

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD., AND
SAMSUNG ELECTRONICS AMERICA, INC.,

Petitioners,

v.

HANNIBAL IP LLC,

Patent Owner.

Case IPR2025-01188
U.S. Patent No. 11,272,535

DECLARATION OF APOSTOLOS K. KAKAES, PH.D.

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I. INTRODUCTION

1. I have been retained by Samsung Electronics Co., Ltd. and Samsung Electronics America, Inc., (collectively “Petitioners”) as a technical expert in connection with a petition for *inter partes* review (“IPR”) of U.S. Patent No. 11,272,535 (“the ’535 patent,” Ex. 1001). I understand that the ’535 patent is assigned to Hannibal IP, LLC (“Hannibal” or “Patent Owner”).

2. I am over 21 years of age and, if I am called upon to do so, I would be competent to testify as to the matters set forth herein.

3. I am being compensated for my time in this matter at an hourly rate. I am also being reimbursed for reasonable and customary expenses associated with my work and testimony in this matter. My compensation is in no way contingent on the nature of my findings, the presentation of my findings in testimony, or the outcome of this matter. I have no personal or financial stake or interest in the outcome of the present proceeding.

4. I understand that this proceeding involves the ’535 patent. The application for the ’535 patent was filed January 8, 2020, as U.S. Patent Application No. 16/737,787 (“the ’787 application”). The ’535 patent claims priority to U.S. Provisional application No. 62/790,099, filed on January 9, 2019. Ex. 1001, Cover.

5. I have been asked, by counsel for Petitioners, to provide opinions based on my experience with and expertise in wireless communication technologies. In particular, I have been asked to offer opinions regarding the patentability of claims 1-20 of the '535 patent (the "Challenged Claims") in view of certain prior art references and the knowledge of a person of ordinary skill in the art ("POSITA"). My opinions are set forth below.

6. I have been asked by Petitioners to provide my opinion whether the Challenged Claims of the '535 patent would have been obvious to a POSITA at the time of the earliest priority date of the '535 patent. In performing my analysis, I have been asked to assume that the earliest priority date of the Challenged Claims of the '535 patent is the earliest claimed priority date, namely January 9, 2019.

7. Throughout this declaration, I refer to specific pages, figures, and/or line numbers of various exhibits. These citations are illustrative and are not intended to suggest that they are the only support for the propositions for which they are cited.

II. SUMMARY OF OPINIONS

8. This declaration considers claims 1-20 of the '535 patent. Below, I set forth the opinions I have formed, the conclusions I have reached, and the bases for these opinions and conclusions. I believe the statements contained in this declaration to be true and correct to the best of my knowledge.

9. Based on my experience, knowledge of the art at the time of the applicable priority date (I was told to assume a priority date of January 9, 2019), it is my opinion that claims 1-20 of the '535 patent would have been obvious based on the asserted grounds discussed below.

10. I am being compensated for my time at my normal hourly rate. My compensation is in no way contingent upon the nature of my findings, the presentation of my findings in testimony, or the outcome of this proceeding.

III. QUALIFICATIONS AND PROFESSIONAL BACKGROUND

11. I believe that I am well qualified to serve as a technical expert in this matter based upon my qualifications, discussed in detail below. A copy of my curriculum vitae is attached as Appendix A to this declaration.

12. I am competent to write this Declaration.

13. I have personal knowledge and expertise concerning the relevant technologies based upon my education, training, or experience. My relevant experience includes a deep understanding of the systems that we broadly refer to as “1G,” “2G,” “3G,” “4G,” “LTE,” and “5G” communications systems, as well as other wireless communication technologies, including those based on the IEEE 802.11 set of standards (often referred to as WiFi) as well as those related to IEEE 802.16 set of standards (often referred to as WiMAX).

14. I am an expert in the field of communication engineering and specifically, among others, the field of wireless communications. I have over 40 years of experience in electrical engineering and computer science and in fixed and mobile communications networks. I attended the University of Colorado from 1974 to 1980, during which I earned a Bachelor of Science (B.S.) and a Master of Science (M.S.) in applied mathematics with a minor in electrical engineering. I attended the Polytechnic Institute of New York between 1982 and 1988, during which I earned a Doctor of Philosophy (Ph.D.) in electrical engineering, with a minor in applied mathematics. My Ph.D. thesis was titled "Topological Properties and Design of Multihop Packet Radio Networks." While pursuing my Ph.D. degree, I held a joint appointment as Special Research Fellow and Adjunct Instructor at the Polytechnic Institute of New York between 1985 and 1986 teaching graduate-level courses in Electrical Engineering.

15. Between 1982 and 1987, I worked at AT&T Bell Laboratories in Holmdel, New Jersey. While at AT&T Bell Laboratories, I worked on modeling, analysis, design, and performance evaluation of voice and data networks. I developed algorithms for DNHR (Dynamic, Non-Hierarchical Routing) used in the telephone network. I also analyzed advanced data services and formulation of long-term plans for development of enhanced data services and network design tools to support such services.

16. I was an Assistant Professor of Electrical Engineering and Computer Science at The George Washington University (GWU) in Washington, D.C., between 1987 and 1994. During my association with GWU, I taught graduate courses in the area of communication engineering, including communication theory, coding theory, voice and data networking, and mobile communications. In the early 1990s I developed and taught the first course on Mobile Communications at GWU to Electrical Engineering graduate students. I also received several research awards/grants, including the prestigious NSF Research Initiation Award.

17. In 1988, I founded Cosmos Communications Consulting Corporation (“Cosmos”), which is a private communications engineering consulting firm specializing in mobile communications, and I have been the President of the company since its founding. Since 1994, I have worked full-time at Cosmos. At Cosmos, among various activities, I have consulted on high level technology-related issues and trends to corporate entities, governmental agencies, and international organizations, such as the United Nations.

18. I have provided technical consultancy to engineering firms, operators, and equipment vendors on issues related to existing or evolving technologies for mobile communications, and to the investment community on issues related to both fixed and wireless communications technologies. I developed and taught hundreds of courses to thousands of engineers around the world in the area of

communication engineering, mostly in the area of mobile, wireless communications.

19. Over the course of my career, I have authored and co-authored some thirty (30) publications on various aspects of fixed and mobile communications, as noted in my curriculum vitae. I am a life member of the Institute of Electrical and Electronics Engineers (IEEE) and have been actively involved in the Communications Society and the Information Theory Society of the IEEE. Between 1991 and 1992, I served as the Secretary of IEEE Communications Society National Capital Area Chapter. Between 1992 and 1993, I was the Vice-Chair of IEEE Communications Society National Capital Area Chapter. I was the Vice-Chair of the Communication Theory Technical Committee of the Communications Society of the IEEE for the 1993–1996 term, and Treasurer of the Communication Theory Technical Committee of the Communications Society of the IEEE for the 1996–1999 term.

20. I have served as a reviewer for the IEEE, book editors, other technical publications, and various National Science Foundation (NSF) Panels. I have organized technical sessions in technical conferences, including the IEEE International Conference on Communications (ICC) and IEEE Global Communications Conference (Globecom). I served as the Technical Program Chair for the Communication Theory Mini-Conference in 1992.

21. During the past 35+ years, I have been lucky enough to be part of the community of engineers that have contributed to the astounding growth of the mobile communications industry. It started from a niche industry that was thought of as being something for the “rich and the famous” to becoming one of the most widespread household concepts, providing useful tools to all segments of the global society.

22. My involvement in this industry included providing consulting services to company executives who needed to make deployment plans, taking into consideration the strengths and weaknesses of the technology, economics, user value, etc. As such, I have developed a deep understanding of all aspects of a given technology, its features, added value, and the like. In addition, my consulting services included developing courses for the companies that were at the forefront of this developing technology. By definition, this previously non-existent technology was not taught in university courses, as it was too new. Having developed hundreds of courses over the years and taught thousands of engineers (and non-engineers alike), I have a solid understanding and knowledge of the technical developments and how their importance fits in the larger puzzle of a fast-developing technology.

23. My consulting included providing training to engineers in the field that were deploying the various networks. For example, I developed courses and

provided training and consulting to the engineers deploying some of the earliest GSM networks in Germany and France, to be followed by many countries in Europe and around the world, including the United States when it was decided that GSM would be used in the U.S. Successful deployments of the initial GSM systems were followed by deployments of GPRS and EDGE, which was then followed by deployments of 3G UMTS systems worldwide. Of course, the 3G systems were followed by the currently most widespread deployments of 4G systems, also referred to as LTE, worldwide and most recently deployments of 5G networks. Thus, as I explain above, my experience includes a deep understanding of the entirety of each system that we broadly refer to as “1G,” “2G,” “3G,” “4G,” “LTE,” and “5G.”

24. Similarly, I developed courses and provided training and consulting to engineers deploying and/or enhancing wireless local area networks using one or more of the IEEE 802.11 set of standards (often referred to as WiFi) as well as networks using the IEEE 802.16 set of standards (often referred to as WiMax).

25. As an expert consultant, I have served on both civil and criminal legal cases, including several patent infringement cases both at the ITC and in district courts, as well as in support of IPR petitions, such as the one in this case. I have also participated as a technical expert consultant in the analysis of large patent portfolios for the purposes of due diligence, sales, and merger and acquisition

activities for some of the largest companies in the mobile communications space.

These projects span a multidimensional spectrum of technologies in both fixed and mobile communications as they have evolved over the past more than 30 years.

IV. MATERIALS CONSIDERED

26. In forming my opinions, I have reviewed the following documents, and any other document cited in this declaration.

Exhibit	Description
Ex. 1001	U.S. Patent No. 11,272,535 to Chen et al. (“’535 patent”)
Ex. 1003	Prosecution History of the ’535 patent (downloaded from the USPTO’s Patent Center Website)
Ex. 1004	International Patent Application Publication No. WO 2020/087369 to Shi, published May 7, 2020 (“ <i>Shi</i> ”) ¹ , including certified English translation and certification
Ex. 1005	International Patent Application Publication No. WO 2020/045920 to Hong, published March 5, 2020 (“ <i>Hong</i> ”) ² , including certified English translation and certification
Ex. 1006	Korean Patent Application No. 10-2018-0102907 to Hong, filed August 30, 2018 (“ <i>Hong Priority</i> ”) ³ , including certified English translation and certification

¹ Citations to *Shi* are made to the English translation.

² Citations to *Hong* are made to the English translation.

³ Citations to *Hong Priority* are made to the English translation.

Exhibit	Description
Ex. 1007	3GPP TS 38.321 v15.3.0 (“Technical Specification Group Radio Access Network; NR; Medium Access Control (MAC) protocol specification (Release 15)”) (Sept. 2018) (“ <i>TS-38.321</i> ”)
Ex. 1008	International Patent Application Publication No. WO 2019/245779 to Alfarhan et al., published December 26, 2019 (“ <i>Alfarhan</i> ”)
Ex. 1009	U.S. Provisional Application No. 62/735,446 to Alfarhan et al., filed September 24, 2018 (“ <i>Alfarhan Provisional</i> ”)
Ex. 1010	3GPP TSG RAN WG2 NR #103bis Meeting, R2-1813741, Chengdu, China, 8th - 12th October 2018, published in 3GPP website (https://www.3gpp.org/ftp/tsg_ran/wg2_rl2/TSGR2_103bis/Docs/) on September 27, 2018 (“ <i>R2-1813741</i> ”).
Ex. 1011	3GPP TSG RAN WG2 NR #104 Meeting, R2-1816829, Spokane, US, 12th - 16th November 2018, published in 3GPP website (https://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_104/Docs) on November 2, 2018 (“ <i>R2-1816829</i> ”).
Ex. 1012	Declaration of Friedhelm Rodermund
Ex. 1013	3GPP TS 38.300 v15.2.0 (“Technical Specification Group Radio Access Network; NR; NR and NG-RAN Overall Description; Stage 2 (Release 15)”) (June 2018) (“ <i>TS-38.300</i> ”)
Ex. 1014	International Patent Application Publication No. WO 2017/136458 to Lim et al., published August 10, 2017 (“ <i>Lim</i> ”)
Ex. 1015	Bertsekas, Dimitri et al., <i>Data Networks</i> (2 nd Edition), Prentice Hall, 1992 (“ <i>Bertsekas</i> ”).
Ex. 1016	U.S. Patent Application Publication No. US 2016/0029413 to Wang et al., published January 28, 2016 (“ <i>Wang</i> ”)
Ex. 1017	3GPP TS 36.300 v8.6.0 (“Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network

Exhibit	Description
	(E-UTRAN); Overall description; Stage 2 (Release 8)”) (September 2008)
Ex. 1018	3GPP 36.331 V8.7.0 (“Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA) Radio Resource Control (RRC); Protocol specification (Release 8)”) (September 2009)
Ex. 1019	Vincent W.S. Wong et al., <i>Key Technologies for 5G Wireless Systems</i> , Cambridge University Press, 2017 (“Wong”)
Ex. 1020	Ali Zaidi et al., <i>5G Physical Layer: Principles, Models and Technology Components</i> , Academic Press, 2018 (“Zaidi”)
Ex. 1021	3GPP 38.331 V15.3.0 (“Technical Specification Group Radio Access Network; NR; Radio Resource Control (RRC) protocol specification (Release 15)”) (September 2018)
Ex. 1022	International Patent Application Publication No. WO 2020/069114 to Terry et al., published April 2, 2020 (“Terry”)
Ex. 1023	U.S. Provisional Application No. 62/753,579 to Terry et al., filed October 31, 2018 (“Terry Provisional”)

27. I have also relied on my education, experience, research, training, and knowledge in the relevant art, and my understanding of any applicable legal principles described in this declaration.

28. All of the opinions contained in this declaration are based on the documents I reviewed and my knowledge and professional judgment. My opinions have also been guided by my understanding of how a person of ordinary skill in the

art would have understood the claims of the '535 patent at the time of the earliest claimed priority date.

29. I reserve the right to supplement and amend any of my opinions in this declaration based on documents, testimony, and other information that becomes available to me after the date of this declaration.

V. LEGAL STANDARDS

30. I am not a lawyer. For purposes of this Declaration, I have been asked to provide my opinions on issues regarding unpatentability. My understanding of the legal standards to apply in reaching the conclusions in this declaration is based on discussions with counsel for Petitioners, my experience applying similar standards in other patent-related matters, and my reading of the documents submitted in this proceeding. In preparing this declaration, I have tried to faithfully apply these legal standards to the challenged claims.

31. I have been informed that there are two ways in which prior art may render a patent claim unpatentable. First, I have been informed that the prior art can “anticipate” a claim. Second, I have been informed that the prior art can render a claim “obvious” to a person of ordinary skill in the art. I understand that a claim is patentable if it was not anticipated and would not have been obvious by the prior art at the effective filing date of the patent.

32. I have been informed that a dependent claim is a patent claim that refers back to another patent claim. I have been informed that a dependent claim includes all of the limitations of the claim to which it refers.

33. I have been asked to provide my opinions as to whether the cited prior art teaches or renders obvious claims 1-20 of the '535 patent from the perspective of a person of ordinary skill in the art at the '535 patent's earliest claimed priority date in 2019, as described in more detail below.

34. I have been informed that in *inter partes* review proceedings, such as this one, the party challenging the patent bears the burden of proving unpatentability by a preponderance of the evidence. I understand that a preponderance of the evidence means "more likely than not."

35. For purposes of this declaration, I have been asked to provide my opinions on issues regarding unpatentability. I have been informed of the following legal standards, which I have applied in forming my opinions.

A. Level of Ordinary Skill

36. I have been informed a person of ordinary skill in the art is determined by considering several factors, including the (i) type of problems encountered in the art; (ii) prior art solutions to those problems; (iii) rapidity with which innovations are made; (iv) sophistication of the technology; and (v) educational level of active workers in the field.

37. I have been instructed to assume a person of ordinary skill in the art is not a specific real individual, but rather a hypothetical individual having the qualities reflected by the factors discussed above.

B. Prior Art

38. I have been advised and understand the information used to evaluate whether an invention was new and not obvious when made is generally referred to as “prior art.” I understand that prior art includes patents and printed publications that existed before the earliest claimed priority date or the earliest filing date of the patent (which I have been informed is also called the “effective filing date”). I have been informed and understand that a patent or published patent application is prior art if it was filed before the earliest filing date of the claimed invention and that a printed publication is prior art if it was publicly available before the earliest filing date.

C. Anticipation

39. I have been informed that under 35 U.S.C. § 102, a patent claim is unpatentable for anticipation if the claimed subject matter was patented or described in a printed publication before the effective filing date of the claimed invention. I have been informed that this is referred to as unpatentability by anticipation. I have been informed that a patent claim is anticipated under § 102 if a single prior art reference discloses all limitations of the claimed invention.

D. Obviousness

40. I have been informed that obviousness under 35 U.S.C. § 103, a patent claim is unpatentable if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious to a person having ordinary skill in the art to which said subject matter pertains at the time the invention was made. I have been informed that this is referred to as unpatentability by obviousness.

41. I have been informed that a proper obviousness analysis includes the following:

- a. Determining the scope and content of the prior art;
- b. Ascertaining the differences between the prior art and the claims at issue;
- c. Resolving the level of ordinary skill in the pertinent art; and
- d. Considering evidence of secondary indicia of non-obviousness (if available).

42. I have been informed that the relevant time for considering whether a claim would have been obvious to a person of ordinary skill in the art is the time of invention. For my obviousness analysis, counsel for Petitioners instructed me to assume that the date of invention for the Challenged Claims is January 9, 2019. My opinions would not change if I assumed a later date of invention.

43. I have been informed that a reference may be modified or combined with other references or with a person of ordinary skill in the art's own knowledge if the person would have found the modification or combination obvious. I have also been informed that a person of ordinary skill in the art is presumed to know all the relevant prior art, and the obviousness analysis may take into account the inferences and creative steps that a person of ordinary skill in the art would employ.

44. I have been informed that whether a prior art reference renders a patent claim obvious is determined from the perspective of a person of ordinary skill in the art. I have also been informed that, while there is no requirement that the prior art contain an express suggestion to combine known elements to achieve the claimed invention, and while a suggestion to combine known elements to achieve the claimed invention may come from the prior art as a whole or individually and may consider the inferences and creative steps a person of ordinary skill in the art would employ, as filtered through the knowledge of one skilled in the art, obviousness grounds cannot be sustained by mere conclusory statements and must include some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.

45. In determining whether a prior art reference could have been combined with another prior art reference or other information known to a person

having ordinary skill in the art, I have been informed that the following principles may be considered:

- a. A combination of familiar elements according to known methods is likely to be obvious if it yields predictable results;
- b. The substitution of one known element for another is likely to be obvious if it yields predictable results;
- c. The use of a known technique to improve similar items or methods in the same way is likely to be obvious if it yields predictable results;
- d. The application of a known technique to a prior art reference that is ready for improvement to yield predictable results;
- e. Any need or problem known in the field and addressed by the reference can provide a reason for combining the elements in the manner claimed;
- f. A person of ordinary skill often will be able to fit the teachings of multiple references together like a puzzle; and
- g. The proper analysis of obviousness requires a determination of whether a person of ordinary skill in the art would have a “reasonable expectation of success”—but not “absolute predictability” of success—in achieving the claimed invention by combining prior art references.

46. I have been informed that, when a work is available in one field, design alternatives and other market forces can prompt variations of it, either in the same field or in another. I have been informed that if a person of ordinary skill in the art could have implemented a predictable variation and would have seen the benefit of doing so, that variation is likely to have been obvious. I have been informed that, in many fields, there may be little discussion of obvious combinations, and in these fields market demand—not scientific literature—may drive design trends. I have been informed that, when there was a design need or market pressure and there are a finite number of predictable solutions, a person of ordinary skill in the art would have had a good reason to pursue those known options.

47. I have been informed that the law permits the application of “common sense” in examining whether a claimed invention would have been obvious to a person skilled in the art. For example, I have been informed that combining familiar elements according to known methods and in a predictable way may suggest obviousness when such a combination would yield nothing more than predictable results. I understand, however, that a claim is not obvious merely because every claim element is disclosed in the prior art and that a party asserting obviousness must still provide a specific motivation to combine or modify the

references as recited in the claims and explain why one skilled in the art would have reasonably expected to succeed in doing so.

48. I have been informed that there is no rigid rule that a reference or combination of references must contain a “teaching, suggestion, or motivation” to combine references. But I also understand that the “teaching, suggestion, or motivation” test can be a useful guide in establishing a rationale for combining elements of the prior art. I have been informed that this test poses the question as to whether there is an express or implied teaching, suggestion, or motivation to combine prior art elements in a way that realizes the claimed invention, and that it seeks to counter impermissible hindsight analysis.

49. I am not aware of any evidence of secondary considerations that would support a determination of non-obviousness of the claimed subject matter in the '535 patent.

50. I have been informed that, in an obviousness analysis, prior art must be analogous prior art to the patent being considered. I have been informed that a prior art reference is considered to be analogous, or in the same field of art, if the reference is either (1) in the same field of endeavor as the challenged patent, regardless of the problems the challenged patent and the prior art address, or (2) reasonably pertinent to the particular problem being solved by the challenged patent.

VI. TECHNOLOGY BACKGROUND AND STATE OF THE PRIOR ART

51. For this Declaration, I have assumed that the priority date of the challenged claims is January 9, 2019, as this is the earliest possible priority date. Thus, for purposes of this analysis, I assume that the time of the purported invention of the '535 patent was January 9, 2019, and have provided an overview of the background of the relevant technology at that time.

A. Field of Technology

52. As is explained in the “FIELD” section of the '535 patent, the relevant field of technology is wireless communication in general and Listen-Before-Talk (LBT) failure indication and LBT failure event determination in particular. Ex. 1001, 1:17–21. In the “BACKGROUND” section, the '535 patent explains that “[v]arious efforts have been made to improve different aspects of wireless communications, such as data rate, latency, reliability and mobility, for the next generation (e.g., fifth generation (5G) New Radio (NR)) wireless communication systems.” Ex. 1001, 1:25-29.

53. In the same “BACKGROUND” section, the '535 patent acknowledges that LBT is a known “mechanism by which a wireless device applies Clear Channel Assessment (CCA) before using the channel.” Ex. 1001, 1:29-31. The '535 patent explains that the 3rd Generation Partnership Project (3GPP) had already specified “a conservative LBT scheme similar to that used by

Wi-Fi nodes to ensure coexistence of Licensed Assisted Access (LAA) with Wi-Fi.” Ex. 1001, 1:31-34. The ’535 patent further explains that “LAA uses carrier aggregation in downlink transmission to combine LTE in an unlicensed spectrum (e.g., 5 GHz) with LTE in a licensed band.” Ex. 1001, 1:34-37.

54. The ’535 patent purports that “[t]here is a need in the industry for an improved and efficient mechanism for a UE to handle LBT failure that may take place in the physical layer.” Ex. 1001, 1:38-41.

55. Indeed, as I discuss in more detail below, the concepts related to LBT failure discussed in the ’535 patent had been part of the development of the Technical Specifications of the 3GPP as recognized by the named inventors of the ’535 patent when explaining, as discussed above, that the “the 3rd Generation Partnership Project (3GPP) specifies a conservative LBT scheme similar to that used by Wi-Fi nodes.” Ex. 1001, 1:31–33.

56. In the interest of clarity and completeness, I will review the development of wireless communications since the early days and the working procedures and work product of the 3GPP in Section VI.B, below, before I discuss the relevant state of the prior art in Section VI.C.

