UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

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

v.

PANTECH CORPORATION,
Patent Owner

IPR2025-00783
U.S. Patent No. 9,288,824

DECLARATION OF DR. ROBERT AKL IN SUPPORT OF PETITION FOR *INTER PARTES REVIEW* OF U.S. PATENT 9,288,824

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IX. Grounds 1 and 2: TS36321-V830 Anticipates or Otherwise Renders Obvious Claims 1 and 7 48

A. Independent Claim 1 48

[1.P] A method for performing a random access procedure by a user equipment (UE), the method comprising: 49

[1.a] transmitting a random access preamble to a base station; 50

[1.b] determining a time period for receiving a random access response responsive to the random access preamble; and 51

[1.c] receiving the random access response from the base station within the time period, ... 52

[1.d] wherein the time period starts at a time point after an end time of transmitting the random access preamble, and a subframe number corresponding, to the time point is obtained by adding an offset to a subframe number corresponding to the end time of transmitting, the random access preamble, and the offset equals three. 54

B. Independent Claim 7 54

[7.P] A user equipment (UE) to perform a random access procedure, the UE comprising: 55

[7.a] a transmitter to transmit a random access preamble to a base station; 55

[7.b] a processor configured to determine a time period for receiving a random access response responsive to the random access preamble; and 56

[7.c] a receiver to receive the random access response from the base station within the time period, ...56

[7.d] wherein the time period starts at a time point after an end time of transmitting the random access preamble, and a subframe number corresponding to the time point is obtained by adding an offset to a subframe number corresponding to the end time of transmitting the random access preamble, and the offset equals three. 57

X. Grounds 3 and 4: Qualcomm Anticipates or Otherwise Renders Obvious Claims 1 and 7.....57

A. Independent Claim 1 57

[1.P] A method for performing a random access procedure by a user equipment (UE), the method comprising:.....57

[1.a] transmitting a random access preamble to a base station;.....58

[1.b] determining a time period for receiving a random access response responsive to the random access preamble; and.....59

[1.c] receiving the random access response from the base station within the time period, ...61

[1.d] wherein the time period starts at a time point after an end time of transmitting the random access preamble, and a subframe number corresponding, to the time point is obtained by adding an offset to a subframe number corresponding to the end time of transmitting, the random access preamble, and the offset equals three. 62

B. Independent Claim 7 63

[7.P] A user equipment (UE) to perform a random access procedure, the UE comprising: 63

[7.a] a transmitter to transmit a random access preamble to a base station;.....63

[7.b] a processor configured to determine a time period for receiving a random access response responsive to the random access preamble; and 64

[7.c] a receiver to receive the random access response from the base station within the time period, ...64

[7.d] wherein the time period starts at a time point after an end time of transmitting the random access preamble, and a subframe number corresponding to the time point is obtained by adding an offset to a subframe number corresponding to the end time of transmitting the random access preamble, and the offset equals three. 65

XI. Grounds 5 and 6: ZTE Anticipates or Otherwise Renders Obvious Claims 1 and 7 66

A. Independent Claim 1 66

[1.P] A method for performing a random access procedure by a user equipment (UE), the method comprising: 66

[1.a] transmitting a random access preamble to a base station; 66

[1.b] determining a time period for receiving a random access response responsive to the random access preamble; and 67

[1.c] receiving the random access response from the base station within the time period, ...70

[1.d] wherein the time period starts at a time point after an end time of transmitting the random access preamble, and a subframe number corresponding, to the time point is obtained by adding an offset to a subframe number corresponding to the end time of transmitting, the random access preamble, and the offset equals three. 71

B. Independent Claim 7 73

[7.P] A user equipment (UE) to perform a random access procedure, the UE comprising: 73

[7.a] a transmitter to transmit a random access preamble to a base station; 73

[7.b] a processor configured to determine a time period for receiving a random access response responsive to the random access preamble; and 73

[7.c] a receiver to receive the random access response from the base station within the time period, ...74

[7.d] wherein the time period starts at a time point after an end time of transmitting the random access preamble, and a subframe number corresponding to the time point is obtained by adding an offset to a subframe number corresponding to the end time of transmitting the random access preamble, and the offset equals three. 74

XII. Ground 7: ZTE in View of TS36321-V800 Renders Obvious Claims 1 and 7.....75

A. Reasons to Combine ZTE and TS36321-V800.....75

B. Independent Claim 1 77

[1.P] A method for performing a random access procedure by a user equipment (UE), the method comprising:.....77

[1.a] transmitting a random access preamble to a base station;.....77

[1.b] determining a time period for receiving a random access response responsive to the random access preamble; and.....77

[1.c] receiving the random access response from the base station within the time period, ...78

[1.d] wherein the time period starts at a time point after an end time of transmitting the random access preamble, and a subframe number corresponding, to the time point is obtained by adding an offset to a subframe number corresponding to the end time of transmitting, the random access preamble, and the offset equals three. 79

C. Independent Claim 7 79

[7.P] A user equipment (UE) to perform a random access procedure, the UE comprising: 79

[7.a] a transmitter to transmit a random access preamble to a base station;.....79

[7.b] a processor configured to determine a time period for receiving a random access response responsive to the random access preamble; and 79

[7.c] a receiver to receive the random access response from the base station within the time period, ...80

[7.d] wherein the time period starts at a time point after an end time of transmitting the random access preamble, and a subframe number corresponding to the time point is obtained by adding an offset to a subframe number corresponding to the end time of transmitting the random access preamble, and the offset equals three. 80

XIII. GROUND 8: TS36321-V800 in View of Nokia Renders Obvious Claims 1 and 7 80

A. Independent Claim 1 80

[1.P] A method for performing a random access procedure by a user equipment (UE), the method comprising: 80

[1.a] transmitting a random access preamble to a base station; 80

[1.b] determining a time period for receiving a random access response responsive to the random access preamble; and [1.c] receiving the random access response from the base station within the time period, ...82

[1.d] wherein the time period starts at a time point after an end time of transmitting the random access preamble, and a subframe number corresponding, to the time point is obtained by adding an offset to a subframe number corresponding to the end time of transmitting, the random access preamble, and the offset equals three. 83

B. Independent Claim 7 86

[7.P] A user equipment (UE) to perform a random access procedure, the UE comprising: 86

[7.a] a transmitter to transmit a random access preamble to a base station; 86

[7.b] a processor configured to determine a time period for receiving a random access response responsive to the random access preamble; and 87

[7.c] a receiver to receive the random access response from the base station within the time period, ...87

[7.d] wherein the time period starts at a time point after an end time of transmitting the random access preamble, and a subframe number corresponding to the time point is obtained by adding an offset to a subframe number corresponding to the end time of transmitting the random access preamble, and the offset equals three. 88

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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. 9,288,824 (also referred to herein as "the '824 Patent") currently assigned to Pantech Corporation ("Pantech" or "Patent Owner"). Specifically, I have been asked to consider the validity of claims 1 and 7 of the '824 Patent (the "Challenged Claims") in view of prior art, anticipation, and obviousness considerations, and understanding of a person of ordinary skill in the art at the time of the invention ("POSITA") as it relates to the '824 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 January 1, 2008—the claimed earliest priority date of the '824 Patent. However, as discussed in Section VII.C, I have opined whether claims 1 and 7 of the '824 Patent satisfy the written description requirement, and my opinion

supports that claims 1 and 7 are not entitled to the claimed U.S. provisional priority date of January 1, 2008 and foreign priority date of May 22, 2008. In this regard, my analyses and conclusions with respect to claims 1 and 7 (using the perspective of a POSITA as of January 1, 2008) remain the same from the perspective of a POSITA as of December 31, 2008, the filing date of its earliest parent patent, should the Board agree that claims 1 and 7 are not entitled to any priority dates before December 31, 2008.

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 January 1, 2008, 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 '824 Patent, the prosecution history of the '824 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. 9,288,824 to Noh *et al*. ("the '824 Patent")
- EX1002: Prosecution History of U.S. Patent No. 9,288,824 ("the '824 Prosecution History")
- EX1004: "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 V8.3.0 (2008-09) ("TS36321-V830")
- EX1005: "Corrections Relating to RACH" by Nokia Corporation, Nokia Siemens Networks, 3GPP TSG-RAN2 Meeting #63, R2-084921, Jeju, Korea, 18 August – 22 August, 2008 ("Nokia-R2")

- EX1006: "RA_WINDOW and RA-RNTI Allocation" by Qualcomm Europe, 3GPP TSG-RAN WG2 #61bis, R2-081559, Shenzhen, China, 31st March – 4th April, 2008 ("Qualcomm")
- EX1007: "Coding of RA-RNTI for Message 2" by ZTE, 3GPP TSG-RAN Working Group 2 meeting #59bis, R2-073933, Shanghai, China, 8th October – 12th October, 2007 ("ZTE")
- EX1008: "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 V8.0.0 (2007-12) ("TS36321-V800")
- EX1009: "Number of HARQ Processes for FDD" by Nokia, Nokia Siemens Networks, 3GPP TSG-RAN WG1 Meeting #50bis, R1-074344, Shanghai, China, October 8th – 12th, 2007 ("Nokia")
- EX1011: U.S. Provisional Application No. 61/018,492 ("the '492 Application")
- EX1012: Certified English Translation of U.S. Provisional Application No. 61/018,492 ("the '492_trans")
- EX1013: Korean Patent Application No. 10-2008-0047656 ("the '656 Application")
- EX1014: Certified English Translation of Korean Patent Application No. 10-2008-0047656 ("the '656_trans")
- EX1015: "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 8)," 3GPP TS 36.300 V8.0.0 (2007-03) ("TS36300-V800")

- EX1017: Joint Claim Construction and Prehearing Statement, *Pantech Corp. et al. v. OnePlus Tech. (Shenzhen) Co., Ltd.*, 5:24-cv-00038-RWS-JBB, Dkt. No. 49 (E.D. Tex. March 26, 2025) ("Claim Construction Statement")
- EX1018: E. Dahlman *et al*., "3G Evolution: HSPA and LTE for Mobile Broadband," 1st ed. Elsevier, 2007 ("Dahlman")
- EX1019: Prosecution History of U.S. Patent No. 8,611,297 ("the '297 Prosecution History")

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.

B. Priority Date

32. 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.

33. 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

34. 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.

35. 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.

36. 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.

37. 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

38. 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.

39. 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.

40. 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.

41. 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.

42. 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

43. 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. 361-362. 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.*, EX1008, Section 5.1; EX1015, Section 10.1.5; EX1018, Section 17.2. 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. 361-362.

44. An overview of the random access procedure is shown in FIG. A (reproduction of Figure 10.1.5-1: Random Access Procedure of TS36300-V800) 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. EX1015, p. 46; EX1018, p. 363. The RACH is an uplink transport channel. EX1008, Section 4.5.1, p. 9. 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). EX1008, Sections 5.1.1, 5.1.2, and 5.1.3, pp. 11-12.

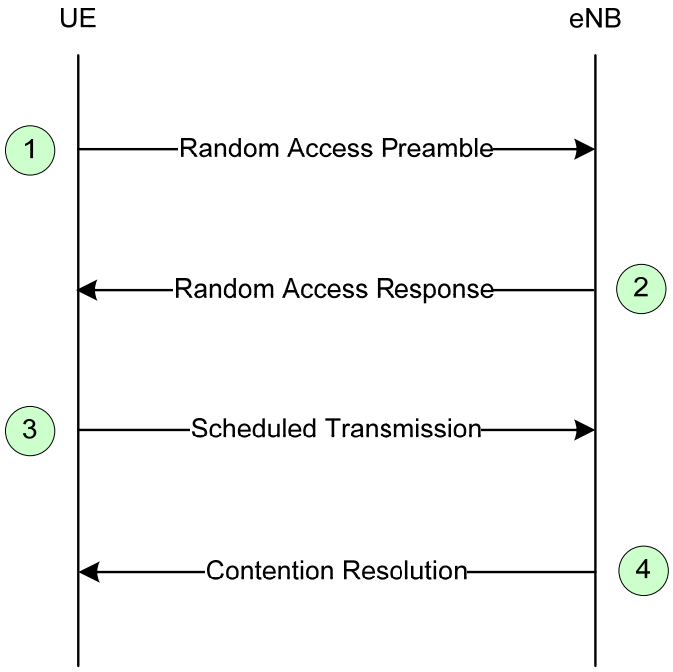


FIG. A – Figure 10.1.5-1: Random Access Procedure of EX1015, TS36300-V800

45. 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. EX1015, p. 46; EX1018, p. 367. The DL-SCH is a

downlink transport channel. EX1008, Section 4.5.1, p. 9. The DL-SCH is mapped to the Physical Downlink Shared Channel (PDSCH). EX1018, p. 333. 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, pp. 333-334. After transmitting the random access preamble, the UE monitors the PDCCH for the random access response corresponding to the random access preamble. EX1008, Section 5.1.4, p. 12; EX1018, p. 367. 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. 368.

46. 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. 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. EX1015, p. 46; EX1018, p. 368. 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. EX1015, p. 46; EX1018, p. 368.

B. LTE Frame Structure

47. FIG. B (reproduction of Figure 16.1 LTE time-domain structure of Dahlman) below shows the high-level time-domain structure for LTE transmission with each (radio) frame with a length T_{frame} equal to 10 ms, each of which consists of ten equally sized subframes with a length $T_{subframe}$ equal to 1 ms. EX1018, p. 317. To provide consistent and exact timing definitions, different time intervals within the LTE radio access specification can be expressed as multiples of a basic time unit T_s =1/30720000. EX1018, p. 317. The time intervals illustrated in FIG. B can thus also be expressed as T_{frame} = 307200 * T_s and $T_{subframe}$ = 30720 * T_s. Within one carrier, the different subframes of a frame can either be used for downlink transmission or for uplink transmission. EX1018, p. 317.

