UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

PANASONIC AUTOMOTIVE SYSTEMS CO., LTD.,

Petitioner,

v.

UNM RAINFOREST INNOVATIONS,

Patent Owner.

INTER PARTES REVIEW OF
U.S. PATENT NO. 8,265,096 B2
Case IPR2024-00364

DECLARATION OF DR. CHRISTOPHER J. HANSEN, Ph.D.
(CORRECTED)
Ex. 1002

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I. INTRODUCTION

1. My name is Christopher J. Hansen. I have been retained by counsel for Petitioner, Panasonic Automotive Systems Co., Ltd., as an expert witness in this *inter partes* review to examine whether claims 8, 44-47, and 49-50 of U.S. Patent No. 8,265,096 ("the '096 Patent) are patentable over certain prior art.

2. I have personal knowledge of all the facts set forth herein, and if called to testify at any hearing in this *inter partes* review, I would competently testify and verify that testimony contained herein.

3. I am being compensated at my hourly rate of $500 per hour. I am also being reimbursed for out-of-pocket expenses. My compensation does not depend in any way on the outcome of this proceeding or the particular opinions I express, or the testimony I give.

4. I expect to be available for deposition and to testify at the evidentiary hearing in this *inter partes* review to the extent required.

5. This declaration contains my conclusions and a summary of my analysis including a summary of my conclusions; an overview of my qualifications as an expert; an overview of the scope and terms of my engagement for this declaration; an overview of the materials I have considered in arriving at my conclusions; an overview of the terminology and legal principles that I applied in my analysis; an overview of the technical background of the subject matter; an

overview of ’096 Patent; an analysis of the level of ordinary skill in the art related to the ’096 Patent; an analysis of the asserted references; and a patentability analysis of the challenged claims.

6. I have been informed that Patent Owner UNM Rainforest Innovations (formerly STC.UNM) has asserted the ’096 Patent in the following lawsuits: *UNM Rainforest Innovations f/k/a STC.UNM v. Toyota Motor North America, Inc. et al*, 2-23-cv-00424 (E.D. Tex.); *UNM Rainforest Innovations v. Zyxel Commc’ns Corp*., 6:20-cv-00522 (W.D. Tex.); *UNM Rainforest Innovations v. Dell Techs., Inc.*, 6:20-cv-00468 (W.D. Tex.); *UNM Rainforest Innovations v. ASUSTek Comput., Inc*., 6:20-cv-00142 (W.D. Tex.); *UNM Rainforest Innovations v. D-Link Corp*., 6:20-cv-00143 (W.D. Tex.); *UNM Rainforest Innovations v. Apple Inc*., 1:20-cv-00351 (W.D. Tex.); *UNM Rainforest Innovations v. TP-Link Techs. Co., Ltd*., 6:19-cv-00262 (W.D. Tex.).

7. This declaration is based on information currently available to me. I intend to continue my investigation and study, which may include a review of documents and information that may yet be produced, as well as deposition testimony from depositions for which transcripts are not yet available or that may yet be taken in this review. Therefore, I expressly reserve the right to expand or modify my opinions as my investigation and study continue, and to supplement my opinions in response to any additional information that becomes available to me,

any matters raised by Patent Owner and/or other opinions provided by Patent Owner's expert(s), or in light of any relevant orders from the Patent Trial and Appeal Board or other authoritative body.

II. BACKGROUND AND QUALIFICATIONS

8. I received a B.S. in electrical engineering from Rensselaer Polytechnic Institute in 1987. I received an M.S. in electrical engineering from University of Massachusetts, Amherst in 1989. I received a Ph.D. in electrical engineering from University of California, Los Angeles in 1997.

9. I have over 25 years of experience working with wireless communications and IEEE standards and over 15 years of experience working in 802.11 WLAN chipsets and cellular base-station systems development.

10. A copy of my curriculum vitae listing my full employment history is included as Appendix A. I will briefly summarize aspects of my experience below.

11. From 1989 through 1992, my work focused on radio frequency (RF) and microwave systems and circuit development for radar systems and cellular (mobile) radio. This work included development of feed-forward amplifiers used in commercial base station equipment.

12. From 1997 through 1999, I was employed by two Silicon Valley startup companies developing advanced digital communications technology for

asymmetrical digital subscriber line (ADSL) and high bit-rate digital subscriber line (HDSL2) systems.

13. From 2000 through 2012, I was employed at Broadcom Corporation, where I served as system engineer for the IEEE 802.11a/b/g wireless local area network chipsets including analysis of radio and baseband DSP architectures for the physical layer design, and then project manager and lead system engineer for the IEEE 802.11n proposal to the IEEE at Broadcom. My responsibilities focused on technology developments and contributions to a number of the IEEE 802.11 standards, and in particular the IEEE 802.11n standard which incorporated a MIMO-OFDM physical layer and enhanced MAC layer for higher throughput wireless networks. My work covered many topics including preamble design, advanced channel coding, channel estimation, and multiple antenna beamforming.

14. From June 2012 through July 2013, I was employed at Apple Inc., where I served as senior wireless system architect for analysis of the IEEE.11 wireless networks for iOS products.

15. From August 2013 to present, I have worked as a self-employed consultant while serving out my leadership role at the IEEE.

16. I am currently President of Covariant Corporation, which is a consulting firm that provides expertise on the IEEE 802.11 standards and product development.

17. I am named inventor on more than 125 issued patents, including many standard essential patents for the IEEE 802.11 standards.

18. I have been a member of the Institute of Electrical and Electronics Engineers ("IEEE") since 1989. I became a senior member of the IEEE since in 2011. I began participating in the IEEE's standards-setting process in January 2000.

19. During my 12 years working for Broadcom, I was one of Broadcom's lead representatives in the IEEE 802.11 standards-setting process. Specifically, I took on a number of significant roles during the development of the IEEE 802.11h, IEEE 802.11n, and the IEEE 802.11ad amendment. For IEEE 802.11n, these roles included making multiple technical contributions and attending all meetings of the study group responsible for defining the scope of the standard and all meetings of the task group responsible for writing the standard.

20. I was significantly involved in the development of IEEE 802.11n as part of my duties at Broadcom. I attended all meetings of the High Throughput Study Group, which was responsible for defining the scope of IEEE 802.11n, and all meetings of the Task Group for 802.11n (TGn), which was responsible for writing the IEEE 802.11n specifications.

21. I was largely responsible for defining the Medium Access Controller (MAC) portion and the physical layer (PHY) of Broadcom's IEEE 802.11n

contributions as well as technical simulations that were used to justify the design choices used in those contributions.

22. In 2005, a Joint Proposal team was formed after none of the competing proposals for IEEE 802.11n received enough "yes" votes during the balloting process to move forward. The Joint Proposal group was responsible for developing a compromise proposal that included elements of three of the competing proposals that had failed. These three proposals were the TGn Sync proposal, another proposal from a group called WWiSE, and a proposal from a group including Mitsubishi and Motorola (MitMot).

23. In January 2006, the IEEE Task Group n ("TGn") voted unanimously to confirm selection of the Joint Proposal for high throughput wireless local area networks. As a result, the Joint Proposal became part of the IEEE 802.11n standard, which was published in 2009.

III. MATERIALS REVIEWED

24. In reaching the conclusions described in this declaration, I have relied on the documents and materials recited herein as well as those identified in this declaration, including the '096 Patent (Ex. 1001), the prosecution history of the '096 Patent, the prior art references, and information discussed and any other references specifically identified in this declaration, including the materials identified in the chart below.

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Exhibit	Description
Ex. 1001	U.S. Patent No. 8,265,096 (the "'096 Patent")
Ex. 1003	U.S. Provisional App. No. 60/929
Ex. 1004	Excerpt of the '096 Patent Prosecution History
Ex. 1005	Claim Construction Order in *STC.UNM v. Apple Inc.*, No. 1-20-cv-00351 (W.D. Tex. Apr. 9, 2020), ECF No. 69
Ex. 1006	Patent Owner's Motion to Amend in *Inter Partes* Review No. 2021-00743
Ex. 1007	Final Written Decision in *Inter Partes* Review No. 2021-00743
Ex. 1008	IEEE P802.11 Wireless LANs Joint Proposal: High throughput extension to the 802.11 Standard: PHY, IEEE 802.11-05/1102r4 (Jan. 13, 2006) ("Joint Proposal")
Ex. 1009	IEEE P802.11 Wireless LANs [Minutes of High Throughput Task Group .11n Session], IEEE 802.11-05/0037r0 (Jan. 16, 2006)
Ex. 1010	U.S. Pub. No. 2006/0072529 A1 ("Mujtaba")
Ex. 1011	U.S. Pub. No. 2007/0204052 A1 ("Trainin")
Ex. 1012	U.S. Pub. No. 2006/0067415 A1 ("Mujtaba II")
Ex. 1013	U.S. Pub. No. 2006/0146867 A1 ("Lee")
Ex. 1014	IEEE Std 802.11a-1999 Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications, ISO/IEC 8802-11:1999/Amd 1:2000(E)
Ex. 1015	Declaration of Dr. James L. Lansford, Ph.D.
Ex. 1016	U.S. Pub. No. 2005/0233709A1 ("Gardner")
Ex. 1017	U.S. Patent No. 7,274,652 ("Webster")
Ex. 1018	U.S. Pub. No. 2007/0104174 ("Nystrom")
Ex. 1019	Mujtaba, et al., IEEE 802.11-05/786r0, "TGn Sync, WWiSE, and Mitmot Closing Report", presentation submission, submitted and publicly available on July 21, 2005.
Ex. 1020	U.S. Pub. No. 2008/0095195A1 ("Ahmadi")
Ex. 1021	U.S. Pub. No. 20070155387A1 ("Li")
Ex. 1022	Patent Owner's Complaint in *UNM Rainforest Innovations f/k/a STC.UNM v. Toyota Motor North America, Inc. et al*, 2-23-cv-00424 (E.D. Tex.)
Ex. 1023	Draft IEEE 802.16m Requirements
Ex. 1024	Work Plan for Development of IEEE P802.16m Draft Standard & IMT-Advanced Submission
Ex. 1025	Extract of ITRI's Submission to TGn
Ex. 1026	Partial Proposal for 802.11n: ITRI Preamble Specification

Ex. 1027	ITRI's complaint in *Industrial Technology Research Institute v. LG Electronics, Inc. et al*, 2-15-cv-00552 (E.D. Tex.)
Ex. 1028	Patent Owner's Infringement Contentions in *UNM Rainforest Innovations f/k/a STC.UNM v. Toyota Motor North America, Inc. et al*, 2-23-cv-00424 (E.D. Tex.)
Ex. 1029	Exemplary Exhibit to Patent Owner's Infringement Contentions in *UNM Rainforest Innovations f/k/a STC.UNM v. Toyota Motor North America, Inc. et al*, 2-23-cv-00424 (E.D. Tex.)
Ex. 1030	[Reserved]
Ex. 1031	[Reserved]
Ex. 1032	U.S. Pub. No. 2005/0159120 ("Kim")
Ex. 1033	Yang Xiao, IEEE 802.11n: Enhancement for Higher Throughput in Wireless LANs publicly available in December 2005 ("Yang").

IV. SUMMARY OF OPINIONS

25. Claims 8, 44-47 and 50 of the '096 Patent are unpatentable as being anticipated by Joint Proposal.

26. Claim 49 is unpatentable as obvious by Joint Proposal and Trainin.

27. Claim 8 is unpatentable as being anticipated by Mujtaba.

28. Claims 8, 44-47 and 49-50 are unpatentable as obvious by Mujtaba and Trainin.

V. UNDERSTANDING OF THE LAW

29. I am not a legal expert. In forming my opinions, I have been informed of and applied the legal standards as follows. I understand that the legal standards relating to anticipation and obviousness apply to the '096 Patent based on its effective filing date of July 7, 2008. My opinions herein would not change if the

’096 Patent were determined to be entitled to claim priority to the date of filing of either provisional application filed on July 12, 2007 or September 17, 2007.

30. I understand that a patent claim is invalid if the claimed invention is not new. For a claim to be invalid on the basis of anticipation because it is not new, all of its elements must be present, either expressly or inherently, in a single previous device or method, or described, either expressly or inherently, in a single previous publication or patent.

31. I understand that the description in a reference does not have to be in the same words as the claim, but all the requirements of the claim must be there, either stated expressly or necessarily implied or inherent to one of ordinary skill in the field of technology of the patent at the time of the invention, so that someone of ordinary skill in the field of technology of the patent looking at that one reference would be able to make and use the claimed invention. I further understand that to be necessarily implied or inherent, the claim element must be a necessary part of the reference that is not expressly discloses. Merely being one option is not sufficient for a claim element to be necessarily implied or inherent to a person of ordinary skill in the art (“POSA”).

32. I have been informed that in relying upon the theory of inherency, there must be a basis in fact and/or technical reasoning to reasonably support the

determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art.

33. I have been informed that a patent claim is invalid under 35 U.S.C. § 102(a) if the invention defined by the claim was known or used by others in the United States or was patented or described in a printed publication, such as a journal, magazine or newspaper article, anywhere in the world before the applicants' invention date. I understand that a printed publication, such as an article published in a magazine or trade publication, constitutes prior art to a claimed invention under 35 U.S.C. § 102(a) if the publication takes place prior to the date of invention. I understand that a U.S. patent constitutes prior art to a claimed invention under 35 U.S.C. § 102(a) if the date of issuance of the patent is before the date of invention.

34. In addition, I have been informed that a patent claim is invalid under 35 U.S.C. § 102(b) if the invention defined by the claim was patented or described in a printed publication anywhere in the world or was in public use or on sale in the United States more than one year before the effective filing date/priority date of the patent in the United States. I understand that a U.S. or foreign patent constitutes prior art to a claimed invention under 35 U.S.C. § 102(b) if the date of issuance of the patent is more than one year before the filing date of a patent application claiming the invention. I understand that a printed publication, such as an article

published in a magazine or trade publication, constitutes prior art to a claimed invention under 35 U.S.C. § 102(b) if the publication takes place more than one year before the filing date of a patent application claiming the invention.

35. I have also been informed that a patent claim is invalid under 35 U.S.C. § 102(e) if the invention defined by the claim was described in a patent by another inventor that was filed in the United States before the applicants' invention date. I understand that a U.S. patent constitutes prior art to a claimed invention under 35 U.S.C. § 102(e) if the patent issues from an application that was filed before the invention by the applicants.

36. I understand that a patent claim is "obvious" and therefore invalid when the differences between the claimed subject matter and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a POSA to which the subject matter pertains.

37. In making an obviousness determination, I understand that there are several factors to consider: (1) the scope and content of the prior art; (2) the level of ordinary skill in the art at the time the invention was made; (3) the differences between the claimed invention and the prior art, if any, and (4) objective considerations, if any exist, such as any commercial success, copying, prior failure by others, licenses, longstanding need, and unexpected results.

38. I understand that prior art used to show that a claimed invention is obvious must be "analogous art." Prior art is analogous art to the claimed invention if (1) it is from the same field of endeavor as the claimed invention (even if it addresses a different problem) or (2) the reference is reasonably pertinent to the problem faced by the inventor (even if it is not from the same field of endeavor as the claimed invention).

39. I have been informed and understand that the U.S. Supreme Court has recognized several rationales for combining references or modifying a reference to show obviousness of claimed subject matter. Some of these rationales include the following: (a) combining prior art elements according to known methods to yield predictable results; (b) simple substitution of one known element for another to obtain predictable results; (c) use of a known technique to improve a similar device (method, or product) in the same way; (d) applying a known technique to a known device (method, or product) ready for improvement to yield predictable results; (e) choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success; and (f) some teaching, suggestion, or motivation in the prior art that would have led a POSA to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention.

40. Also, I have been informed and understand that obviousness does not require physical combination/bodily incorporation, but rather consideration of what

the combined teachings would have suggested to a POSA at the time of the alleged invention.

41. I understand that it is improper to engage in hindsight when trying to determine the obviousness of a patent claim. I understand that the obviousness inquiry must be conducted from the standpoint of a POSA at the time the claimed invention was made. What is known today, and what is learned from the teachings and disclosures of the patent itself containing the claim under analysis, should not be considered.

42. I have been informed that in order to rely on inherency to establish the existence of a claim limitation in the prior art in an obviousness analysis, the limitation at issue necessarily must be present, or the natural result of the combination of elements explicitly disclosed by the prior art.

43. I have been informed that various "secondary considerations" (sometimes referred to as objective indicia of non-obviousness) may support a determination of non-obviousness and that such secondary considerations must be considered as part of an obviousness analysis. I have been informed that secondary considerations of nonobviousness may include:

- commercial success of a product due to the merits of the claimed invention;
- a long felt need for the solution provided by the claimed invention;

- unsuccessful attempts by others to find the solution provided by the claimed invention;
- copying of the claimed invention by others;
- unexpected and superior results from the claimed invention; and
- acceptance by others of the claimed invention as shown by praise from others in the field or from the licensing of the claimed invention.

44. I understand that in order for such "secondary considerations" evidence to be relevant to the obviousness inquiry, there must be a relationship or "nexus" between the advantages and features of the claimed invention and the evidence of secondary considerations.

45. I understand that if a claim element is not obvious, then the claims that depend from it are not obvious.

46. I have been advised that in an *Inter Partes* Review the claim terms generally should be given their ordinary and customary meaning as a POSA would have understood them at the time of the invention and in light of the patent and its prosecution history. Furthermore, I have been instructed that a claim's plain language can help guide the interpretation of the claim terms in question, and the manner in which a claim term is used in a claim may be informative of its meaning.

47. Further, I have been informed that in an *Inter Partes* Review proceeding, only claim terms that are actually in dispute need be construed. Thus, terms that are not in dispute, or ones for which alternative constructions would not render a different finding, do not need to be construed.

48. I have also been advised that the claim terms being construed must be construed in light of, and consistent with, the intrinsic evidence of the patent. I understand that a patent's intrinsic evidence includes the patent's prosecution history (which includes the prior art considered by the Examiner(s)), the patent's claims, and the patent's written description as given in the specification of the patent.

49. I have also been advised that when the meaning of a patent's claim term is disputed, the specification of the patent itself is the best guide to the meaning of that claim term. I understand that while embodiments given by the specification can help understand the meaning of claim terms, preferred embodiments and other examples given in the specification should not further limit the claims by being read into the claim terms being construed.

50. I also understand that an inventor may act as his or her own lexicographer by specifically defining his or her own terms within the specification such that they then possess a specific meaning that can be different than the meaning they would otherwise have. I also understand that such an inventor can

overcome the plain and ordinary meaning of a given claim term if he or she clearly and explicitly defines or redefines a claim term.

51. I have also been advised that after the patent's claims and specification, the next critical source of evidence regarding the meaning of a patent's claim terms comes from the patent's prosecution history. I understand that the prosecution history contains remarks made by the applicant during prosecution of the application that issues as the patent and those remarks may act to define, redefine, disclaim, or limit the meaning of a claim term, and that if a patentee made statements during prosecution that so limits the scope of a claim term, it is improper for a patent owner to regain the scope given up during prosecution that leads to the issuance of the patent.

52. I have also been advised that in addition to the intrinsic evidence discussed above, extrinsic evidence may also be considered when construing claims, although it is generally not as significant as the intrinsic record itself when understanding the meaning of a claim term. It is my understanding that extrinsic evidence is any relevant evidence that would inform the understanding of the claim terms such as textbooks, dictionaries, expert testimony, treatises, or other like material.

VI. CLAIM CONSTRUCTION

53. I have been informed that for purposes of this *Inter Partes* Review, the standard for claim construction is the same as the standard used in federal district court litigation: claim terms should generally be given their ordinary and customary meaning as understood by a POSA at the time of the invention and after reading the patent and its prosecution history.

54. I have been informed that the following terms of the ’096 Patent were construed in a district court case between Patent Owner and Apple:

- “frame structure” (claims 1, 8): “a single structure comprising one or more frames, wherein each frame may have one or more subframes”;
- “symbol” (claims 1, 8): Plain-and-ordinary meaning, wherein the plain-and-ordinary meaning means “a transmissible unit of information”;
- “at least one of […] and […]” (claims 1, 2, 3, 4, 6, 8): “[…] and/or […]”;
- “symbol period” (claim 1): “the time it takes to transmit one symbol”; “pilot symbols that are denser than” (claim 8): “more pilot symbols per unit time than, wherein a unit time is the symbol period of the first communication system”;
- “communication system” (claims 1, 8): Plain-and-ordinary meaning, where the plain-and-ordinary meaning is “a combination of hardware and

software that transmits and receives data according to one or more communications standards";

- "wherein the first communication system's symbols and the second communication system's symbols co-exist in one transmission scheme" (claims 1, 8): Plain-and-ordinary meaning where the plain-and-ordinary meaning is "wherein symbols of the first communication system and symbols of the second communication system exist together in one transmission scheme";
- "data" / "non-data" (claims 1, 2, 3, 6, 7, 8): Plain-and-ordinary meaning (both); and
- "support higher mobility than" (claim 1): "support higher relative velocity between a transmitter and a receiver than." (Claim Construction Order in *STC.UNM v. Apple Inc*., No. 1-20-cv-00351 (W.D. Tex. Apr. 9, 2020), ECF No. 69, Ex. 1005).

55. I offer no opinion herein on the merits of the claim constructions, but reserve my right to do so in the future. The application of these construction would not change or alter my opinions that the challenged claims are unpatentable in view of the prior art discussed below. For the remaining claim terms, I have been asked to assume that the terms have their plain and ordinary meaning.

VII. LEVEL OF ORDINARY SKILL IN THE ART

56. In rendering the opinions set forth in this declaration, I was asked to consider the patent claims and the prior art through the eyes of a POSA at the time of the alleged invention, which I understand is potentially as early as September 17, 2007 (the filing date of the later provisional patent application identified on the face of the ’096 Patent). I understand that the factors considered in determining the ordinary level of skill in a field of art include the level of education and experience of persons working in the field; the types of problems encountered in the field; the teachings of the prior art, and the sophistication of the technology at the time of the alleged invention. I understand that a POSA is not a specific real individual, but rather is a hypothetical individual having the qualities reflected by the factors above. I understand that a POSA would also have knowledge from the teachings of the prior art, including the art cited below.

57. Taking these factors into consideration, in my opinion, on or around September 17, 2007, a POSA relating to the technology of the ’096 Patent would have had a Bachelor’s degree in electrical engineering, computer engineering, or a related field, and around two years of experience in the design or development of wireless communication systems, or the equivalent. Individuals with additional education or additional industrial experience could still be of ordinary skill in the

art if that additional aspect compensates for a deficit in one of the other aspects of the requirements stated above.

58. Well before September 17, 2007, my level of skill in the art was at least that of a POSA. I am qualified to provide opinions concerning what a POSA would have known and understood at that time, and my analysis and conclusions herein are from the perspective of a POSA as of that date.

VIII. BACKGROUND ON THE STATE OF THE ART

A. IEEE-SA Overview

59. The IEEE Standards Association ("IEEE-SA") is part of the Institute of Electrical and Electronics Engineers ("IEEE") that develops industry standards. Based on my familiarity with the IEEE-SA through my participation in IEEE standards development, I understand that IEEE-SA has procedures in place to ensure that their standards development is an open and fair process. Many participants with differing interests and priorities work together to agree on the final outcome of each standard. As part of this process, draft IEEE standards and amendments also go through multiple rounds of review and voting, during which they may be modified to ensure sufficient support.

60. The IEEE-SA is governed by a Board of Governors, which is elected by IEEE-SA members. The Board of Governors is responsible for overseeing the IEEE-SA Standards Board and the executive staff of the IEEE-SA.

61. The IEEE-SA Standards Board, which is responsible for overseeing the standards development process, reports directly to the Board of Governors. The Standards Board is appointed by the Board of Governors.

62. The Standards Board coordinates the development and revision of IEEE standards, approves the initiation of new standards projects, and gives final approval to IEEE standards before they are published. Standards Board members must be members of both IEEE and IEEE-SA.

63. IEEE-SA has two types of memberships: individual and corporate. Individual membership is open to individuals who are interested in participating in the standards-setting process, while corporate membership is for companies. Individual members may not represent entities but may be affiliated with them. For example, employees of a particular company may be individual members. Membership is not required to participate all aspects of the standards-setting process, but certain stages, such as IEEE-SA balloting (explained further below), are only open to members. Whether membership is by individuals or corporations is determined when the working group is established and remains constant throughout the existence of the working group.

64. IEEE-SA develops many different standards, including the well-known family of networking standards from the IEEE 802 LAN/MAN Standards committee. IEEE 802 includes multiple working groups, which are responsible for

actually developing and writing standards. The largest of these are IEEE 802.3, which develops wired Ethernet standards and IEEE 802.11, which develops wireless local area networking standards that are commonly called Wi-Fi. Other groups include 802.15, which develops standards for wireless specialty networks (WSN) such as UWB, and 802.16, which developed standards for Metropolitan Area Networks that is commonly called WiMax up until 2018.

65. Activity in IEEE 802 Working Groups will expand or contract with the level of industry interest in the particular technology that is addressed by the group. For example, IEEE 802.3 and IEEE 802.11 continue to maintain robust levels of activity as engineers work to add new features to their respective standards. IEEE 802.16 on other hand went into hibernation in 2018 due to lack of interest. It is not clear if 802.16 will continue in the future.

66. The IEEE 802.11 Working Group has been active since 1990 and hold six meetings per year. Each meeting has sessions for the entire Working Group and individual study groups and task groups. Task groups are typically devoted to developing a new amendment to the 802.11 standard. Study groups investigate the potential of new ideas and often do the background work to launch a new task group.

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B. Standards Development Process

67. A new task group can only begin work after the approval of a project authorization request ("PAR") by the IEEE-SA. A PAR is a formal document that outlines the scope of the proposed project and what it intends to achieve. Often, a study group will form to draft the PAR and gain the support of the entire working group and sponsor. For wireless networking standards, such as 802.11, the sponsor is the 802 LAN/MAN standards committee.

68. The 802.11 Working Group operates on an individual basis. Individual members are usually affiliated with an entity, such as a corporation or a university and must disclose this affiliation. An individual is not required to be a member of the IEEE or the IEEE-SA.

69. Full participation, via voting on motions and draft standards, is only possible for individuals who regularly attending working group meetings. These people are known as "Voting Members." New or irregular participants who are not voting members may participate in presentations and debate at meetings with the consent of the chair presiding at the meeting. The working group maintains an attendance system for keeping track of the voting members.