B. Third Generation Partnership Project (3GPP)

57. “Wireless communications” necessarily implies that information is transmitted without the use of “wires.” This is accomplished by transmitting

electromagnetic waves from some point of origin A with the intent that the electromagnetic waves will be successfully received at some intended destination point B.

58. The “Advanced Mobile Phone System” (“AMPS”) was the first nationwide wireless communications system standardized in the USA and was released in the 1980s and was an analog, as opposed to digital, system. AMPS is sometimes referred to as a first generation or “1G” cellular communication technology. A subsequent short-lived system, referred to as IS-54, was developed and then quickly replaced by a better system referred to as IS-136 in the early 1990s. IS-54 and IS-136 are now commonly referred to as second generation or “2G” technologies. Around the same time that these 2G systems were released, Qualcomm began developing a different system to replace AMPS in direct competition with IS-54/IS-136. This new system was standardized in what is called the “IS-95 standard,” or simply just “IS-95.” IS-95 was the first ever code division multiple access (“CDMA”) based digital cellular technology. CDMA allows multiple access to digital radio signals for transmission of voice, data, and signaling data. IS-95 was first published in 1995 and adopted as a wireless communications standard in the USA by the Telecommunications Industry Association.

59. Around this same time period that the IS-95 was being developed in the US, the European Telecommunications Standard Institute (“ETSI”) developed the Global System for Mobile Communications (“GSM”) technical specifications. Unlike IS-95, GSM is based on a time division multiple access (“TDMA”) technology. Similar to IS-54 and IS-136, IS-95 and GSM are also commonly referred to as “2G” technologies because they were the first viable cellular systems to use digital transmission techniques, as opposed to the analog techniques used in AMPS.

60. GSM continued to evolve with the development of GPRS (which stands for General Packet Radio Service) and EDGE (which stands for Enhanced Data rates for GSM Evolution). GPRS and/or EDGE have sometimes been referred to as “2.5G” systems, even though there is no general agreement as to what exactly “2.5G” does or does not include. Over time, GSM developed greater market share globally than its IS-95 CDMA-based competitor. In the late 1990s, IS-95 showed that an air interface based on CDMA was viable. GSM had developed the necessary superior networking protocols. The industry then converged by merging the best aspects of the TDMA GSM system with the best aspects of the CDMA IS-95 system to create an improved worldwide system. As part of that effort, a new organization was formed in 1998 called the “3rd Generation Partnership Project,” or “3GPP.” The 3GPP was tasked with developing new wireless communication

specifications for this system, which was referred to as a “3rd Generation” or “3G” specification.

61. 3GPP is a global joint undertaking by national and regional telecommunication standards organizations and member companies focused on defining interoperable telecommunications networks and user equipment. 3GPP was tasked with an initial objective to produce technical specifications for a third generation (“3G”) cellular communication system, called the Universal Mobile Telecommunications Service (“UMTS”). UMTS is a 3G mobile cellular system for networks based on the second generation (2G) GSM standard in conjunction with the best CDMA aspects of the IS-95 air interface, as I mentioned above.

62. While 3GPP is not formally a standards-setting organization, it operates as one from a practical perspective. 3GPP develops technical specifications that are then typically adopted by the respective standards-setting bodies of a given country or region. At the core of 3GPP’s organization are seven “Organizational Partners,” each of which is a standards-setting organization in a different country or region:

- The Association of Radio Industries and Businesses, or ARIB (Japan);
- Telecommunication Technology Committee, or TTC (Japan);

- The Alliance for Telecommunications Industry Solutions, or ATIS (US);
- China Communications Standards Association, or CCSA (China);
- The European Telecommunications Standards Institute, or ETSI (Europe);
- Telecommunications Standards Development Society, or TSDSI (India); and
- Telecommunications Technology Association, or TTA (Korea).

See, e.g., “About 3GPP,” available at <https://www.3gpp.org/about-us/partners>.

63. 3GPP employs a model similar to one that had been used earlier by ETSI, which had developed GSM. This includes a hierarchical structure in which Working Groups (“WGs”) are the source of technical contributions, some of which ultimately mature into Technical Specifications. In addition, several WGs are part of a given Technical Specification Group, or TSG. There are several Technical Specification Groups, each one having a number of WGs and covering technical subject matter that is defined and follows a logical, hierarchical structure. In the 2019 time period, the three active 3GPP TSGs are the Radio Access Network (“RAN”), Service and System Aspects (“SA”), and Core Network and Terminals (“CT”) TSGs. The RAN TSG is the TSG responsible for the standards and proposals relevant to ’535 patent.

64. The RAN TSG, in turn, consists of several Working Groups, referred to, for example, as RAN1 and RAN2 or RAN WG1 and RAN WG2. Each WG holds periodic meetings in which technical documents (or “TDocs”) are presented and discussed for possible inclusion in the Technical Specifications (“TS”), which are sometimes also referred to as Technical Standards. These meetings are numbered and referred to as, for example, TSG-RAN WG2 Meeting #50, which refers to Meeting #50 of Working Group 2 of the RAN TSG. At these meetings, different proposals are discussed, their pros and cons considered, and ultimately some of them, or some hybrid of one or more of them, get approved and included in the TS.

65. In the late 1990s, 3GPP successfully developed UMTS, which enjoyed worldwide success. A few years later, around 2004, 3GPP initiated the “Long Term Evolution”, or “LTE,” project, which is also referred to as “4G.” Around 2017, 3GPP began work on what has come to be known as “New Radio,” or “NR,” and also referred to as “5G.” As mentioned above, the ’535 patent refers to NR and 5G as being developed by 3GPP. Ex. 1001, 1:25-41.

66. The NR project had several goals for a 5G cellular standard, including increased data rates, improved quality of service, and decreased complexity. 3GPP released the first “5G” Technical Specifications (TS) in late 2017 or early 2018, in what was called “Release 15.”

C. State of the Art

67. In this section, I will briefly discuss the state of the art with respect to protocol stacks as well as bandwidth parts before discussing the state of the art of Listen-Before-Talk (LBT) and certain 3GPP discussions relating to LBT failure that are relevant to the '535 patent.

1. Protocol Stack: Physical (PHY) Layer, Medium Access Control (MAC) Layer, Radio Resource Control (RRC) Layer

68. The concept of a “protocol stack” in data networks goes back to at least the 1980s, and has been adopted in mobile communications, including in 3G/UMTS systems, 4G/LTE systems, and 5G/NR systems. In general, the protocol stack is a hierarchy of communication protocols where each layer in the stack handles certain aspects of data transmission and reception.

69. For example, as shown below, the 5G/NR specifications use the following two protocol stacks for the user plane and the control plane, respectively. Ex. 1013 (3GPP TS 38.300 V15.2.0), 16–17.

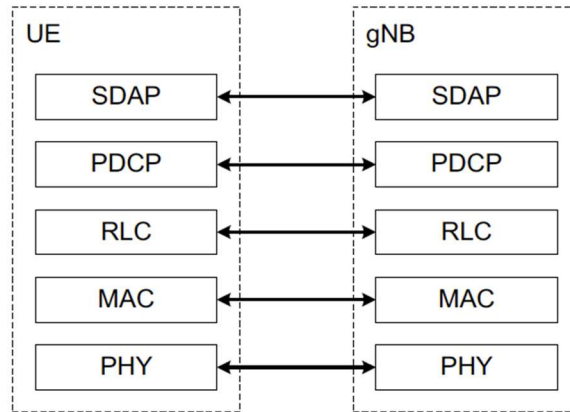


Figure 4.4.1-1: User Plane Protocol Stack

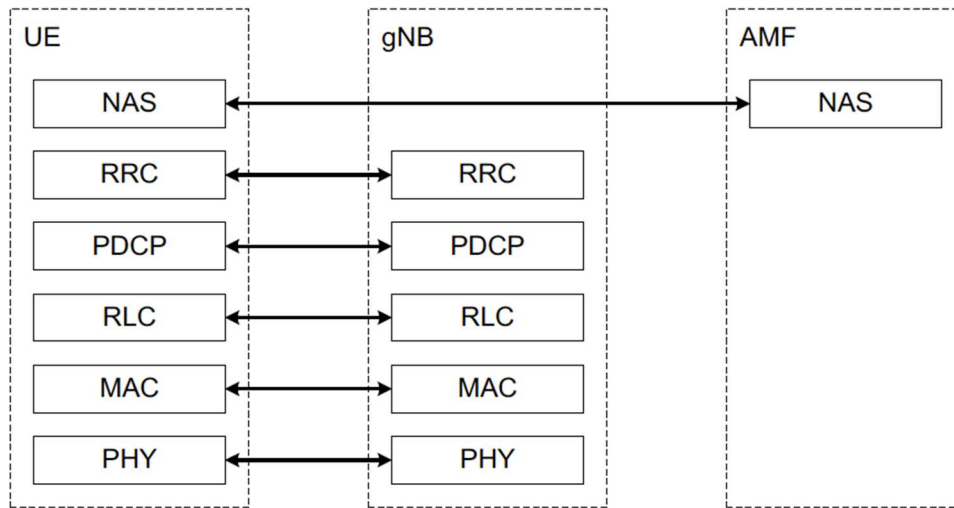


Figure 4.4.2-1: Control Plane Protocol Stack

70. In particular, the “Control Plane Protocol Stack” discussed in Section 4.4.2 of TS-38.300 and depicted above in Figure 4.4.2-1 is relevant to the claimed invention of the ’535 patent. The “Control Plane Protocol Stack” includes at least a Physical (“PHY”) layer, a Medium Access Control (“MAC”) layer, and a Radio Resource Control (“RRC”) layer. As shown above, the PHY layer is the lowest

layer, the MAC layer is higher than the PHY layer, and the RRC layer is higher than the MAC layer.

71. The RRC layer generally controls the lower layers and manages the resources of the radio interface. For example, the RRC layer may perform one or more of the following functions: “Broadcast of System Information related to AS and NAS; Paging initiated by 5GC or NG-RAN; Establishment, maintenance and release of an RRC connection between the UE and NG-RAN including: Addition, modification and release of carrier aggregation; Addition, modification and release of Dual Connectivity in NR or between E-UTRA and NR. Security functions including key management; Establishment, configuration, maintenance and release of Signalling Radio Bearers (SRBs) and Data Radio Bearers (DRBs); Mobility functions including: Handover and context transfer; UE cell selection and reselection and control of cell selection and reselection; Inter-RAT mobility. QoS management functions; UE measurement reporting and control of the reporting; Detection of and recovery from radio link failure; NAS message transfer to/from NAS from/to UE.” Ex. 1013, 31.

72. Meanwhile, the MAC layer generally controls and manages the access to (and from) the physical layer, as its name implies (“medium” in its name is the physical medium used for transmission/reception of information). Thus, for example, the MAC layer may perform one or more of the following functions:

“Mapping between logical channels and transport channels;

Multiplexing/demultiplexing of MAC SDUs belonging to one or different logical channels into/from transport blocks (TB) delivered to/from the physical layer on transport channels; Scheduling information reporting; Error correction through HARQ (one HARQ entity per cell in case of CA); Priority handling between UEs by means of dynamic scheduling; Priority handling between logical channels of one UE by means of logical channel prioritisation; Padding.” Ex. 1013, 26.

73. The MAC layer may provide several “services and functions” using, for example, a “single MAC entity.” Ex. 1013, 27. Or alternatively, the MAC layer may include multiple MAC entities, which may “operate independently unless otherwise specified.” Ex. 1007, 9-10.

74. The PHY layer’s functions include converting information into a permissible form to be transmitted over a transmission medium. For example, the PHY layer may convert digital bits into electromagnetic waves at specified frequencies and times and transmit said waves to another device. Similarly, the PHY layer may convert electromagnetic waves received from another device into digital bits which are passed to upper layers and are converted to the original information they were intended to represent.

75. The layers communicate with one another and work together to enable communication between devices.

76. I should note that the structure of the “Radio Protocol Architecture” (See title of Section 4.4 discussed above) is not new to 5G. The relationship and functions of the Physical Layer (Layer 1), the MAC sublayer of Layer 2, and the Layer 3 RRC was well established in 4G and even before that.

77. For completeness sake, I am including below the relevant figures and portions from the 4G standard, TS 36.300, v8.6.0, dated September 2008, more than 10 years before the claimed priority date of the '535 patent.

4.3.2 Control plane

The figure below shows the protocol stack for the control-plane, where:

- PDCP sublayer (terminated in eNB on the network side) performs the functions listed for the control plane in subclause 6, e.g. ciphering and integrity protection;
- RLC and MAC sublayers (terminated in eNB on the network side) perform the same functions as for the user plane;
- RRC (terminated in eNB on the network side) performs the functions listed in subclause 7, e.g.:
 - Broadcast;
 - Paging;
 - RRC connection management;
 - RB control;
 - Mobility functions;
 - UE measurement reporting and control.
- NAS control protocol (terminated in MME on the network side) performs among other things:
 - EPS bearer management;
 - Authentication;
 - ECM-IDLE mobility handling;
 - Paging origination in ECM-IDLE;
 - Security control.

NOTE: the NAS control protocol is not covered by the scope of this TS and is only mentioned for information.

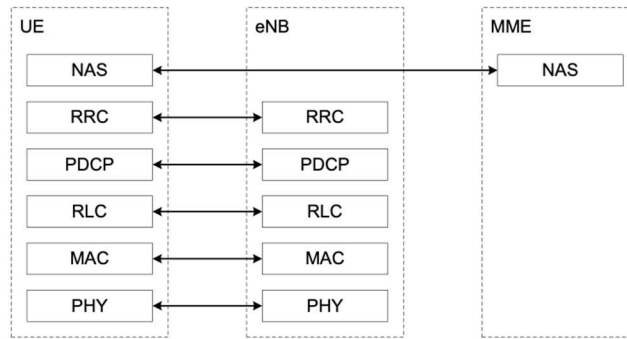


Figure 4.3.2-1: Control-plane protocol stack

Ex. 1017, 18-19.

78. Below I include the relevant section of 36.300 (i.e., 4G/LTE) that correspond to the ones above for 38.300 (i.e., 5G/NR) for the MAC:

6 Layer 2

Layer 2 is split into the following sublayers: Medium Access Control (MAC), Radio Link Control (RLC) and Packet Data Convergence Protocol (PDCP).

This subclause gives a high level description of the Layer 2 sub-layers in terms of services and functions. The two figures below depict the PDCP/RLC/MAC architecture for downlink and uplink, where:

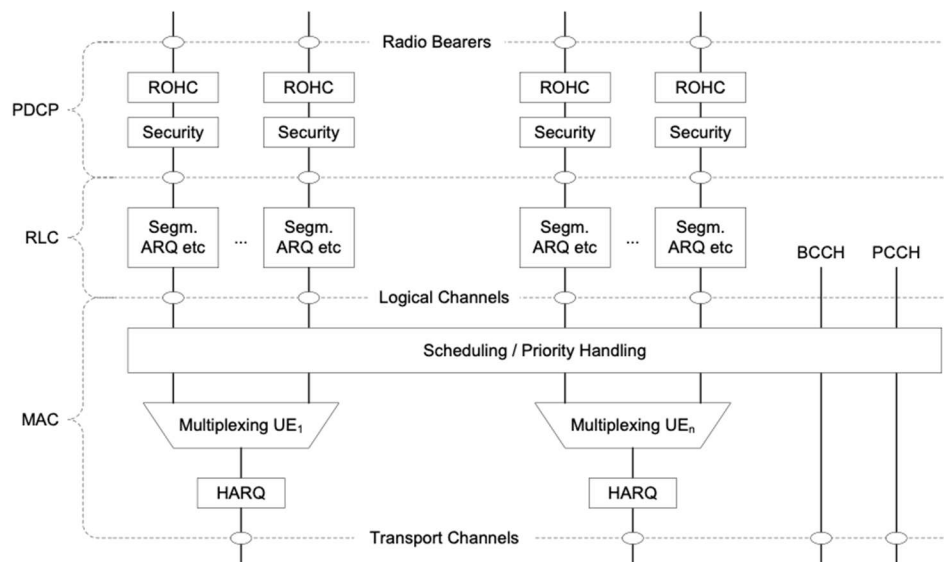


Figure 6-1: Layer 2 Structure for DL

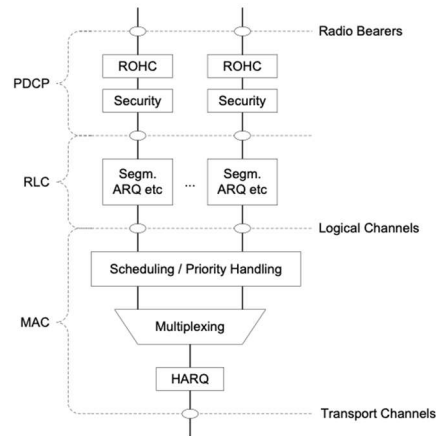


Figure 6-2: Layer 2 Structure for UL

6.1 MAC Sublayer

This subclause provides an overview on services and functions provided by the MAC sublayer.

6.1.1 Services and Functions

The main services and functions of the MAC sublayer include:

- Mapping between logical channels and transport channels;
- Multiplexing/demultiplexing of RLC PDUs belonging to one or different radio bearers into/from transport blocks (TB) delivered to/from the physical layer on transport channels;
- Traffic volume measurement reporting;
- Error correction through HARQ;
- Priority handling between logical channels of one UE;
- Priority handling between UEs by means of dynamic scheduling;
- Transport format selection;
- Padding.

Ex. 1017, 27-29.

79. And I also include the relevant section of 36.300 (i.e., 4G/LTE) that correspond to the ones above for 38.300 (i.e., 5G/NR) for the RRC below:

7 RRC

This subclause provides an overview on services and functions provided by the RRC sublayer.

7.1 Services and Functions

The main services and functions of the RRC sublayer include:

- Broadcast of System Information related to the non-access stratum (NAS);
- Broadcast of System Information related to the access stratum (AS);
- Paging;
- Establishment, maintenance and release of an RRC connection between the UE and E-UTRAN including:
 - Allocation of temporary identifiers between UE and E-UTRAN;
 - Configuration of signalling radio bearer(s) for RRC connection:
 - Low priority SRB and high priority SRB.
- Security functions including key management;
- Establishment, configuration, maintenance and release of point to point Radio Bearers;
- Mobility functions including:
 - UE measurement reporting and control of the reporting for inter-cell and inter-RAT mobility;
 - Handover;
 - UE cell selection and reselection and control of cell selection and reselection;
 - Context transfer at handover.
- Notification for MBMS services;
- Establishment, configuration, maintenance and release of Radio Bearers for MBMS services;
- QoS management functions;
- UE measurement reporting and control of the reporting;
- NAS direct message transfer to/from NAS from/to UE.

Ex. 1017, 34

80. In both 4G and 5G, the RRC was known to be responsible for “perform[ing] the function,” *inter alia*, of “Establishment, maintenance and release of RRC connection between the UE” and the respective network (i.e., the 4G or the 5G network) as is shown in the portion of the specifications above for 4G and for 5G, respectively.

81. Furthermore, the RRC protocol was also defined in the early days of LTE, for example as shown in TS 36.331 V8.7.0, dated September 2009 (Ex. 1018), titled “3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA) radio Resource Control (RRC); Protocol specification (Release 8).” Ex. 1018.

82. A relevant portion of the Table of Contents shows that the RRC defines a number of messages, for example the “*RRCConnectionReconfiguration*” message, as highlighted herein and the “RRCConnectionReestablishmentRequest:

6	Protocol data units, formats and parameters (tabular & ASN.1)	77
6.1	General	77
6.2	RRC messages	78
6.2.1	General message structure	78
–	EUTRA-RRC-Definitions	78
–	BCCH-BCH-Message	78
–	BCCH-DL-SCH-Message	78
–	PCCH-Message	79
–	DL-CCCH-Message	79
–	DL-DCCH-Message	79
–	UL-CCCH-Message	80
–	UL-DCCH-Message	80
6.2.2	Message definitions	81
–	CounterCheck	81
–	CounterCheckResponse	82
–	CSFBParametersRequestCDMA2000	82
–	CSFBParametersResponseCDMA2000	83
–	DLInformationTransfer	83
–	HandoverFromEUTRAPreparationRequest (CDMA2000)	84
–	MasterInformationBlock	84
–	MeasurementReport	85
–	MobilityFromEUTRACommand	86
–	Paging	87
–	RRCConnectionReconfiguration	88
–	RRCConnectionReconfigurationComplete	89
–	RRCConnectionReestablishment	90
–	RRCConnectionReestablishmentComplete	90
–	RRCConnectionReestablishmentReject	91
–	RRCConnectionReestablishmentRequest	91
–	RRCConnectionReject	92
–	RRCConnectionRelease	93
–	RRCConnectionRequest	94
–	RRCConnectionSetup	95
–	RRCConnectionSetupComplete	96
–	SecurityModeCommand	97
–	SecurityModeComplete	97
–	SecurityModeFailure	98
–	SystemInformation	98
–	SystemInformationBlockType1	99
–	UECapabilityEnquiry	100
–	UECapabilityInformation	101
–	ULHandoverPreparationTransfer (CDMA2000)	101
–	ULInformationTransfer	102

Ex. 1018, 6.

83. Specifically, for example, with respect to the *RRCConnectionReestablishmentRequest* message, as it is shown below, it is “used to request the reestablishment of an RRC connection”:

– *RRCConnectionReestablishmentRequest*

The *RRCConnectionReestablishmentRequest* message is used to request the reestablishment of an RRC connection.

Signalling radio bearer: SRB0

RLC-SAP: TM

Logical channel: CCCH

Direction: UE to E-UTRAN

RRCConnectionReestablishmentRequest message

```
-- ASN1START
RRCConnectionReestablishmentRequest ::= SEQUENCE {
    criticalExtensions      CHOICE {
        rrcConnectionReestablishmentRequest-r8
        criticalExtensionsFuture      SEQUENCE {}
    }
}

RRCConnectionReestablishmentRequest-r8-IEs ::= SEQUENCE {
    ue-Identity      ReestabUE-Identity,
    reestablishmentCause      ReestablishmentCause,
    spare            BIT STRING (SIZE (2))
}

ReestabUE-Identity ::= SEQUENCE {
    c-RNTI      C-RNTI,
    physCellId  PhysCellId,
    shortMAC-I   ShortMAC-I
}

ReestablishmentCause ::= ENUMERATED {
    reconfigurationFailure, handoverFailure,
    otherFailure, spare1}
-- ASN1STOP
```

RRCConnectionReestablishmentRequest field descriptions

<i>ue-Identity</i>
UE identity included to retrieve UE context and to facilitate contention resolution by lower layers.
<i>reestablishmentCause</i>
Indicates the failure cause that triggered the re-establishment procedure.
<i>physCellId</i>
The Physical Cell Identity of the cell the UE was connected to prior to the failure.

Ex. 1018, 91-92.

84. As is shown above, at least as of 2009, a POSITA would have understood that a UE could transmit to the network an RRC connection reestablishment request message in order to request a reestablishment of an RRC connection. Said message included a “ReestablishmentCause” used to indicate “the failure cause that triggered the re-establishment procedure” as shown in the “field descriptions” above and the then-named causes included “reconfigurationFailure”, “handoverFailure”, “otherFailure” and a “spare” value.

85. Similar disclosures can be found in TS 38.331 V15.3.0, which specifies the RRC protocol, including relevant messages, for 5G/NR systems. *See e.g.*, Ex. 1021, 6-7, 115-116. Figure 5.3.7.1-1 below shows the transmission by a UE of an RRC connection re-establishment request message (the *RRCReestablishmentRequest* message) as part of a successful RRC connection re-establishment procedure in 5G. Ex. 1021, 53.

