UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

APPLE, INC.,

Petitioner

v.

APEX BEAM TECHNOLOGIES LLC,

Patent Owner

Case IPR2025-00910

U.S. Patent No. 10,979,128

DECLARATION OF DR. ROBERT AKL, D.SC.
IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW

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I, Robert Akl, D.Sc., declare and state as follows:

I. INTRODUCTION

1. I have been retained by counsel for Petitioner Apple Inc. ("Petitioner" or "Apple") as a technical expert in the above matter. I am submitting this Declaration to address the patentability of claims 1-19 ("Challenged Claims") of U.S. Patent No. 10,979,128 ("the '128 Patent"). For the purposes of this Declaration, I have not been asked to opine on any other issues not addressed below.

2. My opinions are based on my years of education, research and experience, as well as my investigation and study of relevant materials, including those identified in this Declaration. I may rely upon these materials, my knowledge and experience, and/or additional materials in forming any necessary opinions. Further, I may also consider additional documents and information to rebut arguments raised by the Patent Owner Apex Beam Technologies LLC ("Patent Owner" or "Apex"). I reserve any right that I may have to supplement this Declaration if further information becomes available or if I am asked to consider additional information. Furthermore, I reserve any right that I may have to consider and comment on any additional expert statements or testimony of Apex's expert(s) in this matter.

3. My analysis of the materials produced in this investigation 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 already provided.

II. BACKGROUND AND QUALIFICATIONS

4. I am an expert in the field of wireless networks. 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. A true and accurate copy of my *curriculum vitae* is attached as Appendix A to this Declaration.

5. I earned two 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."

6. 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.

7. 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 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 multilevel 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.

8. 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.

9. In September 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 2015 and August 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.

10. 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.

11. 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.

12. 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.

13. 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, which 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.

14. 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 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.

15. 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.

16. 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.

17. 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 four 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.

18. I am being compensated for my work in this case at my standard rate of $995 per hour (plus reimbursement for expenses) in connection with my preparation of this declaration, as well as for each hour spent providing deposition or testimony. This compensation is not contingent upon my performance, the outcome of this case, or any issues involved in or related to this case. I have no financial interest in this matter.

III. DOCUMENTS AND MATERIALS CONSIDERED

19. In preparing my opinions, I have reviewed the ’128 Patent and its prosecution history and have also reviewed the other documents and materials cited herein and the materials listed below. When citing from these references, all emphasis is added unless otherwise noted.

Ex.	Description
EX1001	U.S. Patent No. 10,979,128 ("the '128 Patent")
EX1002	Excerpts from the File History of U.S. Patent No. 10,979,128
EX1004	U.S. Publication No. 2021/0100031 to Cirik et al. ("Cirik")
EX1005	U.S. Prov. App. Serial No. 62/908,473 ("Cirik Provisional")
EX1006	U.S. Publication No. 2022/0110153 to Wu et al. ("Wu")
EX1007	R2-1914882, Handling UL LBT Failures in MAC, 3GPP RAN WG2 Meeting #108, InterDigital ("InterDigital")
EX1008	R2-1915141, Handling of UL LBT Failure, 3GPP RAN WG2 Meeting #108, Huawei & HiSilicon
EX1009	R2-1916382, Report of offline-403 - Remaining issues of consistent UL LBT failure, OPPO
EX1011	Erik Dahlman et al., 5G NR the Next Generation Wireless Access Technology (2018)
EX1013	U.S. Publication No. 2020/0314903 ("Jang")
EX1014	U.S. Publication No. 2019/0200248 ("Basu Mallick")
EX1015	Erik Dahlman et al., 4G LTE-Advanced Pro and The Road to 5G (2016)
EX1016	U.S. Publication No. 2020/0367079 ("Chen")
EX1017	TS 138 300, 3GPP TS 38.300 version 15.5.0 Release 15, ETSI (May, 2019)
EX1018	R2-1912096, Report of TSG-RAN WG2 Meeting #107, OPPO (October, 2019)
EX1019	PCT Pub. WO2021/016910 A1 ("Zheng")
EX1020	Techplayon, 5G RACH Procedure Overview – CBRA & CFRA, https://www.techplayon.com/5g-nr-rach-procedure-overview-cbra-cfra/#google_vignette (retrieved April 10, 2025)
EX1021	Agostini et al., Evolution of the 5G New Radio Two-Step Random Access Towards 6G Unsourced MAC, Version 1.0 (April 18, 2024)
EX1022	U.S. Publication No. 2020/0373992 ("Wang")

20. My opinions are also based upon my education, training, research, knowledge, and personal and professional experience. I reserve the right to supplement or amend this Declaration in the event that I hereafter become aware of additional relevant information.

IV. UNDERSTANDING OF LEGAL STANDARDS

21. I am not an attorney and have not been asked to offer an opinion on the law. I understand, however, that certain aspects of the law are relevant to my evaluation and opinions set forth herein. I have therefore been informed of and asked to apply the legal principles summarized below.

A. Earliest Effective Filing Date

22. I understand that the "earliest effective filing date" of a patent is the date of the earliest filing of a patent application in the priority chain of the patent that describes the subject matter of the challenged claims. In this case I understand the '128 Patent claims priority to a provisional application filed December 7, 2019. While I have not independently evaluated whether the subject matter of the challenged claims of the '128 Patent are described in the provisional application sufficiently to support the priority claim, I have nonetheless been instructed by Counsel to treat December 7, 2019 as the earliest effective filing date of the challenged claims for purposes of my analysis in this Declaration. I have done so.

B. Burden of Proof

23. I understand that Apple as the Petitioner bears the burden of establishing by a preponderance of the evidence that the challenged claims are unpatentable. It is my opinion that that prior art and evidence addressed in this Declaration is more than sufficient to meet this burden.

C. Obviousness Under 35 U.S.C. § 103

24. I understand that a claim is invalid if the invention recited in the claim would have been obvious to one of ordinary skill in the art by the earliest effective filing date. I understand this means that even if all the requirements of the claim cannot be found in a single prior art reference that would anticipate the claim, a person of ordinary skill in the field of the invention knowledgeable of the prior art would have come up with the claimed invention. In considering whether a claim is obvious, I have been asked to consider (a) the level of skill in the art at the time of the claimed invention, (b) the scope and content of the prior art, (c) any differences between the prior art and the claims of the patent-in-suit, and (d) any "secondary factors" tending to show non-obviousness of the claimed invention, including commercial success, long-felt but unresolved need, failure of others, copying, praise by others, unexpected results, and simultaneous invention by others.

25. I understand that a claim composed of several elements is not proved obvious merely by demonstrating that each of its elements was independently known in the prior art. I also understand that obviousness should not be analyzed using the benefit of hindsight. Instead, it must be analyzed from the standpoint of what was known and understood by a POSITA at the time of the claimed invention. I further understand demonstrating that a modification to a reference or the combination of multiple references is obvious requires providing a reason for why a POSITA would

modify a reference or combine multiple references and that reason must be supported with some rationale underpinning. Merely pointing out that two references are similar or in the same field of endeavor is not sufficient.

D. Secondary Considerations of Non-Obviousness

26. I understand that in determining whether the claims are obvious I must also consider any evidence bearing on secondary considerations of non-obviousness. These include practical factors such as (1) commercial success, (2) a long-felt need for a solution to the problem facing the inventors, (3) whether others tried and failed to solve the problem, (4) whether others copied the claimed invention, (5) whether the invention achieved unexpected results, (6) whether the prior art teaches away from combining certain known elements, and (7) whether others in the field praised the invention. I also understand that a nexus must be demonstrated between secondary considerations factors and the claimed invention for the factors to be considered.

V. LEVEL OF ORDINARY SKILL

27. I understand there is a concept in patent law known as a person having ordinary skill in the art (POSITA). I understand that this concept refers to a person who is trained in the relevant technical field of a patent without possessing extraordinary or otherwise exceptional skill. I further understand that factors such as the education level of those working in the field, the sophistication of the technology,

the types of problems encountered in the art, prior art solutions to those problems, and the speed at which innovations are made may help establish the level of skill in the art.

28. Taking these factors into consideration, in my opinion, with regard to the ’128 Patent, a person of ordinary skill in the art would have a bachelor’s degree in electrical engineering, computer engineering, computer science, or a similar field, along with two years of experience designing or developing wireless networks, including long-term evolution LTE/4G or 5G new radio (NR) cellular technology. Additional years of experience could substitute for an advanced-level degree (and vice versa).

29. Based at least on my educational and work experience, I was at least a person of ordinary skill in the art as of the effective filing date of the ’128 Patent. And while I note that my qualifications and experiences exceed this definition of a person of ordinary skill of the art, in arriving at the conclusions in this Declaration, I have considered the issues from the perspective of a person of ordinary skill of the art at the relevant time.

30. Unless otherwise stated, I have applied this level of ordinary skill in the art for the purposes of this Declaration.

VI. OVERVIEW OF THE ’128 PATENT

A. Summary of the ’128 Patent

31. The ’128 Patent describes techniques “relat[ing] to beam failure and consistent listen-before-talk (LBT) failure recovery.” EX1001, 3:30-31, FIGs. 29, 34, 43. As background, in wireless communication systems, such as 5G New Radio (NR) systems, “beam failure” can occur when a wireless device—sometimes referred to as a “user equipment” (UE)—loses reception from a base station on a serving radio beam. A wireless device may detect beam failure, for example, when a measurement of the reference signal received power of the serving beam drops below a threshold for a defined period. EX1001, 24:2-7.

32. “Listen-before-talk” (LBT) refers to a protocol that can optionally be implemented in wireless systems such as 5G NR to facilitate communication over shared radio spectrum in unlicensed frequency bands. EX1001, 3:24-32, 27:28-28:2. *See e.g.*, EX1015, 386, 392, 395. In some implementations, the wireless device first “ensures there are no ongoing transmissions on the carrier frequency prior to transmitting.” EX1001, 27:65-28:2. Listening for ongoing transmissions can reduce the risk of interference/collisions with ongoing transmissions from other devices on the same frequency. LBT “failure” can occur when a device is unable to transmit a message on a channel due to ongoing transmissions from other devices on the same channel. *Id.* “Consistent” LBT failure can occur when a channel remains

inaccessible for an extended period. For instance, consistent LBT failure can be determined based on the wireless device being unable to access a shared channel through LBT protocols a minimum number of times within a defined period. *Id*.; EX1001, 33:30-50.

33. When either beam failure or consistent LBT failure occurs, the wireless device can initiate recovery procedures. The '128 Patent explains that a "wireless device may start a beam failure recovery procedure based on the detecting/determining the beam failure on a cell" and "[t]he beam failure recovery may be based on performing a random access process, for example on a primary cell." EX1001, 45:12-16. Likewise, "[t]he wireless device … may perform a random access process to recover from the consistent LBT failures … ." *Id.*, 45:14-19. However, "[w]hen the one or more cells have consistent LBT failures and one or more second cells have beam failure, there may be a conflict between the consistent LBT failures recovery process and the beam failure recovery process." *Id.*, 45:18-22. According to the specification, "[e]xisting solutions for beam failure and consistent LBT failure recovery processes may lead to degraded wireless device and network performance." *Id.*, 45:23-29. The '128 Patent thus purports to provide improved methods for resolving the conflict between beam failure and consistent LBT failure recovery processes by stopping the first random access process for beam failure recovery, switching bandwidth parts (BWPs), and initiating a second random

access process for consistent LBT failure recovery. *Id.*, 3:25-32, 52:9-30, 63:7-65:45. FIG. 34 illustrates one such method:

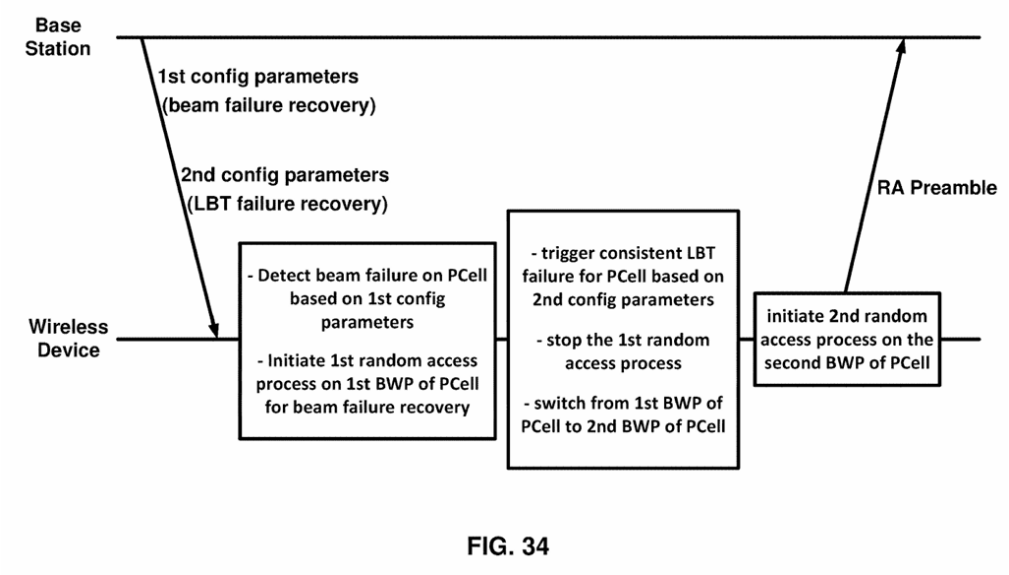


FIG. 34

EX1001, FIG. 34; *see also id.*, 63:7-65:45, 52:9-30, FIG. 29.

34. As shown in FIG. 34, the wireless device detects a beam failure on a primary call based on first configuration parameters. EX1001, 63:7-9. "In response to the detection of the beam failure on the primary cell, the wireless device may initiate a first random access process on a first BWP [bandwidth part] of the primary cell." EX1001, 63:26-29. Next, the "wireless device may trigger the consistent LBT failure for the primary cell while the first random access process for beam failure recovery is ongoing on the primary cell" and, in response to triggering consistent LBT failure, "the wireless device may stop the first random access procedure, for beam failure recovery" and switch from a first BWP to a second BWP of the primary cell. EX1001, 63:35:67. The wireless device then initiates "a second random access

process on the second BWP" for consistent LBT failure recovery. EX1001, 63:17-27. In some embodiments, as shown in FIG. 29, "[t]he wireless device may start a third random access process for beam failure recovery based on the second random access for consistent LBT failures recovery being successfully completed." EX1001, 52:20-24.

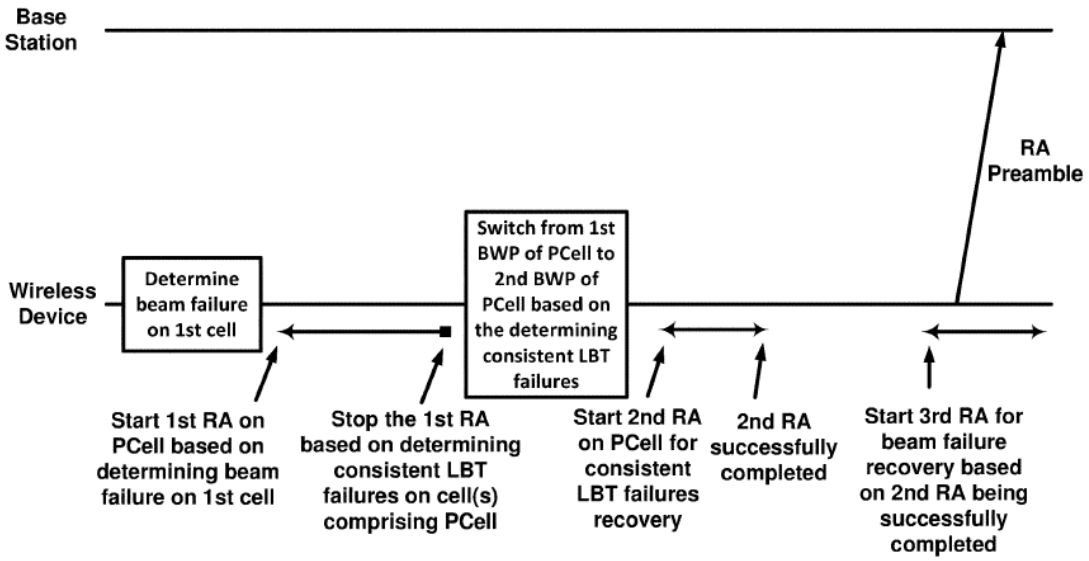


FIG. 29

EX1001, FIG. 29; *see also id.*, 52:9-30.

B. Prosecution History of the '128 Patent

35. I understand that during prosecution of the '128 Patent the examiner rejected claims 1-9 and 13-20 as obvious over Jang (EX1013) in view of Basu Mallick (EX1014) and indicated that dependent claims 10-12 recited allowable

subject matter. EX1002, 21-32. The applicant responded by amending independent claim 1 to integrate subject matter that was deemed allowable from claim 10:

> 1. (Currently Amended) A method comprising:
>
> receiving, by a wireless device, one or more messages comprising:
>
> first configuration parameters, for beam failure recovery, comprising first random access parameters; ~~and~~
>
> second configuration parameters for listen-before-talk (LBT) failure recovery; and
>
> second random access parameters;
>
> initiating, based on the first configuration parameters and in response to detecting a beam failure on a primary cell, a first random access process on a first bandwidth part (BWP) of the primary cell for beam failure recovery based on the first random access parameters;
>
> triggering, based on the second configuration parameters, consistent LBT failure for the primary cell;
>
> stopping the first random access process, for the beam failure recovery, based on the triggering the consistent LBT failure;
>
> switching from the first BWP of the primary cell to a second BWP of the primary cell as an active BWP of the primary cell; and
>
> initiating a second random access process on the second BWP of the primary cell for consistent LBT failure recovery and based on the second random access parameters.

EX1002, 13; *generally id.*, 7-16.

36. Following this amendment, the examiner issued a notice of allowance, without providing reasons for allowance, on March 4, 2021.

C. Claim Construction

37. I understand that the words of a claim are generally given their ordinary and customary meaning, which I understand is the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention, *i.e.*, as

of the effective filing date of the patent application. I understand the person of ordinary skill in the art is deemed to read the claim term not only in the context of the particular claim in which the disputed term appears, but in the context of the entire patent, including the specification and prosecution history. Additionally, I understand other extrinsic evidence external to the patent and prosecution history, such as dictionaries and treatises, may also be useful in determining the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention. I understand that such extrinsic evidence, however, is generally afforded less weight than intrinsic evidence in determining the meaning of claim terms, and overall is unlikely to result in a reliable interpretation of a patent claim scope unless considered in the context of the intrinsic evidence.

38. I have been instructed that the "intrinsic record" includes the patent itself, including the claims, description, and figures (EX1001, '128 Patent), and the patent's prosecution history—*i.e.*, the record of proceedings at the U.S. Patent and Trademark Office ("Patent Office") concerning the patent (EX1002, Prosecution History). I understand that, like the claims and written description, the prosecution history provides evidence to a person of ordinary skill in the art of how the inventor intended his patent to be understood, and how the Patent Office understood the patent. I understand that the inventor is permitted to apply a special definition to the terms or to limit the scope of claim terms in his patent claims, which may differ from

the term's plain and ordinary meaning. That special definition or limitation on scope may be provided in the patent's written description, the patent's prosecution history, or both. I understand that claim interpretation may also be informed by "extrinsic evidence" (that is, evidence outside of the patent record itself). I have been informed that extrinsic evidence may include dictionaries, technical treatises, and other materials evidencing the meaning of a claim term and the understanding held by a POSITA in the relevant time period.

39. I have been asked for purposes of this declaration to apply the plain and ordinary meaning of the claim terms as they would have been understood by a person of ordinary skill in the art at the earliest effective filing date of the '128 Patent.

40. I understand that no claim term's construction is in dispute at this time. Based on my review of these materials and my personal knowledge and experience, I have considered each term of the '128 Patent as it would have been understood by a person of ordinary skill in the art at the earliest effective filing date of December 7, 2019. I also understand that I am to interpret each claim term by its plain and ordinary meaning when applying the prior art, which I have done here. In my opinion, Claims 1-19, under their plain and ordinary meaning, are unpatentable for at least the reasons I address below in Grounds 1A-2B.

VII. GROUND 1A

A. Cirik Renders All Claims of the '128 Patent Obvious.

1) Effective Filing Date of Cirik (EX1004)

41. Cirik (EX1004) claims the benefit of priority to U.S. Provisional Application No. 62/908,473 (EX1005, "Cirik Provisional"), which was filed September 30, 2019 —*i.e.*, more than two months before the earliest effective filing date of the '128 Patent (December 7, 2019). Based on my review, Cirik Provisional provides clear and unambiguous support for at least independent claim 15 of Cirik. The following table identifies exemplary support in the Cirik Provisional for each limitation of Cirik's claim 15.