70. The working group will create a new task group to take on the development of a new amendment. A task group begins by drafting the rules by which it will operate. The most critical of these rules is the procedure for selecting

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features for the amendment. In the past, it was common to have a call for proposal and a series of votes on the proposals. This was the method used in the task groups for 802.11g and 802.11n.

71. More recently, task groups such TGac, which developed 802.11ac, and TGax, which developed 802.11ax, chose a more incremental approach. First the groups created a set of functional requirements. Next participants made contributions to a specification framework for the final amendment. Detailed draft text was then voted in piece by piece to fill out the specification and create the first complete draft.

72. In every IEEE 802 project, participants in the working group and task groups will share technical contributions through the IEEE-SA's file server. This file server is open to the public to download documents. To upload documents, an individual must attend at least one working group meeting. Uploading to the IEEE-SA server automatically gives the IEEE permission and to publish standards based on the submissions.

73. When a task group has completed an initial draft for the new amendment or standard, a vote is called. There IEEE holds a first series of ballots in the working group and then a second series for the entire IEEE-SA. Confirmation requires a 75% approval on the returned ballots. Drafts are rarely confirmed in the first round of voting. Instead, voters who choose to disapprove

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the draft submit comments with suggested changes. The task group reviews the comments and updates the draft before subsequent voting rounds.

74. Each task group has a technical editor, who organizes the ballot comments and the group resolutions into a spreadsheet. The editor also assembles each draft document for voting. Comments and resolutions from the ballots are posted on the IEEE-SA file server.

75. IEEE 802 standards typically receive at least a 90% approval rate in the IEEE-SA ballot series before being forwarded the Standards Board for approval. Once approved, the standard will be published after it is edited by the IEEE standards publication department. The sponsor is a gatekeeper of the request to proceed to the Standards Board for approval. The IEEE 802 sponsor appears to expect approval in the IEEE-SA ballot in the 90% range as a measure of consensus.

C. History of the 802.11 Standard

76. The IEEE Standards development process recognizes standards, amendments, and revisions. A standard, such as IEEE 802.11-2007 is standalone document. An amendment, such as IEEE 802.11n-2009, modifies a standard and can only be read in the context of the standard it modifies, which is called a baseline. A revision is a modification to an existing standard (such as making

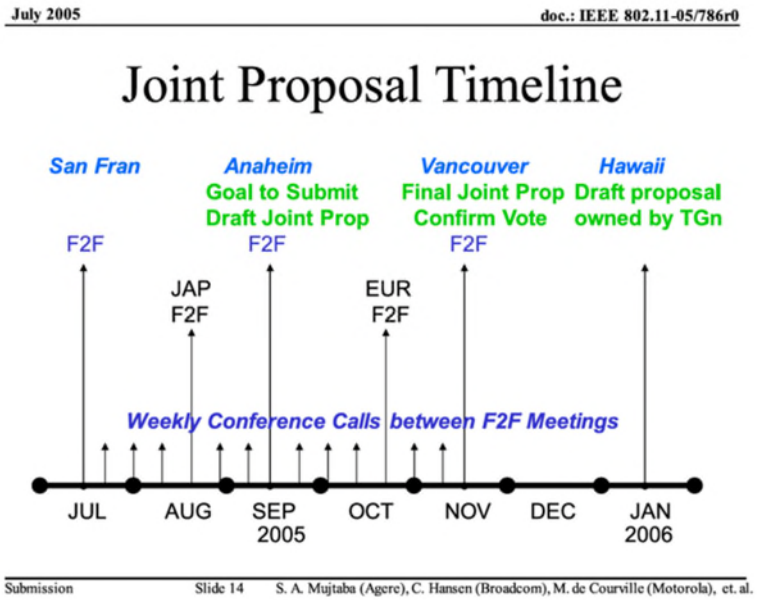
editorial fixes or removing functions that are no longer needed) and rolls up any new amendments into the standard.

77. The IEEE 802.11 Standard was created to enable computers that had traditionally used wired networks, such as IEEE 802.3 (Ethernet), to instead communicate over relatively short ranges using radio communication. IEEE 802.11 created new MAC and PHY layers that would replace the 802.3 MAC and PHY layers. Thus, early systems based on IEEE 802.11 were referred to as "Wireless Ethernet". The first IEEE 802.11 standard was ratified in 1997. Wireless LANs based on 802.11 became popular in the early 2000s.

D. Development of 802.11n

78. IEEE 802.11n was developed in Task Group n of the IEEE 802.11 Working Group (TGn). TGn began conducting meetings in September of 2003. Initial proposals made from several competing industry groups were first reviewed a year later in September 2004. In July 2005, TGn held a meeting in San Francisco and agreed to merge the competing proposals to create a joint proposal. Mujtaba, *et al*., IEEE 802.11-05/786r0, "TGn Sync, WWiSE, and Mitmot Closing Report," July 21, 2005 (Ex. 1019, "July 2005 Closing Report"). As a voting member of the IEEE working group and affiliated with and working for Broadcom, I personally participated in the July San Francisco meeting and jointly authored the July 2005

Closing Report with my colleague Syed Aon Mujtaba,[1] who was also a member of TGn and affiliated with Agere System. *Id*. According to the July 2005 Closing Report, the joint proposal would be submitted to TGn for voting in January 2006 in Hawaii. *Id*. at 14.



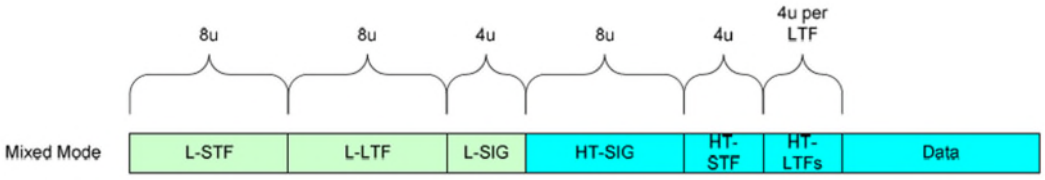
Ex. 1019, Slide 14

79. In the Hawaii meeting from January 16- 20, 2006, the joint proposal (Ex. 1008, "Joint Proposal"), was presented to TGn and was ultimately selected as the baseline specification for the physical layer (PHY) of 802.11n (Ex. 1009).

80. As detailed below, the Joint Proposal for 802.11n defines a new packet format in physical layer (PHY) for data transmission. The following figure

[1] Syed Aon Mujtaba is the named inventor of U.S. Pub. No. 2006/0072529 A1 ("Mujtaba," Ex. 1010).

illustrates the new packet format specified in the Joint Proposal. Joint Proposal, at 11, Figure 1-PLCP packet format (excerpted).



Ex. 1008, Figure 1 (excerpted)
Joint Proposal's Mixed Mode Packet Format

81. This new packet format has an 802.11 a (legacy system) preamble (*i.e.*, L-STF, L-LTF, L-SIG) in the legacy field and a high throughout ("new" or "HT" system) preamble (*i.e.*, HT-SIG, HT-STF, HT-LTFs) in the HT field following by the data field. *Id*. In this new packet format, the legacy preamble is compatible with legacy 802.11a devices and the HT preamble is compatible with HT devices (*i.e.*, 802.11n devices). *Id*. at 11:18-23. The Joint Proposal also specifies that both legacy field transmission and HT field transmission use orthogonal frequency division multiplexing (OFDM) symbols. *Id*. 21:7-19.

82. As a member of TGn, I personally participated and reviewed the joint proposal in the January 2006 Hawaii meeting. According to the Joint Proposal, my colleague Syed Aon Mujtaba is also a co-author of the proposal. (Ex. 1008), at 5. A series of letter ballots were held on drafts for IEEE 802.11n from 2006 to 2009. Each letter ballot included a comment resolution process afterwards in which revisions to each draft were adopted. The final draft of 802.11n was completed in

June of 2009 and the final official version of 802.11n was published later that year. The standard has been labelled as "Wi-Fi 4" by Wi-Fi Alliance.[2]

83. I was informed that the Industrial Technology Research Institute ("ITRI") was the original assignee of the '096 Patent. ITRI's employees were also members of TGn and participated in TGn's meetings. With respect to ITRI's proposals to 802.11n, I have reviewed all documents in the IEEE's Mentor website and only found 11 documents that ITRI uploaded and submitted to TGn including 9 documents authored by Pang-An Ting, who is a named inventor of the '096 Patent. (Ex. 1025). Having reviewed these documents, ITRI's only meaningful proposal to TGn in 2004 was a preamble structure for the short training and long training fields in the HT fields. (Ex. 1026). To my knowledge, ITRI, either alone or in collaboration with any industry group, did not make any proposal or contribution relating to a short guard interval between OFDM symbols transmitted in the HT format and denser pilots in the HT transmission than the legacy transmission.

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[2] The Wi-Fi Alliance is a non-profit organization that owns the Wi-Fi trademark. Manufacturers may use the trademark to brand products certified for Wi-Fi interoperability (https://www.wi-fi.org/certification) .

E. 802.11ac and 802.11ax

84. Both 802.11ac and 802.11ax are amendments to the IEEE 802.11 standard that enabled higher-throughput wireless networks by enhancing the MIMO-OFDM (Multiple Input Multiple Output) PHY protocol that was defined in 802.11n.

85. Like 802.11n, 802.11ac and 802.11ax incorporated packet (PPDU) formats that were backward compatible with older Wi-Fi devices. 802.11ac increased the channel bandwidth from 40 MHz used in 802.11n to 80 MHz, improved the beamforming protocols, and added downlink MU-MIMO. 802.11ax further increased the available bandwidth to 160 MHz, and added uplink MU-MIMO as well as downlink and uplink OFDMA.

86. 802.11ac was approved and published as an IEEE standard on December 2013, and has been labelled as "Wi-Fi 5" by the Wi-Fi Alliance. 802.11ax was approved and published on February 1, 2021, and has been labelled as "Wi-Fi 6" by Wi-Fi Alliance.

87. The Toyota vehicles are being accused of infringing the '096 Patent by Patent Owner on the basis that the accused vehicles support 802.11ac or 802.11ax in *UNM Rainforest Innovations f/k/a STC.UNM v. Toyota Motor North America, Inc. et al*, 2-23-cv-00424 (E.D. Tex) (Ex. 1022).

F. 802.16m

88. I have reviewed the ’096 Patent, which specifically identifies IEEE amendments 802.16e and 802.16m as examples of two communication systems and labels them the “legacy” and “new” systems, respectively. ’096 Patent, at 1:27- 31. One purpose of this combined system is to support backward compatibility in 802.16m systems. *Id*. at 1:31-35.

89. As stated previously, IEEE 802.16 is a series of wireless broadband standards written by the IEEE. The IEEE Standards Board established the 802.16 Working Group in 1999 to develop standards for broadband for wireless metropolitan area networks. The 802.16 Working Group is a unit of the IEEE 802 local area network and metropolitan area network standards committee. Although the 802.16 family of standards is officially called WirelessMAN in the IEEE, it has been commercialized under the name “WiMAX.”

90. Although I was not personally involved in the development of the 802.16 standards, I knew that there was a separate task group—namely IEEE 802.16 Task Group m (TGm)—which was working on the development of the 802.16m standard. I believe that TGm’s activities in the development of 802.16m started long after TGn’s activities in the development of 802.11n. For example, TGm published the first version of draft IEEE 802.16m requirements on January

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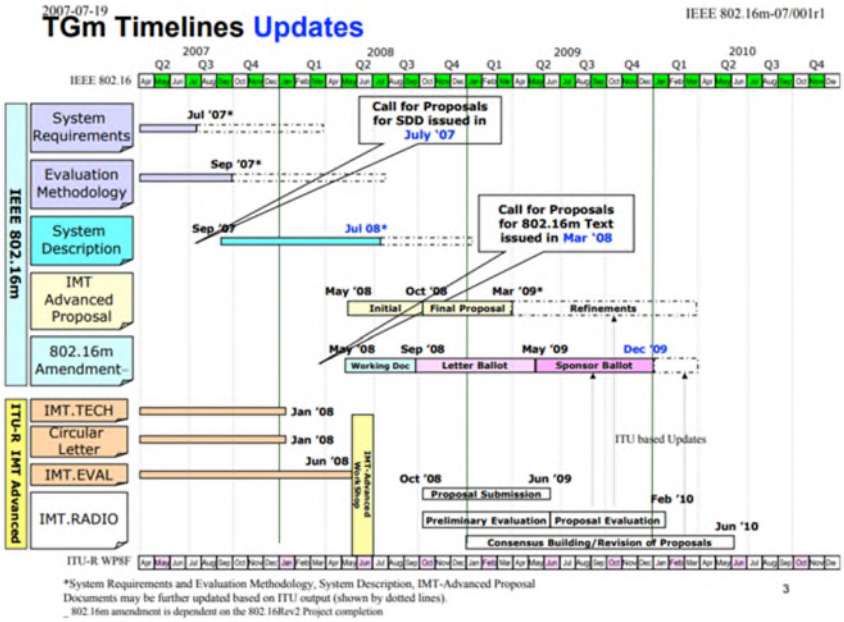
18, 2007 (Ex. 1023).[3] This draft, which was published almost a year after the Joint Proposal for 802.11n was approved in January 2006 in Hawaii, discloses nothing about any packet or frame structure, let alone any symbol length or pilot density. In addition, TGm also published the first version of its work plan for development of IEEE 802.16m draft standard on July 19, 2007 (Ex.1024).[4] According to the timelines in TGm's work plan, TGm's call for the earliest proposals for 802.16m was scheduled in July 2007. *Id*. at 3. In other words, it was highly likely that TGm did not start receiving any detailed technical proposals from members of the working group until July 2007.



Ex. 1024, Slide 3

[3] Available at https://www.ieee802.org/16/tgm/docs/80216m-07_002.pdf
[4] Available at https://www.ieee802.org/16/tgm/docs/80216m-07_001r1.pdf

G. MIMO-OFDM

91. Multiple Input Multiple Output (MIMO) Orthogonal Frequency Division Multiplexing (OFDM) is a technology used for bandwidth efficient wireless communication with multiple antennas at the transmitter and the receiver. MIMO-OFDM works by incorporating multiple antenna technology to add spatial multiplexing on top of the orthogonal channel system of OFDM. *See e.g.*, U.S. Pub. No. 2006/0072529 A1, (Ex. 1010, "Mujtaba") at [0003]. This allows multiple data streams to occupy a radio channel, which greatly increases the available data rate. *Id*.

92. OFDM was introduced to IEEE 802.11 standards with IEEE 802.11a in 1999. IEEE Std 802.11a-1999 Part 11 (Ex. 1014), at 3. OFDM is designed to mitigate the effects of radio channel multipath which cause inter-symbol interference (ISI) in a wireless system. Multipath is the result of multiple signal paths that radio waves travel from a transmitter to a receiver. These paths typically include a direct or line-of-sight path and one or more paths that include reflections from walls, floors, ceilings, and objects nearby. Radio signals, consisting of modulated data symbols, will follow these paths that converge at the receiving antenna. This creates inter-symbol interference. And it was known that such inter-symbol interference would be impacted by different users travel at different speeds and thus experience different Doppler shifts. *See* U.S. Pub. No. 2007/0104174

(Ex. 1018, "Nystrom"), at [0004] (stating that "different users travel at different speeds and thus experience different Doppler shifts.").

93. OFDM mitigates the inter-symbol interference by portioning the radio channel with orthogonal sub-carriers, or sub-channels, using discrete Fourier Transforms (DFTs) at the transmitter and receiver and allowing simple equalization at the receiver. Since the DFT can be implemented efficiently with the Fast Fourier Transform (FFT), it is a practical system that is relatively easy to implement in low cost commercial products.

94. IEEE 802.11n was the first amendment to IEEE 802.11 that supported MIMO technology. New physical layer modes were defined that included support for multiple transmit (*i.e.,* multiple input) and multiple receive antennas (*i.e.,* multiple output). These modes defined the methods for devices to incorporate MIMO into transceiver designs so that would be interoperable. Thus, a MIMO transmitter made by one manufacturer would send signals that would be understood by receivers made by other manufactures.

95. The adoption of IEEE 802.11n made wireless networks that were much faster than earlier 802.11a and 802.11g systems. Thus, IEEE 802.11n was a popular standard that was implemented widely.

96. It was known that OFDM was not only considered and adopted in wireless local area network technologies specified in IEEE 802.11 standards, but

also considered or adopted in the IEEE 802.16 standards (WiMax). *See* U.S. Pub. No. 2008/0095195A1 (Ex. 1020, "Ahmadi"), at [0048], and 3GPP cellular systems. *See* U.S. Pub. No. 2006/0146867 A1 (Ex. 1013, "Lee"), at [0002].

H. OFDM Symbols

97. Data transmissions following IEEE 802.11n employ OFDM symbols. It was known that each symbol is constructed from encoded data that is first interleaved and then mapped to constellation points. *See* Mujtaba (Ex. 1010), , at [0016]. The constellation points, which are represented with a sequence of complex numbers, are processed with an inverse DFT to create the output samples of a data symbol. *Id*.

98. To retrieve the data, the receiver will process the samples that make up a symbol in a series of steps that are the opposite of those used in transmission. First, a DFT is used to create a sequence of received constellation points. These points are then equalized and de-mapped. *Id*., at [0017]. Lastly, they are de-interleaved and decoded in the data bits that were transmitted. *Id*.

I. Guard Interval

99. Guard intervals are used in OFDM systems to help mitigate the effects of inter-symbol interference, which will smear the end of one symbol into the beginning of the next symbol. Each OFDM symbol has a guard interval placed before the start of the DFT output sequence. Since symbols are transmitted in

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sequence, it was known that the guard interval of a symbol will help protect that symbol from interference from the previous symbol. *See e.g.,* U.S. Pub. No. 20070155387A1 (Ex.1021, "Li"), at [0016], [0035], [0037], [0042] (disclosing a system in accordance with 802.11n and earlier standards with shorter symbol duration (*i.e.*, shorter guard interval) assigned to fast subscribers and longer symbol duration (*i.e.*, longer guard interval) assigned to slow subscribers less prone to inter-subcarrier interference.).

100. IEEE 802.11 systems use cyclic pre-fixes for the guard interval. A cyclic prefix is created by copying a sequence of samples at the end of the symbol and placing the copies at the beginning of the sequence. The cyclic pre-fix has the effect of making the inter-symbol interference appear as a cyclic convolution of the symbol sequence and the multipath channel. This allows simple equalization using a DFT in the receiver.

101. It was known that OFDM symbols transmitted in sequence with a guard interval would be used in communication systems in accordance with the IEEE 802.11 standards. Mujtaba, at [0016], [0017]; Li, at [0016], [0020], [0035], [0038]. It was also known that a wireless communication system in accordance with 802.11 standards may assign shorter OFDM symbol period to users moving at faster speed and assign longer OFDM symbol period to users moving at slower speed. Li, at [0016], [0035], [0037], [0042].

J. Pilot Symbol

102. Pilot symbols are used in OFDM systems to allow the receiver to understand and track the effects of the radio channel. This is necessary for the receiver to successfully demodulate and decode the transmitted data.

103. In IEEE 802.11n, pilot symbols are created with a fixed, pseudo-random sequence that is modulated on a subset of the subcarriers that are a part of each OFDM symbol. Since the method for generating the pilot symbols is defined in the standard, the receiver will always know what they are. Thus, each received symbol will contain both the unknown information of the transmitted data and the known information of the pilots. The known information is then used to help demodulate the unknown information.

104. It was known in the art that four subcarriers are assigned to carry pilot symbols in accordance with the IEEE 802.11a standard. *See* U.S. Pub. No. 2006/0067415 A1, (Ex. 1012, "Mujtaba II"), at [0004], [0015], [0017], [0020] (disclosing wireless communication system in accordance with 802.11a/g standard with four pilot symbols employed to transmit data in OFDM symbols.).

K. Channel Estimation

105. Channel estimation is the process by which the receiver determines the distortion produced by the radio channel between the transmitter and the receiver. The channel estimation is then used by the receiver to remove common

phase error (CPE) and to equalize the effects of inter-symbol interference. Mujtaba, at [0005]. Channel estimation is essential to successfully demodulating and decoding the received data.

106. Pilot symbols are used by the receiver for channel estimation. *Id*. Since the receiver knows what pilot symbols were transmitted in each data symbol, it can compare that knowledge with the received pilot symbols. The receiver will use this process to determine or enhance its channel estimates for each symbol. This information will then be used to assist with demodulation and decoding.

107. A conventional process of channel estimation based on pilot symbols in a MIMO-OFDM system, which was designed to modify the 802.11a system, is illustrated in the following figure. U.S. Pub. No. 2005/0233709A1, (Ex. 1016, "Gardner"), at 9:23-47, Fig. 9.

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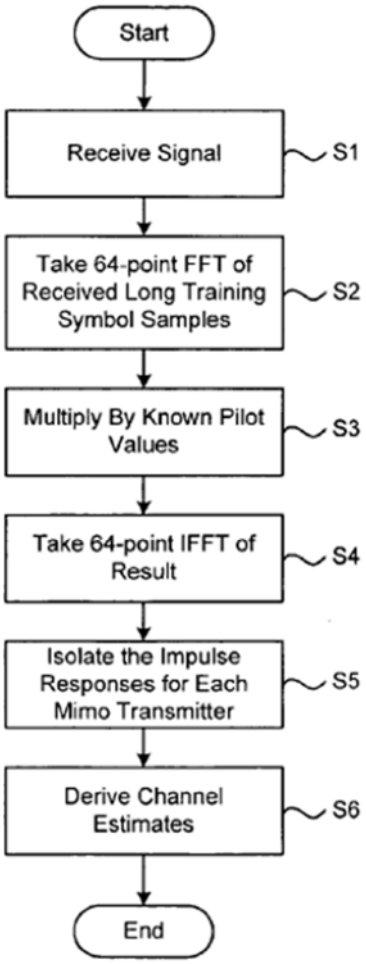


FIG. 9

Ex. 1016, Fig. 9

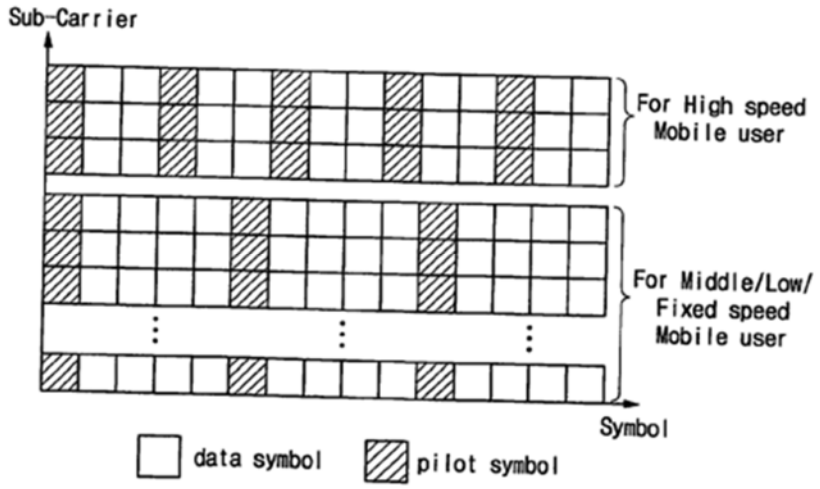
108. It was also known in the art that in a dual packet configuration for wireless communications in accordance with the IEEE 802.11, the number of pilot symbols and guard interval can be modified independently or in combination to achieve various purposes. (Ex. 1017, "Webster"), at Abstract. For example, it was well known in the art that shortening the guard interval between OFDM symbols results in shorter symbol period. *Id*. at 11:5-10, Fig. 8B, Fig.11; *see also* Trainin (Ex. 1011), at [0032], Fig. 2.

109. In addition, it was known in the art that increasing the number of pilot symbols can improve channel estimation for the IEEE 802.11 systems. Mujtaba (Ex. 1011), at [0021].

110. It was known in the art that the technique of using pilot symbol to estimate the channel was not only considered and adopted in the 802.11 systems, but was also considered and adopted in the 802.16 systems. Li, at [0041]; *see also* U.S. Pub. No. 2006/0146867 A1 (Ex. 1013, "Lee"), Abstract, [0014]-[0019].

111. And it was known in the art that the number of pilot symbols can be adaptively assigned to subcarriers in a MIMO-OFDM system according to each user's moving speed, channel status and so on. Lee, at [0014]-[0019], Fig. 12.

Fig. 12



Ex. 1013, Fig. 12

IX. THE CHALLENGED ’096 PATENT

A. Background and ’096 Patent Specification

112. The ’096 Patent is titled “Method For Constructing Frame Structures” and relates to frame structures for transmitting data using a “first section comprising data configured in a first format compatible with a first communication system,” a “second section comprising data configured in a second format compatible with a second communication system, wherein the second format is different from the first format,” and “at least one non-data section containing information describing an aspect of data in at least one of the first section and the second section.” ’096 Patent, Abstract. The second system “has pilot symbols that are denser than those in the first communication system” (Claim 8) and is further “configured to support higher mobility than the first communication system” and uses “a shorter symbol period than that in the first communication system” (Claim 44).

113. The ’096 Patent refers to orthogonal frequency-division multiple access (“OFDMA”) systems that allow “simultaneous transmission of data from different users without interference from one another.” *Id*. at 1:24-27. The ’096 Patent specifically identifies IEEE standards 802.16e and 802.16m as examples of two communication systems and labels them the “legacy” and “new” systems, respectively. *Id*. at 1:27- 31. One purpose of this combined system is to support

backward compatibility in 802.16m systems. *Id*. at 1:31-35. Specifically, the '096 Patent explains that the legacy system may be susceptible to a Doppler effect in a high mobility scenario because the placement may be usually designed with a relatively large symbol period, which in turn may induce relatively short carrier spacing and less dense pilot symbol placement." *Id*. at 2:6-11.

114. The '096 Patent goes on to explain that "the limitation on pilot symbol placement may cause channel estimation error at a receiving end because of insufficient information provided for channel estimation." *Id*. at 2:11-14. To improve channel estimation in a high-mobility environment, the '096 Patent proposes a frame structure for the "new system" under high mobility that has "a shorter symbol period or more pilot symbols" than the "legacy system." *Id*. at 5:1-16. The '096 Patent concludes that "[g]enerally, a shorter symbol period may be more robust to inter-symbol interference, while denser pilot symbols may achieve better channel estimation accuracy." *Id*. at 5:16-18.

115. The patent also discloses the "prior art" frame structure that was defined by the 802.16(e) standard. *Id*. at 1:36-49, Fig.1. This 802.16(e) frame structure includes a preamble, a frame control header (FCH), and a downlink map (DL-MAP) portions, and subframes for carrying downlink and uplink data. *Id*. at 1:46-57.