5.3.7 RRC connection re-establishment

5.3.7.1 General

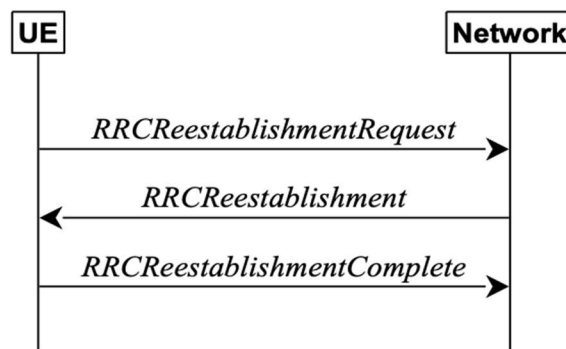


Figure 5.3.7.1-1: RRC connection re-establishment, successful

2. Bandwidth Part (BWP)

86. A Bandwidth Part (BWP) is a specific frequency band available to the service provider (e.g., AT&T or Verizon) that the provider can make available to a device to communicate on. The “receive and transmit bandwidth of a UE need not be as large as the bandwidth of the cell and can be adjusted.” Ex. 1013, 31. For example, “the width can be ordered to change (e.g. to shrink during period of low activity to save power); the location can move in the frequency domain (e.g. to

increase scheduling flexibility); and the subcarrier spacing can be ordered to change (e.g. to allow different services).” Ex. 1013, 31. Thus, a “subset of the total cell bandwidth of a cell is referred to as a Bandwidth Part (BWP).” Ex. 1013, 31.

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- BWP₂ with a width of 10 MHz and subcarrier spacing of 15 kHz;
- BWP₃ with a width of 20 MHz and subcarrier spacing of 60 kHz.

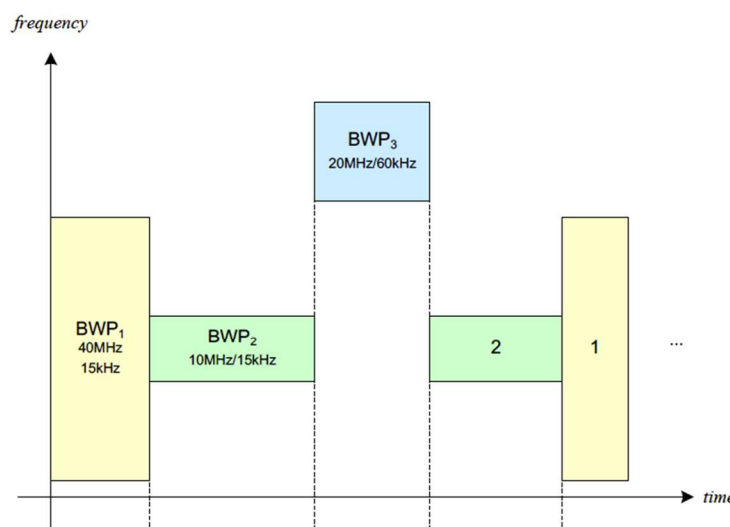
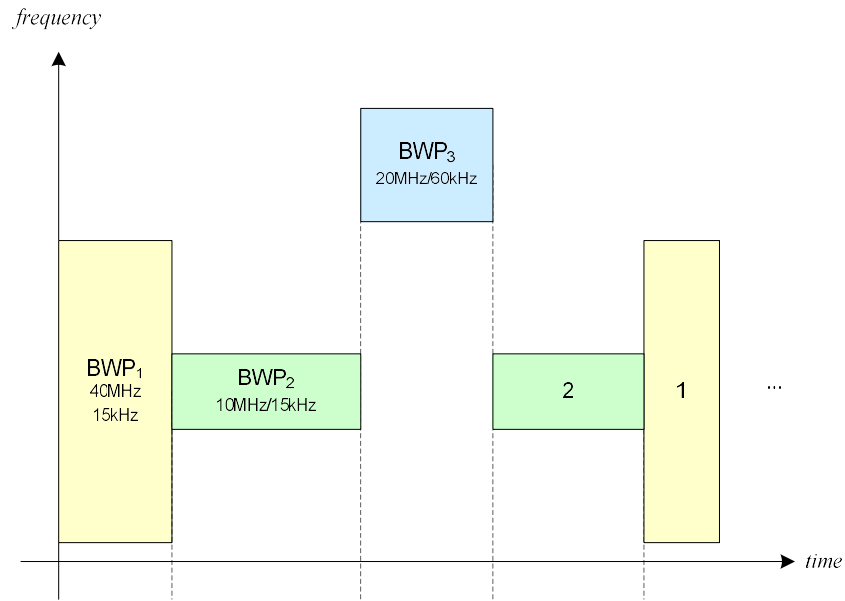


Figure 6.10-1: BA Example

87. Figure 6.10-1 below describes a scenario where 3 different BWPs are configured:

- BWP₁ with a width of 40 MHz and subcarrier spacing of 15 kHz;
- BWP₂ with a width of 10 MHz and subcarrier spacing of 15 kHz;
- BWP₃ with a width of 20 MHz and subcarrier spacing of 60 kHz.

Ex. 1013, 31-32.



Ex. 1013, Figure 6.10-1.

88. As the above TS 38.300 document explains, “Bandwidth Adaptation (BA) is achieved by configuring the UE with BWP(s) and telling the UE which of the configured BWPs is currently the active one.” Ex. 1013, 31. It is common to switch from one BWP to another BWP for both uplink and downlink transmissions. Ex. 1007, 44-46; *see also* Ex. 1004 (*Shi*), 5:35-37; Ex. 1005 (*Hong*), [199]; Ex. 1006 (*Hong Priority*), [0098].

89. I also note that TS 38.321 explains that upon “RRC (re-)configuration of *firstActiveDownlinkBWP-Id* and/or *firstActiveUplinkBWP-Id* respectively (as specified in TS 38.331 [5] is active without receiving PDCCH.... The active BWP for a Serving Cell is indicated by either RRC or PDCCH.” Ex. 1007, 44.

90. A POSITA would understand that the above referenced reference [5], i.e., TS 38.331 corresponds to Ex. 1021.

3. Listen-Before-Talk (LBT)

91. The basic principle of listening for activity on a channel before transmitting information on the channel is very old. It was originally called Carrier Sense Multiple Access (“CSMA”). CSMA was known to be particularly useful when there was no entity in control of the communication medium, such as with local area networks, including what are now known as Wi-Fi networks.

92. A textbook titled “Data Networks,” published in 1992, by Dimitri Bertsekas and Robert Gallager (“*Bertsekas*”) (Ex. 1015), explains the basic function of CSMA in Section 4.4 titled “CARRIER SENSING”. Ex. 1015, 304. Specifically, *Bertsekas* explains that, “[i]n many multiaccess systems, such as local area networks, a node can hear whether other nodes are transmitting after a very small propagation and detection delay relative to a packet transmission time.” Ex. 1015, 304. *Bertsekas* further explains that, “[i]f nodes can detect idle periods quickly, it is reasonable to terminate idle periods quickly and to allow nodes to initiate packet transmission after such idle detections. This type of strategy, called carrier sense multiple access (CSMA) [KIT75], does not necessarily imply the use of a carrier but simply the ability to detect idle periods quickly.” Ex. 1015, 304.

93. *Bertsekas* also references at page 546 to a paper by L. Kleinrock and F.A. Tobagi, published in 1975 titled “Packet Switching in Radio Channels: Part 1: CSMA Modes and Their Throughput-Delay Characteristics”, published in the IEEE Transactions on Communications, COM-23:1400-1416. This paper is also useful background.

94. Although about half a century old, this technique has been found viable in 4G and 5G systems primarily because of the introduction of operation in an “unlicensed band,” or a frequency band that is not controlled by any one entity. The concepts of CSMA are a natural fit for unlicensed bands, but a new name was needed because “CSMA” refers to a specific protocol. The concept of “Listen-Before-Talk,” or LBT, has been used in 4G dating back to 2014 as well as in 5G.

95. A POSITA’s knowledge of LBT is further indicated by books relevant to LBT implementations in 4G and in 5G. For example, the book titled “Key Technologies for 5G Wireless Systems” by Vincent W.S. Wong, Robert Schober, Derrick Wing Kwan Ng, and Li-Chun Wang, Cambridge University Press, 2017 (“*Wong*”, Ex. 1019) devotes Chapter 20 to “LTE-Unlicensed: Overview and Distributed Coexistence Design” where it discusses LBT-related issues.

96. *Wong* explains that “LTE-U [LTE Unlicensed], based on 3GPP Release 10/11/12, targets early deployment by mobile operators in the United States, Korea, and India and markets without a Listen Before Talk (LBT)

requirement. For example, the US deployment of LTE-Unlicensed in the U-NII [Unlicensed National Information Infrastructure] radio bands ranges from 5.15 to 5.85 GHz, as regulated by the Federal Communications Commission (FCC).” *Wong*, 440.

97. *Wong* continues to explain that: “Defined in 3GPP Release 13, LAA [License Assisted Access] targets deployments in Europe, Japan, and beyond, and in regions with specific access procedures with LBT. The performance of LTE-U and LAA, and how they can coexist in a fair manner with Wi-Fi were demonstrated at Mobile World Congress (MWC) 2015.” *Wong*, 440.

98. As *Wong* explains, a POSITA would understand that “where there is an additional unlicensed-band regulation, requiring LBT, the design of coexistence is different from LTE-U, as specified in LAA based on Release 13. The sharing concept is similar to that in LTE-U, but, owing to the LBT requirement, some modifications to the LTE air interface standards are required [2, 12].” *Wong*, 443. *Wong*’s citation to references 2 and 12 correspond to the following two papers: Reference 2: Qualcomm, “Making the best use of unlicensed spectrum for 1000x,” White Paper, 2014. Reference 12: Qualcomm, “Qualcomm research LTE in unlicensed spectrum: Harmonious coexistence with Wi-Fi,” White Paper, Jun. 2014.

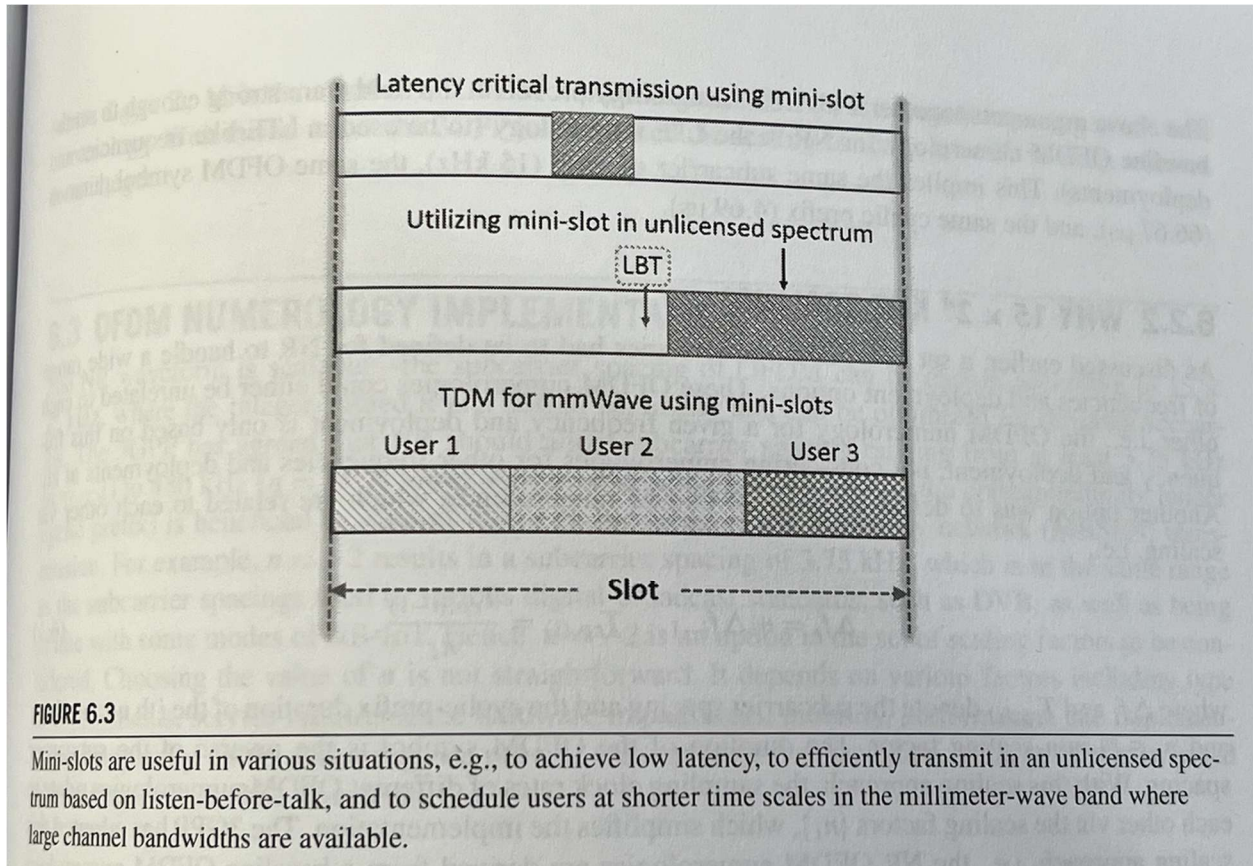
99. Thus, as *Wong* explains, the concept of LBT existed in 4G as far back as 2014 as did the fact that as of 2014 certain improvements of it were needed.

100. LBT in 5G is also discussed in another book titled “5G Physical Layer; Principles, Models and Technology Components” by Ali Zaidi, Fredrik Athley, Jonas Medbo, Ulf Gustavsson, Giuseppe Durisi, and Xiaoming Chen, Academic Press, 2018 (“*Zaidi*”) (Ex. 1020).

101. As *Zaidi* explains, “NR [New Radio, i.e., 5G] can also employ mini-slots to support transmissions with a flexible start position and a duration shorter than a regular slot duration. ... Mini-slots can be useful in various scenarios, including low-latency transmissions, **transmissions in unlicensed spectrum** and transmissions in the millimeter-wave spectrum. ... When transmitting in the unlicensed spectrum, it is beneficial to start transmission immediately **after the listen-before-talk (LBT) mechanism**” *Zaidi*, 30-31 (emphasis added).

102. *Zaidi* further discusses LBT in section 6.2, titled “SCALABLE OFDM FOR NR” where he once again explains the use of mini slots and of LBT: “The 3GPP has introduced the concept of mini-slot in NR to support transmissions shorter than regular slot duration (see Section 2.3). A mini-slot can start at any OFDM symbol in a regular slot. Mini-slots can be useful in various scenarios—three important utilizations are shown in Fig. 6.3... ii) transmissions in an

unlicensed spectrum, where it is beneficial to start transmission immediately after LBT.” *Zaidi*, 164-165.



103. In 5G/NR systems, communications can take place on licensed spectrum or unlicensed spectrum. Licensed spectrums are owned and controlled by specific entities (e.g., network operators, sometimes also referred to as “carriers” or “service providers”). In contrast, unlicensed spectrums are not controlled by any one entity. As a result, there are various protocols associated with communicating on an unlicensed spectrum. LBT is one of those protocols.

104. LBT, as with CSMA before it, ensures that a channel is free before it can be used by a device. Specifically, as discussed in International Patent

Application Publication No. WO 2017/136458 to Lim et al., published August 10, 2017 (Ex. 1014, “*Lim*”), the device can perform LBT by listening to the channel and determining whether the channel is busy. *Lim*, [0022], [0027]. When the channel is busy, the device may not access the channel. *Lim*, [0022], [0027]. This is referred to as LBT failure. *Lim*, [0022]. On the other hand, when the channel is not busy, this indicates that there is no LBT failure, and the device is able to perform a transmission on the channel, i.e. LBT is successful. *Lim*, [0022]. LBT failures can be more frequent when there are many devices operating on the same unlicensed channel.

105. Thus, the use of LBT and detecting LBT failures was well known to a POSITA before the earliest claimed priority date of the ’535 patent, January 9, 2019.

a. 3GPP Proposed Standard

106. As I discuss above in Section VI.B, 3GPP is a well-known organization that develops Technical Specifications (TS) for wireless telecommunications systems, such as 3G/UMTS, 4G/LTE, and 5G/NR. Generally, the 3GPP holds working group meetings several times a year to propose and discuss new TSs and/or changes to existing ones. The 3GPP materials are generally made available to the public on the 3GPP website.

107. During one particular working group meeting (3GPP TSG RAN WG2 NR) held in Chengdu, China, between October 8-12, 2018, the working group discussed the following proposal:

Proposal 4: When consecutive LBT failure times exceed a certain value, MAC terminates the current RACH procedure and indicates random access failure to upper layer.

Ex. 1010, 4; Rodermund Declaration, ¶¶54-62.

108. Specifically, in explaining the need for Proposal 4, the meeting document (*R2-1813741*) states that, “[w]hen preamble transmission is dropped due to LBT failure, *PREAMBLE_TRANSMISSION_COUNTER* will not be incremented.” Ex. 1010, 4. *R2-1813741* further states that “when channel is very busy, UE may have no chance to access the channel for a long time, then RACH procedure will never terminate since *PREAMBLE_TRANSMISSION_COUNTER* will not be incremented.” Ex. 1010, 4. *R2-1813741* recognizes that, “[i]n order to solve this problem, MAC may count LBT consecutive failure times.” Ex. 1010, 4. *R2-1813741* further states that “[w]hen consecutive LBT failure times exceed a certain value, UE may terminate the current RACH procedure and select other carrier, i.e. in this case, MAC should indicate random access failure to upper layer, and then upper layer initiates reestablishment procedure.” Ex. 1010, 4. *R2-1813741* further

states that “[o]nce a preamble transmission happens, LBT failure counter should be reset.” Ex. 1010, 4.

109. *R2-1813741* therefore describes the general procedure of keeping a counter for the number of LBT failures, and when the LBT failure counter reaches a threshold value, determining that LBT failure has occurred and reporting the failure to an upper layer for initiating a recovery procedure. I understand that *R2-1813741* was made publicly available on the 3GPP website on September 27, 2018. Rodermund Declaration, ¶¶54-62.

110. The same proposal was again discussed in a later 3GPP meeting held in Spokane, U.S., between November 12-16, 2018, and made publicly available in a meeting document (*R2-1816829*) on the 3GPP website on November 2, 2018. Ex. 1011, 4; Rodermund Declaration, ¶¶63-71. Specifically, the working group discussed the following proposal:

Proposal 9: When consecutive LBT failure times exceed a certain value, MAC terminates the current RACH procedure and indicates random access failure to upper layer.

Ex. 1010, 4; Rodermund Declaration, ¶¶63-71.

111. Again, in explaining the need for Proposal 9, *R2-1816829* states, “[i]f preamble transmission counter is not incremented, when channel is very busy, UE may have no chance to access the channel for a long time,” so “some ways to

trigger recovery from LBT failures need to be considered.” Ex. 1011, 4. *R2-1816829* states that “the MAC layer may count consecutive LBT failure times.” Ex. 1011, 4. *R2-1816829* further states that “[w]hen consecutive LBT failure times for preamble transmission exceed a certain value, UE may terminate the current RACH procedure and select other carrier, i.e. in this case, MAC should indicate random access failure to upper layer, then the upper layer initiates reestablishment procedure.” Ex. 1011, 4. *R2-1816829* further states that “[o]nce a preamble transmission happens, LBT failure counter should be reset.” Ex. 1011, 4.

112. Just a couple of months after the proposals from the *R2-1813741* and *R2-1816829* documents were discussed, the alleged priority application of the ’535 patent was filed on January 9, 2019, describing the proposals and other already well-known and common-sense concepts.

b. Patent Literature Implementing Proposed Technical Specifications

113. Further, around the same time, and before January 9, 2019, several patent applications were filed on the proposals discussed above. For example, International Patent Application Publication No. WO 2020/087369 (“*Shi*”; Ex. 1004), which was filed on October 31, 2018, discloses a method in a terminal (e.g., UE) communicating with a network device (e.g., base station), where the number of LBT failures for uplink transmission are counted using a counter. *Shi*, 2:37-3:29, 4:26-35, 5:6-8; *see also Shi*, 8:49-9:9, 9:28-30. *Shi* discloses that the counter can be

maintained at the MAC layer. *Shi*, 6:3-5; *see also Shi*, 4:34-35, 8:21-23, 9:5-9. *Shi* further discloses that, when the counter reaches a preset threshold, an upper layer (e.g., RRC layer) can trigger a recovery procedure in response. *Shi*, 5:31-34, 7:29-39.

114. For example, *Shi* discloses that the RRC layer may trigger one of the following recovery procedures: (1) RRC connection re-establishment, (2) Secondary Cell Group (SCG)–Radio Link Failure (RLF) processing, or (3) RRC reconfiguration. *Shi*, 5:31-34. As part of the SCG-RLF processing, *Shi* explains that the SCG Media Access Control (MAC) entity may be reset. *Shi*, 5:37-40. *Shi* also discloses that the LBT failure counter may be reset when the count value of the counter has not changed for a period of time. *Shi*, 5:28-30.

115. As another example, International Patent Application Publication No. WO 2020/045920 (“*Hong*”; Ex. 1005), which claims priority to Korean Patent Application No. 10-2018-0102907, filed on August 30, 2018, similarly discloses a method in a terminal (e.g., UE) communicating with a network device (e.g., base station), where a counter is maintained to detect the number of LBT failures. *Hong*, [30], [32]-[33], [43]-[45], [176]-[178]; *Hong Priority*, [0005]-[0007], [0069]-[0074]. For example, in *Hong*, the UE increments the counter by one when it detects an LBT failure. *Hong*, [178]; *Hong Priority*, [0072]. And, according to *Hong*, if the counter value reaches a threshold value, then the UE can indicate this

to the upper layer (e.g., RRC layer). *Hong*, [178]; *Hong Priority*, [0073]. The UE can then indicate this LBT failure-related information to the base station and/or initiate a procedure to resolve the failure. *Hong*, [187]; *Hong Priority*, [0087].

116. For example, *Hong* discloses that the UE can initiate an RRC connection re-establishment/resumption. *Hong*, [195]; *Hong Priority*, [0095]. As part of this RRC connection re-establishment/resumption, the UE resets the MAC and applies a default MAC main configuration. *Hong*, [195]; *Hong Priority*, [0095]. *Hong* also discloses that the LBT failure counter may be reset, for example, upon a new uplink transmission attempt or upon receiving an indication by the upper layer. *Hong*, [178], [187]; *Hong Priority*, [0071].

117. Yet another example, International Patent Application Publication No. WO 2020/069114 (“*Terry*”; Ex. 1022), which claims priority to U.S. Provisional Application No. 62/753,579 (“*Terry Provisional*”; Ex. 1023), filed October 31, 2018, similarly discloses a method in a terminal (e.g., UE) communicating with a network device (e.g., base station), where an LBT Failure Counter is maintained to detect the number of LBT failures. *Terry*, [00249]-[00250]; *Terry Provisional*, [00246]-[00247]. In *Terry*, when the LBT Failure Counter exceeds a configured threshold, the LBT State may be considered failed. *Terry*, [0071]; *Terry Provisional*, [0068]. *Terry* further discloses that MAC procedures may adjust counters and timers according to the LBT State. *Terry*, [0071]; *Terry Provisional*,

[0068]. In addition, the LBT State may also be indicated to higher layers, for example, to affect RRC procedures. *Terry*, [0071]; *Terry Provisional*, [0068].