Cirik (EX1004, Claim 15)	Exemplary Support Cirik Provisional (EX1005)
A method comprising:	EX1005, FIGs. 17, 19-20, [0251-0253], [0288-0291].
sending, by a wireless device and based on a determination of one or more listen-before-talk (LBT) failures for an active uplink bandwidth part (BWP) of a cell, an uplink signal associated with an LBT failure recovery procedure for the	EX1005, FIGs. 19-20, [0252-0253] *see also* [0212], [0253-0255], [0257], [0264], [0267], [0289] (explaining that the steps TO-T4 in FIG. 20 were discussed in FIG. 19).

active uplink BWP of the cell; and;	
cancelling the LBT failure recovery procedure based on receiving, during the LBT failure recovery procedure, downlink information indicating BWP switching for the cell.	EX1005, FIG. 20, [0237] (explaining that "the wireless device may switch from the uplink BWP to the second uplink BWP based on receiving a downlink signal (e.g., DCI, RRC, MAC CE) indicating the second uplink BWP."), [0279] [0291] (stating that "[b]ased on the switching from the uplink BWP to the second uplink BWP during the (ongoing) LBT failure recovery procedure, the wireless device may stop/abort the (ongoing) LBT failure recovery procedure.").

42. Even beyond supporting at least Claim 15 of Cirik, Cirik Provisional also supports the disclosures from Cirik that I cite in this Declaration. I note that the contents of Cirik Provisional are included in and form part of Cirik's own disclosure at least because Cirik incorporates Cirik Provisional in its entirety. EX1004, [0001]. I cite to Cirik Provisional both here and in the analysis of the Challenged Claims as confirmation that Cirik's teachings were properly disclosed before the earliest effective filing date of the '128 Patent (December 7, 2019).

43. In this Declaration, I will commonly refer to Cirik's disclosure (EX1004) by citation to Cirik's provisional application (EX1005) since the provisional is incorporated by reference in the publication of Cirik's utility

application (EX1004). EX1004, [0001]. The teachings of Cirik's provisional application were also carried into the text/figures of Cirik's non-provisional publication (EX1004). I have analyzed both Cirik's provisional application and the non-provisional publication. In the table below, I map various cited paragraph/figures from the provisional to corresponding paragraph(s)/figure(s) from the non-provisional. These mappings confirm that the cited portions of Cirik are fully supported by the provisional application and Cirik renders the Challenged Claims obvious. To be clear, apart from Cirik's incorporation of Cirik Provisional by reference, it is my opinion that Cirik's non-provisional also includes express disclosure in the published application corresponding to all the disclosures cited in Cirik Provisional, many of which are identified in the following table:

Citations to Cirik Provisional (EX1005)	Corresponding Disclosure in Cirik (EX1004)
[0073]	[0076]-[0077]
[0077]	[0081]
[0100]	[0103]
[0106]-[0107]	[0109]-[0110]
[0148]-[0174]	[0147]-[0174]
[0207]-[0212]	[0209]-[0212]
[0215]-[0218]	[0215]-[0216]
[0227]-[0250]	[0223]-[0244]
[0252]-[0253]	[0245]-[0246]

[0256]	[0247]-[0248]
[0262]	[0254]
[0264]- [0266]	[0256]-[0258]
[0270]	[0261]
[0277]	[0267]
[0281]-[0285]	[0270]-[0271], [0277]-[0279]
[0288]-[0315]	[0286]-[0313]
[0317]-[0318]	[0314]-[0316]
[0332]	[0338]
FIG. 9	FIG. 9
FIGs. 13A-13C	FIGs. 13A-13C
FIGs. 17-22	FIGs. 17-19, 21-23

2) Cirik (EX1004)

44. Cirik describes various methods for beam failure detection and recovery and LBT failure detection and recovery. *See e.g.*, EX1005, [0306]-[0308], FIG. 21; EX1004, [0001] (incorporating Cirik Provisional (EX1005) by reference). For example, FIG. 21 of the Cirik Provisional illustrates an example "beam failure" and "LBT failure recovery procedure":

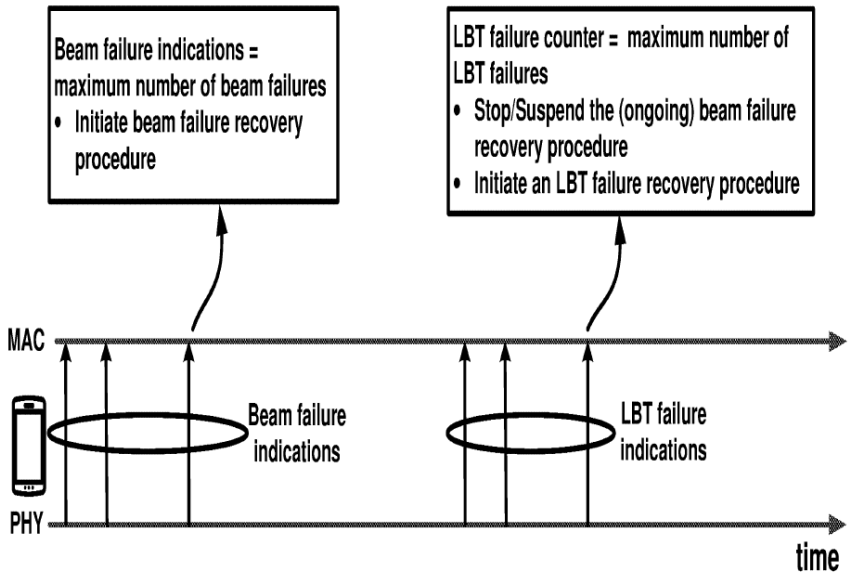


FIG. 21

EX1004, FIG. 21.

45. As shown in FIG. 21, Cirik addresses the conflict between BFR and consistent LBT failure recovery in the same manner as the '128 Patent, including by stopping the random access process for the ongoing BFR procedure and initiating a new random access process for the LBT failure recovery procedure. EX1005, [0307]-[0310], FIG. 21; *see also id.,* [0077], [0100], [0106], [0237], [0291] [0161]-[0163], [0264], FIGs. 13A-13C, 19, 22.

46. Cirik describes standard random access processes for beam failure recovery and consistent LBT failure recovery, which were well known before the earliest effective filing date of the '128 Patent. These random access processes

include both contention-based random access processes (CBRA) and contention-free random access processes (CFRA). CBRA is sometimes referred to as a 4-step random-access process while CFRA is sometimes referred to as either a 2-step or a 3-step random access process (Cirik refers to CFRA as a 2-step process). CBRA and CFRA processes are described in detail in Cirik with respect to FIGS. 13A-13C. EX1005, [0151]-[0174], FIGS. 13A (CBRA process), 13B-C (CFRA processes). A POSITA would have been familiar with both CBRA and CFRA processes. *See e.g.*, EX1020, 1-7 ("In contention based Random access, UE selects a Preamble randomly from a pool of preambles shared with other UE. This means that the UE has a potential risks of selecting the same preamble as another UE and subsequently may experience conflict or contention. The gNodeB uses a contention resolution mechanism to handle this type access requests. … In non contention[] based Random Access, the preamble is allocated by the gNodeB and such preambles are known as dedicated random access preamble. The dedicated preamble is provided to UE either via RRC signalling … or PHY Layer signalling …. Therefore, there is no preamble conflict.").

47. A UE can utilize either a CBRA 4-step process or a CFRA 2-step process for beam failure recovery and consistent LBT failure recovery. Cirik identifies beam failure recovery as one suitable application of a CFRA 2-step process, for example, but beam failure recovery is limited to a 2-step process. To

the contrary, it had already been agreed to by the earliest effective filing date of the '128 Patent that the NR standard would allow beam failure recovery to be performed using either a CFRA 2-step process or a CBRA 4-step process depending on the circumstances. EX1022, [0008] ("In case the UE has no dedicated preamble for BFR, it has been agreed that Contention-Based Random Access (CBRA) should be used instead."); EX1020 ("When dedicated resources are insufficient, the gNodeB instructs UEs to initiate contention-based RA."); EX1021, 1 ("In a recent release [1], the 5G New Radio (5GNR) standard included a modification of the legacy four-step random access (4SRA) protocol …. The modification, aiming at reducing the latency entailed by the four-step handshake of the 4SRA protocol, reduces the RA procedure to two steps, consisting of the transmission of an uplink message, followed by a feedback acknowledgment. The method, referred to as two-step random access (2SRA), allows resuming the legacy 4SRA procedure whenever a transmission fails …). Cirik likewise explains that a variety of factors may impact the UE's choice of random-access procedure. EX1005, [0166] ("The UE may determine, based on one or more factors, whether to initiate the two-step random access procedure. The one or more factors may be: a radio access technology in use (e.g., LTE, NR, and/or the like); whether the UE has valid TA or not; a cell size; the UE's RRC state; a type of spectrum (e.g., licensed vs. unlicensed); and/or any other suitable factors."), [0205] ("[C]ontention-based random access (CBRA) and/or

contention-free random access (CFRA) may be supported on SpCell."). A POSITA would have read Cirik with the understanding that BFR and consistent LBT failure recovery can each employ CBRA or CFRA processes under appropriate conditions. It would be obvious to use CFRA where available to reduce latency and improve performance where possible, but CBRA would be obvious to use in legacy systems or where CFRA fails or when the UE has no dedicated random-access preamble for the requested recovery procedure. Cirik further acknowledges that that the 2-step CFRA procedures are "[s]imilar to the four-step contention-based random access procedure" and that the configuration messages for CFRA and CBRA procedures are "analogous." While Cirik describes the configuration messages in greatest detail with respect to CBRA and FIG. 13A, a POSITA would have understood that analogous configuration messages are similarly employed for CFRA procedures like those described in FIGS. 13B-13C. EX1015, 298 ("Only the first two steps of the preceding procedure are used for contention-free random access as there is no need for contention resolution in a contention-free scheme."), 305, 383-387.

48. As I noted above, the contents of Cirik Provisional are part of Cirik's disclosure at least because Cirik incorporates Cirik Provisional in its entirety. EX1004, [0001]. My declaration cites to Cirik Provisional both here and in the analysis of the Challenged Claims as confirmation that Cirik's teachings were

properly disclosed before the earliest effective filing date of the '128 Patent (December 7, 2019).

3) Claim 1

a) Element 1pre: A method comprising:

49. Cirik renders obvious [1pre]. Like the '128 Patent, Cirik discloses methods for beam failure detection and recovery and listen-before-talk (LBT) failure detection and recovery. EX1005, FIG. 21, [0307]-[0310]; *see also above*, §VII.A.2. For example, one method for beam failure detection and recovery is illustrated and described in reference to FIG. 21:

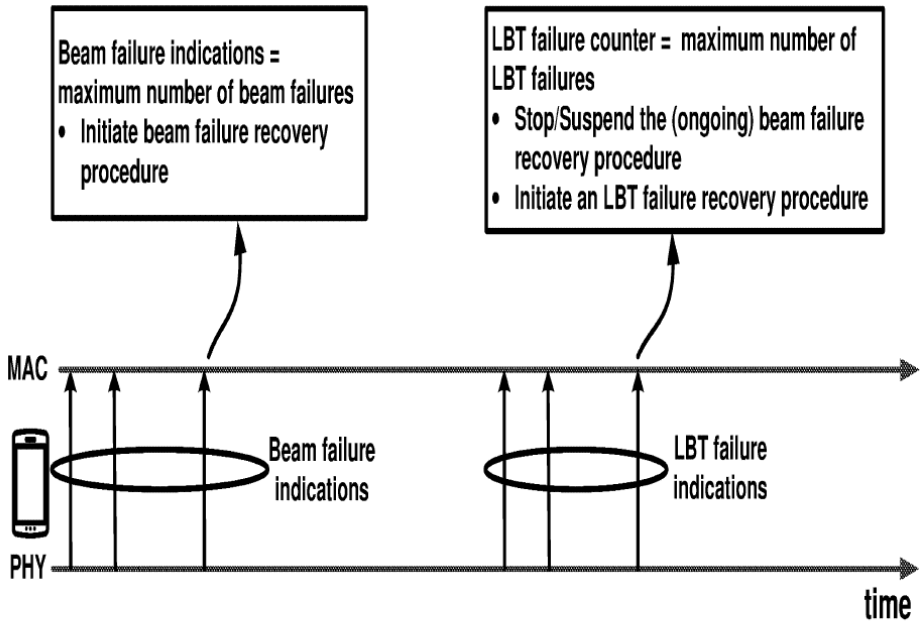


FIG. 21

EX1005, FIG. 21, [0306]-[0310].

50. As I discussed above, the Cirik Provisional (EX1005) is incorporated by reference in Cirik (EX1004) at [0001]. For simplicity, my declaration cites and refers to disclosure from Cirik Provisional as part of Cirik due to its incorporation by reference. The teachings of Cirik Provisional were also carried into the text/figures of Cirik's non-incorporated disclosure. *See above* §VII.A.1.

b) Element 1a.i: receiving, by a wireless device, one or more messages comprising:

51. Cirik renders obvious Element [1a.i]. As discussed, Cirik describes a wireless device that implements random access (RA) procedures for both beam failure recovery and LBT failure recovery. EX1005[1], [0161]-[0163], [0307-0310]; *see also above* Element [1pre], §VII.A.2. As part of these procedures, Cirik discloses that the wireless device receives one or more messages from the base station including first configuration parameters for beam failure recovery including first random access parameters (*see e.g.*, EX1005, [0161]-[0163], [0307] & *below* Element [1a.ii]) and second configuration parameters for LBT failure recovery including second random access parameters (*see e.g.*, EX1005, [0207]-[0209], [0215]-[0218], [0266] & *below* Element [1a.iii]).

c) Element 1a.ii: first configuration parameters for beam failure recovery, comprising first random access parameters;

[1] *See above* ¶¶42-43, 50.

52. Cirik renders obvious Element [1a.ii]. For example, Cirik's wireless device receives "one or more configuration parameters" that "indicate the maximum number of beam failure[s]":

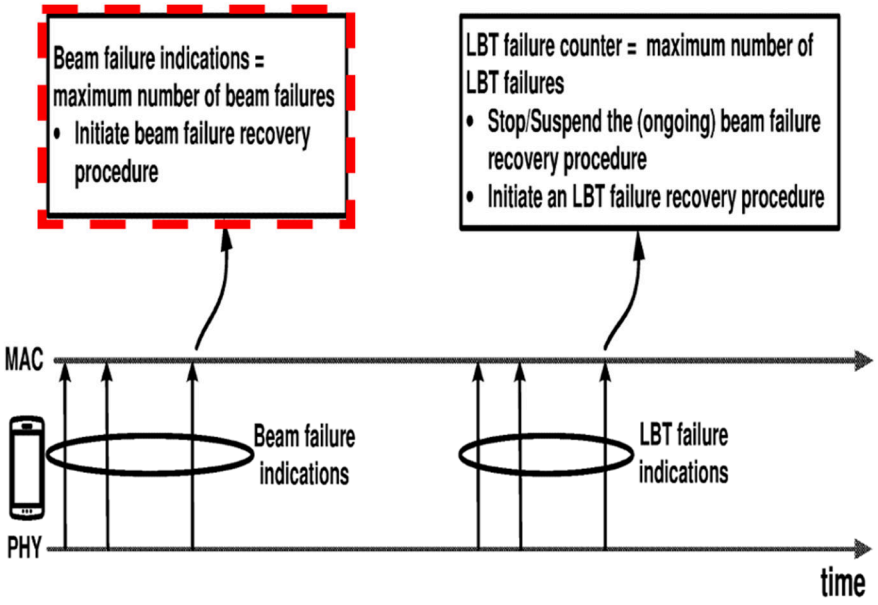


FIG. 21

EX1005[2], FIG. 21 (annotated), [0307].

53. Cirik explains that "the wireless device may detect the beam failure based on a number of beam failure instance indications (*e.g.*, Beam failure indications in FIG. 21) reaching a maximum number of beam failure counter (*e.g.*, maximum number of beam failures in FIG. 21)." EX1005, [0307]. "The one or more

[2] *See above* ¶¶42-43, 50.

configuration parameters may indicate the maximum number of beam failure counter for the active downlink BWP of the second cell." *Id., see also id.* [0103]. Cirik explains that "second cell" can be the primary cell (*e.g.*, "PCell"). *Id.* Cirik's first configuration parameters for beam failure recovery thus include parameters substantially the same as those disclosed in the '128 Patent itself. *See e.g.*, EX1001, 63:9-12 ("The first configuration for beam failure recovery may comprise a first parameter (e.g., beamFailureInstanceMaxCount) indicating a first number of beam failure instances that triggers beam failure recovery."); 41:65-67 (explaining that "the beamFailureDetectionTimer and beamFailureInstanceMaxCount may be configured cell specifically per [downlink] BWP configured.").

54. Cirik also discloses, in connection with random access (RA) procedures initiated for beam failure recovery, that the base station transmits a configuration message to the wireless device, *e.g.*, as illustrated by FIGS. 13A-C. EX1005, [0152], [0161]-[0164], FIGS. 13A-C. The "configuration message" for random access procedures include "one or more random access channel (RACH) parameters." EX1005, [0151]-[0152], *see also* [0153]-[0154], [0156], [0161] ("configuration message 1320 may be analogous … to the configuration message 1310").

55. Cirik describes details for the "configuration message" in FIG. 13A as part of a four-step random access process. EX1005, [0154]-[0174]. Both two- and four-step random access processes utilize a "configuration message," "msg 1," and

"msg 2." EX1005, [0161]. A POSITA would have known that the two-step/contention-free random access process uses the first two steps of the four-step/contention-based random access process. *See* EX1011, , 331-332 (describing the random access response step (*i.e.,* the second step) in a four-step random-access process while noting that if it is a contention-free random-access process the random access response step (*i.e.,* the second step) "is the last step of the random-access procedure as there is no need to handle contention in this case."), 102 (explaining that in contention-free random access "only the two first steps of the random-access procedure are needed."), 248 ("The beam-recovery request is in essence a two-step contention-free random-access request consisting of preamble transmission and random-access response."); EX1015, 298 ("Only the first two steps of the preceding procedure are used for contention-free random access as there is no need for contention resolution in a contention-free scheme."), 305 ("If contention-free random access using a dedicated preamble is used, this is the last step of the random-access procedure as there is no need to handle contention in this case."), 383-387. I also note that a POSITA would have understood and found obvious that the "configuration message," "msg 1," and "msg 2" would carry the same or similar information for both a four-step random access process and a two-step random access processes because these steps are the same in both contention-based and contention-free random access procedures. EX1005, [0161]. Accordingly, a

POSITA would have understood that the configuration message 1320 from FIG. 13B carries carry similar RACH parameters as configuration message 1310 from FIG. 13A.

56. The RACH parameters included in a configuration message can include indications of "one or more Physical RACH (PRACH) occasions available for transmission" of a random-access preamble message and information for determining a power level for the transmission. *Id.*, [0153]-[0154]. The configuration parameters for random access processes used in connection with beam failure recovery, such as the parameters that indicate PRACH resources for beam failure recovery, correspond to "***first random access parameters***" as claimed.

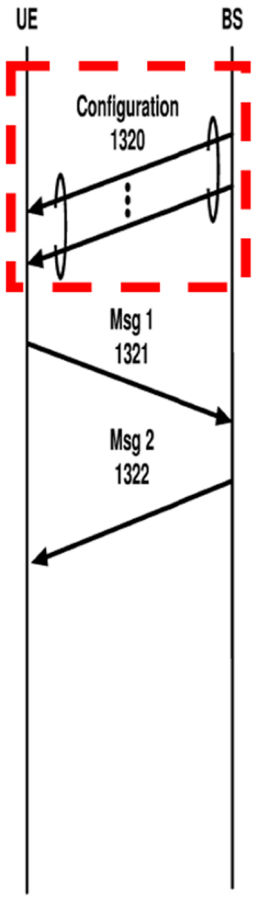


FIG. 13B

EX1005, FIG. 13B (annotated); *see also id.*, [0161], [0162] ("The contention-free random access procedure … may be initiated for a beam failure recovery."), [0163] (explaining that the beam failure recovery parameters can include "a separate time window and/or a separate PDCCH in a search space indicated by an RRC message (e.g., recoverySearchSpaceId)"), [0152]-[0154], [0164], [0208], [0304], [0332] (explaining that the one or more configuration parameters are received at the wireless device); *above*, ¶¶42-43; *below*, Elements [1b], [13a].

d) Element 1a.iii: second configuration parameters for listen-before-talk (LBT) failure recovery; and

57. Cirik renders obvious Element [1a.iii]. For example, Cirik discloses that the wireless device receives "one or more configuration parameters" that "comprise LBT failure detection and recovery configuration parameters." EX1005[3], [0207]-[0210], [0215]-[0219], *see also* FIGs. 17, 21. Like the '128 Patent, Cirik explains that the "LBT failure detection and recovery configuration parameters" can include parameter(s) that define a "maximum number of LBT failures" as shown in FIG. 21:

[3] *See above* ¶¶42-43, 50.