B. Overview of the ’096 Patent Prosecution History

116. The application leading to the ’096 Patent was filed on July 7, 2008 as U.S. Pat. App. No. 12/168,855 and claimed priority to Provisional application Nos. 60/929,798 (“Prov. No. ’798”, Ex. 1003) and 60/973,157 (filed on July 12, 2007 and September 17, 2007, respectively). ’096 Patent, cover.

117. Prov. No. ’798 is a 9-page slide deck that does not contain any disclosure relating to a frame structure with two sections wherein the second section has a shorter symbol period or denser pilot symbols. The Summary refers generically to “[a]n OFDMA system with multiple zones” and “[a]n OFDMA system with multiple DL (UL) subframes from multiple standards,” but it does not refer to any symbol structure for any system. Ex. 1003, at 9-10.

118. The summary also refers to 802.16e and “[n]ew standard 802.16m,” but provides no details about proposed or actual symbol structures of 802.16e or 802.16m systems, let alone anything specific about symbol periods or pilot density for certain communication systems; indeed, at the time Prov. No. ’798 was filed, no draft of the 802.16m standard had yet been issued. A POSA would not have understood generic references of Prov. No. ’798 to 802.16e or 802.16m to indicate specific frame structure with specific symbol duration or pilot density.

119. During prosecution of the application that issued as the ’096 Patent, the applicants amended claim 1 to recite, “the second communication system

configured to support higher mobility than the first communication system, wherein each symbol in the second communication system has a shorter symbol period than that in the first communication system." Excerpt of the'096 Patent Prosecution History (Ex. 1004) at 80.

120. To distinguish prior art cited by the Examiner from the amended claims, the applicants argued in response to a Non-Final Rejection that "[h]owever, the pre-designated legacy system transmission period would be susceptible to a Doppler effect in a high mobility scenario, **because the placement is designed with a relatively large symbol period, which in turn induces relatively short carrier spacing and less dense pilot symbol placement**." *Id*. at 92 (emphasis added). To overcome the following Final Rejection, the Applicants underscored the limitation that "**symbols in the second communication system have a shorter symbol period than those in the first communication system[,]**" and further argued that "[**n]owhere does Ahmadi appear to disclose that a shorter frame size necessarily equates to a shorter symbol period**." *Id*. at 49 (emphasis added).

121. A POSA would understand the arguments by the applicants to indicate that the "first communication system" is susceptible to a problem, referred to as "Doppler effect" attributed to a high mobility system, because the "first communication system" has a larger symbol period with less dense pilot symbols,

but the "second communication system" mitigates the "Doppler effect" because it has a shorter symbol period with denser pilot symbols.

122. The applicants further amended independent claims to recite, "wherein the first communication system and the second communication system co-exist in one transmission scheme." '096 Patent Prosecution History (Ex. 1004) at 2-13. The applicants directed the Examiner to "paragraph [0025]" of the specification for the filed application (corresponding to '096 Patent at 4:21-41) as the support for this amendment. *Id*. at 15. The indicated passage states in relevant part, "Examples of the present invention may allow data of an old [OFDMA] system … and data of a new OFDMA system to co-exist in an OFDMA frame by changing a frame structure of the OFDMA frame." '096 patent at 4:21-41. A POSA would understand this statement by the applicants to indicate that one example of communication systems that "co-exist in one transmission scheme" is when data from two communication systems co-exists in a frame.

C. <u>Overview of ITRI's Infringement Action in 2015</u>

123. I have been informed that ITRI filed a patent infringement lawsuit against LG Electronics and its U.S. subsidiaries ("LGE") in the Eastern District of Texas on April 24, 2015. *Industrial Technology Research Institute v. LG Electronics, Inc. et al*, 2-15-cv-00552 (E.D. Tex) (Ex. 1027). In the complaint, ITRI alleges that LGE infringes the '096 Patent because certain LGE's mobile

phones support the IEEE 802.11n and later standards. *Id*. ¶10. I was informed that the parties in this lawsuit settled without litigating substantively.

D. Overview of Patent Owner's Infringement Contentions in *UNM Rainforest Innovations f/k/a STC.UNM v. Toyota Motor North America, Inc. et al*, 2-23-cv-00424 (E.D. Tex)

124. I was informed that since the '096 Patent was assigned to Patent Owner, Patent Owner filed a series of infringement actions in the U.S. against a number of operating companies including the lawsuit filed on September 18, 2023 against certain Toyota's U.S. subsidiaries in the Eastern District of Texas. (Ex. 1022).

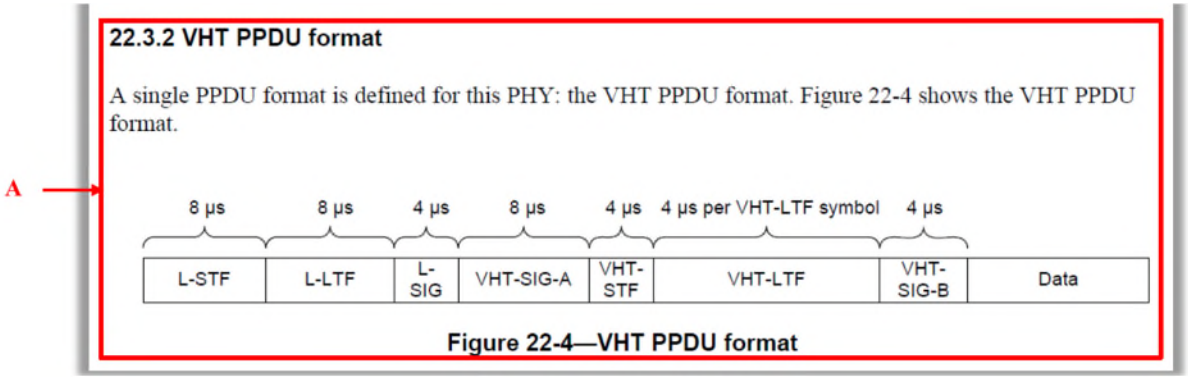
125. In its complaint, Patent Owner alleges that the Toyota defendants infringe claim 8 of the '096 Patent because claim 8 of the '096 Patent is essential to the IEEE 802.11ac or IEEE 802.11ax and the accused Toyota vehicles have built-in Wi-Fi hotspots/access point supporting the IEEE 802.11ac or IEEE 802.11ax wireless networking standard(s). *Id*. ¶ 12.

126. On November 30, 2023, Patent Owner filed its infringement contentions with the court (Ex. 1028), and 19 claim charts contending that claim 8 of the '096 Patent is essential to the IEEE 802.11ac or ax standard. For example, Patent Owner contends that Toyota RAV 4 Prime has a W-Fi hotspot supporting compatible Wi-Fi communication protocols (*i.e.*, IEEE 802.11a, IEEE 802.11n and IEEE 802.11ac) (Ex. 1029), at 5. Patent Owner's contentions that the Toyota

defendants infringe claim 8 of the ’096 Patent on an element-by-element basis are described below.

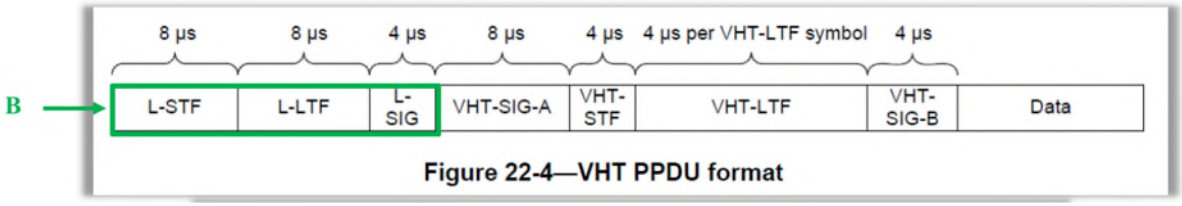
1. 8 [pre]: A method of constructing a frame structure for data transmission, the method comprising

127. Patent Owner contends that the IEEE 802.11ac standard specifies a VHT PPDU format which allegedly constructs the claimed frame structure for data transmission. *Id*. at 9. The accused VHT PPDU format is reproduced in the following figure. *Id*. (excerpted).



2. 8 [a]: generating a first section comprising data configured in a first format compatible with a first communication system using symbols

128. Patent Owner contends that the IEEE 802.11ac generates the claimed first section because the VHT PPDU format has a legacy field including the L-STF field, the L-LTF field and the L-SIG field. *Id*. at 11. The accused legacy field in the VHT PPDU format is reproduced in the following figure. *Id*. at 12 (excerpted).



129. Patent Owner further contends that the data carried in the L-SIG field of the VHT PPDU is configured in a first format compatible with a first communication system because the IEEE 802.11ac specifies that the L-SIG field is used to communicate rate and length information. *Id*. at 18.

21.3.8.2.4 L-SIG definition

The L-SIG field is used to communicate rate and length information. The structure of the L-SIG field is defined in Figure 17-5.

In a VHT PPDU, the RATE field shall be set to the value representing 6 Mb/s in the 20 MHz channel spacing column of Table 17-6. In a non-HT duplicate PPDU, the RATE field is defined in 17.3.4.2 using the L_DATARATE parameter in the TXVECTOR.

130. The accused L-SIG field in the VHT PPDU format is reproduced in the following figure. *Id*. at 21 (excerpted).

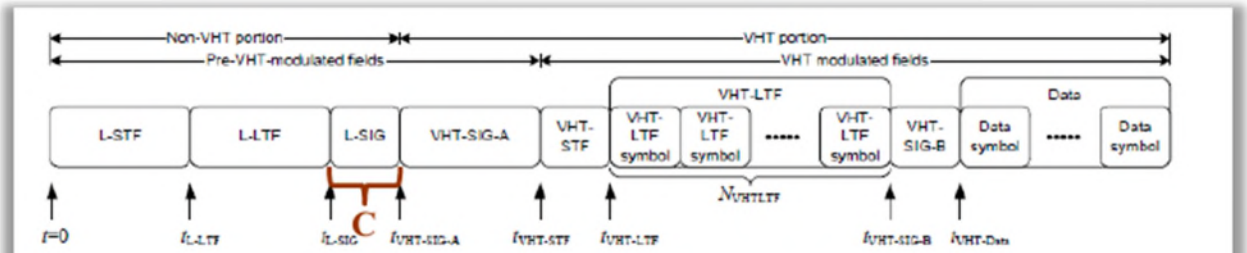


Figure 22-17—Timing boundaries for VHT PPDU fields

131. Patent Owner also contends that the IEEE 802.11ac generates the claimed first section using symbols because the IEEE 802.11 specifies the construction of the L-SIG field using multiple steps including the step of pilot

insertion and the step of IDFT (*i.e.*, Compute the inverse discrete Fourie transform), and the guard interval duration used for each OFDM symbol in the field. *Id*. at 24-28.

3. <u>8 [b]: generating a second section following the first section, the second section comprising data configured in a second format compatible with a second communication system using symbols</u>

132. Patent Owner contends that the IEEE 802.11ac generates the claimed second section following the claimed first section because the VHT PPDU format includes the "Non-VHT portion" followed by the "VHT portion." *Id*. at 29. The accused "VHT portion" following the "VHT portion" is reproduced in the following figure. *Id*.

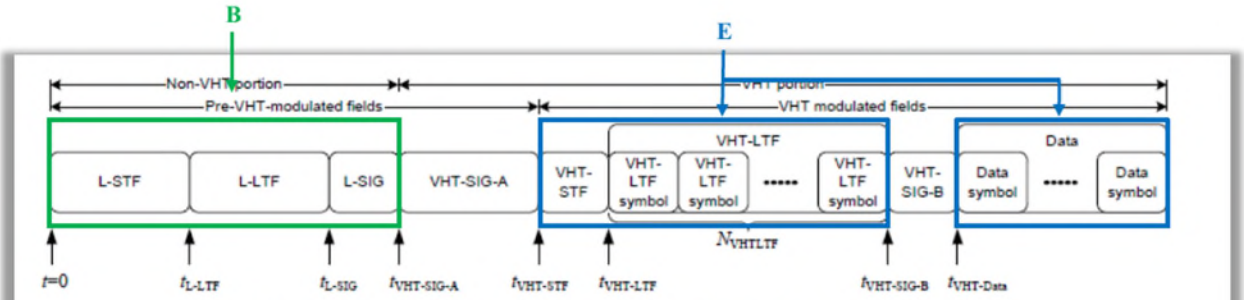


Figure 22-17—Timing boundaries for VHT PPDU fields

133. Patent Owner also contends that the data carried in the claimed second section is configured in a second format compatible with a second communication system because the IEEE 802.11ac specifies that the "VHT-portion" in the VHT PPDU format includes the "Data" field. *Id*. at 34 (excerpted).

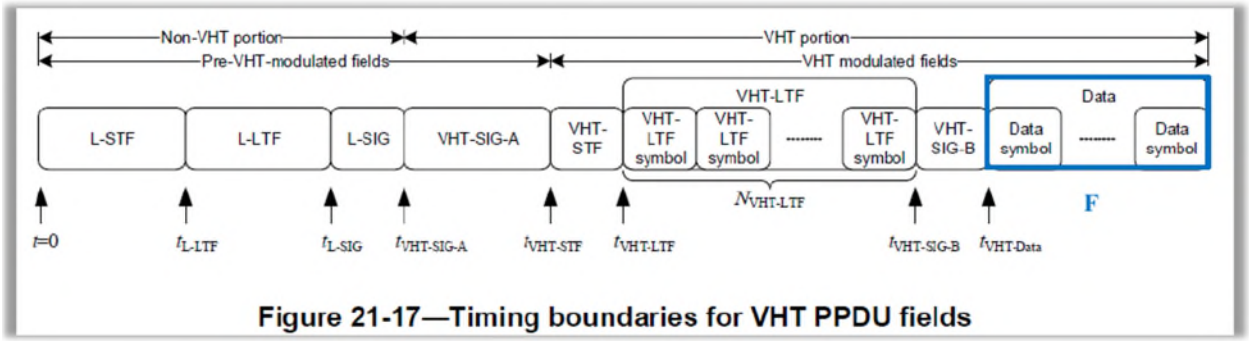


Figure 21-17—Timing boundaries for VHT PPDU fields

134. Patent Owner further contends that the accused "Data" field uses symbols because the IEEE 802.11ac specifies so. *Id*. at 36-38.

4. <u>8 [c]: wherein the first communication system's symbols and the second communication system's symbols co-exist in one transmission scheme</u>

135. Patent Owner contends that the IEEE 802.11ac specifies that the claimed first and second communication systems co-exist in a transmission scheme because the accused legacy fields (*i.e*., L-STF, L-LTG and L-SIG) and the VHT fields (*i.e*., VHT-STF, VHT-LTF and Data) co-exist in the accused VHT PPDU format and make use of OFDM transmission scheme symbols. *Id*. at 39-44. (excerpted).

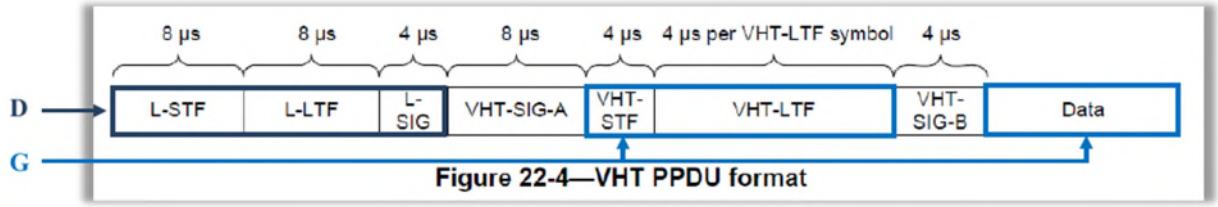


Figure 22-4—VHT PPDU format

5. 8 [d]: wherein the second communication system has pilot symbols that are denser than those in the first communication system

136. Patent Owner contends that the IEEE 802.11a specifies that the pilot symbols in the claimed second communication system are denser than the pilot symbols in the claimed first communication system because the IEEE 802.11ac specifies that the first communication system uses a long guard interval (*i.e.*, T_{GI}) resulting in a longer symbol interval or symbol period of 4 microseconds (*i.e.*, T_{SYM}), and the second communication system uses a short guard interval (*i.e.*, T_{GIS}) resulting in a shorter symbol interval or symbol period of 3.6 microseconds (*i.e.*, T_{SYMS}). *Id*. at 46 (excerpted).

Table 21-5—Timing-related constants

Parameter	CBW20	CBW40	CBW80	CBW80+80	CBW160	Description
T_{SYML}	$4\ \mu s = T_{DFT} + T_{GI} = 1.25 \times T_{DFT}$					Long GI symbol interval D
T_{SYMS}	$3.6\ \mu s = T_{DFT} + T_{GIS} = 1.125 \times T_{DFT}$ J					Short GI symbol interval G
T_{SYM}	T_{SYML} or T_{SYMS} depending on the GI used (see Table 21-8)					Symbol interval

137. Since I have been informed that "pilot symbols that are denser than" recited in claim 8 means "more pilot symbols per unit time than, wherein a unit time is the symbol period of the first communication system" in the Claim Construction Order (Ex. 1005), this infringement contention is based on the premise that (1) the long guard interval is part of the symbol interval or symbol

period in the claimed first communication and the short guard interval is part of the symbol interval or symbol period, and (2) the number of pilot symbols in the claimed second communication system is equal to or larger than the number of pilot symbols in the claimed first communication system.

6. 8[e]: generating at least one non-data section containing information describing an aspect of data in at least one of the first section and the second section

138. Patent Owner contends that the accused VHT PPDU format has a non-data section because it has the "VHT-SIG-A" field in the VHT portion. *Id*. at 50 (excerpted).

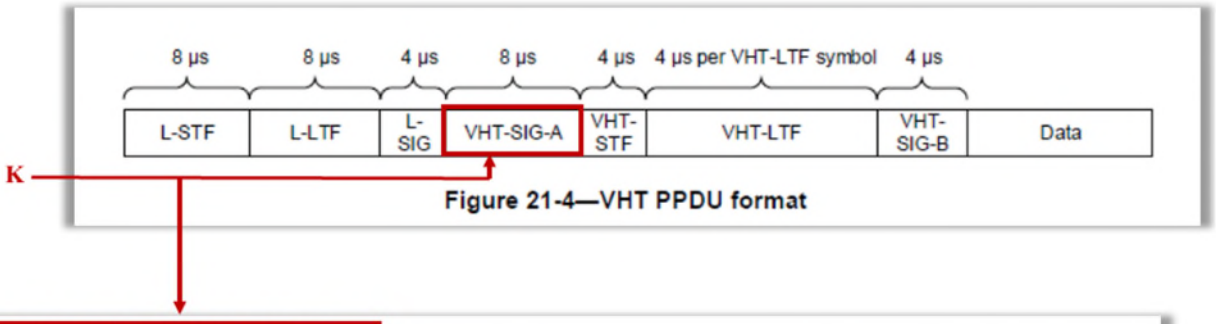


Figure 21-4—VHT PPDU format

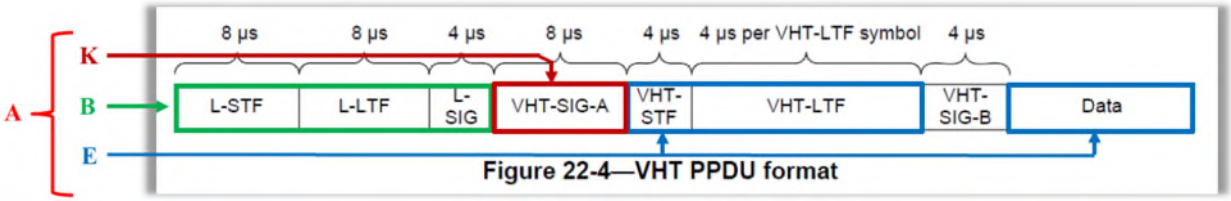
21.3.8.3.3 VHT-SIG-A definition

The VHT-SIG-A field carries information required to interpret VHT PPDUs. The structure of the VHT-SIG-A field for the first part (VHT-SIG-A1) is shown in Figure 21-18 and for the second part (VHT-SIG-A2) is shown in Figure 21-19.

139. Patent Owner further contends that the accused "VHT-SIG-A" field describes an aspect of data in at least one of the claimed first and second sections because the accused "VHT-SIG-A" field caries information required to interpret VHT PPDUs. *Id*. at 51-53.

7. 8[f]: combining the first section, the second section and the at least one non-data section to form the frame structure

140. Patent Owner contends that the IEEE 802.11ac combines the claimed first, second and non-data sections to form the claimed frame structure because the L-STF, L-LTF and L-SIG fields (the claimed "first section"), the VHT-STF, VHT-LTF and the Data fields (the claimed "second section") and the VHT-SIG-A (the claimed non-data section) are combined to form the accused VHT PPDU format. *Id*. at 54 (excerpted).



E. Overview of Final Written Decision in *Inter Partes* Review No. 2021-00734

141. In its Final Written Decision in *Inter Partes* Review No. 2021-00734 ("Final Written Decision," Ex. 1007), the Board finds that the '096 Patent is not entitled to the filing date of Prov. No. '798 because there is insufficient written description support of the '798 Provisional Application for claim 8." (Final Written Decision, Ex. 1007), at 32.

142. In the Final Written Decision, the Board 1) found the challenged claims 1-4 and 6-7 unpatentable as obvious over a combination of certain prior art references; 2) found the challenged claim 8 was not shown to be unpatentable as obvious over the prior art references; and 3) granted Patent Owner's Motion to

Amend, allowing proposed amended claims 44-47 and 49-50, based on determination that they were not obvious over the combination of the prior art references. *Id*. at 83.

143. The Board found claim 8 patentable because Petitioner Qualcomm's Reply arguments provided new reasons why a person of ordinary skill in the art would have been motivated to combine the teachings of the prior art references and these new arguments were not supported by the expert report in the Petition. *Id*. at 60-61. As result, the Board declined to consider Petitioner Qualcomm's new argument.

144. The Board also found the substitute claims 44-47 and 49-50 patentable because (1) the number of substitute claims for claims 1-4, 6-7, which were found unpatentable, is reasonable, (2) the independent substitute claim 44 for claim 1 is narrower than claim 1, and the substitute claims 45-47, 49-50 do not enlarge the scope of the claims of the '096 Patent, (3) the substitute claims are supported in the written description of the '096 Patent, (4) the substitute claims responds to the ground of unpatentability in the Petition, and (5) the substitute claims are patentable over the prior art references because the substitute claim 44 has a limitation that "wherein the second system has pilot symbols that are denser than those in the first communication system," which the Board found that none of the prior art references discloses.

145. Specifically, the Board declined Petitioner Qualcomm's argument that an increased density of pilot symbols is a natural result of a reduced symbol period because the Board found that such argument makes sense "***only when the same number of pilot symbols or pilot symbol distribution are used for both the first and second communication system time period (T and T/2)***." *Id*. at 77-78 (emphasis added). The Board did not find that any prior art reference cited in the Petition and the supporting declarations warrants such "natural result" and therefore found the substitute claims 8 and 44 patentable. *Id*. at 81.

X. OVERVIEW OF THE PRIOR ART REFERENCES

146. I have reviewed and am familiar with the following prior art references: (1) Joint Proposal, (2) Trainin and (3) Mujtaba.

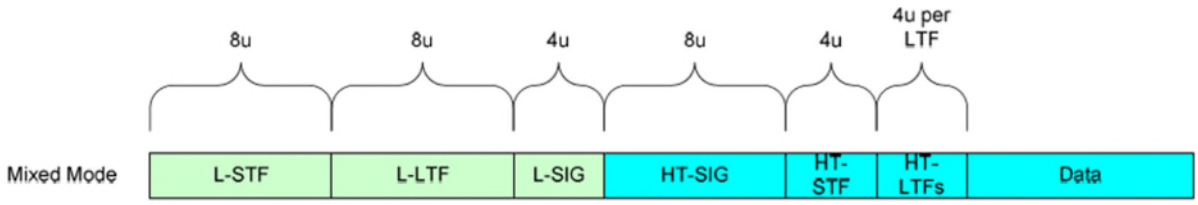
A. Joint Proposal

147. IEEE P802.11 Wireless LANs Joint Proposal: High throughput extension to the 802.11 Standard: PHY, IEEE 802.11-05/1102r4 (Jan. 13, 2006) (Ex. 1008, "Joint Proposal"), entitled "Joint Proposal PHY Specification" by Sean Coffey (Realtek Semiconductor), was submitted to the IEEE TGn and was originally uploaded to the IEEE's Mentor website on January 14, 2006, at which time it would have been publicly available. The Joint Proposal contains the physical layer (PHY) parts of the 802.11 TGn Joint Proposal Technical Specification. Joint Proposal (Ex. 1008), at 1:7-8. The Joint Proposal defines the

physical layer of a wireless communication high throughput packet format (*i.e.*, 802.11n) that is also compatible with the IEEE 802.11a/g standards. *Id*. at 11:18-23.

148. Specifically, the Joint Proposal specifies three operating modes that are (1) legacy mode, (2) mixed mode, and (3) green field. *Id*. at 11:14-12:7. In the legacy mode, packets are transmitted in 802.11 a/g format. *Id*. at 11:16-17. In the mixed mode, packets are transmitted with a preamble including the legacy Short Training Field (STF), the legacy Long Training Field (LTF) and the legacy Signal Field (L-SIG) that are compatible with the legacy 802.11a/g so that the packets can be decoded by legacy 802.11a/d devices. *Id*. at 11:18-23. And the rest of the packet has a new format, which is referred to as high throughput (HT) format. *Id*.

149. According to the Joint Proposal, the receiver can decode both the packets in HT format and the packets in legacy format in the mixed mode. *Id*. at 11:22-23. The Joint Proposal illustrates the mixed mode packet in the following figure. *Id*. at 11; Figure 1-PLCP packet format (excerpted and annotated).



Ex. 1008, Figure 1 (excerpted)
Joint Proposal's Mixed Mode Packet Format

150. The Joint Proposal also discloses that both the legacy field transmission and the HT field transmission use orthogonal frequency division multiplexing (OFDM) symbols. *Id*. at 21:7-19.

151. According to the Joint Proposal, there are four pilot subcarriers carrying pilot symbols in the legacy 20MHz channel for legacy transmission and also four pilot subcarriers for carrying pilot symbols in 20MH HT channel for HT transmission. *Id*. at 16, Table 1.