VII. THE '535 PATENT

A. Alleged Invention of the '535 Patent

118. As I discuss in Section VI.A above, the '535 patent acknowledges that much of its teachings were known LBT operations. I repeat some of that discussion below, followed by a description of what the '535 patent describes as its contribution to the art.

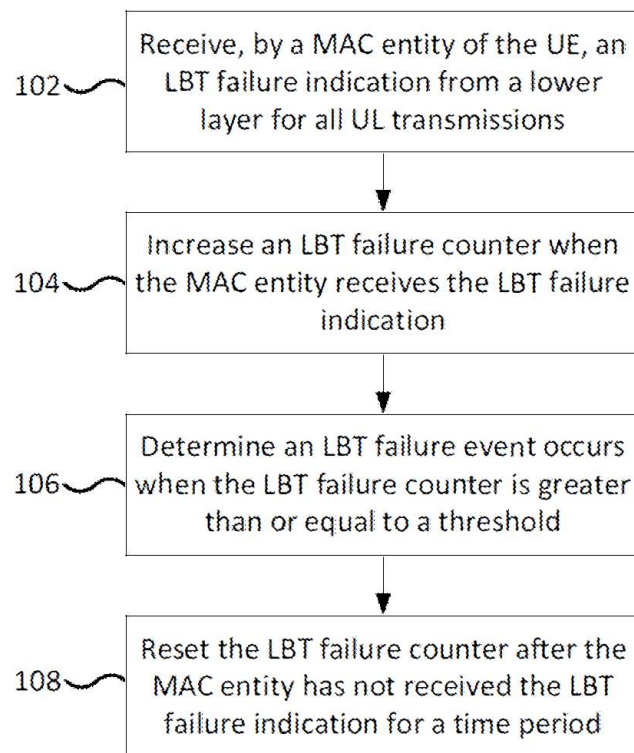
119. The '535 patent relates generally to wireless communication and more particularly to “Listen-Before-Talk (LBT) failure indication and LBT failure event determination.” Ex. 1001, 1:17-21.

120. The '535 patent recognizes that “LBT is a mechanism by which a wireless device applies Clear Channel Assessment (CCA) before using the channel” and that the 3GPP has specified “a conservative LBT scheme similar to that used by Wi-Fi nodes to ensure coexistence of Licensed Assisted Access (LAA) with Wi-Fi.” Ex. 1001, 1:29-34.

121. The '535 patent purports that “[t]here is a need in the industry for an improved and efficient mechanism for a UE to handle LBT failure that may take place in the physical layer.” Ex. 1001, 1:38-41.

122. As I discussed in Section VI.C above, however, the '535 patent simply describes methods and devices for LBT failure detection and recovery that use known procedures. Specifically, the '535 patent uses an LBT failure counter to count the number of LBT failure indications, Ex. 1001, 6:45-50, and contemplates initiating a recovery procedure when the LBT failure counter is greater than or equal to a threshold. Ex. 1001, 6:51-57, 7:32-48, 8:21-39.

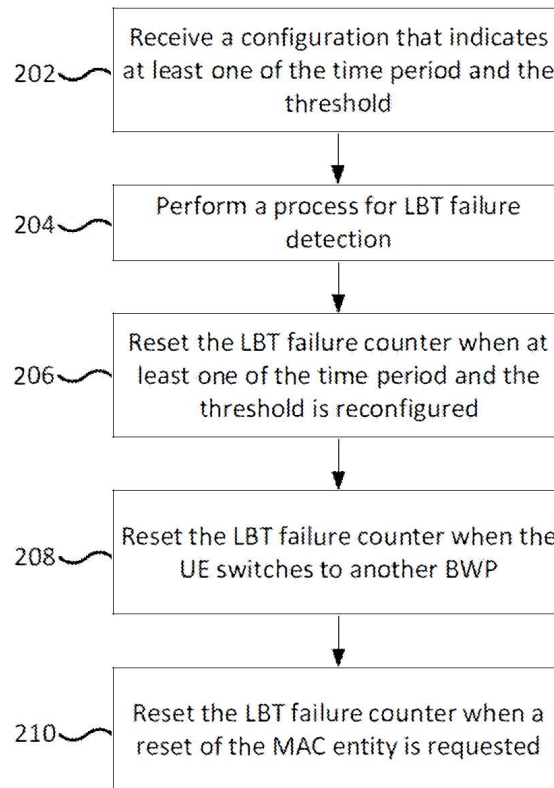
123. For example, FIG. 1 of the '535 patent below illustrates an exemplary method for LBT failure detection performed by the UE. Ex. 1001, 6:30-44.



Ex. 1001, FIG. 1.

124. As shown, at step 102, a MAC entity of the UE may receive an LBT failure indication from a lower layer (e.g., the PHY layer) for all UL transmissions. Ex. 1001, 6:30-44. Then, at step 104, the UE may increase an LBT failure counter when the MAC entity receives the LBT failure indication. Ex. 1001, 6:45-50. At step 106, the UE may determine an LBT failure event occurs when the LBT failure counter is greater than or equal to a threshold. Ex. 1001, 6:51-57. At step 108, the UE may reset the LBT failure counter after the MAC entity has not received the LBT failure indication for a time period. Ex. 1001, 6:58-67.

125. The '535 patent also explains that the UE may reset the LBT failure counter based on other well-known and common-sense conditions, for example, as shown in FIG. 2 below. Ex. 1001, 8:40-67.



Ex. 1001, FIG. 2.

126. For example, the UE may reset the LBT failure counter when at least one of the time period and the threshold is reconfigured. Ex. 1001, 8:52-56. The UE may also reset the LBT failure counter when the UE switches to another Bandwidth Part (BWP). Ex. 1001, 8:56-58. And the UE may reset the LBT failure counter when a reset of the MAC entity is requested. Ex. 1001, 8:58-59.

127. Claim 1 of the '911 patent recites:

[1pre] A user equipment (UE) comprising:

[1a] one or more non-transitory computer-readable media having computer-executable instructions embodied thereon; and

at least one processor coupled to the one or more non-transitory computer-readable media, the at least one processor is configured to execute the computer-executable instructions to:

[1b] receive, by a Medium Access Control (MAC) entity of the UE, a Listen-Before-Talk (LBT) failure indication from a lower layer of the UE for all uplink (UL) transmissions;

[1c] increase an LBT failure counter when the MAC entity receives the LBT failure indication;

[1d] determine that an LBT failure event has occurred when the LBT failure counter is greater than or equal to a threshold; and

[1e] reset the LBT failure counter when a reset of the MAC entity is requested by an upper layer of the UE.

Ex. 1001, 13:27-46.

128. In claim 1, elements [1b], [1c], and [1d] recite merely conventional LBT failure procedures, as explained above. *See* Ex. 1001, 1:25-41; *See* § VI above. Element [1e] was added to claim 1 by amendment to achieve allowance. Ex. 1003, 43, 16-23. But the concept of [1e] was well known to a POSITA as of the '535 patent's assumed priority date of January 9, 2019.

B. Prosecution History

129. The application that matured into the '535 patent was filed on January 8, 2020, as U.S. Patent Application No. 16/737,787 and claims priority to U.S. Provisional Application No. 62/790,099, filed January 9, 2019. Ex. 1001, cover; Ex. 1002, 346, 354.

130. During prosecution of the '535 patent, the examiner rejected original claims 1, 3, 4, 7, 11, 13, 14, and 17 under 35 U.S.C. § 102(a)(2) as anticipated based on U.S. Patent Application Publication No. 2020/0077446 ("Agiwal"), rejected claims 2, 5, 6, 8-10, 12, 15, 16, and 18-20 under 35 U.S.C. § 103 as obvious based on Agiwal and additional prior art. Ex. 1003, 137-147. In response, the Applicant first amended the independent claims by adding the limitation "a reset of the MAC entity is requested by an upper layer of the UE" as an alternative to previously recited "the MAC entity has not received the LBT failure indication for a time period." Ex. 1003, 126-128. However, the Examiner noted that the alternative language did not further limit the claims and again rejected the claims as anticipated and obvious based on Agiwal. Ex. 1003, 105-114.

131. The Applicant then amended the independent claims to remove the alternative limitation of "the MAC entity has not received the LBT failure indication for a time period," such that the claims required "reset[ting] the LBT failure counter when a reset of the MAC entity is requested by an upper layer of

the UE.” Ex. 1003, 43-47. Thereafter, the Examiner allowed the claims. Ex. 1003, 16-23.

VIII. CLAIM CONSTRUCTION

132. I have been instructed that the “intrinsic record” includes the patent itself, including the claims, description, and figures (Ex. 1001), 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 (Ex. 1003). 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.

133. 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.

134. 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 claimed priority date of the '535 patent.

135. 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 '535 patent as it would have been understood by a person of ordinary skill in the art at the earliest claimed priority date of January 9, 2019.

IX. LEVEL OF ORDINARY SKILL IN THE ART

136. In rendering the opinions set forth in this declaration, I have been asked to consider the '535 patent's claims and the prior art through the eyes of a person of ordinary skill in the art (which I may also refer to as "one skilled in the art," "skilled artisan," "POSITA," or similar variation). I have considered factors such as the educational level and years of experience of those working in the pertinent art, the types of problems encountered in the art, the teachings of the prior art, patents and publications of other persons or companies, and the sophistication of the technology.

137. Taking the factors described in the Legal Standards – Level of Ordinary Skill section into consideration, it is my opinion that a person of ordinary

skill in the art (“POSITA”) at least a master’s degree in electrical engineering or a similar field and at least two years of experience working with wireless telecommunications systems. In my opinion, additional relevant work experience can compensate for less education, and *vice versa*.

X. THE PRIOR ART

138. In forming my opinions, I found the following prior art relevant when considering whether the claims of the ’535 patent would have been obvious to a person of ordinary skill in the art.

Ex. 1004	International Patent Application Publication No. WO 2020/087369 to Shi, published May 7, 2020 (“ <i>Shi</i> ”), including certified English translation and certification
Ex. 1005	International Patent Application Publication No. WO 2020/045920 to Hong, published March 5, 2020 (“ <i>Hong</i> ”), including certified English translation and certification
Ex. 1007	3GPP TS 38.321 v15.3.0 (“Technical Specification Group Radio Access Network; NR; Medium Access Control (MAC) protocol specification (Release 15)”) (Sept. 2018) (“ <i>TS-38.321</i> ”)

Ex. 1008	International Patent Application Publication No. WO 2019/245779 to Alfarhan et al., published December 26, 2019 (“ <i>Alfarhan</i> ”)
Ex. 1022	International Patent Application Publication No. WO 2020/069114 to Terry et al., published April 2, 2020 (“ <i>Terry</i> ”)

A. *Shi*

139. International Patent Application Publication No. WO 2020/087369 to Shi (“*Shi*”; Ex. 1004) was filed October 31, 2018, designated the U.S., and was published May 7, 2020. I have been instructed that this makes *Shi* prior art to the ’535 patent.

140. Based on my understanding of analogous art, it is my opinion that *Shi* is analogous art to the ’535 patent because *Shi*, like the ’535 patent, is directed to a communication system with at least one terminal device (e.g., user equipment) that communicates with at least one network device (e.g., base station). *Shi*, 2:37-3:29, FIG. 1; ’535 patent, 3:37-4:30. *Shi* is also directed to the same problem as the ’535 patent, for example, resolving channel access failure (e.g., LBT failure). *Shi*, 4:16-8:38; ’535 patent, 1:17-21, 6:30-11:59.

B. *Hong*

141. International Patent Application Publication No. WO 2020/045920 to Hong (“*Hong*”; Ex. 1005) was filed August 26, 2019, and published March 5, 2020. *Hong* claims priority to Korean Application No. 10-2018-0102907 (“*Hong Priority*”; Ex. 1006), filed August 30, 2018. Throughout this declaration, I cite to both *Hong* and the *Hong Priority* to show the correspondence. I have been instructed that this makes *Hong* prior art to the ’535 patent.

142. I was asked to compare *Hong*’s claim 1 to the disclosures of the *Hong Priority* to determine whether the limitations of *Hong*’s claim 1 are supported by the *Hong Priority*. It is my opinion that they are. In the chart below, I compare *Hong* claim 1 to the prior disclosures in the *Hong Priority*’s disclosures filed August 30, 2018.

<i>Hong</i> Claim 1	<i>Hong Priority</i> Support
1. A method whereby a terminal communicates in an unlicensed band, comprising:	“The present invention proposes a method and apparatus for terminal overload control and failure handling for a next-generation/5G wireless access network configured over an unlicensed band (hereinafter in the present invention referred to as NR-U [New Radio based Access to Unlicensed spectrum].” <i>Hong Priority</i> , [0001].
a step wherein a channel occupancy failure is detected with respect to an unlicensed band radio resource for	“One embodiment of the present invention proposes a method of transmitting uplink data by a terminal,

<i>Hong Claim 1</i>	<i>Hong Priority Support</i>
transmitting or receiving uplink data or downlink data;	the method comprising a step of detecting an LBT failure and a step of initiating a preset procedure based on the result of the LBT failure detection, and an apparatus therefor.” <i>Hong Priority</i>, [0002]. “As described above, because of the need to support LBT, in NR-U it can be difficult to ensure access to a radio channel, and therefore it can be difficult for data transmission and reception to meet a certain QoS level. In particular, if unlicensed band cells are congested, LBT failures can also increase. In this case, a radio link failure can also occur with a delay. Alternatively, radio link failure detection can be delayed if the PCell radio quality of the connected terminal is greatly deteriorated.” <i>Hong Priority</i>, [0056]. “a condition for the relevant indication can be configured in the terminal so as to detect a radio link failure caused by LBT, or so as to limit service interruption time caused by LBT failure, or so as to indicate a reporting of the channel occupancy status of an unlicensed band cell. For example, the base station can configure in the terminal one or more pieces of information from among: a Channel Occupancy threshold value, an RSSI threshold value, a maximum LBT failure threshold value, a measurement time, a measurement period, and

<i>Hong Claim 1</i>	<i>Hong Priority Support</i>
	identifying information of a subband/BWP/cell/CC to be measured. If the condition is fulfilled, then the terminal can report the LBT failure-related information to the base station.” <i>Hong Priority</i>, [0092]. “the LBT failure-related information transmitted from the terminal to the base station can include one or more of the following items of information: channel occupancy, RSSI, number of LBT failures, LBT failure rate, LBT failure duration, measurement time, measurement period, cause of failure owing to LBT failure, reporting cause, identifying information for the relevant subband/BWP/cell/CC, and CO measurement value/RSSI measurement value/LBT failure count/LBT failure rate for each relevant subband/BWP/cell/CC.” <i>Hong Priority</i>, [0093].
a step wherein, if the channel occupancy failure satisfies a certain criterion, then it is determined that the channel occupancy failure is a channel access failure for the unlicensed band radio resource; and	“By way of one example, the terminal can initiate the procedure upon detecting LBT failures that exceed a threshold indicated for an uplink transmission attempt ... The physical layer of the terminal can detect whether there has been a failure to carry out LBT in transmitting the uplink transmission block and can indicate to the upper layer that LBT failures have occurred that exceed the indicated threshold value.” <i>Hong Priority</i>, [0063].

<i>Hong Claim 1</i>	<i>Hong Priority Support</i>
a step wherein, if a channel access failure has occurred, then upper layer signaling is transmitted to a base station.	“The upper layer signaling (High Layer Signaling) described below encompasses RRC signaling, in which RRC information is transmitted that comprises an RRC parameter.” <i>Hong Priority</i>, [0017]. “By way of another example, if the above-mentioned counter reaches a threshold value indicated by the base station, the above-mentioned timer expires, or the above-mentioned ratio reaches the threshold value indicated by the base station, then the terminal can indicate LBT failure-related information to the base station. And/or a procedure to resolve this can be initiated.” <i>Hong Priority</i>, [0087]. “The terminal sets the source PCell as the terminal identifier, sets the physical cell ID as the physical cell identity of the source PCell, sets the re-establishment cause as LBT failure, and transmits an RRC re-establishment request message to the base station. Alternatively, the terminal transmits an RRC resumption request message to the base station, setting the I-RNTI as the terminal identifier and the resumption cause as LBT failure. The terminal can be preconfigured with indication information instructing the terminal to carry out an RRC connection re-establishment/resumption using a new cell other than the source cell in which

<i>Hong Claim 1</i>	<i>Hong Priority Support</i>
	the terminal detected the LBT failure. The terminal can use that information to camp on the cell. The information can include one or more of the following items of information: a physical cell identifier, SSB information (for example, time-domain location of the SSB transmission), subcarrier spacing information, and new terminal identifier (C-RNTI) information.” <i>Hong Priority</i> , [0096].

143. *Hong* is analogous art to the ’535 patent because *Hong*, like the ’535 patent, is directed to a communication system with at least one terminal device (e.g., user equipment) that communicates with at least one network device (e.g., base station). *Hong*, [30], [32], [33], [43]-[45]; *Hong Priority*, [0005]-[0007]; ’535 patent, 3:37-4:30. *Hong* is also directed to the same problem as the ’535 patent, for example, resolving channel access failure (e.g., LBT failure). *Hong*, [166]-[200]; *Hong Priority*, [062]-[0100]; ’535 patent, 1:17-21, 6:30-11:59.

C. *TS-38.321*

144. 3GPP TS 38.321 v15.3.0, entitled “Technical Specification Group Radio Access Network; NR; Medium Access Control (MAC) protocol specification (Release 15)” (“*TS-38.321*”; Ex. 1007). I understand that *TS-38.321* was made publicly available not later than September 25, 2018, on 3GPP’s ftp server where it was accessible and known to be found by POSITAs. Ex. 1012,

Rodermund Declaration, ¶¶72-81. I have been instructed that this makes *TS-38.321* prior art to the '535 patent.

145. *TS-38.321* is analogous art to the '535 patent because *TS-38.321*, like the '535 patent, is directed to a communication system with at least one terminal device (e.g., user equipment) that communicates with at least one network device (e.g., base station). *TS-38.321*, 6-9, 43-44; '535 patent, 3:37-4:30. *TS-38.321* is also directed to a 5G/NR system, which the '535 patent contemplates as well. *TS-38.321*, 1, 7; '535 patent, 1:17-47. *TS-38.321* is directed to the same problem as the '535 patent, for example, taking action in response to some failure event (e.g., resetting a MAC entity). *TS-38.321*, 43-44, 47-48; '535 patent, 1:17-21, 6:30-11:59.

D. *Alfarhan*

146. International Patent Application Publication No. WO 2019/245779 to Alfarhan ("*Alfarhan*"; Ex. 1008) was filed June 10, 2019, and published December 26, 2019. *Alfarhan* claims priority to U.S. Provisional Application No. 62/735,446 (Ex. 1009; "*Alfarhan Provisional*"), filed September 24, 2018. Throughout this declaration, I cite to both *Alfarhan* and the *Alfarhan Provisional* to show the correspondence. I have been instructed that this makes *Alfarhan* prior art to the '535 patent.

147. I was asked to compare *Alfarhan*'s claim 1 to the disclosures of the *Alfarhan Provisional* to determine whether the limitations of *Alfarhan*'s claim 1 are supported by the *Alfarhan Provisional*. It is my opinion that they are. In the chart below, I compare *Alfarhan* claim 1 to the prior disclosures in the *Alfarhan Provisional*'s disclosures filed September 24, 2018.

<i>Alfarhan</i> Claim 1	<i>Alfarhan Provisional</i> Support
1. A method implemented by a wireless transmit/receive unit (WTRU) using a channel, the method comprising:	"A method implemented by a wireless transmit/receive unit (WTRU) using an unlicensed frequency uplink channel, the method comprising:" <i>Alfarhan Provisional</i> , claim 37.
receiving, by the WTRU in a downlink message, a channel transmission trigger (CTT);	"receiving, by the WTRU in a downlink message, uplink channel transmission trigger (UCTT) information;" <i>Alfarhan Provisional</i> , claim 37.
selecting, by the WTRU, a type of a Listen Before Talk (LBT) configuration to be performed based on the received CTT;	"selecting, by the WTRU, a type of a Listen Before Talk (LBT) configuration to be performed based on the received UCTT information;" <i>Alfarhan Provisional</i> , claim 37.
determining, by the WTRU in accordance with the type of LBT configuration selected, whether the	"determining, by the WTRU in accordance with the selected LBT configuration, whether the unlicensed frequency uplink channel is available

<i>Alfarhan Claim 1</i>	<i>Alfarhan Provisional Support</i>
channel is available for transmission; and	for transmission;” <i>Alfarhan Provisional</i> , claim 37.
transmitting data or control information on the channel, on condition that the channel is available for transmission.	“transmitting data or control information over the unlicensed frequency uplink channel, on condition that the unlicensed frequency uplink channel is available for transmission in accordance with the selected LBT configuration.” <i>Alfarhan Provisional</i> , claim 37.

148. *Alfarhan* is analogous art to the ’535 patent because *Alfarhan*, like the ’535 patent, is directed to a communication system with at least one terminal device (e.g., user equipment) that communicates with at least one network device (e.g., base station). *Alfarhan*, [0006]-[0010]; *Alfarhan Provisional*, [0004]-[0008]; ’535 patent, 3:37-4:30. *Alfarhan* is also directed to the same problem as the ’535 patent, for example, resolving channel access failure (e.g., LBT failure). *Alfarhan*, [0161]-[0168]; *Alfarhan Provisional*, [0154]-[0161]; ’535 patent, 1:17-21, 6:30-11:59.

E. Terry

149. International Patent Application Publication No. WO 2020/069114 to Terry (“*Terry*”; Ex. 1022) was filed September 26, 2019, and published April 2,

2020. *Terry* claims priority to U.S. Provisional Application No. 62/753,579 (Ex. 1023; “*Terry Provisional*”), filed October 31, 2018. Throughout this declaration, I cite to both *Terry* and the *Terry Provisional* to show the correspondence. I have been instructed that this makes *Terry* prior art to the ’535 patent.

150. I was asked to compare *Terry*’s claim 1 to the disclosures of the *Terry Provisional* to determine whether the limitations of *Terry*’s claim 1 are supported by the *Terry Provisional*. It is my opinion that they are. In the chart below, I compare *Terry* claim 1 to the prior disclosures in the *Terry Provisional*’s disclosures filed October 31, 2018.

