of Texas, Marshall division, Case No. 2:23-cv-0045-JRG-RSP
Matter: Patent infringement, payment convergence system
Project: Expert report regarding infringement, rebuttal expert report regarding validity, deposition

L14. 2024 **Kilpatrick Townsend & Stockton LLP**
Case: PLR Worldwide Sales Limited v. Flip Phone Games Inc.
IPR2024-00132; IPR2024-00171; IPR2024-00200; IPR2024-00209; IPR2024-00133
Matter: *Inter Partes* Review, mobile gaming
Project: Four declarations to support four Patent Owner's responses, deposition

L15. 2024 **K & L Gates LLP**
Case: STA Group, LLC v. Motorola Solutions, Inc.
Eastern district of Texas, Marshall division, Case No. 2:23-cv-00300-JRG-RSP
Matter: Patent infringement, emergency communication networks
Project: Expert report regarding licenses, rebuttal expert report regarding validity, deposition

L16. 2024 **K & L Gates LLP**
Case: Motorola Solutions, Inc. v. STA Group, LLC
IPR2023-01292; IPR2023-01295 ; IPR2024-00511; IPR2024-00207
Matter: *Inter Partes* Review, emergency communication networks

Project: Four declarations to support four Patent Owner's responses

L17. 2024 **K & L Gates LLP**
Case: STA Group, LLC v. Motorola Solutions, Inc.
Eastern district of Texas, Marshall division, Case No. 2:22-cv-00381-JRG-RSP
Matter: Patent infringement, emergency communication networks
Project: Declaration regarding claim construction, deposition, expert report regarding infringement, rebuttal expert report regarding validity

L18. 2024 **White & Case, LLP**
Case: Wangs Alliance Corporation d/b/a WAC Lighting. v. Minka Lighting, LLC
In the Matter of Certain Smart Ceiling Fans, Components Thereof, and Associated Systems and Software Thereof, ITC Investigation No. 337-TA-1374
Matter: Patent infringement, smart ceiling fans
Project: Expert report regarding invalidity, expert rebuttal report, two-day depositions

L19. 2024 **Folio Law Group PLLP**
Case: Immersion Corporation v. Valve Corporation.
Western district of Washington, Seattle, Case No. 2:23-CV-00712-TL
Matter: Patent infringement, virtual reality and augmented reality
Project: Declaration regarding claim construction

L20. 2024 **Latham & Watkins LLP**
Case: AX Wireless LLC v. Dell Inc., et al.; AX Wireless LLC, v. HP Inc.
Eastern district of Texas, Marshall division, Case No. 2:22-cv-277-RWS-RSP; Case No. 2:22-cv-279-JRG-RSP
Matter: Patent infringement, Wi-Fi networks
Project: Source code review, expert report regarding infringement, rebuttal expert report regarding validity, deposition

L21. 2024 **Perkins Coie LLP**
Case: Wi-LAN Inc. et al. v. Huizhou TCL Mobile Communication Co. Ltd., et al.
Central district of California, Southern division, Case No. 8:19-cv-00870-JVS-ADS
Matter: Patent infringement, QoS enhancements for wireless IP networks
Project: Declaration regarding claim construction

L22. 2024 **Kilpatrick Townsend & Stockton LLP**
Case: Flip Phone Games Inc. v. PLR Worldwide Sales Limited
Eastern district of Texas, Marshall division, Case No. 2:23-cv-00139-JRG
Matter: Patent infringement, mobile gaming
Project: Declaration regarding claim construction, deposition

L23. 2024 **K & L Gates LLP**
Case: STA Group, LLC v. Motorola Solutions, Inc.
Eastern district of Texas, Marshall division, Case No. 2:22-cv-00381-JRG-RSP
Matter: Patent infringement, emergency communication networks
Project: Declaration regarding claim construction, deposition, expert report regarding infringement, rebuttal expert report regarding validity

L24. 2024 **Alston & Bird LLP**
Case: Stingray IP Solutions v. Snap One Holdings Corp., et al.
Eastern district of Texas, Marshall division, Case No. 2:23-cv-00003-JRG-RSP
Matter: Patent infringement, mobile ad-hoc networks
Project: Declaration regarding claim construction, deposition

L25. 2024 **Kilpatrick Townsend & Stockton LLP**
Case: Askeladden LLC v. Calabrese Stemer LLC
IPR2024-00367; IPR2024-00368; IPR2024-00369
Matter: *Inter Partes* Review, secure transactions and payments
Project: Declaration to support three IPR petitions

L26. 2023 **McGuireWoods LLP**
Case: VoIP-Pal.com, Inc. v. Huawei Technologies Co., Ltd., et al.
Northern district of Texas, Dallas division, Case No. 3:23-cv-0151-X
Matter: Patent infringement, call routing
Project: Declaration regarding 101 Motion

L27. 2023 **Steptoe LLP**
Case: Corrigent Corporation v. Cisco Systems, Inc.
Western district of Texas, Waco division, Case No. 6:22-cv-00396-ADA
Matter: Patent infringement, telecommunication systems, switches and routers
Project: Source code review, expert report regarding infringement, expert report regarding validity, two-day depositions, supplemental expert report, jury trial testimony

L28. 2023 **Latham & Watkins LLP**
Case: Netgear Inc. v. TP-Link Technologies Co., Ltd., TP-Link Corporation Limited, TP-Link USA Corporation, and TP-Link Research America Corp.
In the Matter of Certain Wi-Fi Routers, Wi-Fi Devices, Mesh Wi-Fi Network Devices, and Hardware and Software Components Thereof, ITC Investigation No. 337-TA-1361
Matter: Patent infringement, Wi-Fi and mesh networks
Project: Source code review, expert report regarding infringement and domestic industry, expert report regarding validity, supplemental expert report, deposition, ITC hearing testimony

L29. 2023 **Winston & Strawn LLP**
Case: Google, LLC. v. Flypsi, Inc.
IPR2023-00357; IPR2023-00358; IPR2023-00359; IPR2023-00360; IPR2023-00361
Matter: *Inter Partes* Review, primary and secondary call processing
Project: Five declarations to support five Patent Owner's responses, deposition

L30. 2023 **Carter Arnett**
Case: Correct Transmission, LLC v. Nokia Corporation, et al.
Eastern district of Texas, Marshall division, Case No. 2:22-cv-00343-JRG-RSP
Matter: Patent infringement, telecommunication systems, switches and routers
Project: Declaration regarding claim construction

L31. 2023 **Carter Arnett**
Case: Smart Path Connections, LLC v. Nokia Corporation, et al.
Eastern district of Texas, Marshall division, Case No. 2:22-cv-00296-JRG
Matter: Patent infringement, network communication systems, switches and routers
Project: Two declarations regarding claim construction

L32. 2023 **Devlin Law Firm**
Case: Google, LLC. v. Motion Offense, LLC
IPR2022-01311; IPR2022-01312; IPR2022-01313
Matter: *Inter Partes* Review, cloud storage and file requests
Project: Three declarations to support three Patent Owner's responses, deposition

L33. 2023 **Carter Arnett**
Case: Cisco Systems, Inc. v. Zilkr Cloud Technologies, LLC
IPR2023-00553; IPR2023-00663; IPR2023-00822
Matter: *Inter Partes* Review, integration of communication services

Project: Two declarations to support two Patent Owner's preliminary responses

L34. 2023 **Friedman, Suder & Cooke; Kane Russell Coleman Logan PC**
Case: Q Technologies, Inc. v. Walmart Inc.
Western district of Texas, Waco division, Case No. 4W-21-CV-00321-ADA
Matter: Patent infringement, content sharing and payment systems
Project: Validity expert report, deposition

L35. 2023 **K & L Gates LLP**
Case: Entropic Communications, LLC v. DirectTV, LLC, Dish Network Corporation et al.
Central district of California, Southern division, Case No. 2:22-cv-07775-JWH-JEM, 2:22-cv-07959
Matter: Patent infringement, satellite and cable receivers and systems
Project: Declaration regarding claim construction, deposition, tech tutorial testimony

L36. 2023 **Folio Law Group PLLP**
Case: Immersion Corporation v. Meta Platforms, Inc., f/k/a Facebook, Inc.
Western district of Texas, Waco division, Case No. 6:22-cv-00541-ADA
Matter: Patent infringement, virtual reality and augmented reality
Project: Source code review, expert report regarding infringement, supplemental expert report regarding infringement, rebuttal expert report regarding validity, two depositions

L37. 2023 **Cole Schotz P.C.**
Case: SB IP Holdings, Inc. v. Vivint Smart Home, Inc., Vivint, Inc.
Eastern district of Texas, Sherman division, Case No. 4:20-cv-00886-ALM
Matter: Patent infringement, wireless telecommunication systems
Project: Source code review, expert report regarding infringement, expert report regarding validity, two-day depositions, rebuttal expert report regarding non-infringing alternatives, 2 additional depositions, jury trial testimony

L38. 2023 **Cole Schotz P.C.**
Case: Vivint Inc. v. SB IP Holdings LLC
IPR2022-00812; IPR2022-01449
Matter: *Inter Partes* Review, wireless telecommunication systems
Project: Two declarations to support Patent Owner's responses, deposition

L39. 2023 **Carter Arnett**
Case: Samsung Electronics Co., LTD v. G+ Communications, LLC
IPR2022-01598; IPR2023-00171; IPR2023-00665
Matter: *Inter Partes* Review, 4G/5G cellular systems
Project: Three declarations to support three Patent Owner's preliminary responses, two declarations to support Patent Owner's responses, two depositions

L40. 2023 **Fish & Richardson, P.C.**
Case: Neo Wireless, LLC v. General Motors Co. et al.;
Neo Wireless, LLC v. Tesla Inc.
Eastern district of Michigan, Southern division, Case No. 2:22-cv-11407-TGB; Case No. 2:22-cv-11408-TGB
Matter: Patent infringement, 4G/LTE wireless communication
Project: Tech tutorial testimony, declaration regarding claim construction

L41. 2023 **Carter Arnett**
Case: G+ Communications v. Samsung Electronics Co., LTD et al.
Eastern district of Texas, Marshall division, Case No. 2:22-cv-00078-JRG
Matter: Patent infringement, 4G/5G cellular systems
Project: Source code review, declaration regarding claim construction, supplemental declaration regarding claim construction, infringement expert report, rebuttal expert report regarding validity, deposition, two supplemental reports, second deposition, jury trial testimony, jury retrial testimony (for damages)

L42. 2022 **Kilpatrick Townsend & Stockton LLP**
Case: TP-Link Technologies Co., Ltd. and TP-Link Corporation Limited v. Stingray IP Solutions
IPR2022- *To be Assigned*; IPR2022-*To be Assigned*
Matter: *Inter Partes* Review, security and intrusion detection in wireless systems
Project: Two declarations to support two IPR petitions

L43. 2022 **Devlin Law Firm**
Case: CDN Innovations, LLC v. Mediacom Communication Corporation
Middle district of Georgia, Columbus division
Matter: Patent infringement, telecommunication systems
Project: Declaration to support infringement contentions

L44. 2022 **Jenner & Block LLP**
Case: WSOU Investments, LLC v. Netgear, Inc.
District of Delaware, Case No. 21-cv-01117-MN-CJB, 21-cv-01119-MN-CJB, 21-cv-01120-MN-CJB
Matter: Patent infringement, adaptive antennas, routers

Project: Declaration regarding claim construction

L45. 2022 **Simpson Thacher & Bartlett LLP**
Case: XR Communications, LLC. v. Ubiquiti Networks, Inc.
Central district of California, Case No. 2:21-cv-1065-DOC(JDE)
Matter: Patent infringement, Wi-Fi and adaptive antennas
Project: Non-infringement expert report, deposition

L46. 2022 **Ropes & Gray LLP**
Case: Speir Technologies Ltd. v. Apple Inc.
Western district of Texas, Waco division, Case No. 6:22-cv-00077-ADA
Matter: Patent infringement, channel estimation
Project: Declaration regarding claim construction

L47. 2022 **Fish & Richardson, P.C.**
Case: Constellation Designs, LLC v. LG Electronics, Inc. et al.
Eastern district of Texas, Marshall division, Case No. 2:21-cv-448
Matter: Patent infringement, channel coding
Project: Source code review, invalidity expert report, non-infringement expert report, two-day depositions, jury trial testimony

L48. 2022 **Calfee, Halter & Griswold LLP**
Case: Resi Media LLC v. BoxCast Inc.
IPR2022-00066; IPR2022-00067
Matter: *Inter Partes* Review, autonomous broadcasting
Project: Combined declaration to support Patent Owner's response, declaration to support Patent Owner's sur-reply, deposition

L49. 2022 **Fish & Richardson, P.C.**
Case: FedEx Corporation v. Transcend Shipping Systems, LLC
IPR2022-01117; IPR2022-01219; IPR2022-01252;
IPR2022-01261; IPR2022-01314
Matter: *Inter Partes* Review, location management
Project: Five declarations to support five IPR petitions

L50. 2022 **Finnegan Henderson Farabow Garrett & Dunner LLP**
Case: Toyota Motor Corp and Continental Automotive Systems. v. Intellectual Ventures II, LLC
IPR2022-00971; IPR2022-00972; IPR2022-00973; IPR2022-00974; IPR2022-01130
Matter: *Inter Partes* Review, multicarrier communication
Project: Five declarations to support five IPR petitions, four depositions, three supplemental declarations, two depositions

L51. 2022 **Fenwick & West LLP**
Case: TrackThings LLC v. Amazon.com, Inc. et al.
Western district of Texas, Waco division, Case No. 6:21-cv-00720
Matter: Patent infringement, mobile ad-hoc networks
Project: Invalidity consulting

L52. 2022 **Fenwick & West LLP**
Case: Stingray IP Solutions v. Amazon.com, Inc. et al.
Eastern district of Texas, Marshall division, Case No. 2:21-cv-00193-JRG; Case No. 2:21-cv-00194-JRG
Matter: Patent infringement, mobile ad-hoc networks
Project: Noninfringement consulting

L53. 2022 **Fitch, Even, Tabin & Flannery**
Case: L2 Mobile Technologies LLC v. Ford Motor Company
District of Delaware, Case No. 1:21-cv-01409-JLH
Matter: Patent infringement, wireless communication systems
Project: Standard essentiality consulting

L54. 2022 **Susman Godfrey LLP**
Case: California Institute of Technology v. Samsung Electronics Co., Ltd. et al.
Eastern district of Texas, Marshall division, Case No. 2:21-cv-00446-JRG
Matter: Patent infringement, low-density parity-check codes
Project: Source code review, infringement expert report, deposition, supplemental infringement expert report

L55. 2022 **Devlin Law Firm**
Case: Dropbox, Inc. v. Motion Offense, LLC; Motion Offense, LLC v. Dropbox, Inc.
Western district of Texas, Waco division, Case No. 6:20-cv-00251-ADA; 6:21-cv-00758-ADA
Matter: Patent infringement, telecommunication systems and networking
Project: Source code review, infringement expert report, supplemental infringement expert report, validity expert report, supplemental validity expert report, deposition, jury trial testimony

L56. 2022 **Bayes PLLC**
Case: Guangdong OPPO Mobile Telecommunications Corp., Ltd. v. Nokia Solutions and Networks Oy
IPR2022-00632
Matter: *Inter Partes* Review, PDU and SDU
Project: Declaration to support IPR petition, deposition, supplemental declaration, second deposition

L57. 2022 **Finnegan Henderson Farabow Garrett & Dunner LLP**
Case: NetApp, Inc. v. Proven Networks, LLC
IPR2022-00644
Matter: *Inter Partes* Review, allocating resources
Project: Declaration to support IPR petition

L58. 2022 **Devlin Law Firm**
Case: Motion Offense, LLC v. Google, LLC
Western district of Texas, Waco division, Case No. 6:21-cv-00514-ADA
Matter: Patent infringement, telecommunication systems and networking
Project: Declaration regarding claim construction