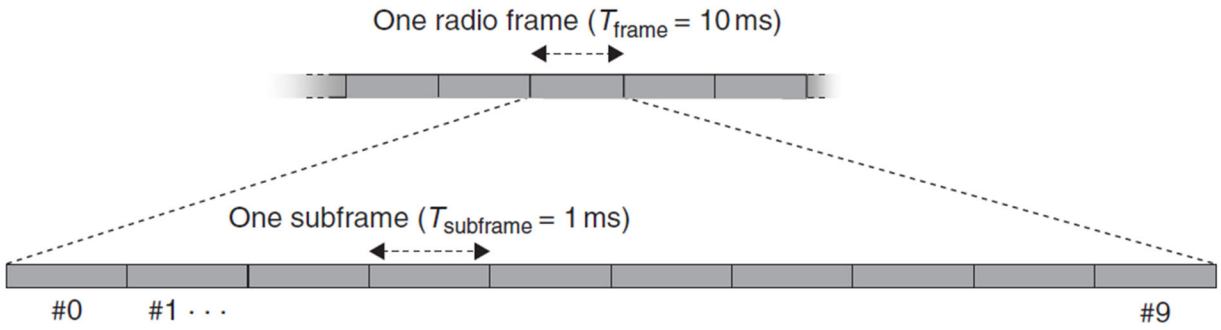


Figure 16.1 *LTE time-domain structure.*

FIG. B – Figure 16.1 LTE time-domain structure of EX1018, Dahlman

48. The time-domain structure shown in FIG. B above is also referred to as the generic or Type 1 LTE frame structure, which is applicable for both Frequency

Division Duplex (FDD) and Time Division Duplex (TDD). EX1018, p. 318. In case of FDD, *i.e.*, operation in paired spectrum, all subframes of a carrier are either used for downlink transmission (a downlink carrier) or uplink transmission (an uplink carrier). EX1018, p. 318.

VII. Overview of the '824 Patent

A. Subject Matter Overview

49. The '824 Patent is titled "METHOD FOR TRANSMITTING AND RECEIVING RANDOM ACCESS REQUEST AND TRANSMITTING AND RECEIVING RANDOM ACCESS RESPONSE." EX1001, Cover. The '824 Patent was issued on March 15, 2016, from U.S. Application No. 13/960,448, which is a continuation of Application No. 13/340,447, filed on December 29, 2011, which is a continuation of Application No. 12/347,352, filed on December 31, 2008. The '824 Patent claims the priorities to U.S. Provisional Application No. 61/018,492 ("the '492 Application"), filed on January 1, 2008, and Korean Application No. 10-2008-0047656 ("the '656 Application"), filed on May 22, 2008. EX1001, Cover.

50. The '824 Patent pertains to a wideband radio access system, particularly addressing the transmission and reception of random access requests (preambles) and random access responses. EX1001, 1:21-25. The '824 Patent aims to resolve the issue of "distinguishing between a delayed response and a response which is

transmitted on time or between delayed responses" when the response cannot be transmitted on time by the base station. EX1001, 2:30-37. The '824 Patent attempts to "solve the problem lies on a method of transmitting and receiving a random access response, which is capable of preventing a user equipment which attempts to access using, a randomly selected sequence from erroneously receiving a response for the access of another user equipment, which attempts access with the same sequence, as a response for its access." EX1001, 2:44-50.

51. In the "Discussion of the Related Art" section, the '824 Patent acknowledges that the random access procedure—where the user equipment (UE) transmits a random access preamble to a base station and receives a random access response from the base station—is well-established in the art, *e.g.*, as defined in 3GPP technical specification published in December 2007. EX1001, 1:26-55. This admission is in line with the common knowledge of a POSITA in the wireless communication industry well before the '824 Patent, as I discussed above in Section VI.A. The '824 Patent further explains that its embodiments apply to "a wideband radio access system, which may refer to '3GPP TS 36.211 v.8.1.0, 'Evolved Universal Terrestrial Radio Access (E-UTRA); Physical channels and modulation,' 2007 Dec. 20' regarding to random access in a wideband radio access system." EX1001, 4:40-45.

52. As summarized in the "Summary of the Invention" section, the '824 Patent discloses two different approaches, which attempt to solve the problem that the UE "recognizes a random access response for a random access request transmitted by another user equipment as a response for its random access request." EX1001, 2:51-3:45.

53. The first approach of the '824 Patent, as illustrated with respect to FIGs. 3A-10, involves the base station: (i) determining time related information (*i.e.*, time information) of a time point when the random access preamble is transmitted (*e.g.*, uplink subframe number); and (ii) including the time information in the random access response transmitted to the UE. EX1001, 2:51-3:23. Then, the UE receives and uses the time information in the random access response, such as the uplink subframe number when the UE transmitted the random access preamble, to determine whether the received random access response is for a random access preamble transmitted by the UE itself or other UE. EX1001, 3:42-45, 9:38-56, 13:6-26.

54. While in the second approach of the '824 Patent described with respect to FIGs. 11-14, the UE determines a time period for receiving random access response (*e.g.*, default time or response reception time location) and uses such a predetermined time period (*e.g.*, default time) to check whether the received random

access response is for a random access preamble transmitted by the UE itself or other UE. EX1001, 3:24-45, 13:52-58, 15:3-7. The second approach corresponds to the challenged claims 1 and 7.

55. As an example of the second approach, as shown in FIG. C (annotated FIG. 14 of the '824 Patent) below, the user equipment 1 (UE1) "decide[s] default times, in which the random access responses of the random access preambles to be transmitted will be received" at step S1420 (annotated in the red box). EX1001, 15:23-26. At step S1430 (annotated in the green box), UE1 "transmit[s] the random access preamble[]" "at time point[] corresponding to the uplink subframe number[] sf_F_N=1." EX1001, 15:36-42. At step S1460 (annotated in the blue box), UE1 "receive[s] the respective random access response[]" and "check[s] whether the received random access response[] [is] received at the default time[] set in the steps S14[2]0." EX1001, 15:61-65.

FIGURE 14

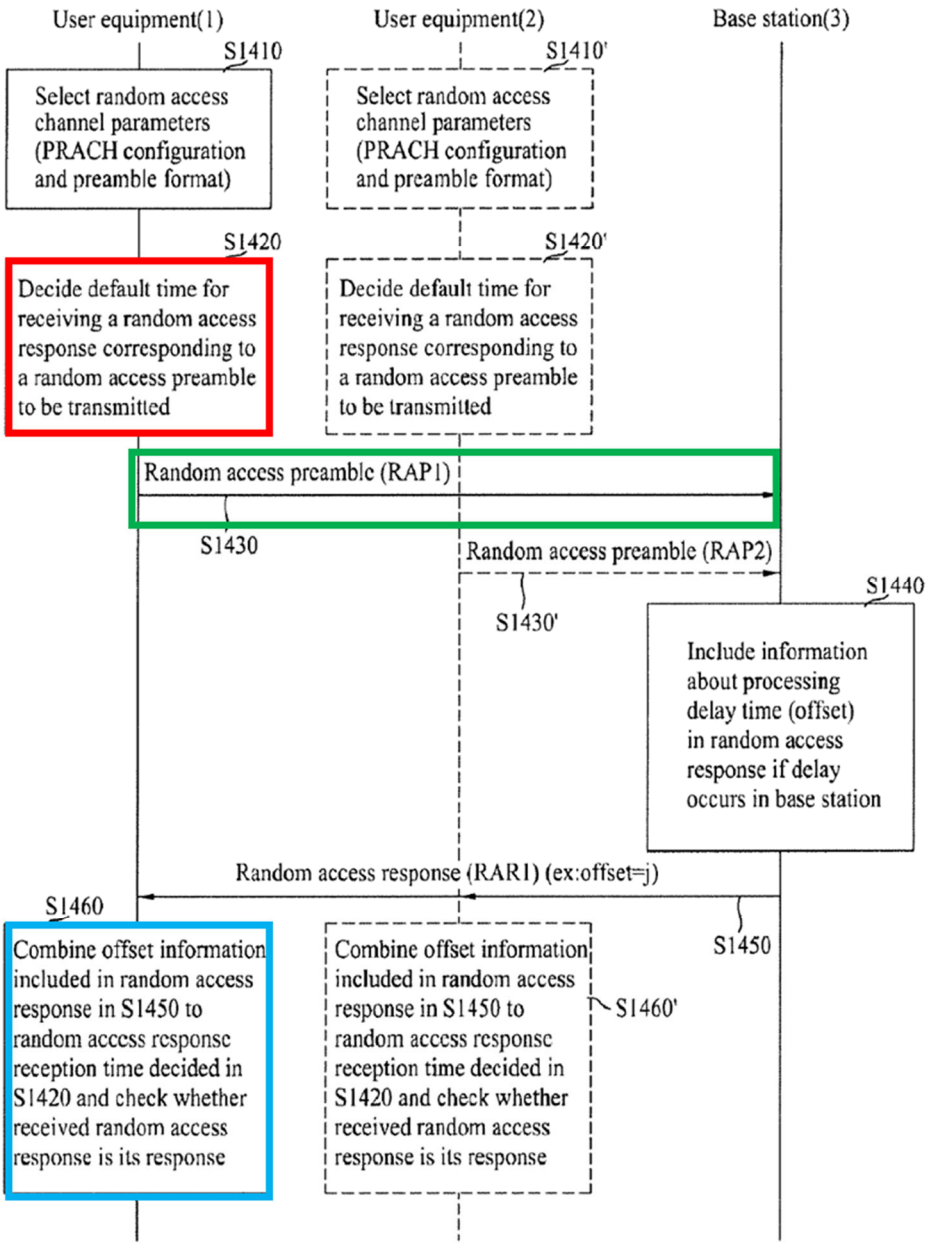


FIG. C – FIG. 14 of EX1001, the '824 Patent (annotated)

56. In this embodiment, the '824 Patent further discusses the case in which a processing delay occurs at the base station 3, such that the base station 3 "may

include information about the processing delay time (timing offset) in the random access response (S1440)." EX1001, 15:46-53. If the offset included in the received random access response is not 0, *e.g.*, j sections (or the number of subframes or the time), then it is assumed that for the random access preamble transmitted by UE1, UE1 "receives the random access response after j sections (or the number of subframes or the time) from a time decided in the step S1420. At this time, the offset included in the received random access response corresponds to the j sections, it is determined that the received random access response is the response of the random access preamble transmitted by the user equipment 1." EX1001, 16:32-49.

B. Prosecution History of the '824 Patent

57. I have reviewed the prosecution history of the '824 Patent. Upon the issuance of the Non-Final Office Action dated April 1, 2015, claims 1-14 were pending in the application, with claims 1, 4, and 7 being rejected on the ground of nonstatutory double patenting over U.S. Patent No. 8,611,297 ("the '297 Patent"). EX1002, 85, 87. In response, Patent Owner filed a terminal disclaimer against the '297 Patent without presenting arguments on the merits. EX1002, 77, 79.

58. The Examiner issued the Notice of Allowance afterwards. EX1002, 51. In the Notice of Allowance, the Examiner stated that claim 1 is allowable over U.S. Patent Application Publication No. 2010/0323736 in the name of Fischer *et al*.

("Fischer") and U.S. Patent Application Publication No. 2008/0232317 in the name of Jen ("Jen") since none of Fischer and Jen discloses that "*wherein the time period starts at a time point after an end time of transmitting the random access preamble, and a subframe number corresponding, to the time point is obtained by adding an offset to a subframe number corresponding to the end time of transmitting, the random access preamble, and the offset equals three*." EX1002, 57.

C. Written Description Requirement for Claims 1 and 7

59. On its face, the '824 Patent claims the benefit of priorities to U.S. Provisional Application No. 61/018,492 (hereinafter "'492 Application," EX1011), filed on January 1, 2008, and Korean Application No. 10-2008-0047656 (hereinafter "'656 Application," EX1013), filed on May 22, 2008. EX1001, cover.

60. I have been asked to analyze whether the '492 Application and the '656 Application describe the claimed invention of claims 1 and 7 in sufficient detail that a POSITA can reasonably conclude that the inventor had possession of the claimed invention. My opinion is that a POSITA cannot reasonably conclude that the inventor had possession of the claimed invention, in particular, the features related to "*determining/determine a time period for receiving a random access response responsive to the random access preamble*, … *wherein the time period starts at a time point after an end time of transmitting the random access preamble, and a*

subframe number corresponding to the time point is obtained by adding an offset to a subframe number corresponding to the end time of transmitting the random access preamble, and ***the offset equals three***" (hereinafter "determining-offset limitations") because none of the '492 Application and the '656 Application describes the determining-offset limitations with reasonable clarity, let alone in sufficient detail.

61. It is noted that since the preambles of claims 1 and 7 recite "*a user equipment (UE)*" to "*perform a random access procedure*," the determining-offset limitations are performed by the UE in the random access procedure.

1. The '492 Application

62. Claims 1 and 7 are directed to the second approach of the '824 Patent in which the UE predetermines the time period for receiving the random access response. *See* Section VII.A. This approach is described as "Method 1: Response location based on a predetermined timing period" in the '492 Application. EX1012, 4-6. With respect to the claimed subframe offset in the determining-offset limitations, the '492 Application references the term "*offset*" only three times within Method 1, all of which are bolded in the paragraph reproduced below:

> "Alternatively, a method of applying an **offset** in consideration of a difference between a data processing time and a random access processing time may be used. For example, a method of receiving a downlink signal by the user equipment at a location **offset** from a time determined by the number of HARQ processes by one subframe is possible. This **offset** may be represented by adding or subtracting of a predetermined number and may be represented by a multiple of the

number of HARQ processes." EX1012, 6.

63. A POSITA reading the above-cited text, which describes an alternative method from other methods described in Method 1, would understand that an offset "may be represented by adding or subtracting of a predetermined number." This disclosure, however, does not specify or even suggest the value of such "a predetermined number," much less the value being "***three***," as recited in the determining-offset limitations.

64. Although the above-cited text also mentions that the offset may be represented by "a multiple of the number of HARQ processes," the only disclosure in the '492 application regarding the "number of HARQ processes" is that "the number of HARQ process is **8**." EX1012, 5. Therefore, "a multiple of the number of HARQ processes" would be at least 8, for example, 8, 16, 24, etc., but would not be the claimed "***three***."