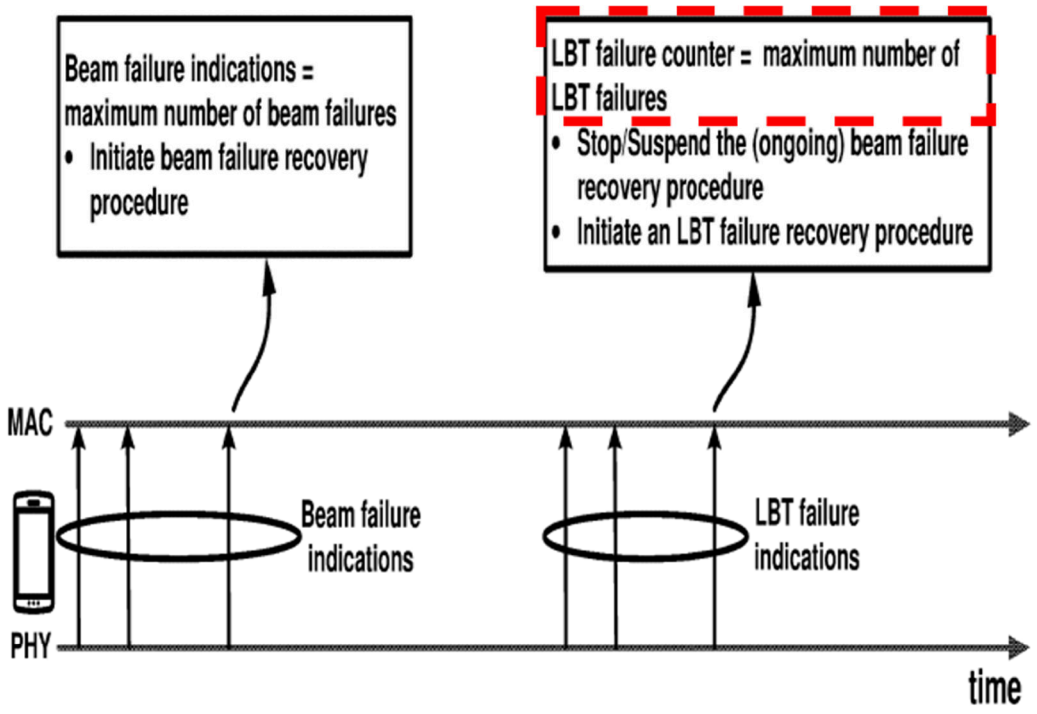


FIG. 21

EX1005, FIG. 21 (annotated), *see also* [0207]-[0209], [0216]-[0217], [0245]-[0246] ("the second LBT failure detection and recovery configuration parameters may indicate a second maximum number of LBT failures"), FIGS. 17-18; *cf.* EX1001, 63:42-46 ("The second configuration for LBT failure recovery may comprise a first parameter (e.g., FailureInstanceMaxCount) indicating a first number of LBT failure instances that triggers LBT failure recovery."); *above*, ¶¶42-43; *below*, Elements [1f], [16a].

e) Element 1a.iv: second random access parameters;

58. Cirik renders obvious Element [1a.iv]. For example, Cirik discloses that the wireless device receives "one or more configuration parameters [that] indicate one or more uplink channel resources" including "PRACH resources" (*i.e.*, physical random access channel resources). EX1005[4], [0266]. The configuration parameters for random access processes used in connection with consistent LBT failure recovery, such as the parameters that indicate PRACH resources for LBT failure recovery, correspond to "***second random access parameters***" as claimed. EX1005, [0266] ("In an example, the one or more uplink channel resources may be (dedicated) for LBT failure recovery procedures of one or more cells."), [0207]-[0210], [0264]-[0266], FIGS. 17, 19, 21; *see also* [0151]-[0174] & FIGS. 13A-13C (describing random access procedures involving receipt of configuration messages containing random access parameters).

59. As an example, Cirik discloses use of a "two-step random access procedure" for LBT failure recovery. EX1005, [0264] ("In an example, when the wireless device detects/determines/declares the uplink LBT failure, the wireless device may trigger transmission of an uplink signal (e.g., SR) for an LBT failure recovery procedure … In an example, the uplink grant may be indicated/obtained by a random-access response. In an example, the uplink grant may be a PUSCH

[4] *See above* ¶¶42-43, 50.

occasion indicated by configuration parameters of a two-step random access procedure."); [0164]-[0174] & FIGS. 13B, 13C (describing details of two-step random access procedures); *above*, ¶¶42-43.

f) Element 1b: initiating, based on the first configuration parameters and in response to detecting a beam failure on a primary cell, a first random access process on a first bandwidth part (BWP) of the primary cell for beam failure recovery based on the first random access parameters;

60. Cirik renders obvious Element [1b]. For example, in connection with FIG. 21, Cirik discloses that "the wireless device may initiate a beam failure recovery procedure (e.g., PRACH-based, PUCCH-based) based on the detecting the beam failure." EX1005[5], [0308]. Cirik's PRACH-based (*i.e.*, physical random access channel-based) beam failure recovery procedure provides a "***first random access process***" as claimed. EX1005, [0150] ("The UE may initiate the random access procedure for a beam failure recovery request.").

[5] *See above* ¶¶42-43, 50.

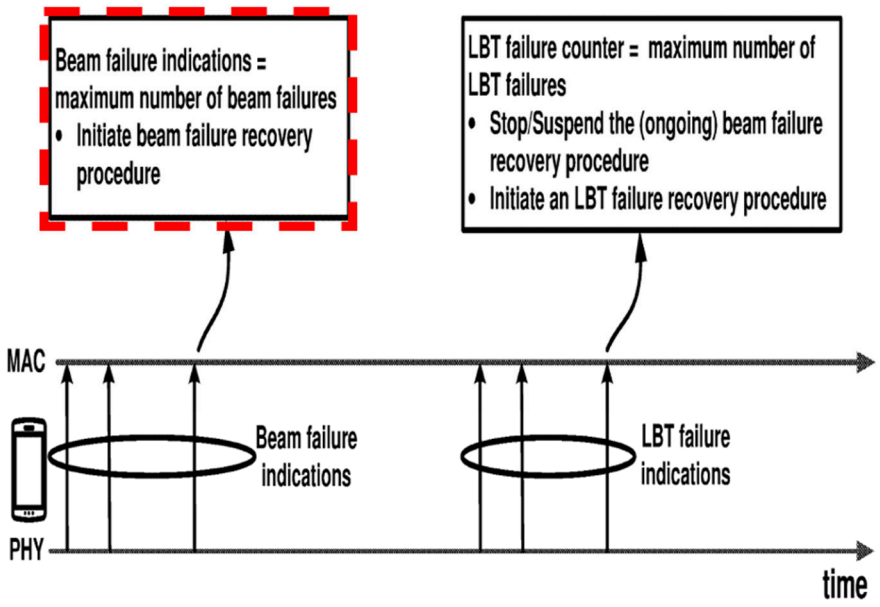


FIG. 21

EX1005, FIG. 21 (annotated).

61. Cirik's wireless device performs the beam failure recovery procedure based on the first configuration parameters discussed above (*above*, [1a.ii]) and in response to detecting a beam failure. Indeed, Cirik specifically explains that beam failure recovery is initiated "based on the detecting the beam failure" and that the beam failure is detected "based on a number of beam failure instance indications (e.g., Beam failure indications in FIG. 21) reaching a maximum number of beam failure counter (e.g., maximum number of beam failures in FIG. 21)." EX1005, [0307]-[0308]; *see also id.*, [0307] ("The one or more configuration parameters may indicate the maximum number of beam failure counter …"); *above*, Element [1a.ii].

Cirik further discloses that the beam failure can be detected on a primary cell (PCell) and that the beam failure recovery procedure can be initiated on a first BWP of the same primary cell. EX1005, [0307] ("detect a beam failure for a … PCell"), [0308] ("initiate the beam failure recovery procedure for the active downlink BWP" of the PCell (*i.e.*, the same second cell referenced in [0307]); *see also id.*, [0112], [0196], [0209], [0321], [0333]; *cf.*]; EX1001, 17:7-22.

62. Cirik likewise describes techniques for initiating beam failure recovery using a random access process (*e.g.*, "PRACH-based") and based on the first random access parameters. EX1005, [0308], [0161]-[0163]; *see also id.*, [0151]-[0160], [0164]-[0174], FIGS. 13A-C. For instance, Cirik explains that random access procedures are initiated by the wireless device using "one or more random access channel (RACH) parameters" received in configuration messages from the base station (*e.g.*, configuration messages 1310, 1320, 1330). EX1005, [0151]-[0154], [0161]-[0163], FIGS. 13A-13C; *above*, Element [1a.ii]. A POSITA also would have understood that a PRACH-based beam failure recovery procedure would be initiated on a first BWP of the primary cell because a BWP configured with random access occasions is standard, and even necessary, to initiate a PRACH-based BFR procedure. EX1005, [0161]-[0163], [0270], FIG. 13B, *see also id.*, [0151]-[0157], [0212] (explaining that "in the active state of an uplink BWP of the one or more uplink BWPs, the wireless device may transmit an uplink signal/channel (e.g.,

PUCCH, preamble, PUSCH, PRACH, SRS, etc) via the uplink BWP."), FIG. 13A; *above*, ¶¶42-43.

63. I note that it would have been well known to a POSITA to initiate the random access procedure for beam failure recovery on a first BWP of the primary cell. *See for example,* EX1006 (Wu), [0073]-[0074] (explaining that a terminal device initiates a RA procedure on a BWP); *See* EX1016, [0060]-[0061](" the UE initiates a random access on a selected BWP to perform the beam failure recovery"), [0083]-[0088]; EX1011, 248-249 (explaining that the beam-recovery request is a random access request and that the "preamble configuration (RACH occasion and preamble sequence…) … should be transmitted within the uplink beam that coincides with the identified downlink beam."). Cirik also explains that "the wireless device may initiate the beam failure recovery procedure for the active downlink BWP of the second cell," and describes how the second cell is also the primary cell (*e.g.*, PCell) on which the beam failure was detected. EX1005, [0308], [0307] ("[T]he wireless device may detect a beam failure for a second cell (e.g., PCell[] …). In an example, the wireless device may detect the beam failure for an active downlink BWP of the second cell."); *see also id.*, [0270], [0161]-[0163], FIG. 13B.

g) Element 1c: triggering, based on the second configuration parameters, consistent LBT failure for the primary cell;

64. Cirik renders obvious Element [1c]. For example, Cirik's wireless device "may detect/determine/declare the uplink LBT failure for the uplink BWP of the cell." EX1005[6], [0309], *see also id.*, [0310]-[0315]. Cirik further explains that the "the cell" on which consistent LBT failure is triggered (*e.g.*, detected/determined/declared) is in some cases the same primary cell (PCell) as the cell (*e.g.*, second cell) on which beam failure was detected and on which BFR was initiated. EX1005, [0307] ("detect a beam failure for a second cell (e[.]g., PCell …) … the second cell and the cell may be the same").

[6] *See above* ¶¶42-43, 50.

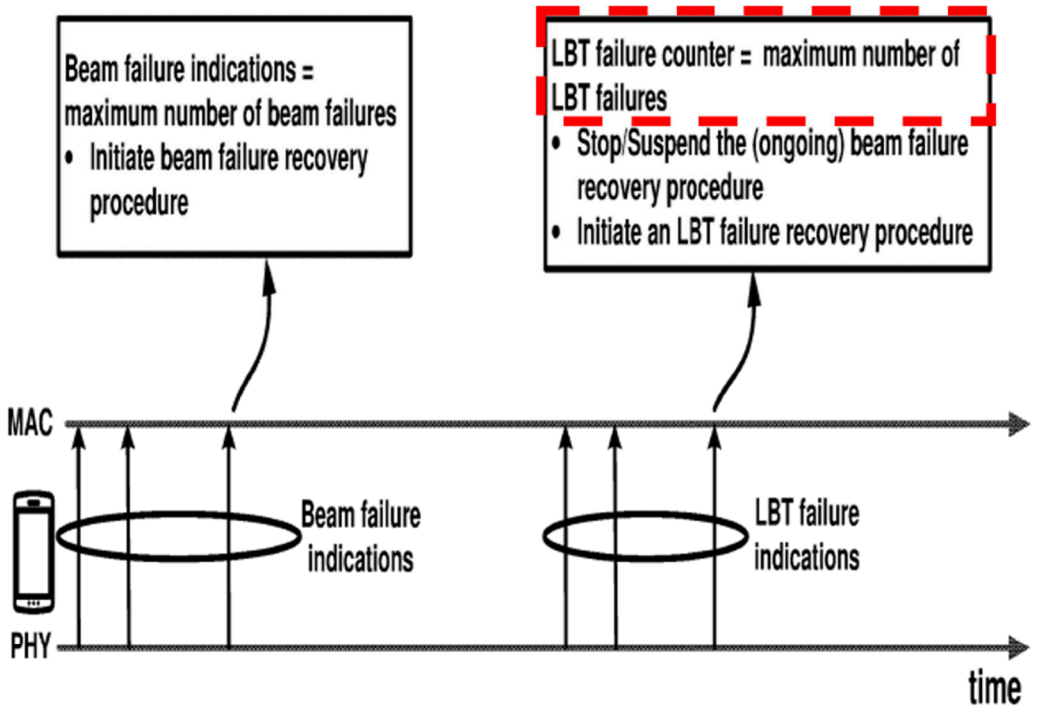


FIG. 21

EX1005, FIG. 21 (annotated). Cirik explains that the wireless device triggers (*e.g.*, detects/determines/declares) LBT failure based on the "LBT failure detection and recovery configuration parameters" included among the "***second configuration parameters***" described above in connection with [1a.iiii]. EX1005, [0215]-[0217], *see also id.*, [0207]-[0209], FIG. 17; *above*, [1a.iii]. For example, Cirik's "LBT failure detection and recovery configuration parameters" include a "maximum number of LBT failures" and Cirik explains that "the wireless device may detect/determine/declare an uplink LBT failure for the uplink BWP of the cell based

on a number of LBT failure indications reaching the maximum number of LBT failures." EX1005, [0216]-[0217], [0231]-[0233].

65. I note that the '128 Patent also discloses that "[a] consistent uplink LBT failure event may be triggered based on the uplink LBT failure counter reaching the threshold value." EX1001, 33:36-38, *see also* 36:31-34; 38:63-67.

h) Element 1d: stopping the first random access process, for the beam failure recovery, based on the triggering the consistent LBT failure;

66. Cirik renders obvious Element [1d]. For example, regarding the process depicted in FIG. 21, Cirik discloses that "based on the detecting/determining/declaring the uplink LBT failure for the uplink BWP of the call during the (ongoing) beam failure recovery procedure, the wireless device may suspend the (ongoing) beam failure recovery procedure until the LBT failure recovery procedure is completed (e.g., time T4 in FIG. 19)." EX1005[7], [0310]; *see also id.*, [0309] (explaining that "based on the detecting/determining/declaring the uplink LBT failure for the uplink BWP of the cell during the (ongoing) beam failure recovery procedure, the wireless device may stop/abort the (ongoing) beam failure recovery procedure"), [0312]-[0314], [0318].

[7] *See above* ¶¶42-43, 50.

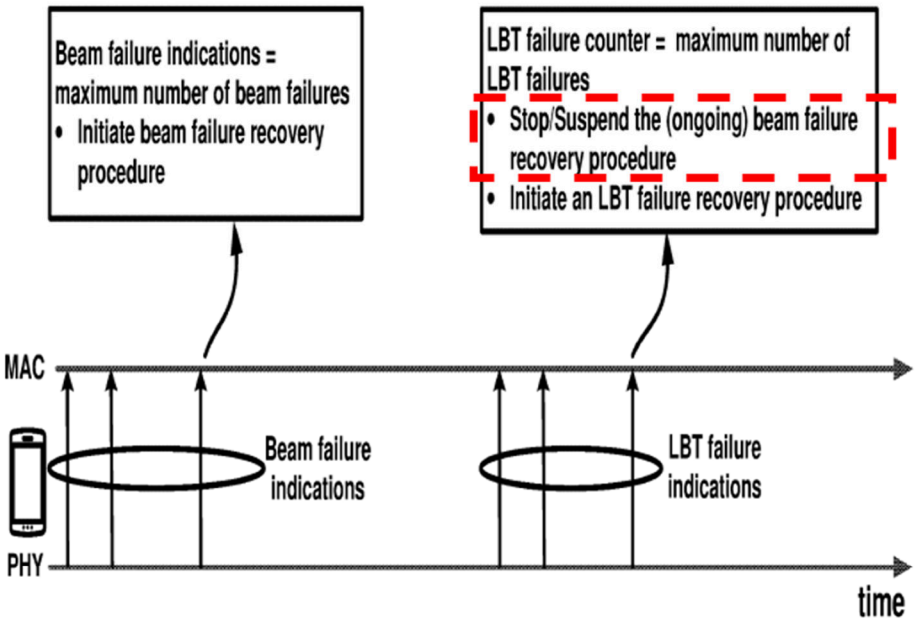


FIG. 21

FIG. 21 (annotated).

67. As I discussed above (*above*, Element [1b]) the beam failure recovery procedure involves a first random access process. *Above*, Element [1b]; EX1005, [0161]-[0163], [0308], FIG. 13B; *see also id.*, [0151]-[0174], FIG. 13A-C. Suspending/stopping/aborting the beam failure recovery procedure to initiate a new random access for consistent LBT failure recovery as taught in Cirik would therefore include stopping the first random access process. A POSITA would have known that only one random access process can occur at a time and stopping ongoing random access processes was the known option for stopping procedures such as beam failure

recovery as taught in Cirik. *See e.g.,* EX1007, 1-4 (explaining that that "[u]pon BWP switching caused by detection of consistent uplink LBT failures on SpCell, the MAC entity shall therefore stop the ongoing RA procedure-if any-and initiate a new RA procedure on the active BWP" and "BWP switching caused by detection of consistent uplink LBT failures on SpCell, MAC shall stop any ongoing RA procedure and initiate a new RA procedure.").

i) Element 1e: switching from the first BWP of the primary cell to a second BWP of the primary cell as an active BWP of the primary cell; and

68. Cirik renders obvious Element [1e]. As an initial matter, Cirik explains that the wireless device may switch between bandwidth parts (BWPs) of a cell "for any suitable reason." EX1005[8], [0107], FIG. 9. For example, "[s]witching between configured BWPs may occur based on RRC [radio resource control] signaling, DCI [downlink control information], expiration of a BWP inactivity timer, and/or an initiation of random access." EX1005, [0106]; *see also id.* ("Downlink and uplink BWP switching (where BWP refers to switching from a currently active BWP to a not currently active BWP) may be performed independently in paired spectra. In unpaired spectra, downlink and uplink BWP switching may be performed simultaneously."), [0235]-[0237] ("based on initiating a random-access procedure"),

[8] *See above* ¶¶42-43, 50.

[0291] ("the wireless device may switch from the uplink BWP to a second uplink BWP … during the (ongoing) LBT failure recovery procedure"), FIG. 18.

69. Based on these disclosures, a POSITA would have recognized that Cirik describes the wireless device switching from a first BWP of a cell on which the first random access process for beam failure recovery was initiated (*above*, Element [1b]) to a second BWP of the cell as an active BWP of the cell. The switch may occur "for any suitable reason" according to Cirik (EX1005, [0107]), including based on initiation of a random-access process. EX1005, [0106], [0237]. Cirik thus indicates that the wireless device would switch from a first uplink BWP to a second uplink BWP of a cell to initiate a second random access process for consistent LBT failure recovery (*e.g.*, after suspending/stopping/aborting the first random access process for beam failure recovery) since BWP switching occurs upon "initiation of random access" and "initiat[ing] an LBT failure recovery procedure" involves initiating a random access process. EX1005, [0309] ("[b]ased on the stopping/aborting the (ongoing) beam failure recovery procedure, the wireless device may trigger transmission of an uplink signal (e.g., scheduling request (SR), ***random-access preamble***) for an LBT failure recovery procedure of the uplink BWP of the cell"), [0106], [0237], [0155]-[0156], [0306]-[0315], FIGS. 21-22; *below*, Element [1f].