L59. 2022 **Jenner & Block LLP**
Case: Netgear, Inc. v. WSOU Investments, LLC
IPR2022-00516; IPR2022-00606
Matter: *Inter Partes* Review, telecommunication systems
Project: Two declarations to support two IPR petitions

L60. 2022 **Calfee, Halter & Griswold LLP**
Case: BoxCast Inc. v. Resi Media LLC
Eastern district of Texas, Marshall division, Case No. 2:21-cv-00217-JRG
Matter: Patent infringement, autonomous broadcasting
Project: Source code review, declaration regarding claim construction, declaration regarding validity, declaration regarding infringement, deposition

L61. 2022 **Fish & Richardson, P.C.**
Case: Apple Inc. v. Ericsson Inc.
IPR2022-00341; IPR2022-00346;
IPR2022-*To be assigned*; IPR2022-*To be assigned*;
IPR2022-*To be assigned*
Matter: *Inter Partes* Review, wireless communication systems
Project: Five declarations to support five IPR petitions, deposition

L62. 2022 **Ropes & Gray LLP**
Case: Godo Kaisha IP Bridge 1 v. Nokia Corporation, Ericsson Inc. et al.
Eastern district of Texas, Marshall division, Case No. 2:21-CV-213-JRG; Case No. 2:21-CV-215-JRG
Matter: Patent infringement, wireless communication systems
Project: Declaration regarding claim construction

L63. 2022 **Fish & Richardson, P.C.**
Case: Apple Inc. and HP Inc. v. XR Communication Inc
IPR2022-00367; IPR2022-01155; IPR2022-01362
Matter: *Inter Partes* Review, adaptive antennas
Project: Two declarations to support two IPR petitions, deposition, declaration to support petitioners' reply

L64. 2021 **Mayer Brown LLP**
Case: Pantech Corp. v. Coolpad Group Ltd.
Eastern district of Texas, Texarkana division, Case No. 5:21-cv00065
Matter: Patent infringement, LTE wireless communication systems
Project: Infringement consulting

L65. 2021 **Fitch, Even, Tabin & Flannery**
Case: L2 Mobile Technologies LLC v. Google LLC
Western district of Texas, Waco division, Case No. 6:21-cv-00358-ADA
Matter: Patent infringement, wireless communication systems
Project: Claim construction consulting

L66. 2021 **Morgan Lewis & Bockius LLP**
Case: Intellectual Tech LLC v. Zebra Technologies Corporation
Western district of Texas, Waco division, Case No. 6:19-cv-00628-ADA
Matter: Patent infringement, RFID tags
Project: Source code review, claim construction consulting, invalidity expert report

L67. 2021 **Carter Arnett**
Case: Correct Transmission LLC v. Adtran, Inc.
Northern district of Alabama, Northeastern division, Case No. 5:21-cv-00690-LCB
Matter: Patent infringement, telecommunication systems, switches and routers
Project: Declaration regarding claim construction

L68. 2021 **Carter Arnett**
Case: Juniper Networks, Inc. v. Correct Transmission, LLC
IPR2021-00463; IPR2021-00682; IPR2022-00815
Matter: *Inter Partes* Review, network communication systems, switches and routers
Project: Two declarations to support 2 Patent Owner's responses, two depositions; declaration to support Patent Owner's preliminary response

L69. 2021 **King & Wood Mallesons LLP**
Case: ToT Power Control, S.L. v. AT&T Mobility et al.; ToT Power Control, S.L. v. T-Mobile USA, Inc. et al.
Western district of Texas, Waco division, Case No. 6:21-CV-00107-ADA; 6:21-CV-00109-ADA
Matter: Patent infringement, WCDMA cellular systems
Project: Declaration regarding claim construction

L70. 2021 **Finnegan Henderson Farabow Garrett & Dunner LLP**
Case: Xiaomi Communications Co., Ltd. v. Koninklijke KPN N.V.
IPR2022-00025
Matter: *Inter Partes* Review, network communication systems
Project: Declaration to support IPR petition

L71. 2021 **Carter Arnett**
Case: Juniper Networks, Inc. v. Smart Path Connections, LLC
IPR2021-001170; IPR2021-01356; IPR2022-00240; IPR2022-00815
Matter: *Inter Partes* Review, network communication systems, switches and routers
Project: Declaration to support Patent Owner's preliminary response, three declarations to support three Patent Owner's responses, two depositions

L72. 2021 **Devlin Law Firm**
Case: Dyfan LLC v. Target Corporation
District of Delaware, Case No. 6:19-cv-00179-ADA
Matter: Patent infringement, network communications
Project: Declaration to support summary judgement, deposition

L73. 2021 **Alston & Bird LLP**
Case: Stingray IP Solutions v. Signify N.V., et al.
Eastern district of Texas, Marshall division, Case No. 2:21-cv-00043-JRG; Case No. 2:21-cv-00044-JRG
Matter: Patent infringement, mobile ad-hoc networks
Project: Declaration regarding claim construction

L74. 2021 **Cole Schotz P.C.**
Case: SkyBell Technologies, Inc. v. Vivint Smart Home, Inc., SimpliSafe, Inc., and Arlo Technologies Inc
In the Matter of Certain IP Camera Systems Including Video Doorbells and Components Thereof, ITC Investigation No. 337-TA-1242
Matter: Patent infringement, wireless telecommunication systems
Project: Source code review, expert report infringement and domestic industry, rebuttal expert report, three-day depositions

L75. 2021 **Axinn, Veltrop & Harkrider LLP**
Case: Koninklijke Philips N.V. v. Thales DIS AIS USA, LLC et al.
In the Matter of Certain UMTS and LTE Cellular Communication Modules and Products Containing the Same, ITC Investigation No. 337-TA-1240
Matter: Patent infringement, wireless communication systems
Project: Expert report regarding non-infringement and no domestic industry, deposition, ITC hearing testimony

L76. 2021 **Morgan Lewis & Bockius LLP**
Case: SIPCO, LLC v. Aruba Networks, LLC and Hewlett Packard Enterprise Company
District of Delaware, Case No. 1:20-cv-00537-MN
Matter: Patent infringement, wireless communication systems
Project: Declaration regarding claim construction

L77. 2021 **Ropes & Gray LLP**
Case: Palo Alto Networks Inc. v. Centripetal Networks, Inc.
IPR2021-01150, IPR2021-01151, IPR2021-01155, IPR2021-01156, IPR2021-01270, PGR2021-00108, IPR2021-01520, IPR2021-01521
Matter: *Inter Partes* Review, network security systems
Project: Seven declarations to support seven IPR petitions, declaration to support post grant review, deposition

L78. 2021 **Devlin Law Firm**
Case: CDN Innovations, LLC v. Grande Communications Networks, LLC
Eastern district of Texas, Sherman division, Case No. 4:20-cv-653-SDJ
Matter: Patent infringement, telecommunication systems
Project: Declaration to support infringement contentions

L79. 2021 **Banner Witcoff**
Case: Sisvel International S.A., 3G Licensing S.A. v. ZTE (USA) Inc. et al.
Northern district of Texas, Case No. 3:20-cv-01289-M
Matter: Patent infringement, wireless communication systems
Project: Declaration regarding claim construction, deposition

L80. 2021 **Paul Hastings LLP**
Case: G. Holdings Ltd. v. Samsung Electronics Co., et al.
Eastern district of Texas, Marshall division, Case No. 2:20-cv-00342-JRG
Matter: Patent infringement, electronic payment systems
Project: Declaration regarding claim construction

L81. 2021 **Morgan Lewis & Bockius LLP**
Case: Aruba Networks, LLC and Hewlett Packard Enterprise Company v. SIPCO, LLC
IPR2021-00787
Matter: *Inter Partes* Review, wireless communication systems
Project: Declaration to support IPR petition

L82. 2021 **Jenner & Block LLP**
Case: Virentem Ventures LLC D/B/A Enounce v. TiVo Corp and Xperi Holding Corporation
District of Delaware, Case No. 20-787-MN
Matter: Patent infringement, telecommunication systems
Project: Declaration regarding claim construction

L83. 2021 **Carter Arnett**
Case: Correct Transmission LLC v. Adtran, Inc. and Juniper Networks, Inc.
Western district of Texas, Waco division, Case No. 6:20-cv-669-ADA
Matter: Patent infringement, telecommunication systems
Project: Source code review, declaration regarding claim construction

L84. 2021 **Fish & Richardson, P.C.**
Case: Quectel Wireless Solutions Co. Ltd. v. Koninklijke Philips N.V.
IPR2021-00558, IPR2021-00559, IPR2021-00561
Matter: *Inter Partes* Review, wireless communication systems
Project: Three declarations to support three IPR petitions, declaration to support reply, two depositions

L85. 2021 **Goldberg Kohn Ltd**
Case: United States ex. rel. Todd Heath v. Wisconsin Bell, Inc
District of Columbia, Case No. 11-cv-01897
Matter: Networking systems
Project: Technology consulting

L86. 2021 **Fish & Richardson, P.C.**
Case: Samsung Electronics Co. Ltd. v. Ericsson Inc.
IPR2021-00447, IPR2021-00588, IPR2021-00613, IPR2021-00614, IPR2021-00643, IPR2021-00645, IPR2021-00684
Matter: *Inter Partes* Review, wireless communication systems
Project: Seven declarations to support seven IPR petitions

L87. 2020 **Kilpatrick Townsend & Stockton LLP**
Case: GREE Inc. v. Supercell Oy
Eastern district of Texas, Marshall division, Case No. 2:19-cv-00413-JRG-RSP
Matter: Patent infringement, mobile gaming

Project: Source code review, infringement expert report, supplemental expert report, validity expert report, deposition

L88. 2020 **Banner Witcoff**
Case: Sisvel International S.A., 3G Licensing S.A. v. ZTE (USA) Inc. et al.
Northern district of Texas, Case No. 3:19-cv-01694-N
Matter: Patent infringement, wireless communication systems
Project: Declaration regarding claim construction, deposition

L89. 2020 **Fish & Richardson, P.C.**
Case: Cellco Partnership D/B/A Verizon Wireless v. Huawei Technologies Co., Ltd
IPR2020-01352, IPR202-01356, IPR2020-01357
Matter: *Inter Partes* Review, network communication systems
Project: Three declarations to support 3 Patent Owner' responses

L90. 2020 **Kilpatrick Townsend & Stockton LLP**
Case: GREE Inc. v. Supercell Oy
Eastern district of Texas, Marshall division, Case No. 2:20-cv-00113-JRG-RSP
Matter: Patent infringement, mobile gaming
Project: Source code review, declaration supporting claim construction, infringement expert report, validity expert report, supplemental report, deposition

L91. 2020 **Kilpatrick Townsend & Stockton LLP**
Case: GREE Inc. v. Supercell Oy
Eastern district of Texas, Marshall division, Case No. 2:19-cv-00200-JRG-RSP, Case No. 2:19-cv-00237-JRG-RSP, Case No. 2:19-cv-00310-JRG-RSP; Case No. 2:19-cv-00311-JRG-RSP
Matter: Patent infringement, mobile gaming
Project: Source code review, four infringement expert reports, two supplemental infringement expert reports, four validity expert reports, two supplemental expert reports, two second supplemental expert reports, three-day depositions, jury trial testimony

L92. 2020 **Sheridan Ross P.C.**
Case: Justservice.net LLC v. Dropbox, Inc.
Western district of Texas, Waco division, Case No. 6:20-CV-00070-ADA
Matter: Patent infringement, computer systems and networking
Project: Source code review, declaration regarding claim construction

L93. 2020 **Perkins Coie LLP**
Case: Huizhou TCL Mobile Communication Co. Ltd., TCT Mobile (US) Inc., and TCL Mobile Communication (HK) Co., Ltd. v. Wi-LAN Inc.
Matter: *Ex Partes* Reexamination, QoS enhancements for wireless IP networks
Project: Declaration to support Requesters

L94. 2020 **Perkins Coie LLP**
Case: Intel Corporation v. UNM Rainforest Innovations
IPR2020-01576, IPR2020-01578, IPR2020-*to be assigned*
Matter: *Inter Partes* Review, wireless broadband
Project: Three declarations to support three IPR petitions

L95. 2020 **Calfee, Halter & Griswold LLP**
Case: Motorola Solutions, Inc. v. Hytera Communications Corp. Ltd. et al.
Northern district of Illinois, Case No. 1:17-cv-01972
Matter: Patent infringement, two-way radios
Project: Declaration regarding claim construction, deposition, expert report regarding invalidity, rebuttal expert report regarding non-infringement, three-day depositions

L96. 2020 **Fish & Richardson, P.C.**
Case: Huawei Technologies Co., Ltd et al. v. Verizon Communications, Inc. et al.
Western district of Texas, Waco division, Case No. 6-20-cv-00090
Matter: Patent infringement, video communication
Project: Source code review, declaration regarding claim construction, infringement expert report, validity expert report, deposition

L97. 2020 **Kilpatrick Townsend & Stockton LLP**
Case: GREE Inc. v. Supercell Oy
Eastern district of Texas, Marshall division, Case No. 2:19-cv-00070-JRG-RSP, Case No. 2:19-cv-00071-JRG-RSP
Matter: Patent infringement, mobile gaming
Project: Source code review, two infringement expert reports, two supplemental infringement expert reports, two second supplemental infringement expert reports, two rebuttal expert reports on validity, two-day depositions, seven declarations supporting Gree's opposition to Supercell's motions for summary judgement, jury trial testimony

L98. 2020 **Cooley LLP**
Case: Saint Lawrence Communications, LLC v. Amazon.com, Inc., et al.
Eastern district of Texas, Marshall division, Case No. 2:19-cv-00027-JRG
Matter: Patent infringement, AMR-WB, speech compression, coding and decoding

Project: Invalidity expert report

L99. 2020 **Prince Lobel Tye LLP**
Case: Intellectual Ventures I and II LLC v. VMware, Inc.
Western district of Texas, Austin division, Case No. 1:19-cv-01075-ADA
Matter: Patent infringement, networking systems
Project: Declaration regarding claim construction

L100. 2020 **Gibson, Dun & Crutcher LLP**
Case: Cellular Evolution LLC v. T-Mobile US, Inc. et al.
Eastern district of Texas, Marshall division, Case No. 2:19-cv-232-JRG
Matter: Patent infringement, cellular systems
Project: Invalidity consulting

L101. 2020 **Faegre Baker Daniels LLP**
Case: CommScope, Inc. v. Rosenberger Technology, et al.
District of New Jersey, Case No. 19-cv-15962-MCA-LDW
Matter: Trade secret software, base station antenna design
Project: Declaration, deposition

L102. 2020 **Ropes & Gray LLP**
Case: Canon, Inc. v. TCL Electronics Holdings Ltd., et al.
Eastern district of Texas, Marshall division, Case No. 2:18-cv-546-JRG
Matter: Patent infringement, communication interfaces
Project: Source code review, declaration regarding claim construction, deposition

L103. 2019 **Perkins Coie LLP**
Case: Huizhou TCL Mobile Communication Co. Ltd., TCT Mobile (US) Inc., and TCL Mobile Communication (HK) Co., Ltd. v. Wi-LAN Inc.
IPR2020-00302, IPR2020-00303
Matter: *Inter Partes* Review, QoS enhancements for wireless IP networks
Project: Two declarations to support two IPR petitions

L104. 2019 **Fish & Richardson**
Case: Bell Northern Research v. Huawei, et al.
Southern district of California, Case No. 3:18-cv-1784-CAB-BLM
Matter: Patent infringement, wireless networks
Project: Invalidity consulting

L105. 2019 **K & L Gates LLP**
Case: EVS CODEC Technologies, LLC and Saint Lawrence Communications, LLC v. ZTE Corporation, et al.
Northern district of Texas, Dallas division, Case No. 3:19-cv-00385-MBH
Matter: Patent infringement, EVS, speech compression, coding and decoding
Project: Invalidity expert report