65. Moreover, the sentence "a method of receiving a downlink signal by the user equipment at a location offset from a time determined by the number of HARQ processes by one subframe is possible" at most discloses that the value of an offset is "**one** subframe," as opposed to the claimed "***three***." Accordingly, it is clear to me that the '492 Application fails to provide written disclosure support for the determining-offset limitations, particularly the specific value of subframe offset

being "***three***."

66. I understand that besides Method 1, the term "offset" is also referenced twice on page 9 in "Method 2: Method for including transmitted or received time location information in RACH response." EX1012, 6, 9. However, Method 2 of the '492 Application corresponds to the first approach of the '824 Patent in which the base station determines the time information and includes it in the random access response. *See* Section VII.A. Thus, Method 2 is not relevant to the written description discussion here for claims 1 and 7.

67. FIG. [2]: Example of HARQ processing on page 5 of the '492 Application also does not illustrate the value of subframe offset being "*three.*" FIG. 2 shows a HARQ (hybrid automatic repeat request) procedure, which is a separate and distinct procedure from the claimed "*random access procedure.*" In short, HARQ is an error correction procedure by retransmission for ongoing data transfer after a connection is established, while random access is a procedure for initial access to the network or request for uplink resources. EX1008, Sections 5.1, 5.4.2; EX1015, Sections 9.1, 10.1.5; EX1018, Sections 15.2.4, 17.2. That is, the HARQ and random access procedures serve very different purposes and are used in different situations.

68. Specifically, the HARQ procedure in LTE serves a purpose "to provide

robustness against transmission errors," and "[i]t is also a tool for enhanced capacity." EX1008, p. 309. The HARQ procedure employs a retransmission mechanism triggered by transmission errors after initial transmission. EX1008, pp. 309-311. On the other hand, as I discussed in Section VI.A above, the random access procedure allows a UE to establish or re-establish a connection with a base station triggered by initial access, handover, or uplink timing misalignment, and serves two main purposes including (i) establishment of uplink synchronization, and (ii) establishment of a unique terminal identity known to both the base station and the UE. EX1018, pp. 361-362.

69. It is worth noting that the 3GPP LTE standard—TS36300-V800—defines that in the second step of the random access procedure regarding Random Access Response on DL-SCH, "No HARQ." EX1015, Section 10.1.5, p. 46. This is because a UE receiving a random access response intended for another UE will have incorrect uplink timing, and if HARQ were used, the timing of the ACK/NAK for the UE would also be incorrect and may disturb uplink control signaling from other UEs due to contention between UEs in the random access procedure. EX1018, Section 17.2.2, pp. 367-368.

70. Because the HARQ procedure is separate and distinct from the random access procedure, a POSITA would not consider any specific timing requirement in

the HARQ procedure, as illustrated in FIG. 2 of the '492 Application and its corresponding disclosure, to be applicable to the claimed "*random access procedure,*" including the determining-offset limitations.

2. The '656 Application

71. The second approach of the '824 Patent, which corresponds to claims 1 and 7, is described with respect to FIGs. 11-14 of the '656 Application.

72. Like the '492 Application, the '656 Application discloses, in an alternative method of applying delay offset, "an offset of one sub-frame determined by the HARQ round trip time or the total number of HARQ processes" and that the "offset may be represented by adding or subtracting a predetermined number, and may be represented by a multiple of the number of HARQ processes." EX1014, ¶61. However, those disclosures do not convey with reasonable clarity to a POSITA that the '656 Application provides written description support for the determining-offset limitations, particularly the specific value of subframe offset being "***three***" for the same reasons I explained above with respect to the '492 Application in Section VII.C.1.

73. Also, like that of FIG. 2 of the '492 Application, any specific timing requirement in the HARQ procedure illustrated in FIG. 13 of the '656 Application is not applicable to the determining-offset limitations in the claimed "*random access procedure*" since the HARQ procedure is separate and distinct from the random

access procedure as I explained above with respect to the '492 Application in Section VII.C.1.

74. Moreover, FIG. 14 and its accompanying descriptions in paragraphs 66-68 of the '656 Application also reference the term "offset" (*i.e.*, the processing delay time of the base station 3) and describe its inclusion in the random access response by the base station 3. However, the '656 Application does not disclose that the UE predetermines the time period including the offset for receiving the random access response, much less that the value of the offset is "***three***." EX1014, ¶¶66-68, FIG. 14.

75. If Patent Owner contends that FIG. 6b of the '656 Application and its corresponding texts provide support that "*the offset equals three*," I believe this argument is misplaced since FIG. 6b of the '656 Application is part of the distinct first approach. In this approach, the base station determines the time information and includes the time information in the random access response. Then, the UE extracts the time information from the random access response to differentiate random access responses intended for different UEs. EX1014, ¶10. For example, the '656 Application explains that the time information related to the delayed time, *i.e.*, delay offset information, is preferably included in the random access response by the base station. EX1014, ¶45. However, this approach—the same as that of FIG.

6B and its corresponding descriptions in the ’824 Patent—is not what the claimed invention is directed to. *See* Section VII.A. Thus, no matter whether FIG. 6b of the ’656 Application discloses or suggests any subframe offset being three or not, such an offset is not associated with a time period for receiving random access response that is predetermined by a UE, let alone for obtaining a starting time point at which the time period for receiving random access response starts, as part of the determining-offset limitations in claims 1 and 7.

D. Interpretation of the ’824 Patent Challenged Claims

76. I have been instructed that the challenged claims of the ’824 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 ’824 Patent.

77. I understand that in a pending district court litigation between Pantech and OnePlus, Petitioner proposes that the term “*time period*” recited in claims 1 and 7 should be construed as “an amount of time.” EX1017, 2-3. I also understand that Patent Owner asserts that this term should be given their plain and ordinary meaning,

without specifying what it believes the plain and ordinary meaning is. EX1017, 2-3. As I explain below with respect to Grounds 1-8, the challenged claims are anticipated and/or rendered obvious by the prior art under either party's construction.

VIII. Overview of the Cited References

78. 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. TS36321-V830 (EX1004)

79. TS36321-V830 is one version of the technical specification released by 3GPP in September 2008 as part of the LTE standard, specifically defining the Medium Access Control (MAC) protocol in LTE. EX1004, Cover, Section 1.

80. TS36321-V830 defines various aspects of the random access procedure (Section 5.1) including random access procedure initialization (Section 5.1.1), random access resource selection (Section 5.1.2), random access preamble transmission (Section 5.1.3), random access response reception (Section 5.1.4), contention resolution (Section 5.1.5), and completion of the random access procedure (Section 5.1.6). *See generally* EX1004, Section 5.1.

81. Particularly, Section 5.1.4 of TS36321-V830 discloses that "[o]nce the Random Access Preamble is transmitted and regardless of the possible occurrence

of a measurement gap, the UE shall monitor the PDCCH for Random Access Response(s) identified by the RA-RNTI defined below, in the **TTI window RA_WINDOW_BEGIN—RA_WINDOW_END which starts at the subframe that contains the end of the preamble transmission** [] **plus three subframes** and has length *ra-ResponseWindowSize* subframes." EX1004, Section 5.1.4, p. 13. This particular definition was introduced through a Change Request from the earlier version (V8.2.0) of the technical specification, submitted by Nokia Corporation and Nokia Siemens Network in August 2008 for the purpose of clarifying the RA response reception window (RA_WINDOW) calculation, particularly on how to define when the window begins and ends. EX1005, Cover, Section 5.1.4.

82. Section 5.1.4 of TS36321-V830 also requires that "if the Random Access Response contains a Random Access Preamble identifier corresponding to the transmitted Random Access Preamble …, the UE shall[] consider this Random Access Response reception successful," and that "[i]f no Random Access Response is received within the TTI window [RA_WINDOW_BEGIN—RA_WINDOW_END], or if all received Random Access Responses contain Random Access Preamble identifiers that do not match the transmitted Random Access Preamble, the Random Access Response reception is considered not successful." EX1004, Section 5.1.4, pp. 13-14.

B. TS36321-V800 (EX1008)

83. TS36321-V800 is an earlier version of the 3GPP technical specification specifying MAC protocol in LTE, compared with TS36321-V830. EX1008, Cover, Section 1.

84. TS36321-V800 defines various aspects of the random access procedure (Section 5.1) including the random access procedure initialization (Section 5.1.1), random access resource selection (Section 5.1.2), random access preamble transmission (Section 5.1.3), and random access response reception (Section 5.1.4). *See generally* EX1008, Section 5.1.

85. For instance, section 5.1.4 of TS36321-V800 defines that "[o]nce the Random Access Preamble is transmitted, the UE shall monitor the [PDCCH] in the TTI window [RA_WINDOW_BEGIN—RA_WINDOW_END] for Random Access Response(s)." EX1008, Section 5.1.4, p. 12.

C. Qualcomm (EX1006)

86. Qualcomm proposes to progress the definition of begin and end of the random access response reception window RA_WINDOW_BEGIN—RA_WINDOW_END. EX1006, Section 1, p. 1.

87. In Section 2.2, Qualcomm proposes to fix the value of RA_WINDOW_BEGIN, *i.e.*, the beginning of the random access response reception

window, which is set relative to the end of the PRACH transmission. EX1006, Section 2.2, p. 1. Qualcomm explains that "3ms is a reasonable minimum amount of time to process the PRACH" "after PRACH transmission." EX1006, Section 2.2, p. 1.

88. FIG. D (annotated Figure 1 of Qualcomm) below illustrates RA_WINDOW_BEGIN, which is set with a delay offset of 3 ms after PRACH transmission for FDD (frequency division duplex). EX1006, Section 2.2, pp. 1-2. As I explained above in Section VI.B, each time unit in FIG. D represents 1 ms, which corresponds to 1 subframe for FDD in LTE. EX1018, pp. 317-318. Thus, the offset of 3 ms in Qualcomm corresponds to 3 subframes.

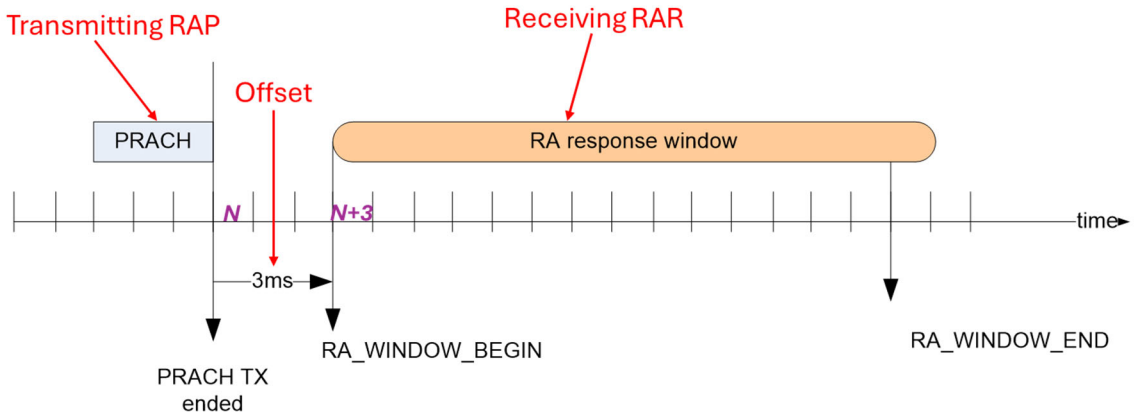


FIG. D - Figure 1 RA_WINDOW_BEGIN starting at least 3ms after PRACH transmission for FDD of EX1006, Qualcomm (annotated)

89. As shown in FIG. D above, a random access preamble (RAP) is transmitted in PRACH by a UE, and the corresponding random access response

(RAR) is received in a random access (RA) response window by the UE. Qualcomm further discloses that subframe *N* corresponds to the end time "PRACH TX ended" of transmitting RAP in PRACH, and the beginning "RA_WINDOW_BEGIN" of the RA response window for receiving RAR is the first downlink (DL) subframe with a subframe number equal to *N*+3. EX1006, Section 2.2, p. 2. In other words, Qualcomm discloses setting the offset between the subframe number (*N*) corresponding to "PRACH TX ended" and the subframe number (*N*+3) corresponding to "RA_WINDOW_BEGIN" to be 3 for FDD in LTE.

D. ZTE (EX1007)

90. ZTE proposes the coding scheme of RA-RNTI for message 2. EX1007, § 1, p. 1. As I explained in Section VI.A, "message 2" refers to the random access response in the random access procedure. RA-RNTI, the abbreviation of Random Access-radio Network Temporary Identifier, refers to the identifier in the random access response messages (*i.e.*, message 2), which identifies the time-frequency resource utilized by the UE to transmit the random access preamble. EX1008, Section 3.1, p. 7; EX1015, Section 10.1.5, p. 46.

91. ZTE discloses that "RAN2 group has agreed that message 2 will be received in asynchronous way *i.e.* within a reception TTI window." EX1007, Section 2.1, p. 1. In LTE, TTI, the abbreviation of Transmission Time Interval, is the

smallest unit of time in which the eNB can schedule any UE for uplink or downlink transmission (*e.g.*, at most one transport block is transmitted over the radio interface per TTI in the absence of spatial multiplexing). EX1018, pp. 303-304. In LTE, one TTI is 1 ms. EX1018, p. 304.

92. Further, FIG. E (annotated FIG. 1 of ZTE) below illustrates a reception TTI window within which the corresponding random access response (message 2) will be received. EX1007, Section 2.1, p. 1. Two reception windows (reception window 1 in yellow and reception window 2 in red) are shown in FIG. E, each having a length of "Wleng" subframes, for receiving two random access responses, respectively. EX1007, Section 2.1, p. 1. ZTE further discloses that "as long as Sdistance (distance between two subframe[s]) is not smaller than Wlength[,] the two reception window[s] will not overlap with each other." EX1007, Section 2.1, p. 1. It is clear that the term "Wlength" in the text and the figure legend "Wleng" in Figure 1 of ZTE refer to the same concept—the length of the reception window.