<i>Terry Claim 1</i>	<i>Terry Provisional Support</i>
1. An apparatus comprising a processor; and a memory coupled with the processor, the memory storing executable instructions that when executed by the processor cause the processor to effectuate operations comprising:	“A device comprising: a processor; and a memory coupled with the processor, the memory comprising executable instructions stored thereon that when executed by the processor cause the processor to effectuate operations comprising:” <i>Terry Provisional</i> , claim 1.
obtaining downlink information, wherein the downlink information is detected by a base station, wherein the downlink information is associated with channel access of the base station	“With respect to the effect on MAC procedures LBT failures are considered in the UL or in the DL. Depending on the MAC procedure, and specific actions within the procedure, both UL and DL LBT failures maybe

<i>Terry Claim 1</i>	<i>Terry Provisional Support</i>
and comprises an indication of downlink listen-before-talk failure;	considered, or only UL or only DL LBT failures may be considered. Additionally, how LBT indications are provided to the MAC and what information is provided may be different for the UL and DL.” <i>Terry Provisional</i>, [0049]. “For DL LBT operation the NB can signal to the UE DL LBT success or failures. The DL LBT success or failure indication may be associated with an DL transmission or the DL LBT procedure may be performed independently of an DL transmission. Each DL LBT success or failure indication may be associated with one or more MAC procedures.” <i>Terry Provisional</i>, [0051].
obtaining uplink information, wherein the uplink information is detected by the apparatus, wherein the uplink information is associated with channel access of the apparatus and comprises an indication of uplink listen-before-talk failure; and	“With respect to the effect on MAC procedures LBT failures are considered in the UL or in the DL. Depending on the MAC procedure, and specific actions within the procedure, both UL and DL LBT failures maybe considered, or only UL or only DL LBT failures may be considered. Additionally, how LBT indications are provided to the MAC and what information is provided may be different for the UL and DL.” <i>Terry Provisional</i>, [0049]. “For UL LBT operation the PHY layer may indicate to the MAC, LBT success

<i>Terry Claim 1</i>	<i>Terry Provisional Support</i>
	or failure. The UL LBT success or failure indication may be associated with an UL transmission or the UL LBT procedure may be performed independently of an UL transmission. Each UL LBT success or failure indication may be associated with one or more MAC procedures.” <i>Terry Provisional</i>, [0050].
based on the indication of uplink listen-before-talk failure or the indication of downlink listen-before-talk failure, executing medium access control operations.	“With respect to the effect on MAC procedures LBT failures are considered in the UL or in the DL. Depending on the MAC procedure, and specific actions within the procedure, both UL and DL LBT failures maybe considered, or only UL or only DL LBT failures may be considered. Additionally, how LBT indications are provided to the MAC and what information is provided may be different for the UL and DL.” <i>Terry Provisional</i>, [0049]. “Uplink LBT success or failure indications may also provide timing information identifying periods when transmissions can and cannot be made in order for MAC procedures to be able to able to determine transmission opportunities accurately. To accomplish this, it is proposed in addition to, or included with the LBT success or failure indication, the period of Clear Channel Assessment (CCA), the selected Maximum Channel Occupancy Time (MCOT), the selected

<i>Terry Claim 1</i>	<i>Terry Provisional Support</i>
	Contention Window Size (CWS), and/or other timing information is provided to the MAC to allow for proper determination of uplink transmission opportunities. The MCOT, CWS and other may be identified by the Channel Access Priority Class (CAPC) or another index representing the selected timing.” <i>Terry Provisional</i>, [0071]. “MAC procedures may also have timers that may be used to control the frequency the procedure is performed. These timers may be known as prohibit timers. When some MAC procedures are performed prohibit timers set the earliest time the procedure is allowed to be performed again. MAC procedures currently set these timers when the procedure is performed. Multiple methods or systems may be used to address this, such as 1) Prohibit timers may be no longer set when the procedures are performed and may be now set or not depending on LBT success or failure. Only upon LBT Success for the transmission associated with the MAC procedure should prohibit timers be set. The LBT procedure may take some time to succeed. In this case starting of the prohibit timer may be delayed relative to when the MAC procedure was performed. This is necessary to ensure the frequency the MAC procedure is performed is properly restricted; or 2)

<i>Terry Claim 1</i>	<i>Terry Provisional Support</i>
	Prohibit timers which may be set upon performing the MAC procedure are cleared if an LBT Failure indication is received for the transmission associated with the MAC procedure. If the LBT procedure results in a delayed transmission the prohibit timer may be extended to take the time from when the MAC procedure was performed to the time when LBT success was determined into account.” <i>Terry Provisional</i>, [0084]. “Several MAC procedures take actions when downlink assignments or uplink grants may not be received within a configured monitoring time period. We disclose LBT Failures or LBT Successes may be taken into account in MAC procedure criteria for not receiving downlink assignments and uplink grants. In addition to uplink and/or downlink LBT success, failure, indications further LBT procedure information may be provided to MAC procedures. In addition to, or included with the LBT success or failure indication, the period of Clear Channel Assessment (CCA), the selected Maximum Channel Occupancy Time (MCOT), the selected Contention Window Size (CWS), and other timing information is provided to the MAC to allow for proper determination of downlink and uplink transmission opportunities. The MCOT, CWS and

<i>Terry Claim 1</i>	<i>Terry Provisional Support</i>
	other may be identified by the Channel Access Priority Class (CAPC) or another index representing the selected timing..” <i>Terry Provisional</i> , [0086].

151. *Terry* is analogous art to the ’535 patent because *Terry*, like the ’535 patent, is directed to a communication system with at least one terminal device (e.g., user equipment) that communicates with at least one network device (e.g., base station). *Terry*, [00249]-[00250]; *Terry Provisional*, [00246]-[00247]; ’535 patent, 3:37-4:30. *Terry* is also directed to the same problem as the ’535 patent, for example, resolving channel access failure (e.g., LBT failure). *Terry*, [0050]-[0060]; *Terry Provisional*, [0047]-[0057]; ’535 patent, 1:17-21, 6:30-11:59.

XI. GROUNDS OF UNPATENTABILITY

152. Based on my review of the materials set forth above, including my application of the knowledge of a person of ordinary skill in the art, it is my opinion that claims 1-20 of the ’535 patent would have been obvious to one of ordinary skill in the art.

153. In particular, it is my opinion that claims 1-20 of the ’535 patent would have been obvious to a person of ordinary skill in the art based on the Grounds and respective combinations shown below:

Ground	Challenged Claims	Basis	Prior Art
1	1, 3, 4, 7, 8, 10, 12, 13, 16, 17, 19, and 20	Obviousness	<i>Shi</i> and <i>TS-38.321</i>
2	1-8, 10-17, 19, and 20	Obviousness	<i>Shi</i> , <i>Hong</i> , and <i>TS-38.321</i>
3	2, 3, 11, and 12	Obviousness	<i>Shi</i> , <i>TS-38.321</i> , and <i>Terry</i>
4	9 and 18	Obviousness	<i>Shi</i> , <i>Hong</i> , <i>TS-38.321</i> , and <i>Alfarhan</i>

XII. THE CHALLENGED CLAIMS ARE OBVIOUS OVER THE PRIOR ART

154. In my opinion claims 1-20 would have been rendered obvious to one skilled in the art based on the prior art at the earliest priority date of the '535 patent.

A. Ground 1: Claims 1, 3, 4, 7, 8, 10, 12, 13, 16, 17, 19, and 20 Are Obvious over *Shi* in view of *TS-38.321*

155. In my opinion, *Shi* in view of *TS-38.321* renders obvious claims 1, 3, 4, 7, 8, 10, 12, 13, 16, 17, 19, and 20.

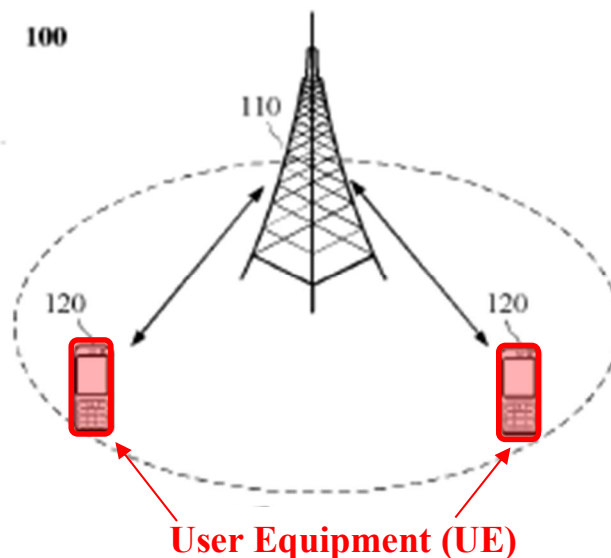
1. Independent Claim 1

156. A POSITA would have understood that *Shi* in view of *TS-38.321* renders obvious claim 1.

a. [1pre]: “A user equipment (UE) comprising:”

157. A POSITA would have recognized that *Shi* discloses a user equipment (UE).

158. For example, as shown in FIG. 1 below, *Shi* discloses a “communication system 100” comprising “a network device 110” and “at least one terminal device 120 located within the coverage area of the network device 110.” *Shi*, 2:37-3:29.⁴



Shi, FIG. 1 (annotated).

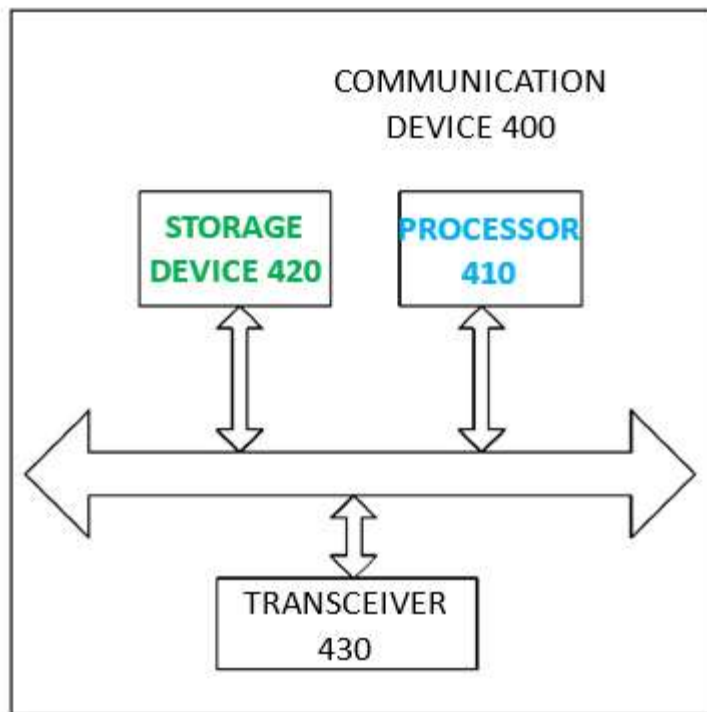
⁴ All emphasis is added unless noted otherwise. Also, all figures in this petition containing color are annotated relative to the original figures in the patent or prior art and all text in color is added.

159. According to *Shi*, the “**terminal device** may refer to an access terminal, **user equipment** (terminal equipment), user unit, user station, mobile station, mobile platform, remote station, remote terminal, mobile device, user terminal, terminal, wireless communication device, user agent, or user apparatus.” *Shi*, 3:21-24. The “access terminal may be a cellular telephone, a cordless telephone, a Session Initiation Protocol (SIP) telephone, a Wireless Local Loop (WLL) station, a Personal Digital Assistant (PDA), a handheld device having a wireless communication function, a computing device or other processing device connected to a wireless modem, a vehicle-mounted device, a wearable device, a terminal device in a 5G network, or a terminal device in a future evolved PLMN, etc.” *Shi*, 3:24-29.

- b. **[1a]: “one or more non-transitory computer-readable media having computer-executable instructions embodied thereon; and at least one processor coupled to the one or more non-transitory computer-readable media, the at least one processor is configured to execute the computer-executable instructions to:”**

160. A POSITA would have recognized that *Shi* discloses one or more non-transitory computer-readable media having computer-executable instructions embodied thereon, and at least one processor coupled to the one or more non-transitory computer-readable media, the at least one processor being configured to execute the computer-executable instructions to perform limitations [1b]-[1e].

161. For example, *Shi* discloses that the terminal device (UE) comprises “a **processor** and a **storage device**,” in which the “**storage device** is used for storing a computer program, and the **processor** is used for invoking and running the computer program stored in the storage device” for executing various implementations of methods described in *Shi*. *Shi*, 1:28-31. As shown below, FIG. 4 illustrates an exemplary terminal device (communication device 400) that includes a **processor** 410 coupled to a **storage device** 420. *Shi*, 13:14-38; *see also Shi*, 16:25-34.



Shi, FIG. 4 (annotated).

162. In my opinion, a POSITA would have understood that *Shi*’s **storage device** is a non-transitory computer readable medium. For example, *Shi* explains

that the **storage device** “may be volatile memory or non-volatile memory, or may comprise both volatile and non-volatile memory,” such as, for example, a “Read-Only Memory (ROM)” or a “Random-Access Memory (RAM).” *Shi*, 14:39-15:15. Further, a POSITA would have understood that *Shi*’s **processor** is coupled to the **storage device** because *Shi* discloses that “the **processor 410** can invoke and run a computer program from the **storage device** to implement the method of embodiments of the present application” in the **storage device** 420. *Shi*, 13:14-23; *see also Shi*, FIG. 4. A POSITA would have also understood that *Shi*’s **processor** is configured to execute computer-executable instructions because it is used to run computer programs “for causing a computer device (which may be a personal computer, server, or network device, etc.) to execute all or some of the steps of the method described by each of the embodiments of [*Shi*].” *Shi*, 16:25-34.

- c. **[1b]: “receive, by a Medium Access Control (MAC) entity of the UE, a Listen-Before-Talk (LBT) failure indication from a lower layer of the UE for all uplink (UL) transmissions;”**

163. A POSITA would have recognized that *Shi* discloses receiving, by a Medium Access Control (MAC) entity of the UE, a Listen-Before-Talk (LBT) failure indication from a lower layer of the UE for all uplink (UL) transmissions.

164. For example, *Shi* discloses “a counting method applicable to a terminal device” (e.g., UE). *Shi*, 4:16-22; *see also Shi*, 8:40-45 (providing a terminal device (e.g., UE) for executing the counting method). According to *Shi*,

“in the event of an LBT failure, the first indication information sent by a physical layer (PHY) can be received, **the first indication information being used for indicating LBT failure.**” *Shi*, 4:26-28; *see also Shi*, 6:34-43, 8:49-9:1. *Shi* further discloses that “the **first indication information sent via the physical layer** may also be information received from the network side and **transmitted to the MAC layer** or RRC layer via the physical layer, after which the RRC layer or MAC layer maintains the global counter and/or at least one counter for at least one uplink transmission.” *Shi*, 4:32-35; *see also Shi*, 9:5-9. Thus, *Shi* discloses that first indication information indicating LBT failure is transmitted from a physical layer to a MAC layer, where the MAC layer maintains a global counter for uplink transmission.

165. A POSITA would have understood that *Shi*’s physical layer is a “lower layer” because the ’535 patent specifically provides a physical layer as an example of a lower layer relative to the MAC layer. *See e.g.*, ’535 patent, 6:1-29. Further, it was well known that the physical layer is the lowest layer in the protocol stack. Ex. 1013, 16-17. *See also* Section VI.C.1 above. A POSITA would have also understood that *Shi*’s MAC layer includes at least one MAC entity. Ex. 1007, 9-10. Therefore, *Shi*’s disclosure of the MAC layer receiving the indication of LBT failure means that at least one MAC entity of the UE receives the indication of LBT failure.

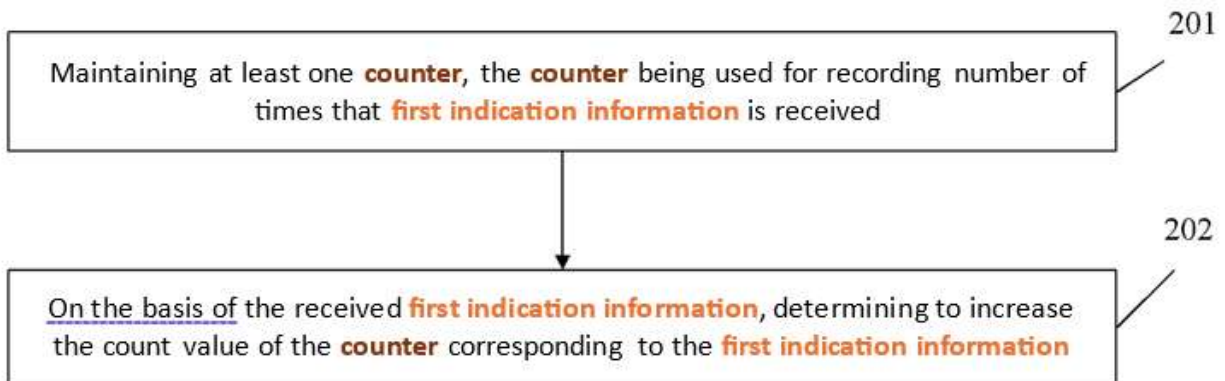
166. A POSITA would have further understood that *Shi*'s LBT failure indication is for "all uplink (UL) transmissions" because *Shi* discloses a "global counter." Specifically, *Shi* explains that the first indication information includes "the count value of the global counter," which "will be increased **regardless of which type of uplink transmission** fails." *Shi*, 5:6-8; *see also Shi*, 9:28-30. This is in contrast to another embodiment in *Shi*, where there is "at least one counter for at least one uplink transmission," meaning that "a corresponding counter may be maintained for each uplink transmission, or a counter may be maintained for a first portion of the uplink transmissions and another counter maintained for the remainder of the uplink transmissions." *Shi*, 6:8-14; *see also Shi*, 10:31-37.

d. [1c]: "increase an LBT failure counter when the MAC entity receives the LBT failure indication;"

167. A POSITA would have recognized that *Shi* discloses increasing an LBT failure counter when the MAC entity receives the LBT failure indication.

168. For example, as discussed for limitation [1b], *Shi* discloses that the MAC layer (at least one MAC entity) receives the **LBT failure indication**. *See* Section XII.A.1.c. *Shi* further discloses that "the **global counter** may be maintained at the MAC layer of the terminal device." *Shi*, 6:3-5; *see also Shi*, 4:32-35, 8:21-23, 9:5-9. As shown in FIG. 2, *Shi* discloses that, when the first indication information (LBT failure indication) is received, it is determined "to **increase the**

count value of the **counter**.” *Shi*, 4:41-43 *see also Shi*, 5:2-5, 6:34-43, 9:15-17, 9:26-27.



Shi, FIG. 2.

- e. [1d]: “determine that an LBT failure event has occurred when the LBT failure counter is greater than or equal to a threshold; and”

169. A POSITA would have recognized that *Shi* discloses determining that an LBT failure event has occurred when the LBT failure counter is greater than or equal to a threshold.

170. For example, *Shi* discloses “configuring at least one **threshold value** for the at least one counter for at least one uplink transmission.” *Shi*, 7:27-28. The preset threshold value “may be a threshold value that is set according to actual conditions; for example, it may be set to 10; of course, it may also be set to other values.” *Shi*, 5:41-43; *see also Shi*, 8:4-6, 10:15-17.

171. *Shi* further discloses that, “when the global counter reaches a preset threshold value, the Radio Resource Control (RRC) layer triggers one of the

following processes: RRC connection re-establishment; Secondary Cell Group (SCG)–Radio Link Failure (RLF) processing; and RRC reconfiguration.” *Shi*, 5:31-34. Similarly, *Shi* discloses that one or more of the following actions are taken when the count value exceeds a threshold value:

- notifying the RRC layer to trigger RRC re-establishment;
- notifying the RRC layer to trigger RRC reconfiguration;
- notifying the RRC layer to release all configured PUCCH resources;
- notifying the RRC layer to release all SRSes;
- clearing all configured downlink scheduling resources and uplink grant resources;
- initiating an RACH process;
- notifying the network side of the number of LBT failures; and
- notifying the network side of an event that triggers LBT.

Shi, 7:29-39.

172. A POSITA would have understood that *Shi*’s UE determines that an LBT failure event has occurred when the LBT failure counter is greater than or equal to a threshold. For example, each of the actions triggered in response to exceeding the LBT-relevant threshold value (e.g., RRC re-establishment, RRC reconfiguration, Secondary Cell Group (SCG)–Radio Link Failure (RLF) processing) indicates that an LBT failure event has occurred, and some action is

being taken to recover from that failure. Thus, a POSITA would have understood that the UE determines an LBT failure event before triggering the subsequent recovery procedure.

- f. **[1e]: “reset the LBT failure counter when a reset of the MAC entity is requested by an upper layer of the UE.”**

173. A POSITA would have recognized that *Shi* in combination with *TS-38.321* renders obvious resetting the LBT failure counter when a reset of the MAC entity is requested by an upper layer of the UE.

174. For example, as discussed for limitations [1c] and [1d], *Shi* discloses a global counter for counting the number of LBT failures and triggering a recovery procedure in response to the counter being greater than or equal to a threshold value. *See* Sections XII.A.1.d, XII.A.1.e above. *Shi* further discloses one of the following recovery procedures is triggered by the RRC layer: “RRC connection re-establishment; Secondary Cell Group (SCG)–Radio Link Failure (RLF) processing; and RRC reconfiguration.” *Shi*, 5:31-34.

175. *Shi* discloses that the SCG-RLF processing includes, among other things, “reset[ting] the SCG Media Access Control (MAC) address entity.” *Shi*, 5:37-40.

176. A POSITA would have understood that *Shi*’s RRC layer is an “upper layer” because the ’535 patent specifically provides an RRC layer as an example of

an upper layer relative to the MAC layer. *See e.g.*, '535 patent, 7:32-34. Further, it was well known that the RRC layer is above the MAC layer in the protocol stack. Ex. 1013, 16-17. *See also* Section VI.C.1 above. *Shi* therefore discloses resetting a MAC entity (SCG MAC address entity) in response to a request from an upper layer (RRC layer) of the UE.

177. In my opinion, a POSITA would have found it obvious that *Shi*'s resetting of the MAC entity would include resetting the global counter (LBT failure counter) because, as discussed for limitation [1c], the global counter is maintained at the MAC layer. *See* Section XII.A.1.d above. It was well known to a POSITA that resetting a MAC entity includes, for example, resetting counters associated with the MAC entity. Ex. 1007 (*TS-38.321*), 43-44; Ex. 1016, [0009], [0051], [0073], [0078], [0083]); Rodermund Declaration, ¶¶72-81. For example, *TS-38.321* discloses that, "[i]f a reset of the MAC entity is requested by upper layers, the MAC entity shall," among other things, "reset *BFI_COUNTER*." *TS-38.321*, 43-44. Similar to the LBT failure counter, a "*BFI_COUNTER*" counts the number of beam failure instance indications and triggers a recovery procedure when the counter reaches a threshold value. *TS-38.321*, 47-48.

178. A POSITA would have been motivated to incorporate *TS-38.321*'s teachings of resetting a failure counter when resetting a MAC entity into *Shi*'s method. Both *Shi* and *TS-38.321* disclose wireless communication systems where a

reset of the MAC entity is requested by an upper layer. *See e.g., Shi*, 5:31-40; *TS-38.321*, 43-44. And *TS-38.321* further discloses that a failure counter is reset in response to resetting the MAC entity. *TS-38.321*, 43-44.

179. A POSITA would therefore have found it obvious to combine *Shi* and *TS-38.321* by implementing *TS-38.321*'s teachings of resetting a failure counter when resetting a MAC entity into *Shi*'s method, because this was a well-known, conventional procedure, as taught by *TS-38.321*. A POSITA would have understood that *TS-38.321*'s disclosure simply provides additional details and explanation about the details of *Shi*'s reset of a MAC entity, and, thus, would have found it obvious to look to the conventional procedure described in *TS-38.321* to understand and implement the details not expressly described in *Shi*'s method.

180. A POSITA would have been motivated to implement *TS-38.321*'s teachings of resetting a failure counter when resetting a MAC entity into *Shi*'s method because the purpose of resetting the MAC entity is to reset it to its default configurations. For example, resetting the MAC entity involves clearing any data or recorded values and restarting any timers or counters. A POSITA would have understood that, if the upper layer requests that the MAC entity be reset, then all of the configurations associated with the MAC entity would be reset, and not just some configurations, in order to improve the chances of resolving the issue that is causing the need to reset the MAC entity (e.g., LBT failure).