L106. 2019 **Feinberg Day Alberti Lim & Belloli LLP**
Case: Uniloc 2017 LLC v. AT&T Mobility LLC, et al.
Eastern district of Texas, Marshall division, Case No. 2:18-cv-00514-JRG
Matter: Patent infringement, wireless frequency bands and devices
Project: Two declarations regarding claim construction, deposition

L107. 2019 **Susman Godfrey LLP**
Case: Sol IP, LLC v. AT&T Mobility LLC, et al.
Eastern district of Texas, Marshall division, Case No. 2:18-cv-00526; 2:18- cv-00527; and 2:18-cv-00528
Matter: Patent infringement, Wi-Fi and LTE
Project: Validity consulting

L108. 2019 **Ropes & Gray LLP**
Case: Huawei Technologies Co. Ltd. v. Harris Global Communications, Inc.
IPR2019-01512, IPR2019-01631
Matter: *Inter Partes* Review, routing and security in wireless networks
Project: Two declarations to support two IPR petitions

L109. 2019 **Ropes & Gray LLP**
Case: Harris Corporation v. Huawei Device USA, Inc. et al.
Eastern district of Texas, Marshall division, Case No. 2:18-cv-00439-JRG
Matter: Patent infringement, routing and security in wireless networks
Project: Declaration regarding claim construction

L110. 2019 **Erise IP**
Case: Semcon IP Inc. v. ASUSTeK Computer Inc.
Eastern district of Texas, Marshall division, Case No. 2:18-cv-00193-JRG
Matter: Patent infringement, adaptive power control
Project: Non-infringement expert report

L111. 2019 **Cooley LLP**
Case: Facebook Inc. v. BlackBerry Corp. et al.
Northern District of California, Oakland division, Case No. 4:18-cv-05434-JSW
Matter: Patent infringement, mobile computing
Project: Declaration regarding claim construction

L112. 2019 **Sidley Austin LLP**
Case: Semcon IP Inc. v. Amazon.com, Inc.
Eastern district of Texas, Marshall division, Case No. 2:18-cv-00192-JRG
Matter: Patent infringement, adaptive power control
Project: Expert report regarding patent marking, rebuttal report regarding patent marking, deposition

L113. 2019 **Oblon, McClelland, Maier & Neustadt, LLP**
Case: MV3 Partners LLC v. Roku, Inc.
Western district of Texas, Waco division, Case No. 6:18-cv-308-ADA
Matter: Patent infringement, mobile set top box
Project: Declaration regarding claim construction, deposition, Markman hearing and tech tutorial testimony

L114. 2019 **Banner & Witcoff, LTD.**
Case: Kathrein USA, Inc. v. Fractus S.A.
IPR2019-00954, IPR2019-00955, IPR2019-00956, IPR2019-00957
Matter: *Inter Partes* Review, multiband antenna arrays
Project: Four declarations to support four IPR petitions

L115. 2019 **Fish & Richardson, P.C.**
Case: LG Electronics Inc. v. Saint Lawrence Communications LLC
Southern district of New York, Case No. 1:18-cv-11082-DLC
Matter: Patent infringement, EVS, speech compression, coding and decoding
Project: Declaration relating to motion for summary judgment, expert report, deposition

L116. 2019 **Ropes & Gray LLP**
Case: SIPCO, LLC v. Emerson Electric Co.
In the Matter of Certain Wireless Mesh Networking Products and Related Components Thereof, ITC Investigation No. 337-TA-1131
Matter: Patent infringement, links in wireless networks and remote monitoring
Project: Source code review, declaration regarding claim construction, invalidity expert report, rebuttal expert report regarding non-infringement and no domestic industry

L117. 2019 **Fish & Richardson, P.C.**
Case: Maxell Ltd. v. Huawei Technologies Co. Ltd., ZTE, et al.
Eastern district of Texas, Texarkana division, Case No. 5:18-cv-0033-RWS
Matter: Patent infringement, portable computing devices
Project: Declaration regarding claim construction

L118. 2019 **Ropes & Gray LLP**
Case: Emerson Electric Co. v. SIPCO, LLC
IPR2019-00548, IPR2019-00549
Matter: *Inter Partes* Review, routing in wireless networks
Project: Two declarations to support two IPR petitions

L119. 2018 **Mishcon de Reya New York LLP; King & Wood Mallesons LLP**
Case: ChanBond, LLC v. Cox Communications, Inc.
District of Delaware, Case No. 1:15-cv-00849-RGA
Matter: Patent infringement, wideband signal distribution system
Project: Validity expert report, deposition, sur-reply expert report, second sur-reply expert report, second deposition, jury trial with settlement mid-trial

L120. 2018 **Fish & Richardson, P.C.**
Case: In re: Qualcomm Antitrust Litigation (Client: Apple)
Southern district of California, Case No. 3:17-cv-00108-GPC-MDD
Matter: Qualcomm antitrust litigation
Project: Two expert rebuttal reports, deposition

L121. 2018 **Susman Godfrey LLP**
Case: In re: Qualcomm Antitrust Litigation (Client: Class Action)
Northern district of California, Case No. 5:17-md-02773-LHK
Matter: Qualcomm antitrust litigation
Project: Expert declaration on standard essential patents, expert report on deemed essential patents, rebuttal expert report, deposition

L122. 2018 **284 Partners**
Case: Federal Trade Commission. v. Qualcomm Incorporated
Northern district of California, Case No. 5:17-cv-00220
Matter: Qualcomm antitrust litigation
Project: Expert report on standard essential patents, expert rebuttal report, deposition

L123. 2018 **Vorys, Sater, Seymour and Pease LLP**
Case: Route1 Inc. v. Airwatch LLC
District of Delaware, Case No. 17-331-RGA
Matter: Patent infringement, remote access

Project: Source code review, declaration regarding claim construction, infringement expert report, validity expert report, reply expert report, deposition, three declarations regarding re-exam

L124. 2018 **Sidley Austin LLP**
Case: Samsung Electronics Co., Ltd v. Huawei Technologies Co., Ltd.
IPR2017-01471, IPR2017-01474, IPR2017-01475
Matter: *Inter Partes* Review, 4G/LTE
Project: Three declarations to support three Patent Owner's responses, supplemental declaration, deposition

L125. 2018 **Fitzpatrick Cella Harper & Scinto**
Case: IPC Systems, Inc. v. Cloud9 Technologies, LLC
District of Delaware, Case No. 16-cv-443-GMS
Matter: Patent infringement, telephone stations and trading turrets
Project: Source code review, declaration regarding claim construction, supplemental declaration regarding claim construction

L126. 2018 **Haynes and Boone, LLP**
Case: LG Electronics Inc., et al. v. Wi-LAN Inc., et al.
IPR2018-00673, IPR2018-00674, IPR2018-00704, IPR2018-00705, IPR2018-00709, IPR2018-00710
Matter: *Inter Partes* Review, bandwidth allocation
Project: Six declarations to support six IPR petitions, two depositions, two reply declarations

L127. 2018 **Pillsbury Winthrop Shaw Pittman LLP**
Case: Cellular Communications Equipment v. ZTE, HTC Corporation, et al.
Eastern district of Texas, Case No. 6:16-cv-475-RWS
Matter: Patent infringement, LTE, power control, emergency notification
Project: Invalidity expert report, deposition

L128. 2018 **Finnegan Henderson Farabow Garrett & Dunner LLP**
Case: FanDuel, Inc. DraftKings, Inc., and Bwin.Party Digital Entertainment PLC. v. CG Technology Development, LLC
IPR2017-00902, IPR2017-01333, IPR2017-01491, IPR2017-01532
Matter: *Inter Partes* Review, location-based gaming
Project: Four declarations to support four Patent Owner's responses, two supplemental declarations, four depositions

L129. 2018 **Calfee, Halter & Griswold LLP**
Case: Hytera Communications Corp. Ltd. v. Motorola Solutions, Inc.
Northern district of Ohio, Case No. 1:17-cv-01794-DNC
Matter: Patent infringement, two-way radios

Project: Source code review, declaration regarding claim construction, rebuttal declaration regarding claim construction, deposition, infringement expert report, validity expert report, two-day depositions

L130. 2017 **Covington & Burling LLP**
Case: Sharp Corporation, et al. v. Hisense Co., Ltd., et al.
In the Matter of Certain Wi-Fi Enabled Electronic Devices and Components Thereof, ITC Investigation No. 337-TA-1072
Matter: Patent infringement, Wi-Fi, OFDMA
Project: Declaration regarding claim construction

L131. 2017 **Vorys, Sater, Seymour and Pease LLP**
Case: Airwatch LLC and VMWare Inc. v. Route1 Inc.
IPR2017-02145
Matter: *Inter Partes* Review, remote access
Project: Declaration to support Patent Owner's response

L132. 2017 **Arnold & Porter Kaye Scholer**
Case: Uniloc USA, Inc. v. Google, Inc.
Eastern district of Texas, Marshall division, Case No. 2:17-cv-0214-JRG, 2:17-cv-0224-JRG, 2:17-cv-0231-JRG, 2:17-cv-0465-JRG, 2:17-cv-0466-JRG, 2:17-cv-0467JRG
Matter: Patent infringement, VoIP messaging
Project: Invalidity consulting

L133. 2017 **Simpson Thacher & Bartlett LLP**
Case: XR Communications, LLC. v. Ubiquiti Networks, Inc.
Central district of California, Case No. 2:17-cv-02968-AG(JCGx)
Matter: Patent infringement, Wi-Fi and adaptive antennas
Project: Declaration regarding claim construction, deposition

L134. 2017 **Covington & Burling LLP**
Case: Huawei Device USA Inc. v. Hitachi Maxell, Ltd.
IPR2018-00209, IPR2018-00210
Matter: *Inter Partes* Review, base station selection, GPS/Cellular location
Project: Two declarations to support two IPR petitions

L135. 2017 **Calfee, Halter & Griswold LLP**
Case: Hytera Communications Corp. Ltd. v. Motorola Solutions, Inc.
IPR2018-00128, IPR2017-02183
Matter: *Inter Partes* Review, two-way radios
Project: Declaration to support IPR petition, deposition, two supplemental declarations, two depositions

L136. 2017 **Finnegan Henderson Farabow Garrett & Dunner LLP**
Case: Hytera Communications Corp. Ltd. v. Motorola Solutions, Inc.
IPR2017-02179, IPR2017-02183
Matter: *Inter Partes* Review, two-way radios
Project: Two declarations to support two IPR petitions, deposition

L137. 2017 **Mayer Brown LLP**
Case: Silver Spring Networks, Inc. v. Sunrise Technologies, Inc.
Silver Spring Networks, Inc. v. Weatherproof Wireless, LLC
IPR2017-*To Be Assigned*, IPR2017-*To Be Assigned*
Matter: *Inter Partes* Review, power meter
Project: Two declarations to support two IPR petitions

L138. 2017 **Covington & Burling LLP**
Case: Hitachi Maxell, Ltd. v. Huawei Device USA Inc. et al.
Eastern district of Texas, Texarkana division, Case No. 5:16-cv-00178-RWS
Matter: Patent infringement, 3G/4G
Project: Source code review, declaration regarding claim construction, invalidity expert report, non-infringement expert report, non-infringing alternatives expert report, two depositions

L139. 2017 **Finnegan Henderson Farabow Garrett & Dunner LLP**
Case: LG Electronics, Inc. et al. v. BLU Products, Inc. and CT Miami, LLC
In the Matter of Certain LTE Wireless Communication Devices and Components Thereof, ITC Investigation No. 337-TA-1051
Matter: Patent infringement, 4G/LTE
Project: Declaration regarding claim construction, second declaration regarding claim construction

L140. 2017 **Sidley Austin LLP**
Case: Huawei Technologies Co., Ltd. v. Samsung Electronics Co., Ltd.
IPR2017-01979, IPR2017-01980, IPR2017-01986
Matter: *Inter Partes* Review, 4G/LTE
Project: Three declarations to support three IPR petitions, deposition

L141. 2017 **Finnegan Henderson Farabow Garrett & Dunner LLP**
Case: Motorola Solutions, Inc. v. Hytera Communications Corp. Ltd. et al.
In the Matter of Certain Two-way Radio Equipment Systems, Related Software and Components Thereof, ITC Investigation No. 337-TA-1053
Matter: Patent infringement, two-way radio
Project: Source code review, declaration regarding claim construction, invalidity expert report, non-infringement expert report, deposition, ITC hearing testimony

L142. 2017 **Haynes and Boone, LLP**
Case: Rackspace US, Inc. v. Realtime Data LLC
IPR2017-01691
Matter: *Inter Partes* Review, data compression
Project: Declaration to support IPR petition

L143. 2017 **Pillsbury Winthrop Shaw Pittman LLP**
Case: ZTE (USA), HTC Corporation, et al. v. Cellular Communications Equipment
IPR2017-01508, IPR2017-01509
Matter: *Inter Partes* Review, LTE, power control, emergency notification
Project: Two declarations to support two IPR petitions, two depositions

L144. 2017 **Alston & Bird LLP; Womble Carlyle Sandridge & Rice LLP**
Case: Itron, Inc. and Duke Energy Corp. v. Smart Meter Technologies
IPR2017-01199
Matter: *Inter Partes* Review, power meter
Project: Declaration to support IPR petition, deposition

L145. 2017 **Haynes and Boone, LLP**
Case: Ericsson Inc. v. Regents of the University of Minnesota
IPR2017-01186, IPR2017-01200, IPR2017-01213
Matter: *Inter Partes* Review, OFDM and MIMO
Project: Three declarations to support three IPR petitions

L146. 2017 **Quinn Emanuel Urquhart & Sullivan, LLP**
Case: GENBAND US, LLC v. Metaswitch Networks Ltd, et al.
Eastern district of Texas, Marshall division, Case No. 2:16-cv-582-JRG-RSP
Matter: Patent infringement, Internet protocols and VoIP, switches and routers
Project: Expert report regarding essentiality

L147. 2017 **Mayer Brown LLP**
Case: Uniloc USA, Inc. et al. v. Avaya Inc., ShoreTel, Inc., et al.
Eastern district of Texas, Tyler division, Case Nos. 6:15-cv-1168-JRG
Matter: Patent infringement, instant messaging and conference calling
Project: Source code review, non-infringement consulting

L148. 2017 **Fish & Richardson P.C.**
Case: Nokia Solutions and Networks US LLC, et al. v. Huawei Technologies Co. Ltd., et al.
Eastern district of Texas, Marshall division, Case Nos. 2:16-cv-753-JRG-RSP, 2:16-cv-754
Matter: Patent infringement, 4G/LTE
Project: Claim construction, two declarations

L149. 2017 **Rothwell Figg Ernst & Manbeck, PC; Pepper Hamilton LLP**
Case: Samsung Electronics, et al. v. Rembrandt Wireless Technologies, LP IPR2015-00555
Matter: *Ex Parte* Reexamination, Bluetooth
Project: Two declarations to support two Patent Owner's responses, supplemental declaration to support Patent Owner's reply

L150. 2016 **Sidley Austin LLP**
Case: Huawei Technologies Co., et al. v. Samsung Electronics Co, et al. and Samsung Research America v. Hisilicon Technologies Co, LTD Northern district of California, San Francisco division, Case No. 3:16-cv-2787-WHO
Matter: Patent infringement, 3G/4G/LTE
Project: Source code review, declaration regarding claim construction, declaration opposing summary judgement, infringement expert report, invalidity expert report, non-infringement expert report, validity expert report, two depositions

L151. 2016 **Bragalone Conroy PC**
Case: Securus Technologies, Inc. v. Global Tel*Link Corporation CBM2017-00034
Matter: Covered Business Method Review, call monitoring and recording
Project: Declaration to support CBM petition, deposition