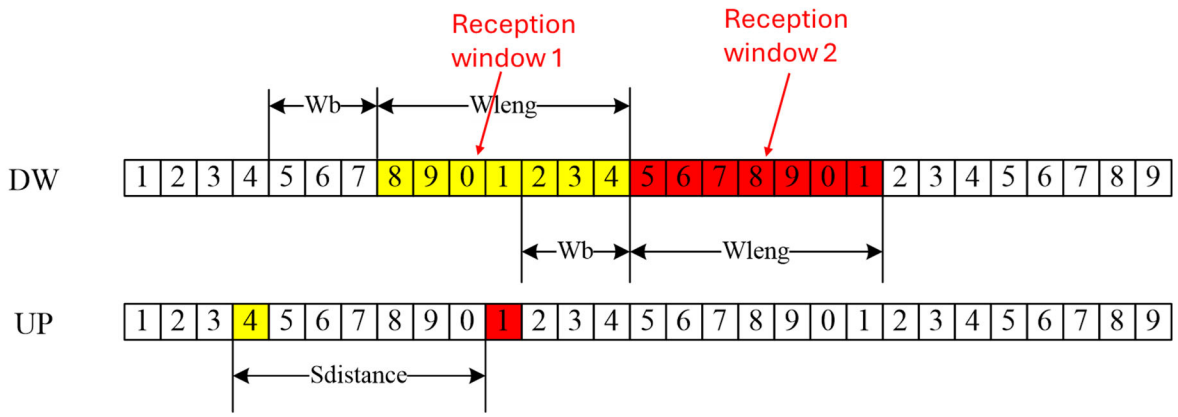


FIG. E – Figure 1 reception window of EX1007, ZTE (annotated)

93. ZTE further defines RA-RNTI as "the subframe number within radio frame." EX1007, Section 2.1, FIG. 2, p. 2. FIG. F (annotated FIG. 2 of ZTE) below shows (i) two PRACH slots (PRACH 1 in yellow and PRACH 2 in red) in which two random access preambles are transmitted by a UE in the uplink (UP), respectively, and (ii) two reception windows (reception window 1 in yellow and reception window 2 in red) within which the corresponding random access responses are received by the UE in the downlink (DW), respectively. EX1007, Section 2.1, p. 2.

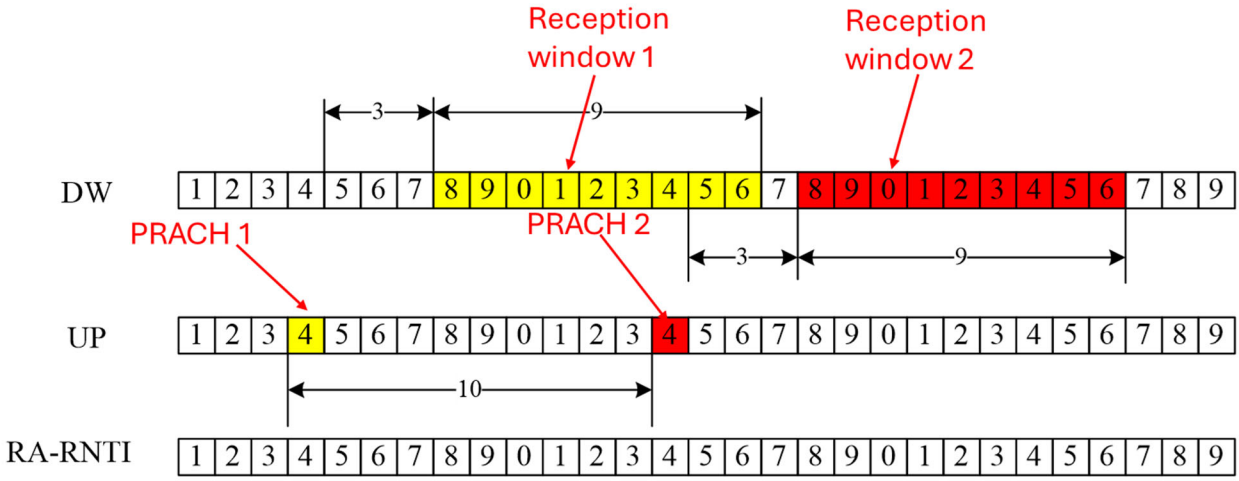


FIG. F – Figure 2 RA-RNTI = Subframe Number of EX1007, ZTE (annotated)

E. Nokia (EX1009)

94. Nokia discusses the processing times for eNB in the HARQ procedure. EX1009, Section 1, p. 1.

95. Figure 1 of Nokia shows the uplink transmission timing diagram in the HARQ procedure. EX1009, p. 2. Figure 1 of Nokia is compared with FIG. 2 of

the ’492 Application and FIG. 13 of the ’656 Application below in FIG. G. From FIG. G, it is clear that Figure 1 of Nokia is identical to FIG. 2 of the ’492 Application. Figure 1 of Nokia is also substantially the same as FIG. 13 of the ’656 Application except that the uplink physical channels for “UL timing at UE/eNB” in Figure 1 of Nokia are labeled as “PUSCH,” whereas the uplink physical channels in FIG. 13 of the ’656 Application for “UL timing at UE/eNB” are erroneously labeled as “PDCCH.” In fact, PDCCH in UL timing at UE shall be PUSCH, like that in Figure 1 of Nokia and FIG. 2 of the ’492 Application, since PDCCH is a downlink (DL) channel, not an uplink (UL) channel.

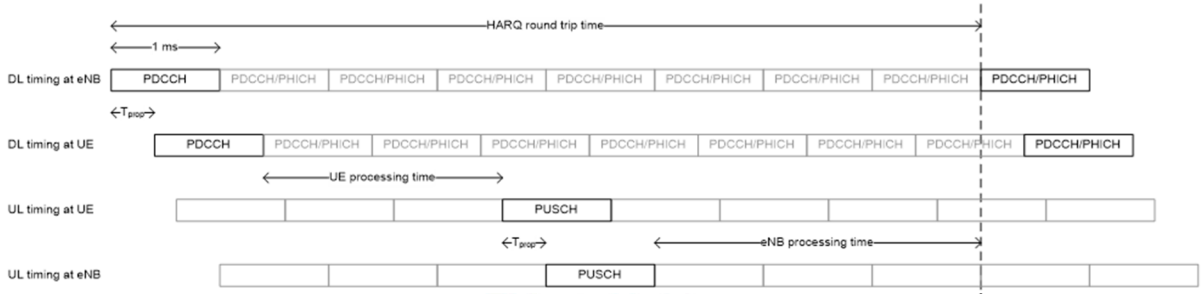


FIG. 1, Nokia

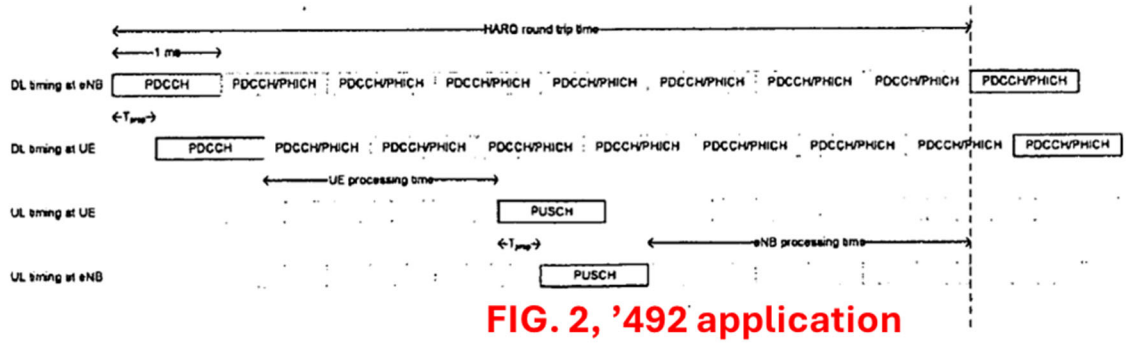


FIG. 2, '492 application

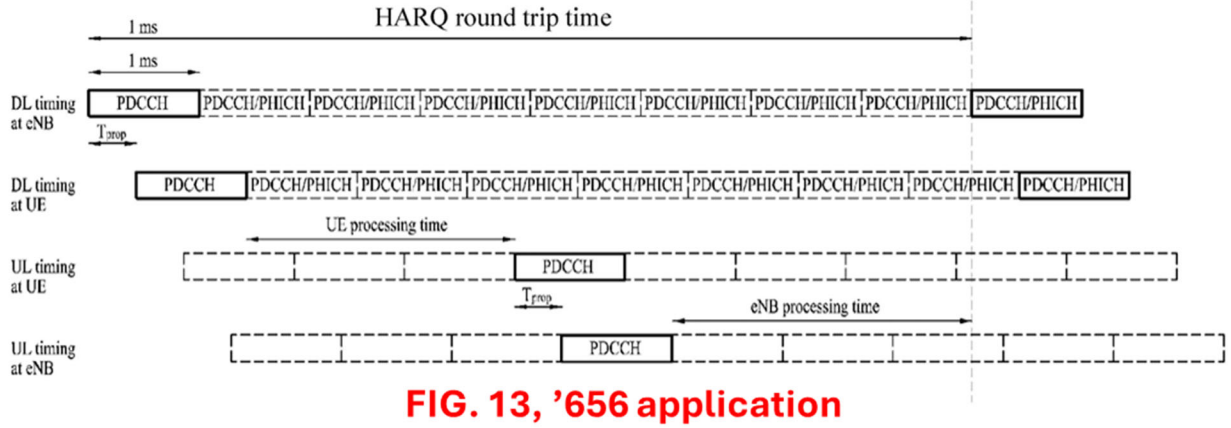


FIG. 13, '656 application

<Example of HARQ process>

FIG. G – Comparing FIG. 1 of EX1009, Nokia, FIG. 2 of EX1012, the '492 Application, and FIG. 13 of EX1014, the '656 Application (annotated)

IX. Grounds 1 and 2: TS36321-V830 Anticipates or Otherwise Renders Obvious Claims 1 and 7

A. Independent Claim 1

96. Claim 1 is reproduced below. For ease of discussion, I have included a

label for each claim limitation.

> **[1.P]** A method for performing a random access procedure by a user equipment (UE), the method comprising:
> **[1.a]** transmitting a random access preamble to a base station;
> **[1.b]** determining a time period for receiving a random access response responsive to the random access preamble; and
> **[1.c]** receiving the random access response from the base station within the time period,
> **[1.d]** wherein the time period starts at a time point after an end time of transmitting the random access preamble, and a subframe number corresponding, to the time point is obtained by adding an offset to a subframe number corresponding to the end time of transmitting, the random access preamble, and the offset equals three.

[1.P] A method for performing a random access procedure by a user equipment (UE), the method comprising:

97. TS36321-V830 discloses a method for performing a random access procedure by a UE, including random access procedure initialization (EX1004, Section 5.1.1), random access resource selection (EX1004, Section 5.1.2), random access preamble transmission (EX1004, Section 5.1.3), random access response reception (EX1004, Section 5.1.4), contention resolution (EX1004, Section 5.1.5), and completion of the random access procedure (EX1004, Section 5.1.6). EX1004, Section 5.1.

[1.a] transmitting a random access preamble to a base station;

98. TS36321-V830 discloses the UE transmits a random access preamble to an eNB ("*base station*"). For example, TS36321-V830 discloses the following:

> "RA-RNTI: The Random Access RNTI is used on the PDCCH when Random Access Response messages are transmitted. It unambiguously identifies which time-frequency resource was utilized by the UE to transmit the Random Access preamble." EX1004, Section 3.1, p. 7.

> "5.1.3 Random Access Preamble transmission
> The random-access procedure shall be performed as follows:
> …
> instruct the physical layer to transmit a preamble using the selected PRACH resource, corresponding RA-RNTI, preamble index and PREAMBLE_RECEIVED_TARGET_POWER." EX1004, Section 5.1.3, p. 13.

99. In other words, TS36321-V830 discloses that the UE transmits a random access preamble via PRACH. As I explained in Section VI.A, PRACH is an uplink physical channel through which the UE transmits a random access preamble to a base station (*e.g.*, eNB in LTE). EX1015, Section 10.1.5, p. 46; EX1018, p. 362. For example, TS36321-V830 also discloses the eNB in the random access procedure: "[w]hen an uplink transmission is required, *e.g.*, for contention resolution, the **eNB** should not provide a grant smaller than 80 bits in the Random Access Response." EX1004, Section 5.1.4, p. 14.

100. Further, as I discussed above in Sections VI.A and VII.A, transmitting a random access preamble from a UE to a base station is part of the well-known

random access procedure, as admitted in the "Discussion of the Related Art" section by the '824 Patent itself. EX1001, 1:26-55.

[1.b] determining a time period for receiving a random access response responsive to the random access preamble; and

101. TS36321-V830 discloses monitoring in a TTI window RA_WINDOW_BEGIN—RA_WINDOW_END (hereinafter "RA_WINDOW," "*a time period*") for receiving a random access response responsive to the random access preamble.

102. Specifically, as I discussed above in Section VIII.A, Section 5.1.4 of TS36321-V830 requires that "[o]nce the Random Access Preamble is transmitted …, the UE shall monitor the PDCCH for Random Access Response(s)…, in the TTI window RA_WINDOW_BEGIN—RA_WINDOW_END which starts at the subframe that contains the end of the preamble transmission [] plus three subframes and has length *ra-ResponseWindowSize* subframes," and that the received random access response "correspond[s] to the Random Access Preamble transmission." EX1004, Section 5.1.4, p. 13. It is clear that the RA_WINDOW represents an amount of time, which is defined by the "length *ra-ResponseWindowSize* subframes." Therefore, the RA_WINDOW is the claimed "*time period*."

103. Moreover, since TS36321-V830 explicitly requires the UE to monitor the reception of the random access response corresponding to the random access

preamble in the RA_WINDOW, it is clear or at least obvious that the UE needs to first determine the RA_WINDOW before monitoring. Specifically, after transmitting the random access preamble, the UE of TS36321-V830 determines the corresponding RA_WINDOW based on (i) the end of the preamble transmission, (ii) the offset ("three subframes"), and (iii) the length *ra-ResponseWindowSize* subframes. EX1004, Section 5.1.4, p. 13.