181. A POSITA would have been motivated to reset the LBT failure counter in particular because, with the MAC entity being reset, it also would make sense to restart the LBT failure counter, as the UE attempts to retry the LBT process. Accordingly, it would not make sense to use the existing LBT failure counter, after an LBT failure event has already occurred. For example, if the threshold was set to 10, an LBT failure count of 10 would trigger an LBT failure event, which would lead to resetting the MAC entity. Then, after the MAC has been reset, if there is another LBT failure indication, the counter would increase to 11, which would again detect an LBT failure event, even though it was the first LBT attempt after the MAC was reset. A POSITA therefore would have been motivated to reset the LBT failure counter when the MAC entity has been reset to clear the count and start the counting from the beginning. As discussed above, this would avoid premature detection of an LBT failure event after the MAC entity is reset.

182. A POSITA would have had a reasonable expectation of success as it would have been straightforward for a POSITA to implement *TS-38.321*'s teachings of resetting a failure counter when resetting a MAC entity in *Shi*'s method. In fact, *Shi* already teaches how to reset the LBT failure counter under certain circumstances. *Shi*, 5:29-30 ("when the count value of the global counter has not changed for a very long period of time, it is possible to restart the counting

of the global counter.). Thus, it would simply be a matter of changing the condition or adding another condition upon which *Shi*'s method resets the LBT failure counter. Further, as mentioned above, *Shi* and *TS-38.321* include similar components that perform similar functions. *TS-38.321* simply provides additional details and explanation about how *Shi*'s MAC reset occurs. Thus, it would have been straightforward to implement *TS-38.321*'s teachings of resetting a failure counter when resetting a MAC entity into *Shi*'s method.

183. Therefore, in my opinion, *Shi* and *TS-38.321* render obvious this limitation [1e].

2. Claim 3

- a. **“The UE of claim 1, wherein the at least one processor is further configured to execute the computer-executable instructions to: indicate, by the MAC entity of the UE, to the upper layer of the UE an LBT failure problem after determining that the LBT failure event has occurred.”**

184. A POSITA would have recognized that *Shi* discloses or renders obvious indicating, by the MAC entity of the UE, to the upper layer of the UE an LBT failure problem after determining that the LBT failure event has occurred.

185. For example, as explained for limitation [1d], *Shi* discloses determining that an LBT failure event has occurred when the LBT failure counter is greater than or equal to a threshold. *See* Section XII.A.1.e above. *Shi* also discloses “notifying the RRC layer” to trigger one or more actions in response to

the counter being greater than or equal to the threshold value. *Shi*, 7:29-34. As discussed for limitation [1e], a POSITA would have understood that *Shi*'s RRC layer is an "upper layer of the UE" because (a) the RRC was well known to be an "upper layer" (see, for example, the '535 patent which provides a RRC layer as an example of an upper layer relative to the MAC layer, '535 patent, 7:32-34; see Section XII.A.1.f above; Section VI.C.1), and (b) *Shi* explains that the RRC layer is notified "to **trigger** RRC re-establishment" or, among other possibilities, "to **trigger** RRC reconfiguration" (*Shi*, 7:29-34). Triggering an RRC reestablishment or an RRC reconfiguration is performed by the RRC (i.e., "upper layer") of the UE, as I also explained in Section VI.C.1.

186. Further, as discussed for limitation [1b], *Shi*'s LBT failure counter is maintained at the MAC layer. Thus, a POSITA would have understood that a MAC entity in the MAC layer indicates to ("notif[ies]") the RRC layer the LBT failure problem after the MAC entity determines that the LBT failure event has occurred.

187. To the extent it is argued that *Shi* does not disclose this limitation, in my opinion, it would have been obvious in view of *Shi*. For example, because *Shi*'s MAC layer maintains the counter to determine when there has been an LBT failure event, and because its RRC layer triggers the recovery procedure, it would have been obvious for the MAC layer to indicate that there is an LBT failure problem to the RRC layer, so that the RRC layer can promptly trigger the recovery procedure.

Indeed, a POSITA would have recognized that it would be most efficient for the MAC layer to communicate the LBT failure problem to the RRC layer as it is the RRC layer that is responsible for taking appropriate corrective action(s), as I discussed above. Thus, a POSITA would have been motivated to modify *Shi*'s MAC layer to indicate whether there is an LBT failure problem to the RRC layer, to the extent it is not disclosed already.

188. A POSITA would have had a reasonable expectation of success as it would have been straightforward for a POSITA to modify *Shi*'s MAC layer to indicate whether there is an LBT failure problem to its RRC layer, to the extent it is not disclosed already. Because *Shi*'s MAC layer and RRC layer are already in communication (*Shi*, 5:35-37; Ex. 1013, 16–17), it would have been a straightforward modification for the MAC layer to indicate to the RRC layer that there is an LBT failure problem, thus allowing the RRC layer to engage in whatever corrective action is deemed appropriate.

3. Claim 4

- a. **“The UE of claim 3, wherein the at least one processor is further configured to execute the computer-executable instructions to: perform a Radio Link Failure (RLF) recovery procedure.”**

189. A POSITA would have recognized that *Shi* discloses performing a Radio Link Failure (RLF) recovery procedure.

190. For example, *Shi* discloses that “when the global counter reaches a preset threshold value, the Radio Resource Control (RRC) layer triggers one of the following processes: RRC connection re-establishment; **Secondary Cell Group (SCG)–Radio Link Failure (RLF) processing**; and RRC reconfiguration.” *Shi*, 5:31-34. As discussed for limitation [1e], *Shi*’s SCG-RLF processing is a “Radio Link Failure (RLF) recovery procedure.” *See* Section XII.A.1.f above. The ’535 patent confirms my understanding because it specifically provides an SCG RLF recovery procedure as an example of an RLF recovery procedure. *See e.g.*, ’535 patent, 10:11-16.

4. Claim 7

- a. **“The UE of claim 1, wherein the at least one processor is further configured to execute the computer-executable instructions to: receive a configuration that indicates the threshold.”**

191. A POSITA would have recognized that *Shi* discloses receiving a configuration that indicates the threshold.

192. For example, *Shi* discloses “configuring at least one **threshold value** for the at least one counter for at least one uplink transmission.” *Shi*, 7:27-28. The preset threshold value “may be a threshold value that is set according to actual conditions; for example, it may be set to 10; of course, it may also be set to other values.” *Shi*, 5:41-43; *see also Shi*, 8:4-6, 10:15-17, 12:22-24. Thus, a POSITA

would have understood that *Shi*'s UE receives a configuration that indicates the threshold value.

5. Claim 8

- a. **“The UE of claim 1, wherein the at least one processor is further configured to execute the computer-executable instructions to: reset the LBT failure counter when the threshold is reconfigured.”**

193. A POSITA would have recognized that *Shi* and *TS-38.321* render obvious resetting the LBT failure counter when the threshold is reconfigured.

194. For example, as discussed for limitation [1e], *Shi* discloses resetting the LBT failure counter in certain circumstances. *Shi*, 5:28-30; *see also Shi*, 10:2-4, 12:1-3, 17:32-34, 19:4-5. Also, as discussed for claim 7, *Shi* discloses configuring a threshold for the LBT failure counter. *Shi*, 5:41-43, 7:27-28; 8:4-6, 10:15-17, 12:22-24.

195. The '535 patent states that “the UE may reset the LBT failure counter when at least one of the time period and the threshold is reconfigured (e.g., when the UE receives an RRC reconfiguration message that changes at least one of the time period and the threshold).” '535 patent, 8:52-56. Similarly, *Shi* discloses that when the “global counter reaches a preset threshold value, the Radio Resource Control (RRC) layer triggers . . . RRC reconfiguration.” *Shi*, 5:31-34. *Shi* further discloses that “the RRC reconfiguration may be at least one of the following: reconfiguring the uplink BWP, or reconfiguring PRACH resources, reconfiguring

PUCCH resources, reconfiguring PUSCH resources, reconfiguring the uplink carrier, etc.” *Shi*, 5:35-37.

196. In my opinion, a POSITA would have found it obvious that the RRC reconfiguration also reconfigures the threshold value for the LBT failure counter. For example, *TS-38.321* discloses that “[w]hen a reconfiguration of the MAC entity is requested by upper layers [e.g., an RRC layer], the MAC entity shall: . . . **apply the new maximum parameter value when counters are initialized.**” *TS-38.321*, 43. A POSITA would have found it obvious that, when the threshold for LBT failure is reconfigured, the LBT failure counter should be reset as well. For example, if the threshold is reconfigured to be lower than the current LBT counter value, it would make sense to reset the LBT failure counter.

197. A POSITA would have been motivated to incorporate *TS-38.321*’s teachings of reconfiguring a counter threshold. *Shi* discloses a 5G system, which is also referred to as a New Radio (NR) system (*Shi*, 3:32-33) that uses a MAC protocol, and *TS-38.321* is a technical specification that specifies the NR MAC protocol (*TS-38.321*, 7). Thus, a POSITA would have been motivated to implement *TS-38.321*’s NR MAC protocol in *Shi*’s system with a reasonable expectation of success. Moreover, a POSITA would have been motivated to implement resetting the LBT counter when the threshold is reconfigured in *Shi*’s MAC protocol. For example, if the threshold is reconfigured to be smaller than the current LBT

counter value, it would make sense to reset the LBT failure counter. Otherwise, the reconfiguration of the threshold is meaningless as the threshold is already exceeded. Similarly, if the threshold is reconfigured to be larger than the current LBT counter value, continuing with the current value of the counter would not make sense either as that would not allow for the larger value of the threshold to be applicable. In other words, for example, if the threshold is reconfigured from being 8 to being 10 and the current value of the counter is 7, then, without resetting the counter, 3 more failures would result in the counter having the value $7+3 = 10$, i.e., “greater than or equal to” 10, as required by element [1d]. This would thus trigger a failure when in fact the objective was to change the triggering to occur after 10 failures, not merely 3. In short, it is common sense and would have been obvious to a POSITA to reset the counter when the threshold is reconfigured.

198. A POSITA would have had a reasonable expectation of success as it would have been straightforward for a POSITA to implement resetting a counter when the threshold is reconfigured in *Shi*’s method. In fact, *Shi* already teaches how to reset the LBT failure counter under certain circumstances. *Shi*, 5:29-30 (“when the count value of the counter has not changed for a very long period of time, it is possible to restart the counting of the counter.”). Thus, it would simply be a matter of changing the condition or adding another condition upon which *Shi*’s method resets the LBT failure counter. Thus, it would have been straightforward to

implement *TS-38.321*'s teachings and a POSITA's knowledge in *Shi*'s existing LBT method.

6. Independent Claim 10

- a. **[10pre]: “A method for Listen-Before-Talk (LBT) failure detection performed by a User Equipment (UE), the method comprising:”**

199. A POSITA would have recognized that *Shi* discloses a method for Listen-Before-Talk (LBT) failure detection performed by a User Equipment (UE) for the reasons discussed for [1pre]-[1e].

- b. **[10a]: “receiving, by a Medium Access Control (MAC) entity of the UE, a Listen-Before-Talk (LBT) failure indication from a lower layer of the UE for all uplink (UL) transmissions;”**

200. Element [10a] recites substantively the same limitations as element [1b], which *Shi* discloses for at least the reasons I discuss for element [1b].

- c. **[10b]: “increasing an LBT failure counter when the MAC entity receives the LBT failure indication;”**

201. Element [10b] recites substantively the same limitations as element [1c], which *Shi* discloses for at least the reasons I discuss for element [1c].

- d. **[10c]: “determining that an LBT failure event has occurred when the LBT failure counter is greater than or equal to a threshold; and”**

202. Element [10c] recites substantively the same limitations as element [1d], which *Shi* discloses for at least the reasons I discuss for element [1d].

- e. **[10d]: “resetting the LBT failure counter when a reset of the MAC entity is requested by an upper layer of the UE.”**

203. Element [10d] recites substantively the same limitations as element [1e], which *Shi* in combination with *TS-38.321* render obvious, for at least the reasons I discuss for element [1e].

7. Claim 12

- a. **“The method of claim 10, further comprising: indicating, by the MAC entity of the UE, to the upper layer of the UE an LBT failure problem after determining that the LBT failure event has occurred.”**

204. Claim 12 recites substantively the same additional limitations as claim 3, which *Shi* discloses or renders obvious for at least the reasons I discuss for claim 3.

8. Claim 13

- a. **“The method of claim 12, further comprising: performing a Radio Link Failure (RLF) recovery procedure.”**

205. Claim 13 recites substantively the same additional limitations as claim 4, which *Shi* discloses for at least the reasons I discuss for claim 4.

9. Claim 16

- a. **“The method of claim 10, further comprising: receiving a configuration that indicates the threshold.”**

206. Claim 16 recites substantively the same additional limitations as claim 7, which *Shi* discloses for at least the reasons I discuss for claim 7.

10. Claim 17

- a. **“The method of claim 10, further comprising: resetting the LBT failure counter when the threshold is reconfigured.”**

207. Claim 17 recites substantively the same additional limitations as claim 8, which *Shi* and *TS-38.321* render obvious for at least the reasons I discuss for claim 8.

11. Claim 19

- a. **“The user equipment (UE) of claim 1, wherein the at least one processor is further configured to execute the computer-executable instructions to: reset the LBT failure counter after the MAC entity has not received the LBT failure indication for a time period.”**

208. A POSITA would have recognized that *Shi* discloses resetting the LBT failure counter after the MAC entity has not received the LBT failure indication for a time period.

209. For example, *Shi* discloses that a global timer may be added, such that “it is possible to reset the global counter when the global timer times out.” *Shi*,

5:28. That is, “when the count value of the global counter has not changed for a very long period of time, it is possible to restart the counting of the global counter.” *Shi*, 5:29-30.

210. As discussed for limitation [1b], *Shi* discloses that first indication information indicating LBT failure is transmitted from a physical layer to a MAC layer, where the MAC layer maintains a global counter for uplink transmission. See Section XII.A.1.c above. Thus, a POSITA would have understood that *Shi*’s disclosure of the “global timer times out” and “the global counter has not changed for a very long period of time” to mean that the MAC entity within its MAC layer has not received the LBT failure indication for a time period.

12. Claim 20

- a. **“The method of claim 10, further comprising: resetting the LBT failure counter after the MAC entity has not received the LBT failure indication for a time period.”**

211. Claim 20 recites substantively the same additional limitations as claim 19, which *Shi* discloses for at least the reasons I discuss for claim 19.

B. Ground 2: Claims 1-8, 10-17, 19, and 20 Are Obvious over *Shi* in view of *Hong* and *TS-38.321*

212. In my opinion, *Shi* in view of *Hong* and *TS-38.321* renders obvious claims 1-8, 10-17, 19, and 20.

1. Independent Claim 1

213. As discussed above for Ground 1, *Shi* discloses limitations [1pre]-[1d]. See Section XII.A.1.a-e above. To the extent it is argued that *Shi* and *TS-38.321* do not render obvious limitation [1e], the combination of *Shi*, *Hong*, and *TS-38.321* renders it obvious. As discussed above, *Shi* discloses that one of the following recovery procedures is triggered by the RRC layer: “RRC connection re-establishment; Secondary Cell Group (SCG)–Radio Link Failure (RLF) processing; and RRC reconfiguration.” *Shi*, 5:31-34.

214. Like *Shi*, *Hong* discloses that a terminal (UE) manages a counter for counting the number of LBT failures and triggering a recovery procedure in response to the counter exceeding a threshold value. *Hong*, [177], [178], [187], [195]; *Hong Priority*, [0070]-[0074], [0087], [0095]. Also like *Shi*, *Hong* discloses that the UE can initiate an RRC connection reestablishment/resumption procedure in response to LBT failure. *Hong*, [195]; *Hong Priority*, [0095]. According to *Hong*, the RRC connection reestablishment/resumption procedure includes, among other things, “reset[ting] the MAC.” *Hong*, [195]; *Hong Priority*, [0095]. A POSITA would have understood that resetting the MAC means resetting the MAC layer, including each MAC entity in the MAC layer. *Hong* therefore discloses resetting a MAC entity in the MAC layer in response to a request from an upper layer (RRC layer) of the UE.

215. As discussed for Ground 1, a POSITA would have found it obvious that resetting a MAC entity of the MAC layer would include resetting the LBT failure counter when the counter is maintained at the MAC layer, as taught in *Shi*. *Shi*, 6:3-5; *see also Shi*, 4:32-35, 8:21-23, 9:5-9. Further, it was well known to a POSITA that resetting a MAC entity includes, for example, resetting counters associated with the MAC entity. Ex. 1007 (*TS-38.321*), 43-44; Ex. 1016, [0009], [0051], [0073], [0078], [0083]; Rodermund Declaration, ¶¶72-81. For example, *TS-38.321* discloses that, “[i]f a reset of the MAC entity is requested by upper layers, the MAC entity shall,” among other things, “reset *BFI_COUNTER*.” *TS-38.321*, 43-44. Similar to the LBT failure counter, a “*BFI_COUNTER*” counts the number of beam failure instance indications and triggers a recovery procedure when the counter reaches a threshold value. *TS-38.321*, 47-48.

216. A POSITA would have been motivated to implement *Hong*’s teachings of resetting the MAC layer entity as part of RRC connection re-establishment in *Shi*’s method. Both *Shi* and *Hong* disclose wireless communication systems that include LBT failure counters for counting the number of LBT failures and triggering an LBT failure recovery procedure when the LBT failure counter is greater than or equal to a threshold. *Shi*, 2:37-3:29, 4:26-35, 5:6-8, 5:31-40, 7:29-39; *Hong*, [177], [178], [187], [195]; *Hong Priority*, [0070]-[0074], [0087], [0095]. Both *Shi* and *Hong* also disclose that the UE can initiate an

RRC connection reestablishment procedure in response to LBT failure. *Shi*, 5:31-34; *Hong*, [195]; *Hong Priority*, [0095].

217. A POSITA would therefore have found it obvious to combine *Shi* and *Hong* by implementing *Hong*'s teachings of resetting the MAC layer entity as part of RRC connection re-establishment in *Shi*'s method, because this was a well-known, conventional procedure, as taught by *Hong*. A POSITA would have understood that *Hong*'s disclosure simply provides additional details and explanation about the details of *Shi*'s RRC connection re-establishment procedure, and, thus, would have found it obvious to look to the conventional procedure described in *Hong* to understand and implement the details not expressly described in *Shi*'s method.

218. A POSITA would have been motivated to implement *Hong*'s teachings of resetting the MAC layer entity as part of RRC connection re-establishment in *Shi*'s method because of the well-known benefits of resetting the MAC layer. As discussed above for Ground 1, resetting the MAC entity involves clearing any data or recorded values and restarting any timers or counters. A POSITA would have understood that, if the upper layer requests that the MAC entity be reset, then all of the configurations associated with the MAC entity would be reset, and not just some configurations, in order to improve the chances of resolving the issue that is causing the need to reset the MAC entity (e.g., LBT

failure). A POSITA therefore would have been motivated to reset the MAC layer entity as part of RRC connection re-establishment.

219. A POSITA would have had a reasonable expectation of success as it would have been straightforward for a POSITA to implement *Hong's* teachings of resetting the MAC layer entity in *Shi's* method. In fact, *Shi* already teaches how to reset a MAC entity as part of the SCG-RLF processing. *Shi*, 5:37-40. Thus, it would simply be a matter of applying these same techniques for the RRC connection re-establishment procedure. Further, as mentioned above, *Shi* and *Hong* include similar components that perform similar functions. Further, *Hong* simply provides additional details and explanation about how *Shi's* RRC connection re-establishment occurs. Thus, it would have been straightforward to implement *Hong's* teachings of resetting the MAC layer entity as part of RRC connection re-establishment in *Shi's* method.

220. Moreover, for at least the reasons discussed above for Ground 1, a POSITA would have further been motivated to incorporate *TS-38.321's* teachings of resetting a failure counter in response to resetting a MAC entity into *Shi/Hong's* method, and a POSITA would have had a reasonable expectation of success of doing so. *See* Section XII.A.1.f above.

221. Specifically, as discussed above, *Shi*, *Hong*, and *TS-38.321* each disclose wireless communication systems where a reset of the MAC entity is

requested by an upper layer. *See e.g., Shi*, 5:31-40; *Hong*, [195]; *Hong Priority*, [0095]; *TS-38.321*, 43-44. And *TS-38.321* further discloses that a failure counter is reset in response to resetting the MAC entity. *See TS-38.321*, 43-44.

222. A POSITA would therefore have found it obvious to combine *Shi*, *Hong*, and *TS-38.321* by implementing *TS-38.321*'s teachings of resetting a failure counter when resetting a MAC entity into *Shi/Hong*'s method, because this was a well-known, conventional procedure, as taught by *TS-38.321*. A POSITA would have understood that *TS-38.321*'s disclosure simply provides additional details and explanation about the details of *Shi/Hong*'s reset of a MAC entity, and, thus, would have found it obvious to look to the conventional procedure described in *TS-38.321* to understand and implement the details not expressly described in *Shi/Hong*'s method.

223. A POSITA would have been motivated to implement *TS-38.321*'s teachings of resetting a failure counter when resetting a MAC entity into *Shi/Hong*'s method because the purpose of resetting the MAC entity is to reset it to its default configurations. For example, resetting the MAC entity involves clearing any data or recorded values and restarting any timers or counters. A POSITA would have understood that, if the upper layer requests that the MAC entity be reset, then all of the configurations associated with the MAC entity would be reset,

and not just some configurations, in order to improve the chances of resolving the issue that is causing the need to reset the MAC entity (e.g., LBT failure).

224. A POSITA would have been motivated to reset the failure counter in particular because, with the MAC entity being reset, it also would make sense to restart the LBT failure counter, as the UE attempts to retry the LBT process. Accordingly, it would not make sense to use the existing LBT failure counter, after an LBT failure event has already occurred. For example, if the threshold was set to 10, an LBT failure count of 10 would trigger an LBT failure event, which would lead to resetting the MAC entity. Then, after the MAC has been reset, if there is another LBT failure indication, the counter would increase to 11, which would again detect LBT failure event, even though it was the first LBT attempt after the MAC was reset. A POSITA therefore would have been motivated to reset the LBT failure counter when the MAC entity has been reset to clear the count and start the counting from the beginning.

225. A POSITA would have had a reasonable expectation of success as it would have been straightforward for a POSITA to implement *TS-38.321*'s teachings of resetting a failure counter when resetting a MAC entity in *Shi/Hong*'s method. In fact, *Shi* already teaches how to reset the LBT failure counter under certain circumstances. *Shi*, 5:29-30 ("when the count value of the counter has not changed for a very long period of time, it is possible to restart the counting of the

counter.). Thus, it would simply be a matter of changing the condition or adding another condition upon which *Shi/Hong*'s method resets the LBT failure counter. Further, as mentioned above, *Shi, Hong*, and *TS-38.321* include similar components that perform similar functions. Further, *TS-38.321* simply provides additional details and explanation about how *Shi/Hong*'s MAC reset occurs. Thus, it would have been straightforward to implement *TS-38.321*'s teachings of resetting a failure counter when resetting a MAC entity into *Shi/Hong*'s method.

226. Thus, in my opinion, *Shi, Hong*, and *TS-38.321* render obvious this limitation [1e].

2. Claim 2

- a. **“The UE of claim 1, wherein the at least one processor is further configured to execute the computer-executable instructions to: switch an active Bandwidth Part (BWP) of the UE to another BWP after determining that the LBT failure event has occurred.”**

227. A POSITA would have recognized that *Shi* and/or *Hong* further render obvious switching an active Bandwidth Part (BWP) of the UE to another BWP after determining that the LBT failure event has occurred.