L152. 2016 **Braxton, Hilton & Perrone PLLC**
Case: Biosonix, LLC. v. Hydrowave, LLC et al.
Eastern district of Texas, Case No. 2:16-cv-139-RC
Matter: Patent infringement, underwater transceivers
Project: Claim construction, Markman hearing and tech tutorial testimony

L153. 2016 **Gray Reed & McGraw**
Case: Optis Cellular Technology, LLC and PanOptis Patent Management, LLC. v. Blackberry Corporation, et al.
Eastern district of Texas, Marshall division, Case No. 2:16-cv-59-JRG-RSP, Case No. 2:16-cv-61-JRG-RSP, Case No. 2:16-cv-62-JRG-RSP
Matter: Patent infringement, LTE
Project: Claim construction, three declarations regarding claim construction, deposition

L154. 2016 **Ropes & Gray LLP; Davidson Berquist Jackson & Gowdey**
Case: SIPCO, LLC et al v. Emerson Electric Co. et al
Eastern district of Texas, Tyler division, Case No. 6:15-cv-907
Emerson Electric Co. et al v. SIPCO, LLC et al.
Northern district of Georgia, Atlanta division, Case No. 1:15-cv-00319-AT
Matter: Patent infringement, links in wireless networks and remote monitoring
Project: Source code review, invalidity consulting

L155. 2016 **McKool Smith**
Case: Regents of University of Minnesota v. AT&T Mobility LLC, et al.
District of Minnesota, Case No. 0:14-cv-04666-JRT-TNL
Matter: Patent infringement, LTE and MIMO
Project: Invalidity consulting

L156. 2016 **EIP US LLP**
Case: GENBAND US, LLC et al. v. Metaswitch Networks Ltd
IPR2015-01456, IPR2015-01457
Matter: *Inter Partes* Review, media gateways, switches and routers
Project: Two declarations to support Patent Owner's responses, two depositions

L157. 2016 **Haynes and Boone, LLP**
Case: Cox Communications, Inc. v. AT&T Intellectual Property I, II, LP
IPR2015-01187, IPR2015-01227, IPR2015-01273, IPR2015-01536
Matter: *Inter Partes* Review, cable networks
Project: Four declarations to support Patent Owner's responses, four depositions

L158. 2016 **Mayer Brown LLP**
Case: Odyssey Wireless v. Motorola Mobility LLC
Eastern district of North Carolina, Western division, Case No. 5:14-cv-491-D
Southern district of California, Case No. 3:15-cv-01741-H-RBB
Matter: Patent infringement, LTE
Project: Source code review, non-infringement consulting

L159. 2016 **Cooley LLP; Finnegan LLP**
Case: Saint Lawrence Comm. LLC v. Motorola Mobility LLC, ZTE (USA) Inc., et al.
Eastern district of Texas, Marshall division, Case No. 2:15-cv-000351-JRG, Case No. 2:15-cv-000349-JRG
Matter: Patent infringement, speech compression, coding and decoding
Project: Invalidity expert report, expert report regarding AMR-WB standard, expert report regarding Opus and Silk, supplemental expert report

regarding invalidity, two-day depositions, jury trial testimony for Motorola

L160. 2015 **Sidley Austin LLP**
Case: Evolved Wireless, LLC v. Microsoft Corp, et al.
District of Delaware, Case No. 15-cv-546
Matter: Patent infringement, LTE
Project: Prior art and invalidity consulting

L161. 2015 **McKool Smith**
Case: Optis Wireless Technology, LLC and PanOptis Patent Management, LLC. v. ZTE Corporation and ZTE (USA) Inc.
Eastern district of Texas, Marshall division, Case No. 2:15-cv-300-JRG-RSP
Matter: Patent infringement, cellular messages and multimedia attachments
Project: Source code review, claim construction, declaration

L162. 2015 **Fish & Richardson, P.C.**
Case: Saint Lawrence Comm. LLC v. LG Elec., Inc. et al.
Eastern district of Texas, Marshall division, Case No. 2:14-cv-1055-JRG
Matter: Patent infringement, speech compression, coding and decoding
Project: Invalidity expert report

L163. 2015 **Finnegan Henderson Farabow Garrett & Dunner LLP**
Case: LG Electronics, Inc. v. Cellular Communications Equipment LLC
IPR2016-00178
Matter: *Inter Partes* Review, LTE
Project: Declaration to support IPR petition

L164. 2015 **McKool Smith**
Case: AT&T, et al. v. Cox Communication, Inc., et al.
District of Delaware, Case No. 14-1106-GMS
Matter: Patent infringement, cable networks
Project: Claim construction, declaration

L165. 2015 **McKool Smith**
Case: Ericsson Inc., et al. v. TCL Communication, et al.
Eastern district of Texas, Marshall division, Case No. 2:15-cv-00011-RSP
Matter: Patent infringement, wireless devices and systems
Project: Source code review, claim construction, declaration, infringement expert report, validity expert report, two-day depositions

L166. 2015 **Foley & Lardner LLP**
Case: Kyocera Communications, Inc. v. Cellular Communications Equipment LLC
IPR2015-01559, IPR2015-01564
Matter: *Inter Partes* Review, LTE, power control, emergency notification
Project: Two declarations to support two IPR petitions

L167. 2015 **Fish & Richardson, P.C.**
Case: Fairfield Industries Inc. v. Wireless Seismic, Inc.
Southern district of Texas, Case No. 4:14-cv-02972-KPE
Matter: Patent infringement, wireless sensor networks
Project: Non-infringement expert report

L168. 2015 **Quinn Emanuel Urquhart & Sullivan, LLP**
Case: GENBAND US, LLC v. Metaswitch Networks Ltd, et al.
Eastern district of Texas, Marshall division, Case No. 2:14-cv-33-JRG-RSP
Matter: Patent infringement, Internet protocols and VoIP, switches and routers
Project: Expert report regarding essentiality, non-infringement expert report, rebuttal expert report regarding non-practice, supplemental rebuttal expert report, three-day depositions, jury trial testimony

L169. 2015 **Duane Morris LLP; Foley & Lardner LLP**
Case: Mobile Telecommunications Technologies, LLC v. Leap Wireless International, Cricket Communications, Inc.
Eastern district of Texas, Marshall division, Case No. 2:13-cv-00885-RSP
Matter: Patent infringement, OFDM and MIMO
Project: Non-infringement expert report, deposition

L170. 2015 **Hogan Lovells US LLP; Kenyon & Kenyon LLP**
Case: One-E-Way v. Beats Electronics, LLC, Sony Corporation, et al.
In the Matter of Certain Wireless Headsets, ITC Investigation No. 337-TA-943
Matter: Patent infringement, wireless communication
Project: Claim construction, declaration

L171. 2015 **McKool Smith**
Case: Solocron Media, LLC v. AT&T Inc., et al.
Eastern district of Texas, Marshall division, Case No. 2:13-cv-1059-JRG
Matter: Patent infringement, ringtone download
Project: Claim construction, invalidity expert report

L172. 2015 **EIP US LLP**
Case: Good Technology Software, Inc. v. Mobile Iron, Inc.
IPR2015-00833, IPR2015-00836, IPR2015-01090
Matter: *Inter Partes* Review, software management in wireless devices
Project: Three declarations to support three IPR petitions

L173. 2015 **McKool Smith**
Case: AirWatch LLC v. Good Technology Corp
Northern district of Georgia, Case No. 1:14-cv-02281-SCJ
Matter: Patent infringement, software management in wireless devices
Project: Claim construction, declaration

L174. 2015 **Simpson Thacher & Bartlett LLP**
Case: IXI Mobile (R&D) Ltd. et al. v. Apple Inc.
Southern district of New York, Case No. 14-cv-7594-RJS
Matter: Patent infringement, PDA and Bluetooth
Project: Invalidity consulting

L175. 2014 **Bragalone Conroy PC**
Case: Global Tel*Link Corporation v. Securus Technologies, Inc.
IPR2014-00785, IPR2014-00810, IPR2014-00824, IPR2014-00825, IPR2014-01278, IPR2014-01282, IPR2014-01283
Matter: *Inter Partes* Review, VoIP call monitoring and recording, allocating telecommunication resources and information systems
Project: Seven declarations to support seven Patent Owner's responses, five depositions

L176. 2014 **Orrick, Herrington & Sutcliffe LLP**
Case: Shopkick, Inc. v. Novitaz, Inc.
IPR2015-00277, IPR2015-00278
Matter: *Inter Partes* Review, wireless customer service management
Project: Two declarations to support two IPR petitions

L177. 2014 **Paul Hastings LLP**
Case: Cellular Communications Equipment LLC v. AT&T, et al.
Eastern district of Texas, Tyler division, Case No. 6:13-cv-507-LED (Lead Case for Consolidation)
Matter: Patent infringement, 3G cellular communication
Project: Claim construction, declaration

L178. 2014 **Baker Botts LLP**
Case: Orlando Communications LLC v. AT&T, et al.
M.D. Florida, Case No. 6:14-cv-01021
Matter: Patent infringement, 3G/4G cellular communication
Project: Non-infringement and claim construction consulting

L179. 2014 **EIP US LLP**
Case: Good Technology Software, Inc. v. AirWatch, LLC
IPR2015-00248, IPR2015-00875
Matter: *Inter Partes* Review, software management in wireless devices
Project: Two declarations to support two IPR petitions

L180. 2014 **Bragalone Conroy PC**
Case: Securus Technologies, Inc. v. Global Tel*Link Corporation
IPR2015-00153, IPR2015-00155, IPR2015-00156
Matter: *Inter Partes* Review, VoIP call monitoring and recording
Project: Three declarations to support three IPR petitions, two depositions

L181. 2014 **Andrews Kurth LLP**
Case: Sony Mobile Communications (USA) v. Adaptix Inc.
IPR2014-01524, IPR2014-01525
Matter: *Inter Partes* Review, subcarrier selection in LTE
Project: Two declarations to support two IPR petitions, deposition

L182. 2014 **Steptoe & Johnson LLP; Baker & McKenzie LLP**
Case: VTech Communications, Inc. and Uniden America Corporations v. Spherix Incorporated
IPR2014-01432
Matter: *Inter Partes* Review, IP telephony
Project: Declaration to support IPR petition, deposition, reply declaration, deposition

L183. 2014 **Steptoe & Johnson LLP; Baker & McKenzie LLP**
Case: Spherix Inc. v. VTech Telecommunications Ltd., et al.
Spherix Inc. v. Uniden Corp, et al.
Northern district of Texas, Dallas division, Case No. 3:13-cv-3494 and 3:13-cv-3496
Matter: Patent infringement, IP telephony
Project: Claim construction, declaration, deposition

L184. 2014 **McKool Smith**
Case: Good Technology Corp. v. MobileIron, Inc.
Northern district of California, Case No. 5:12-cv-05826-PSG
Matter: Patent infringement, software management in wireless devices
Project: Claim construction, three declarations, claim invalidity expert report, non-infringement expert report, deposition, jury trial testimony

L185. 2014 **Lee & Hayes**
Case: Broadcom Corp. v. Ericsson, Inc.
IPR2013-00601, IPR2013-00602, and IPR2013-00636
Matter: *Inter Partes* Review, ARQ protocols

Project: Three declarations to support Patent Owner's responses, two declarations to support Patent Owner's Motion to Amend, deposition, two reply declarations

L186. 2014 **Sidley Austin LLP**
Case: Adaptix, Inc. v. Huawei Technologies Co., et al.
Eastern district of Texas, Case No. 6:13-cv-00438, 439, 440 and 441
Matter: Patent infringement, subcarrier selection in LTE
Project: Source code review, non-infringement consulting

L187. 2014 **Finnegan Henderson Farabow Garrett & Dunner LLP**
Case: Cell and Network Selection LLC v. Huawei Technologies Co., et al.
Eastern district of Texas, Case No. 6:13-cv-00404-LED-JDL
Matter: Patent infringement, base station selection in LTE
Project: Non-infringement consulting

L188. 2014 **Feinberg Day Alberti & Thompson LLP**
Case: DSS Technology Management, Inc. v. Apple Inc.
Eastern district of Texas, Tyler division, Case No. 6:13-cv-00919-JDL
Matter: Patent infringement, PDA and Bluetooth
Project: Claim construction and invalidity consulting

L189. 2014 **Sheppard Mullin Richter & Hampton LLP**
Case: Digcom Inc. v. ZTE (USA), Inc.
District of Nevada, Case No. 3:13-cv-00178-RCJ-WGC
Matter: Patent infringement, cellular communication
Project: Claim construction consulting

L190. 2014 **Lott & Fischer**
Case: Zenith Electronics, LLC, et al. v. Craig Electronics, Inc.
Southern district of Florida, Case No. 9:13-cv-80567-DMM/DLB
Matter: Patent infringement, HDTV transmission and reception
Project: Opening expert report regarding nonessentiality

L191. 2013 **McKool Smith**
Case: Zenith Electronics, LLC, et al. v. Curtis International Ltd.
Southern district of Florida, Case No. 9:13-cv-80568-DMM/DLB
Matter: Patent infringement, HDTV transmission and reception
Project: Claim construction, declaration, deposition

L192. 2013 **Gibson Dunn**
Case: Straight Path IP Group v. Sharp Corp. and Sharp Electronics Corp.
In the Matter of Certain Point-to-Point Network Communication Devices and Products Containing Same, ITC Investigation No. 337-TA-892
Matter: Patent infringement, point-to-point network communication

Project: Non-infringement consulting

L193. 2013 **Kilpatrick Townsend & Stockton LLP; Cooley LLP**
Case: Monec Holding AG v. Motorola Mobility LLC, HTC, et al.
District of Delaware, Case No. 1:11-cv-798-LPS-SRF
Matter: Patent infringement, displaying books on tablets
Project: Non-infringement expert report for Motorola, non-infringement expert report for HTC, deposition

L194. 2013 **Gartman Law Group**
Case: Lone Star WiFi LLC v. Legacy Stonebriar Hotel, Ltd; et al.
Eastern district Of Texas, Tyler, Case No. 6:12-cv-957
Matter: Patent infringement, levels of access in Wi-Fi networks
Project: Claim validity consulting

L195. 2013 **White & Case, LLP**
Case: Nokia Corp and Nokia, Inc. v. HTC Corp and HTC America, Inc. and Google, Inc.
In the Matter of Certain Portable Electronic Communication Devices, Including Mobile Phones and Components Thereof, ITC Investigation No. 337-TA-885
Matter: Patent infringement, App download and installation
Project: Non-infringement consulting

L196. 2013 **Heim, Payne & Chorush, LLP**
Case: Rembrandt Wireless v. Samsung Electronics Co., et al.
Eastern district of Texas, Marshall, Case No. 2:13-cv-213-JRG-RSP
Matter: Patent infringement, Bluetooth
Project: Expert report regarding validity, deposition, jury trial testimony

L197. 2013 **Baker Hostetler; Davis Polk & Wardwell LLP**
Case: Comcast v. Sprint; and Nextel Inc.
Eastern district of Pennsylvania, Case No. 2:12-cv-00859-JD
Matter: Patent infringement, SMS/MMS in Cellular Networks
Project: Infringement expert report, validity expert report, reply expert report, declaration, two-day depositions, jury trial testimony

L198. 2013 **McKool Smith**
Case: Samsung Electronics America v. Ericsson Inc.
In the Matter of Certain Wireless Communications Equipment and Articles Therein, ITC Investigation No. 337-TA-866
Matter: Patent infringement, LTE uplink and downlink
Project: Source code review, prior art research, claim construction, claim invalidity expert report, non-infringement expert report, ITC hearing testimony

L199. 2012 **DLA Piper US LLP**
Case: CSR Technology Inc. v. Freescale Semiconductor, Inc.
USDC-San Francisco, Case No. 3:12-cv-02619-RS
Matter: Patent infringement, radio transceivers
Project: Claim construction, declaration