[1.c] receiving the random access response from the base station within the time period,

104. TS36321-V830 discloses receiving the random access response from the eNB ("*base station*") within the RA_WINDOW ("*time period*").

105. Specifically, Section 5.1.4 of TS36321-V830 requires that "UE shall monitor the PDCCH for Random Access Response(s) … in the TTI window RA_WINDOW_BEGIN—RA_WINDOW_END," and "UE may stop monitoring for Random Access Response(s) after successful reception of a Random Access Response corresponding to the Random Access Preamble transmission." EX1004, Section 5.1.4, p. 13. The same section of TS36321-V830 also requires that "if the Random Access Response contains a Random Access Preamble identifier corresponding to the transmitted Random Access Preamble … the UE shall[] consider this Random Access Response reception successful," and that "[i]f no Random Access Response is received within the TTI window

[RA_WINDOW_BEGIN—RA_WINDOW_END], or if all received Random Access Responses contain Random Access Preamble identifiers that do not match the transmitted Random Access Preamble, the Random Access Response reception is considered not successful." EX1004, Section 5.1.4, pp. 13-14.

106. As I explained above in Section VI.A, it is well known in the art that PDCCH for random access response(s) is a downlink physical channel through which the base station (*e.g.*, eNB in LTE) communicates with the UE. EX1015, Section 10.1.5, p. 46; EX1018, p. 362. TS36321-V830 further indicates that the eNB plays the role of providing the random access response: "[w]hen an uplink transmission is required, *e.g.*, for contention resolution, the eNB should not provide a grant smaller than 80 bits in the Random Access Response." EX1004, Section 5.1.4, p. 14. Thus, TS36321-V830 discloses that the random access response is sent by the eNB.

107. Moreover, as I discussed above in Sections VI.A and VII.A, receiving a random access response by the UE from the base station is part of the well-known random access procedure, as admitted in the "Discussion of the Related Art" section by the '824 Patent itself. EX1001, 1:26-55.

[1.d] wherein the time period starts at a time point after an end time of transmitting the random access preamble, and a subframe number corresponding, to the time point is obtained by adding an offset to a subframe number corresponding to the end time of transmitting, the random access preamble, and the offset equals three.

108. As I explained above in Section IX.A([1.b]), TS36321-V830 discloses that "the TTI window RA_WINDOW_BEGIN—RA_WINDOW_END [] starts at the subframe that contains the end of the preamble transmission [] plus three subframes and has length *ra-ResponseWindowSize* subframes." EX1004, Section 5.1.4, p. 13.

109. That is, TS36321-V830 discloses that the RA_WINDOW ("*time period*") starts at RA_WINDOW_BEGIN ("*time point*") after the end of the preamble transmission ("*after an end time of transmitting the random access preamble*"), and that RA_WINDOW_BEGIN is at the subframe that contains the end of the preamble transmission plus three subframes ("*a subframe number corresponding, to the time point is obtained by adding an offset to a subframe number corresponding to the end time of transmitting, the random access preamble, and the offset equals three*").

B. Independent Claim 7

110. Claim 7 is reproduced below. For ease of discussion, I have included a label for each claim limitation.

[7.P] A user equipment (UE) to perform a random access procedure, the UE comprising:

[7.a] a transmitter to transmit a random access preamble to a base station;

[7.b] a processor configured to determine a time period for receiving a random access response responsive to the random access preamble; and

[7.c] a receiver to receive the random access response from the base station within the time period,

[7.d] wherein the time period starts at a time point after an end time of transmitting the random access preamble, and a subframe number corresponding to the time point is obtained by adding an offset to a subframe number corresponding to the end time of transmitting the random access preamble, and the offset equals three.

[7.P] A user equipment (UE) to perform a random access procedure, the UE comprising:

111. As I explained above in Section IX.A([1.P]), TS36321-V830 discloses a UE to perform a random access procedure. I incorporate my discussion in Section IX.A([1.P]).

[7.a] a transmitter to transmit a random access preamble to a base station;

112. As I explained above in Section IX.A([1.a]), TS36321-V830 discloses that the UE transmits a random access preamble to a base station. I incorporate my discussion in Section IX.A([1.a]).

113. While TS36321-V830 does not explicitly mention "*transmitter*," it is clear or at least obvious that the UE described in TS36321-V830 includes a transmitter to enable the UE to perform its disclosed transmission functions, such as transmitting the random access preamble to the base station.

[7.b] a processor configured to determine a time period for receiving a random access response responsive to the random access preamble; and

114. As I explained above in Section IX.A([1.b]), TS36321-V830 discloses or at least suggests that the UE determines a time period for receiving a random access response responsive to the random access preamble. I incorporate my discussion in Section IX.A([1.b]).

115. While TS36321-V830 does not explicitly mention "*processor*," it is clear or at least obvious that the UE described in TS36321-V830 includes a processor to enable the UE to perform its disclosed processing functions, such as determining the time period for receiving the random access response responsive to the random access preamble.

[7.c] a receiver to receive the random access response from the base station within the time period,

116. As I explained above in Section IX.A([1.c]), TS36321-V830 discloses that the UE receives the random access response from the base station within the time period. I incorporate my discussion in Section IX.A([1.c]).

117. While TS36321-V830 does not explicitly mention "*receiver*," it is clear or at least obvious that the UE described in TS36321-V830 includes a receiver to enable the UE to perform its disclosed reception functions, such as receiving the random access response from the base station within the time period.

[7.d] wherein the time period starts at a time point after an end time of transmitting the random access preamble, and a subframe number corresponding to the time point is obtained by adding an offset to a subframe number corresponding to the end time of transmitting the random access preamble, and the offset equals three.

118. As I explained above in Section IX.A([1.d]), TS36321-V830 discloses "*wherein the time period starts at a time point after an end time of transmitting the random access preamble, and a subframe number corresponding to the time point is obtained by adding an offset to a subframe number corresponding to the end time of transmitting the random access preamble, and the offset equals three.*" I incorporate my discussion in Section IX.A([1.d]).

X. Grounds 3 and 4: Qualcomm Anticipates or Otherwise Renders Obvious Claims 1 and 7

A. Independent Claim 1

[1.P] A method for performing a random access procedure by a user equipment (UE), the method comprising:

119. As I discussed above in Section VIII.C, Qualcomm discloses a method for performing a random access procedure by a UE, including random access

preamble transmission on PRACH and random access response reception. EX1006, Section 1, p. 1.

[1.a] transmitting a random access preamble to a base station;

120. As shown in FIG. D (annotated FIG. 1 of Qualcomm) below, Qualcomm discloses that the UE transmits a random access preamble (RAP) on PRACH (in light blue). Specifically, FIG. 1 of Qualcomm is titled "RA_WINDOW_BEGIN starting at least 3ms after PRACH transmission for FDD." EX1006, Section 2.2, p. 2.

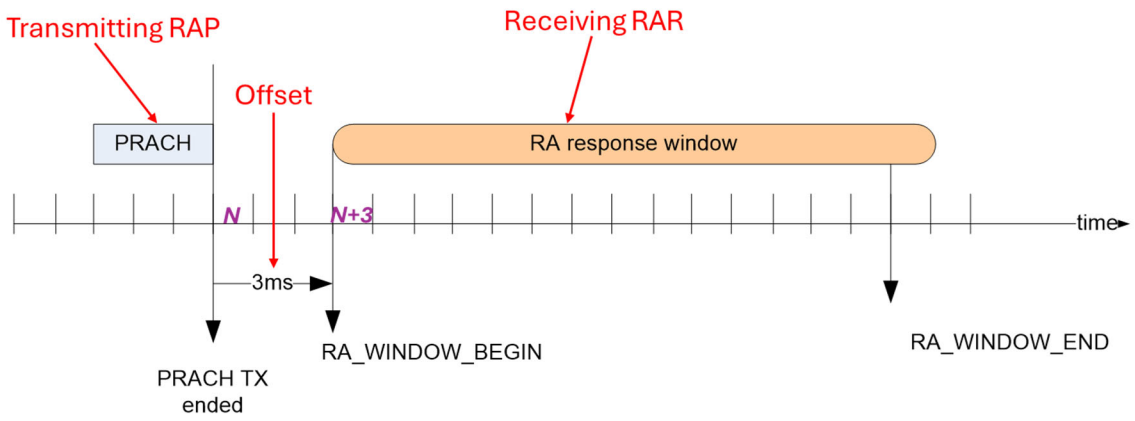


FIG. D - Figure 1 RA_WINDOW_BEGIN starting at least 3ms after PRACH transmission for FDD of EX1006, Qualcomm (annotated)

121. Qualcomm also discloses that "random access response is not synchronized with the transmission of the random access preamble," and "MAC must be aware of when the PRACH is transmitted." EX1006, Sections 1, 2.1, p. 1. In other words, Qualcomm discloses that the UE transmits a random access preamble on PRACH. As I explained above in Section VI.A, PRACH is an uplink physical

channel through which the UE transmits a random access preamble to a base station (*e.g.*, eNB in LTE). EX1015, Section 10.1.5, p. 46; EX1018, 362.

122. Further, as I discussed above in Sections VI.A and VII.A, transmitting a random access preamble from a UE to a base station is part of the well-known random access procedure, as admitted in the "Discussion of the Related Art" section by the '824 Patent itself. EX1001, 1:26-55.

[1.b] determining a time period for receiving a random access response responsive to the random access preamble; and

123. Qualcomm discloses monitoring during a random access (RA) response window RA_WINDOW_BEGIN—RA_WINDOW_END ("*time period*") for receiving a random access response responsive to the random access preamble. EX1006, Section 1, p. 1. As shown in FIG. D, Qualcomm illustrates the RA response window (in light orange) for receiving RAR corresponding to the RAP transmitted in PRACH (in light blue).

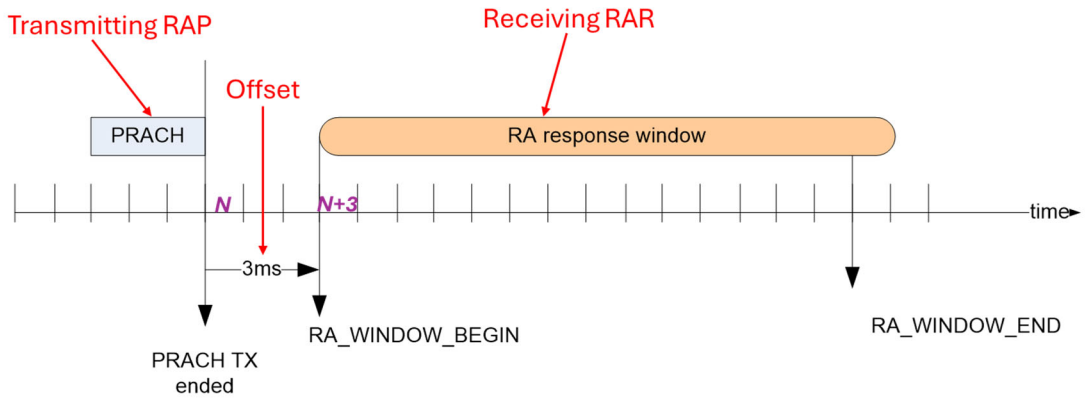


FIG. D - Figure 1 RA_WINDOW_BEGIN starting at least 3ms after PRACH transmission for FDD of EX1006, Qualcomm (annotated)

124. Qualcomm also makes (i) Proposals 2 and 2bis for determining a start time point RA_WINDOW_BEGIN of the RA response window, and (ii) Proposals 3 and 4 for determining an end time point RA_WINDOW_END of the RA response window. EX1006, Sections 2.2-2.3, pp. 1-2. For example, Qualcomm defines the response window size RA_WINDOW_WIDTH, such that "RA_WINDOW_END is set to the subframe occurring RA_WINDOW_WIDTH DL subframes after RA_WINDOW_BEGIN." EX1006, Section 2.3, p. 2.

125. It is clear that the RA response window represents an amount of time defined by the response window size RA_WINDOW_WIDTH. For example, FIG. D shows the RA response window having 14 ms between RA_WINDOW_BEGIN and RA_WINDOW_END. Thus, the RA response window is the claimed "*time period*."

126. Moreover, since Qualcomm explicitly requires the UE to monitor the reception of the random access response corresponding to the random access preamble transmission in the RA response window, it is clear or at least obvious that the UE needs to first determine the RA response window before monitoring. Specifically, as shown in FIG. D above, after transmitting RAP on PRACH, the UE determines the corresponding RA response window based on (i) the end time of transmitting RAP ("PRACH TX ended"), (ii) the offset ("3 ms/3 subframes"), and

(iii) the response window size ("RA_WINDOW_WIDTH"). *See* EX1006, Section 2.3, p. 2.

[1.c] receiving the random access response from the base station within the time period,

127. As shown in FIG. D below, Qualcomm discloses that the UE receives the random access response (RAR) within the RA response window ("*time period*"). EX1006, Section 1, p. 1.