228. For example, as explained for limitation [1d], *Shi* discloses determining that an LBT failure event has occurred when the LBT failure counter is greater than or equal to a threshold. *See* Section XII.A.1.e. *Shi* also discloses “reconfiguring the uplink BWP” in response to the LBT failure event. *Shi*, 5:35-37.

As I explained in Section VI.C.2, Bandwidth Part (BWP) is a specific frequency band available to the service provider (e.g., AT&T or Verizon) that the provider can make available to a device to communicate on. Therefore, a POSITA would have understood that reconfiguring the BWP includes switching from a BWP that is not available (e.g., has had too many failed attempts) to another BWP in the expectation that it would be available, i.e., performing a reconfiguration of the BWP as *Shi* explains.

229. To the extent that it is argued that *Shi* does not explicitly disclose this limitation, *Shi* and *Hong* render it obvious. Specifically, *Hong* discloses that the base station can instruct the UE to “change the subband/**BWP**/cell/CC in which the channel access failure [i.e., LBT failure] was detected.” *Hong*, [199]; *Hong Priority*, [0098]. *Hong* therefore discloses switching an active BWP of the UE to another BWP after determining that the LBT failure event has occurred.

230. In my opinion, a POSITA would have found it obvious to combine *Shi* and *Hong* by adopting *Hong*’s teachings in *Shi*’s method because it was well known to switch BWPs in response to LBT failure detected at an active BWP, as taught by *Hong*. As discussed above for limitation [1e], both *Shi* and *Hong* disclose wireless communication systems that include LBT failure counters for counting the number of LBT failures and triggering an LBT failure recovery procedure when the LBT failure counter is greater than or equal to a threshold. *Shi*, 2:37-3:29, 4:26-

35, 5:6-8, 5:31-40, 7:29-39; *Hong*, [177], [178], [187], [195]; *Hong Priority*, [0070]-[0074], [0087], [0095]. Both *Shi* and *Hong* also disclose that the UE can initiate an RRC connection reestablishment procedure in response to LBT failure. *Shi*, 5:31-34; *Hong*, [195]; *Hong Priority*, [0095]. *Shi* also discloses “reconfiguring the uplink BWP” in response to the LBT failure event. *Shi*, 5:35-37. And *Hong* discloses changing an active BWP of the UE to another BWP in response to LBT failure at the active BWP. *Hong*, [199]; *Hong Priority*, [0098].

231. A POSITA would have been motivated to implement *Hong*’s teaching of switching BWPs in response to LBT failure in *Shi*’s method because doing so can help the UE to successfully engage in communication with a base station. For example, as *Hong* acknowledges, it is important to allocate to the terminal radio resources that have a higher probability of LBT success in a subsequent uplink data transmission or retransmission. *Hong*, [102]-[103]; *Hong Priority*, [0041]. That is, by switching from a BWP where LBT is known to have failed a number of times to a different BWP, the UE may improve its chances of successfully completing the LBT procedure, and thereby improve the efficiency of communication. To put it differently, the very reason that a base station may have allocated multiple BWP to a mobile station, as I discussed in Section VI.C.2 above, is to increase the likelihood (and capacity) of successful communication between the base station

and the UE. Thus, a POSITA would have been motivated to implement *Hong's* method because of the advantages provided by *Hong's* method.

232. A POSITA would have had a reasonable expectation of success as it would have been straightforward for a POSITA to implement *Hong's* teachings in *Shi's* method. As mentioned above, the availability and usage of multiple BWP was known to a POSITA. Furthermore, *Shi* and *Hong* include similar components that perform similar functions. *Shi's* UE is also already capable of reconfiguring BWPs. *Shi*, 5:35-37. Thus, it would simply be a matter of configuring *Shi's* method to allow the switching of the BWP as part of the reconfiguration of the BWPs, to the extent it is not already part of it. And therefore, to the extent *Shi* is not explicit enough, it would have been straightforward to implement *Hong's* teachings to *Shi's* existing method.

3. Claim 5

- a. **“The UE of claim 1, wherein the at least one processor is further configured to execute the computer-executable instructions to: perform a re-establishment procedure by transmitting a Radio Resource Control (RRC) re-establishment request message indicating a re-establishment cause as LBT failure, when the LBT failure event occurs in a Primary Cell (PCell).”**

233. A POSITA would have recognized that *Shi* and *Hong* further render obvious performing a re-establishment procedure by transmitting a Radio Resource

Control (RRC) re-establishment request message indicating a re-establishment cause as LBT failure, when the LBT failure event occurs in a Primary Cell (PCell).

234. For example, as discussed above for limitation [1e], *Shi* discloses one of the following recovery procedures is triggered by the RRC layer: “**RRC connection re-establishment**; Secondary Cell Group (SCG)–Radio Link Failure (RLF) processing; and RRC reconfiguration.” *Shi*, 5:31-34. *Shi* further discloses that, “when initiating **RRC connection re-establishment** and **initiating a connection re-establishment request** to the network side, the connection re-establishment request includes: the number of LBT failures, and/or an **event that triggers LBT**.” *Shi*, 5:44-46; *see also Shi*, 5:47-49.

235. To the extent it is argued that *Shi* does not disclose performing a re-establishment procedure “when the LBT failure event occurs in a Primary Cell (PCell),” a POSITA would understand that *Shi*’s disclosure that an “RRC connection re-establishment” applies to a PCell whenever, for example, there is no SCG and there is only one cell for the UE to use in communicating with the base station, and said one cell is, by definition, a Primary Cell (PCell).

236. To the extent that it is argued that *Shi* does not disclose or render obvious this limitation to a POSITA, *Shi* and *Hong* render it obvious. Specifically, *Hong* discloses that, **if a channel access failure (LBT failure) occurs in a PCell (Primary Cell)**, the terminal **transmits an RRC connection re-establishment**

request message to the base station, initiating an **RRC connection re-establishment procedure**. *Hong*, [135]; *Hong Priority*, [0096]; *see also Hong*, [149], [162], [183]; *Hong Priority*, [0099].

237. In my opinion, a POSITA would have found it obvious to combine *Shi* and *Hong* by adopting *Hong*'s re-establishment procedure triggered by an LBT failure in a PCell to *Shi*'s RRC connection re-establishment procedure. *Shi* contemplates a UE with dual connectivity with PCells and SCells based on its ability to trigger “**Secondary Cell Group (SCG)–Radio Link Failure (RLF)** processing.” *Shi*, 5:31-34. A POSITA would have understood that an LBT failure can take place in a PCell or an SCell.

238. A POSITA would have been motivated to implement *Hong*'s connection re-establishment procedure triggered by an LBT failure in a PCell to recover from an LBT failure in *Shi*'s method. Both *Shi* and *Hong* disclose wireless communication systems that include LBT failure counters for counting the number of LBT failures and triggering an LBT failure recovery procedure when the LBT failure counter is greater than or equal to a threshold. *Shi*, 2:37-3:29, 4:26-35, 5:6-8, 5:31-40, 7:29-39; *Hong*, [177], [178], [187], [195]; *Hong Priority*, [0070]-[0074], [0087], [0095]. Both *Shi* and *Hong* also disclose that the UE can initiate an RRC connection re-establishment procedure in response to LBT failure. *Shi*, 5:31-34; *Hong*, [195]; *Hong Priority*, [0095].

239. A POSITA would therefore have found it obvious to combine *Shi* and *Hong* by implementing *Hong*'s teachings of a connection re-establishment procedure triggered by an LBT failure in a PCell to recover from an LBT failure in *Shi*'s method, because this was a well-known, conventional procedure, as taught by *Hong*. A POSITA would have understood that *Hong*'s disclosure simply provides additional details and explanation about the details of *Shi*'s RRC connection re-establishment procedure, and thus would have found it obvious to look to the conventional procedure described in *Hong* to understand and implement the details not expressly described in *Shi*'s method.

240. A POSITA would have been motivated to implement *Hong*'s connection re-establishment procedure triggered by an LBT failure in a PCell to recover from an LBT failure because doing so would improve efficiency, reliability, and mobility of *Shi*'s wireless communication network. Indeed, *Hong* provides that its method can reduce service interruptions when frequent LBT failures occur for a base station and cause data transmission to be difficult. *Hong*, [102]-[103]; *Hong Priority*, [0041]. *Hong* further provides that its method makes it possible to control data transmission to be more stable, by allocating to the terminal radio resources that have a higher probability of LBT success in a subsequent uplink data transmission or retransmission. *Hong*, [102]-[103]; *Hong Priority*, [0041].

241. Furthermore, as I discussed above in Section VI.C.1, Radio Resource Control (RRC) re-establishment request message indicating a re-establishment cause was well known to a POSITA prior to the '535 patent's claimed priority date. Thus, at least in the case where a UE is communicating with a base station using only one cell, which is, as I mentioned above, by definition the PCell, then if the LBT failure occurs on said only one cell available to the UE, it would be obvious to send the message indicating the cause as being LBT failure.

242. A POSITA would have had a reasonable expectation of success combining *Shi* and *Hong* because they both involve similar wireless network components (e.g., a UE with dual connectivity to MCG and SCG) and procedures that perform similar functions (e.g., a connection re-establishment procedure when there is an LBT failure event). Thus, a POSITA would have had a reasonable expectation of combining *Hong*'s connection re-establishment procedure in response to an LBT failure in a PCell with *Shi*'s connection re-establishment procedure because doing so would have involved combining prior art elements according to known wireless communication techniques (e.g., a connection re-establishment procedure for an LBT failure in a PCell) to yield predictable results to improve efficiency and reliability of wireless communications.

4. Claim 6

- a. **“The UE of claim 1, wherein the at least one processor is further configured to execute the computer-executable instructions to: transmit, to a master node, a Secondary Cell Group (SCG) failure report indicating the LBT failure problem when the LBT failure event occurs in a Primary Secondary Cell (PSCell).”**

243. A POSITA would have recognized that *Shi* and *Hong* further render obvious transmitting, to a master node, a Secondary Cell Group (SCG) failure report indicating the LBT failure problem when the LBT failure event occurs in a Primary Secondary Cell (PSCell).

244. For example, as discussed above for limitation [1e], *Shi* discloses one of the following recovery procedures is triggered by the RRC layer: “RRC connection re-establishment; **Secondary Cell Group (SCG)–Radio Link Failure (RLF) processing**; and RRC reconfiguration.” *Shi*, 5:31-34. *Shi* explains that the SCG–RLF processing is to “suspend all Signaling Radio Bearers (SRB) and Data Radio Bearers (DRB) of the SCG, reset the SCG Media Access Control (MAC) address entity, and **report the number of LBT failures** to the network **via an MCG**.” *Shi*, 5:37-40.

245. As the '535 patent explains, a “UE configured with multi-connectivity may be connected to a Master Node (MN) as an anchor and one or more Secondary Nodes (SNs) for data delivery. Each one of these nodes may be formed by a cell

group that includes one or more cells. For example, an MN may be formed by a Master Cell Group (MCG), and an SN may be formed by a Secondary Cell Group (SCG).” ’535 patent, 4:57-64. A POSITA would have thus understood that “MCG” described in *Shi* refers to “Master Cell Group,” which forms a master node.

246. To the extent that it is argued that *Shi* does not disclose this limitation, *Hong* discloses that, **if a channel access failure (LBT failure) occurs in a PSCell or SCell**, then the terminal transmits a PSCell (Primary SCel) or SCell (Secondary Cell) failure information message or an **SCG (Secondary Cell Group) failure information message** to the base station. *Hong*, [135]; *Hong Priority*, [0088], [0089]; *see also Hong*, [184]; *Hong Priority*, [0099]. *Hong* further discloses that a terminal using a **PSCell** of an SCG in an unlicensed band can **transmit SCG LBT failure-related information** to the base station **via an MCG**. For example, the terminal can transmit an SCG Failure Information message to the base station. *Hong*, [188]; *Hong Priority*, [0088]; *see also Hong*, [218], [228]. As discussed above, a POSITA would have thus understood that “MCG” described in *Hong* refers to “Master Cell Group,” which forms a master node. ’535 patent, 4:57-64.

247. In my opinion, a POSITA would have found it obvious to implement *Hong*’s teachings of transmitting an SCG failure report indicating the channel access failure (e.g., LBT failure) to a master node when the LBT failure event occurs in a PSCell into *Shi*’s method. As disclosed in *Shi* and *Hong*, it was well

known that a wireless communication network can include a Secondary Cell Group, which can include a “PSCell,” which is a special cell among the SCells, to which a PUCCH transmission function is allocated. *Hong*, [111]; *Hong Priority*, [0099]. And it was well known that an LBT failure can take place in a PSCell. *Hong*, [200]; *Hong Priority*, [0099].

248. A POSITA would have been motivated to implement *Hong*’s transmitting an SCG failure report indicating the channel access failure (e.g., LBT failure) to a master node when the LBT failure event occurs in a PSCell in *Shi*’s method. Both *Shi* and *Hong* disclose wireless communication systems that include LBT failure counters for counting the number of LBT failures and triggering an LBT failure recovery procedure when the LBT failure counter is greater than or equal to a threshold. *Shi*, 2:37-3:29, 4:26-35, 5:6-8, 5:31-40, 7:29-39; *Hong*, [177], [178], [187], [195]; *Hong Priority*, [0070]-[0074], [0087], [0095]. Both *Shi* and *Hong* also disclose that the UE can initiate an RRC connection reestablishment procedure in response to LBT failure. *Shi*, 5:31-34; *Hong*, [195]; *Hong Priority*, [0095].

249. A POSITA would therefore have found it obvious to combine *Shi* and *Hong* by implementing *Hong*’s teachings of transmitting an SCG failure report indicating the LBT failure to a master node when the LBT failure event occurs in a PSCell in *Shi*’s method, because this was a well-known, conventional procedure,

as taught by *Hong*. A POSITA would have understood that *Hong*'s disclosure simply provides additional details and explanation about the details of *Shi*'s RRC connection re-establishment procedure, and thus would have found it obvious to look to the conventional procedure described in *Hong* to understand and implement the details not expressly described in *Shi*'s method.

250. A POSITA would have been motivated to implement *Hong*'s procedure for transmitting an SCG failure report to a master node when there is an LBT failure event in a PSCell in *Shi*'s method because doing so would improve efficiency, reliability, and mobility of *Shi*'s wireless communication network. Indeed, *Hong* provides that its method can reduce service interruptions when frequent LBT failures occur for a base station and cause data transmission to be difficult. *Hong*, [0102]-[0103]; *Hong Priority*, [0041]. *Hong* further provides that its method makes it possible to control data transmission to be more stable, by allocating to the terminal radio resources that have a higher probability of LBT success in a subsequent uplink data transmission or retransmission. *Hong*, [0102]-[0103]; *Hong Priority*, [0041].

251. A POSITA would have had a reasonable expectation of success combining *Shi* and *Hong* because they both involve similar wireless network components (e.g., a UE with dual connectivity to MCG and SCG) and procedures that perform similar functions (e.g., providing a failure report to a master node

when there is an LBT failure event). Thus, a POSITA would have had a reasonable expectation of combining *Hong*'s transmission of an SCG LBT failure report to an MCG (master node) when there is an LBT failure event in a PSCell with *Shi*'s method because doing so would have involved combining prior art elements according to known wireless communication techniques (e.g., generating an SCG failure report when an LBT failure event occurs in a PSCell) to yield predictable results to improve efficiency and reliability of wireless communications.

5. Claim 7

- a. **“The UE of claim 1, wherein the at least one processor is further configured to execute the computer-executable instructions to: receive a configuration that indicates the threshold.”**

252. To the extent that it is argued that *Shi* does not disclose this limitation, in my opinion, it would have been obvious in view of *Shi* and *Hong*. For example, *Hong* discloses that a threshold value associated with LBT failure can be configured by the base station. *Hong*, [128], [145]; *Hong Priority*, [0092]. A POSITA would have thus understood that *Hong* discloses that the UE receives a configuration from the base station that indicates the threshold.

253. A POSITA would have found it obvious to combine *Shi* and *Hong* by adopting *Hong*'s teachings in *Shi*'s method because it was well known for the UE to receive from the base station a configuration indicating a threshold associated with LBT failure, as taught by *Hong*. As discussed above, both *Shi* and *Hong*

disclose wireless communication systems that include LBT failure counters for counting the number of LBT failures and triggering an LBT failure recovery procedure when the LBT failure counter is greater than or equal to a threshold. *Shi*, 2:37-3:29, 4:26-35, 5:6-8, 5:31-40, 7:29-39; *Hong*, [177], [178], [187], [195]; *Hong Priority*, [0070]-[0074], [0087], [0095]. Both *Shi* and *Hong* also disclose that the UE can initiate an RRC connection reestablishment procedure in response to LBT failure. *Shi*, 5:31-34; *Hong*, [195]; *Hong Priority*, [0095]. *Hong* further discloses the UE receiving a configuration from the base station indicating a threshold associated with LBT failure. *Hong*, [128], 145; *Hong Priority*, [0092].

254. A POSITA would have been motivated to implement *Hong's* teaching of receiving a configuration that indicates the threshold in *Shi's* method because it is very common for the base station to communicate one or more configuration parameters to the UE. Further, the base station may be better positioned than the UE to determine an appropriate threshold value associated with LBT failure because the base station may gather information from other UEs that may indicate the most appropriate threshold. Thus, a POSITA would have been motivated to implement *Hong's* teaching of receiving a configuration that indicates the threshold in *Shi's* method.

255. A POSITA would have had a reasonable expectation of success as it would have been straightforward for a POSITA to implement *Hong's* teachings in

Shi's method. As mentioned above, *Shi* and *Hong* include similar components that perform similar functions. *Shi*'s UE is also already capable of configuring the threshold value. *Shi*, 7:27-28. And therefore, it would have been straightforward to implement *Hong*'s teachings to *Shi*'s existing method.

6. Independent Claim 10

256. As I discuss above in Ground 1, a POSITA would have recognized that *Shi* discloses a method for Listen-Before-Talk (LBT) failure detection performed by a User Equipment (UE). See Section XII.A.6 above. Independent claim 10 recites substantively the same limitations as independent claim 1, which *Shi*, *Hong*, and *TS-38.321* render obvious for at least the reasons I discuss for independent claim 1.

7. Claim 11

- a. **“The method of claim 10, further comprising:
switching an active Bandwidth Part (BWP) of the UE
to another BWP after determining that the LBT
failure event has occurred.”**

257. Claim 11 recites substantively the same additional limitations as claim 2, which *Shi* and *Hong* render obvious for at least the reasons I discuss for claim 2.

8. Claim 14

- a. “The method of claim 10, further comprising: performing a re-establishment procedure by transmitting a Radio Resource Control (RRC) re-establishment request message indicating a re-establishment cause as LBT failure, when the LBT failure event occurs in a Primary Cell (PCell).”**

258. Claim 14 recites substantively the same additional limitations as claim 5, which *Shi* and *Hong* render obvious for at least the reasons I discuss for claim 5.

9. Claim 15

- a. “The method of claim 10, further comprising: transmitting, to a master node, a Secondary Cell Group (SCG) failure report indicating the LBT failure problem when the LBT failure event occurs in a Primary Secondary Cell (PSCell).”**

259. Claim 15 recites substantively the same additional limitations as claim 6, which *Shi* and *Hong* render obvious for at least the reasons I discuss for claim 6.

10. Claim 16

- a. “The method of claim 10, further comprising: receiving a configuration that indicates the threshold.”**

260. Claim 16 recites substantively the same additional limitations as claim 7, which *Shi* and *Hong* render obvious, for at least the reasons I discuss for claim 7.

11. Claims 3, 4, 8, 12, 13, 17, 19, and 20

261. As I discuss above in Ground 1, *Shi* discloses, or *Shi* and/or *TS-38.321* renders obvious, the additional limitations of claims 3, 4, 8, 12, 13, 17, 19, and 20. *See* Section XII.A above.

C. Ground 3: Claims 2, 3, 11, and 12 Are Obvious over *Shi* in view of *TS-38.321* and *Terry*

262. In my opinion, *Shi* in view of *TS-38.321* and *Terry* renders obvious claims 2, 3, 11, and 12.

1. Claim 2

- a. **“The UE of claim 1, wherein the at least one processor is further configured to execute the computer-executable instructions to: switch an active Bandwidth Part (BWP) of the UE to another BWP after determining that the LBT failure event has occurred.”**

263. A POSITA would have recognized that *Shi* and *Terry* further render obvious switching an active Bandwidth Part (BWP) of the UE to another BWP after determining that the LBT failure event has occurred.

264. For example, as explained for limitation [1d], *Shi* discloses determining that an LBT failure event has occurred when the LBT failure counter is greater than or equal to a threshold. *See* Section XII.A.1.e above. *Shi* also discloses “reconfiguring the uplink BWP” in response to the LBT failure event. *Shi*, 5:35-37. As I explained in Section VI.C.2, Bandwidth Part (BWP) is a specific

frequency band available to the service provider (e.g., AT&T or Verizon) that the provider can make available to a device to communicate on. Therefore, a POSITA would have understood that reconfiguring the BWP includes switching from a BWP that is not available (e.g., has had too many failed attempts) to another BWP in the expectation that it would be available, i.e., performing a reconfiguration of the BWP as *Shi* explains.

265. To the extent that it is argued that *Shi* does not explicitly disclose this limitation, *Shi* and *Terry* render it obvious. Specifically, *Terry* discloses switching to an alternate Bandwidth Part (BWP) based on a detected LBT failure. *Terry*, [0040]-[0041], [0045], [00115], [00117], FIG. 2; *Terry Provisional*, [0027], [00108], [00114], [00116]. *Terry* therefore discloses switching an active BWP of the UE to another BWP after determining that the LBT failure event has occurred.

266. In my opinion, a POSITA would have found it obvious to combine *Shi* and *Terry* by adopting *Terry*'s teachings in *Shi*'s method because it was well known to switch BWPs in response to LBT failure detected at an active BWP, as taught by *Terry*. Both *Shi* and *Terry* disclose wireless communication systems that include LBT failure counters for counting the number of LBT failures and triggering an LBT failure recovery procedure when the LBT failure counter is greater than or equal to a threshold. *Shi*, 2:37-3:29, 4:26-35, 5:6-8, 5:31-40, 7:29-39; *Terry*, [0071]; *Terry Provisional*, [0068]. *Shi* also discloses "reconfiguring the

uplink BWP” in response to the LBT failure event. *Shi*, 5:35-37. And *Terry* discloses changing an active BWP of the UE to another BWP in response to LBT failure at the active BWP. *Terry*, [0040]-[0041], [0045], [00115], [00117]; *Terry Provisional*, [0027], [00108], [00114], [00116].

267. A POSITA would have been motivated to implement *Terry*’s teaching of switching of BWPs in response to LBT failure in *Shi*’s method because doing so can help the UE to successfully engage in communication with a base station. For example, as *Terry* acknowledges, “LBT Failures can result in unnecessary and unintended effects” on MAC procedures. *Terry*, [0051]; *Terry Provisional*, [0048]. That is, by switching from a BWP where LBT is known to have failed a number of times to a different BWP, the UE may improve its chances of successfully completing the LBT procedure, and thereby improve the efficiency of communication. To put it differently, the very reason that multiple BWP are allocated to a mobile station, as I discussed in Section VI.C.2 above, is to increase the likelihood (and capacity) of successful communication between the base station and the UE. Thus, a POSITA would have been motivated to implement *Terry*’s method because of the advantages provided by *Terry*’s method.