70. I note that a POSITA also would have known that BWP switching in this context had been described in various contexts before the Critical Date. For example, it was agreed to include switching BWPs when initiating a random access process for LBT failure recovery in the 3GPP standard before the earliest effective filing date of the '128 Patent to. *See* EX1006, 1-2 (stating "Upon declaring a consistent UL LBT failure on the SpCell, the UE switches to another configured BWP with PRACH configured and initiates RACH."); EX1007 (InterDigital), 2-4 (stating that "RAN2 agreed that random access with BWP switching is used to recovery from UL LBT failure on PCell/PSCell, i.e. a new random access trigger is introduced" and "in the previous meeting, we have agreed … that the UE can switch the active BWP to a new BWP with RACH resource for recovery from UL LBT failure."); EX1009, 9 (stating that the "UE switches to another BWP and initiates RACH upon declaration of consistent LBT failure on PCell or PSCell"), *see also* 2, 10-11.

71. At a minimum, switching BWPs would have been obvious to ensure the wireless device uses a suitable BWP appropriately configured with resources for transmission of a new random-access preamble, and because switching would facilitate the wireless device's ability to recover more efficiently from consistent LBT failure than if a whole re-establishment procedure were performed. *See e.g.,* EX1006 (Abstract ("switching to another BWP on different LBT sub-channels can

be much more efficient than going through the whole re-establishment and configuration procedures."), [0090] ("switching to another BWP on different LBT sub-channels can be much more efficient than going through the whole re-establishment and reconfiguration procedures") and EX1007, 1-2, 4 ("UE switch[ing] to another BWP … on PCell or PSCell"). A POSITA would have reasonably expected success since wireless devices commonly switched BWPs when initiating a new random-access procedure, and because switching BWPs in this context is consistent with Cirik's explanation that BWP switching can occur for any suitable reason. .

72. As noted above, Cirik further teaches that the wireless device can switch BWPs during an ongoing LBT failure recovery procedure. EX1005, [0291]; *see also id.*, [0288]-[0305], FIG. 20. For example, "the wireless device may switch from the uplink BWP to the second uplink BWP during the (ongoing) LBT failure recovery procedure (e.g., between time T0 and time T4 in FIG. 20)":

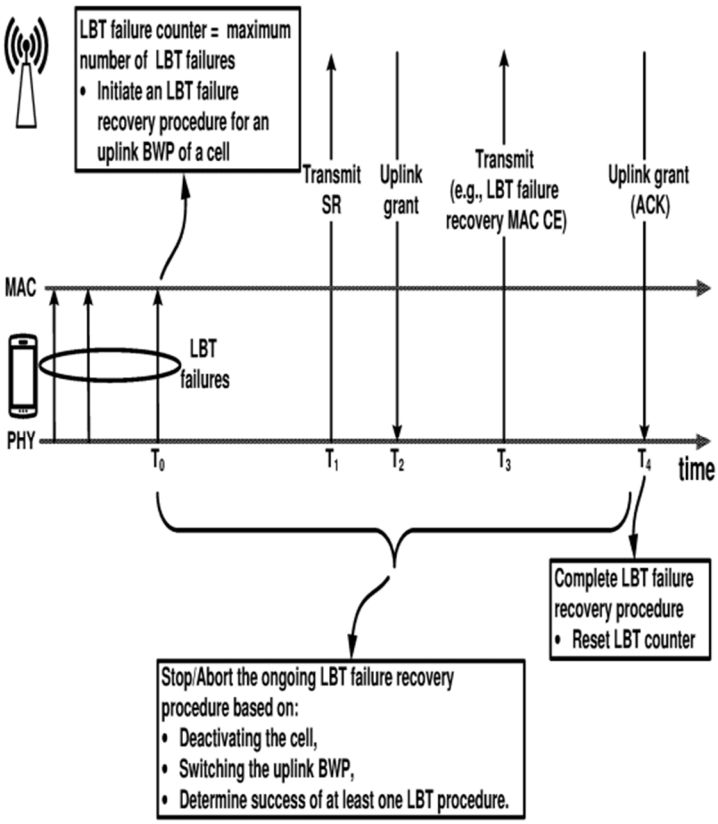


FIG. 20

EX1005, FIG. 20, [0291]; *see also id.*, EX1005, [0210]-[0211] (explaining that each of the BWPs of the cell may be "one of an active state and an inactive state"), [0214], [0237], [0309]-[0310]. Cirik's disclosure at paragraph [0291] and FIG. 20 provides yet another basis for understanding that the wireless device can switch BWPs when initiating an LBT failure recovery procedure, especially since the switch can occur as early as the start of the procedure at time T0. EX1005, [0291] ("between time T0 and time T4"). These teachings further show how Cirik's wireless device switches to a different, second BWP to initiate the LBT failure recovery procedure following suspension/stopping/aborting of the beam failure recovery procedure. *See e.g.,*

EX1006, [0070]-[0074], [0078], [0080], [0082]-[0083], [0088], FIG. 2; EX1007, 1-2, 4) *below* Ground 2A Element [1e]. A POSITA also would have understood that the act of switching BWPs occurs on the same cell, which Cirik confirms is the primary cell in some examples. EX1005, [0307]-[0309], [0112], [0108]; *above*, [1b]-[1c]; *see also* EX1008, 1-5 ("BWP switching for LBT failure recovery on PCell.") and EX1018, 3 (explaining why using BWP switching for LBT failure on the primary cell is advantageous given the wide supported bandwidth). In fact, switching BWPs on the primary cell in such a circumstance was already agreed to in the 3GPP standard. *See e.g.,* EX1007, 4 (agreed to "UE switch[ing] to another BWP … on PCell")).

j) Element 1f: initiating a second random access process on the second BWP of the primary cell for consistent LBT failure recovery and based on the second random access parameters.

73. Cirik renders obvious Element [1f]. For example, Cirik discloses that "[b]ased on the stopping/aborting the (ongoing) beam failure recovery procedure, the wireless device may initiate an LBT failure recovery procedure for the uplink BWP of the cell." EX1005[9], [0309], FIG. 21; *see also id.*, [0312], [0317]-[0318].

[9] *See above* ¶¶42-43, 50.

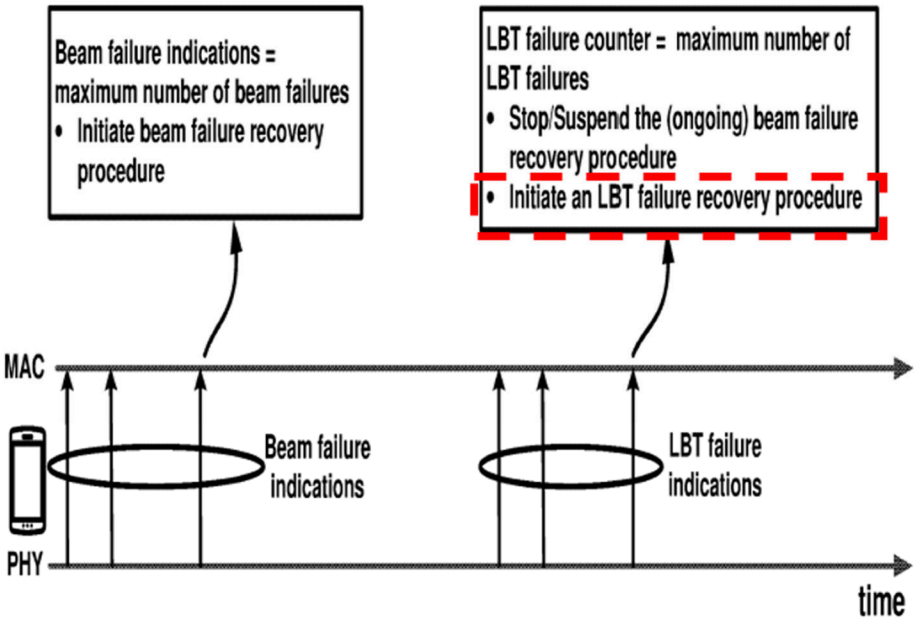


FIG. 21

EX1005, FIG. 21 (annotated).

74. Cirik also explains that initiating an LBT failure recovery procedure includes initiating a second random access process. For example, "[b]ased on the stopping/aborting the (ongoing) beam failure recovery procedure, the wireless device may trigger transmission of an uplink signal (e.g., scheduling request (SR), ***random-access preamble***) for an LBT failure recovery procedure of the uplink BWP of the cell." EX1005, [0309]. A POSITA would have known that the wireless device transmits a random-access preamble to initiate a random-access process. EX1005, [0155]-[0156] ("The Msg 1 1311 may include one or more preamble transmissions

…"), [0161]-[0163] ("transmitting a preamble"), [0165] ("one or more transmissions of a preamble"), FIGS. 13A-13C; *above*, ¶¶42-43.

75. Cirik further discloses that the second random access process for LBT failure recovery can be initiated based on the second random access parameters discussed above with respect to Element [1a.iv]. *Above*, [1a.iv]. For example, Cirik describes determining a random access preamble "based on the one or more RACH parameters provided in the configuration message." EX1005, [0156]; *see also id.*, [0150]-[0174]. The wireless device also uses "PRACH resources" identified in a configuration message to initiate a random access process for LBT failure recovery. EX1005, [0253], [0266] ("the one or more configuration parameters may indicate one or more uplink channel resources (e.g., … PRACH resources[] …). In an example, the one or more uplink channel resources may be (dedicated) for LBT failure recovery procedures of one or more cells."), [0264] ("[W]hen the wireless device detects/determines/declares the uplink LBT failure, the wireless device may trigger transmission of an uplink signal (e.g., SR) for an LBT failure recovery procedure … In an example, the uplink grant may be indicated/obtained by a random-access response. In an example, the uplink grant may be a PUSCH occasion indicated by configuration parameters of a two-step random access procedure."), [0153] ("transmitted to the base station via one or more PRACH occasions") [0164]-[0174] & FIGS. 13A-C (describing details of conventional random access

procedures). It would have been obvious to a POSITA that initiating a random access process for LBT failure recovery would be based on RACH parameters. EX1007 (InterDigital), 1 (stating that the "the UE switches to another configured BWP with PRACH configured."), 4 (explaining that that "N" is ""the number of configured BWPs with configured PRACH resources."); EX1008, 1-3 (explaining that "in case of UL LBT failure, the UE can switch the active BWP to a new BWP with RACH resource for recovery from UL LBT failure."): EX1011, 322-325.

76. As I discussed in further detail above (*above*, Element [1e]), Cirik discloses, and it would have been obvious, to initiate the second random access process for consistent LBT failure recovery on a second BWP of the primary cell different than the first BWP. For example, Cirik describes techniques for switching uplink BWPs on a primary cell for "any suitable reason," including for "initiation of random access," which occurs when initiating consistent LBT failure recovery. EX1005, [0106]-[0107], [0237], [0309]; *above*, Element [1e]. Cirik also expressly discloses switching BWPs at initiation of an LBT failure recovery procedure (*e.g.*, time T0). EX1005, [0291], FIGS. 20-21; *see also id.*, [0161]-[0163], [0209], [0264].

4) Claim 2

a) Element 2: The method of claim 1, wherein the second random access process, for consistent LBT failure recovery, is one of a two-step random access process and a four-step random access process.

77. Cirik renders obvious Claim 2. As discussed with respect to Claim 1, Cirik discloses a second random access process, for consistent LBT failure recovery. *See above* Element [1a.iii]-[1a.iv], [1f]. Cirik discloses that the LBT failure recovery procedure can be a "two-step random access procedure." EX1005[10], [0264], *see also* [0150]-[0174] (describing details of random-access processes including two-step random access processes of FIGS. 13B-13C and a four-step random access process of FIG. 13A) & FIGS. 13A-13C, [0256], [0309] (transmitting "random-access preamble"), [0310].

5) Claim 3

a) Element 3: The method of claim 2, further comprising initiating a third random access process, for the beam failure recovery, after the second random access process is successfully completed.

78. Cirik renders obvious Claim 3. For example, Cirik discloses that "the wireless device may suspend the (ongoing) beam failure recovery procedure until the LBT failure recovery procedure is completed" and then "the wireless device may resume the (ongoing) beam failure recovery procedure based on (e.g., after) the LBT failure recovery procedure being completed." EX1005[11], [0310], *see also id.*, [0312], [0314].

[10] *See above* ¶¶42-43, 50.

[11] *See above* ¶¶42-43, 50.

79. A POSITA would have understood that resuming the beam failure recovery procedure as taught in Cirik involves initiating a third random access process since performing beam failure recovery itself involves initiating a random access process. EX1005, [0162] ("The contention-free random access procedure … may be initiated for a beam failure recovery"), [0308] ("wireless device may initiate a beam failure recovery procedure (e.g., PRACH-based[] …)"), *above*, Element [1b]. Further, to the extent the claim requires, a POSITA also would have appreciated that resuming the beam failure recovery procedure after switching from the first BWP to the second BWP would involve initiating a new (third) random access process for beam failure recovery distinct from the first random access process that was earlier used to initiate the beam failure recovery procedure before it was stopped/suspended. *Above*, [1e]-[1f]. For example, Cirik teaches that switching BWPs causes the BWP from which the device switched (*e.g.*, the first BWP) to be deactivated, which would thus require the wireless device to resume beam failure recovery on an active BWP other than the deactivated BWP (*e.g.*, other than the deactivated first BWP), and thus requiring initiation of a new random access process for beam failure recovery on the active BWP after consistent LBT failure recovery is completed. EX1005, [0237], [0106]-[0107], [0318]. Resuming beam failure recovery would also require the BWP to initiate a new random access procedure by transmitting a new random access preamble (*e.g.*, Msg 1 1311, 1321,

or 1331) as Cirik describes with respect to FIGS. 13A-13C. EX1005, [0150]-[0174], FIGS. 13A-C. At the very least, it would have been obvious to a POSITA to initiate a new (third) random access process when resuming beam failure recovery to ensure the beam failure recovery is performed on an active BWP and that the preamble counter and the power ramping power counter are reset. *See e.g.,* EX1007, 1-2 (explaining that "the UE should initiate a new RA procedure … to ensure the preamble counter and the power ramping counter are reset.").

80. Additionally, even if the claim encompasses a third random access process for beam failure recovery prompted by a beam failure that is *separate* from the beam failure that prompted the first random access process for the earlier-suspended beam failure recovery procedure (*e.g.*, an independent/separate beam failure event that occurs later in time), Cirik would still render element [3] obvious. For example, Cirik discloses that a random-access process can be initiated for beam failure recovery upon detecting any beam failure event, including later beam failures. EX1005, [0150], [0308], FIGS. 13A-13C, 21; *above*, Element [1b].

6) Claim 4

a) Element 4: The method of claim 2, wherein the second random access process comprises transmitting a transport block comprising an LBT failure medium access control (MAC) control element (CE).

81. Cirik renders obvious Claim 4. As discussed, Cirik discloses a random access process for consistent LBT failure recovery. *Above*, Elements [1a.iii], [1f],

[2]; EX1005[12], [0309] ("trigger transmission of an uplink signal (e.g., … random-access preamble) for an LBT failure recovery procedure"), [0264] ("random access procedure"). Cirik describes details of a two-step random-access procedure, for example, that includes transmitting a "transport block 1342":

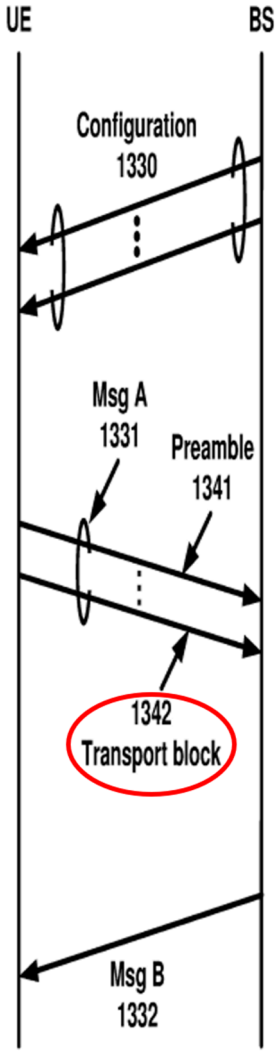


FIG. 13C

[12] *See above* ¶¶42-43, 50.

EX1005, FIG. 13C (annotated), [0164]-[0165], *see also* [0167-0168]. Cirik explains that the transport block comprises a MAC CE. EX1005, FIGs. 4A-B, [0073], [0159], [0165]-[0168]. The wireless device transmits an "LBT failure recovery MAC CE" in a "transport block" in response to detecting consistent LBT failure as part of a random-access procedure for LBT failure recovery, for example.

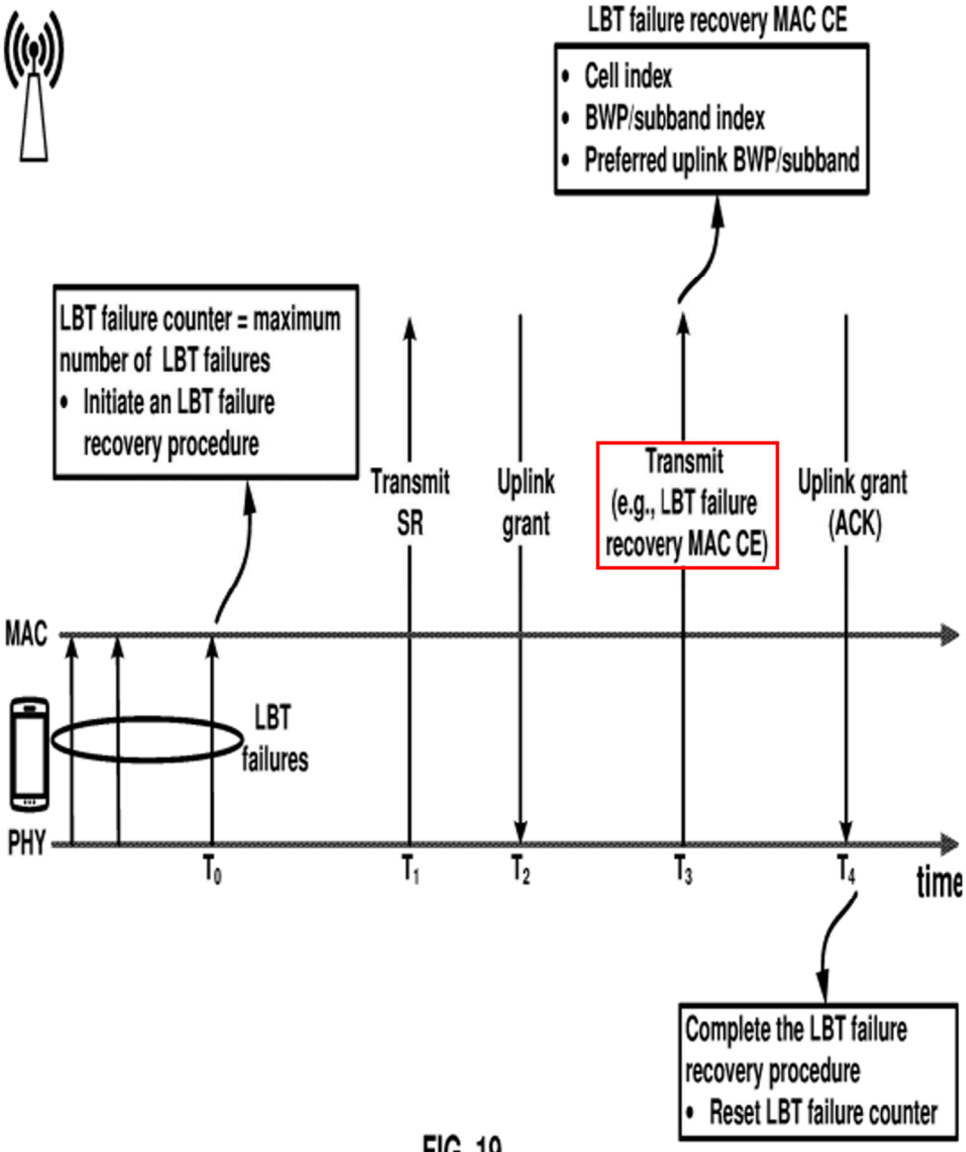


FIG. 19

EX1005, FIG. 19 (annotated), [0264], *see also* [0265], [0277], [0281-0285], FIG. 20. The MAC CE included in the transport block comprises an LBT failure recovery MAC CE when initiating a random access process for consistent LBT failure recovery. *Id.*.

7) Claim 5

a) Element 5a: The method of claim 4, wherein: the transmitting the transport block is based on a logical channel prioritization procedure; and

82. Cirik renders obvious Element [5a]. For example, Cirik explains that the "logical channels (LCHs) may be prioritized" including for the "LBT failure recovery MAC CE." EX1005[13], [0281]-[0283]. As discussed, the "LBT failure recovery MAC CE" is included in a transport block. *See above*, Claim [4]. The transmitting of the transport block is therefore based on a logical channel prioritization procedure. Indeed, Cirik's LBT failure recovery MAC CE is included in the transport block and is transmitted based on a logical channel prioritization scheme. EX1005, [0281]-[0283].

b) Element 5b: a first priority associated with the LBT failure MAC CE is higher than a second priority associated with data from any logical channel except uplink common control channel (UL-CCCH) logical channel.