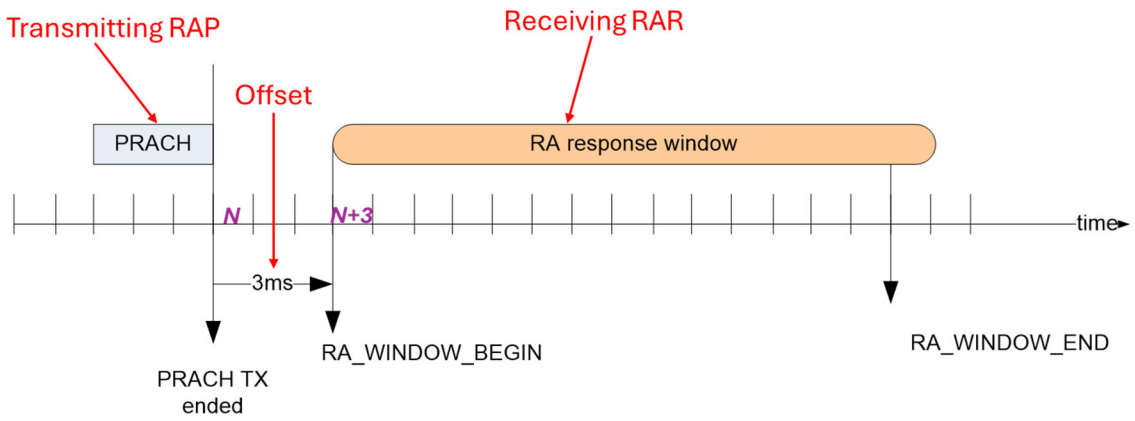


FIG. D - Figure 1 RA_WINDOW_BEGIN starting at least 3ms after PRACH transmission for FDD of EX1006, Qualcomm (annotated)

128. Qualcomm also discloses, "[i]n addition the PDCCH indicating RA response is addressed to the RA-RNTI matching the PRACH occasion." EX1006, Section 1, p. 1. That is, Qualcomm discloses that the UE receives the random access response indicated by the PDCCH. As I explained above in Section VI.A, PDCCH is a downlink physical channel through which the base station (*e.g.*, eNB in LTE) communicates with the UE. EX1015, Section 10.1.5, p. 46; EX1018, p. 362.

129. Moreover, as I discussed above in Sections VI.A and VII.A, receiving a random access response by the UE from the base station is part of the well-known random access procedure, as admitted in the "Discussion of the Related Art" section by the '824 Patent itself. EX1001, 1:26-55.

> ***[1.d] wherein the time period starts at a time point after an end time of transmitting the random access preamble, and a subframe number corresponding, to the time point is obtained by adding an offset to a subframe number corresponding to the end time of transmitting, the random access preamble, and the offset equals three.***

130. As I explained above in Section VIII.C, Qualcomm discloses that the RA response window ("*time period*") starts at RA_WINDOW_BEGIN ("*time point*") after the end of the PRACH transmission ("*after an end time of transmitting the random access preamble*"), and that RA_WINDOW_BEGIN is at subframe *N*+3 when PRACH transmission ends at subframe *N* ("*a subframe number corresponding, to the time point is obtained by adding an offset to a subframe number corresponding to the end time of transmitting, the random access preamble, and the offset equals three*"). EX1006, Section 2.2, p. 1.

131. For example, as shown in FIG. D below and explained in Section VIII.C, PRACH for transmitting RAP ends at subframe *N*, and RA_WINDOW_BEGIN of the RA response window is at the first DL subframe with a subframe number equal to *N*+3. EX1006, Section 2.2, p. 2. In other words, Qualcomm discloses setting the

offset between the subframe number (*N*) corresponding to "PRACH TX ended" and the subframe number (*N*+3) corresponding to "RA_WINDOW_BEGIN" to be 3 for FDD in LTE. Also, as I explained above in Sections VI.B and VIII.C, each time unit in FIG. D represents 1 ms, which corresponds to 1 subframe for FDD in LTE. EX1018, pp. 317-318. Thus, the offset of 3 ms in FIG. D corresponds to 3 subframes.

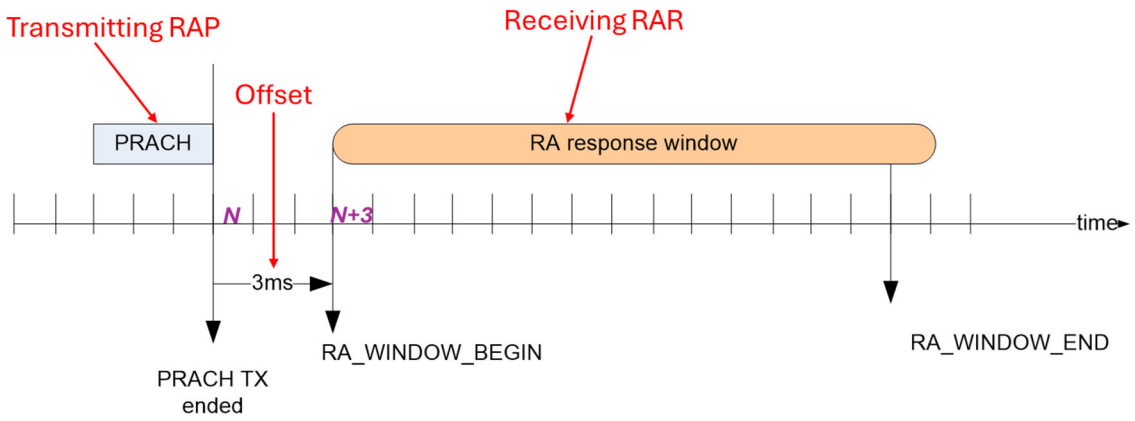


FIG. D - Figure 1 RA_WINDOW_BEGIN starting at least 3ms after PRACH transmission for FDD of EX1006, Qualcomm (annotated)

B. Independent Claim 7

[7.P] A user equipment (UE) to perform a random access procedure, the UE comprising:

132. As I explained above in Section X.A([1.P]), Qualcomm discloses a UE that performs a random access procedure. I incorporate my discussion in Section X.A([1.P]).

[7.a] a transmitter to transmit a random access preamble to a base station;

133. As I explained above in Section X.A([1.a]), Qualcomm discloses that

the UE transmits a random access preamble to a base station. I incorporate my discussion in Section X.A([1.P]).

134. While Qualcomm does not explicitly mention "*transmitter*," it is clear or at least obvious that the UE described in Qualcomm includes a transmitter to enable the UE to perform its disclosed transmission functions, such as transmitting the random access preamble to the base station.

[7.b] a processor configured to determine a time period for receiving a random access response responsive to the random access preamble; and

135. As I explained above in Section X.A([1.b]), Qualcomm discloses or at least suggests that the UE determines a time period for receiving a random access response responsive to the random access preamble. I incorporate my discussion in Section X.A([1.b]).

136. While Qualcomm does not explicitly mention "*processor*," it is clear or at least obvious that the UE described in Qualcomm includes a processor to enable the UE to perform its disclosed processing functions, such as determining the time period for receiving the random access response responsive to the random access preamble.

[7.c] a receiver to receive the random access response from the base station within the time period,

137. As I explained above in Section X.A([1.c]), Qualcomm discloses that

the UE receives the random access response from the base station within the time period. I incorporate my discussion in Section X.A([1.c]).

138. While Qualcomm does not explicitly mention "*receiver*," it is clear or at least obvious that the UE described in Qualcomm includes a receiver to enable the UE to perform its disclosed reception functions, such as receiving the random access response from the base station within the time period.

[7.d] wherein the time period starts at a time point after an end time of transmitting the random access preamble, and a subframe number corresponding to the time point is obtained by adding an offset to a subframe number corresponding to the end time of transmitting the random access preamble, and the offset equals three.

139. As I explained above in Section X.A([1.d]), Qualcomm discloses "*wherein the time period starts at a time point after an end time of transmitting the random access preamble, and a subframe number corresponding to the time point is obtained by adding an offset to a subframe number corresponding to the end time of transmitting the random access preamble, and the offset equals three.*" I incorporate my discussion in Section X.A([1.d]).

XI. Grounds 5 and 6: ZTE Anticipates or Otherwise Renders Obvious Claims 1 and 7

A. Independent Claim 1

[1.P] A method for performing a random access procedure by a user equipment (UE), the method comprising:

140. As I explained above in Section VIII.D, ZTE discloses a method for performing a random access procedure by a UE, including random access preamble transmission on PRACH and random access response reception. EX1007, Section 2.1, pp. 1-2. For example, ZTE discloses that "RA-RNTI will be used both for contention-based and contention-free random access procedure." EX1007, Section 2.1, p. 1.

[1.a] transmitting a random access preamble to a base station;

141. As shown in FIG. F (annotated Figure 2 of ZTE) below, ZTE discloses transmitting a 1st random access preamble on PRACH 1 (in yellow) and then a 2nd random access preamble on PRACH 2 (in red) within 10 subframes. EX1007, Section 2.1, p. 2. ZTE also discloses that "UE may even send random preamble in consecutive subframe" and "in some case UE does not know SFN when sending random access preamble." EX1007, Section 2.1, p. 1.

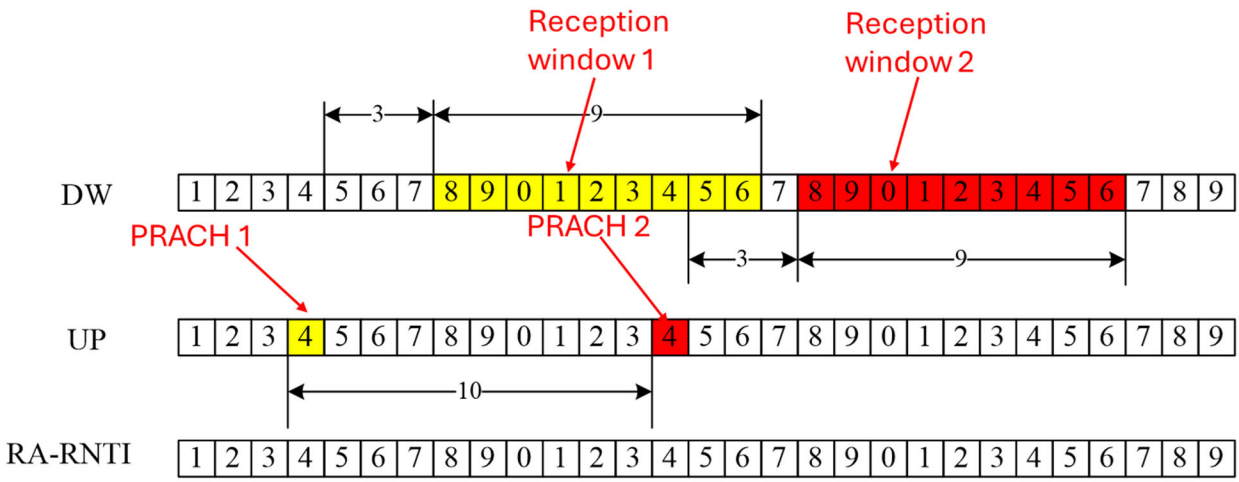


FIG. F – Figure 2 RA-RNTI = Subframe Number of EX1007, ZTE (annotated)

142. In other words, ZTE discloses transmitting a random access preamble on PRACH. As I explained in Section VI.A, PRACH is an uplink physical channel through which the UE transmits a random access preamble to a base station (*e.g.*, eNB in LTE). EX1015, Section 10.1.5, p. 46; EX1018, p. 362. For example, ZTE also discloses the eNB in the random access procedure: "[t]he maximum value of Wlength mainly related to the processing load of eNB." EX1007, Section 2.1, p. 1.

143. Further, as I discussed above in Sections VI.A and VII.A, transmitting a random access preamble from a UE to a base station is part of the well-known random access procedure, as admitted in the "Discussion of the Related Art" section by the '824 Patent itself. EX1001, 1:26-55.

[1.b] determining a time period for receiving a random access response responsive to the random access preamble; and

144. ZTE discloses or at least suggests determining a reception window

("*time period*") for receiving a random access response responsive to the random access preamble. As I discussed in Section VIII.D above, ZTE discloses reception windows, with each reception window for receiving a respective random access response (message 2) responsive to the corresponding random access preamble. EX1007, Section 2.1, p. 1. For example, FIG. F (annotated Figure 2 of ZTE) below illustrates a 1st reception window 1 (in yellow) for receiving the 1st random access response responsive to the 1st random access preamble transmitted on PRACH 1 (in yellow), and a 2nd reception window 2 (in red) for receiving the 2nd random access response responsive to the 2nd random access preamble transmitted on PRACH 2 (in red).

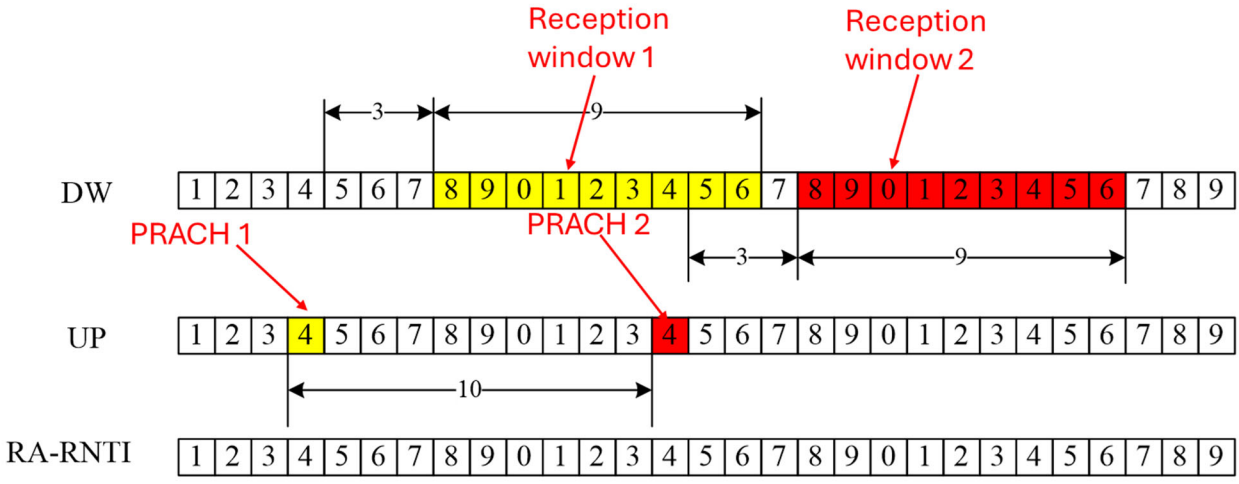


FIG. F – Figure 2 RA-RNTI = Subframe Number of EX1007, ZTE (annotated)

145. ZTE also discloses that each reception window has a window length Wlength, which is "predefined or configured through signalling." EX1007, Section 2.1, p. 1. ZTE further discusses various factors in determining Wlength, such as

"processing load of eNB and the scheduling flexibility in time domain especially for low bandwidth system." EX1007, Section 2.1, p. 1. It is clear that the reception window represents an amount of time defined by the window length Wlength. For instance, FIG. F above shows reception windows each having 9 ms (corresponding to 9 subframes in FDD of LTE). Thus, the reception window is the claimed "*time period*."