268. A POSITA would have had a reasonable expectation of success as it would have been straightforward for a POSITA to implement *Terry*’s teachings in *Shi*’s method. As mentioned above, the availability and usage of multiple BWP

was known to a POSITA. Furthermore, *Shi* and *Terry* include similar components that perform similar functions. *Shi*'s UE is also already capable of reconfiguring BWPs. *Shi*, 5:35-37. Thus, it would simply be a matter of configuring *Shi*'s method to allow the switching of the BWP as part of the reconfiguration of the BWPs, to the extent it is not already part of it. And therefore, to the extent *Shi* is not explicit enough, it would have been straightforward to implement *Terry*'s teachings to *Shi*'s existing method.

2. Claim 3

- a. **“The UE of claim 1, wherein the at least one processor is further configured to execute the computer-executable instructions to: indicate, by the MAC entity of the UE, to the upper layer of the UE an LBT failure problem after determining that the LBT failure event has occurred.”**

269. To the extent it is argued that *Shi* does not render obvious this limitation, in my opinion, it would have been obvious in view of *Shi* and *Terry*. For example, *Terry* explicitly discloses that, after an LBT Failure Counter reaches a maximum threshold, “[t]he LBT State may also be indicated to higher layers,” for example, “to affect RRC procedures.” *Terry*, [0071]; *Terry Provisional*, [0068]. As I discuss above in Section XII.A.2, because *Shi*'s MAC layer maintains the counter to determine when there has been an LBT failure event, and because its RRC layer triggers the recovery procedure, it would have been obvious for the MAC layer to indicate that there is an LBT failure problem to the RRC layer, so that the RRC

layer can promptly trigger the recovery procedure. Indeed, a POSITA would have recognized that it would be most efficient for the MAC layer to communicate the LBT failure problem to the RRC layer as it is the RRC layer that is responsible for taking appropriate corrective action(s), as I discussed above. Thus, a POSITA would have been motivated to modify *Shi*'s MAC layer to indicate whether there is an LBT failure problem to the RRC layer, as taught by *Terry*, to the extent *Shi* does not already disclose it.

270. A POSITA would have had a reasonable expectation of success as it would have been straightforward for a POSITA to modify *Shi*'s MAC layer to indicate whether there is an LBT failure problem to its RRC layer. Because *Shi*'s MAC layer and RRC layer are already in communication (*Shi*, 5:35-37; Ex. 1013, 16–17), it would have been a straightforward modification for the MAC layer to indicate to the RRC layer that there is an LBT failure problem, thus allowing the RRC layer to engage in whatever corrective action is deemed appropriate.

3. Claim 11

- a. **“The method of claim 10, further comprising:
switching an active Bandwidth Part (BWP) of the UE
to another BWP after determining that the LBT
failure event has occurred.”**

271. Claim 11 recites substantively the same additional limitations as claim 2, which *Shi* and *Terry* render obvious for at least the reasons I discuss for claim 2.

4. Claim 12

- a. **“The method of claim 10, further comprising: indicating, by the MAC entity of the UE, to the upper layer of the UE an LBT failure problem after determining that the LBT failure event has occurred.”**

272. Claim 12 recites substantively the same additional limitations as claim 3, which *Shi* and *Terry* render obvious for at least the reasons I discuss for claim 3.

D. Ground 4: Claims 9 and 18 Are Obvious over *Shi* in View of *Hong*, *TS-38.321*, and *Alfarhan*

273. In my opinion, *Shi* in view of *Hong*, *TS-38.321*, and *Alfarhan* renders obvious claims 9 and 18.

1. Claim 9

- a. **“The UE of claim 1, wherein the at least one processor is further configured to execute the computer-executable instructions to: reset the LBT failure counter when the UE switches from an active Bandwidth Part (BWP) of the UE to another BWP.”**

274. In my opinion, a POSITA would have found that *Shi*, *Hong*, and *Alfarhan* render obvious resetting the LBT failure counter when the UE switches from an active Bandwidth Part (BWP) of the UE to another BWP.

275. For example, as discussed for claim 2, *Hong* discloses switching an active BWP of the UE to another BWP after determining that the LBT failure event has occurred. *See* Section XII.B.2 above. Also, as discussed for limitation

[1e], *Shi* and *Hong* each disclose resetting the LBT failure counter in certain conditions. *See* Section XII.B.1.f above.

276. In my opinion, a POSITA would have found it obvious to reset the LBT counter when the UE switches from an active BWP of the UE to another BWP. It was well known to a POSITA to reset a counter when switching from one BWP to another BWP, as taught by *Alfarhan*. Specifically, *Alfarhan* discloses that “[u]pon switching to a different sub-band and/or BWP for a preamble transmission attempt . . . [t]he WTRU [wireless transmit/receive unit] 102 may reset the preamble attempt counter upon and/or after switching BWPs/sub-bands.” *Alfarhan*, [0165]; *Alfarhan Provisional*, [0158], [0184].

277. A POSITA would have been motivated to implement *Alfarhan*’s teachings of resetting a counter when switching BWPs into *Shi*’s method. Like *Shi*, *Alfarhan* discloses an LBT procedure in a wireless communication network. *Alfarhan*, [0161]-[0165]; *Alfarhan Provisional*, [0154]-[0158]. A POSITA would have been motivated to reset the LBT failure counter when the UE switches from an active BWP of the UE to another BWP because the existing LBT failure counter would no longer be accurate, or even relevant, for the new BWP. Thus, it would not make sense to use the existing count value when restarting communication on a new BWP. For example, if the existing count was used for the new BWP, the UE would prematurely detect LBT failure as the number of actual failures would, by

definition, be smaller than what the counter would suggest. Using a similar example discussed above for limitation [1e], if the threshold was set to 10, an LBT failure count of 10 would trigger an LBT failure event, which would lead to switching BWPs. Then, after switching BWPs, if there is another LBT failure indication, the counter would increase to 11, which would again detect LBT failure event, (assuming the new threshold was also 10) even though it was the first LBT attempt on the new BWP. As another example, if the threshold in the active BWP is, again, 10 and there is a BWP switch, for whatever reason, when the LBT counter is at, say, 6 and the threshold in the new BWP is some number, e.g., 9, then a failure would be declared only after 3 failed attempts, i.e., prematurely relative to the threshold of 9. Thus, not only is it a common sense, but a POSITA would have been motivated to reset the LBT failure counter for the new BWP to clear the count and start the counting from the beginning so as to make the counting be meaningful.

278. A POSITA would have had a reasonable expectation of success as it would have been straightforward for a POSITA to implement *Alfarhan's* teachings of resetting a counter when switching BWPs in *Shi's* method. In fact, *Shi* already teaches how to reset the LBT failure counter under certain circumstances. *Shi*, 5:29-30 (“when the count value of the counter has not changed for a very long period of time, it is possible to restart the counting of the counter.”). Thus, it would

simply be a matter of changing the condition or adding another condition upon which *Shi*'s method resets the LBT failure counter. Further, as mentioned above, *Alfarhan* and *Shi* include similar components that perform similar functions. Thus, it would have been straightforward to implement *Alfarhan*'s additional disclosure regarding resetting a counter when switching BWPs in *Shi*'s existing LBT method.

2. Claim 18

- a. **“The method of claim 10, further comprising:
resetting the LBT failure counter when the UE
switches from an active Bandwidth Part (BWP) of the
UE to another BWP.”**

279. Claim 18 recites substantively the same additional limitations as claim 9, which *Shi*, *Hong*, and *Alfarhan* render obvious for at least the reasons I discuss for claim 9.

XIII. CONCLUSION

280. For the reasons set forth in Section XII, it is my opinion that one skilled in the art would have found claims 1-20 of the '535 patent obvious.

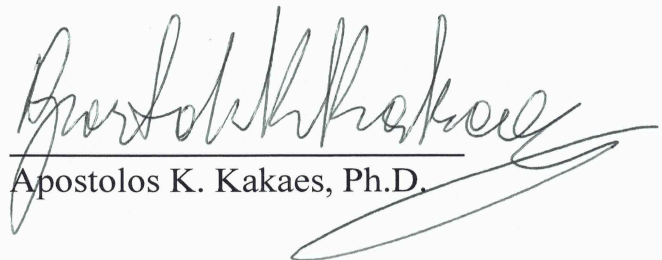
281. In signing this declaration, I understand that the declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I acknowledge that I may be subject to cross-examination in this case and that cross-examination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

cross-examination within the United States during the time allotted for cross-examination.

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

Date: July 11, 2025

Respectfully submitted,



Apostolos K. Kakaes, Ph.D.

Claims Listing

1. **[1pre]**⁵ A user equipment (UE) comprising:
[1a] one or more non-transitory computer-readable media having computer-executable instructions embodied thereon; and
at least one processor coupled to the one or more non-transitory computer-readable media, the at least one processor is configured to execute the computer-executable instructions to:
[1b] receive, by a Medium Access Control (MAC) entity of the UE, a Listen-Before-Talk (LBT) failure indication from a lower layer of the UE for all uplink (UL) transmissions;
[1c] increase an LBT failure counter when the MAC entity receives the LBT failure indication;
[1d] determine that an LBT failure event has occurred when the LBT failure counter is greater than or equal to a threshold; and
[1e] reset the LBT failure counter when a reset of the MAC entity is requested by an upper layer of the UE.

⁵ I have added the bold brackets for ease of reference within the claims.

2. The UE of claim 1, wherein the at least one processor is further configured to execute the computer-executable instructions to: switch an active Bandwidth Part (BWP) of the UE to another BWP after determining that the LBT failure event has occurred.
3. The UE of claim 1, wherein the at least one processor is further configured to execute the computer-executable instructions to: indicate, by the MAC entity of the UE, to the upper layer of the UE an LBT failure problem after determining that the LBT failure event has occurred.
4. The UE of claim 3, wherein the at least one processor is further configured to execute the computer-executable instructions to: perform a Radio Link Failure (RLF) recovery procedure.
5. The UE of claim 1, wherein the at least one processor is further configured to execute the computer-executable instructions to: perform a re-establishment procedure by transmitting a Radio Resource Control (RRC) re-establishment request message indicating a re-establishment cause as LBT failure, when the LBT failure event occurs in a Primary Cell (PCell).

6. The UE of claim 1, wherein the at least one processor is further configured to execute the computer-executable instructions to: transmit, to a master node, a Secondary Cell Group (SCG) failure report indicating the LBT failure problem when the LBT failure event occurs in a Primary Secondary Cell (PSCell).
7. The UE of claim 1, wherein the at least one processor is further configured to execute the computer-executable instructions to: receive a configuration that indicates the threshold.
8. The UE of claim 1, wherein the at least one processor is further configured to execute the computer-executable instructions to: reset the LBT failure counter when the threshold is reconfigured.
9. The UE of claim 1, wherein the at least one processor is further configured to execute the computer-executable instructions to: reset the LBT failure counter when the UE switches from an active Bandwidth Part (BWP) of the UE to another BWP.

10. **[10pre]** A method for Listen-Before-Talk (LBT) failure detection performed by a User Equipment (UE), the method comprising:
 - [10a]** receiving, by a Medium Access Control (MAC) entity of the UE, a Listen-Before-Talk (LBT) failure indication from a lower layer of the UE for all uplink (UL) transmissions;
 - [10b]** increasing an LBT failure counter when the MAC entity receives the LBT failure indication;
 - [10c]** determining that an LBT failure event has occurred when the LBT failure counter is greater than or equal to a threshold; and
 - [10d]** resetting the LBT failure counter when a reset of the MAC entity is requested by an upper layer of the UE.
11. The method of claim 10, further comprising: switching an active Bandwidth Part (BWP) of the UE to another BWP after determining that the LBT failure event has occurred.
12. The method of claim 10, further comprising: indicating, by the MAC entity of the UE, to the upper layer of the UE an LBT failure problem after determining that the LBT failure event has occurred.

13. The method of claim 12, further comprising: performing a Radio Link Failure (RLF) recovery procedure.
14. The method of claim 10, further comprising: performing a re-establishment procedure by transmitting a Radio Resource Control (RRC) re-establishment request message indicating a re-establishment cause as LBT failure, when the LBT failure event occurs in a Primary Cell (PCell).
15. The method of claim 10, further comprising: transmitting, to a master node, a Secondary Cell Group (SCG) failure report indicating the LBT failure problem when the LBT failure event occurs in a Primary Secondary Cell (PSCell).
16. The method of claim 10, further comprising: receiving a configuration that indicates the threshold.
17. The method of claim 10, further comprising: resetting the LBT failure counter when the threshold is reconfigured.

18. The method of claim 10, further comprising: resetting the LBT failure counter when the UE switches from an active Bandwidth Part (BWP) of the UE to another BWP.
19. The user equipment (UE) of claim 1, wherein the at least one processor is further configured to execute the computer-executable instructions to: reset the LBT failure counter after the MAC entity has not received the LBT failure indication for a time period.
20. The method of claim 10, further comprising: resetting the LBT failure counter after the MAC entity has not received the LBT failure indication for a time period.

APPENDIX A

APOSTOLOS K. KAKAES
Cosmos Communications Consulting Corporation, President
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Vienna, Virginia 22180
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AREAS OF EXPERTISE

All aspects of fixed and mobile communications. Over the years, my emphasis has been both in breadth and in depth, originally in fixed communications networks and then in mobile communications. Specific areas of in-depth expertise include:

- NR/5G, LTE/LTE-Advanced and evolution issues of 3G to 4G and 5G
- UMTS, including FDD, TDD, HSDPA/HSUPA, HSPA+, both air interface (UTRA) and Radio Access Network (RAN) as well as Core Network (CN) technologies
- GSM, GPRS, EDGE (EGPRS) and related evolutionary problems and solutions
- cdma2000 family from IS-95, through its evolution to 1x, 3x, 1xEV-DO (HDR), 1xEV-DV (all aspects of the evolution to “3G” and beyond)
- Wired and Wireless Local Area Networks (LAN) including all variants of IEEE 802.11 (WiFi)
- Metropolitan Area Networks (MAN), and Personal Area Networks (PAN) technologies, Paging networks, Ad hoc networks, including IEEE 802.16 (WiMAX), HIPERLAN, Bluetooth, Near Field Communications, IrDA (Infrared Data Association) operating with any of the available access technologies
- North American TDMA and IS-54/IS-136
- IMS, SIP, and VoIP (Voice over IP), including VoIP over LTE
- TETRA
- iDEN™
- Core Network technologies, IS-41, SS7, ATM, MAP, SAE, etc.
- Design and implementation of voice and data networking (circuit switching as well as all the evolving all IP-based technologies)
- Traffic engineering and network design; both air interface aspects (including resource allocation, QoS, MAC protocol, etc.) and design of core network, both user plane and control plane

EMPLOYMENT HISTORY

9/88 – Present

Cosmos Communications Consulting Corporation. Founder and president of private communications engineering consulting firm specializing in mobile communications. Initially part time; full time since 1994.

- Developed and presented courses, seminars, and lectures on fixed and mobile communications to both corporate and government entities, such as the FCC and the US Marshal’s Office.
- Consulted on high level technology-related issues and trends, pros and cons of each, etc. to corporate entities, governmental agencies, and international organizations, such as the UN.

- Consulted at the detailed technical level to engineering firms, operators, and equipment vendors on technical issues related to existing or evolving technologies for mobile communications.
- Served as technology consultant to the investment community on issues related to both fixed and wireless communications technologies.
- Served as consultant and/or testifying expert witness on both civil and criminal legal cases, including a class action lawsuit brought in California, a murder case in Illinois, and several patent infringement cases both at the ITC and in US district courts as well as in the High Court in the UK.
- Served as consultant and/or testifying expert witness on several Inter-Parte Re-examinations (IPRs).
- Served as consultant and testifying witness in Arbitrations involving mobile communications.
- Served as consultant and/or testifying expert witness in multiple legal proceedings involving the determination of "FRAND" rates for global licenses involving "SEP" patents.
- Participated as a technical consultant in the analysis of large patent portfolios for the purposes of due diligence, sales, and/or M/A activities for some of the largest companies in the mobile communications space.

Many of the above projects spanned a multidimensional spectrum of

- Technologies: both fixed and mobile communications as they have evolved over the past 30+ years;
- Audiences: non-technical support personnel, highly specialized engineers, Wall Street analysts, hedge fund managers, litigation teams, as well as decision making executives at the CEO/CFO/CTO level;
- Geographic and cultural backgrounds that span all continents and over 40 countries.

9/87 - 5/94

The George Washington University, Washington, D.C.; Department of Electrical Engineering and Computer Science.

- Taught mostly graduate courses in the area of communication engineering, including communication theory, coding theory, voice and data networking, and mobile communications.
- Proposed, developed and taught new graduate courses in the area of mobile communications.
- Received several research awards/grants, including the prestigious NSF Research Initiation Award.
- Participated in several committees, including the departmental Graduate Curriculum Committee as well as various University-wide committees.

7/85 - 12/86

Polytechnic Institute of New York, Brooklyn, New York. Joint appointment as Special Research Fellow and Adjunct Instructor (while pursuing the Ph.D. degree).

1/82 - 7/87

AT&T Bell Laboratories, Holmdel, New Jersey. Worked on modeling, analysis, design, and performance evaluation of voice and data networks. Developed algorithms for DNHR (Dynamic, Non-Hierarchical Routing) used in the telephone network. Analysis of advanced data services and formulation of long term plans for development of enhanced data services and network design tools to support such services.

7/76 - 12/81

University of Colorado, Boulder, Colorado and Michigan State University, East Lansing, Michigan. Undergraduate and then graduate teaching assistant.

EDUCATION

09/82 - 01/88

Polytechnic Institute of New York. Ph.D. in Electrical Engineering with a minor in Applied Mathematics.

Thesis Title: Topological Properties and Design of Multihop Packet Radio Networks.

Thesis Advisor: Professor Robert R. Boorstyn.

09/74 - 06/80

University of Colorado.

M.S. in Applied Mathematics with a minor in Electrical Engineering.

B.S. in Applied Mathematics with a minor in Electrical Engineering.

PROFESSIONAL ASSOCIATIONS AND ACTIVITIES

- Member of the IEEE (Active in the Communications Society, Vehicular Technology Society, and the Information Theory Society).
- Secretary, IEEE Communications Society National Capital Area Chapter, 91/92.
- Vice-Chair, IEEE Communications Society National Capital Area Chapter, 92/93.
- Vice-Chair of the Communication Theory Technical Committee of the Communications Society of the IEEE; Elected for the 1993-1996 term.
- Treasurer of the Communication Theory Technical Committee of the Communications Society of the IEEE, Elected for the 1996-1999 term.
- Reviewer for the IEEE, book editors, and other technical publications.
- Reviewer for various NSF Panels.
- Active Participant and Organizer of Technical Sessions in Technical Conferences, including the IEEE International Conference on Communications (ICC) and IEEE Global Communications Conference (Globecom).
- Technical Program Chair for the Communication Theory Mini-Conference, Dec. 1992.

PUBLICATIONS AND PRESENTATIONS

1. "Topological Properties and Design of Multi-Hop Packet Radio Networks"; Presented at the IEEE Information Theory Society Meeting; Arlington, Virginia; February 1988.
2. "Topology and Capacity of Multi-Hop Packet Radio Networks" (Joint with R.R. Boorstyn); 1988 International Symposium on Information Theory; Kobe, Japan; June 1988.
3. "Placing Repeaters in Multi-Hop Packet Radio Networks" (Joint with R.R. Boorstyn); *Proceeding of Globecom '89*, Dallas, Texas; November 1989.
4. "Topological Properties and Design of Packet Radio Networks"; Invited Presentation at the National Technical University of Athens; Athens, Greece; January 10, 1990.
5. "Channel Allocation Strategies in Dual Mode Digital Cellular Networks"; *Proceedings of Globecom '90*, San Diego, California; December 1990.
6. "Bandwidth Allocation Techniques in Dual Mode Cellular Systems"; Invited Presentation at the Rutgers University Wireless Information Networks Laboratory (WINLAB); January 25, 1991.
7. "Some Topological Properties of Different Classes of Random Graphs with Applications to Communication Networks", *Proceedings of the IEEE Information Theory Symposium*, Budapest, Hungary; June 1991.
8. "The Effects of Residual Bandwidth in TDMA Cellular Networks", IEEE Communication Theory Workshop, Rhodes, Greece, July 1991.
9. "Concentrators and Concentrator Design", *Encyclopedia of Telecommunications*, Fritz E. Froehlich, Editor-in-chief; Marcel Dekker, Inc, 1992.
10. "Comparison of TDMA and CDMA for Cellular Networks," Ecole Nationale Supérieure des Telecommunications, Paris, France, March 5, 1992.
11. "Dual Mode Digital Cellular Networks: The Effects of Bandwidth Segmentation on Digital and Analog Users," Presented at the IEEE Communications Society Meeting, April 16, 1992.
12. "Dynamic Channel Allocation and Reallocation for Dual-System Cellular Networks, *Workshop Record*, (with Sirin Tekinay and Bijan Jabbari), Third Winlab Workshop on Third Generation Wireless Information Networks, Piscataway, NJ, April 28-29, 1992.
13. "Spread Spectrum Technology Applications in Telecommunications," Tutorial presented at the 1992 IEEE Mohawk Valley Section Conference, June 1992.
14. "Spread Spectrum Fundamentals: Techniques and Applications", Tutorial (in cooperation with Giovanni Vannucci) presented at ICC'92, June 1992.
15. "Global System for Mobile Communications (GSM)", Presented at ICC'93, Geneva, Switzerland, May 25, 1993.
16. "Data Communications Basics", *Encyclopedia of Software Engineering*, John Wiley & Sons, Inc., 1993.
17. "Modelling of Cellular Communication Networks with Heterogeneous Traffic Sources" (with Sirin Tekinay and Bijan Jabbari), *Proceedings of the International Conference on Universal Personal Communications, 1993*, October 1993.
18. "Global System for Mobile Communications (GSM)", Presented at the Francusko-Polska Wysza Szkowa, Poznan, Poland, March 1994.

19. "Traffic Engineering for Cellular Network Design", Presented at the Francusko-Polska Wysza Szkola, Poznan, Poland, March 1994.
20. "Principles of Traffic Engineering and Network Design", Presented at the Regional Seminar on Mobile Cellular Radio Telephone Systems, by invitation of the ITU, April 19, 1994.
21. "Principles of Spread Spectrum Systems for Mobile Communications", Presented at the Regional Seminar on Mobile Cellular Radio Telephone Systems, by invitation of the ITU, April 20, 1994.
22. "Global System for Mobile Communications (GSM)", Presented at the Regional Seminar on Mobile Cellular Radio Telephone Systems, by invitation of the ITU, April 21, 1994.
23. "Global System for Mobile Communications (GSM)", Presented at ICC'94, New Orleans, LA.; May 1, 1994.
24. "GSM and DCS1900: Evolution to PCS", ICC/Supercom 1996, Dallas, Texas; June 23-27, 1996.
25. "Traffic Engineering Models for Mobile Communications", ICUPC96, Cambridge, Massachusetts; Sept. 29 - October 2, 1996.
26. "GSM-Recent Advances and Future Developments", Globecom'96, London, UK; November 1996.
27. "Advances in GSM and DCS1800/1900", ICC '97, Montreal, Canada; June 1997.
28. "The Global System for Mobile Communications (GSM) and its Derivatives (DCS1800, PCS1900)", ICC/Supercom '98, Atlanta, GA; June 1998.
29. "Teletraffic Engineering", Globecom '98, Sydney, Australia; November 1998.
30. "Traffic Engineering" in Encyclopedia of Telecommunications; Edited by John Proakis, John Wiley, 2002.