[13] *See above* ¶¶42-43, 50.

83. Cirik renders obvious Element [5b]. For example, Cirik explains that the LBT failure recovery MAC CE has a higher priority than data from other logical channels including "a BFR MAC CE" and a "Configured Grant Confirmation MAC CE." EX1005[14], [0281]. Cirik also explains that "the LBT failure recovery MAC CE has a lower priority than … data from UL-CCCH." EX1005, [0282]. Cirik also explains that the LBT failure recovery MAC CE may have the same priority as "data from UL-CCCH." EX1005, [0284]. Accordingly, Cirik teaches that the priority associated with the LBT failure MAC CE is higher than a second priority associated with data from any logical channel (*e.g.*, data from the logical channel for BFR MAC CE) except the UL-CCCH, which can have either a higher priority or the same priority as the BFR MAC CE. EX1005, [0281-0283].

84. I note that Element [5b] does not require that the first priority associated with the LBT failure MAC CE be higher than the priority of data from *every* logical channel except UL-CCCH. The language of Element [5b] instead refers to a single "second priority" associated with data from *any* logical channel except UL-CCCH. The BFR MAC CE is data from one such logical channel. Moreover, given the wide range of prioritization options provided in Cirik, and the various examples in which the priority associated with the LBT failure MAC CE is higher than a priority

[14] *See above* ¶¶42-43, 50.

associated with data from other logical channels, Cirik's teachings would have plainly suggested to a POSITA that the priority associated with the LBT failure MAC CE can be higher than a priority associated with data from all other logical channels except the UL-CCCH, and at a minimum, this would have been an obvious option so as to prioritize LBT failure recovery..

8) Claim 6

a) Element 6: The method of claim 1, wherein the first random access process, for the beam failure recovery, is one of a two-step random access process and a four-step random access process.

85. Cirik renders obvious Claim 6. For example, Cirik describes a two-step random access process for "beam failure recovery" like that illustrated in FIG. 13B. EX1005[15], [0161]-[0163], FIG. 13B; *above*, Element [1b]. Cirik also discloses options for at least three contention-free and contention-based random access processes that would be suitable for initiating beam failure recovery. EX1005, FIGS. [0151]-[0174], 13A-13C.

[15] *See above* ¶¶42-43, 50.

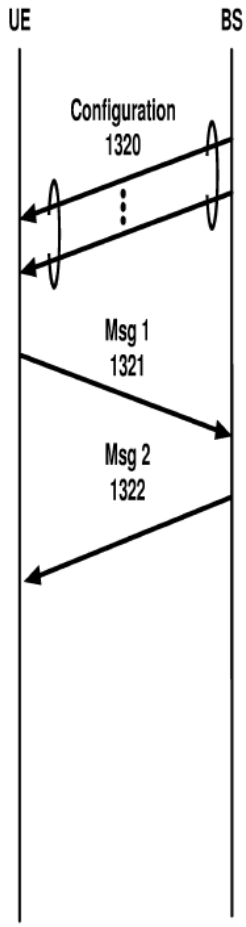


FIG. 13B

EX1005, FIG. 13B.

9) Claim 7

a) Element 7: The method of claim 6, further comprising initiating a third random access process for beam failure recovery after the second random access process is successfully completed.

86. Cirik discloses and renders obvious Element [7] for each of the reasons I addressed above with respect to Element [3]. *See Above*, Element [3].

10) Claim 8

a) Element 8: The method of claim 7, wherein the third random access process comprises transmitting a transport block comprising a beam failure recovery medium access control (MAC) control element (CE).

87. Cirik renders obvious Claim 8. As discussed, Cirik discloses that the wireless device initiates a random access process for beam failure recovery. *See above* Element [1a.ii], [1b], [3], [7]. The wireless device "may initiate a beam failure recovery (BFR) procedure" by "transmit[ting] a BFR request (e.g., ***a preamble, … a MAC CE***, and/or the like) based on the initiating of the BFR procedure." EX1005, [0148]. Cirik further teaches that MAC CEs are transmitted in transport blocks and that transport blocks can be included in a message sent from the wireless device to the base station in a random-access process. EX1005, [0067], [0069]-[0074], [0159], [0169], [0164]-[0169], FIGS. 4A-B, 21, 13A-13C; *see also* [0281]-[0283], [0311], [0313], [0315], [0319]. A POSITA therefore would have understood that the third random access process for beam failure recovery can include transmitting a transport block comprising a BFR MAC CE. *See e.g.,* EX1019, [0031] (describing "improved methods, systems, devices, and apparatuses that support beam failure recovery processes via MAC CE.").

88. Additionally, it would have been obvious to apply the random access procedure shown in FIG. 13C for the claimed third random access procedure. In particular, a POSITA would have known that MAC CEs for beam failure recovery

would be transmitted in transport blocks. *See* EX1011, 89, 247-249 (explaining that "[i]n 5G networks, control information (for uplink and/or downlink) may be conveyed in a medium access control (MAC) control element (CE) (i.e., in a MAC header) of a physical channel packet (i.e., a data packet or physical channel signal)" and "MAC CEs can be transmitted in a payload of a physical channel packet.").

11) Claim 9

a) Element 9a: The method of claim 8, wherein: the transmitting the transport block is based on a logical channel prioritization procedure; and

89. Cirik renders obvious Element [9a]. For example, Cirik explains that the "logical channels (LCHs) may be prioritized" including for the "BFR MAC CE." EX1005[16], [0281]-[0283]. As discussed, the "BFR MAC CE" is included in the transmitting of a transport block. *See above* Claim [8]. A POSITA thus would have understood from Cirik's teachings that the transmitting of the transport block is based on a logical channel prioritization procedure since Cirik's BFR MAC CE is included in the transport block and is transmitted based on a logical channel prioritization scheme. EX1005, [0281]-[0283].

b) Element 9b: a first priority associated with the beam failure recovery MAC CE is higher than a second priority associated with data from any logical channel except uplink common control channel (UL-CCCH) logical channel.

[16] *See above* ¶¶42-43, 50.

90. Cirik renders obvious Element [9b]. For example, Cirik explains that "a LBT failure recovery MAC CE" may have a lower priority than a beam failure recovery (BFR) MAC CE. EX1005[17], [0282]. Cirik also discloses that "the LBT failure recovery MAC CE may have a lower priority than … data from UL-CCCH." EX1005, [0282]. Accordingly, a first priority associated with the BFR MAC CE can be higher than a second priority associated with a logical channel for the LBT failure recovery MAC CE. Because the logical channel for the LBT failure recovery MAC CE is distinct from the UL-CCCH logical channel, Element [9b] is met by Cirik's disclosure that the BFR MAC CE priority is higher than the priority of the logical channel for the LBT failure recovery MAC CE (*i.e.*, higher than a second priority associated with data from any logical channel except the UL-CCCH logical channel).

91. I note that Element [9b] does not require that the first priority associated with the BFR MAC CE be higher than the priority of data from *every* logical channel except UL-CCCH. The language of [9b] instead refers to a single "second priority" associated with data from *any* logical channel except UL-CCCH. The LBT failure MAC CE is data from one such logical channel. Moreover, given the wide range of prioritization options provided in Cirik, and the various examples in which the

[17] *See above* ¶¶42-43, 50.

priority associated with the BFR MAC CE is higher than a priority associated with data from other logical channels, Cirik's teachings would have plainly suggested to a POSITA that the priority associated with the BFR MAC CE can be higher than a priority associated with data from all other logical channels except the UL-CCCH, and at a minimum, this would have been an obvious option so as to prioritize beam failure recovery.

92. Additionally, it would have been obvious to a POSITA to assign a first priority for BFR MAC CE that is higher than a second priority associated with data from any logical channel except the UL-CCCH in view of Cirik's teachings. First, Cirik indicates that the BFR MAC CE can have a higher priority than the LBT failure recovery MAC CE. EX1005, [0282]. Second, Cirik provides several examples of various logical channels that have a lower priority than the LBT failure recovery MAC CE. EX1005, [0281]. Third, Cirik indicates that the LBT failure recovery MAC CE can have a lower priority the UL-CCCH. EX1005, [0282]. Accordingly, Cirik teaches that the BFR MAC CE and UL-CCCH can have a higher priority than various logical channels including the LBT failure recovery MAC CE. Cirik's prioritization scheme thus leaves three options for prioritizing the BFR MAC CE relative to UL-CCCH: (1) the UL-CCCH having a higher priority than the BFR MAC CE; (2) the UL-CCCH having the same priority as the BFR MAC CE (as suggested in EX1005, [0283]); or (3) the UL-CCCH having a lower priority than the

BFR MAC CE. The first two of these options satisfy [9b], and a POSITA would have found it obvious to try making a priority associated with the BFR MAC CE lower than or equal to a priority of UL-CCCH given the limited number of options available. It likewise would have been obvious and a POSITA would have been motivated to make a priority associated with the BFR MAC CE lower than or equal to a priority of UL-CCCH to ensure BFR MAC CE does not interfere with UL-CCCH functions and to improve system performance. This also would have been the natural result when the LBT failure recovery MAC CE has a lower priority than UL_CCCH and the BFR MAC CE has the same priority as the LBT failure recovery MAC CE. *Above,* [5b]; EX1004, [0283].

12) Claim 10

a) Element 10: The method of claim 1, wherein the first random access parameters indicate random access resources for a beam failure recovery random access process.

93. Cirik renders obvious Claim 10. As discussed, Cirik discloses "one or more random access channel (RACH) parameters" used for beam failure recovery, which provide an example of "first random access parameters." *Above* Elements [1a.ii], [1b]; EX1005[18], [0152], *see also* [0153-0154], [0156], [0161]. "The UE may determine, based on the one or more RACH parameters, a time-frequency resource"

[18] *See above* ¶¶42-43, 50.

for transmission of messages in the random access procedure. EX1005, [0152]. For example, "[t]he one or more RACH parameters provided in the configuration message 1310 may indicate one or more Physical RACH (PRACH) occasions available for transmission of the Msg 1 1311." *Id.*, [0153]; *see also id.*, [0161] (analogizing Msg 1 1321 (FIG. 13B) to Msg 1311 (FIG. 13A) and configuration message 1320 (FIG. 13B) to 1310 (FIG. 13A), [0167] ("The UE may determine, based on two-step RACH parameters included in the configuration message 1330, a radio resource … for the preamble 1341 and/or the transport block 1342 included in the Msg A 1331."), [0167] ("time-frequency resource"), [0168], [0170].

13) Claim 11

a) Element 11pre: The method of claim 1, wherein the first random access parameters indicate:

94. Cirik renders obvious Element [11pre]. As discussed, Cirik discloses first random access parameters for beam failure recovery, including "one or more random access channel (RACH) parameters." *Above*, Elements [1a.ii], [1b], [10]; EX1005[19], [0152], *see also* [0153]-[0154], [0156], [0161]. Cirik's random access parameters indicate the information recited in Elements [11a]-[11d]. *Below* Elements [11a]-[11d].

[19] *See above* ¶¶42-43, 50.

b) Element 11a: a random access response window for beam failure recovery;

95. Cirik renders obvious Element [11a]. As discussed, Cirik discloses configuring a wireless device using "one or more random access channel (RACH) parameters" in the "configuration messages" for beam failure recovery. *Above*, Elements [1a.ii], [1b], [10], [11pre]. Cirik explains that "[i]n the event of a beam failure recovery request, the base station may configure the UE with a separate time window" for example a "ra-ResponseWindow." EX1005[20], [0162]-[0163]. Cirik's random access parameters indicate a "ra-ResponseWindow" or other separate time window for a random access response for beam failure recovery. *See* EX1005, [0161-0163].

c) Element 11b: a first number of preamble transmissions before declaring a random access failure for beam failure recovery;

96. Cirik renders obvious Element [11b]. As discussed, Cirik discloses configuring a wireless device using "one or more random access channel (RACH) parameters" in the "configuration messages" for beam failure recovery. *Above*, Elements [1a.ii], [1b], [10], [11pre]. Cirik explains that the "[wireless device] may determine that a random access procedure completed unsuccessfully, for example, if the number of preamble transmissions exceeds a threshold configured by the one

[20] *See above* ¶¶42-43, 50.

or more RACH parameters." EX1005[21], [0157], *see also* [0156] (explaining that the "RACH parameters may indicate…a maximum quantity/number of preamble transmissions"), [0148]-[0149], FIGS. 13A-13C, 21.

d) Element 11c: a power ramping step for a beam failure recovery random access process; and

97. Cirik renders obvious Element [11c]. As discussed, Cirik discloses configuring a wireless device using "one or more random access channel (RACH) parameters" in the "configuration messages" for beam failure recovery. *Above*, Elements [1a.ii], [1b], [10], [11pre]. Cirik explains that the "RACH parameters may indicate: a power ramping step." EX1005[22], [0154].

e) Element 11d: a configuration index for beam failure recovery.

98. Cirik renders obvious Element [11d]. As discussed, Cirik discloses configuring a wireless device using "one or more random access channel (RACH) parameters" in the "configuration messages" for beam failure recovery. *Above*, Elements [1a.ii], [1b], [10], [11pre]. Cirik explains that the "RACH parameters" may indicate a "prach-ConfigIndex" as the claimed "*configuration index*." EX1005[23], [0153], *see also* [0152] (describing various general configuration parameters),

[21] *See above* ¶¶42-43, 50.

[22] *See above* ¶¶42-43, 50.

[23] *See above* ¶¶42-43, 50.

[0158] (describing various indices including an "OFDM symbol index; a slot index; a frequency domain index; and/or a UL carrier indicator of the PRACH occasions").

14) Claim 12

a) Element 12: The method of claim 1, wherein the first configuration parameters for beam failure recovery comprise an identifier of a search space for monitoring a control channel in a beam failure recovery random access process.

99. Cirik renders obvious Claim 12. As discussed, Cirik's wireless device receives "one or more configuration parameters" that provide the claimed "*first configuration parameters*" for the beam failure recovery. *Above*, Elements [1a.ii], [1b]. Cirik explains that "the base station may configure the [wireless device] with … a separate PDCCH in a search space indicated by an RRC message (e.g., recoverySearchSpaceid)." EX1005[24], [0163]; *see also* [0152] (explain that the configuration messages are transmitted "using one or more RRC messages"), [0158], [0162].

15) Claim 13

a) Element 13a: The method of claim 1, wherein: the first configuration parameters comprise a first parameter indicating a first number of beam failure instances that triggers beam failure recovery; and

100. Cirik renders obvious Element [13a]. As discussed, Cirik's wireless device receives "one or more configuration parameters" that provide the claimed

[24] *See above* ¶¶42-43, 50.

"*first configuration parameters*" for the beam failure recovery, and the configuration parameters may include a first parameter indicating a first number of beam failure instances that triggers beam failure recovery. EX1005[25], [0307] ("[T]he wireless device may detect the beam failure based on a number of beam failure instance indications (e.g., Beam failure indications in FIG. 21) reaching a maximum number of beam failure counter (e.g., maximum number of beam failures in FIG. 21)"; "The one or more configuration parameters may indicate the maximum number of beam failure counter for the active downlink BWP of the second cell.").

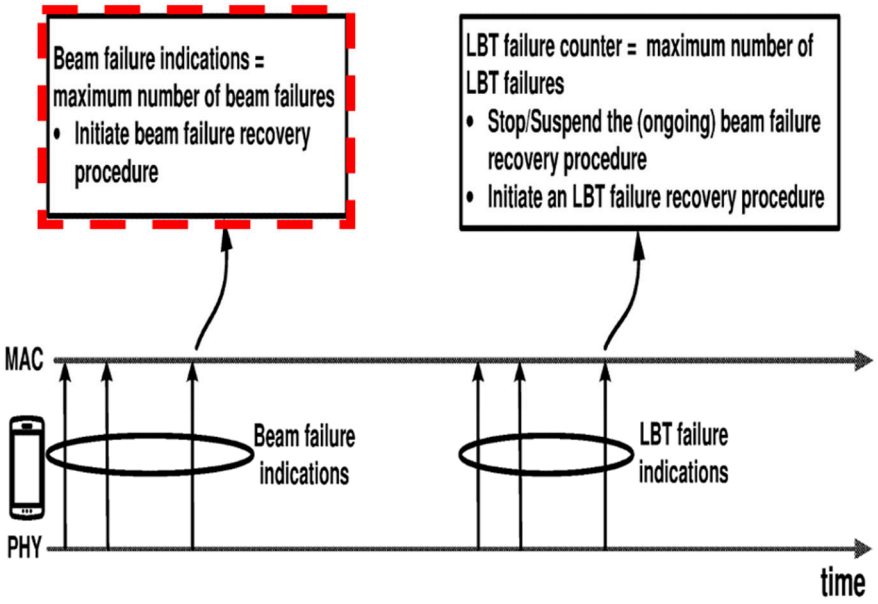


FIG. 21

[25] *See above* ¶¶42-43, 50.

EX1005, FIG. 21 (annotated), [0307]; *see also* EX1005, [0208], [0304], [0332]; *above*, Elements [1a.ii], [1b]; *below*, Element [13b].

b) Element 13b: the detecting the beam failure is based on a beam failure instance indication counter reaching the first number.

101. Cirik renders obvious Element [13b]. For example, Cirik discloses that "the wireless device may detect the beam failure based on a number of beam failure instance indications (e.g., Beam failure indications in FIG. 21) reaching a maximum number of beam failure counter (e.g., maximum number of beam failures in FIG. 21)." EX1005[26], [0307]; *see also id.*, [0148].

[26] *See above* ¶¶42-43, 50.

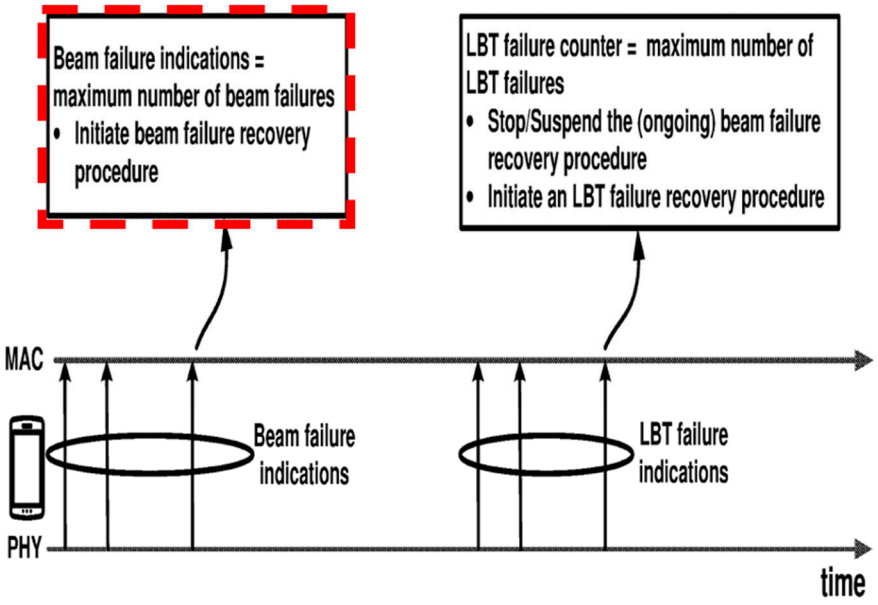


FIG. 21

EX1005, FIG. 21 (annotated).

16) Claim 14

a) Element 14: The method of claim 13, wherein the detecting the beam failure comprises incrementing the beam failure instance indication counter by one based on a beam failure indication.

102. Cirik renders obvious Claim 14. As discussed, Cirik's wireless device detects beam failure "based on a number of beam failure instance indications (e.g., Beam failure indications in FIG. 21) reaching a maximum number of beam failure

counter (e.g., maximum number of beam failures in FIG. 21)." EX1005[27], [0307], FIG. 21; *see also id.*, [0148]; *above*, Elements [13a]-[13b]. A POSITA would have understood and found obvious that the determination of beam failure based on a number of beam failure instance indications reaching a maximum number of beam failure counter to include incrementing the counter by one. Cirik's disclosure expressly indicates that the counter represents a number of beam failure indications that have occurred since the counter was reset, and the standard method of counting would involve incrementing the counter by one each time a beam failure indication is detected. In fact, Cirik expressly suggests incrementing a counter by one with an analogous counter used for LBT failure detection. EX1005, [0228] ("increment the LBT failure counter by one"), FIGs. 17-18. A POSITA would have implemented the same conventional mechanism taught for LBT failure detection for beam failure detection to simplify the design of the counter and to ensure the counter represents the actual number of beam failure indications detected. *See also id.*, [0148] (explaining that beam failure is detected based on determining that the beam pair links have "an error rate higher than an error rate threshold"), FIG. 21. A POSITA would have reasonably expected success given the conventional nature of counting by one.

[27] *See above* ¶¶42-43, 50.