L200. 2012 **Fish & Richardson P.C.**
Case: GPNE Corp. v. Apple, Inc.; et al.
USDC-ND California, Case No. 5:12-cv-02885-LHK
Matter: Patent infringement, resource allocation in wireless networks
Project: Prior art research consulting

L201. 2012 **Polsinelli Shughart PC**
Case: Single Touch Interactive, Inc. v. Zoove Corporation
Northern district of California, Case No. 3:12-cv-00831-JSC
Matter: Patent infringement, abbreviated dialing, information delivery
Project: Claim construction, Markman hearing and tech tutorial testimony, two declarations

L202. 2012 **K & L Gates**
Case: EON Corp. IP Holdings, LLC v. Novatel Wireless, Inc.; et al.
DC-Tyler, Texas, Case No. 6:11-cv-00015-LED-JDL
Matter: Patent infringement, wireless modem and 3G services
Project: Non-infringement expert report, deposition

L203. 2012 **Simpson Thacher & Bartlett LLP**
Case: CSR Technology, Inc. v. Bandspeed, Inc.
Western district of Texas, Case No. 1:12-cv-297-LY
Matter: Patent infringement, packet identification in 2.4 GHz and 5 GHz
Project: Source code review, Markman hearing and tech tutorial testimony, infringement expert report

L204. 2012 **Sheppard Mullin Richter & Hampton LLP**
Case: Wi-LAN v. HTC America, Inc., et al.
Eastern district of Texas, Case No. 6:10-cv-521-LED
Matter: Patent infringement, CDMA, Orthogonal Codes
Project: Source code review, non-infringement expert report, deposition, jury trial testimony

L205. 2012 **Dechert LLP**
Case: Hitachi v. TPV and Vizio, Inc.; and Vizio v. Hitachi, LTD.
Eastern district of Texas, Case No. 2:10-cv-260
Matter: Patent infringement, HD television transmission and reception
Project: Prior art research, claim invalidity consulting

L206. 2012 **Fish & Richardson P.C.; Covington & Burling; Alston & Bird; Brinks Hofer Gilson & Lione**
Case: InterDigital Commc'n, LLC v. Huawei Tech. Co. LTD; LG Electronics, Inc.; Nokia, Inc.; and ZTE (USA) Inc.
Certain Wireless Devices With 3G Capabilities and Components Thereof, ITC Investigation No. 337-TA-800
Matter: Patent infringement, channel coding in UMTS, HSDPA
Project: Non-infringement consulting

L207. 2012 **Fish & Richardson P.C.; Covington & Burling; Alston & Bird; Brinks Hofer Gilson & Lione**
Case: InterDigital Commc'n, LLC v. Huawei Tech. Co. LTD; LG Electronics, Inc.; Nokia, Inc.; and ZTE (USA) Inc.
District of Delaware, Case No. 1:11-cv-00654-UNA
Matter: Patent infringement, channel coding in UMTS, HSDPA
Project: Non-infringement consulting

L208. 2011 **O'Melveny & Myers LLP**
Case: MobileMedia Ideas, LLC v. Apple, Inc.
District of Delaware, Case No. 1:10-cv-00258-SLR-MPT
Matter: Patent infringement, voice control, call rejection in mobile phones
Project: Source code review, prior art research, declaration, claim invalidity expert report, non-infringement expert report, deposition, jury trial testimony

L209. 2011 **Wilmer Cutler Pickering Hale and Dorr**
Case: Apple, Inc. v. Samsung Electronics Co.
Northern district of California, Case No. 5:11-cv-01846-LHK
Matter: Patent infringement, channel coding in CDMA, E-AGCH, TFCI
Project: Prior art research, claim construction consulting

L210. 2011 **Weil, Gotshal & Manges LLP**
Case: Vizio, Inc. v. Renesas Electronics America, Inc.
ITC Investigation No. 337-TA-789
Matter: Patent infringement, HD television transmission and reception
Project: Claim invalidity consulting

L211. 2011 **Shapiro Cohen**
Case: TenXc Wireless Inc. v. Andrew LLC
TenXc Wireless Inc. v. Mobi Antenna Technologies Ltd.
Matter: Patent infringement, antenna design, sectorized cellular network
Project: Claim validity consulting

L212. 2010 **Fish & Richardson P.C.**
Case: Vizio, Inc., v. LG Electronics, Inc.
ITC Investigation No. 337-TA-733

Matter: Patent infringement, HD television transmission and reception
Project: Claim charts, claim construction expert report, deposition

L213. 2010 **Fish & Richardson P.C.**
Case: Vizio, Inc., v. LG Electronics, Inc.
District of Maryland, Case No. 1:09-cv-1481-BEL
Matter: Patent infringement, HD television transmission and reception
Project: Claim charts, claim construction expert report, deposition

L214. 2008 **Kaye Scholer LLP**
Case: eBay Inc. v. IDT.
Western district of Arkansas, Case No. 4:08-cv-4015-HFB
Matter: Patent infringement, long distance communication using Internet
Project: Prior art research, claim construction consulting

L215. 2008 **Simpson Thacher & Bartlett LLP**
Case: Commil USA, LLC v. Cisco Systems, Inc.
Eastern district of Texas, Case No. 2:07-cv-00341-DF-CE
Matter: Patent infringement, two-level wireless protocol
Project: Prior art research

L216. 2006 **Woodfill and Pressler**
Case: Charles Russell v. Interinsurance Exchange of the Auto Club
Harris County, Texas, Case No. 2005-19706
Matter: House fire and insurance claim
Project: Determining user location using cellular phone records, expert report, deposition, jury trial testimony

Consulting History

From: 11/2022 **Abe, Ikubo & Katayama (Client: ASUS Japan K.K.)**
To: 12/2022 Japan
Duties: Analyze 3GPP standards contribution.

From: 8/2022 **JLP Enterprise Holdings LLC**
To: 8/2022 Dallas, TX
Duties: Analyze patents for essentiality to 5G standards.

From: 5/2022 **Washington Utilities and Transportation Commission DOCKET UT-181051**
To: 12/2022 Olympia, WA
Duties: Analyze cause(s) of network failure, provide testimony on behalf of Staff, deposition, hearing testimony

From: 8/2021 **Carter Arnett (Client: G+ Communications)**
To: 5/2022 Dallas, TX

Duties: Analyze patents for essentiality to 4G and 5G standards.

From: 2/2021 **ExpertsDirect Pty Ltd**
To: 3/2021 Australia
Duties: Analyze antenna arrays.

From: 11/2020 **Licks Attorneys**
To: 1/2021 Brazil
Duties: Analyze patents for essentiality to 4G standards.

From: 6/2019 **Fish & Richardson, P.C. (Client: Huawei)**
To: 5/2022 Dallas, TX
Duties: Analyze patents for essentiality to 3G, 4G, and 5G standards.

From: 1/2013 **Heim, Payne & Chorush, LLP**
To: 3/2013 Houston, TX
Duties: Analyze patents on wireless technologies.

From: 4/2007 **Collin County Sheriff's Office**
To: 5/2007 McKinney, TX
Duties: Analyzed cellular record data and determined user location in a double-homicide investigation.

From: 4/2004 **Allegiant Integrated Solutions**
To: 5/2004 Fort Worth, TX
Duties: Designed and developed an integrated set of tools for fast deployment of wireless networks. The tools optimize the placement of Access Points and determine their respective channel allocations to minimize interference and maximize capacity.

From: 3/2002 **Input/Output Incorporated**
To: 4/2002 New Orleans, LA
Duties: Designed and implemented an algorithm in MATLAB for optimizing the frequency selection process used by sonar for scanning the bottom of the ocean.

From: 6/1998 **Teleware Corporation**
To: 7/1998 Seoul, South Korea
Duties: Designed and developed a software package for analyzing the capacity in a CDMA network to maximize the number of subscribers.

Employment History

From: 5/2023 **University of North Texas**
To: Present Denton, TX
Position: *Tenured Professor Department of Computer Science and Engineering*

Conducting research on MIMO and 5G cellular networks. Teaching telecommunication courses. Advising graduate and undergraduate students.

From: 1/2015 **University of North Texas**
To: 8/2021 Denton, TX
Position: *Associate Chair of Graduate Studies Department of Computer Science and Engineering*
In charge of all administrative duties related to the Master's and Ph.D. programs in the department.

From: 5/2008 **University of North Texas**
To: 5/2023 Denton, TX
Position: *Tenured Associate Professor Department of Computer Science and Engineering*
Conducting research on cellular networks and wireless sensor networks. Teaching wireless communication courses. Advising graduate and undergraduate students.

From: 9/2002 **University of North Texas**
To: 5/2008 Denton, TX
Position: *Assistant Professor Department of Computer Science and Engineering*
Conducting research on WCDMA/UMTS wireless networks. Teaching wireless communication and computer architecture courses. Advising graduate and undergraduate students.

From: 1/2002 **University of New Orleans**
To: 8/2002 New Orleans, LA
Position: *Assistant Professor Department of Electrical Engineering*
Designed and taught two new courses "Computer Systems Design I and II". Developed a Computer Engineering Curriculum with strong hardware-design emphasis. Formed a wireless research group. Advised graduate and undergraduate students.

From: 10/2000 **Comspace Corporation**
To: 12/2001 Coppell, TX
Position: *Senior Systems Engineer*
Designed, coded (in MATLAB), and simulated Viterbi decoding, Turbo coding, trellis coded modulation (TCM), and Reed-Muller codes. Optimized soft decision parameters and interleavers for additive white Gaussian and Rayleigh faded channels. Extended the control and trunking of push-to-talk Logic Trunked Radio (LTR) to include one-to-one and one-to-many voice and data messaging.

From: 8/1997 **MinMax Corporation**
To: 5/1999 Saint Louis, MO

Position: *Research Associate*
Designed software packages that provide the tools to flexibly allocate capacity in a CDMA network and maximize the number of subscribers. Analyzed and simulated different audio compression schemes. Validated, simulated (logical and timing), and developed the hardware architecture for an ATM switch capable of channel group switching.

From: 8/1994 **Washington University**
To: 8/2000 Saint Louis, MO
Position: *Research and Teaching Assistant*
Taught, consulted, and graded Circuit Analysis at the undergraduate level and Network Design at the graduate level.

Publications

Conference Proceedings

C1. R. Chataut, **R. Akl**, "An Adaptive User Scheduling Algorithm for 6G Massive MIMO Systems," *26th IEEE International Conference on Advanced Communications Technology (IEEE ICACT 2024)*, February 2024, pp. 1475-1482.

C2. R. Chataut, **R. Akl**, U.K. Dey, "An Adaptive User Scheduling Algorithm for 6G Massive MIMO Systems," *25th IEEE International Conference on Advanced Communications Technology (IEEE ICACT 2023)*, February 2023, pp. 158-163.

C3. U.K. Dey, **R. Akl**, R. Chataut, "Performance Improvement in Cellular V2X (CV2X) by Using Massive MIMO Jacobi Detector," *2022 IEEE 19th International Conference on Smart Communities: Improving Quality of Life Using ICT, IoT and AI (HONET)*, December 2022, pp. 122-127.

C4. U.K. Dey, **R. Akl**, R. Chataut, "Performance Improvement in Cellular V2X (CV2X) by Using Low Density Parity Check (LDPC) Code," *2022 IEEE 13th Annual Ubiquitous Computing, Electronics & Mobile Communication Conference (UEMCON)*, October 2022, pp. 296-302.

C5. M. Robaei, **R. Akl**, "Distributed Compressed Sensing Karhunen-Loéve Expansion - Application to Millimeter-Wave Resource Allocation Through Group Beamforming," *2022 IEEE International Workshop Technical Committee on Communications Quality and Reliability (CQR)*, September 2022, pp. 7-12.

C6. R. Chataut, **R. Akl**, U.K. Dey, "Massive MIMO Uplink Signal Detector for 5G and Beyond Networks," *2022 IEEE Texas Symposium on Wireless and Microwave Circuits and Systems (WMCS)*, April 2022, 7 pgs.

C7. M. Robaei, **R. Akl**, R. Chataut, U.K. Dey, "Adaptive Millimeter-Wave Channel Estimation and Tracking," *2022 24th International Conference on Advanced Communication Technology (ICACT)*, February 2022, pp. 23-28.

C8. U.K. Dey, **R. Akl**, R. Chataut, "Throughput Improvement in Vehicular Communication by Using Low Density Parity Check (LDPC) Code," *IEEE CCWC 2022 The 12th Annual Computing and Communication Workshop and Conference*, January 2022, pp. 836-843.

C9. U.K. Dey, **R. Akl**, R. Chataut, M. Robaei, "Selective MIMO in Vehicular Communication for Reliable Safety Services and High Speed Non-Safety Services," *2021 IEEE 12th Annual Ubiquitous Computing, Electronics & Mobile Communication Conference (UEMCON)*, 2021, pp. 785-790, 6 pgs.

C10. R. Chataut, **R. Akl**, U.K. Dey, "An Efficient and Fast-convergent Detector for 5G and Beyond Massive MIMO Systems," *2021 IEEE 12th Annual Ubiquitous Computing, Electronics & Mobile Communication Conference (UEMCON)*, 2021, pp. 866-872, 7 pgs.

C11. M. Robaei, **R. Akl**, "Millimeter-Wave Blockage Modeling And Mitigation," *2021 IEEE International Workshop Technical Committee on Communications Quality and Reliability (CQR 2021)*, 2021, 6 pgs.

C12. M. Robaei, **R. Akl**, "Characterizing Non-Stationary Millimeter-Wave Communication Using Fuzzy Entropy," *2021 55th Annual Conference on Information Sciences and Systems (CISS)*, 2021, 6 pgs.

C13. M. Robaei, **R. Akl**, R. Chataut, U.K. Dey, "Adaptive Millimeter-Wave Channel Estimation and Tracking," *2021 23rd International Conference on Advanced Communication Technology (ICACT)*, February 2021, pp. 23-28, 6 pgs.

C14. U.K. Dey, **R. Akl**, R. Chataut, M. Robaei, "Modified PHY Layer for High Performance V2X Communication using 5G NR," *IEEE UEMCON 11th IEEE Annual Ubiquitous Computing, Electronics & Mobile Communication Conference*, October 2020, pp. 137-142, 6 pgs.

C15. R. Chataut, **R. Akl**, "An Efficient and Fair Scheduling for Downlink 5G Massive MIMO Systems," *IEEE Texas Symposium on Wireless and Microwave Circuits and Systems*, June 2020, paper no.TSWMCS2020-39, 8 pgs.

C16. R. Chataut, **R. Akl**, "Efficient and Low-Complexity Iterative Detectors for 5G Massive MIMO Systems," *IEEE DCOSS 2020 International Conference on Distributed Computing in Sensor Systems*, May 2020, pp. 442-449, 8 pgs.

C17. U.K. Dey, **R. Akl**, R. Chataut, "High Throughput Vehicular Communication Using Spatial Multiplexing MIMO," *IEEE CCWC 2020 The 10th Annual Computing and Communication Workshop and Conference*, January 2020, paper no. 1570613408, 6 pgs.

C18. R. Chataut, **R. Akl**, M. Robaei, "Accelerated and Preconditioned Refinement of Gauss-Seidel Method for Uplink Signal Detection in 5G Massive MIMO Systems," *IEEE CCWC 2020 The 10th Annual Computing and Communication Workshop and Conference*, January 2020, paper no. 1570605343, 7 pgs.

C19. M. Robaei, **R. Akl**, "Examining Spatial Consistency for Millimeter-Wave Massive MIMO Channel Estimation in 5G-NR," *IEEE ICCE 2020 The 38th International Conference on Consumer Electronics*, January 2020, paper no. 1570596880, 6 pages.