152. In addition, the Joint Proposal also specifies a guard interval (GI), referred to as T_{GI}, which is 0.8 microseconds, and a short guard interval (Short GI), referred to as T_{GIS}, which is 0.4 microseconds. *Id*. at 17, Table 1. When using the 0.8 microsecond guard interval in data transmission, the symbol period, referred to as T_{SYM}, is 4 microseconds. *Id*. at 16, Table 1. When using the 0.4 microsecond short guard interval, the symbol period, referred to as T_{SYMS}, is 3.2 microseconds. *Id*. at 17, Table 1.

153. The Joint Proposal specifies that the short guard interval is only available to transmit data packet in the HT field. Specifically, the Joint Proposal defines that "[s]hort guard interval is used in the data field of the packet when the Short GI field in the HT signal field (SIG) is set to 1." *Id*. at 56:1-6. It further specifies that "[w]hen it is used, the same formula for the formation of the signal is

used as in sections 14.7.2 [*sic*][5] and 4.7.3 with the exception of T_{GI} replaced by T_{GIS} and T_{SYM} is replaced by T_{SYMS}." *Id*.

154. Since both section 4.7.2 and section 4.7.3 define the HT transmission in 20MHz and 40 MHz, both the guard interval (0.8 microseconds) and the short guard interval (0.4 microseconds) are available for transmission in HT format in either 20MHz channel or 40MHz channel. *Id*. at 56:7-13. As explained in greater detail, this makes sense since the legacy field is designed to be understood by the legacy 802.11a/g devices which will only understand the 0.8 microsecond guard interval.

B. <u>Mujtaba</u>

155. Mujtaba (U.S. Pub. No. 2006/0072529 A1, Ex. 1010, "Mujtaba") was filed on September 9, 2005 and was published on April 6, 2006. It claims priority to Provisional Application No. 60/608,472 which was filed on September 9, 2004. *Id*.

156. Mujtaba discloses a "multiple antenna communication system" in which data is transmitted by "selecting a number of pilot tones to be employed to transmit the data and transmitting an indication of the selected number of pilot tones in a preamble of a packet containing the data." Mujtaba, at [0008]. Mujtaba

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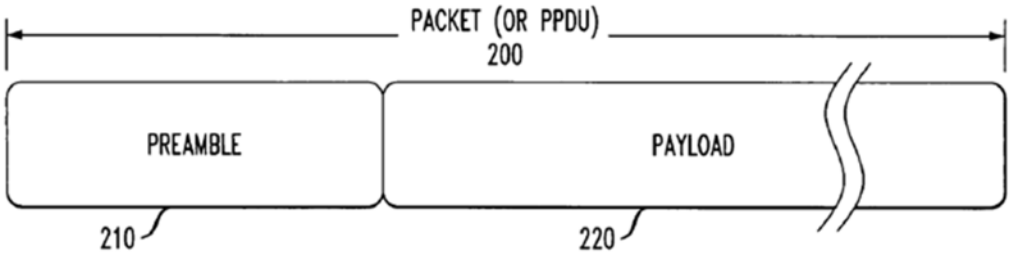
[5] This is a typo; the cite should be Section 4.7.2.

further discloses that "the indication of the selected number of pilot tones can be transmitted, for example, in a SIGNAL field of an exemplary IEEE 802.11 preamble." *Id*. Mujtaba also discloses that "[t]he number of pilot tones can be selected, for example, based on one or more of (i) a delay spread of a channel; (ii) the SNR at the receiver; or (iii) a number of antennas at a receiver." *Id*.

157. Mujtaba illustrates a conventional 802.11a/g transmitter and explains how the information bits are encoded, interleaved, mapped onto subcarriers in OFDM symbol, and serialized in a data packet format with guard interval added to each OFDM symbol at the transmitter side. *Id*. Fig. 1, at [0016]. Mujtaba further illustrates a conventional 802.11a/g receiver and explains how the received OFDM signal is decoded at the receiver side. *Id*. at [0017], Fig. 1.

158. With respect to the conventional packet format, Mujtaba discloses "a typical packet format 200 for an exemplary IEEE 802.11 or another IP-based OFDM system." *Id*. [0018]. The conventional packet format is illustrated in the following figure. *Id*. Fig. 2.

FIG. 2



Ex. 1010, Figure 2

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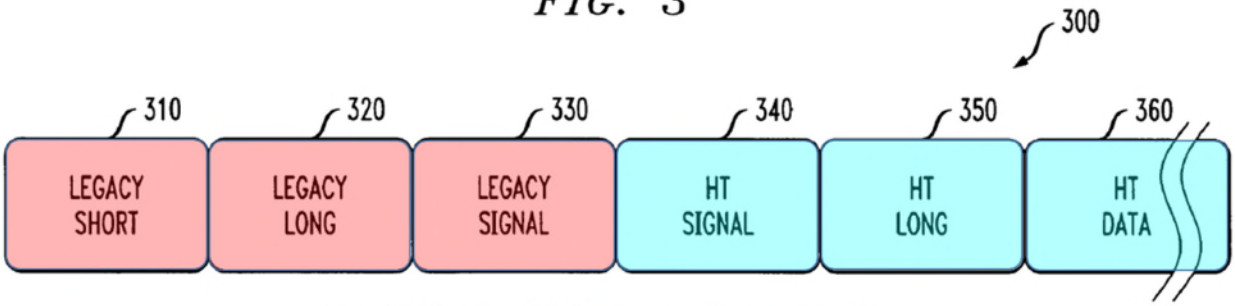
159. With reference to this figure (*i.e.,* Fig.2), Mujtaba explains that "each packet 200 or PLCP Protocol Data Unit (PPDU) (for wireless LANs) comprises a preamble 210 and a payload 220." *Id*. [0018]. Mujtaba further explains that "[e]ach preamble 210 contains all relevant information needed to decode the payload 220, such as synchronization information and a SIGNAL field." *Id*. Mujtaba also discloses that "[t]he payload 220 contains data and one or more pilot tones." *Id*.

160. In addition to the conventional data packet format, Mujtaba further discloses an "exemplary preamble format 300 for IEEE 802.11n." *Id*. [0019]. Mujtaba's 802.11n packet format is illustrated in the following figure. *Id*. Fig. 3 (color-coding added).

FIG. 3



Ex. 1010, Fig. 12 (color-coding added)
Mujtaba's Packet Format

161. With reference to this figure (*i.e.,* Fig.3), Mujtaba explains that "the exemplary preamble 300 includes a legacy short training symbol 310, a legacy long training symbol 320, a legacy SIGNAL field 330, a high throughput (HT)

SIGNAL field 340, an HT long training symbol 350 and an HT data field (payload) 360." *Id*. at [0019].

162. As an example, Mujtaba discloses that the "HT SIGNAL field 340 can convey to the receiver the number of pilot tones[]" and "can be encoded with a value indicating whether two, four, or six pilot tones were employed." *Id*. Mujtaba explains that "the number of pilot tones can be selected, for example, based on the delay spread of the channel, or the SNR at the receiver, or the number of antennas at the receiver (or all of the above)." *Id*. at [0021].

163. Mujtaba further explains certain advantages and disadvantages of using greater number of pilots. As advantages, Mujtaba explains that "a greater number of pilots increases the accuracy of the CPE estimation, thereby reducing the packet error rate, and increasing the reliability of the transmission." *Id*. According to Mujtaba, "[a] greater number of pilots, however, reduces the effective data rate, since actual data is now replaced by the pilots (which are known at both the transmitter and the receiver)." *Id*.

C. <u>Trainin</u>

164. Trainin (U.S. Pub. No. 2007/0204052 A1, Ex. 1011, "Trainin") was filed on February 24, 2006 and was published on August 30, 2007.

165. Trainin discloses "a wireless communication system 100" that may be "a wireless local area network (WLAN) in accordance with the 802.11 family of

standards." Trainin, Fig. 1, at [0019]. Trainin illustrates the wireless communication 100 in the following figure. *Id*. Fig. 1

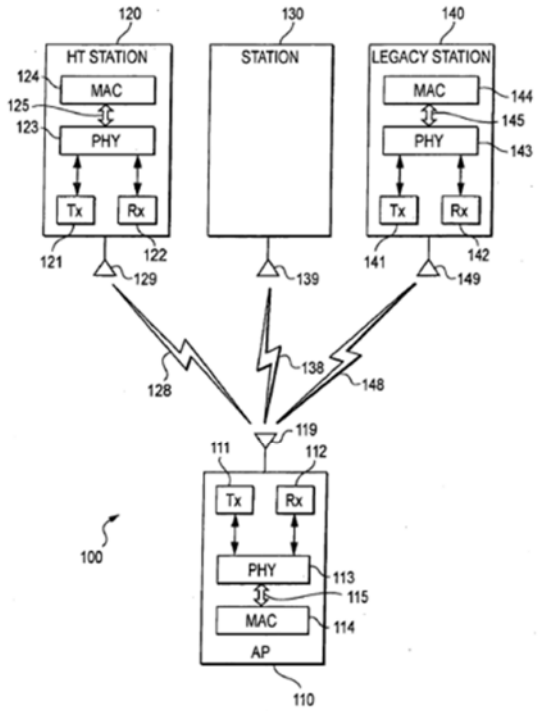


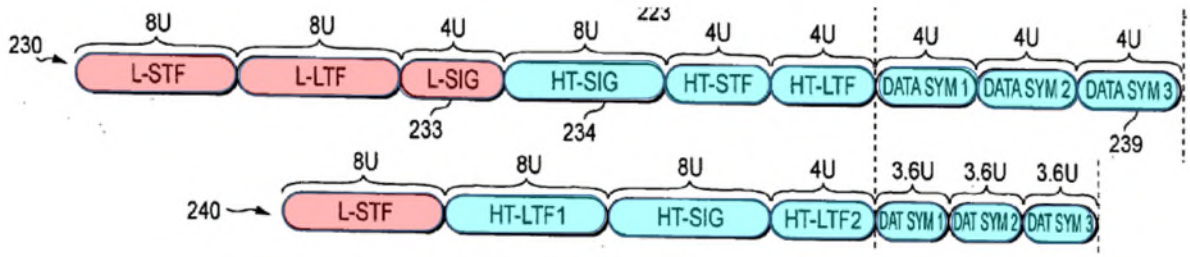
FIG. 1

Ex. 1010, Fig. 1
Trainin's Wireless Communication System

166. With reference to this figure (*i.e.,* Fig. 1), Trainin explains that the "communication system 100" includes "a basic service set (BSS) provider such as an access point (AP) 110" and "one or more wireless mobile units such as a station (STA), for example stations 120, 130, and 140." *Id*. at [0019]. Trainin further discloses that "AP 110 and one or more of STA 120, 130, and 140 may communicate network traffic over a shared access medium using one or more wireless links, *e.g.,* links 128, 138, and 148, respectively." *Id*. at [0020]. Trainin

also explains that "[l]inks 128, 138, and 148 may each include a downlink and an uplink, **as are known in the art**." *Id*. (emphasis added).

167. According to Trainin, the "wireless communication system 100 may enable **coexistence of different modulation schemes and/or frame formats**, as explained in more detail below with reference to FIG. 2." *Id*. [0020] (emphasis added). Trainin illustrates the mixed mode frame format in the following figure. *Id*. Fig. 2 (excerpted and color-coding added).



Ex. 1011, Fig. 2 (excerpted and color-coding added)
Trainin's Mixed Mode Frame Format

168. With reference to Fig. 2, Trainin describes that a legacy format 210 may correspond to OFDM modulation in accordance with 802.11a, and a greenfield format 220 may correspond to MIMO-OFDM modulation in accordance with 802.11n, **as is known in the art**. *Id*. at [0030] (emphasis added). Trainin also explains that "[l]egacy format 210 may include a legacy signal field 213 in the preamble portion 260, which may identify the type of modulation scheme used, and may include information such as the data rate and the length of the subsequent data portion 270." *Id*. Trainin further explains that "[t]he legacy signal field may

be read by a legacy station, *e.g.,* STA 140." *Id*. Trainin goes on to explain that "[s]imilarly, greenfield format 220 may include a high-throughput signal field 223, which may not be readable by a station that is not adapted to use the high-throughput modulation, *e.g.,* a legacy OFDM station." *Id*.

169. In addition to the "legacy format 210" and the "green field format 220," Trainin also discloses a "mixed-mode format 230" that "may also correspond to MIMO-OFDM modulation in accordance with 802.11n, but include both a legacy signal field 233 and a high-throughput signal field 234." *Id*. [0031]. Trainin explains that "[t]hus, stations using either a first modulation scheme, *e.g.,* MIMO-OFDM, or a second modulation scheme, *e.g.,* legacy OFDM, may be able to obtain information regarding the data rate and length of the subsequent data portion 270." *Id*.

170. Trainin further discloses that "the modulation scheme used may include a shortened guard interval (GI) in the data symbols of data portion 270." *Id*. at [0032]. Specifically, Trainin discloses that "a format 240 may be a short GI format corresponding to the regular GI greenfield format 220 and a format 250 may be a short GI format corresponding to the regular GI mixed-mode format 230." *Id*. According to Trainin, "a data symbol in a regular GI format, *e.g.,* data symbol 239 of mixed-mode format 230, may have a length measured in 4 units, *e.g.,* 4 microseconds, whereas a data symbol in a short GI format, *e.g.,* data symbol

259 of short GI mixed mode-format 250, may have a length measured in 3.6 units, *e.g.,* 3.6, microseconds." *Id*.

XI. GROUND 1: JOINT PROPOSAL ANTICIPATES CLAIMS 8, 44-47 AND 50

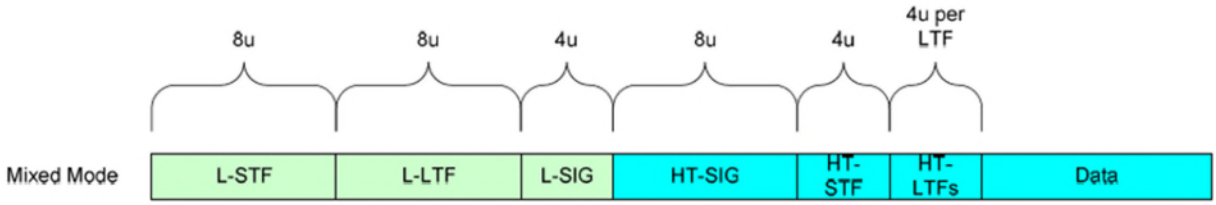
A. Claim 8

171. All elements of claim 1 are disclosed by the Joint Proposal as explained below.

1. Claim 8 [pre]: A method of constructing a frame structure for data transmission, the method comprising

172. I have been informed that the preamble is not a limitation. However, even if it were a limitation, the Joint Proposal discloses a method of constructing a frame structure for data transmission.

173. Specifically, the Joint Proposal discloses three PLCP (PHY Layer Convergence Protocol) packet formats in three different operating modes including the Mixed Mode for data transmission. The Joint Proposal illustrates the Mixed Mode packet format in the following figure. Joint Proposal, Figure 1 (excerpted).



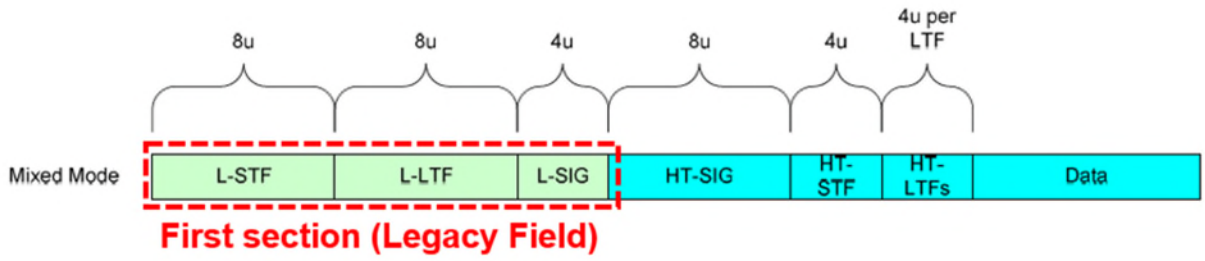
Ex. 1008, Figure 1 (excerpted)
Joint Proposal's Mixed Mode Packet Format

174. For example, the Joint Proposal discloses "constructing" a packet format in the Mixed Mode by combining the legacy field consisting of the L-STF field, the L-LTF field and the L-SIG field with the high throughput (HT) field consisting of the HT-SIG field, the HT-STF field, the HT-LTFs field and the Data field that could be used for data transmission between HT devices (*i.e.*, 802.11n devices). *Id*. at 11:15-12:7. In this mode the receiver shall be able to decode both the Mixed Mode packets and legacy packets. *Id*.

175. Thus, the Joint Proposal discloses the preamble of claim 8 because the PLCP packet format specified in Figure 1 of the Joint Proposal constructs the claimed frame structure for data transmission.

2. Claim 8[a]: generating a first section comprising data configured in a first format compatible with a first communication system using symbols

176. The Joint Proposal discloses this limitation. Specifically, the Joint Proposal discloses a packet format in the "Mixed Mode" in the following figure. *Id*. Figure 1 – PLCP Packet format (excerpted and annotated).



Ex. 1008, Figure 1 (excerpted and annotated)
Joint Proposal's Mixed Mode Packet Format

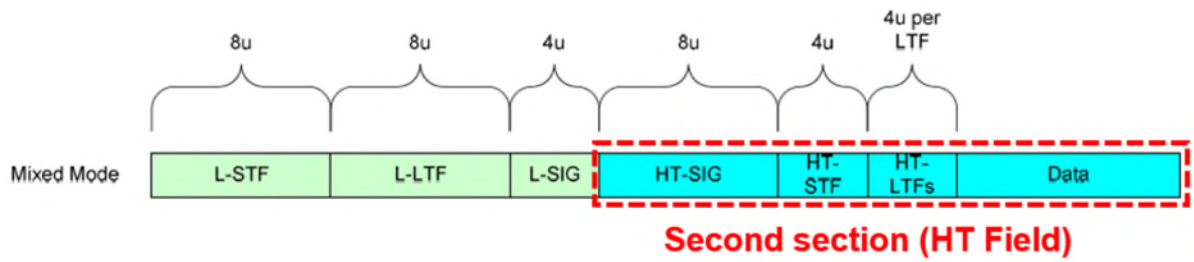
177. The Joint Proposal discloses that the packet format includes a legacy field (the claimed first section) including a legacy short training field (L-STF), a legacy long training field (L-LTF) and a legacy signal field (L-SIG) (the claimed data configured in the claimed first format). *Id*. at 11:4-6, 18-23. According to the Joint Proposal, the legacy field can be decoded by legacy 802.11a/g devices (the claimed first communication system). *Id*. In other words, the legacy field is compatible with legacy devices (*e.g.*, 802.11a devices). The Joint Proposal also discloses that the legacy field transmission uses OFDM symbol. *See e.g., id.* at 21:15-19; 22:4-5; 42:2-5.

178. Thus, the Joint Proposal discloses claim 8[a].

3. <u>Claim 8[b]: generating a second section following the first section, the second section comprising data configured in a second format compatible with a second communication system using symbols</u>

179. The Joint Proposal discloses this limitation. Specifically, the Joint Proposal discloses that "the rest of the packet" following the legacy field "has a

new format" in the "Mixed Mode." *Id*. at 11:21-23. Figure 1 – PLCP Packet format (excerpted and annotated).



Ex. 1008, Figure 1 (excerpted and annotated)
Joint Proposal's Mixed Mode Packet Format

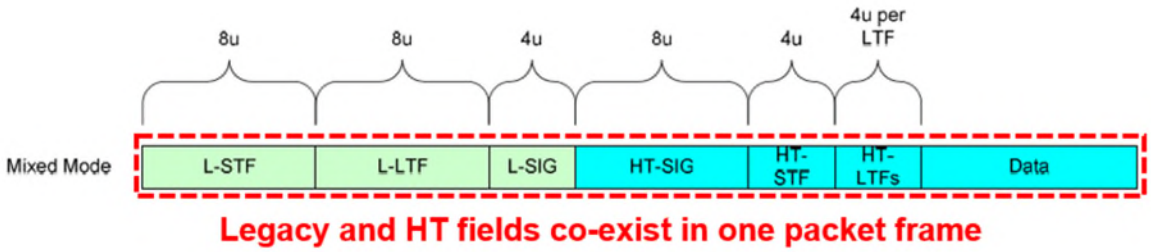
180. According to the Joint Proposal, the new packet format, which follows the legacy field (the claimed first section), includes a high throughput field (the claimed second section) consisting of a signal field (HT-SIG), a high throughput short training field (HT-STF), a high throughput long training field (HT-LTFs) and a data field (data) (the claimed data configured in a second format). *Id*. at 11:7-13. The Joint Proposal explains that in the Mixed Mode the receiver shall be able to decode both the Mixed Mode packets and legacy packets." *Id*. at 11:22-23. In other words, the legacy field (the claimed first section) and the HT field (the claimed second section) enable data transmission in the Mixed Mode packet format to be compatible with legacy devices (*e.g.*, 802.11a devices) (the claimed first communication system) and HT devices (*i.e.*, HT devices or 802.11n devices) (the claimed second communication system), respectively.

181. The Joint proposal also discloses that the high throughput (HT) field transmission uses OFDM symbols. *See e.g., id.* at 21:15-19; 42:2-5.

182. Thus, the Joint Proposal discloses claim 8[b].

4. <u>Claim 8[c]: wherein the first communication system's symbols and the second communication system's symbols co-exist in one transmission scheme</u>

183. The Joint Proposal discloses this limitation. First, the data packet format in the "Mixed Mode" disclosed in Figure 1 of the Joint Proposal shows that the legacy field for the legacy transmission (the claimed first communication system) and the HT field for the HT transmission (the claimed second communication system) co-exist in one packet frame. Figure 1 – PLCP Packet format (excerpted and annotated).



Ex. 1008, Figure 1 (excerpted and annotated)
Joint Proposal's Mixed Mode Packet Format

184. Second, the legacy transmission in the legacy field (the claimed first communication system) and the HT transmission in the HT field (the claimed second communication system) are transmitted in OFDM symbols (the claimed one transmission scheme). *See e.g., id.* at 21:15-19; 42:2-5.

185. The Joint Proposal further explains that "the signal field shall be encoded, interleaved and mapped, and have pilots inserted following the steps described in sections 17.3.5.5, 17.3.5.6, 17.3.5.8 of the IEEE802.11a standard [1]." *Id*. at 24:4, 25:3-5. According to the Joint Proposal, the transmission scheme for the high throughput signal field is identical to the transmission scheme for the legacy signal field. Specifically, the Joint Proposal discloses that "[t]he HT-SIG parts are encoded, interleaved, mapped, and have pilots inserted following the steps described in sections 17.3.5.5, 17.3.5.6, 17.3.5.8 of the IEEE 802.11a standard [1]." *Id*. at 28:7-9.

186. Thus, the transmission in OFDM symbols in the legacy field (the claimed first communication system's symbols) and the transmission in OFDM symbols in the HT field (the claimed second communication system's symbols) co-exist in the same OFDM transmission (the claimed one transmission scheme) following the IEEE 802.11a standard.

187. Thus, claim 8[c] is disclosed by the Joint Proposal.

5. Claim 8[d]: wherein the second communication system has pilot symbols that are denser than those in the first communication system

188. The Joint Proposal discloses this limitation for the reasons discussed below.

189. First, the Joint Proposal discloses that both the legacy 20MHz channel and the high throughput (HT) 20MHz channel have the same number of pilot symbols. As shown in Table 1 of the Joint Proposal, there are four pilot subcarriers carrying pilot symbols in legacy 20MHz channel for the legacy field transmission and also four pilot subcarriers for carrying pilot symbols in the 20MHz HT channel for the HT field transmission. *Id*. at 16, Table 1 (excepted). Thus, the number of pilot symbols in the legacy transmission and the number of pilot symbols in the HT transmission are identical (*i.e*., four pilot symbols).

Parameter	Value in legacy 20MHz channel	Value in 20MHz HT channel
⋮		
N_{SP}: Number of pilot subcarriers	4	4
⋮		

Ex. 1008, Table 1 (excerpted)

190. Second, the Joint Proposal discloses a guard interval (GI), referred to as T_{GI}, which is 0.8 microseconds, and a ***short*** guard interval (Short GI), referred to as T_{GIS}, which is 0.4 microseconds. *Id*. at 17, Table 1 (excerpted).

T_{GI}: Guard Interval length	0.8μsec= $T_{FFT}/4$
⋮	
T_{GIS}: Short Guard Interval length	0.4μsec= $T_{FFT}/8$

Ex. 1008, Table 1 (excerpted)

191. According to the Joint Proposal, when using the 0.8 microsecond guard interval (*i.e.,* T_{GI}) in data transmission, the symbol period, referred to as T_{SYM}, is 4 microseconds. *Id*. at 16, Table 1. The Joint Proposal further explains that when using the 0.4 microsecond short guard interval (*i.e.,* T_{GIS}), the symbol interval, referred to as T_{SYMS}, is 3.2 microseconds. *Id*. at 17, Table 1 (excerpted and annotated).

T_{SYM}: Symbol	4μsec= T_{FFT}+T_{GI}
⋮	
T_{SYMS}: Short GI Symbol Interval	3.6μsec= T_{FFT}+T_{GIS}

Ex. 1008, Table 1 (excerpted and annotated)

192. The Joint Proposal specifies that the short guard interval (*i.e.,* T_{GIS}) is only employed in a data packet in the HT field when it is signaled in the HT field. Specifically, the Joint Proposal defines that "[s]hort guard interval is used in the

data field of the packet when the Short GI field in the HT signal field (SIG) is set to 1." *Id*. at 56:1-6. It further states that "[w]hen it is used, the same formula for the formation of the signal is used as in sections 14.7.2 [*sic*][6] and 4.7.3 with the exception of T_{GI} replaced by T_{GIS} and T_{SYM} is replaced by T_{SYMS}." *Id*. Since both section 4.7.2 and section 4.7.3 define high throughput (HT) transmission in 20MHz and 40 MHz, both the regular guard interval (0.8 microseconds) and the short guard interval (0.4 microseconds) are available for the HT transmission in either a 20MHz channel or a 40MHz channel. Indeed, in the following equation for data transmission in the legacy format to the legacy 802.11a devices, only T_{GI} and T_{SYM} are used. *Id*. at 56: 7-13 (annotated).

$$
\begin{aligned}
r_{LEG-DUP}^{i_{TX}}(t-nT_{SYM}) = \frac{1}{\sqrt{N_{Duplicate}^{Tones}}} w_{TSYM}(t-nT_{SYM}) \\
\Bigg(\sum_{k=0}^{47} \left[Q_{M(k)-32} \right]_{i_{TX},1} d_{k,n} \exp\left(j2\pi \left(M(k)-32 \right) (\Delta_F \left(t-nT_{SYM} - \boxed{T_{GI}} + T_{CS}^{i_{TX}} \right) \right) + \\
j \sum_{k=0}^{47} \left[Q_{M(k)+32} \right]_{i_{TX},1} d_k \exp\left(j2\pi \left(M(k)+32 \right) (\Delta_F \left(t-nT_{SYM} - \boxed{T_{GI}} + T_{CS}^{i_{TX}} \right) \right) + \\
p_n \sum_{k=-N_{SR}}^{N_{SR}} \left[Q_{k-32} \right]_{i_{TX},1} P_k \exp\left(j2\pi (k-32) \Delta_F \left(t-nT_{SYM} + \boxed{T_{GI}} - T_{CS}^{i_{TX}} \right) \right) + \\
jp_n \sum_{k=-N_{SR}}^{N_{SR}} \left[Q_{k+32} \right]_{i_{TX},1} P_k \exp\left(j2\pi (k+32) \Delta_F \left(t-nT_{SYM} - \boxed{T_{GI}} + T_{CS}^{i_{TX}} \right) \right) \Bigg)
\end{aligned}
$$

Ex. 1008, Legacy 802.11a Transmission Equation

[6] This is a typo; the cite should be Section 4.7.2.