17) Claim 15

a) Element 15: The method of claim 13, wherein the detecting the beam failure comprises setting the beam failure instance indication counter to zero based on a beam failure detection timer expiring.

103. Cirik renders obvious Claim 15. For example, as discussed, Cirik's wireless device detects beam failure "based on a number of beam failure instance indications (e.g., Beam failure indications in FIG. 21) reaching a maximum number of beam failure counter (e.g., maximum number of beam failures in FIG. 21)." EX1005[28], [0307], FIG. 21; *above*, Element [13b]. In an analogous mechanism for LBT failure detection, Cirik teaches resetting an LBT failure counter when any of a variety of conditions occur such as an LBT detection timer expiring, switching uplink BWPs, deactivating the cell, resetting the MAC layer, expiry of an alignment timer, reaching a maximum number of SR transmissions, clearing uplink channels/signals, or reaching the maximum number of LBT failure indications. EX1005, [0230], [0236]-[0250], FIG. 17. It would have been obvious to implement many of the same conventional mechanisms that Cirik describes for resetting the LBT failure counter to similarly reset the beam failure counter. A POSITA would have been motivated to reset the beam failure instance indication counter to zero based on a beam failure detection timer expiring to ensure that beam failure is

[28] *See above* ¶¶42-43, 50.

determined/triggered/declared only when the beam failure instance indications occur sufficiently close in time to reflect a persistent beam failure incident, thereby avoiding false positives where beam failure is wrongly declared as a result of the counter continuing to increment from unrelated beam failure instance indications that accumulate over a long period of time. Indeed, the use of such timers for resetting beam failure counters was well known before the '128 Patent. *See* EX1008, 1-3, 5 (describing an equivalent counter and timer mechanism for LBT failure detection); EX1017, 58 ("the UE declares beam failure when the number of beam failure instance indications from the physical layer reaches a configured threshold before a configured timer expires.").

18) Claim 16

a) Element 16a: The method of claim 1, wherein: the second configuration parameters comprise a first parameter indicating a first number of LBT failure instances that triggers LBT failure recovery; and

104. Cirik renders obvious Element [16a]. For example, Cirik discloses that the "one or more configuration parameters" for LBT failure recovery that provide the claimed "*second configuration parameters*" include parameter(s) that define a "maximum number of LBT failures" as shown in FIG. 21. *Above*, Elements [1a.iii], [1c]. Cirik's wireless device determines LBT failure when the LBT failure counter meets the maximum number of LBT failure instances and initiates an LBT failure recovery procedure:

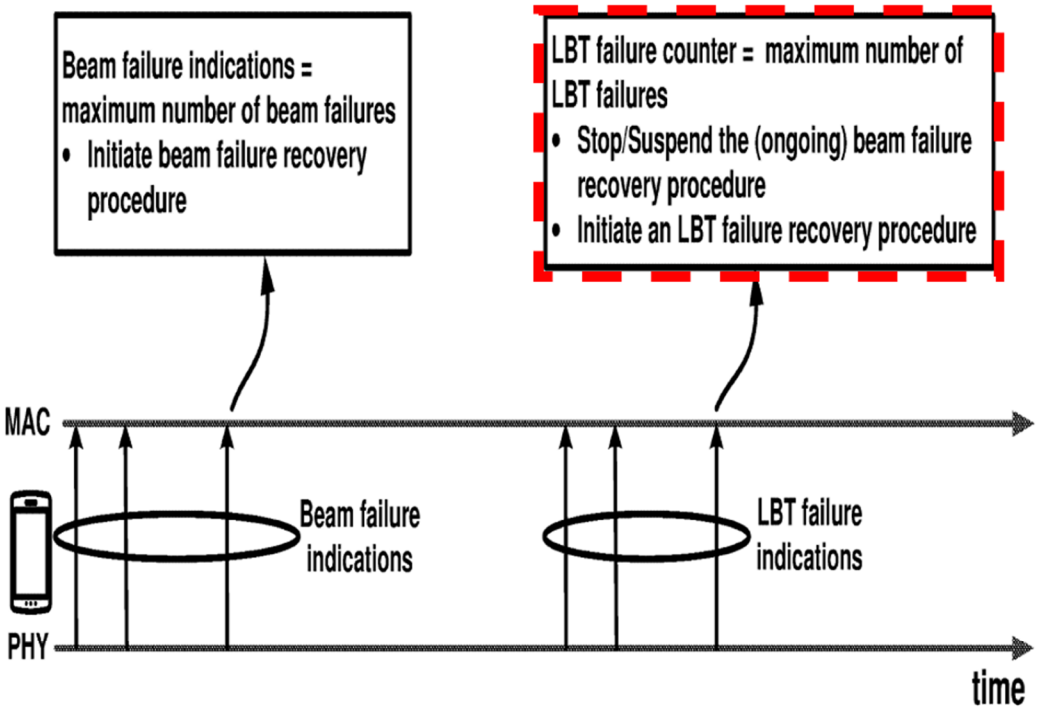


FIG. 21

EX1005[29], FIG. 21 (annotated); *see also* EX1005, [0207]-[0209], [0216]-[0217], [0245]-[0246] ("the second LBT failure detection and recovery configuration parameters may indicate a second maximum number of LBT failures"), [0226]-[0231], [0232] (explaining that the LBT failure "may comprise consistent uplink LBT failures"), [0247]-[0250], [0262], FIGs. 17-19; *above*, Elements [1a.iii]-[1a.iv], [1f].

[29] *See above* ¶¶42-43, 50.

b) Element 16b: the triggering the consistent LBT failure is based on an LBT failure indication counter reaching the first number.

105. Cirik renders obvious Element [16b]. For example, Cirik's wireless device triggers consistent LBT failure and then initiates an LBT failure recovery procedure when the LBT failure instance indication counter reaches the maximum number of LBT failure instances:

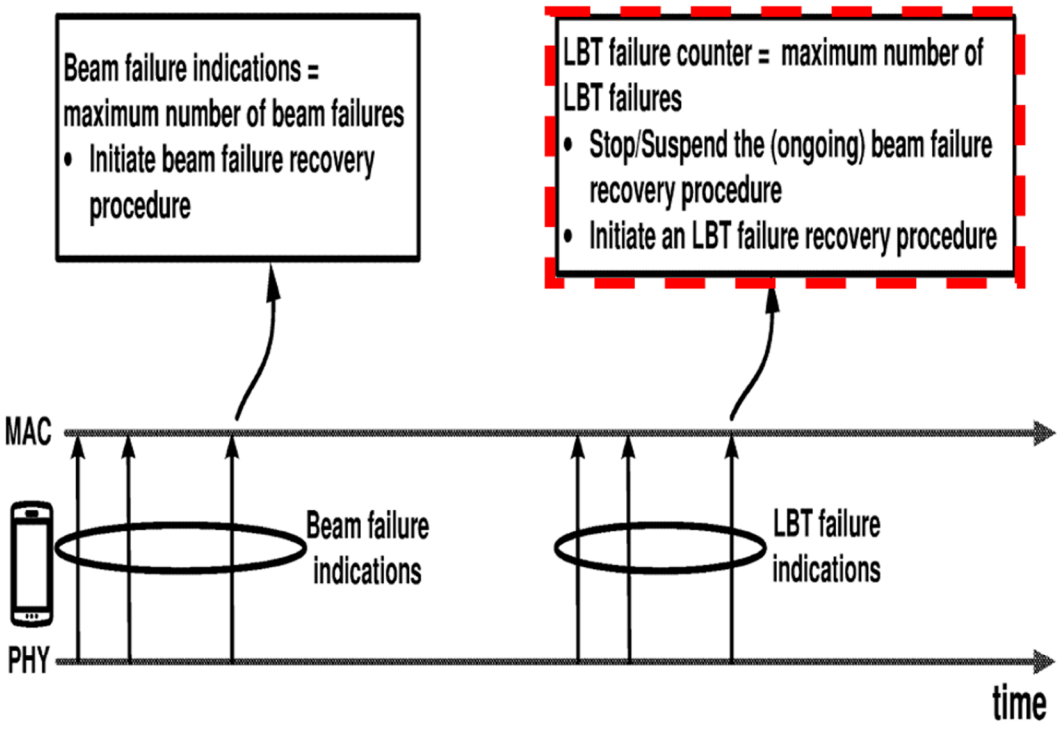


FIG. 21

EX1005[30], FIG. 21 (annotated); *see also id.*, [0232], [0233] ("[T]he wireless device may detect/determine/declare an uplink LBT failure … based on a number of LBT failure indications reaching the maximum number of LBT failures."), [0234], [0252], FIGs. 17-19; *above*, [1a.iii], [1c], [16a].

19) Claim 17

a) Element 17: The method of claim 16, wherein the triggering the consistent LBT failure comprises incrementing the LBT failure indication counter by one based on an LBT failure indication.

106. Cirik renders obvious Claim 17. For example, Cirik discloses that "[b]ased on the receiving the LBT failure indication, the wireless device may increment the LBT failure counter …. In an example, the wireless device may increment the LBT failure counter by one." EX1005[31], [0228]; *generally id.*, [0227]-[0234].

[30] *See above* ¶¶42-43, 50.

[31] *See above* ¶¶42-43, 50.

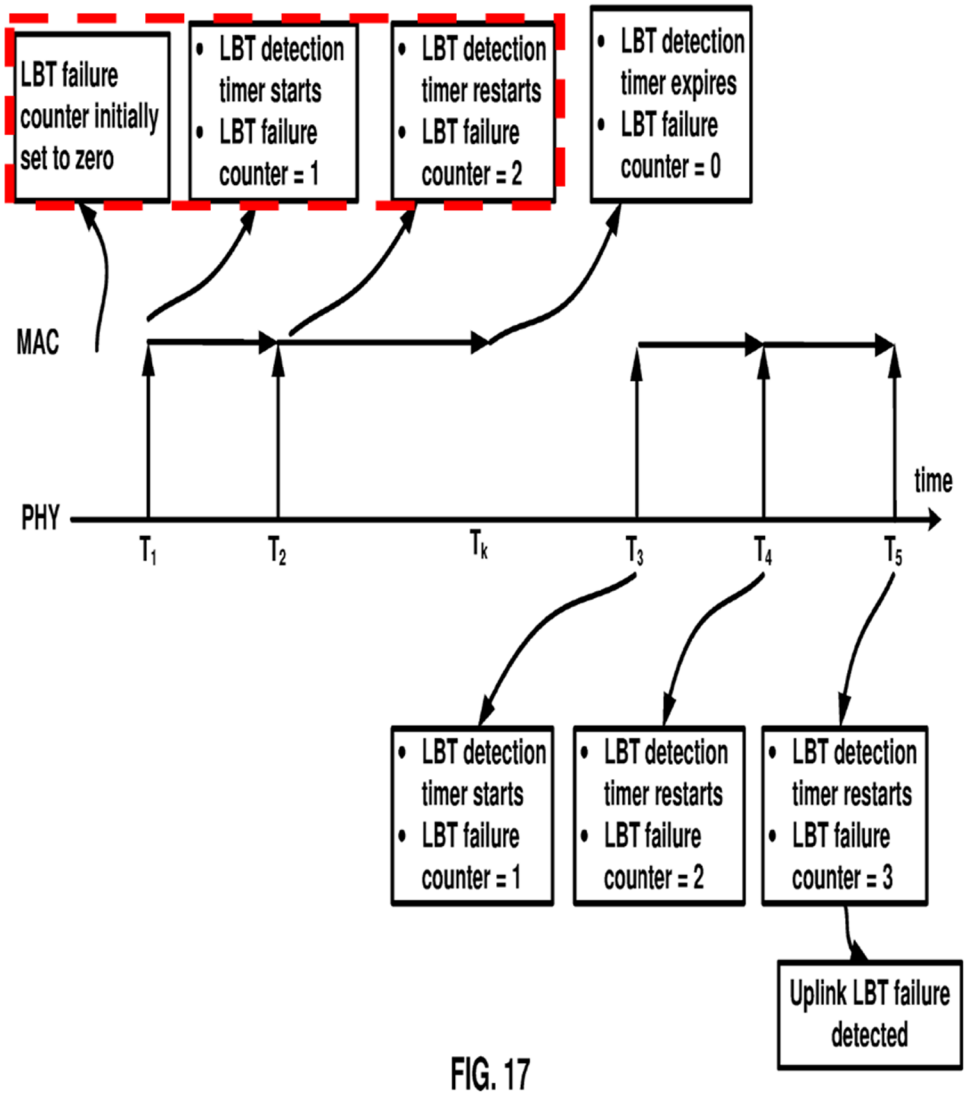


FIG. 17

EX1005, FIG. 17 (annotated), [0233]; *see also id.*, FIG. 18.

20) Claim 18

a) Element 18: The method of claim 16, wherein the triggering the consistent LBT failure comprises setting the LBT failure indication counter to zero based on an LBT failure detection timer expiring.

107. Cirik renders obvious Claim 18. For example, Cirik discloses that "[b]ased on the LBT detection timer expiring, the wireless device may reset the LBT

failure counter" and "resetting the LBT failure counter may comprise setting a value of the LBT failure counter to zero":

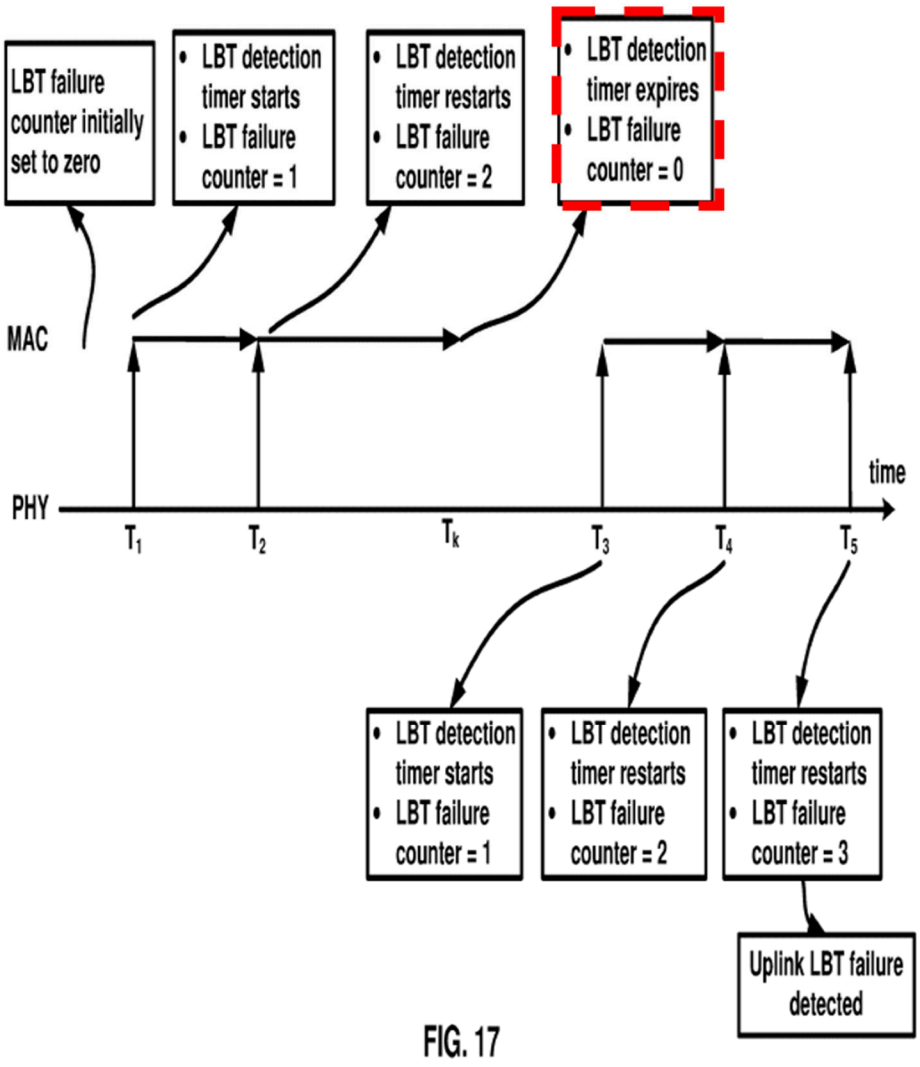


FIG. 17

EX1005[32], FIG. 17 (annotated), [0230].

[32] *See above* ¶¶42-43, 50.

21) Claim 19

a) Element 19a: The method of claim 1, wherein: the second BWP of the primary cell is configured with random access occasions; and

108. Cirik renders obvious Element [19a]. As discussed, Cirik's wireless device switches from a first BWP to a second BWP of the primary cell as the active BWP, *e.g.*, to initiate a random access process for LBT failure recovery. *Above*, Elements [1e]-[1f]. Cirik further discloses that the random-access configuration messages sent to the wireless device include indications of one or more "Physical RACH (PRACH) occasions" and that the wireless device may initiate a random access process by transmitting a preamble or other message "via one or more PRACH occasions." EX1005[33], [0153], [0156], [0158]. The wireless device switches from a first uplink BWP to a second uplink BWP based on "initiating a random access procedure" (*e.g.*, the random access procedure for the LBT failure recovery procedure). EX1005, [0237], FIG. 19. Accordingly, Cirik's second BWP is configured with random access occasions (*e.g.*, PRACH occasions) that allow the wireless device to initiate the random-access procedure for LBT failure recovery including transmitting a random-access preamble or related message "via one or more PRACH occasions." *Id.*, [0153].

[33] *See above* ¶¶42-43, 50.

b) Element 19b: the switching from the first BWP of the primary cell to a second BWP of the primary cell is based on the second BWP of the primary cell being configured with the random access occasions.

109. Cirik renders obvious Element [19b]. As discussed, Cirik's wireless device switches from a first BWP to a second BWP of the primary cell as the active BWP, *e.g.*, to initiate the random-access procedure for LBT failure recovery. *Above*, Elements [1e]-[1f], [19a]. The wireless device switches to the second BWP based on initiating the random-access process. EX1005[34], [0153], [0237], FIG. 19. Initiating the random-access process includes transmitting a random-access preamble or related message "via one or more PRACH occasions." *Id.* A POSITA thus would have understood that switching from the first BWP to the second BWP is based on the second BWP being configured with the random-access occasions. Indeed, it would not be possible to initiate a random-access procedure for consistent LBT failure recovery on the second BWP if the second BWP were not configured with random-access occasions, and it thus would have been obvious to a POSITA to make the switch to the second BWP based on the second BWP being configured with random-access occasions to ensure consistent LBT failure recovery could be performed upon switching BWPs. *See e.g.*, EX1006 [0008]-[0009] (explaining that the second BWP can be selected, for example, based on the second BWP being

[34] *See above* ¶¶42-43, 50.

configured with "a resource for performing a random access procedure" (*e.g.*, random access occasions)); *see also id.*, [0077]-[0079], Claims 8-9; *below* Ground 2A, Element [19b].

VIII. GROUNDS 1B AND 1C

A. Cirik in view of Wu (Ground 1B) and Cirik in view of InterDigital Ground (1C) Render All Claims of the '128 Patent Obvious.

1) Wu (EX1006)

110. Like the '128 Patent, Wu discloses methods for beam failure recovery (BFR) and LBT failure recovery. EX1006, [0070], see also *id.* [0065], [0074], [0078], [0086], FIGs. 2-3. Wu explains that a terminal device determines "a plurality of BWPs each configured with at least one of the following: a resource for performing a scheduling request (SR) procedure (also referred to as "SR resource"), and a RACH resource." *Id.*, [0076]. The terminal device selects a second BWP to switch to from a first BWP, for example, in response to detecting beam failure or LBT failure. *Id.*, [0072]-[0074], [0076], [0078], [0080]. The terminal device may receive "a configuration" from the network device (*e.g.*, a base station) for the "BWP to be switched to":

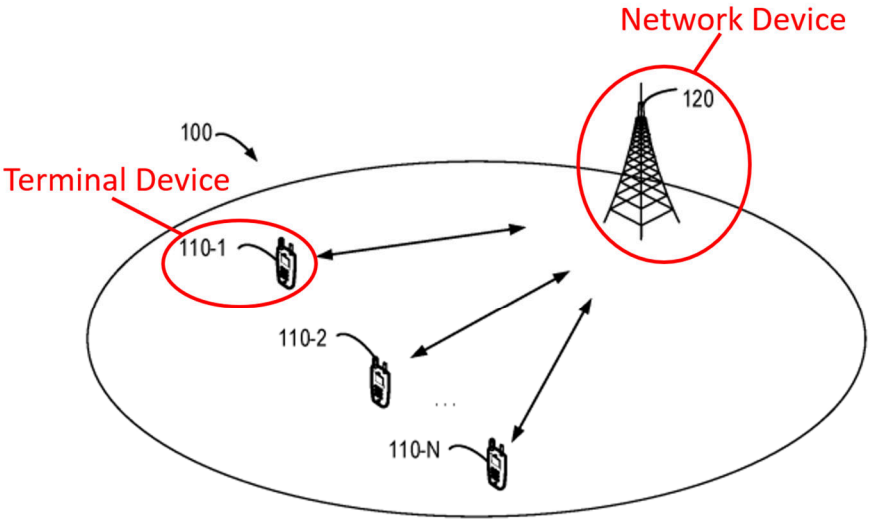


FIG. 1

EX1006, FIG. 1 (annotated), [0079].