146. Moreover, as shown in FIG. F above, ZTE further discloses an offset between the subframe number (5) corresponding to the end time of transmitting a random access preamble (the end of PRACH 1 or 2) and the subframe number (8) corresponding to the start of the respective reception window 1 or 2, where the offset is equal to 3 subframes. The subframe offset value of 3 is consistent in both examples (yellow and red) shown in FIG. F, as well as in all other figures and examples throughout Section 2 "Discussion" of ZTE (*i.e.*, FIGs. 1 and 3). EX1007, FIGs. 1-3. This is a strong indication that ZTE intends to set 3 subframes as the value of the offset. Thus, ZTE discloses, or at a minimum suggests, setting the offset to be 3 subframes.

147. It is clear or at least obvious that responsive to transmitting the random access preamble on PRACH, the UE determines the corresponding reception window based on (i) the end time of PRACH, (ii) the offset (3 subframes), and (iii)

the window length Wlength. For example, with reference to FIG. F above, for the 1st random access preamble transmitted on PRACH 1 (in yellow) in the 1st radio frame in the uplink (UP), the UE determines the corresponding 1st reception window 1 (in yellow), which has (i) a start time point at subframe 8 of the 1st radio frame in the downlink (DW) and (ii) a window length Wlength of 9 subframes. The start time point of the 1st reception window 1 is offset by 3 subframes from the end time of PARCH 1. Similarly, for the 2nd random access preamble transmitted on PRACH 2 (in red) in the 2nd radio frame in the uplink (UP), the UE determines the corresponding 2nd reception window 2 (in red), which has (i) a start time point at subframe 8 of the 2nd radio frame in the downlink (DW) and (ii) a window length Wlength of 9 subframes. The start time point of the 2nd reception window 2 is also offset by 3 subframes from the end time of PARCH 2.

[1.c] receiving the random access response from the base station within the time period,

148. As I explained above in Section XI.A([1.b]), ZTE discloses receiving each random access response in the downlink (DW) ("*from the base station*") within the respective reception window ("*time period*") as shown in FIG. F below. ZTE discloses that "message 2 will be received in asynchronous way *i.e.* within a reception TTI window," and that "the reception TTI window of random access response is most likely the same for all random preamble within the same cell."

EX1007, Section 2.1, p. 1.

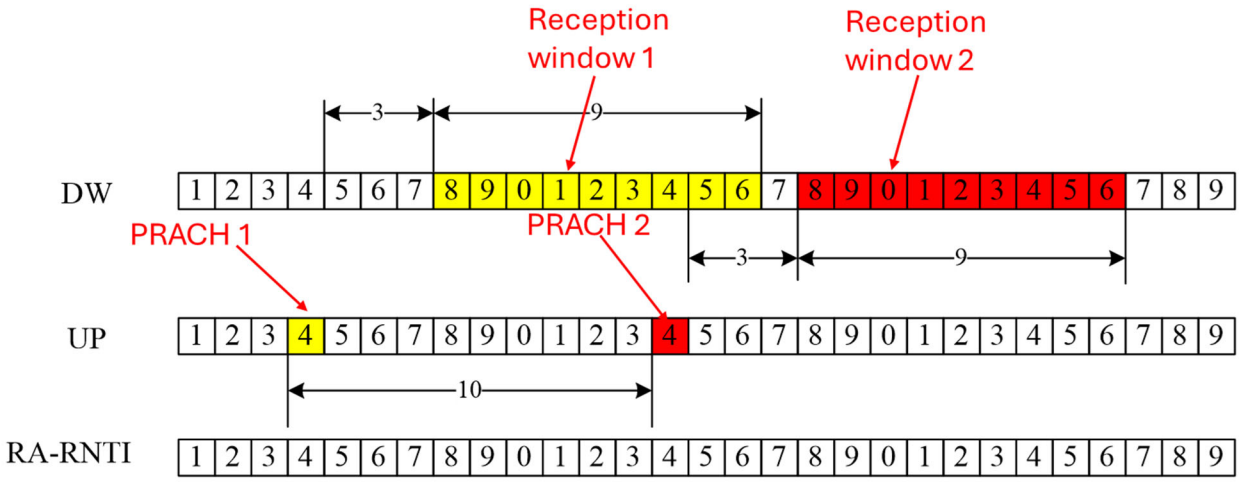


FIG. F – Figure 2 RA-RNTI = Subframe Number of EX1007, ZTE (annotated)

149. Moreover, as I discussed above in Sections VI.A and VII.A, receiving a random access response by the UE from the base station is part of the well-known random access procedure, as admitted in the "Discussion of the Related Art" section by the '824 Patent itself. EX1001, 1:26-55.

> ***[1.d] wherein the time period starts at a time point after an end time of transmitting the random access preamble, and a subframe number corresponding, to the time point is obtained by adding an offset to a subframe number corresponding to the end time of transmitting, the random access preamble, and the offset equals three.***

150. As I explained above with respect to Section XI.A([1.b]) and also referring to FIG. F below, ZTE discloses or at least suggests that each reception window ("*time period*") starts at a respective start time point (*e.g.*, the start of the 1st reception window 1 in yellow or the 2nd reception window 2 in red) after a

respective end time of transmitting the respective random access preamble (*e.g.*, the end of PRACH 1 in yellow or PRACH 2 in red).

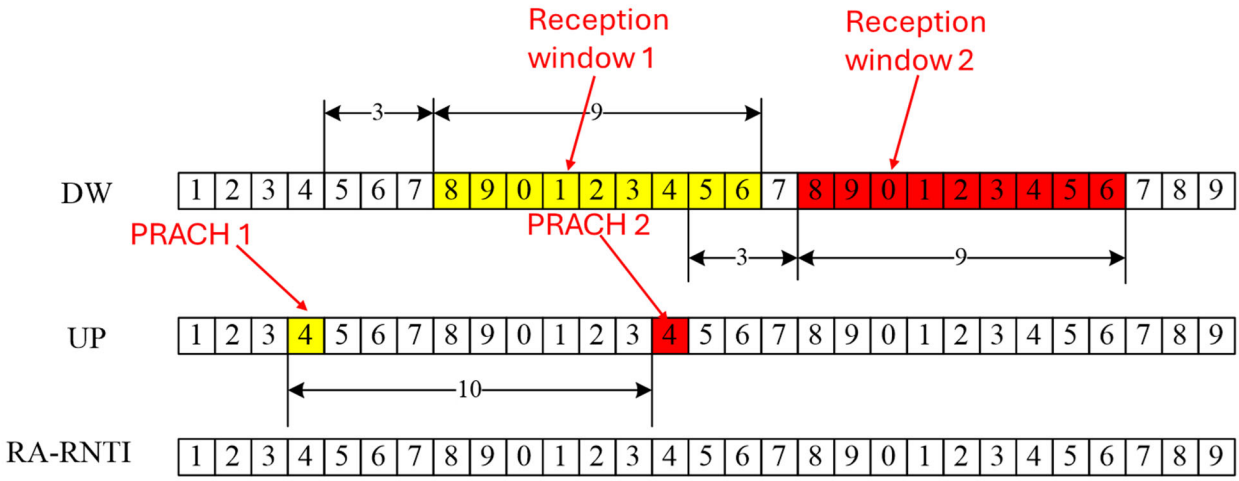


FIG. F – Figure 2 RA-RNTI = Subframe Number of EX1007, ZTE (annotated)

151. ZTE further discloses "[i]n Figure 2, RA-RNTI is defined as the subframe number within radio frame." EX1007, § 2.1, p. 2. As I explained above with respect to Section XI.A([1.b]) and also referring to FIG. F above, ZTE further discloses that the subframe number corresponding to the respective start time point (*e.g.*, subframe 8) is obtained by adding an offset (3 subframes) to the subframe number corresponding to the end time (*e.g.*, subframe 5) of transmitting the random access preamble.

152. Additionally, as I explained in Section XI.A([1.b]), ZTE discloses or at least suggests the subframe offset equals three. EX1007, FIGs. 1-3.

B. Independent Claim 7

[7.P] A user equipment (UE) to perform a random access procedure, the UE comprising:

153. As I explained above in Section XI.A([1.P]), ZTE discloses a UE that performs a random access procedure. I incorporate my discussion in Section XI.A([1.P]).

[7.a] a transmitter to transmit a random access preamble to a base station;

154. As I explained above in Section XI.A([1.a]), ZTE discloses that the UE transmits a random access preamble to a base station. I incorporate my discussion in Section XI.A([1.a]).

155. While ZTE does not explicitly mention "*transmitter*," it is clear or at least obvious that the UE described in ZTE includes a transmitter to enable the UE to perform its disclosed transmission functions, such as transmitting the random access preamble to the base station.

[7.b] a processor configured to determine a time period for receiving a random access response responsive to the random access preamble; and

156. As I explained above in Section XI.A([1.b]), ZTE discloses or at least suggests that the UE determines a time period for receiving a random access response responsive to the random access preamble. I incorporate my discussion in Section XI.A([1.b]).

157. While ZTE does not explicitly mention "*processor*," it is clear or at least obvious that the UE described in ZTE includes a processor to enable the UE to perform its disclosed processing functions, such as determining the time period for receiving the random access response responsive to the random access preamble.

[7.c] a receiver to receive the random access response from the base station within the time period,

158. As I explained above in Section XI.A([1.c]), ZTE discloses that the UE receives the random access response from the base station within the time period. I incorporate my discussion in Section XI.A([1.c]).

159. While ZTE does not explicitly mention "*receiver*," it is clear or at least obvious that the UE described in ZTE includes a receiver to enable the UE to perform its disclosed reception functions, such as receiving the random access response from the base station within the time period.

[7.d] wherein the time period starts at a time point after an end time of transmitting the random access preamble, and a subframe number corresponding to the time point is obtained by adding an offset to a subframe number corresponding to the end time of transmitting the random access preamble, and the offset equals three.

160. As I explained above in Section XI.A([1.d]), ZTE discloses or at least suggests "*wherein the time period starts at a time point after an end time of transmitting the random access preamble, and a subframe number corresponding to the time point is obtained by adding an offset to a subframe number corresponding*

to the end time of transmitting the random access preamble, and the offset equals three.". I incorporate my discussion in Section XI.A([1.d]).

XII. Ground 7: ZTE in View of TS36321-V800 Renders Obvious Claims 1 and 7

161. As I explained above in Section XI, ZTE anticipates or otherwise renders obvious claims 1 and 7. To the extent further disclosures are required, ZTE in view of TS36321-V800 renders claims 1 and 7 obvious.

A. Reasons to Combine ZTE and TS36321-V800

162. As I discussed above in Section XI.A([1.b]), ZTE discloses or at least suggests "*determining a time period for receiving a random access response responsive to the random access preamble*."

163. A POSITA, upon reviewing ZTE's disclosure of "the reception TTI window for random access response" in conjunction with TS36321-V800's explicit teaching that the UE "monitors the [PDCCH] in the TTI window [RA_WINDOW_BEGIN—RA_WINDOW_END] for Random Access Response(s)" "[o]nce the Random Access Preamble is transmitted," would have understood, or at minimum found it obvious, that ZTE likewise contemplates monitoring the reception TTI window for a random access response following the transmission of the random access preamble. EX1007, Section 2.1, p. 1; EX1008, § 5.1.4, p. 12.

164. ZTE is a proposal submitted to the 3GPP Technical Specification

Group Radio Access Network (TSG-RAN) Working Group 2 (WG2), whereas TS36.321-V800 is a formal technical specification issued by the same standards body. ZTE's proposal specifically addresses aspects of the Random Access procedure for LTE systems and was submitted with the intent of being considered for incorporation into TS36.321-V800, particularly in connection with Section 5.1 titled "Random Access Procedure." Accordingly, the subject matter disclosed in ZTE is not only directly relevant to, but expressly targets, the same technical domain addressed in Section 5.1 of TS36.321-V800. This section outlines the LTE-specific implementation of the random access procedure, providing the practical framework into which ZTE's proposal is intended to integrate. A POSITA would naturally consider Section 5.1 of TS36.321-V800 in conjunction with the ZTE proposal to understand how the system and method described in ZTE would be implemented within the standardized LTE protocol in detail.

165. Therefore, a POSITA would have been motivated to combine ZTE's proposal with the teachings of TS36.321-V800, particularly Section 5.1, which directly addresses the random access procedure that ZTE relates to. Given that ZTE was intended to influence or be incorporated into this section of the specification, a POSITA would have naturally looked to TS36.321-V800 to supply any implementation details not explicitly disclosed in ZTE. This includes, for example,

the UE's monitoring in the reception TTI window for a random access response following the transmission of the random access preamble—a detail that is clearly taught in Section 5.1 of TS36.321-V800. Thus, the combination would have been straightforward, logical, and consistent with how proposals and specifications are integrated in the standardization process.

B. Independent Claim 1

[1.P] A method for performing a random access procedure by a user equipment (UE), the method comprising:

166. As I explained above in Section XI.A([1.P]), ZTE discloses [1.P]. I incorporate my discussion in Section XI.A([1.P]).

[1.a] transmitting a random access preamble to a base station;

167. As I explained above in Section XI.A([1.a]), ZTE discloses [1.a]. I incorporate my discussion in Section XI.A([1.a]).

[1.b] determining a time period for receiving a random access response responsive to the random access preamble; and

168. As I explained above in Section XI.A([1.b]), ZTE discloses or at least suggests [1.b]. I incorporate my discussion in Section XI.A([1.b]).