193. This makes sense since the legacy field is designed to be understood by the legacy 802.11a devices which will only understand the 0.8 microsecond guard interval.

194. Thus, when the short guard interval (0.4 microseconds) is used in the high throughput (HT) transmission (the claimed second communication system) in the Mixed Mode, the short symbol interval (3.6 microseconds) in the high throughput (HT) transmission (the claimed second communication system) is shorter than the symbol interval (4.0 microseconds) in the legacy transmission (the claimed first communication system). As a result, the symbol period in the HT transmission (the claimed second communication system) carrying 4 pilot symbols is shorter than the symbol period in the legacy transmission (the claimed first communication system) carrying the same number of pilot symbols (*i.e.*, four pilot symbols).

195. The following figure conceptualizes the legacy and HT transmissions with two different guard intervals in length. As shown in the demonstrative figure, the pilot symbols in the legacy transmission (the claimed first communication system) are less dense than the pilot symbols in the high throughput transmission (the claimed second communication system) because both the legacy and HT transmissions carry the same number of pilot symbols in two different symbol periods in length.

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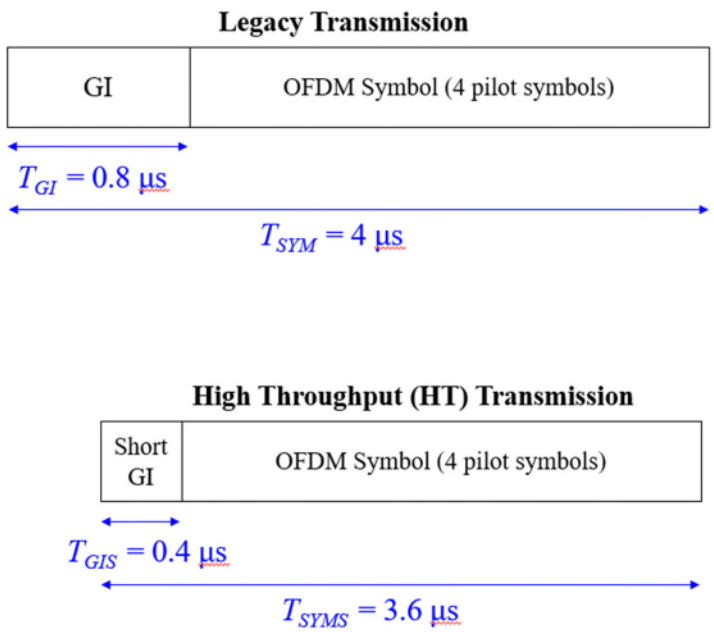


196. I have been informed that "pilot symbols that are denser than" recited in claim 8 means "more pilot symbols per unit time than, wherein a unit time is the symbol period of the first communication system" in the Claim Construction Order (Ex. 1005). Thus, it is my opinion that claim 8[d] is disclosed by the Joint Proposal because the four pilot symbols in the HT transmission (the claimed second communication system) with a shorter guard resulting in a shorter symbol period are denser than the four pilot symbols in the legacy transmission (the claimed first communication system) with a regular guard interval resulting in a regular (longer) symbol period.

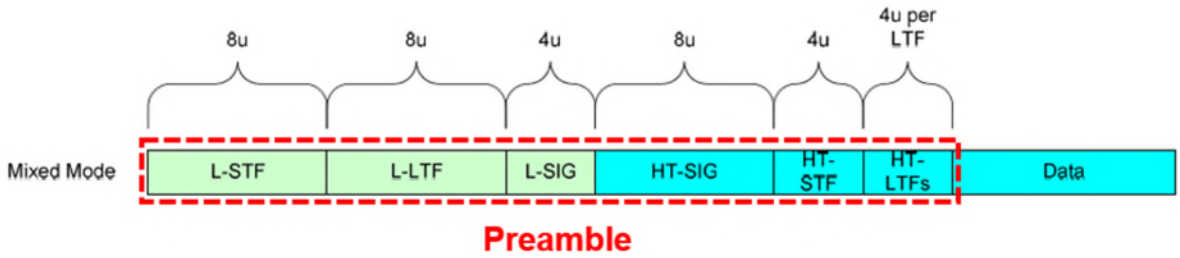
6. Claim 8[e]: generating at least one non-data section containing information describing an aspect of data in at least one of the first section and the second section

197. I understand that the phase "at least one of […] and […]" in this limitation has been construed as "[…] and/or […]". *Supra* § VI. The "at least one of" language in limitation 8[e] applies to only two items, the first section and the second section, and operates as shorthand for "and/or." I also understand that the terms "data" and "non-data" have been construed in their plain and ordinary meaning. *Id*.

198. This construction is consistent with the specification, which describes embodiment with non-data followed by data sections. For example, the '096 Patent discloses a downlink subframe (DL sub-frame 16) that may include a "preamble 10-1," a "frame control header (FCH 11)," a "downlink map (DL-MAP) 12" and a "downlink burst (DL burst#) 13" followed by a "data region DATA 14-1." '096 Patent, at 1:46-50. The '096 Patent further explains that "the DL-MAP 12 may be used to identify the division or structure of the DATA 14-1." *Id*. at 1:50-52.

199. The Joint Proposal discloses this limitation. Specifically, the Joint Proposal discloses that the Mixed Mode packets are transmitted with a "preamble compatible with the legacy 802.11a/g" because the preamble includes a "Legacy Short Training Field (STF)," a "legacy Long Training Field (LTF)" and a "legacy

signal field" (the claimed non-data section) that can be transmitted and "decoded by legacy 802.11a/g devices." Joint Proposal, at 11:18-21. In addition to the legacy field, the Joint Proposal also discloses that the preamble further includes an "HT signal field," an "HT short training field" and an "HT long training field" (the claimed non-data section). *Id*. at 26:1-3. The preamble specified in the Joint Proposal in the Mixed Mode operation is illustrated in the following figure. *Id*. Figure 1 – PLCP packet format (excerpted and annotated).



Ex. 1008, Figure 1 (excerpted and annotated)
Joint Proposal's Mixed Mode Packet Format

200. With respect to the HT-SIG field in the HT field (the claimed second section), the Joint Proposal specifically explains that this field "is used to carry information required to interpret the HT packet formats[]"(the claimed information describing an aspect of data). *Id*. at 26:13-16. According to the Joint Proposal, the HT-SIG field (the claimed non-data section) carries information for a receiver to understand the aspects of the HT data packet including, for example, "Modulation and Coding Scheme" explaining how the data packet is modulated and coded, "BW 20/40" explaining if the data is transmitted in 20 MHz or 40 MHz bandwidth,

and "Length" explaining the number of data bytes in the data field (the claimed information describing an aspect of data). *Id*. Table 7 - Fields of High Throughput Signal Field (excerpted).

Table 7 - Fields of High Throughput Signal Field

Field Name	Num of Bits	Explanation and coding
Modulation and Coding Scheme	7	Index into The MCS table, LSB first
BW 20/40	1	0 if 20MHz or 40 MHz upper/lower; 1 if 40MHz
Length	16	The number of bytes of data in the PSDU – 0*-65535

Ex. 1008, Table 7 (excerpted)

201. More importantly, the HT-SIG field also carries one bit indicating whether the HT transmission uses a short guard interval. *Id*. (excerpted).

Short GI	1	Set to 1 to Indicate that the short GI is used after the HT training. Set to 0 otherwise

Ex. 1008, Table 7 (excerpted)

202. As explained in the following excerpt of the Joint Proposal, if the "Short GI" field is set to "1," it means that the OFDM symbols in the data field are transmitted with a short guard interval resulting in a short symbol period. *Id*. at 56-

1:6.

4.7.5 Transmission with a short guard interval

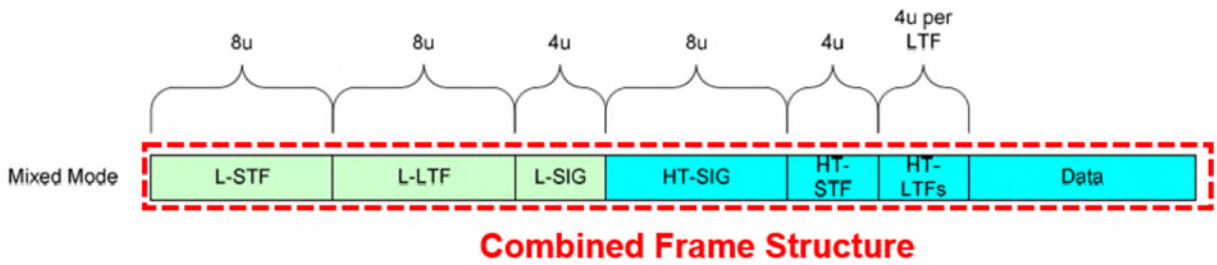
Short guard interval is used in the data field of the packet, when the Short GI field in the HT-SIG is set to 1. When it is used, the same formula for the formation of the signal is used as in sections 14.7.2 and 4.7.3 with the exception of T_{GI} replaced by T_{GIS} and T_{SYM} is replaces with T_{SYMS}. Short GI shall not be used in GF mode when the MCS indicates a single spatial stream.

Ex. 1008 (excerpted)
Transmission with short guard interval

203. In other words, if the "Short GI" field is set to "0" in the HT-SIG field, the receiver side will understand that the OFDM symbols in the data field are transmitted with a regular guard interval resulting in a regular symbol period. A POSA would have understood that the HT-SIG field (the claimed non-data section) in the HT field (the claimed second section) describes a number of aspects of data (the claimed information describing an aspect of data) in the HT transmission for a receiver to understand and interpret the "division or structure" of the HT transmission such as modulation and coding scheme, length of data field, bandwidth, symbol period and so on. Thus, claim 8[e] is disclosed by the Joint Proposal.

7. Claim 8[f]: combining the first section, the second section and the at least one non-data section to form the frame structure

204. The Joint Proposal teaches this limitation. Specifically, as illustrated in Figure 1, the packet format shown in Figure 1 of the Joint Proposal combines the legacy field (the claimed first section), the HT field (the claimed section section) including the "HT-SIG" field (the claimed non-data section) to form a single data packet or frame (the claimed frame structure) in the Mixed Mode. *Id*. 11, Figure 1 (excerpted).



Ex. 1008, Figure 1 (excerpted and annotated)
Joint Proposal's Mixed Mode Packet Format

205. The Joint Proposal teaches that the signals in both the legacy field and the HT field are encoded, interleaved and mapped, and have pilots inserted in compliance with the IEEE802.11a standard. *Id*. at 24:4, 25:3-5, 28:7-9. A POSA would have understood from the teachings of the Joint Proposal that the legacy field (the claimed first section), the HT field (the claimed second section) and the HT SIG field (the claimed non-data section) are combined to form the packet format (the claimed frame structure) in the Mixed Mode.

B. Claim 44

206. Claim 44 is disclosed by the Joint Proposal. Claim 44 is reproduced below (with labels added).

> 44[pre]: A method of constructing a frame structure for data transmission, the method comprising:
>
> 44[a]: generating a first section comprising data configured in a first format compatible with a first communication system using symbols;
>
> 44[b]: generating a second section following the first section, the second section comprising data configured in a second format compatible with a second communication system using symbols,
>
> 44[c] wherein the first communication system's symbols and the second communication system's symbols co-exist in one transmission scheme and
>
> 44[d]: wherein: the second format is compatible with the second communication system configured to support higher mobility than the first communication system,
>
> 44[e]: wherein each symbol in the second communication system has a shorter symbol period than that in the first communication system; and
>
> 44[f]: wherein the second communication system has pilot symbols that are denser than those in the first communication system;
>
> 44[g]: generating at least one non-data section containing information describing an aspect of data in at least one of the first section and the second section; and
>
> 44[h]: combining the first section, the second section and the at least one non-data section to form the frame structure.

207. I have reviewed claim 44 and it has the same limitation as claim 8, except for limitation 44[d] and limitation 44[e]. Because of these similarities, my opinion is that limitations 44[pre]-44[c] and 44[f]-44[h] are unpatentable for the

same reasons given regarding the unpatentability of limitations 8[pre]-8[f]. *Supra* § XI(A).

1. Claim 44[d]: wherein: the second format is compatible with the second communication system configured to support higher mobility than the first communication system

208. The Joint Proposal discloses this limitation.

209. The ’096 Patent explains that the legacy system may be susceptible to a Doppler effect in a high mobility scenario because the placement may be usually designed with a relatively large symbol period, which in turn may induce relatively short carrier spacing and less dense pilot symbol placement. ’096 Patent, at 2:6-11. Specifically, the ’096 Patent explains that “the limitation on pilot symbol placement may cause channel estimation error at a receiving end because of insufficient information provided for channel estimation.” *Id*. at 2:11-14. To improve channel estimation in a high-mobility environment, the ’096 Patent proposes a frame structure for the “new system” under high mobility that has “a shorter symbol period or more pilot symbols” than the “legacy system.” *Id*. at 5:1-16. The ’096 Patent further states that “[g]enerally, a shorter symbol period may be more robust to inter-symbol interference, while denser pilot symbols may achieve better channel estimation accuracy.” *Id*. at 5:16-18.

210. During prosecution of the application that issued as the ’096 Patent, the applicants amended claim 1 to recite, “the second communication system

configured to support higher mobility than the first communication system, wherein each symbol in the second communication system has a shorter symbol period than that in the first communication system." Excerpt of the'096 Patent Prosecution History (Ex. 1004), at 80. To distinguish prior art cited by the Examiner from the amended claims, the applicants argued in response to a Non-Final Rejection that "[h]owever, the pre-designated legacy system transmission period would be susceptible to a Doppler effect in a high mobility scenario, because the placement is designed with a relatively large symbol period, which in turn induces relatively short carrier spacing and less dense pilot symbol placement." *Id*. at 92. To overcome the following Final Rejection, the applicants underscored the limitation that "symbols in the second communication system have a shorter symbol period than those in the first communication system[,]" and further argued that "nowhere does Ahmadi appear to disclose that a shorter frame size necessarily equates to a shorter symbol period." *Id*. at 49.

211. Additionally, Patent Owner argued in its Motion to Amend that "the second format…is designed to support higher mobility *i.e.*, speed at which the mobile unit is moving, and uses symbols that are shorter (*i.e*., the bandwidth is larger) than the symbols in 802.11e." (Patent Owner's Motion to Amend in *Inter Partes* Review No. 2021-00743, Ex. 1006), at 5.

212. In view of the written description in the ’096 Patent, and the applicants’ arguments during the prosecution history, and Patent Owner’s arguments in its Motion to Amend in a separate IPR proceedings (Ex. 1006), it is my opinion that a POSA would have understood that the claimed “second communication system configured to support higher mobility than the first communication system” means the claimed second communication system having a “shorter symbol period” and “denser pilot symbols” than the claimed first communication system.

213. The Joint Proposal discloses a short guard interval in the high throughput (HT) transmission (the claimed second communication system) and a regular guard interval in the legacy transmission (the claimed first communication system. *Supra* § XI(A)(5). Because the two different guard intervals in length result in that the symbol period in the high throughput transmission (the claimed second communication system) carrying four pilot symbols is shorter than the symbol period in the legacy transmission (the claimed first communication system) also carrying four pilot symbols, a POSA would understand that the pilot symbols in the high throughput transmission (the claimed second communication system) are denser than the pilot symbols in the legacy transmission (the claimed first communication system).

214. To the extent Patent Owner argues that the Joint Proposal does not explicitly teach this limitation, a POSA would have understood from the teachings of the ’096 patent that the implementation of a “shorter symbol period” and “denser pilots” was necessary for the “second communication system” in a “higher mobility” environment to improve channel estimation and mitigate inter-symbol interference. In other words, a POSA would have understood that the capability of supporting “higher mobility” in the “second communication system” necessarily flows from the claimed “shorter symbol period than that in the first communication system” and the claimed “pilot symbols that are denser than those in the first communication system[.]”

215. I have been informed that in relying upon the theory of inherency there must be a basis in fact and/or technical reasoning to reasonably support the determination that the inherent characteristic necessarily flows from the teachings of the applied prior art. A POSA would have understood from the teachings of the Joint Proposal that the high throughput transmission (the claimed second communication system) in the Mixed Mode inherently supports a higher mobility environment than the legacy transmission (the claimed first communication system) and such characteristic of supporting the claimed higher mobility necessarily flows from the packet format for high throughput transmission (the

claimed second communication system) with a short guard interval (*i.e.*, a shorter symbol period) and denser pilot symbols. *Supra* § XI(A)(5).

216. Thus, claim 44[d] is at least inherently disclosed by the Joint Proposal.

2. <u>Claim 44[e]: wherein each symbol in the second communication system has a shorter symbol period than that in the first communication system</u>

217. The Joint Proposal disclose this limitation. The Joint Proposal discloses a guard interval (GI), referred to as T_{GI}, which is 0.8 microseconds, and a short guard interval (Short GI), referred to as T_{GIS}, which is 0.4 microseconds. *Id*. at 17, Table 1 (excerpted).

T_{GI}: Guard Interval length	0.8μsec= T_{FFT}/4
⋮	
T_{GIS}: Short Guard Interval length	0.4μsec= T_{FFT}/8

Ex. 1008, Table 1 (excerpted)

218. The Joint Proposal further discloses that when using the 0.8 microsecond guard interval (*i.e.,* T_{GI}) in transmission, the symbol period, referred to as T_{SYM}, is 4 microseconds, and when using the 0.4 microsecond short guard interval (*i.e.,* T_{GIS}) in transmission, the symbol period, referred to as T_{SYMS}, is 3.2 microseconds. *Id*. at 17, Table 1 (excerpted and annotated).

T_{SYM}: Symbol	4μsec= T_{FFT}+T_{GI}
⋮	
T_{SYMS}: Short GI Symbol Interval	3.6μsec= T_{FFT}+T_{GIS}

Ex. 1008, Table 1 (excerpted and annotated)

219. The Joint Proposal specifies that the short guard interval (*i.e.,* T_{GIS}) is only employed in the HT transmission (the claimed second communication system) when the HT signal field is set to "1." *Id*. at 56:1-6. The Joint Proposal further explains that "[w]hen it is used, the same formula for the formation of the signal is used as in sections 14.7.2 [*sic*] and 4.7.3 with the exception of T_{GI} replaced by T_{GIS} and T_{SYM} is replaced by T_{SYMS}." *Id*. Since both section 4.7.2 and section 4.7.3 define high throughput (HT) transmission (the claimed second communication system) in 20MHz and 40 MHz, both the regular guard interval (0.8 microseconds) and the short guard interval (0.4 microseconds) are available for the HT transmission (the claimed second communication system) in either a 20MHz channel or a 40MHz channel. Indeed, in the following equation for data transmission in the legacy transmission (the claimed first communication system) to the legacy 802.11a devices, only T_{GI} and T_{SYM} are used. *Id*. at 56: 7-13 (annotated).

$$r_{LEG-DUP}^{i_{TX}}\left(t-nT_{SYM}\right)=\frac{1}{\sqrt{N_{Duplicate}^{Tones}}}w_{TSYM}\left(t-nT_{SYM}\right)$$
$$\left(\sum_{k=0}^{47}\left[Q_{M(k)-32}\right]_{i_{TX},1}d_{k,n}\exp\left(j2\pi\left(M\left(k\right)-32\right)(\Delta_F\left(t-nT_{SYM}-\boxed{T_{GI}}-T_{CS}^{i_{TX}}\right)\right)+\right.$$
$$j\sum_{k=0}^{47}\left[Q_{M(k)+32}\right]_{i_{TX},1}d_k\exp\left(j2\pi\left(M\left(k\right)+32\right)(\Delta_F\left(t-nT_{SYM}-\boxed{T_{GI}}-T_{CS}^{i_{TX}}\right)\right)+$$
$$p_n\sum_{k=-N_{SR}}^{N_{SR}}\left[Q_{k-32}\right]_{i_{TX},1}P_k\exp\left(j2\pi(k-32)\Delta_F\left(t-nT_{SYM}-\boxed{T_{GI}}-T_{CS}^{i_{TX}}\right)\right)+$$
$$\left.jp_n\sum_{k=-N_{SR}}^{N_{SR}}\left[Q_{k+32}\right]_{i_{TX},1}P_k\exp\left(j2\pi(k+32)\Delta_F\left(t-nT_{SYM}-\boxed{T_{GI}}-T_{CS}^{i_{TX}}\right)\right)\right)$$

Ex. 1008, Legacy 802.11a Transmission Equation

220. This makes sense since the legacy field is designed to be understood by the legacy 802.11a devices which will only understand the 0.8 microsecond guard interval. A POSA would have understood from the teachings of the Joint Proposal that the high throughout transmission (the claimed second communication system "has a shorter symbol period than that" in the legacy transmission (the claimed first communication system). Thus claim 44[e] is disclosed by the Joint Proposal.

C. <u>Claim 45</u>

221. Claim 45 is disclosed by the Joint Proposal as explained below.

1. Claim 45: The method of claim 44, wherein the non-data section comprises mapping information for at least one of the first section and the second section

222. I understand that the phrase "at least one of […] and […]" in this limitation has been construed as "[…] and/or […]". The "at least one of" language in claim 45 applies to only two items, the "first section" and the "second section," and operates as shorthand for "and/or." This claim 45 therefore requires a non-data section that comprises mapping information for the first section *or* the second section (or a non-data section that comprises mapping information for the first section *and* the second section). This construction is consistent with the specification, which describes embodiment with non-data sections—for example, "DL-MAP 11 and the sub-MAP 42-2 of DATA 40-3... [or] the UL-MAP (not shown) in the DL burst#1 13"—that provide information for the "new system (extended system) under high mobility" (*i.e.*, "data in... the second section") only. '096 Patent, at 5:18-26.

223. As a preliminary matter, the '096 Patent explains an OFDMA frame structure in the background section and illustrates the OFDMA frame structure in the following figure and labels the OFDMA frame structure "Prior Art." '096 Patent, at 1:36-45., Fig.1 (annotated).

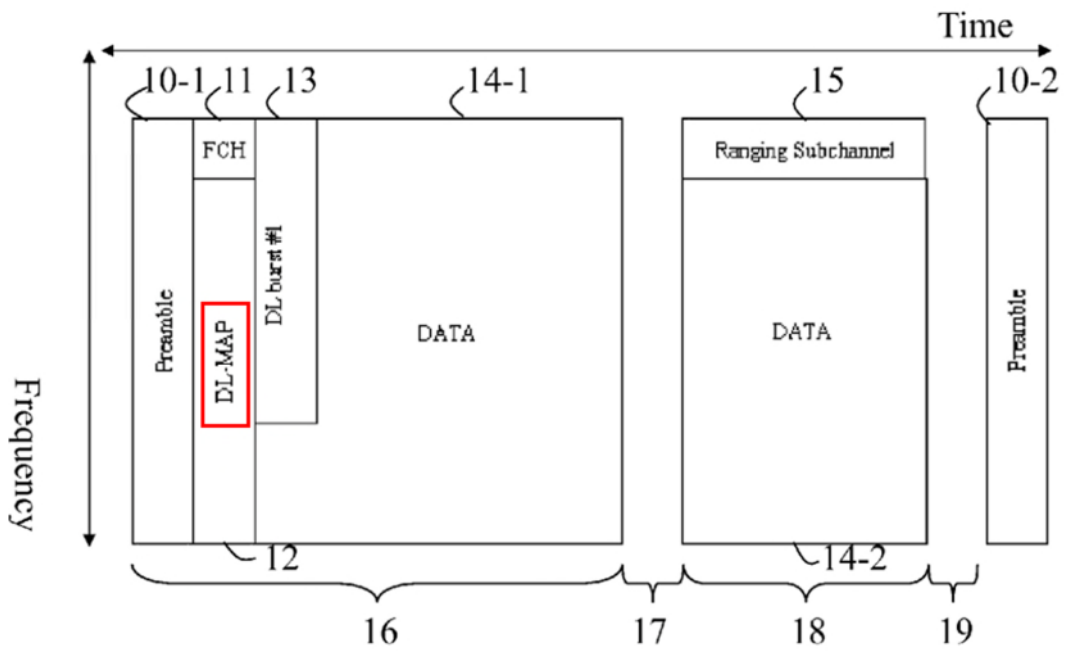


FIG. 1 (Prior Art)

Ex. 1001, Fig. 1 (annotated)

224. The ’096 Patent states that “[t]he DL sub-frame 16 may include a preamble 10-1, a frame control header (FCH) 11, a downlink map (DL-MAP) 12, a downlink burst (DL burst#1) 13 and a data region (DATA) 14-1.” *Id*. at 1:46-57. A POSA would understand that the frame control header 11, the downlink map 12 and the downlink burst 13 are non-data regions because they are followed by the data region 14-1 in the frame structure of the ’096 patent. The ’096 Patent goes on to explain that the “DL-MAP 12 may be used to identify the **division** or **structure** of the DATA 14-1 in the DL sub-frame 16[.]” *Id*. (emphasis added). The ’096 Patent further states, that “DATA 40-3 of the DL sub-frame 16-2 for the new

system under high mobility may be divided based on the mapping information" and such "mapping information" may be defined in "DL-MAP11."[7] *Id*. at 5:18-24, Fig.4. From the teachings of the '096 Patent, a POSA would have understood that the "mapping information" is a certain type of information carried in the "DL-MAP12" field prior to the "DATA" field for the receiver to understand the "division" or "structure" of data in the "DATA" field for the new system under high mobility.