111. Wu discloses that the terminal device can detect beam failure and trigger a BFR procedure that includes performing a random access (RA) process on one of the configured BWPs. EX1006, [0073]-[0074], see also *id.* [0070], [0078]. Wu also explains that the beam failures may be "caused by continuous LBT failures." *Id.*, [0070]. The terminal device can detect continuous LBT failure by using, for example, "a counter or a timer." *Id.*, [0066]-[0067], FIG. 2. In response to detecting continuous LBT failure, the terminal device "switches to a second BWP." EX1006, [0072]. Wu discloses triggering a RA procedure "on the second BWP due to the continuous LBT failures." *Id.*, [0072], [0078], [0080].

2) InterDigital (EX1007)

112. InterDigital is a standards proposal submitted to the 3rd Generation Partnership Project (3GPP) Radio Access Network (RAN) Working Group #2's Meeting #108 in November 2019 related to "Handling UL [Uplink] LBT [Listen-Before-Talk] Failures in MAC" in a 5G New Radio communications network. EX1007, 1. InterDigital describes techniques for recovering from a "consistent UL LBT Failure." EX1007, 1-2. Like the '128 Patent, InterDigital teaches that the UE (*i.e., a* wireless/terminal device) should "initiate a new RA procedure upon switching to another BWP, i.e. to ensure the preamble counter and the power ramping counter are reset." EX1007, 1-2. InterDigital proposes that in response to "BWP switching caused by detection of consistent uplink LBT failures on SpCell, MAC shall stop any ongoing RA procedure and initiate a new RA procedure." EX1007, 1-3.

3) Analysis

113. As I discussed above in Ground 1A, Cirik describes techniques for switching between BWPs of a cell "for any suitable reason" including "based on initiating a random-access procedure." EX1005[35], [0107], [0235]-[0237], FIG. 9; *above*, Ground 1A, [1e]. To the extent it is argued that Cirik does not expressly

[35] *See above* ¶¶42-43, 50.

disclose switching BWPs to initiate a second random access process for consistent LBT failure recovery (*e.g.*, upon stopping a first random access process), these features were nonetheless known before the Critical Date of the '128 Patent as evidenced by both Wu and InterDigital. For example, Wu teaches that "in response to the continuous LBT failures occurring on the first BWP, switching to a second BWP different from the first BWP." EX1006, Abstract; *see also id.*, [0073]-[0074], [0069]-[0079], FIGS. 2-3. InterDigital likewise teaches that "[u]pon declaring a consistent UL LBT failure …, the UE switches to another configured BWP with PRACH configured and initiates RACH"). EX1007, 1; *see also id.*, ("UE will switch to another BWP with PRACH configured after detection").

114. Multiple reasons would have motivated a POSITA to apply the respective teachings of Wu and InterDigital to Cirik such that Cirik's wireless device would switch from a first BWP to a second BWP of a primary cell upon stopping the ongoing RA procedure for beam failure recovery and initiating a new random access process for consistent LBT failure recovery.

115. First, Cirik, Wu, and InterDigital are all analogous art in the same field of endeavor as the '128 Patent and similarly describe techniques for handling recovery from consistent LBT failures in wireless systems such as 5G New Radio (NR) systems. EX1006, [0054]-[0055]; EX1007, 1; *above* §VII.A.2, §VIII.A.1-2.

116. Second, a POSITA would have implemented the combinations to achieve benefits like those expressly described in Wu, including that "switching to another BWP on different LBT sub-channels can be much more efficient than going through the whole re-establishment and configuration procedures." EX1006, Abstract; *see also id.*, [0090].

117. Third, a POSITA would have been motivated to implement the combinations to achieve benefits like those expressly described in InterDigital, including that "initiat[ing] a new RA procedure upon switching to another BWP" will "ensure the preamble counter and the power ramping counter are reset." EX1007, 1-2.

118. Fourth, a POSITA would have been motivated to implement the combinations because, before the Critical Date of the '128 Patent, it had already been agreed to by the relevant 3GPP standard working group that the wireless device should "switch to another BWP and initiate[] RACH upon declaration of consistent LBT failure on PCell or PSCell if there is another BWP with configured RACH resources." EX1007, 4. A POSITA would have implemented these features in view of these developments of the 3GPP standard. *Id.*

119. Fifth, switching BWPs in this context would have been obvious to provide the wireless device with a better opportunity to successfully perform

consistent LBT failure recovery since the new BWP is likely to perform better than the prior BWP on which failure had been determined.

120. Sixth, the combinations involve a straightforward application of a known technique as taught by each of Wu and InterDigital to a known system as taught by Cirik to achieve predictable results. A POSITA would have reasonably expected success implementing the combination since it merely entails the application of known techniques for switching BWPs when initiating a new random-access process (*e.g.*, for consistent LBT failure recovery) that had been evaluated and approved by the 3GPP working group before the Critical Date.

121. The Cirik-Wu and Cirik-InterDigital combinations render each element of the Challenged Claims obvious for the same reasons described above in connection with Ground 1A, except that Elements [1e]-[1f] are further rendered obvious based on Wu's and InterDigital's respective teachings for the wireless device to switch BWPs of the primary cell upon initiating a new random access process for consistent LBT failure recovery, as discussed in the preceding paragraphs in this section.

122. The Cirik-Wu combination further would have rendered obvious the additional features recited in claim 19 based on Wu's explanation that switching BWPs involves selecting a second BWP based on the second BWP being configured with "a resource for performing a random access procedure" (*e.g.*, random access

occasions). EX1006, [0008]-[0009], *see also id.*, [0076] ("select one of the plurality of BWPs" "configured with … a RACH resource"), [0077] ("prioritize a BWP configured with a resource for performing a Contention Free Random Access (CFRA)"), [0078]-[0079], Claims 8-9; *below*, Ground 2A at [19a]-[19b].

123. The Cirik-InterDigital combination also reinforces the obviousness of stopping an ongoing random access procedure in response to triggering consistent LBT failure (Element [1d]) based on InterDigital's express teachings to do exactly this. EX1007, 1-2 ("After BWP switching caused by detection of consistent uplink LBT failures on SpCell, MAC shall stop any ongoing RA procedure and initiate a new RA procedure"). It would have been obvious to stop the ongoing RA procedure for BFR in response to triggering consistent LBT failure to

IX. GROUND 2A

A. Wu in view of InterDigital Renders Claims 1, 10, and 16-19 of the '128 Patent Obvious.

1) The Wu-InterDigital Combination

124. Wu discloses the same scenario described in the '128 Patent in which consistent/continuous LBT failure is detected during an ongoing random access process for beam failure recovery (BFR):

> At block 220, in response to the continuous LBT failures occurring on the first BWP, the terminal device 110 switches to a second BWP different from the first BWP. … In some embodiments, in response to a beam

> failure being detected on the first BWP and a BFR procedure being triggered, the terminal device 110 may select a BWP configured with a resource for performing a RA procedure (also referred to as 'RACH resource') as the second BWP to be switched to. The terminal device 110 may switch to the second BWP and initiate a RA procedure there[] …

EX1006, [0071]-[0074], FIG. 2. I note that a POSITA would interpret this disclosure of Wu as describing switching to a second BWP for continuous LBT failure recovery.

125. While Wu explains that the terminal device 110 may switch from a first BWP to a second BWP to initiate a RA procedure for consistent/continuous LBT failure recovery, Wu nonetheless leaves various implementation details around these processes to a POSITA. For example, Wu does not expressly address whether to immediately initiate the RA procedure for consistent/continuous LBT failure recovery by preempting the ongoing RA procedure for BFR or wait until the ongoing RA procedure for BFR is completed. A POSITA would have looked to references such as InterDigital to inform this choice. Along these lines, InterDigital teaches that the preferred option is to stop the ongoing RA procedure and immediately initiate a new RA procedure for consistent/continuous LBT failure recovery:

> It should be noted that the consistent UL LBT failure can be detected as part of a given random access

> procedure, in which case the UE will switch to another BWP with PRACH configured after detection. It's worthwhile to clarify that the UE should initiate a new RA procedure upon switching to another BWP, i.e. to ensure the preamble counter and the power ramping counter are reset. Upon BWP switching caused by detection of consistent uplink LBT failures on SpCell, the MAC entity shall therefore stop the ongoing RA procedure -if any- and initiate a new RA procedure on the active BWP.
>
> Proposal 2: After BWP switching caused by detection of consistent uplink LBT failures on SpCell, MAC shall stop any ongoing RA procedure and initiate a new RA procedure.

EX1007, 1-2.

126. It would have been obvious to a POSITA to apply InterDigital's suggestion to stop an ongoing RA procedure (*e.g.*, an ongoing RA procedure for BFR) and initiate a new RA procedure for consistent/continuous LBT failure recovery in Wu. Multiple reasons would have prompted a POSITA to make this combination before the Critical Date of the '128 Patent.

127. First, Wu and InterDigital are both analogous art in the same field of endeavor as the '128 Patent and similarly describe techniques for handling recovery from consistent LBT failures in wireless systems such as 5G New Radio (NR) systems. EX1006, [0054]-[0055]; EX1007, 1; *above* §VIII.A.1-2.

128. Second, a POSITA would have been prompted to modify Wu in view of InterDigital to realize the benefits expressly identified in InterDigital, including to "ensure the preamble counter and the power ramping counter are reset." EX1006, 1-2. InterDigital's technique also ensures that a new RA procedure is initiated (*e.g.*, for LBT failure recovery) when "consistent UL LBT failure [is] detected as part of a given random access procedure," thereby ensuring the UE behaves predictably and continues efforts to communicate with the network even when confronted by BWP switching after consistent LBT failure is detected during an ongoing RA procedure (*e.g.*, for BFR). EX1007, 1-2.

129. Third, InterDigital's solution would have been obvious to try. A POSITA would have recognized that the only two practical options for initiating a RA procedure for consistent/continuous LBT failure during an ongoing RA procedure for BFR as described in Wu would be to continue the ongoing RA procedure and initiate the RA procedure for consistent/continuous LBT failure once the ongoing RA procedure completes or stop the ongoing RA procedure and initiate the RA procedure for consistent/continuous LBT failure recovery sooner. A POSITA would have had reason to pursue the latter option based on the known advantages attendant to this option as described in InterDigital.

130. Fourth, the combination also amounts to straightforward application of a known technique as taught by InterDigital to a known system as taught by Wu to

achieve predictable results. A POSITA would have reasonably expected success implementing the combination since it merely entails the application of known techniques for initiating RA process to a known situation in similar radio systems as described in Wu and InterDigital.

2) Claim 1

a) Element 1pre: A method comprising:

131. Wu-InterDigital renders obvious Element [1pre]. For example, Wu discloses methods for beam failure recovery (BFR) and LBT failure recovery. EX1006, [0070], *see also id.* [0065], [0074], [0078], [0086], FIGs. 2-3.

b) Element 1a.i: receiving, by a wireless device, one or more messages comprising:

132. Wu-InterDigital renders obvious Element [1a.i]. For example, Wu discloses a terminal device, *e.g.*, terminal device 110, (***wireless device***) that receives "configuration" messages from a network device, *e.g.*, network device 120:

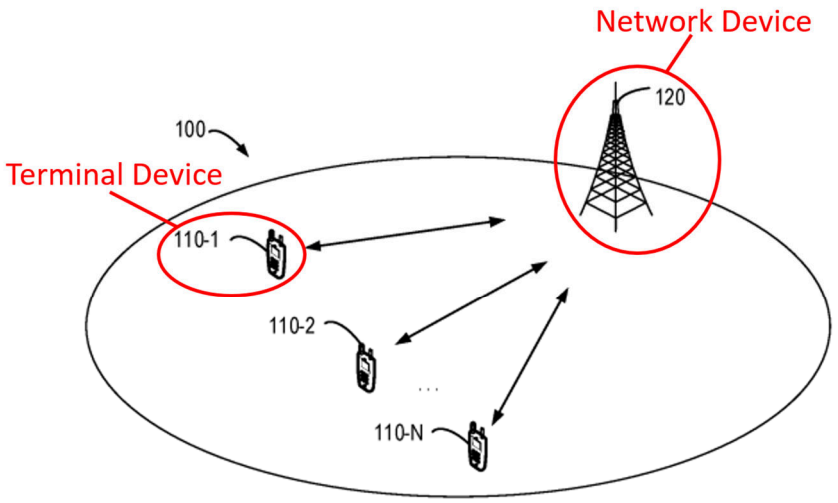


FIG. 1

EX1006, FIG. 1 (annotated), [0010], [0024], [0073-0074], [0076], [0078]-[0079], [0098]. Wu explains that the terminal device has "means for receiving … a configuration" from the network device. *See* EX1006, [0098]. Wu also explains that the terminal device receives messages indicating a configuration of each BWP, which would include a BWP that a first RA process is initiated on for BFR and a second BWP that a second RA process is initiated on for LBT failure recovery. EX1006, [0008] ("cause the device to determine a plurality of BWPs each configured with … a resource for performing a random access procedure"), [0068] ("configured by the network device 120"), [0022], [0070]-[0077], [0096], claims 4, 17; *see also below* [1a.ii]-[1a.iv]; EX1006, [0010], [0024], [0073-0074], [0076], [0078-0079], [0085], Claim 6.

133. I note that a POSITA would have known that the parameters in Wu (including the claimed first configuration parameters for beam failure recovery including the first random access parameters, the second configuration parameters for LBT failure recovery, and second random access parameters) would have been sent from the base station to the terminal device via one or more messages. For example, as I discussed above in Ground 1A for Elements [1a.i]-[1a.iv], Cirik demonstrates that such parameters were conventionally communicated from the base station to the wireless device via one or more messages. *See e.g.,* EX1005, [0161]-[0163], [0207]-[0209], [0215]-[0218], [0266], [0307],

c) Element 1a.ii: first configuration parameters for beam failure recovery, comprising first random access parameters;

134. Wu-InterDigital renders obvious Element [1a.ii]. As discussed in connection with [1a.i], Wu's terminal device receives messages that define a "configuration" of BWPs from the network device. EX1006, [0076], [0079], [0098], *above*, Element [1a.i]. Wu also explains that the network device can configure the terminal device with parameters for beam failure recovery, such as parameters that indicate "whether to initiate the RA procedure on the first or second BWP for BFR." EX1006, [0073]-[0074]. Wu also discloses that each BWP can be configured with "a resource for performing a RA procedure (also referred to as "RACH resource")." *Id.*; *see also id.*, [0078]-[0079]. "If a plurality of BWPs are available …, the terminal device 110 may prioritize a BWP configured with a resource for performing a

Contention Free Random Access (CFRA) procedure (also referred to as "CFRA resource")" or "may prioritize a BWP configured with a SR [scheduling request] resource." *Id.*, [0077]. Based on Wu's disclosure that the terminal device 110 may prioritize BWPs based on whether the BWPs are configured with a resource for performing a random access procedure at all, and/or based on whether the BWPs are configured with a resource for performing a particular type of random access procedure (*e.g.*, contention-free as opposed to contention-based), a POSITA would have understood and it would have been obvious that the terminal device 110 receives configuration parameters for beam failure recovery that allow it to make a prioritized selection of a BWP from among the available BWPs. EX1006, [0070]-[0078]. The parameters that the terminal device 110 references to prioritize and select an available BWP for beam failure recovery, and then to perform the RA process for beam failure recovery, including the parameters for "determin[ing] whether to initiate the RA procedure on the first or second BWP for BFR," provide "*first configuration parameters, comprising first random access parameters*" as recited in claim 1.

d) Element 1a.iii: second configuration parameters for listen-before-talk (LBT) failure recovery; and

135. Wu-InterDigital renders obvious Element [1a.iii]. As discussed in connection with [1a.i]-[1a.ii], Wu's terminal device receives messages that define a "configuration" of BWPs from the network device. EX1006, [0079]; *above*,

Elements [1a.i]-[1a.ii]. Wu also explains that the terminal device is configured by the network device with a "threshold number" of LBT failures for declaring continuous/consistent LBT failure (an example of the claimed "*second configuration parameters*"). EX1006, [0068]-[0069]; *see also id.*, [0076] (explaining that the BWPs can be configured with an "SR resource") [0079], [0085]-[0087], [0098], FIGS. 2-3. Accordingly, the one or more messages received by the terminal device includes second configuration parameters for LBT failure recovery, such as a "threshold number" of LBT failures and indications of an "SR resource" for LBT failure recovery. *Id.*, [0068], [0076]; *cf.* EX1001, 63:42-46 ("The second configuration for LBT failure recovery may comprise a first parameter (e.g., FailureInstanceMaxCount) indicating a first number of LBT failure instances that triggers LBT failure recovery.").

136. Based on Wu's disclosure that the terminal device 110 may prioritize BWPs based on whether the BWPs are configured with a resource for performing a random access procedure at all, and/or based on whether the BWPs are configured with a resource for performing a particular type of random access procedure (*e.g.*, contention-free as opposed to contention-based), a POSITA would have understood and it would have been obvious that the terminal device 110 receives configuration parameters for beam failure recovery that allow it to make a prioritized selection of a BWP from among the available BWPs. EX1006, [0070]-[0078].

e) Element 1a.iv: second random access parameters;

137. Wu-InterDigital renders obvious Element [1a.iv]. As discussed in connection with [1a.i]-[1a.iii], Wu's terminal device receives messages that define a "configuration" of BWPs from the network device. EX1006, [0079], *above*, Elements [1a.i]-[1a.iii]. Wu explains that the terminal device can include "a plurality of BWPs each configured with … a RACH resource" and/or a "CFRA resource." EX1006, [0076]-[0078]. "If a plurality of BWPs are available …, the terminal device 110 may prioritize a BWP configured with a resource for performing a Contention Free Random Access (CFRA) procedure (also referred to as "CFRA resource")" or "may prioritize a BWP configured with a SR [scheduling request] resource." *Id.*, [0077]. Based on Wu's teachings that the terminal device prioritizes BWPs based on whether the BWPs are configured with a resource for performing a random access procedure or a particular type of random access procedure (*e.g.*, contention-free or contention-based), the configuration parameters received by the terminal device include "*second random access parameters*" used for initiating a random access process for consistent/continuous LBT failure recovery. EX1006, [0011]-[0012], [0060]-[0061], [0070]-[0078], Abstract, FIGS. 2-3; *See also e.g.,* EX1005, [0151]-[0174] & FIGS. 13A-13C (describing random access procedures involving receipt of configuration messages containing random access parameters); *see also* EX1005, [0207]-[0210], [0264]-[0266], FIGS. 17, 19, 21.

138. I note that a POSITA would have understood from paragraphs [0075]-[0079] of Wu that the terminal device would receive random access parameters for both BFR and LBT failure recovery to allow the terminal device to perform both a random access process in response to detecting beam failure and/or a random access process in response to LBT failure. A POSITA would have also known that the terminal device could receive configuration parameters for different RA processes including for BFR and LBT failure recovery. In some instances these could include standard parameters ordinarily received in the configuration messages for RA procedures. For example, Cirik lists examples of such parameters included in configuration messages for RA procedures, as I discussed above in Ground 1A for Elements [1a.i]-[1a.iv]. *See e.eg.,* EX1005, [0207]-[0210], [0264]-[0266], FIGS. 17, 19, 21; *see also* EX1005, [0151]-[0174] & FIGS. 13A-13C (describing random access procedures involving receipt of configuration messages containing random access parameters).

f) Element 1b: initiating, based on the first configuration parameters and in response to detecting a beam failure on a primary cell, a first random access process on a first bandwidth part (BWP) of the primary cell for beam failure recovery based on the first random access parameters;

139. Wu-InterDigital renders obvious Element [1b]. For example, Wu discloses initiating a "RA procedure" on a first BWP "in response to a beam failure being detected … and a BFR [beam failure recovery] procedure being triggered."