C20. R. Chataut, **R. Akl**, "Channel Gain Based User Scheduling for 5G Massive MIMO Systems," *IEEE HONET-ICT 2019 The 16th International Conference on Smart Cities: Improving Quality of Life Using ICT & IoT and AI*, October 2019, paper no. 1570565594, 5 pgs.

C21. M. Robaei, **R. Akl**, "Time-Variant Broadband mmWave Channel Estimation Based on Compressed Sensing," *IEEE UEMCON 2019 The 10th Annual Ubiquitous Computing, Electronics & Mobile Communication Conference*, October 2019, paper no. 1570577430, 7 pages.

C22. R. Chataut, **R. Akl**, U. Dey, "Least Square Regressor Selection Based Detection for Uplink 5G Massive MIMO Systems," *IEEE WAMICON 2019 The 20th Annual IEEE Wireless and Microwave Technology Conference*, April 2019, paper no. 1570524727, 6 pgs.

C23. R. Chataut, **R. Akl**, "Huber Fitting Based ADMM Detection for Uplink 5G Massive MIMO Systems," *IEEE UEMCON 2018 The 9th Annual Ubiquitous Computing, Electronics & Mobile Communication Conference*, November 2018, paper no. 1570492416, 5 pgs.

C24. R. Chataut, **R. Akl**, "Efficient and Low Complex Uplink Detection for 5G Massive MIMO Systems," *IEEE WAMICON 2018 The 19th Annual Wireless and Microwave Technology Conference*, April 2018, paper no. 1570431593, 6 pgs.

C25. R. Chataut, **R. Akl**, "Optimal Pilot Reuse Factor Based on User Environments in 5G Massive MIMO," *IEEE CCWC 2018 The 8th Annual Computing and Communication Workshop Conference*, January 2018, paper no. 1570413394, 6 pgs.

C26. S. Alotaibi, **R. Akl**, "Radio Resource Management in LTE Femtocell Networks," *IEEE NCA '17 International Symposium on Network Computing and Applications*, November 2017, paper no. 117, 5 pgs.

C27. U. Sawant, **R. Akl**, "Subcarrier Allocation in LTE Network Deployment with Mobility," *IEEE UEMCON 2017 8th Annual Ubiquitous Computing, Electronics*

and Mobile Communication Conference, October 2017, paper no. 1570349184, 8 pgs.

C28. S. Alotaibi, **R. Akl**, "Packet Scheduling Bandwidth Type-Based Mechanism for LTE," *IEEE UEMCON 2017 8th Annual Ubiquitous Computing, Electronics and Mobile Communication Conference*, October 2017, paper no. 1570394639, 6 pgs.

C29. S. Alotaibi, **R. Akl**, "Dynamic Fractional Frequency Reuse (FFR) Scheme for Two-Tier Network in LTE," *IEEE UEMCON 2017 8th Annual Ubiquitous Computing, Electronics and Mobile Communication Conference*, October 2017, paper no. 1570394969, 6 pgs.

C30. U. Sawant, **R. Akl**, "Evaluation of Adaptive and Non Adaptive LTE Fractional Frequency Reuse Mechanisms," *IEEE WOCC 2017 The 26th Annual Wireless and Optical Communications Conference*, April 2017, paper no. 1570341174, 6 pgs.

C31. S. Alotaibi, **R. Akl**, "Range-Based Scheme for Adjusting Transmission Power for Femtocells in Co-Channel Deployment," *IEEE WTS 2017 The 16th Annual Wireless Telecommunications Symposium*, April 2017, paper no. 1570334744, 5 pgs.

C32. U. Sawant, **R. Akl**, "A Novel Metric to Study the Performance of Sectorized Fractional Frequency Reuse Techniques in LTE," *IEEE WTS 2017 The 16th Annual Wireless Telecommunications Symposium*, April 2017, paper no. 1570338498, 7 pgs.

C33. S. Alotaibi, **R. Akl**, "Dynamic Frequency Partitioning Scheme for LTE HetNet Networks Using Fractional Frequency Reuse," *IEEE WCNC '17 Wireless Communications and Networking Conference*, March 2017, paper no. 1570332420, 5 pgs., demo and poster.

C34. U. Sawant, **R. Akl**, "Performance Evaluation of Network Productivity for LTE Heterogenous Networks with Reward-Penalty Weights Assessment," *IEEE CCWC 2017 The 7th Annual Computing and Communication Workshop Conference*, January 2017, paper no. 1570328396, 6 pgs.

C35. S. Alotaibi, **R. Akl**, "Self-Adjustment Downlink Transmission Power for Femtocells in Co-Channel Deployment in Heterogeneous Networks," *IEEE CCWC 2017 The 7th Annual Computing and Communication Workshop Conference*, January 2017, paper no. 1570326815, 6 pgs.

C36. U. Sawant, **R. Akl**, "Performance Evaluation of Sectorized Fractional Frequency Reuse Techniques Using Novel Metric," *IEEE ISCC 2016 The Twenty-First IEEE Symposium on Computers and Communications*, June 2016, paper no. 1570275270, 7 pgs.

C37. R. Tidwell, S. Akumalla, S. Karlaputi, **R. Akl**, K. Kavi, and D. Struble, "Evaluating the Feasibility of EMG and Bend Sensors for Classifying Hand Gestures," *1st International Conference on Multimedia and Human Computer Interaction*, July 2013, paper no. 63, 8 pgs.

C38. **R. Akl**, K. Pasupathy, and M. Haidar, "Anchor Nodes Placement for Effective Passive Localization," *2011 IEEE International Conference on Selected Topics in Mobile and Wireless Networks (iCOST)*, October 2011, paper no. 1569490799, pp. 127 - 132.

C39. **R. Akl**, P. Kadiyala, and M. Haidar, "Non-Uniform Grid-Based Routing in Sensor Networks," *9th IEEE Malaysia International Conference on Communications*, December 2009, paper no. 1569243649, pp. 536 - 540.

C40. M. Haidar, M. Al-Rizzo, Y. Chan, **R. Akl**, M. Bouharras, "Throughput Validation of an Advanced Channel Assignment Algorithm in IEEE 802.11 WLAN," *ICCSN 2009 – International Conference on Communication Software and Networks*, February 2009, paper no. P385, pp. 801 - 806.

C41. **R. Akl** and D. Keathly, "Robocamp: Encouraging Young Women to Embrace STEM," 4th Annual TETC Best Practices Conference, February 2009, 13 pgs.

C42. M. Haidar, R. Ghimire, M. Al-Rizzo, **R. Akl**, Y. Chan, "Channel Assignment in an IEEE 802.11 WLAN Based on Signal-to-interference Ratio," *IEEE CCECE – Canadian Conference on Electrical and Computer Engineering: Communications and Networking*, May 2008, paper no. 1569092894, pp. 1169 - 1174.

C43. H. Al-Rizzo, M. Haidar, **R. Akl**, and Y. Chan, "Enhanced Channel Assignment and Load Distribution in IEEE 802.11 WLANs," *IEEE International Conference on Signal Processing and Communication*, November 2007, paper no. 1569042132, pp. 768 - 771.

C44. **R. Akl** and Y. Saravanos, "Hybrid Energy-Aware Synchronization Algorithm in Wireless Sensor Networks," *18th Annual IEEE International Symposium on Personal, Indoor and Mobile Radio Communications*, September 2007, paper no 692, 5 pgs.

C45. M. Haidar, **R. Akl**, and H. Al-Rizzo, "Channel Assignment and Load Distribution in a Power-Managed WLAN," *18th Annual IEEE International Symposium on Personal, Indoor and Mobile Radio Communications*, September 2007, paper no. 463, 5 pgs.

C46. D. Keathly and **R. Akl,** "Attracting and Retaining Women in Computer Science and Engineering: Evaluating the Results," *Proceedings of American Society for Engineering Education: ASEE Annual Conference*, June 2007, paper no. AC 2007-1229, 10 pgs.

C47. M. Haidar, **R. Akl**, H. Al-Rizzo, Y. Chan, R. Adada, "Optimal Load Distribution in Large Scale WLAN Networks Utilizing a Power Management Algorithm," *Proceedings of IEEE Sarnoff Symposium*, May 2007, 5 pgs.

C48. R. Dantu, P. Kolan, **R. Akl,** and K. Loper, "Classification of Attributes and Behavior in Risk Management Using Bayesian Networks," *Proceedings of IEEE Intelligence and Security Informatics Conference*, May 2007, pp. 71-74.

C49. **R. Akl** and A. Arepally, "Dynamic Channel Assignment in IEEE 802.11 Networks," *Proceedings of IEEE Portable 2007: International Conference on Portable Information Devices*, March 2007, pp 309-313.

C50. **R. Akl** and U. Sawant, "Grid-based Coordinated Routing in Wireless Sensor Networks," *Proceedings of IEEE CCNC 2007: Consumer Communications and Networking Conference*, January 2007, pp. 860-864.

C51. **R. Akl** and A. Arepally, "Simulation of Throughput in UMTS Networks with Different Spreading Factors," *Proceedings of IEEE VTC Fall 2006: Vehicular Technology Conference,* September 2006, pp. C1-5.

C52. A. Alhabsi, H. Al-Rizzo, and **R. Akl,** "Parity Assisted Decision Making for QAM Modulation," *International Conference on Mobile Computing and Wireless Communications*, September 2006, paper no. 1568988776, 5 pgs.

C53. **R. Akl** and R. Garlick**,** "Retention and Recruitment of Women in Computer Engineering," *ICEE 2006: International Conference on Engineering Education,* July 2006, paper no. 3318, 5 pgs.

C54. R. Garlick and **R. Akl,** "Intra-Class Competitive Assignments in CS2: A One-Year Study," *ICEE 2006: International Conference on Engineering Education,* July 2006, paper no. 3325, 5 pgs.

C55. **R. Akl**, D. Tummala, and X. Li, "Indoor Propagation Modeling at 2.4 GHz for IEEE 802.11 Networks," *WNET 2006: Wireless Networks and Emerging Technologies,* July 2006, paper no. 510-014, 6 pgs.

C56. P. Chen, K. Kavi, and **R. Akl,** "Performance Enhancement by Eliminating Redundant Function Execution," *Proceedings of IEEE: 39th Annual Simulation Symposium*, April 2006, pp. 143-150.

C57. **R. Akl** and S. Nguyen, "Capacity Allocation in Multi-cell UMTS Networks for Different Spreading Factors with Perfect and Imperfect Power Control," *Proceedings of IEEE CCNC 2006: Consumer Communications and Networking Conference*, January 2006, vol. 2, pp. 928-932.

C58. W. Li, K. Kavi, and **R. Akl**, "An Efficient Non-Preemptive Real-Time Scheduling," *18th International Conference on Parallel and Distributed Computing Systems*, Las Vegas, NV, September 2005, pp. 154-160.

C59. S. Nguyen and **R. Akl**, "Approximating User Distributions in WCDMA Networks Using 2-D Gaussian," *CCCC20T 05: International Conference on Computing, Communications, and Control Technologies*, July 2005, 5 pgs.

C60. **R. Akl** and S. Park, "Optimal Access Point Selection and Traffic Allocation in IEEE 802.11 Networks," *Proceedings of 9th World Multiconference on Systemics, Cybernetics and Informatics (WMSCI 2005): Communication and Network Systems, Technologies and Applications*, July 2005, vol. 8, pp. 75-79.

C61. **R. Akl**, M. Naraghi-Pour, M. Hegde, "Throughput Optimization in Multi-Cell CDMA Networks," *IEEE WCNC 2005 - Wireless Communications, and Networking Conference*, March 2005, vol. 3, pp. 1292-1297.

C62. **R. Akl**, "Subscriber Maximization in CDMA Cellular Networks," *Proceedings of CCCT 04: International Conference on Computing, Communications, and Control Technologies*, August 2004, vol. 3, pp. 234-239.

C63. **R. Akl** and A. Parvez, "Global versus Local Call Admission Control in CDMA Cellular Networks," *Proceedings of CITSA 04: Communications, Information and Control Systems, Technologies and Applications*, July 2004, vol. 2, pp. 283-288.

C64. **R. Akl** and A. Parvez, "Impact of Interference Model on Capacity in CDMA Cellular Networks," *Proceedings of SCI 04: Communication and Network Systems, Technologies and Applications*, July 2004, vol. 3, pp. 404-408. Selected as **best paper** of those presented in the session: Tele-Communication Systems, Technologies and Application II.

C65. **R.G. Akl**, M.V. Hegde, M. Naraghi-Pour, P.S. Min, "Call Admission Control Scheme for Arbitrary Traffic Distribution in CDMA Cellular Systems," *IEEE Wireless Communications and Networking Conference*, September 2000, vol. 1, pp. 465-470.

C66. **R.G. Akl**, M.V. Hegde, M. Naraghi-Pour, P.S. Min, "Cell Placement in a CDMA Network," *IEEE Wireless Communications and Networking Conference*, September 1999, vol. 2, pp. 903-907.

C67. **R.G. Akl**, M.V. Hegde, P.S. Min, "Effects of Call Arrival Rate and Mobility on Network Throughput in Multi-Cell CDMA," *IEEE International Conference on Communications*, June 1999, vol. 3, pp. 1763-1767.

C68. **R.G. Akl**, M.V. Hegde, M. Naraghi-Pour, P.S. Min, "Flexible Allocation of Capacity in Multi-Cell CDMA Networks," *IEEE Vehicular Technology*

Conference, May 1999, vol. 2, pp. 1643-1647.

Journal Publications

J1. R. Chataut, M. Nankya, **R. Akl**, "6G Networks and the AI Revolution – Exploring Technologies, Applications, and Emerging Challenges," *Sensors 2024,* March 2024, 29 pgs.

J2. R. Chataut, **R. Akl**, "An Adaptive User Scheduling Algorithm for 6G Massive MIMO Systems," *IEEE Transactions on Advanced Communications Technology*, November 2023, 8 pgs.

J3. M. Nankya, R. Chataut, **R. Akl**, "Securing Industrial Control Systems: Components, Cyber Threats, and Machine Learning-Driven Defense Strategies," *Sensors 2023,* October 2023, 41 pgs.

J4. R. Chataut, A. Phoummalayvane, **R. Akl**, "Unleashing the Power of IoT: A Comprehensive Review of IoT Applications and Future Prospects in Healthcare, Agriculture, Smart Homes, Smart Cities, and Industry 4.0," *Sensors 2023*, August 2023, 19 pgs.

J5. M. Robaei, **R. Akl**, "Quadratic Displacement Operators—Theory and Application to Millimeter-Wave Channel Tracking," *IEEE Transactions on Wireless Communications,* January 2023, Vol. 22, No. 1, 15 pgs.

J6. M. Robaei, **R. Akl**, "Continuous Compressed Sensing Hilbert-Schmidt Integral Operator," *IEEE Access*, August 2022, pp. 80264-80276.

J7. R. Chataut, **R. Akl**, U.K. Dey, M. Robaei, "SSOR Preconditioned Gauss-Seidel Detection and Its Hardware Architecture for 5G and beyond Massive MIMO Networks," *Electronics 2021 ISSN 2079-9292*, 10(5), 578, *Special Issue MIMO for Next Generation Wireless Systems,* March 2021, 17 pgs.

J8. R. Chataut, **R. Akl**, "Massive MIMO Systems for 5G and Beyond Networks – Overview, Recent Trends, Challenges, and Future Research Direction," *Sensors 2020*, 20(10), 2753, May 2020.

J9. R. Chataut, **R. Akl,** "Massive MIMO Systems for 5G," *Encyclopedia 2020*, doi:10.32545, 2020, (ISSN 2309-3366).

J10. S. Alotaibi, **R. Akl**, "Range-Based Scheme for Adjusting Transmission Power of Femtocell in Co-Channel Deployment," *International Journal of Interdisciplinary Telecommunications and Networking*, IJITN Vol. 10, No. 4, pgs. 14-24, 2018.