225. The Joint Proposal discloses this limitation. As illustrated in Figure 1 of the Joint Proposal, the preamble of the Mixed Mode PLCP packet format specified in the Joint Proposal carries information in the HT signal (HT-SIG) field (the claimed non-data section) within the HT field (the claimed second section) for the receiver to interpret and understand the HT packet formats for the high throughput transmission (the claimed second communication system). *Id*. at 26:14-15, Figure 1 (excerpted and annotated).

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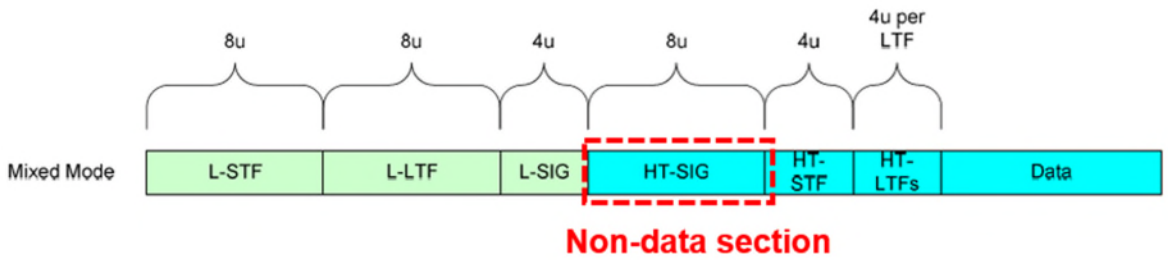
[7] This is a typo; the cite should be DL-MAP 12 as shown in Figure 3.



Ex. 1008, Figure 1 (excerpted and annotated)
Joint Proposal's Mixed Mode Packet Format

226. Table 7 of the Joint Proposal discloses a number of fields in the HT signal field (the claimed non-data section) for carrying certain types of information including "Modulation and Coding Scheme" on top of the table. *Id*. 26, Table 7 – Fields of High Throughput Signal Field.

Table 7 - Fields of High Throughput Signal Field

Field Name	Num of Bits	Explanation and coding
Modulation and Coding Scheme	7	Index into The MCS table, LSB first
BW 20/40	1	0 if 20MHz or 40 MHz upper/lower; 1 if 40MHz
Length	16	The number of bytes of data in the PSDU – 0*-65535

Ex. 1008, Table 7 (excerpted)

227. In the column of "Explanation and coding" corresponding to "Modulation and Coding Scheme," "Index into The MCS table" are provided. *Id*. The transmitter uses the information in this "Modulation and Coding Scheme" (MCS) to map the sequence of OFDM symbols on the subcarriers and the receiver

uses the MCS information to decode the OFDM symbols with reference to the "MCS Index." *Id*. at 69-74, Table A-1-Table A-11. A POSA would have understood from the teachings of the Joint Proposal that the information carried in the field of "Modulation and Coding Scheme" of the HT signal field (the claimed non-data section) is a "mapping information" for the receiver to understand the "division" of data in the data field. Specifically, the MCS index indicates a modulation type (BPSK, QPSK, 16-QAM or 64-QAM) which is a mapping from bits to constellation points on each sub-carrier of the data symbol. *See e.g., id.* at 47.

228. As another example, the HT signal field (the claimed non-data section) in the HT field also carries one bit indicating whether the HT transmission uses a short guard interval. *Id*. 27 (excerpted).

Short GI	1	Set to 1 to Indicate that the short GI is used after the HT training. Set to 0 otherwise

Ex. 1008, Table 7 (excerpted)

229. According to the Joint Proposal, if the "Short GI" field is set to "1," it means that the OFDM symbols in the HT transmission (the claimed second communication system) are transmitted in a short guard interval, which results in a short symbol period. *Id*. at 56-1:6. In other words, if the "Short GI" field is set to

"0," the receiver side will understand that the OFDM symbols in the HT transmission (the claimed second communication system) are transmitted with a regular guard interval resulting in a regular symbol period.

4.7.5 Transmission with a short guard interval

Short guard interval is used in the data field of the packet, when the Short GI field in the HT-SIG is set to 1. When it is used, the same formula for the formation of the signal is used as in sections 14.7.2 and 4.7.3 with the exception of T_{GI} replaced by T_{GIS} and T_{SYM} is replaces with T_{SYMS}. Short GI shall not be used in GF mode when the MCS indicates a single spatial stream.

Ex. 1008 (excerpted)
Transmission with short guard interval

230. A POSA would understand that the information carried in the HT-SIG field specified in the Joint Proposal's Mixed Mode packet format describes the structure and division of data in the HT transmission, and therefore constitutes the claimed "mapping information.

D. Claim 46

231. Claim 46 is disclosed by the Joint Proposal as explained below.

1. Claim 46: The method of claim 44, wherein the non-data section comprises at least one of a preamble, a frame control header 60 (FCH), a burst, and a map of at least one of the first section and the second section

232. I understand that the phrase "at least one of [...] and [...]" in this limitation has been construed as "[...] and/or [...]." Claim 46 includes two occurrences of this language. In the last clause of claim 46—"a map of at least one

of the first section and the second section"—the "at least one of" language applies to only two items, the first section and the second section, and operates as shorthand for "and/or." This construction is consistent with the specification, which describes non-data sections (*e.g.*, sub-MAP 42-2 and UL-MAP in DL burst #1) that contain a map for only one of the first and second sections (only for data for the higher-mobility section). '096 Patent at 5:18-26 ("Moreover, the DATA 40-3 ... for the new system (extended system) under high mobility may be divided based on the mapping information defined in ... the sub-MAP 42-2 of DATA 40-3... [or] in the UL-MAP (not shown) in the DL burst#1 13.").

233. The language is also found in the first clause of claim 46: "the non-data section comprises at least one of a preamble, a frame control header (FCH), a burst, and a map." The specification indicates that the "at least one of" language in this clause should also be construed as "and/or," because the '096 Patent discloses embodiments in which the non-data section includes fewer than all of these recited preamble, frame control header, burst, and map components. For example, the '096 Patent discloses a non-data section made up of only a preamble and sub-MAP (elements 43 and 42-2). The '096 Patent, at 5:18-33, Fig.4.

234. Further, the '096 Patent uses expressly permissive language, indicating that the frame "may" (and thus may not) include these distinct components. *Id*. at 5:43-45. The disjunctive construction ("and/or") is correct for

each occurrence of the "at least one of" clauses in claim 46, meaning that claim 46 requires that the non-data section comprises a preamble, a frame control header (FCH), a burst, *or* a map (or a preamble, a frame control header (FCH), a burst, *and* a map) of the first section and/or the second section.

235. The '096 Patent explains an OFDMA frame structure in the background section and illustrates the OFDMA frame structure in the following figure and labels the OFDMA frame structure "Prior Art." *Id*. at 1:36-45, Fig.1 (annotated).

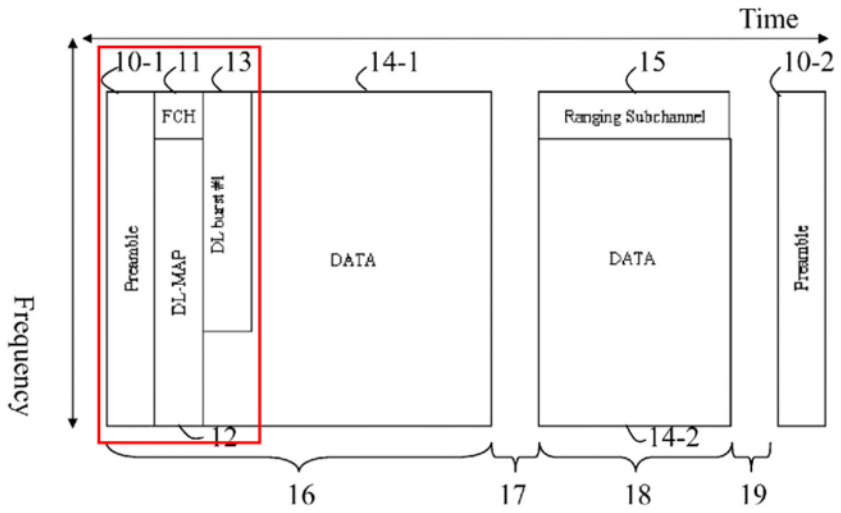


FIG. 1 (Prior Art)

Ex. 1001, Figure 1 (annotated)

236. The '096 Patent states that "[t]he DL sub-frame 16 may include a preamble 10-1, a frame control header (FCH) 11, a downlink map (DL-MAP) 12, a downlink burst (DL burst#1) 13 and a data region (DATA) 14-1." *Id*. at 1:46-57.

237. The ’096 Patent further states, that “DATA 40-3 of the DL sub-frame 16-2 for the new system under high mobility may be divided based on the mapping information” and such “mapping information” may be defined in “DL-MAP11.”[8] *Id*. at 5:18-24, Fig.4. From the teachings of the ’096 Patent, a POSA would have understood that the recited “map” refers to “DL-MAP12” field prior to the “DATA” field and is used to carry certain types of information for the receiver to understand the “division” or “structure” of data in the “DATA” field.

238. Because the “map” recited in claim 46 is substantially the same limitation as the “mapping information” recited in claim 45, it is my opinion that claim 46 is disclosed by the Joint Proposal for the same reasons given regarding the unpatentability of claim 45. *Supra* § XI (C).

E. Claim 47

239. Claim 47 is disclosed by the Joint Proposal as explained below.

1. Claim 47: The method of claim 46, wherein the second section follows the first section in at least one of time sequence and frequency spectrum

240. I understand that the phrase “at least one of […] and […]” in this limitation has been construed as “[…] and/or […]”. The “at least one of” language in claim 47 applies to only two items, the “time sequence” and the “frequency spectrum,” and operates as shorthand for “and/or.” This claim 47 therefore

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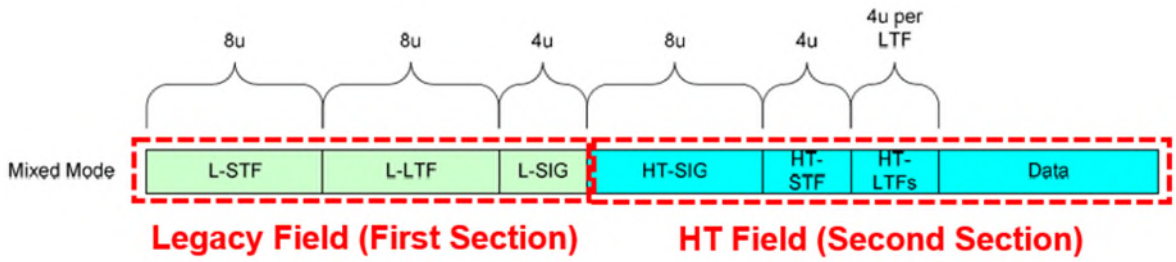
[8] This is a typo; the cite should be DL-MAP 12 as shown in Figure 3.

requires that the second section follows the first section in time sequence *or* frequency spectrum (or the second section follows the first section in time sequence *and* frequency spectrum). This construction is consistent with the specification, because the '096 Patent discloses embodiments in which the second section follows the first section in the time sequence. '096 Patent, Figs. 3 and 4 (Zones 2 and 3 carrying data for a new, higher-mobility system (the claimed "second section") follow Zone 1, which carries data for an old system (the claimed "first section"), in time sequence.

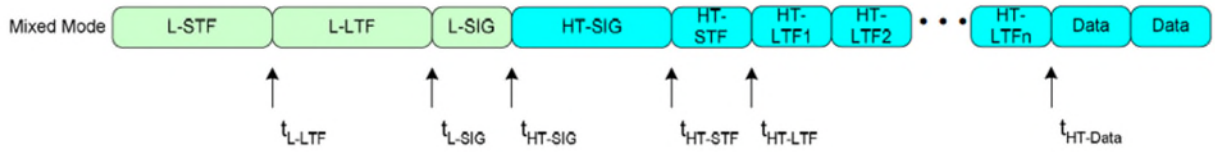
241. The Joint Proposal discloses this limitation. The Joint Proposal discloses three PLCP (PHY Layer Convergence Protocol) packet formats in three different operating modes including the Mixed Mode illustrated in the following figure. Joint Proposal, at 11, Figure 1 (excerpted and annotated).



Ex. 1008, Figure 1 (excerpted and annotated)
Joint Proposal's Mixed Mode Packet Format

242. The Joint Proposal further teaches that the high throughput field (the claimed second section) follows the legacy field (the claimed first section) in time sequence. Specifically, the Joint Proposal illustrates the starting time of each field

of the packet format in the Mixed Mode in the following figure. *Id*. at 18:9-14, Figure 3: Timing boundaries for PPDU Fields.



Ex. 1008, Figure 3 (excerpted)
Timing Boundaries for PPDU Fields

243. As shown in Figure 3, a POSA would have understood that $t_{L\text{-}LTF}$, $t_{L\text{-}SIG}$, are the starting times for the L-LTF and L-SIG fields in the legacy field (the claimed first section), respectively, and $t_{HT\text{-}SIG}$, $t_{HT\text{-}STF}$, $t_{HT\text{-}LTF}$ and $t_{HT\text{-}Data}$ are the starting times for the HT-SIG, HT-STF, HT-LTF and Data fields in the HT field (the claimed second section), respectively. A POSA would have understood from the teachings of the Joint Proposal that the HT field (the claimed second section) follows the legacy field (the claimed first section) in time sequence according to the starting times for each field specified in the Joint Proposal. Thus, claim 47 is disclosed by the Joint Proposal.

F. <u>Claim 50</u>

244. Claim 50 is disclosed by the Joint Proposal as explained below.

1. Claim 50: The method of claim 44, wherein the second section carries mapping information for data in the second section

245. Because the "mapping information" recited in claim 50 is the same limitation as the "mapping information" recited in claim 45, it is my opinion that claim 50 is disclosed by the Joint Proposal for the same reasons given regarding the unpatentability of claim 45. *Supra* § XI(C).

XII. GROUND 2: JOINT PROPOSAL RENDERS CLAIM 49 OBVIOUS IN VIEW OF TRAININ

A. Claim 49

246. Claim 49 is disclosed by the combination of the Joint Proposal and Trainin and a POSA would have been motivated to combine them. Claim 49 depends on independent claim 44 and recites that "wherein each of the first section and the second section carries at least one of uplink and downlink data." Claim 49 is disclosed by the combination of the Joint Proposal and Trainin as explained below.

247. I understand that the phrase "at least one of […] and […]" in this limitation has been construed as "[…] and/or […]". The "at least one of" language in claim 49 applies to only two items, uplink and downlink data, and operates as shorthand for "and/or." This construction is consistent with the specification, which describes embodiments where each of the first and second sections carries only uplink or down-link data (*e.g.*, the first section carries only downlink data, and

the second section also carries only downlink data). For example, the specification discloses an OFDMA frame structure in which sections 40-1 and 40-3 (a "first section" and "second section," respectively) carry downlink data only for the old and new systems; and sections 44- 1 and 44-3 (also a "first section" and "second section," respectively) carry uplink data only for the old and new systems. '096 Patent, at 4:39-5:40, Fig. 4. This claim requires that each of the first section and the second section carries uplink *or* downlink data (or that each of the first section and the second section carries uplink *and* downlink data).

1. Scope and Content of the Prior Art

248. As I have described above, it is my opinion that a POSA would find each element of claim 44 disclosed by and present in the Joint Proposal. *Supra* § XI(B). I understand that a POSA is considered to have in his or her possession that which is in the prior art and that would include the Joint Proposal among additional and inherent well-known teachings in the art.

249. To the extent Patent Owner may argue that the Joint Proposal does not explicitly teach claim 49, the combination of the Joint Proposal with Trainin discloses all elements of claim 49, and a POSA would understand that Trainin's teachings of using downlink and uplink for communication between a transmitter and a receiver in a wireless communication network in accordance with the IEEE 802.11 family (*e.g.*, 802.11a and 802.11n) in combination of the Mixed Mode

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packet format specified in the Joint Proposal, which is designed to make the wireless communication compatible with both the legacy 802.11a transmission and the high throughput (HT) transmission (*i.e.*, 802.11n), discloses claim 49.

250. I understand that the phrase "at least one of […] and […]" in this limitation has been construed as "[…] and/or […]". The "at least one of" language in claim 49 applies to only two items, uplink and downlink data, and operates as shorthand for "and/or." This construction is consistent with the specification, which describes embodiments where each of the first and second sections carries only uplink or down-link data (*e.g.*, the first section carries only downlink data, and the second section also carries only downlink data). For example, the specification discloses an OFDMA frame structure in which sections 40-1 and 40-3 (a "first section" and "second section," respectively) carry downlink data only for the old and new systems; and sections 44- 1 and 44-3 (also a "first section" and "second section," respectively) carry uplink data only for the old and new systems. '096 Patent, 4:39-5:40, Fig. 4. This claim requires that each of the first section and the second section carries uplink *or* downlink data (or that each of the first section and the second section carries uplink *and* downlink data).

251. First, Trainin discloses a wireless local area network (WLAN) communication system. U.S. Pub. No. 2007/0204052A1, (Ex. 1011, "Trainin"), at [0012]. Trainin explains that its system includes "modems, mobile units (MU),

access points (AP), wireless transmitters/receivers, and the like." *Id*. Trainin defines that "AP" means "a basic service set (BSS) provider such as an access point (AP) 110," and "STA" means "one or more wireless mobile units such as a station (STA), for example stations 120, 130, and 140." *Id*. at [0019].

252. Trainin also teaches that "AP 110 and one or more of STA 120, 130, and 140 may communicate network traffic over a shared access medium using one or more wireless links, *e.g.,* links 128, 138, and 148, respectively[]" and such "[l]inks 128, 138, and 148 may each include **a downlink and an uplink, as are known in the art**." *Id*. at [0020] (emphasis added). Trainin further teaches that "the traffic that may be carried via links 128, 138, and 148 may include packets, frames, or other collections of signals and/or data, such as, *e.g.,* media access controller (MAC) protocol data units (MPDUs) and/or physical layer (PHY) protocol data units (PPDUs), that may make up a transmission of wireless signals." *Id*.

253. According to Trainin, "MAC1114 of AP110, may perform functionality related to the **data link layer** of the open systems interconnect (OSI) model, **as known in the art**, and prepare data for transmission by the PHY, *e.g.,* PHY 113." *Id*. at [0034] (emphasis added).

254. These teachings of Trainin using a downlink and an uplink for data transmission between a transmitter and a receiver could be used to transmit data in

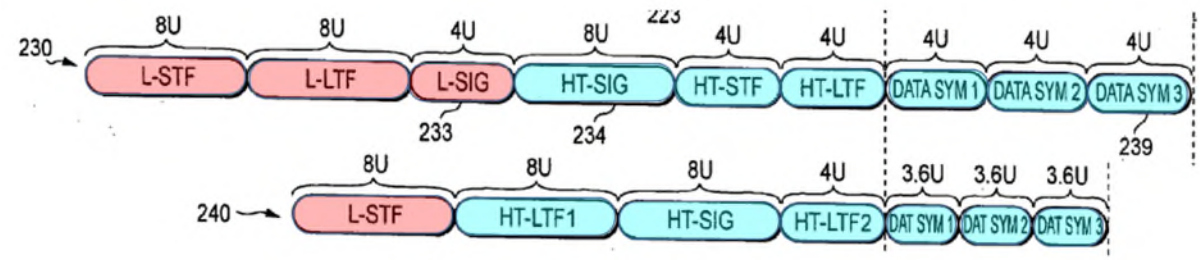
the packet format with a legacy field for the legacy transmission and an HT field for the HT transmission specified by the Joint Proposal. To combine Trainin with the Joint Proposal, a POSA would have understood that the Joint Proposal's legacy field (the claimed first section) for the legacy transmission via Trainin's downlink and uplink constitutes the claimed "first section" carrying the claimed "at least one of uplink and downlink data." In addition, to combine Trainin with the Joint Proposal, a POSA would have understood that the Joint Proposal's HT field (the claimed second section) for the HT transmission via Trainin's downlink and uplink constitutes the claimed "second section" carrying the claimed "at least one of uplink and downlink data." This implementation would have been within a POSA's level of ordinary skill.

2. Motivation to Combine

255. In my opinion, a POSA would have been motivated to combine Trainin with the Joint Proposal.

256. First, both Solomon B. Trainin and Assaf Kasher, the named inventors of Trainin, are listed as co-authors of the Joint Proposal. *Compare* Joint Proposal (Ex. 1008), at 1, 4 and 6 *with* Trainin (Ex. 1011). It is my opinion that a POSA would be aware that ideas contributed by a member of a task group working on standard development may also be reflected in patent filings. Indeed, Trainin explicitly references "Joint Proposal: High throughput extension to the 802.11

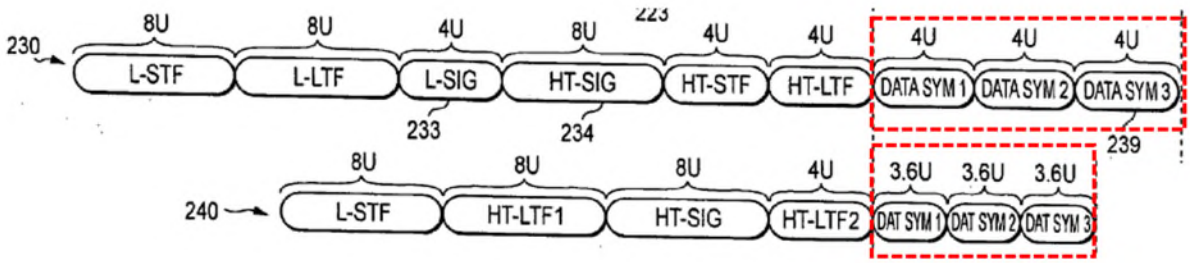
Standard: PHY, which is part of the IEEE 802.11 TGn Joint Proposal Technical Specification, dated Jan. 13, 2006" (Trainin, at [0047]), and discloses a "mixed-mode format 230" in the following figure. Trainin, Fig. 2 (excerpted and color-coding added).



Ex. 1011, Fig. 2 (excerpted and color-coding added)
Trainin's Mixed Mode Frame Format

257. As shown in Figure 2 of Trainin, a POSA would have understood from the teachings of Trainin and the Joint Proposal that the "mixed-mode format 230" in Trainin is substantially identical to the packet format in the Mixed Mode disclosed by the Joint Proposal. *Compare* Joint Proposal) (Ex. 1008), at 11, Figure 1 *with* Trainin (Ex. 1011), Fig 2.

258. Trainin also discloses a revised mixed-mode "format 240" which "may be a short GI format corresponding to the regular GI greenfield format 220 and a format 250 may be a short GI format corresponding to the regular GI mixed-mode format 230." *Id*. at [0032], Fig.2 (excepted and annotated).



Ex. 1011, Figure 2 (excerpted and annotated)
Training's Mixed Mode Frame Format

259. According to Trainin, "a data symbol in a regular GI format, *e.g.,* data symbol 239 of mixed-mode format 230, may have a length measured in 4 units, *e.g.,* 4 microseconds, whereas a data symbol in a short GI format, *e.g.,* data symbol 259 of short GI mixed mode-format 250, may have a length measured in 3.6 units, *e.g.,* 3.6, microseconds." *Id*.

260. A POSA would have understood from the teachings of Trainin and the Joint Proposal that the two different guard intervals in length and the resulting two different symbol periods in length taught by Trainin are substantially **identical** to the two guard intervals and two symbol periods taught by the Joint Proposal.

261. A POSA would have been motivated to combine Trainin's teachings of using an uplink and a downlink to carry out wireless communications with the Joint Proposal's packet format including the legacy field (the claimed first section) for the legacy transmission and the HT field (the claimed second section) for the HT transmission because Trainin explicitly references the Joint Proposal in the

patent specification (*id*. [0014], [0047]), and discloses a "mixed-mode format 230" including two different guard internals in length resulting in two different symbol periods in length and such "mixed-mode format 230" is identical to the packet format in the Mixed Mode specified by the Joint Proposal. *Compare* Joint Proposal, at 11, Figure 1 *with* Trainin, Fig 2. More importantly, Trainin expressly teaches that "the traffic that may be carried via links 128, 138, and 148 may include packets, frames, or other collections of signals and/or data, such as, *e.g.*, media access controller (MAC) protocol data units (MPDUs) and/or physical layer (PHY) protocol data units (PPDUs)." *Id*. at [0020]. Thus, a POSA would have understood from the teachings of Trainin that data transmission using an uplink and a downlink may include packets or frames of physical layer (PHY) protocol data units (PPDUs) (the claimed uplink and downlink data). A POSA would have understood that the legacy field (the claimed first section) and the HT field (the claimed section section) specified in the Joint Proposal are nothing more than a PPDU packet or frame. Joint Proposal, at 10 n.1 (stating the "[p]acket is equivalent to PPDU in this document."), at 14 (stating "Figure 3: Timing boundaries for PPDU Fields[.]).

262. Additionally, a POSA would have understood that the combination is simply the combination of prior art elements according to known methods to yield predictable results. A POSA would have understood that the results of the

combination would have been predictable and there would be a reasonable expectation of success in the combination. Indeed, Trainin explains that "[l]inks 128, 138, and 148 may each include a downlink and an uplink, **as are known in the art[,]**" and such combination simply "**make up a transmission of wireless signals**." *Id*. at [0020] (emphasis added). Thus, the combination of Trainin and Mujtaba simply constitutes a conventional wireless transmission system.

263. It was known in the art to use downlink and uplink for wireless data transmission. *See* Kim (Ex. 1032), at [0005], [0020] (teaching that RF (radio frequency) channels used by a transmitter to communicate with a receiver are downlink channels, RF (radio frequency) channels used by a receiver to communicate with a transmitter are uplink channels in an MIMO system in accordance with 802.11n.); Yang (Ex. 1033) at 6 (teaching that uplink (UL) transmissions are those from stations to the AP, and downlink (DL) transmissions are those from the AP to stations in the IEEE 802.11n wireless network.).