169. To the extent additional disclosures are required to disclose or suggest [1.b] besides ZTE's disclosures and suggestions as explained above in Section XI.A([1.b]), TS36321-V800 discloses (i) monitoring PDCCH in a TTI window RA_WINDOW for receiving a random access response responsive to the random

access preamble, and (ii) receiving the random access response within the RA_WINDOW. EX1008, Section 5.1.4, p. 12. Analogous to ZTE's TTI reception window, the TTI window RA_WINDOW in TS36321-V800 similarly represents an amount of time between the start time point RA_WINDOW_BEGIN and the end time point RA_WINDOW_END. Thus, it is clear that the TTI window RA_WINDOW in TS36321-V800 is the claimed "*time period*."

170. Moreover, since TS36321-V800 explicitly requires the UE to monitor the reception of the random access response corresponding to the random access preamble in the RA_WINDOW, it is clear or at least obvious that the UE needs to first determine the RA_WINDOW before monitoring. EX1008, Section 5.1.4, p. 12.

171. Further, as I discussed in Section XII.A, a POSITA would have been motivated to combine ZTE and TS36321-V800, such that the combination of ZTE and TS36321-V800 also suggests "*determining a time period for receiving a random access response responsive to the random access preamble*."

[1.c] receiving the random access response from the base station within the time period,

172. As I explained above in Section XI.A([1.c]), ZTE discloses [1.c]. I incorporate my discussion in Section XI.A([1.c]).

[1.d] wherein the time period starts at a time point after an end time of transmitting the random access preamble, and a subframe number corresponding, to the time point is obtained by adding an offset to a subframe number corresponding to the end time of transmitting, the random access preamble, and the offset equals three.

173. As I explained above in Section XI.A([1.d]), ZTE discloses or at least suggests [1.d]. I incorporate my discussion in Section XI.A([1.d]).

C. Independent Claim 7

[7.P] A user equipment (UE) to perform a random access procedure, the UE comprising:

174. As I explained above in Section XI.B([7.P]), ZTE discloses [7.P]. I incorporate my discussion in Section XI.B([7.P]).

[7.a] a transmitter to transmit a random access preamble to a base station;

175. As I explained above in Section XI.B([7.a]), ZTE discloses [7.a]. I incorporate my discussion in Section XI.B([7.a]).

[7.b] a processor configured to determine a time period for receiving a random access response responsive to the random access preamble; and

176. As I explained above in Sections XI.B([7.b]) and XII.B([1.b]), ZTE in view of TS36321-V800 suggests [7.b]. I incorporate my discussion in Sections XI.B([7.b]) and XII.B([1.b]).

[7.c] a receiver to receive the random access response from the base station within the time period,

177. As I explained above in Section XI.B([7.c]), ZTE discloses [7.c]. I incorporate my discussion in Section XI.B([7.c]).

[7.d] wherein the time period starts at a time point after an end time of transmitting the random access preamble, and a subframe number corresponding to the time point is obtained by adding an offset to a subframe number corresponding to the end time of transmitting the random access preamble, and the offset equals three.

178. As I explained above in Section XI.B([7.d]), ZTE discloses or at least suggests [7.d]. I incorporate my discussion in Section XI.B([7.d]).

XIII. GROUND 8: TS36321-V800 in View of Nokia Renders Obvious Claims 1 and 7

A. Independent Claim 1

[1.P] A method for performing a random access procedure by a user equipment (UE), the method comprising:

179. TS36321-V800 discloses a method for performing a random access procedure by a UE, including random access procedure initialization (EX1008, Section 5.1.1), random access resource selection (EX1008, Section 5.1.2), random access preamble transmission (EX1008, Section 5.1.3), and random access response reception (EX1008, Section 5.1.4). EX1008, Section 5.1.

[1.a] transmitting a random access preamble to a base station;

180. TS36321-V800 discloses that the UE transmits a random access

preamble to an eNB ("*base station*"). For example, TS36321-V800 discloses the following:

> "RA-RNTI: The Random Access RNTI is used on the [PDCCH] when Random Access Response messages are transmitted. It unambiguously identifies which time-frequency resource was utilized by the UE to transmit the Random Access preamble." EX1008, Section 3.1, p. 7.

> "5.1.3 Random Access Preamble transmission
> The random-access procedure shall be performed as follows:
> …
> - instruct the physical layer to transmit a preamble using the selected PRACH resource, corresponding RA-RNTI, preamble index and PREAMBLE_TRANSMISSION_POWER." EX1008, Section 5.1.3, p. 12.

181. In other words, TS36321-V800 discloses that the UE transmits a random access preamble using PRACH. As I explained in Section VI.A, PRACH is an uplink physical channel through which the UE transmits a random access preamble to a base station (*e.g.*, eNB in LTE). EX1015, Section 10.1.5, p. 46; EX1018, p. 362.

182. Further, as I discussed above in Sections VI.A and VII.A, transmitting a random access preamble from a UE to a base station is part of the well-known random access procedure, as admitted in the "Discussion of the Related Art" section by the '824 Patent itself. EX1001, 1:26-55.

[1.b] determining a time period for receiving a random access response responsive to the random access preamble; and [1.c] receiving the random access response from the base station within the time period,

183. TS36321-V800 requires that "[o]nce the Random Access Preamble is transmitted, the UE shall monitor the [PDCCH] in the TTI window [RA_WINDOW_BEGIN—RA_WINDOW_END] for Random Access Response(s)," and that the received random access response "correspond[s] to the Random Access Preamble transmission." EX1008, Section 5.1.4, p. 12.

184. In other words, TS36321-V800 discloses (i) monitoring PDCCH in a TTI window RA_WINDOW_BEGIN—RA_WINDOW_END (hereinafter "RA_WINDOW," "*a time period*") for receiving a random access response responsive to the random access preamble, and (ii) receiving the random access response within the RA_WINDOW. It is clear that the TTI window RA_WINDOW represents an amount of time between the start time point RA_WINDOW_BEGIN and the end time point RA_WINDOW_END. Thus, the RA_WINDOW is the claimed "*time period*."

185. Moreover, since TS36321-V800 explicitly requires the UE to monitor the reception of the random access response corresponding to the random access preamble in the RA_WINDOW, it is clear or at least obvious that the UE needs to first determine the RA_WINDOW before monitoring.

186. As I explained above in Section VI.A, it is well known in the art that PDCCH for random access response(s) is a downlink physical channel through which the base station (*e.g.*, eNB in LTE) communicates with the UE. EX1015, Section 10.1.5, p. 46; EX1018, p. 362.

187. Moreover, as I discussed above in Sections VI.A and VII.A, receiving a random access response by the UE from the base station is part of the well-known random access procedure, as admitted in the "Discussion of the Related Art" section by the '824 Patent itself. EX1001, 1:26-55.

[1.d] wherein the time period starts at a time point after an end time of transmitting the random access preamble, and a subframe number corresponding, to the time point is obtained by adding an offset to a subframe number corresponding to the end time of transmitting, the random access preamble, and the offset equals three.

188. As I discussed above with respect to Sections XIII.A([1.b]) and XIII.A([1.c]), TS36321-V800 requires that "[o]nce the Random Access Preamble is transmitted, the UE shall monitor the [PDCCH] in TTI window [RA_WINDOW_BEGIN—RA_WINDOW_END] for Random Access Response(s)." EX1008, Section 5.1.4, p. 12. That is, the RA_WINDOW ("*time period*") starts at RA_WINDOW_BEGIN ("*a time point"*) after the random access preamble is transmitted ("*after an end time of transmitting the random access preamble*").

189. It is clear or at least obvious that TS36321-V800 employs subframe numbers to identify both the start time point RA_WINDOW_BEGIN of the RA_WINDOW and the end time of transmitting random access preamble. For example, TS36321-V800 specifically requires that "RA-RNTI is defined as the subframe number within radio frame." EX1007, Section 2.1, p. 2. This use of subframe numbering for RA-RNTI assignment demonstrates that subframe indices serve as a temporal reference within the random access procedure, reinforcing the understanding that RA_WINDOW timing is likewise defined in subframe units.

190. To the extent that (i) TS36321-V800 does not disclose the remaining limitations of [1.d], *i.e.*, the subframe offset between RA_WINDOW_BEGIN and the end time of transmitting random access preamble being equal to three, and that (ii) the written description support for the remaining limitations of [1.d] is found in FIG. 2 of the '492 Application and/or FIG. 13 of the '656 Application, Nokia discloses the remaining limitations. *See* Sections VII.C and VIII.E. As I discussed in Section VIII.E above, Figure 1 of Nokia is identical to FIG. 2 of the '492 Application and is substantially the same as FIG. 13 of the '656 Application. If the remaining limitations of [1.d] are found to be supported by FIG. 2 of the '492 Application and FIG. 13 of the '656 Application, they are also disclosed by Figure 1 of Nokia for the same reasons.

191. At the time Nokia was proposed, the configuration of the RA_WINDOW, including its start point (RA_WINDOW_BEGIN) and length (Wlength), remained under active standardization within 3GPP. Notably, the processing time required by the eNB during the random access procedure was a key consideration when defining these parameters. For instance, Qualcomm explicitly recognized the significance of eNB processing time, stating: "The value of RA_WINDOW_BEGIN may be fixed by the standard or configured … discussions related to processing timeline have mentioned that 3ms is a reasonable minimum amount of time to process the PRACH." EX1006, Section 2.2, p. 1. Similarly, ZTE proposed that the eNB's processing load should be taken into account when determining the maximum value of Wlength. EX1007, Section 2.1, p. 1. These contemporaneous discussions confirm that the industry viewed the eNB processing time as a practical and reasonable design choice within the evolving standard, further reinforcing its relevance and applicability to the RA_WINDOW configuration.

192. Nokia, on the other hand, addresses eNB processing times in the context of the HARQ procedure. EX1009, Section 1, p. 1. To the extent that FIG. 2 of the '492 Application and/or FIG. 13 of the '656 Application and their related texts, which are directed to the HARQ procedure, are deemed reasonably compatible with teachings related to random access procedure in the '492 Application and/or FIG. 13

of the ’656 Application, and thus found to disclose the determining-offset limitations (*e.g.*, a subframe offset of three), a POSITA would have been similarly motivated to look into teachings related to processing times for eNB in the context of the HARQ procedure, such as disclosed by Nokia as discussed above in Section VIII.E, when standardizing the RA_WINDOW.

B. Independent Claim 7

[7.P] A user equipment (UE) to perform a random access procedure, the UE comprising:

193. As I explained above in Section XIII.A([1.P]), TS36321-V800 discloses a UE that performs a random access procedure. I incorporate my discussion in Section XIII.A([1.P]).

[7.a] a transmitter to transmit a random access preamble to a base station;

194. As I explained above in Section XIII.A([1.a]), TS36321-V800 discloses that the UE transmits a random access preamble to a base station. I incorporate my discussion in Section XIII.A([1.a]).

195. While TS36321-V800 does not explicitly mention “*transmitter*,” it is clear or at least obvious that the UE described in TS36321-V800 includes a transmitter to enable the UE to perform its disclosed transmission functions, such as transmitting the random access preamble to the base station.

[7.b] a processor configured to determine a time period for receiving a random access response responsive to the random access preamble; and

196. As I explained above in Section XIII.A([1.b]), TS36321-V800 discloses or at least suggests that the UE determines a time period for receiving a random access response responsive to the random access preamble. I incorporate my discussion in Section XIII.A([1.b]).

197. While TS36321-V800 does not explicitly mention "*processor*," it is clear or at least obvious that the UE described in TS36321-V800 includes a processor to enable the UE to perform its disclosed processing functions, such as determining the time period for receiving the random access response responsive to the random access preamble.

[7.c] a receiver to receive the random access response from the base station within the time period,

198. As I explained above in Section XIII.A([1.c]), TS36321-V800 discloses that the UE receives the random access response from the base station within the time period. I incorporate my discussion in Section XIII.A([1.c]).

199. While TS36321-V800 does not explicitly mention "*receiver*," it is clear or at least obvious that the UE described in TS36321-V800 includes a receiver to enable the UE to perform its disclosed reception functions, such as receiving the random access response from the base station within the time period.

[7.d] wherein the time period starts at a time point after an end time of transmitting the random access preamble, and a subframe number corresponding to the time point is obtained by adding an offset to a subframe number corresponding to the end time of transmitting the random access preamble, and the offset equals three.

200. As I explained above in Section XIII.A([1.d]), TS36321-V800 in view of Nokia suggests "*wherein the time period starts at a time point after an end time of transmitting the random access preamble, and a subframe number corresponding to the time point is obtained by adding an offset to a subframe number corresponding to the end time of transmitting the random access preamble, and the offset equals three.*" I incorporate my discussion in Section XIII.A([1.d]).

XIV. Secondary Considerations

201. I have seen no evidence in the '824 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 '824 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.

XV. Additional Remarks

202. 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.

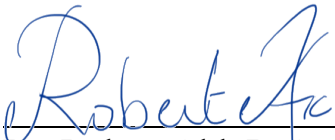
203. In signing this declaration, I recognize that the declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also recognize that I may be subject to cross-examination in the case and that cross-examination 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.

204. I have reviewed the accompanying Petition for *Inter Partes* Review of the ’824 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) TS36321-V830 anticipates or otherwise renders obvious claims 1 and 7, (2) Qualcomm anticipates or otherwise renders obvious claims 1 and 7, (3) ZTE anticipates or otherwise renders obvious claims 1 and 7, (4) ZTE in view of TS36321-V800 renders obvious claims 1 and 7, and (5) TS36321-V800 in view of Nokia renders obvious claims 1 and 7.

* * *

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: April 17, 2025

By: 

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

APPENDIX A

Professor Robert Akl, D.Sc.

Professional Summary

Dr. Akl has over 30 years 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 **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

L2. 2025 **Bayes PLLC**
Case: OnePlus Technology (Shenzhen) Co. Ltd. v. Pantech Corporation
IPR2025-00637; IPR2025-00783
Matter: *Inter Partes* Review, radio link failure
Project: Two declarations to support two IPR Petitions

L3. 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

L4. 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

L5. 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

L6. 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

L7. 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

L8. 2024 **Fish & Richardson, P.C.**
Case: Apple Inc. v. Apex Beam Technologies LLC
IPR2024-*To be Assigned*
Matter: *Inter Partes* Review, multi-antenna transmission
Project: Declaration to support IPR Petition

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