J11. U. Sawant, **R. Akl**, "Adaptive and Non Adaptive LTE Fractional Frequency Reuse Mechanisms Mobility Performance," *Advances in Science, Technology and*

Engineering Systems Journal, ASTES Vol. 3, No. 3, 02-11, 11 pgs., 2018.

J12. M. Haidar, H.M. Al-Rizzo, **R. Akl**, and Z. Elbazzal, "The Effect of an Enhanced Channel Assignment Algorithm in an IEEE 802.11 WLAN," *World Scientific and Engineering Academy and Society Transactions on Communications*, WSEAS, Vol. 8, Issue 12, December 2009.

J13. **R. Akl**, P. Kadiyala, and M. Haidar, "Non-Uniform Grid-Based Coordinated Routing in Wireless Sensor Networks," *Journal of Sensors*, article ID 491349, volume 2009, 11 pages.

J14. M. Haidar, M. Al-Rizzo, Y. Chan, **R. Akl**, "User-Based Channel Assignment Algorithm in a Load-Balanced IEEE 802.11 WLAN," *International Journal of Interdisciplinary Telecommunications & Networking (IJITN)*, April-June 2009, 1(2), pp. 66-81.

J15. **R. Akl**, D. Keathly, and R. Garlick, "Strategies for Retention and Recruitment of Women and Minorities in Computer Science and Engineering," *iNEER Special Volume: Innovations 2007- World Innovations in Engineering Education and Research*, 9 pgs., 2007.

J16. R. Garlick and **R. Akl**, "Motivating and Retaining CS2 Students with a Competitive Game Programming Project," *iNEER Special Volume: Innovations 2007- World Innovations in Engineering Education and Research*, 9 pgs., 2007.

J17. **R. Akl** and S. Nguyen, "UMTS Capacity and Throughput Maximization for Different Spreading Factors," *Journal of Networks*, July 2006, vol. 1, issue 3, pp. 40-49. ISSN: 1796-2056

J18. W. Li, K. Kavi, and **R. Akl**, "A Non-preemptive Scheduling Algorithm for Soft Real-time Systems," *Journal of Computer and Electrical Engineering,* 2006, vol. 32, 18 pgs. ISSN: 0045-7906

J19. **R. Akl**, A. Parvez, and S. Nguyen, "Effects of Interference on Capacity in Multi-Cell CDMA Networks," *Journal of Systemics, Cybernetics and Informatics*, 2006, vol. 3, no. 1, p825612, 7 pgs. ISSN: 1690-4524

J20. **R.G. Akl**, M. Hegde and M. Naraghi-Pour, "Mobility-based CAC Algorithm for Arbitrary Traffic Distribution in CDMA Cellular Systems," *IEEE Transactions on Vehicular Technology,* March 2005*,* vol. 54, no. 2, pp. 639-651.

J21. **R.G. Akl**, M.V. Hegde, M. Naraghi-Pour, P.S. Min, "Multi-Cell CDMA Network Design," *IEEE Transactions on Vehicular Technology*, May 2001, vol. 50, no. 3, pp. 711-722.

Technical Papers

T1. J. Williams, **R. Akl,** et al, "Flight Control Subsystem," *The Eagle Feather*, Special Section: Undergraduate Research Initiative in Engineering, University of North Texas, Vol. 7, 2010.

T2. **R.G. Akl**, M.V. Hegde, A. Chandra, P.S. Min, "CDMA Capacity Allocation and Planning," Technical Document, Washington University Department of Electrical Engineering WUEE-98, April 1998.

Book Chapters

B1. R. Akl, Y. Saravanos, and M. Haidar, "Chapter 18: Hybrid Approach for Energy-Aware Synchronization in Sensor Networks," *Sustainable Wireless Sensor Networks*, December 2010, pgs. 413-429, ISBN: 978-953-307-297-5.

B2. K. Kavi, **R. Akl** and A. Hurson, "Real-Time Systems: An Introduction and the State-of-the-Art," *Encyclopedia of Computer Science and Engineering*, John Wiley & Sons, Volume 4, January 2009, pgs. 2369-2377.

B3. **R. Akl** and K. Kavi, "Chapter 12: Modeling and Analysis using Computational Tools," *Introduction to Queuing Theory: Modeling and Analysis*, Birkhauser Boston, December 2008, pgs. 295-320.

Technical Presentations

P1. "Bio-Com Project," Raytheon, Richardson TX, May 2012, (invited).

P2. "Bio-Com Project," Net-Centric Software and Systems I/UCRC Meeting, Denton TX, December 2011, (invited).

P3. "Student Outreach Report: Robocamp," College of Engineering Advisory Board Meeting, Denton TX, May 2011, (invited).

P4. "Robocamp: Encouraging Young Women to Embrace STEM," 4th Annual TETC Best Practices Conference, Austin TX, February 2009, (invited).

P5. "Self-Configuring Wireless MEMS Network (demo)," Southern Methodist University, Dallas TX, January 2008, (invited).

P6. "Energy-aware Routing and Hybrid Synchronization in Sensor Networks," *Southern Methodist University,* Dallas TX, September 2007, (invited).

P7. "Retention and Recruitment of Women in Computer Engineering," *ICEE 2006: International Conference on Engineering Education,* Puerto Rico, July 2006, (refereed).

P8. "Capacity Allocation in Multi-cell UMTS Networks for Different Spreading Factors with Perfect and Imperfect Power Control," *IEEE CCNC 2006: Consumer Communications and Networking Conference*, Las Vegas, NV, January 2006, (refereed).

P9. "Research, Teaching, and Outreach," CSE Advisory Council Meeting, *UNT Research Park*, Denton, TX, December 2005, (invited).

P10. "Wi-Fi and WCDMA Network Design," *University of Arkansas*, Little Rock, AR, April 2005, (invited).

P11. "Wi-Fi and WCDMA Network Design," *Southern Methodist University*, Dallas, TX, March 2005, (invited).

P12. "Current Research in Wireless at UNT," *Nortel Networks*, Richardson, TX, October 2004, (invited).

P13. "Subscriber Maximization in CDMA Cellular Networks," *International Conference on Computing, Communications, and Control Technologies*, Austin, TX, August 2004, (refereed).

P14. "Global versus Local Call Admission Control in CDMA Cellular Networks," *International Conference on Cybernetics and Information Technologies, Systems and Applications*, Orlando, FL, July 2004, (refereed).

P15. "Impact of Interference Model on Capacity in CDMA Cellular Networks," *8th World Multi-Conference on Systemics, Cybernetics, and Informatics*, Orlando, FL, July 2004, (refereed).

P16. "CDMA Network Design," IEEE Communications Society – New Orleans Chapter, New Orleans, LA, May 2002, (invited).

P17. "Cell Design to Maximize Capacity in CDMA Networks," Louisiana State University, Baton Rouge, LA, April 2002, (invited).

P18. "Call Admission Control Scheme for Arbitrary Traffic Distribution in CDMA Cellular Systems," *IEEE Wireless Communications and Networking Conference*, Chicago, IL, September 2000, (refereed).

P19. "Cell Placement in a CDMA Network," *IEEE Wireless Communications and Networking Conference*, September 1999, (refereed).

P20. "Effects of Call Arrival Rate and Mobility on Network Throughput in Multi-Cell CDMA," *IEEE International Conference on Communications*, June 1999, (refereed).

P21. "Flexible Allocation of Capacity in Multi-Cell CDMA Networks," *IEEE Vehicular Technology Conference*, May 1999, (refereed).

P22. "CCAP: A Strategic Tool for Managing Capacity of CDMA Networks," Teleware Co. Ltd., Seoul, South Korea, 1998, (invited).

Courses Developed

- CSCE 5933: LTE Physical Layer Using MATLAB.
  Research issues in the design of LTE physical layer and simulate using MATLAB. Topics include modulation and coding, OFDM, channel modeling, MIMO, and link adaption.

- CSCE 6590: Advanced Topics in Wireless Communications & Networks: 4G/LTE.
  Research issues in the design of next generation wireless networks: cellular systems, medium access techniques, signaling, mobility management, control and management for mobile networks, wireless data networks, Internet mobility, quality-of-service for multimedia applications, caching for wireless web access, and ad hoc networks.

- CSCE 5933: Fundamentals of VoIP.
  Fundamentals of VoIP, with emphasis on network infrastructure implementation and security. Topics include IP protocol suite, SS7, speech-coding techniques, quality of service, session initiation protocol, and security issues.

- CSCE 5540: Introduction to Sensor Networks.
  Topics include: design implications of energy (hardware and software), and otherwise resource-constrained nodes; network self-configuration; services such as routing under network dynamics, localization, time-synchronization and calibration; distributed data management, in-network aggregation and collaborative signal processing, programming tools and language support.

- CSCE 5510. Wireless Communication.
  Point-to-point signal transmission through a wireless channel, channel capacity, channel encoding, and multi-user transmissions. First, second, and third generation cellular systems, and mobility management.

- CSCE 3510. Introduction to Wireless Communication.
  Fundamentals of wireless communications and networking, with emphasis on first, second, and third generation cellular systems. Topics include point-to-point signal transmission through a wireless channel, cellular capacity, multi-user transmissions, and mobility management.

- CSCE 3020. Communications Systems.

Introduction to the concepts of transmission of information via communication channels. Amplitude and angle modulation for the transmission of continuous-time signals. Analog-to-digital conversion and pulse code modulation. Transmission of digital data. Introduction to random signals and noise and their effects on communication. Optimum detection systems in the presence of noise.

- ENEE 3583. Computer Systems Design I (UNO).
  The design process of digital computer systems is studied from the instruction set level, system architecture level, and digital logic level. Topics include machine organization, register transfer notation, processor design, memory design, and input/output considerations. Includes semester project.

- ENEE 3584. Computer Systems Design II (UNO).
  The design and evaluation of contemporary computer systems are analyzed to compare the performance of different architectures. Topics include performance metrics, computer arithmetic, pipelining, memory hierarchies, and multiprocessor systems.

- ENEE 3514. Computer Architecture Laboratory (UNO).
  Selected experiments examining programmable logic, VHDL and logic synthesis, and including a final design project, to accompany and complement the lecture course ENEE 3584. Three hours of laboratory.

Courses Taught

Spring 2025
- CSCE 3020.1: Communication Systems (no evaluation yet)

Spring 2024
- CSCE 3020.1: Communication Systems (4.0 / 5.0)

Fall 2023
- CSCE 3010.1: Signals and Systems (3.6 / 5.0)

Spring 2023
- CSCE 3020.1: Communication Systems (4.5 / 5.0)

Fall 2022
- CSCE 3010.1: Signals and Systems (4.4 / 5.0)
- CSCE 6950.743: Dissertation (no evaluation done)

Spring 2022
- CSCE 3020.1: Communication Systems (4.2 / 5.0)
- CSCE 6950.743: Dissertation (no evaluation done)

Fall 2021
- CSCE 3010.1: Signals and Systems (4.2 / 5.0)
- CSCE 5933.1: LTE Physical Layer Using MATLAB (5.0 / 5.0)
- CSCE 6950.743: Dissertation (no evaluation done)

Spring 2021
- CSCE 2610.2: Computer Organization (4.0 / 5.0)

- CSCE 3020.1: Communication Systems (4.2 / 5.0)
- CSCE 6950.743: Dissertation (no evaluation done)

Fall 2020
- CSCE 3010.1: Signals and Systems (4.1 / 5.0)
- CSCE 6940.743: 5G MIMO Systems (no evaluation done)
- CSCE 6950.743: Dissertation (no evaluation done)

Spring 2020
- CSCE 6940.743: 5G MIMO Systems (no evaluation done)
- CSCE 6950.743: Dissertation (no evaluation done)

Fall 2019
- CSCE 5933.3: LTE Physical Layer Using MATLAB (4.3 / 5.0)
- CSCE 6940.743: 5G MIMO Systems (no evaluation done)
- CSCE 6950.743: Dissertation (no evaluation done)

Spring 2019
- CSCE 6940.743: 5G MIMO Systems (no evaluation done)
- CSCE 6940.743: Software Defined Radios (no evaluation done)
- CSCE 6950.743: Dissertation (no evaluation done)

Fall 2018
- CSCE 5933.3: LTE Physical Layer Using MATLAB (4.8 / 5.0)
- CSCE 6940.743: 5G MIMO Systems (no evaluation done)
- CSCE 6950.743: Dissertation (no evaluation done)

Spring 2018
- CSCE 6940.743: 5G MIMO Systems (no evaluation done)
- CSCE 6940.743: Jitter-buffer Management and Interference in VoIP (no evaluation done)
- CSCE 6950.743: Dissertation (no evaluation done)

Fall 2017
- CSCE 5933.3: LTE Physical Layer Using MATLAB (4.9 / 5.0)
- CSCE 6940.743: 5G MIMO Systems (no evaluation done)
- CSCE 6940.743: VoLTE and VoWiFi (no evaluation done)
- CSCE 6950.743: Dissertation (no evaluation done)

Spring 2017
- CSCE 6950.743: Dissertation (no evaluation done)

Fall 2016
- CSCE 5933.3: LTE Physical Layer Using MATLAB (4.7 / 5.0)
- CSCE 6950.743: Dissertation (no evaluation done)

Spring 2016
- CSCE 5950.743: Thesis (no evaluation done)
- CSCE 6950.743: Dissertation (no evaluation done)

Fall 2015
- CSCE 3010.1: Signals and Systems (5.7 / 7.0)
- CSCE 5950.743: Thesis (no evaluation done)
- CSCE 6950.743: Dissertation (no evaluation done)

Spring 2015

- CSCE 5934.743: Directed Study (no evaluation done)
- CSCE 5950.743: Thesis (no evaluation done)
- CSCE 6950.743: Dissertation (no evaluation done)

Fall 2014
- CSCE 3010.1: Signals and Systems (3.32 / 4.00)
- CSCE 5950.743: Thesis (no evaluation done)
- CSCE 6950.743: Dissertation (no evaluation done)
- CSCE 6590.1: Advanced Topics in Wireless Communications & Networks: 4G/LTE (3.79 / 4.00)

Spring 2014
- CSCE 3510.1: Intro to Wireless Communication (808 – Highly Effective)
- CSCE 5510.1: Wireless Communications (808 – Highly Effective)
- CSCE 5950.743: Thesis (no evaluation done)
- CSCE 6950.743: Dissertation (no evaluation done)

Fall 2013
- CSCE 5950.743: Thesis (no evaluation done)
- CSCE 6950.743: Dissertation (no evaluation done)
- CSCE 6590.1: Advanced Topics in Wireless Communications & Networks: 4G/LTE (804 – Highly Effective)

Spring 2013
- CSCE 4890.743: Directed Study (no evaluation done)
- CSCE 5950.743: Thesis (no evaluation done)
- CSCE 6940.743: Individual Research (no evaluation done)
- CSCE 6950.743: Dissertation (no evaluation done)

Fall 2012
- CSCE 3010.1: Signals and Systems (793 – Highly Effective)
- CSCE 5540.1: Intro to Sensor Networks (814 – Highly Effective)
- CSCE 5950.743: Thesis (no evaluation done)
- CSCE 6950.743: Dissertation (no evaluation done)

Spring 2012
- CSCE 3020.1: Communication Systems (809 – Highly Effective)
- CSCE 3510.1: Intro to Wireless Communication (811 – Highly Effective)
- CSCE 5510.1: Wireless Communications (817 – Highly Effective)
- EENG 3810.1: Communication Systems (801 – Highly Effective)

Fall 2011
- CSCE 3010.1: Signals and Systems (793 – Highly Effective)
- CSCE 5540.1: Intro to Sensor Networks (824 – Highly Effective)

Spring 2011
- CSCE 3020.1: Communication Systems (820 – Highly Effective)
- CSCE 3510.1: Intro to Wireless Communication (812 – Highly Effective)
- CSCE 5510.1: Wireless Communications (812 – Highly Effective)
- EENG 3810.1: Communication Systems (826 – Highly Effective)