XIII. GROUND 3: MUJTABA ANTICIPATES CLAIM 8

A. Claim 8

264. All elements of claim 8 are disclosed by Mujtaba as explained below.

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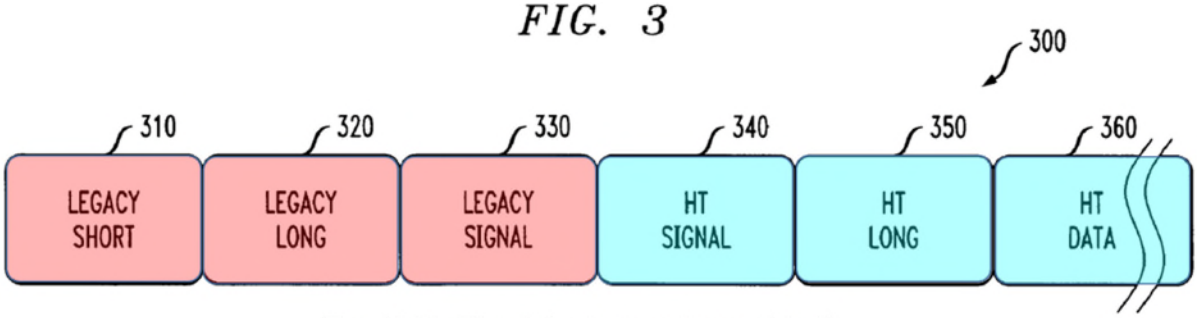
1. Claim 8 [preamble]: A method of constructing a frame structure for data transmission, the method comprising

265. I have been informed that the preamble is not a limitation. However, even if it were a limitation, Mujtaba discloses and teaches a method of constructing a frame structure for data transmission.

266. As an example, Mujtaba discloses a frame structure for data transmission in a multi antenna communication system. *See e.g.,* Mujtaba, at [0008]. Mujtaba illustrates a frame structure in the following figure. *Id*. Fig. 3.

FIG. 3



Ex. 1010, Fig. 3 (color-coding added)
Mujtaba's Packet Format

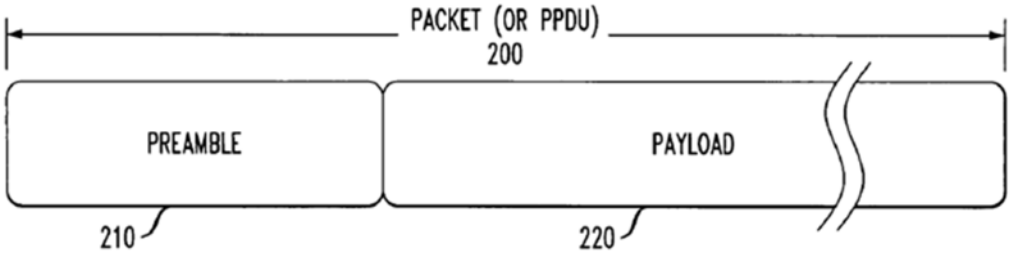
267. Mujtaba discloses the preamble of claim 8 because Mujtaba discloses "constructing" a packet format for 802.11n by combining the legacy field (310, 320, 330) with the HT field (340, 350, 360) in the same packet format. *Id*. [0019], Fig.3.

268. Thus, Mujtaba discloses this limitation.

2. Claim 8[a]: generating a first section comprising data configured in a first format compatible with a first communication system using symbols

269. Mujtaba discloses and teaches this limitation. Specifically, Mujtaba discloses "a typical packet format 200 for an exemplary IEEE 802.11 or another IP-based OFDM system." *Id*. at [0018]. Mujtaba illustrates the "packet format 200" in the following figure. *Id*. Fig. 2.

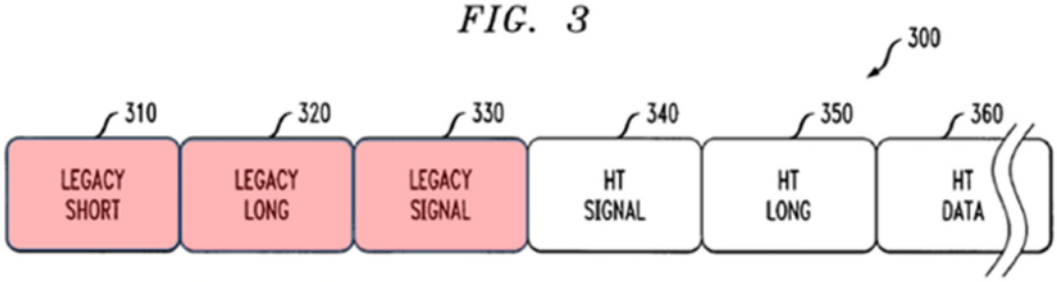
FIG. 2



Ex. 1010, Figure 2

270. Mujtaba further discloses "an exemplary preamble format 300 for IEEE 802.11n[]" in the following figure. *Id*. [0019], Fig. 3 (color-coding added).

FIG. 3



Ex. 1010, Fig. 3 (color-coding added)
Mujtaba's Packet Format

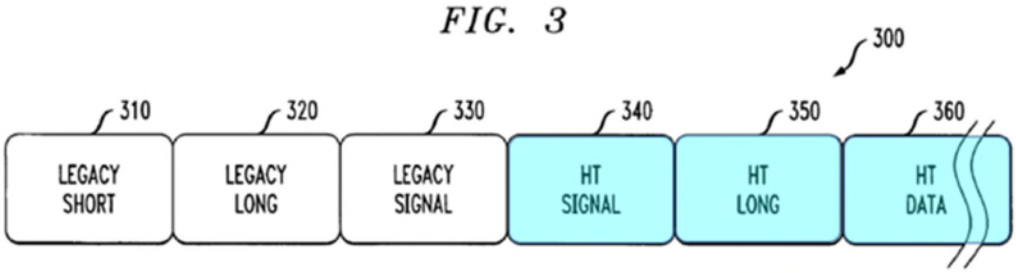
271. While referencing Figure 3, Mujtaba specifically teaches a legacy field (the claimed first section) including "the exemplary preamble 300 includes a legacy short training symbol 310, a legacy long training symbol 320, a legacy SIGNAL field 330[.]" *Id*. at [0019]. Mujtaba further teaches that each preamble "contains all relevant information needed to decode the payload." *Id*. at [0018]. A POSA would have understood from Mujtaba that the legacy field (the claimed first section) carries information in the legacy format (the claimed first format) that enables data (*i.e.*, payload) transmission to be compatible with the legacy devices (the claimed first communication system).

272. Mujtaba also teaches that the information bits at the transmitter side are encoded, interleaved, mapped on to subcarriers as an OFDM signal in which a guard interval is added to each OFDM symbol (the claimed using symbol). *Id*. at [0016].

273. Thus, claim 8[a] is disclosed by Mujtaba.

3. Claim 8[b]: generating a second section following the first section, the second section comprising data configured in a second format compatible with a second communication system using symbols

274. Mujtaba discloses and teaches this limitation in the following figure. *Id.* Fig.3 (color-coding added).



Ex. 1010, Fig. 3 (color-coding added)
Mujtaba's Packet Format

275. According to Mujtaba, "the exemplary preamble 300" further includes an HT field (the claimed second section) including an HT signal field, an HT long field and an HT data field (the claimed second format), following the legacy field in the packet frame. *Id*. at [0019].

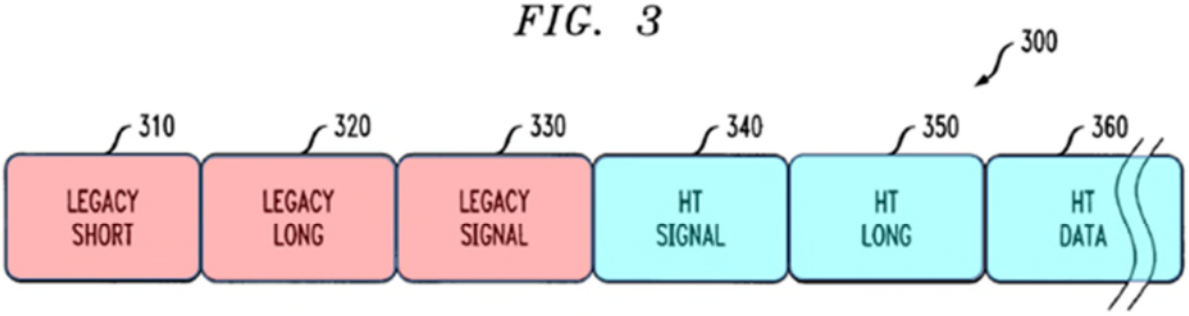
276. Mujtaba also teaches that each preamble "contains all relevant information needed to decode the payload." *Id*. [0018]. Thus, a POSA would have understood from Mujtaba that the HT field (the claimed first section) carries information in the HT format (the claimed second format) that enables payload (*i.e.*, data) to be compatible with HT devices (the claimed second communication system). Also, Mujtaba teaches that the information bits at the transmitter side are encoded, interleaved, mapped on to subcarriers as OFDM signal in which a guard interval is added to each OFDM symbol (the claimed using symbol). *Id*. at [0016].

277. Thus, claim 8[b] is disclosed by Mujtaba.

4. Claim 8[c]: wherein the first communication system's symbols and the second communication system's symbols co-exist in one transmission scheme

278. Mujtaba discloses this limitation. A POSA would have understood from the teachings of Mujtaba that the data packet format disclosed in Figure 3 of Mujtaba shows that the symbols in the legacy field for the legacy transmission (the claimed first communication's symbols) and the symbols in the high throughput (HT) field for the HT transmission (the claimed second communication's symbols) co-exist in one packet frame. *Id*. [0019], Fig. 3 (color-coding added).

FIG. 3



Ex. 1010, Fig. 3 (color-coding added)
Mujtaba's Packet Format

279. Mujtaba also discloses a transmission scheme that is compatible with "a conventional 802.11 a/g" (the claimed one transmission scheme) and specifically explains the general steps for generating OFDM symbols including the steps of encoding, interleaving, mapping data in both time domain and frequency domain at the transmitter side, and the steps of decoding the received OFDM symbols at the receiver side. *Id*. at [0016], [0017], Fig. 1. A POSA would have

understood from the teachings of Mujtaba that the packet format disclosed in Figure 3 shows that the symbols in the legacy field for the legacy transmission (the claimed first communication's symbols) and the symbols in the HT field for the HT transmission (the claimed second communication's symbols) co-exist in one packet frame.

280. Thus, claim 8[c] is disclosed by Mujtaba.

5. Claim 8[d]: wherein the second communication system has pilot symbols that are denser than those in the first communication system

281. I have been informed that "pilot symbols that are denser than" recited in claim 8 means "more pilot symbols per unit time than, wherein a unit time is the symbol period of the first communication system" in the Claim Construction Order (Ex. 1005).

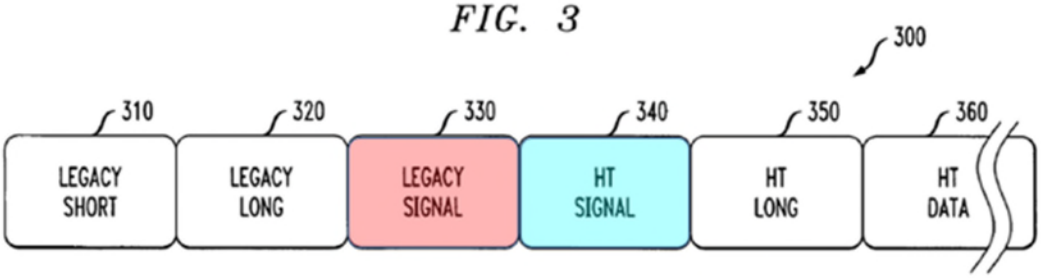
282. Mujtaba discloses this limitation. First, Mujtaba discloses "methods and apparatus are provided for varying the number of pilot tones in a multiple antenna communication system." *Id*. at [0008], [0009]. Specifically, Mujtaba explains that "data is transmitted in a multiple antenna communication system by selecting a number of pilot tones to be employed to transmit the data[.]" *Id*.

283. Mujtaba further teaches "transmitting an indication of the selected number of pilot tones in a preamble of a packet containing the data." *Id*. Without limiting any version of the 802.11 standards, Mujtaba goes on to state that "[t]he

indication of the selected number of pilot tones can be transmitted, for example, in **a SIGNAL field** of an exemplary IEEE 802.11 preamble." *Id*. at [0008] (emphasis added). Mujtaba also teaches that "[t]he number of pilot tones can be selected, for example, based on one or more of (i) a delay spread of a channel; (ii) the SNR at the receiver; or (iii) a number of antennas at a receiver." *Id*.

284. Second, Mujtaba discloses two separate signal fields that are "legacy SIGNAL field 330" and "HT SIGNAL field 340" in the "preamble 300 for IEEE 802.11n." *Id*. at [0019], Fig. 3 (color-coding added).

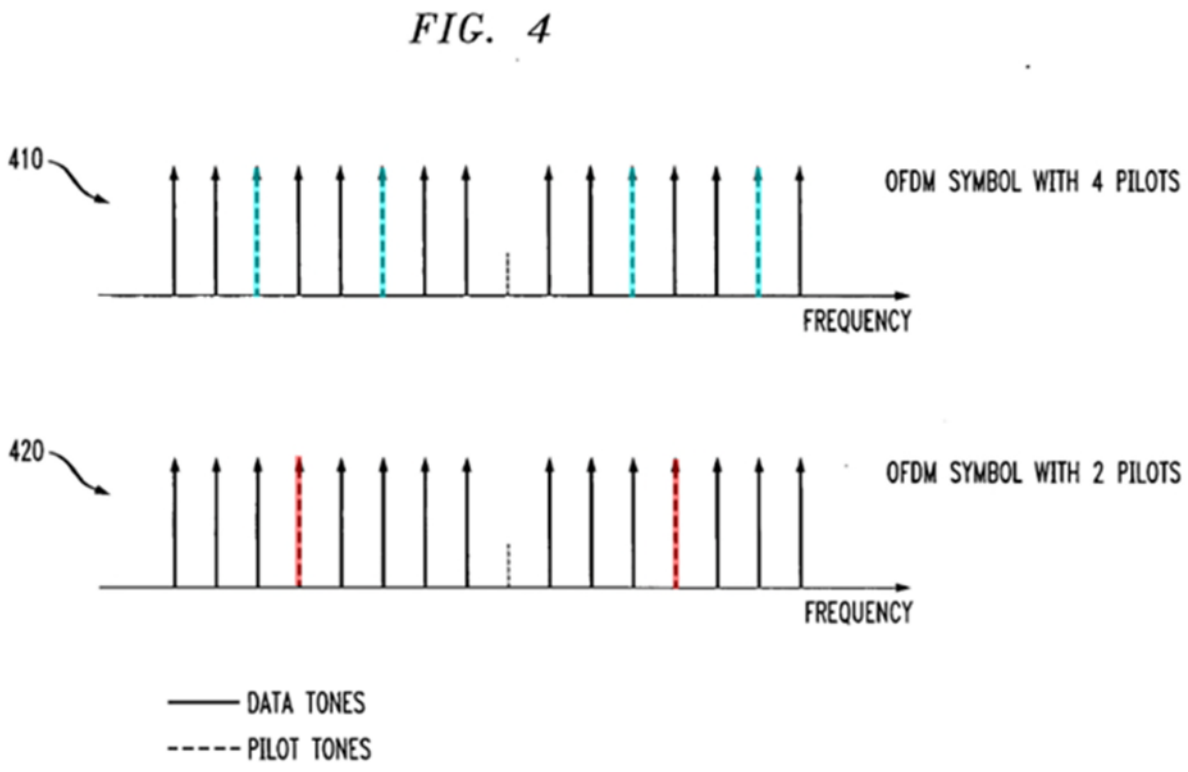
FIG. 3



Ex. 1010, Fig. 3 (color-coding added)
Mujtaba's Packet Format

285. Mujtaba, as an example, illustrates in the following figure "an exemplary OFDM symbol 410 with **four** pilot tones and an exemplary OFDM symbol 410[9] [*sic*] with **two** pilot tones." *Id*. [0024], Fig. 4 (color-coding added).

[9] This is a typo; the cite should be an exemplary OFDM symbol 420 as shown in Figure 4.



Ex. 1010, Fig. 4 (color-coding added)

286. Without limiting the number of pilot symbols, Mujtaba explains that "the HT SIGNAL field 340 can be encoded with a value indicating whether two, four, or six pilot tones were employed." *Id*. at [0019].

287. In addition to the pilot symbol assignments, Mujtaba further teaches "a guard interval" that "is added to each OFDM symbol" at the transmitter side and "the guard interval is removed" at the receiver side. *Id*. at [0016], [0017].

288. A POSA would have understood from the teachings of Mujtaba that (1) Mujtaba's OFDM symbols are transmitted in one single guard interval in a

fixed length, (2) Mujtaba's "legacy SIGNAL field 330" and "HT SIGNAL field 340" can indicate the same number or different numbers of pilot symbols to be employed to transmit data in the legacy format for the legacy transmission (the claimed first communication system) and in the HT format for the HT transmission (the claimed second communication system), and (3) the signal field in the legacy format can indicates, for example, four pilot tones to be employed to transmit data in the legacy format for the legacy transmission (the claimed first communication system), and the signal field in the HT format can indicate, for example, two, four or six pilot tones to be employed to transmit data in the HT format for the HT transmission (the second communication system), and (4) the number of pilot tones can be selected based on one or more of (i) a delay spread of a channel; (ii) the SNR at the receiver; or (iii) a number of antennas at a receiver.

289. A POSA would also have understood from Mujtaba's teachings that if the "legacy SIGNAL field 330" indicates 4 pilot tones and the "HT SIGNAL field 340" indicates 6 pilot tones, the pilot symbols employed to transmit data in the HT packet format for HT transmission (the claimed second communication system) are denser than the pilot symbols employed to transmit data in the legacy format for the HT transmission (the claimed first communication system). Indeed, it was known in the art that four subcarriers are assigned to carry pilot symbols in accordance with the IEEE 802.11a standard. U.S. Pub. No. 2006/0067415 A1,

(Ex. 1012, "Mujtaba II"), at [0004], [0015], [0017], [0020] (disclosing wireless communication system in accordance with 802.11a/g standard with four pilot symbols employed to transmit data in OFDM symbols.).

290. Thus, claim 8[d] is disclosed by Mujtaba.

6. Claim 8[e]: generating at least one non-data section containing information describing an aspect of data in at least one of the first section and the second section

291. I understand that the phase "at least one of […] and […]" in this limitation has been construed as "[…] and/or […]". *Supra* § VI. The "at least one of" language in limitation 1[d] applies to only two items, the first section and the second section, and operates as shorthand for "and/or." I also understand that the terms "data" and "non-data" have been construed in its plain and ordinary meaning. *Id*.

292. This construction is consistent with the specification, which describes embodiment with non-data followed by data sections. For example, the '096 Patent discloses a downlink subframe (DL sub-frame 16) that may include a "preamble 10-1," a "frame control header (FCH 11)," a "downlink map (DL-MAP) 12" and a "downlink burst (DL burst#) 13" followed by a "data region DATA 14-1." '096 Patent, 1:46-50. The '096 Patent further explains that "the DL-MAP 12 may be used to identify the "division or structure" of the DATA 14-1." *Id*. 1:50-52.

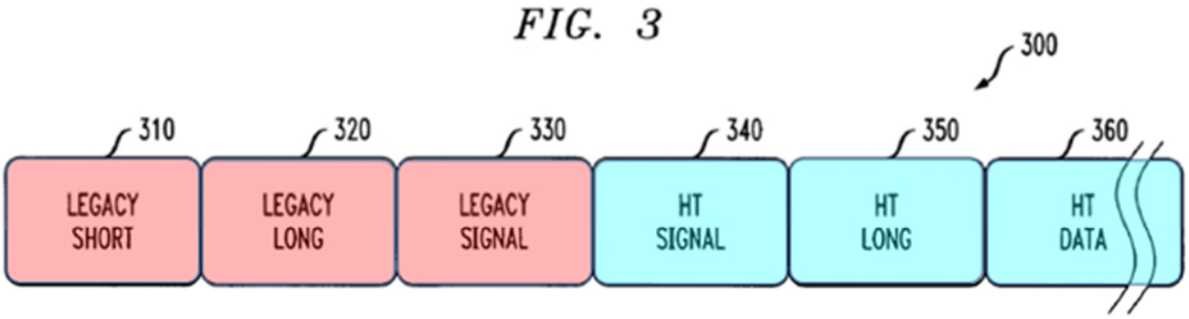
293. It is my opinion that Mujtaba discloses this limitation. Specifically, Mujtaba discloses that the number of pilots is signaled to the receiver in the signal field (the claimed non-data section), or any such field that indicates to the receiver the parameters (the claimed aspect of data) that are required to successfully decode the payload. *Id*. at [0015]. Mujtaba further teaches that the "SIGNAL field" (the claimed non-data section) may include other parameters such as data rate, coding rate and modulation level (the claimed aspect of data). *Id*. A POSA would have understood from the teachings of Mujtaba that both the legacy signal field (the claimed non-data section) in the legacy field (the claimed first section) and the HT signal field (the claimed non-data section) in the HT field (the claimed section section) may contain information describing a number of aspect of the payload such as the number of pilot symbols, data rate, coding rate and modulation rate.

294. Thus, claim 8[e] is disclosed by Mujtaba.

7. Claim 8[f]: combining the first section, the second section and the at least one non-data section to form the frame structure

295. Mujtaba discloses this limitation. A POSA would have understood from the teachings of Mujtaba that the packet format shown in Figure 3 of Mujtaba combines the legacy field preamble (the claimed first section) including the legacy signal field (the claimed non-data section) and the HT field (the claimed second section) including the HT signal field (the claimed non-data section) to form a

single data packet (the claimed frame structure). *Id*. at [0018], Figure 3 (color-coding added).



Ex. 1010, Fig. 3 (color-coding added)
Mujtaba's Packet Format

296. In addition, the signals in both the legacy field and the HT field are encoded, interleaved and mapped, and have a guard interval added to each OFDM symbol. *Id*. at [0016].

297. Thus, claim 8[f] is disclosed by Mujtaba.

XIV. GROUND 4: MUJTABA RENDERS CLAIMS 8, 44-47 AND 49-50 OBVIOUS IN VIEW OF TRAININ

A. Claim 8

298. All elements of claim 8 are disclosed by the combination of Mujtaba and Trainin and a POSA would have been motivated to combine the references.

1. Scope and Content of the Prior Art

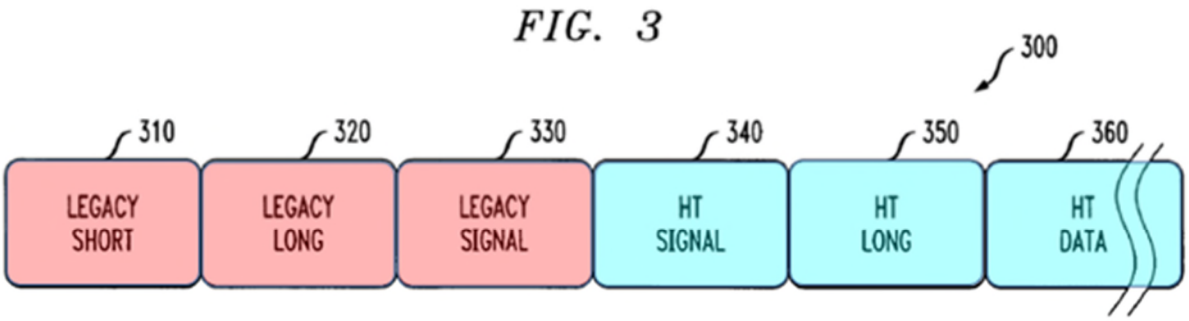
299. As I have described above, it is my opinion that a POSA would find each element of claim 8 disclosed by and present in Mujtaba. *Supra* § XIII. I understand that a POSA is considered to have in his or her possession that which is

in the prior art and that would include Mujtaba among additional and inherent well-known teachings in the field.

300. Mujtaba discloses claim 8[pre]-8[c] and 8[e]-8[f]. *Supra* § XIII. To the extent Patent Owner may argue that Mujtaba does not explicitly teaching claim 8[d] reciting that "the second communication system has pilot symbols that are denser than those in the first communication system," the combination of Mujtaba with Trainin discloses all elements of claim 8 including claim 8[d], and a POSA would have been motivated to incorporate Trainin's teachings of using a symbol period at a fixed length in a wireless communication network in accordance with the IEEE 802.11 family (*e.g.*, 802.11a and 802.11n) into Mujtaba's 802.11n compliant mixed-mode packet, which also teaches that channel estimation can be improved by increasing the number of pilot symbols in the HT data field.

301. First, Mujtaba teaches "transmitting an indication of the selected number of pilot tones in a preamble of a packet containing the data." Mujtaba, at [0008]. Mujtaba also discloses that "[t]he indication of the selected number of pilot tones can be transmitted, for example, in **a SIGNAL field** of an exemplary IEEE 802.11 preamble." *Id*. (emphasis added). Mujtaba also teaches that "[t]he number of pilot tones can be selected, for example, based on one or more of (i) a delay spread of a channel; (ii) the SNR at the receiver; or (iii) a number of antennas at a receiver." *Id*. Mujtaba further discloses two separate signal fields

that are "legacy SIGNAL field 330" and "HT SIGNAL field 340" in the "preamble 300 for IEEE 802.11n." *Id*. [0019], Fig. 3 (color-coding added).



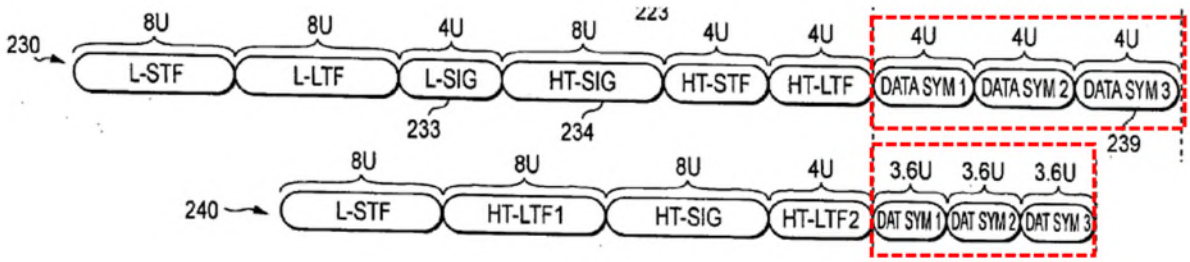
Ex. 1010, Fig. 3 (color-coding added)
Mujtaba's Packet Format

302. A POSA would have understood from the teachings of Mujtaba that pilot symbols are employed in both the legacy transmission (the claimed first communication system) and the HT transmission (the claimed second communication system) in the mixed-mode packet in accordance with 802.11n, and the number of the pilot symbols can be selected based on various factors. Mujtaba teaches that the number of pilot symbols, as examples, could be two, four or six. *Id*. at [0019], [0020], [0024], Fig. 4

303. In addition to the teachings of Mujtaba, Trainin discloses a wireless local area network (WLAN) communication system. U.S. Pub. No. 2007/0204052 A1 (Ex. 1011, "Trainin"), at [0012]. Trainin explains that its system includes "modems, mobile units (MU), access points (AP), wireless transmitters/receivers, and the like." *Id*. Trainin defines that "AP" means "a basic service set (BSS)

provider such as an access point (AP) 110," and "STA" means "one or more wireless mobile units such as a station (STA), for example stations 120, 130, and 140." *Id*. at [0019].