EX1006, [0073]-[0074]. As discussed, Wu teaches first configuration parameters that indicate, among other things, "whether to initiate the RA procedure on the first or second BWP for BFR" and "a resource for performing a RA procedure." *Id.*; *above*, Element [1a.ii]. Accordingly, Wu's first RA procedure is initiated based on the first configuration including first random access parameters, such as parameters indicating "whether to initiate the RA procedure on the first or second BWP for BFR" and the "resource for performing a RA procedure." EX1006, [0073]-[0074]; *see also id.*, [0070], [0078]. Wu also explains that the beam failure is detected on a first BWP and that the RA procedure can be performed on the same first BWP or another (second) BWP of the same cell, and it would have been obvious to a POSITA that this cell would be a primary cell when it is the first cell to which the terminal device connected. EX1006, [0070], [0074]; EX1001, 17:7-22; *see also* EX1017, 58 ("triggers beam failure recovery by initiating a Random Access procedure on the PCell"). A POSITA also would have appreciated that initiating random access procedures in 3GPP system like that described in Wu ordinarily and commonly involve doing so in accordance with random access parameters received in configuration messages from the network device. *See* EX1005, FIGs. 13A-13C, 21, [0150], [0152]-[0154], [0161]-[0163], [0307]-[0308].

140. To the extent Wu does not expressly disclose that the first BWP on which the first RA process for BFR is initiated is on a "primary cell," this detail

nonetheless would have been obvious to a POSITA. For example, Wu is clear that the reference is directed to recovering from a failure on a new radio (NR) cell which ordinarily includes a primary cell. EX1006, [0003], [0059]-[0060]. It would have been obvious to initiate the first RA process for BFR on a primary cell in this circumstance because this feature was defined in the 3GPP standard before the earliest effective filing date of the '128 Patent. EX1017, 58 ("triggers beam failure recovery by initiating a Random Access procedure on the PCell").

g) Element 1c: triggering, based on the second configuration parameters, consistent LBT failure for the primary cell;

141. Wu-InterDigital renders obvious Element [1c]. As discussed, Wu discloses that the terminal device is configured by the network with a "threshold number" of LBT failures for declaring continuous/consistent LBT failure (an example of the claimed "*second configuration parameters*"). EX1006, [0068]-[0069]; *see also id.*, [0076] (explaining that the BWPs can be configured with an "SR resource"), [0079], [0085]-[0087], [0098]. Accordingly, Wu discloses that the terminal device triggers consistent LBT failure based on second configuration parameters as claimed. EX1006, [0068], *see also id.* [0066-0067], [0069], [0070-72], [0084]-[0085]. Wu further explains that the continuous/consistent LBT failure can occur on the same cell as the cell on which beam failure occurred, which would be a primary cell, for example, when it is the first cell to which the terminal device connects. EX1006, [0070]-[0074]; EX1001, 17:7-22.

142. It would have been obvious that the consistent LBT failure would be triggered for a primary cell when the LBT failures are detected on a primary cell because the primary cell supports a large bandwidth that includes multiple BWPs configurations supported by the wireless device. EX1018, 3 ("if the UE is configured with multiple UL BWPs … It can try at least other UL BWP which configures with RACH resources.") The wireless device would therefore advantageously be configured to try other BWPs on the primary cell to avoid triggering radio link failure on the primary cell when the LBT failure may just occur on "a portion of the supported large bandwidth." EX1018, 3.

h) Element 1d: stopping the first random access process, for the beam failure recovery, based on the triggering the consistent LBT failure;

143. Wu-InterDigital renders obvious Element [1d]. As an initial matter, Wu discloses that "in response to a beam failure being detected on the first BWP and a beam failure recovery (BFR) procedure being triggered, the terminal device 110 may determine that continuous beam failures occur on the first BWP, since the beam failure on the first BWP may be probably caused by continuous LBT failures as well." EX1006, [0070]; *see also id.*, [0071]-[0074], FIG. 2. "[I]n response to the continuous LBT failures occurring on the first BWP, the terminal device 110 switches to a second BWP different from the first BWP." *Id.*, [0071]-[00072]. InterDigital additionally teaches that "[u]pon BWP switching caused by detection of

consistent uplink LBT failures on SpCell, the MAC entity shall therefore stop the ongoing RA procedure-if any-and initiate a new RA procedure on the active BWP." EX1007, 1-2; *see above* §VIII.A.2-3. Wu confirms that an "ongoing RA procedure" like that referenced in InterDigital can be a RA procedure for beam failure recovery in response to detecting beam failure (*see* EX1006, [0073]-[0074]; *above*, Element [1b]), and as described above, it would have been obvious in this context to stop the ongoing RA procedure for beam failure recovery and initiate a new RA procedure for consistent/continuous LBT failure recovery on the active BWP. *Above*, §VIII.A.3.

i) Element 1e: switching from the first BWP of the primary cell to a second BWP of the primary cell as an active BWP of the primary cell; and

144. Wu-InterDigital renders obvious Element [1e]. As discussed, Wu discloses initiating a first random access process for BFR on a first BWP. *Above* Element [1b]; EX1006, [0073]-[0074]. Wu discloses switching to a second BWP based on a determination of consistent/continuous LBT failure:

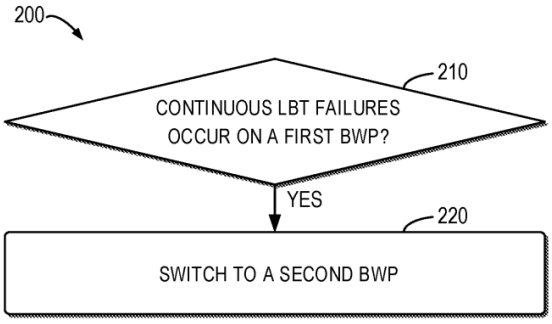


FIG. 2

EX1006, FIG. 2, [0070]-[0072], *see also id.* [0078] ("The terminal device 110 may use the CFRA resource allocated for BFR to perform the RA procedure on the second BWP."), [0080], [0082]-[0083], [0088].

145. Further, as discussed in the combination overview and with respect to Element [1d], it would have been obvious to apply InterDigital's teachings to Wu such that upon BWP switching caused by detection of consistent uplink LBT failures, the MAC entity of the terminal device will stop the ongoing RA procedure for beam failure recovery and initiate a new RA procedure for LBT failure recovery on the active BWP on the primary cell. EX1007, 1-2, 4 (agreed to "UE switch[ing] to another BWP … on PCell or PSCell"); *above*, Elements [1c]-[1d], §VIII.A.3; EX1007, 1-2; *See also* EX1005 [0106]-[0107] (explaining that the switch could occur "for any suitable reason" including based on RRC signaling, expiration of BWP inactivity timers, and/or initiation of a random access process), [0237], [0306]-[0315], FIG. 21; and EX1018, 3 (discussing why using BWP switching for LBT

failure on the primary cell is advantageous given the wide supported bandwidth of the primary cell).

146. InterDigital describes switching from a first BWP to a second BWP of a special cell (SpCell) as an active BWP of the SpCell. EX1007 (InterDigital), 1-2. A POSITA would have known that an SpCell represents a combination of the primary cell (PCell) in a master cell group and a primary secondary cell (PSCell) in a primary secondary cell group, and InterDigital's disclosure therefore renders obvious switching BWPs on at least a *primary cell* (*e.g.*, as part of the SpCell) as claimed. *See e.g.,* Cirik Provisional (EX1005) [0106]-[0107] ("[s]witching between configured BWPs may occur based on RRC [radio resource control] signaling, DCI [downlink control information], expiration of a BWP inactivity timer, and/or an initiation of random access."), [0237]. Indeed, a POSITA would have found it obvious to switch BWPs on a primary cell. *See e.g.,* EX1008, 1-5 ("BWP switching for LBT failure recovery on PCell.") and EX1018, 3 (explaining why using BWP switching for LBT failure on the primary cell is advantageous given the wide supported bandwidth).

j) Element 1f: initiating a second random access process on the second BWP of the primary cell for consistent LBT failure recovery and based on the second random access parameters.

147. Wu-InterDigital renders obvious Element [1f]. For example, Wu discloses triggering a RA procedure "on the second BWP due to the continuous LBT

failures." EX1006, [0078], [0070]-[0072], [0080]-[0083], FIGS. 2-3. Wu explains that the RA procedure may be based on the second random access parameters indicated in the configuration received by the wireless device as described above in connection with [1a.iv]. *Above*, Element [1a.iv]; EX1006, [0079] ("The terminal device 110 may determine, based on the received configuration, the second BWP to be switch to."), [0076] ("select one of the plurality of BWPs as the second BWP to be switched to"), [0078] ("the CFRA resource can be used for performing the RA procedure"); *see also id.*, [0082]-[0083], [0088].

148. Further, as discussed in the combination overview and with respect to Elements [1d]-[1e], it would have been obvious to apply InterDigital's teachings to Wu such that upon BWP switching caused by detection of consistent uplink LBT failures, the MAC entity of the terminal device will stop the ongoing RA procedure for beam failure recovery and initiate a new RA procedure for continuous/consistent LBT failure recovery on the active BWP of the primary cell. EX1007, 1-2; *above*, Elements [1d]-[1e], §VIII.A.3; *see also* EX1007, 1 ("Upon declaring a consistent UL LBT failure on the SpCell, the UE switches to another configured BWP with PRACH configured and initiates RACH.").

3) Claim 10

a) Element 10: The method of claim 1, wherein the first random access parameters indicate random access resources for a beam failure recovery random access process.

149. Wu-InterDigital renders obvious Claim 10. As discussed, Wu discloses first random access parameters that indicate random access resources for a beam failure recovery random access process. *Above*, Elements [1a.ii], [1b]; *generally id.*, EX1006, [0070]-[0079].

4) Claim 16

a) Element 16a: The method of claim 1, wherein: the second configuration parameters comprise a first parameter indicating a first number of LBT failure instances that triggers LBT failure recovery; and

150. Wu-InterDigital renders obvious Element [16a]. As discussed, the second configuration parameters include a parameter for a "threshold number." *Above* Element [1a.iii]; EX1006, [0068]. Wu explains that "the terminal device 110 may determine that continuous LBT failures occur" when "the number of LBT failures occurring continuously exceeds [the] threshold number." EX1006, [0068]. Accordingly, the "threshold number" indicates a number of LBT failure instances that triggers LBT failure recovery.

b) Element 16b: the triggering the consistent LBT failure is based on an LBT failure indication counter reaching the first number.

151. Wu-InterDigital renders obvious [16b]. For example, Wu discloses that "the terminal device 110 may determine that continuous LBT failures occur" when "the number of LBT failures occurring continuously exceeds [the] threshold number." EX1006, [0068], *see also* [0067]-[0069], [0087]; *above*, Element [1a.iii].

5) Claim 17

a) Element 17: The method of claim 16, wherein the triggering the consistent LBT failure comprises incrementing the LBT failure indication counter by one based on an LBT failure indication.

152. Wu-InterDigital renders obvious Claim 17. For example, Wu teaches that "the terminal device 110 may use a counter to count the number of LBT failures occurring continuously." EX1006, [0067], *See also id.* [0068]. A POSITA would have understood Wu's teaching to include incrementing the LBT failure indication counter by one based on an LBT failure indication, especially since incrementing a counter by one was the ordinary and standard technique for counting events in digital systems like Wu's before the '128 Patent. EX1006, [0067]-[0068], [0078]. Incrementing by one is also a simple and conventional design choice that a POSITA would have pursued to obtain an accurate count of LBT failures in a straightforward fashion. In fact, such a counter was well known and commonly used before the earliest effective filing date of the '128. For example, as I discussed above in Ground 1A at Element [17], Cirik expressly discloses the use of such a counter. EX1005[36], [0227]-[0234], FIGs. 17-18.

6) Claim 18

a) Element 18: The method of claim 16, wherein the triggering the consistent LBT failure comprises setting the LBT failure

[36] *See above* ¶¶42-43, 50.

indication counter to zero based on an LBT failure detection timer expiring.

153. Wu-InterDigital renders obvious Claim 18. For example, InterDigital teaches that "the UE maintains a counter and timer to detect a consistent UL LBT failure." EX1007, 1. "The UE resets the counter upon timer expiry." EX1007, 1. It would be obvious to incorporate this teaching from InterDigital into Wu because this was the agreed upon implementation for the 5G NR standard and the reset would ensure that consistent LBT failure is not falsely declared if a prolonged period has passed between detection of consecutive UL LBT failures. EX1007, 1 ("As agreed in RAN2#107 as a baseline …"), 3; *see also* EX1008, 1.

7) Claim 19

a) Element 19a: The method of claim 1, wherein the first random access process, for the beam failure recovery, is one of a two-step random access process and a four-step random access process.

154. Wu-InterDigital renders obvious Element [19a]. For example, Wu discloses "a plurality of BWPs each configured with … a resource for performing a random access procedure; and select one of the plurality of BWPs as the second BWP." EX1006, [0008], *see also id.*, [0002], [0009], [0012]-[0013], [0022]-[0023], [0026]-[0028], [0077], [0080], [0096]-[0097], [0100]-[0101], Claims 4-5, 8-9, 17. A BWP configured with resources for performing a RA procedure is configured with

random access occasions with which the terminal device may transmit a message in accordance with a RA procedure.

b) Element 19b: The method of claim 1, wherein the first random access process, for the beam failure recovery, is one of a two-step random access process and a four-step random access process.

155. Wu-InterDigital renders obvious Element [19b]. As discussed, Wu teaches that the second BWP of the primary cell is configured with random access occasions. *Above*, Element [19a]. Wu and InterDigital also disclose switching to a second BWP of the primary cell. *Above*, Element [1e]. Wu teaches that the second BWP can be selected, for example, based on the second BWP being configured with "a resource for performing a random access procedure" (*e.g.*, random access occasions). EX1006, [0008]-[0009], *see also id.*, [0077]-[0079], Claims 8-9..

X. GROUND 2B

A. Wu in view of InterDigital and Cirik Renders Claims 2-9 and 11-15 of the '128 Patent Obvious.

1) The Wu-InterDigital-Cirik Combination

156. Wu discloses substantially the same scenario described in the '128 Patent in which consistent/continuous LBT failure is detected during an ongoing random access process for beam failure recovery (BFR). EX1006, [0071]-[0074], FIG. 2. While Wu explains that the terminal device 110 may switch from a first BWP to a second BWP to initiate a RA procedure for consistent/continuous LBT failure

recovery, Wu nonetheless leaves various implementation details to a POSITA. For example, Wu does not expressly describe the protocols used to perform a contention-free or contention-based RA procedure, details of the configuration parameters for determining/declaring BFR and continuous/consistent LBT failure, how data in logical channels would be prioritized for BFR and continuous/consistent LBT failure recovery, or additional options for handling a suspended BFR procedure after completing consistent/continuous LBT failure recovery. A POSITA would have looked to other references that address these topics, such as Cirik, to inform the implementation of the system. It would have been obvious to a POSITA to further modify the Wu-InterDigital system by integrating the teachings of Cirik in this regard. A POSITA would have been motivated to make the combination because Wu, InterDigital, and Cirik are all analogous art to the '128 Patent and address similar problems for performing BFR and continuous/consistent LBT failure recovery in similar wireless systems (*e.g.*, 5G NR). Additionally, a POSITA would have turned to Cirik to provide a more complete solution and to facilitate implementation of a complete and operable system using known techniques for random access, BF detection, BFR, LBT failure detection, and LBT failure recovery. The combination also involves a merely straightforward application of a known technique as taught by InterDigital to a known system as taught by Wu to achieve predictable results. A POSITA would have reasonably expected success in light of

the similar wireless systems and similar solutions for BFR and consistent/continuous LBT failure recovery described in each of Wu, InterDigital, and Cirik.

2) Claim 2

a) Element 2: The method of claim 1, wherein the second random access process, for consistent LBT failure recovery, is one of a two-step random access process and a four-step random access process.

157. *Above*, Ground 1A at Claim 2.

3) Claim 3

a) Element 3: The method of claim 2, further comprising initiating a third random access process, for the beam failure recovery, after the second random access process is successfully completed.

158. *Above*, Ground 1A at Claim 3.

4) Claim 4

a) Element 4: The method of claim 2, wherein the second random access process comprises transmitting a transport block comprising an LBT failure medium access control (MAC) control element (CE).

159. The Wu-InterDigital-Cirik combination provides Claim 4. For example, Wu discloses that for a RA procedure triggered on the second BWP for continuous LBT failures "the terminal device 110 may transmit an indication on the RA procedure triggered by the continuous LBT failures" EX1006, [0082]. Wu explains that "the indication may be transmitted via a Media Access Control (MAC) control element (CE)." *Id.*. [0082], *see also id.* [0016], [0030], [0102], Claim 11. A

POSITA would have understood that a transport block would comprise the MAC CE to transmit the indication. *See also* EX1007, 2 (describing "multiplexing the LBT failure MAC CE into the TB."); EX1006,[0082]-[0084]. In the combination, Cirik also discloses these features. *Above*, Ground 1A at Claim 3.

5) Claim 5

a) Elements 5a-5b: The method of claim 4, wherein: the transmitting the transport block is based on a logical channel prioritization procedure; and a first priority associated with the LBT failure MAC CE is higher than a second priority associated with data from any logical channel except uplink common control channel (UL-CCCH) logical channel.

160. *Above*, Ground 1A at Claim 5.

6) Claim 6

a) Element 6: The method of claim 1, wherein the first random access process, for the beam failure recovery, is one of a two-step random access process and a four-step random access process.

161. *Above*, Ground 1A at Claim 6.

7) Claim 7

a) Element 7: The method of claim 6, further comprising initiating a third random access process for beam failure recovery after the second random access process is successfully completed.

162. Above, Ground 1A at Claims 3, 7.

8) Claim 8

a) Element 8: The method of claim 7, wherein the third random access process comprises transmitting a transport block

comprising a beam failure recovery medium access control (MAC) control element (CE).

163. The Wu-InterDigital-Cirik renders obvious Element [8]. As discussed, Wu discloses transmitting a transport block comprising an LBT failure MAC CE as part of the random access process for LBT failure recovery. See Element [4]. InterDigital explains that the design for LBT failure recovery MAC CE "can generally be similar to the MAC CE used to report a beam failure." EX1007, 2. Based on these teachings a POSITA would have understood that a RA process for BFR (*e.g.*, a ***third random access process***) would include transmitting a transport block comprising a BFR MAC CE in the same manner the random access process for LBT failure recovery includes transmitting a transport block comprising LBT failure mac CE. EX1007, 2; *above* Claim [4]. In the combination, Cirik also discloses these features. *Above*, Ground 1A at Claim 8.

9) Claim 9

a) Elements 9a-9b: The method of claim 8, wherein: the transmitting the transport block is based on a logical channel prioritization procedure; and a first priority associated with the beam failure recovery MAC CE is higher than a second priority associated with data from any logical channel except uplink common control channel (UL-CCCH) logical channel.

164. *Above*, Ground 1A at Claim 9.

10) Claim 11

a) Elements 11pre-11d: The method of claim 1, wherein the first random access parameters indicate: a random access response window for beam failure recovery; a first number of

preamble transmissions before declaring a random access failure for beam failure recovery; a power ramping step for a beam failure recovery random access process; and a configuration index for beam failure recovery.

165. *Above*, Ground 1A at Claim 11.

11) Claim 12

a) Element 12: The method of claim 1, wherein the first configuration parameters for beam failure recovery comprise an identifier of a search space for monitoring a control channel in a beam failure recovery random access process.

166. *Above*, Ground 1A at Claim 12.

12) Claim 13

a) Element 13a-13b: The method of claim 1, wherein: the first configuration parameters comprise a first parameter indicating a first number of beam failure instances that triggers beam failure recovery; and : the detecting the beam failure is based on a beam failure instance indication counter reaching the first number.

167. *Above*, Ground 1A at Claim 13.

13) Claim 14

a) Element 14: The method of claim 13, wherein the detecting the beam failure comprises incrementing the beam failure instance indication counter by one based on a beam failure indication.

168. *Above*, Ground 1A at Claim 14.

14) Claim 15

a) Element 15: The method of claim 13, wherein the detecting the beam failure comprises setting the beam failure instance

indication counter to zero based on a beam failure detection timer expiring.

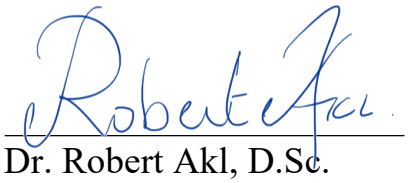
169. *Above*, Ground 1A at Claim 15.

XI. CONCLUSION

170. For the reasons I explain above, all of the Challenged Claims of the '128 Patent are rendered obvious by the prior art at issue.

171. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Executed on April 25 , 2025 in Dallas, Texas.



Dr. Robert Akl, D.Sc.

APPENDIX A

Professor Robert Akl, D.Sc.



Professional Summary

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

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

Areas of Expertise

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

Education

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

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

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

Litigation Support and Expert Witness Experience

L1. 2025 **Fish & Richardson, P.C.**
Case: Apple Inc. v. Apex Beam Technologies LLC
IPR2025-*To be Assigned*
Matter: *Inter Partes* Review, multi-antenna transmission
Project: Eight declarations to support eight IPR Petitions

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

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

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

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

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

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

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

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

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