Fall 2010
- CSCE 3010.1: Signals and Systems (857 – Highly Effective)

- CSCE 5540.1: Intro to Sensor Networks (831 – Highly Effective)

Spring 2010
- CSCE 3020.1: Communication Systems (792 – Highly Effective)
- CSCE 3510.1: Intro to Wireless Communication (793 – Highly Effective)
- CSCE 5510.1: Wireless Communications (834 – Highly Effective)
- EENG 3810.1: Communication Systems (854 – Highly Effective)

Fall 2009
- CSCE 3010.1: Signals and Systems (4.40 / 5.00)
- CSCE 5540.1: Intro to Sensor Networks (4.70 / 5.00)
- EENG 2620.1: Signals and Systems (4.40 / 5.00)

Spring 2009
- CSCE 3020.1: Communication Systems (4.87 / 5.00)
- CSCE 3510.1: Intro to Wireless Communication (4.65 / 5.00)
- CSCE 5510.1: Wireless Communications (4.79 / 5.00)

Fall 2008
- CSCE 3010.1: Signals and Systems (4.91 / 5.00)
- CSCE 5540.2: Intro to Sensor Networks (4.10 / 5.00)
- EENG 2620.3: Signals and Systems (4.91 / 5.00)

Spring 2008
- CSCE 3020.1: Communication Systems (4.68 / 5.00)
- CSCE 3510.1: Intro to Wireless Communication (3.96 / 5.00)
- CSCE 5510.1: Wireless Communications (4.75 / 5.00)

Fall 2007
- CSCE 3010.1: Signals and Systems (4.57 / 5.00)
- CSCE 5540.2: Intro to Sensor Networks (4.01 /5.00)

Summer 2007
- CSCE 3020.1: Fund. of Communication Theory (no evaluation done)
- EENG 3810.1: Communication Systems (no evaluation done)

Spring 2007
- CSCE 5510.2: Wireless Communications (4.75 / 5.00)
- CSCE 5933.6: Fundamentals of VoIP (4.70 / 5.00)

Fall 2006
- CSCE 3010.1: Signals and Systems (4.58 / 5.00)
- CSCE 5540.1: Intro to Sensor Networks (4.70 / 5.00)
- EENG 2620.1: Signals and Systems (4.58 / 5.00)

Summer 2006
- CSCE 3020.1: Fund. of Communication Theory (no evaluation done)
- CSCE 3510.21: Intro to Wireless Communications (no evaluation done)
- CSCE 5510.21: Intro to Wireless Communications (no evaluation done)
- EENG 3810.1: Communication Systems (no evaluation done)

Spring 2006
- CSCE 2610.2: Computer Organization (3.69 / 5.00)
- CSCE 3010.1: Signals and Systems (4.41 / 5.00)
- EENG 2620.1: Signals and Systems (4.41 / 5.00)

Fall 2005
- CSCE 3510.1: Intro to Wireless Communications (4.52 / 5.00)
- CSCE 5510.1: Wireless Communications (4.46 / 5.00)
- CSCE 5933.6: Intro to Sensor Networks (4.60 / 5.00)

Summer 2005
- CSCE 3010.21: Signals and Systems (no evaluation done)
- CSCE 3510.21: Intro to Wireless Communications (no evaluation done)

Spring 2005
- CSCE 3510.02: Intro to Wireless Communications (4.46 / 5.00)
- CSCI 3100.02: Computer Organization (4.14 / 5.00)

Fall 2004
- CSCE 3510.01: Intro to Wireless Communications (4.15 / 5.00)
- CSCI 4510.01: Machine Structures (4.55 / 5.00)
- CSCI 5330.02: Intro to Wireless Communications (4.05 / 5.00)

Summer 2004
- CSCI 4330.22: Intro to Wireless Communications (no evaluation done)
- CSCI 4330.23: Intro to Wireless Communications (no evaluation done)
- CSCI 5330.22: Intro to Wireless Communications (no evaluation done)

Spring 2004
- CSCI 3100: Computer Organization (4.64 / 5.00)
- CSCI 4330: Intro to Wireless Communications (4.22 / 5.00)

Fall 2003
- CSCI 4510: Machine Structures (4.49 / 5.00)
- CSCI 5330: Intro to Wireless Communications (4.83 / 5.00)

Summer 2003
- CSCI 3100: Computer Organization (no evaluation done)

Spring 2003
- CSCI 3100: Computer Organization (3.84 / 5.00)

Fall 2002
- CSCI 4510: Machine Structures (4.38 / 5.00)

Funded Proposals

R1. "I/UCRC Industrial Membership - Ashum Corp," 2020. Krishna Kavi (PI), Robert Akl (co-PI), **$52,000.**

R2. "I/UCRC Industrial Membership - Ashum Corp," 2019. Krishna Kavi (PI), Robert Akl (co-PI), **$60,900.**

R3. "I/UCRC Industrial Membership - Ashum Corp," 2018. Krishna Kavi (PI), Robert Akl (co-PI), **$57,700.**

R4. "Robotics and App Design Summer Camp" under Texas Higher Education Coordinating Board: Engineering Summer Program. Requested amount is $11,727. Submitted 5/5/17. Robert Akl (PI), **$11,727.**

R5. "I/UCRC Industrial Membership - Ashum Corp," 2017. Krishna Kavi (PI), Robert Akl (co-PI), **$50,000.**

R6. "UNT GenCyber Summer Program: Inspiring the Next Generation of Cyber Stars in North Texas," National Security Agency (NSA). Requested amount is $85,000. Submitted 11/4/2016. Robert Akl (co-PI), **$85,000**.

R7. "App Design Summer Camp" under Texas Higher Education Coordinating Board: Engineering Summer Program. Requested amount is $12,900. Submitted 5/6/16. Robert Akl (PI), **$12,900.**

R8. "I/UCRC Industrial Membership - Ashum Corp," 2016. Krishna Kavi (PI), Robert Akl (co-PI), **$65,000.**

R9. "Robotics, Game and App Programming Summer Camps" under Texas Workforce Commission: Summer Merit Program. Requested amount is $63,000. Submitted 11/16/15. Robert Akl (PI), **$63,000**.

R10. "App Design Summer Camp" under Texas Higher Education Coordinating Board: Engineering Summer Program. Requested amount is $13,998. Submitted 5/1/15. Robert Akl (PI), **$13,988**.

R11. "I/UCRC Industrial Membership - Ashum Corp," 2015. Krishna Kavi (PI), Robert Akl (co-PI), **$40,000.**

R12. "App Design Summer Camp" under Texas Higher Education Coordinating Board: Engineering Summer Program. Requested amount is $12,500. Submitted 5/2/14. Robert Akl (PI), **$12,500**.

R13. "I/UCRC Industrial Membership - Ashum Corp," 2014. Krishna Kavi (PI), Robert Akl (co-PI), **$46,000.**

R14. "I/UCRC Industrial Membership - Ashum Corp," 2013. Krishna Kavi (PI), Robert Akl (co-PI), **$38,500.**

R15. "Robotics, Game and App Programming Summer Camps" under Texas Workforce Commission: Summer Merit Program. Requested amount is $63,000. Submitted 12/14/12. Robert Akl (PI), **$63,000**.

R16. "Bio-Com Project," funded by Raytheon under Net-Centric Software and Systems I/UCRC 2nd year. Requested amount is $30,000. Submitted 5/12/12. Krishna Kavi (PI), Robert Akl (co-PI), **$30,000.**

R17. "Bio-Com Project," funded by Raytheon under Net-Centric Software and Systems I/UCRC. Requested amount is $30,000. Submitted 5/12/11. Krishna Kavi (PI),

Robert Akl (co-PI), **$30,000.**

R18. "Game Programming for Xbox 360 Summer Camp" under Texas Higher Education Coordinating Board: Engineering Summer Program. Requested amount is $20,000. Submitted 3/21/11. Robert Akl (PI), **$20,000**.

R19. "RoboCamps and Game Programming Summer Camps" under Texas Workforce Commission: Summer Merit Program. Requested amount is $63,000. Submitted 2/17/11. Robert Akl (PI), **$63,000**.

R20. "Game Programming for Xbox 360 Summer Camp" under Texas Higher Education Coordinating Board: Engineering Summer Program. Requested amount is $13,000. Submitted 2/22/10. Robert Akl (PI), **$18,000.**

R21. "Robotics and Game Programming Summer Camps" under Texas Workforce Commission: Summer Merit Program. Requested amount is $63,000. Submitted 10/16/09. Robert Akl (PI), **$63,000**.

R22. "Micro Air Vehicle Design: A Collaborative Undergraduate Project for Electrical Engineering, Computer Engineering, and Computer Science Students," under UNT Undergraduate Research Initiative. Submitted 9/25/2009. Robert Akl (co-PI), **$8,000**.

R23. "Summer Merit Program" under Texas Workforce Commission. Requested amount is $42,000. Submitted 3/20/09. Robert Akl (PI), **$42,000**.

R24. "Robocamp at Stewpot" under Dallas Women's Foundation. Requested amount is $20,000. Submitted 2/23/09. Robert Akl (PI), **$18,600**.

R25. "Robocamp Jump Start" under Motorola Foundation Innovation Generation Grant. Requested amount is $29,852. Submitted 2/12/09. Robert Akl (PI), **$30,700**.

R26. "Engineering Summer Program" under Texas Higher Education Coordinating Board. Requested amount is $7,944. Submitted 2/13/09. Robert Akl (PI), **$11,111**.

R27. "Texas Youth in Technology" under Texas Workforce Commission. Requested amount is $152,393. Submitted 11/10/08. Robert Akl (PI), **$152,393**.

R28. "I/UCRC Center Proposal: Net-Centric Software and Systems," under NSF-07-537: Industry/University Cooperative Research Centers. Requested amount is $349,482. Submitted 9/26/08. Krishna Kavi (PI), Robert Akl (co-PI), **$60,000 per year for 5 years**.

R29. "Robocamp and Beyond" under Motorola Foundation Innovation Generation Grant. Requested amount is $30,000. Submitted 6/20/08. Robert Akl (PI),

$30,000.

R30. Texas Youth in Technology" under Texas Workforce Commission. Requested amount is $30,000. Submitted 2/27/08. Robert Akl (PI), **$31,500**.

R31. "Robocamp Program for Young Women" under RGK foundation. Requested amount is $30,000. Submitted 11/5/07. Robert Akl (PI), **$15,000**.

R32. "Texas Youth in Technology" under Texas Workforce Commission. Requested amount is $102,514. Submitted 10/22/07. Robert Akl (PI), **$102,514**.

R33. "Women Art Technology" under Hispanic and Global Studies Initiatives Fund. Requested amount is $14,125. Submitted 9/30/07. Jennifer Way (PI), Robert Akl (co-PI), **$12,785**.

R34. "Robocamp Mobile Unit" under Motorola Foundation Innovation Generation Grant. Requested amount is $35,000. Submitted 6/20/07. Robert Akl (PI), **$30,000**.

R35. "ICER: UNT Engineering Challenge Camps" under NSF 0547299. Requested amount is $35,000. Submitted 4/27/07. Oscar Garcia (PI), Robert Akl (senior personnel), **$32,792**.

R36. "I/UCRC-Planning Proposal: UNT Research Site Proposal to join Embedded Systems I/UCRC," under NSF-01-116: Industry/University Cooperative Research Centers. Requested amount is $10,000. Submitted 3/31/07. Krishna Kavi (PI), Robert Akl (co-PI), **$10,000**.

R37. "High-assurance NCCS: Ultra Dependability Integration Engineering," Department of Defense. Requested amount is $20,000. Submitted 3/12/07. Krishna Kavi (PI), Robert Akl (co-PI), **$20,000**.

R38. "Recruiting and Retention Strategies for Computer Science at UNT" under Texas Technology Workforce Development Grant Program – 2005. Requested amount is $163,322. Submitted 3/17/05. Robert Akl (PI), **$125,322**.

R39. UNT Faculty Research Grant for Fall 2003, Robert Akl (PI), $5,000, **$4,000**.

R40. UNT Junior Faculty Summer Research Fellowship for Summer 2003, Robert Akl (PI), $5,000, **$5,000**.

Professional Associations and Achievements

Membership in Professional Organizations

- Senior Member IEEE
- Member, Federation Council of North Texas Universities
- Member, Eta Kappa Nu Electrical Engineering Honor Society
- Member, Golden Key National Honor Society
- Member, Tau Beta Pi Engineering Honor Society

Offices and Committee Assignments in Professional Organizations

- Technical Program Committee Member, IEEE Wireless Communications and Networking Conference, IEEE WCNC
- Technical Program Committee Member, International Wireless Symposium, IWS
- Technical Program Committee Member, IEEE International Conference on Computational Science, IEEE ICCS
- Technical Program Committee Member, IASTED International Conference on Wireless Communications, WC
- Technical Program Committee Member, WTS Wireless Telecommunications Symposium
- Technical Program Committee Member, Mosharaka International Conference on Computer Science and Engineering, Amman
- Invitation to serve as an NSF reviewer/panelist for Engineering Research Centers (ERC) proposals
- Technical Program Committee Member, 18th IEEE International Symposium on Personal, Indoor and Mobile Radio Communication, Greece
- International Program Committee, IASTED International Conference on Wireless and Optical Communication, Canada
- Program Committee Member, Fifth Annual Wireless Telecommunications Symposium, CA
- Technical Publications Chair, IEEE Vehicular Technology Conference, Dallas TX
- Session Chair, International Conference on Computing, Commun. and Control Tech., Austin TX
- Session Chair, International Conference on Cybernetics and Information Technologies, Orlando FL
- Session Chair, 8th World Multi Conference on Systemics, Cybernetic, and Informatics, Orlando FL

Additional Responsibilities and Activities

- Reviewer, *Wireless Communications and Mobile Computing*, 2012 – present
- Reviewer, *Journal of Sensor and Actuator Networks*, 2012 – present
- Reviewer, *IEEE Transactions on Vehicular Technology*, 2011 – present

- Reviewer, *Elsevier Journal of Computers & Electrical Engineering*, 2008 – present
- Reviewer, *IEEE Globecom*, 2007 – present
- Reviewer, *IEEE International Conference on Advanced Networks and Telecommunication Systems (ANTS)*, 2008 – present
- Reviewer, *The International Wireless Communications and Mobile Computing Conference*, 2007 – present
- Reviewer, *Journal on Wireless Communications and Networking*, 2007 – present
- Reviewer, *IEEE Transactions on Communications*, 2007 - present
- Reviewer, *International Journal of Communication Systems*, 2007 – present
- Reviewer, *IEEE Communications Magazine*, 2005 – present
- Reviewer, *Journal of Wireless Networks*, 2004 – present
- Reviewer, *IEEE Transactions on Mobile Computing*, 2004 – present
- Reviewer, *IEEE Transactions on Wireless Communications*, 2004 – present
- Reviewer, *ACM Crossroads*, 2004 – present

Honors and Awards

- Who's Who in America, 2012 Edition
- Winner of Tech Titan of the Future – University Level Award for UNT Robocamps for Girls, Metroplex Technology Business Council, 2010 with **$15,000 cash prize**.
- IEEE Professionalism Award, Ft Worth Chapter, 2008
- UNT College of Engineering Outstanding Teacher Award, 2008
- Certificate of Appreciation: IEEE Vehicular Technology Conference, Dallas, TX, 2005
- Certificate of Appreciation: Denton County Boosting Engineering, Science and Technology (BEST) Robotics Competition, 2004
- Summa Cum Laude Graduate, Ranked First in Undergraduate Class
- The Computer Science Departmental Award for Academic Excellence, Washington University, 1993
- The Dual Degree Engineering Award for Outstanding Senior, Washington University, 1993
- The 1992 Technical Writing Competition Award, The Society for Technical Communication