304. Trainin also discloses a mixed-mode "formation 240" which "may be a short GI format corresponding to the regular GI greenfield format 220 and a format 250 may be a short GI format corresponding to the regular GI mixed-mode format 230." *Id*. at [0032], Fig.2 (excepted and annotated).



Ex. 1011, Figure 2 (excerpted and annotated)
Training's Mixed Mode Frame Format

305. According to Trainin, "a data symbol in a regular GI format, *e.g.,* data symbol 239 of mixed-mode format 230, may have a length measured in 4 units, *e.g.,* 4 microseconds, whereas a data symbol in a short GI format, *e.g.,* data symbol 259 of short GI mixed mode-format 250, may have a length measured in 3.6 units, *e.g.,* 3.6, microseconds." *Id*. Trainin further explains that short guard interval is only available in the HT transmission. *Id*. at [0033] (teaching a "guard interval

format (*e.g.*, regular or shortened, **as indicated in the HT signal field**.") (emphasis added).

306. A POSA would have understood from the teachings of Trainin that data can be transmitted in the mixed-mode packet format including the legacy format for legacy transmission (the claimed first communication system) and the HT format for HT transmission (the claimed second communication system) via a downlink and an uplink. A POSA would also have understood from the teachings of Trainin that the legacy transmission in the legacy format (the claimed first communication system) has a regular guard interval resulting in a regular symbol period, and the transmission in the HT format (the claimed second communication system) can have either a regular symbol period or a shorter symbol period.

307. The combination of Mujtaba and Trainin discloses claim 8 because Mujtaba's teaching of selecting, for example, four pilot symbols employed in the legacy transmission (the claimed first communication system) and in the HT transmission (the claimed second communication system) would have been used in Trainin's data transmission with a regular guard interval in the legacy format for the legacy transmission (the claimed first communication system) and a short guard interval in the HT format for the HT transmission (the claimed second communication system) in the mixed mode. Such implementation results in that the pilot symbols in the HT transmission (the claimed second communication

system) are denser than the pilot symbols in the legacy transmission (the claimed first communication system). This implementation would have been within a POSA's level of ordinary skill.

2. Motivation to Combine

308. In my opinion, a POSA would have been motivated to combine Mujtaba with Trainin.

309. First, Syed Aon Mujtaba, the name inventor of Mujtaba, is listed as a co-author of the Joint proposal. *Compare* Joint Proposal, at 5 *with* Mujtaba, cover. In addition, both Solomon B. Trainin and Assaf Kasher, the named inventors in Trainin, are also listed as co-authors of the Joint Proposal. *Compare* Joint Proposal, at 1, 4 and 6 *with* Training, cover. A POSA would be aware that ideas contributed by a member of a standard task group may also be reflected in patent filings.

310. Second, the '096 Patent discloses that "the placement of the pilot symbols in a first region…may be the same as that in the prior art[]" and "the placement of the pilot symbols in a second region…supporting lower mobility may be the same or denser than the that in the prior art[.]" '096 Patent, at 7:61-8:1. The '096 Patent explains that "the new OFDMA system supporting high mobility may use more denser pilot placement with more pilot symbols for increasing accuracy of the channel estimation." *Id*. at 8:4-6. A POSA would have understood

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from the teachings of the ’096 Patent that the denser pilot symbols improve channel estimation for its “new OFDM system supporting high mobility.” The ’096 Patent, however, does not specifically disclose what parameters that may impact accuracy of channel estimation.

311. By contrast, Mujtaba specifically discloses various parameters that may affect channel estimation including “the delay spread of a channel, the signal to noise ratio (SNR) at the receiver, and the number of antennas at the receiver.” Mujtaba, at [0006].

312. In addition, Mujtaba specifically teaches that “a number of pilot tones are embedded in the OFDM data symbols to estimate the phase noise and residual frequency offset.” *Id*., at [0005]. Mujtaba explains that “[p]hase noise at the local oscillators of the transmitter and receiver creates a common phase error (CPE) at the FFT output that generally needs to be corrected for every OFDM symbol[]” and “[r]esidual frequency offset at the input of the FFT also creates CPE.” *Id*. A POSA would have understood that common phase error (CPE) estimation is an essential component of channel estimation. *Id*. at [0004]-[0005](stating that preamble helps receiver estimate “the frequency offset between the transmitter and receiver, and correct for the frequency offset prior to FFT demodulation” and further states that “[r]esidual frequency offset at the input of the FFT also creates CPE.”).

313. Having taught that the number of pilot symbols affects the various parameters for channel estimation, Mujtaba also explains pros and cons when varying the number of pilot symbols. One the one hand, Mujtaba explains that "the accuracy of the CPE estimation increases with the number of pilots, thereby reducing the packet error rate, and increasing the reliability of the transmission." *Id*. at [0006], [0021]. On the other hand, Mujtaba also explains that "[a] greater number of pilots, however, reduces the effective data rate, since actual data is now replaced by pilots (which are known at both the transmitter and the receiver)." *Id*.

314. A POSA would have been motivated to combine Mujtaba and Trainin. First, Mujtaba's system teaches increasing number of pilots for transmission in a packet format including legacy fields and HT fields in accordance with 802.11n. *Supra* §X(B). Trainin also teaches a mixed-mode transmission, including legacy transmission and HT transmission, which is also in accordance with 802.11n. *Supra* §X(C). Thus, both Mujtaba and Trainin are in the same field of endeavor.

315. Moreover, Trainin expressly teaches that "the traffic that may be carried via links 128, 138, and 148 may include packets, frames, or other collections of signals and/or data, such as, *e.g.*, media access controller (MAC) protocol data units (MPDUs) and/or physical layer (PHY) protocol data units (PPDUs)." Trainin at [0020]. A POSA would have understood from Trainin's teachings to use an uplink and a downlink to carry out wireless communications in

packets or frames of physical layer (PHY) protocol data units (PPDUs). A POSA would also have understood from the teachings of Mujtaba that the legacy field (the claimed first section) and the HT field (the claimed section section) are nothing more than a PPDU packet or frame. Mujtaba, at [0018] (stating that a typical packet format for an exemplary IEEE 802.11 is PLCP Protocol Data Units (PPDU).).

316. Additionally, a POSA would have understood that the combination is simply the combination of prior art elements (Mujtaba's packet format in 802.11n and Trainin's short guard interval in 802.1n) according to known methods to yield predictable results. A POSA would have understood that the results of the combination would have been predictable and there would be a reasonable expectation of success in the combination because Mujtaba explicitly teaches that increasing the number of pilot symbols improves channel estimation (Mujtaba at [0006], [0021]; *see also* Mujtaba II, at [0004],[0015], [0017], [0020] (disclosing four pilot symbols employed to transmit data in OFDM symbols in legacy 802.11 systems.)), and Trainin explicitly explains that "[l]inks 128, 138, and 148 may each include a downlink and an uplink, **as are known in the art[,**]" and such combination simply "**make[s] up a transmission of wireless signals**." Trainin at [0020] (emphasis added). Thus, the combination of Trainin and Mujtaba simply constitutes a conventional wireless transmission system.

317. It was known in the art to use downlink and uplink for wireless data transmission. *See* Kim (Ex. 1032), at [0005], [0020] (teaching that RF (radio frequency) channels used by a transmitter to communicate with a receiver are downlink channels, RF (radio frequency) channels used by a receiver to communicate with a transmitter are uplink channels in an MIMO system in accordance with 802.11n.); Yang (Ex. 1033) at 6 (teaching that uplink (UL) transmissions are those from stations to the AP, and downlink (DL) transmissions are those from the AP to stations in the IEEE 802.11n wireless network.).

B. Claim 44

318. Claim 44 is disclosed by the combination of Mujtaba and Trainin and a POSA would have been motivated to combine them. I have reviewed claim 44 and it has the same limitation as claim 8, except for limitation 44[d] and limitation 44[e]. Because of these similarities, my opinion is that limitations 44[pre]-44[c] and 44[f]-44[h] are unpatentable for the same reasons given regarding the unpatentability of limitations 8[pre]-8[f]. *Supra* § XIV(A).

1. Scope and Content of the Prior Art

a. Claim 44[d]

319. Claim 44[d] recites that "wherein: the second format is compatible with the second communication system configured to support higher mobility than the first communication system[.]" Claim 44 [d] is disclosed by the combination of Mujtaba and Trainin.

320. The ’096 Patent explains that the legacy system may be susceptible to a Doppler effect in a high mobility scenario because the placement may be usually designed with a relatively large symbol period, which in turn may induce relatively short carrier spacing and less dense pilot symbol placement.” ’096 Patent, at 2:6-11. Specifically, the ’096 Patent explains that “the limitation on pilot symbol placement may cause channel estimation error at a receiving end because of insufficient information provided for channel estimation.” *Id*. at 2:11-14.

321. To improve channel estimation in a high-mobility environment, the ’096 Patent proposes a frame structure for the “new system” under high mobility that has “a shorter symbol period or more pilot symbols” than the “legacy system.” *Id*. at 5:1-16. The ’096 Patent explains that “[g]enerally, a shorter symbol period may be more robust to inter-symbol interference, while denser pilot symbols may achieve better channel estimation accuracy.” *Id*. at 5:16-18.

322. During prosecution of the application that issued as the ’096 Patent, the applicants amended claim 1 to recite “the second communication system configured to support higher mobility than the first communication system, wherein each symbol in the second communication system has a shorter symbol period than that in the first communication system.” Excerpt of the’096 Patent Prosecution History (Ex. 1004) at 80. To distinguish prior art cited by the Examiner from the amended claims, the applicants argued in response to a Non-

Final Rejection that "[h]owever, the pre-designated legacy system transmission period would be susceptible to a Doppler effect in a high mobility scenario, because the placement is designed with a relatively large symbol period, which in turn induces relatively short carrier spacing and less dense pilot symbol placement." *Id*. at 92.

323. To overcome the following Final Rejection, the Applicants underscored the limitation that "symbols in the second communication system have a shorter symbol period than those in the first communication system[,]" and further argued that "[n]owhere does Ahmadi appear to disclose that a shorter frame size necessarily equates to a shorter symbol period." *Id*. at 49.

324. Additionally, Patent Owner argues in its Motion to Amend that "the second format…is designed to support higher mobility *i.e.*, speed at which the mobile unit is moving, and uses symbols that are shorter (*i.e.*, the bandwidth is larger) than the symbols in 802.11e." Patent Owner's Motion to Amend in *Inter Partes* Review No. 2021-00743 (Ex. 1006), at 5.

325. In view of the written description in the '096 Patent, and the applicants' arguments during the prosecution history, and Patent Owner's arguments in its Motion to Amend in a separate IPR proceedings (Ex. 1006), it is my opinion that a POSA would have understood that the claimed "second communication system configured to support higher mobility than the first

communication system" means the claimed second communication system having "shorter symbol period" and "denser pilot symbols" than the claimed first communication system. *Supra* § XI(B)(1).. The combination of Mujtaba and Trainin discloses a short guard interval resulting in a shorter symbol period in the high throughput (HT) transmission (the claimed second communication system) and a regular guard interval resulting in a regular (longer) symbol period in the legacy transmission (the claimed first communication system). Thus, this limitation is taught by the combination of Mujtaba and Trainin *Supra* § XIV(A)(1).

326. To the extent Patent Owner argues that the combination of Mujtaba and Trainin does not explicitly teach this limitation, a POSA would have understood from the teaching of Mujtaba and Trainin that the implementation of a "shorter symbol period" and "denser pilots" was necessary for the "second communication system" in a "higher mobility" environment to improve channel estimation and mitigate inter-symbol interference. In other words, a POSA would have understood that the capability of supporting "higher mobility" in the "second communication system" necessarily flows from the claimed "shorter symbol period than that in the first communication system" and the claimed "pilot symbols that are denser than those in the first communication system[.]"

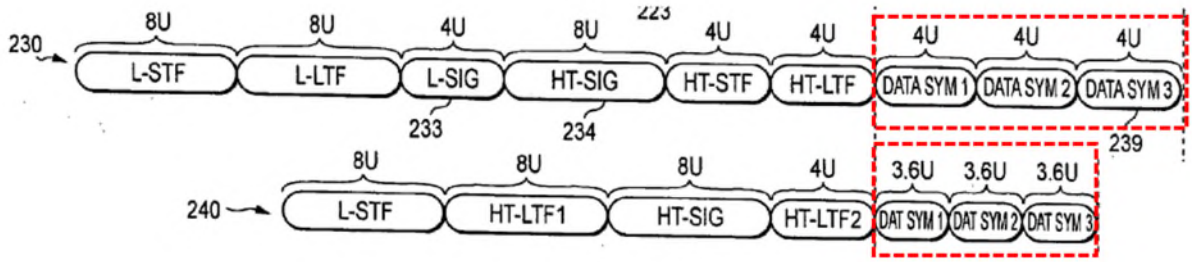
327. As I have been informed that in order to rely on inherency to establish the existence of a claim limitation in the prior art in an obviousness analysis – the limitation at issue necessarily must be present, or the natural result of the combination of elements explicitly disclosed by the prior art. A POSA would have understood from the combination of Mujtaba with Trainin that the capability of supporting "higher mobility" in the HT transmission (the claimed second communication system) is necessarily present or the natural result of the combination of Mujtaba of Trainin. This is because a POSA would have understood from the teachings of Mujtaba and Trainin that claim 44[d] is necessarily present, or the natural result of the combination of Mujtaba and Trainin because it discloses a system including an HT transmission (the claimed second communication system) with a shorter symbol period and denser pilot symbols than the legacy transmission (the claimed first communication system) and such system necessarily results in that the HT transmission supports a higher mobility than the legacy transmission. Thus, the combination of Mujtaba and Trainin discloses claim 44 [d].

b. <u>Claim 44[e]</u>

328. Claim 44[e] recites that "wherein each symbol in the second communication system has a shorter symbol period than that in the first communication system[.]"

329. As previously discussed, Mujtaba discloses that a guard interval is added to each OFDM symbol in a conventional 802.11 a/g transmission. Mujtaba, at [0016].

330. In addition to the teachings of Mujtaba, Trainin also discloses a mixed-mode "formation 240" which "may be a short GI format corresponding to the regular GI greenfield format 220 and a format 250 may be a short GI format corresponding to the regular GI mixed-mode format 230." *Id*. [0032], Fig.2 (excepted and annotated).



Ex. 1011, Figure 2 (excerpted and annotated)
Training's Mixed Mode Frame Format

331. According to Trainin, "a data symbol in a regular GI format, *e.g.,* data symbol 239 of mixed-mode format 230, may have a length measured in 4 units, *e.g.,* 4 microseconds, whereas a data symbol in a short GI format, *e.g.,* data symbol 259 of short GI mixed mode-format 250, may have a length measured in 3.6 units, *e.g.,* 3.6, microseconds." *Id*. Trainin states that the short guard interval is only available in the HT transmission (the claimed second communication system). *Id*.

at [0033] ("guard interval format (*e.g.*, regular or shortened), as indicated in the HT signal field.").

332. Thus, a POSA would have understood from the combination of Mujtaba (teaching a legacy transmission in the legacy format (the claimed first communication system) and an HT transmission in the HT format (the claimed second communication system) in OFDM symbols with a guard interval) with Trainin teaching that data may be transmitted in the HT transmission (the claimed second communication system) with a shorter guard interval, which results in a shorter symbol period. Thus, the combination of Mujtaba and Trainin discloses all elements of claim 44.

2. <u>Motivation to Combine</u>

333. In my opinion, a POSA would have been motivated to combine Mujtaba with Trainin.

334. First, Syed Aon Mujtaba, the name inventor of Mujtaba, is listed as a co-author of the Joint proposal. *Compare* Joint Proposal, at 5 *with* Mujtaba, cover. In addition, both Solomon B. Trainin and Assaf Kasher, the named inventors in Trainin, are also listed as co-authors of the Joint Proposal. *Compare* Joint Proposal, at 1, 4 and 6 *with* Training, cover. A POSA would be aware that ideas contributed by a member of a standard task group may also be reflected in patent filings.

335. Second, the ’096 Patent discloses that “the placement of the pilot symbols in a first region…may be the same as that in the prior art[]” and “the placement of the pilot symbols in a second region…supporting lower mobility may be the same or denser than the that in the prior art[.]” ’096 Patent, at 7:61-8:1. The ’096 Patent explains that “the new OFDMA system supporting high mobility may use more denser pilot placement with more pilot symbols for increasing accuracy of the channel estimation.” *Id*. at 8:4-6. A POSA would have understood from the teachings of the ’096 patent that the denser pilot symbols improve channel estimation for its “new OFDM system supporting high mobility.”

336. The ’096 Patent, however, does not specifically disclose what parameters that may impact accuracy of channel estimation. By contrast, Mujtaba specifically discloses various parameters that may affect channel estimation including “the delay spread of a channel, the signal to noise ratio (SNR) at the receiver, and the number of antennas at the receiver.” Mujtaba, at [0006].

337. In addition, Mujtaba specifically teaches that “a number of pilot tones are embedded in the OFDM data symbols to estimate the phase noise and residual frequency offset.” *Id*. at [0005]. Mujtaba explains that “[p]hase noise at the local oscillators of the transmitter and receiver creates a common phase error (CPE) at the FFT output that generally needs to be corrected for every OFDM symbol[]” and “[r]esidual frequency offset at the input of the FFT also creates CPE.” *Id*. A

POSA would have understood that common phase error (CPE) estimation is an essential component of channel estimation. *Id*. at [0004]-[0005](stating that preamble helps receiver estimate "the frequency offset between the transmitter and receiver, and correct for the frequency offset prior to FFT demodulation " and further states that "[r]esidual frequency offset at the input of the FFT also creates CPE.").

338. Having taught that the number of pilot symbols affects the various parameters for channel estimation, Mujtaba also explains pros and cons when varying the number of pilot symbols. One the one hand, Mujtaba explains that "the accuracy of the CPE estimation increases with the number of pilots, thereby reducing the packet error rate, and increasing the reliability of the transmission." *Id*. at [0006], [0021]. On the other hand, Mujtaba also explains that "[a] greater number of pilots, however, reduces the effective data rate, since actual data is now replaced by pilots (which are known at both the transmitter and the receiver)." *Id*.

339. A POSA would have been motivated to combine Mujtaba and Trainin. First, Mujtaba's system teaches increasing number of pilots for transmission in a packet format including legacy fields and HT fields in accordance with 802.11n. Trainin also teaches a mixed-mode transmission, including legacy transmission and HT transmission, which is also in accordance with 802.11n. Thus, both Mujtaba and Trainin are in the same field of endeavor.

340. Furthermore, Trainin expressly teaches that "the traffic that may be carried via links 128, 138, and 148 may include packets, frames, or other collections of signals and/or data, such as, *e.g.*, media access controller (MAC) protocol data units (MPDUs) and/or physical layer (PHY) protocol data units (PPDUs)." Trainin at [0020]. A POSA would have understood from Trainin's teachings of using an uplink and a downlink to carry out wireless communications in packets or frames of physical layer (PHY) protocol data units (PPDUs). A POSA would also have understood from the teachings of Mujtaba that the legacy field (the claimed first section) and the HT field (the claimed section section) are nothing more than a PPDU packet or frame. Mujtaba at [0018] (stating that a typical packet format for an exemplary IEEE 802.11 is PLCP Protocol Data Units (PPDU).).

341. Additionally, a POSA would have understood that the combination is simply the combination of prior art elements (Mujtaba's packet format in 802.11n and Trainin's short guard interval in 802.1n) according to known methods to yield predictable results. A POSA would have understood that the results of the combination would have been predictable and there would be a reasonable expectation of success in the combination because Mujtaba explicitly teaches that increasing the number of pilot symbols in the improves channel estimation (Mujtaba at [0006], [0021]; *see also* Mujtaba II, at [0004], [0015], [0017], [0020]

(disclosing four pilot symbols employed to transmit data in the legacy 802.11 systems), and Trainin explicitly explains that "[l]inks 128, 138, and 148 may each include a downlink and an uplink, **as are known in the art[,]**" and such combination simply "**make up a transmission of wireless signals**." Trainin at [0020] (emphasis added). Thus, the combination of Trainin and Mujtaba simply constitutes a conventional wireless transmission system.

342. It was known in the art to use downlink and uplink for wireless data transmission. S*ee* Kim, at [0005], [0020] (teaching that RF (radio frequency) channels used by a transmitter to communicate with a receiver are downlink channels, RF (radio frequency) channels used by a receiver to communicate with a transmitter are uplink channels in an MIMO system in accordance with 802.11n.); Yang, at 6 (teaching that uplink (UL) transmissions are those from stations to the AP, and downlink (DL) transmissions are those from the AP to stations in the IEEE 802.11n wireless network.).

C. <u>Claim 45</u>

343. Claim 45 is disclosed by the combination of Mujtaba and Trainin and a POSA would have been motivated to combine them Claim 45. Claim 45 depends on independent claim 44 and recites that "wherein the non-data section comprises mapping information for at least one of the first section and the second section."

344. I understand that the phrase "at least one of […] and […]" in this limitation has been construed as "[…] and/or […]". The "at least one of" language in claim 45 applies to only two items, the "first section" and the "second section," and operates as shorthand for "and/or." This claim 45 therefore requires a non-data section that comprises mapping information for the first section *or* the second section (or a non-data section that comprises mapping information for the first section *and* the second section). This construction is consistent with the specification, which describes embodiment with non-data sections—for example, "DL-MAP 11 and the sub-MAP 42-2 of DATA 40-3... [or] the UL-MAP (not shown) in the DL burst#1 13"—that provide information for the "new system (extended system) under high mobility" (*i.e.*, "data in... the second section") only. '096 Patent, at 5:18-26.

345. As a preliminary matter, the '096 Patent explains an OFDMA frame structure in the background section and illustrates the OFDMA frame structure in the following figure and labels the OFDMA frame structure as "Prior Art." '096 Patent, at 1:36-45., Fig.1 (annotated).

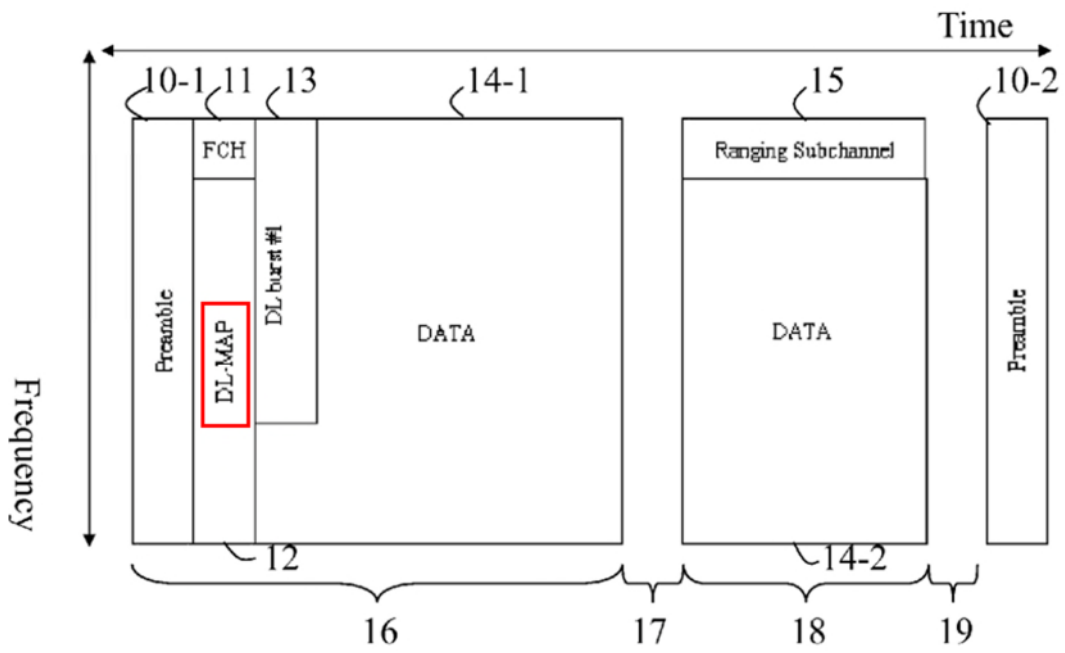


FIG. 1 (Prior Art)

Ex. 1001, Fig. 1 (annotated)

346. The ’096 Patent states that “[t]he DL sub-frame 16 may include a preamble 10-1, a frame control header (FCH) 11, a downlink map (DL-MAP) 12, a downlink burst (DL burst#1) 13 and a data region (DATA) 14-1.” *Id*. at 1:46-57. The ’096 Patent goes on to explain that the “DL-MAP 12 may be used to identify the **division** or **structure** of the DATA 14-1 in the DL sub-frame 16[.]” *Id*. (emphasis added). The ’096 Patent further states, that “DATA 40-3 of the DL sub-frame 16-2 for the new system under high mobility may be divided based on the mapping information” and such “mapping information” may be defined in “DL-

MAP11.[10]" *Id*. at 5:18-24, Fig.4. From the teachings of the '096 Patent, a POSA would have understood that the "mapping information" is a certain type of information carried in the "DL-MAP12" field prior to the "DATA" field and is used for the receiver to understand the "division" or "structure" of data in the "DATA" field for the new system under high mobility.

1. Scope and Content of the Prior Art

347. The combination of Mujtaba and Trainin discloses claim 45. First, Mujtaba generally discloses a data packet format with a preamble including "SIGNAL field" followed by a payload for carrying data. Mujtaba, at [0015], Fig. 2. Mujtaba explains that the signal field (the claimed no-data section) may carry information indicating the number of pilots to the receiver and some other information indicating data rate, coding rate and modulation level (the claimed mapping information) for the data field (claimed second section). *Id*. at [0015].

348. Mujtaba further discloses that the data is mapped as part of the process of transmission. Mujtaba, at [0016], Fig. 1. Mujtaba notes that "encoded and interleaved bits are then mapped onto subcarriers (tones) at stage 130 and form a frequency domain OFDM symbol." *Id*.

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[10] This is a typo; the cite should be DL-MAP 12 as shown in Figure 3.

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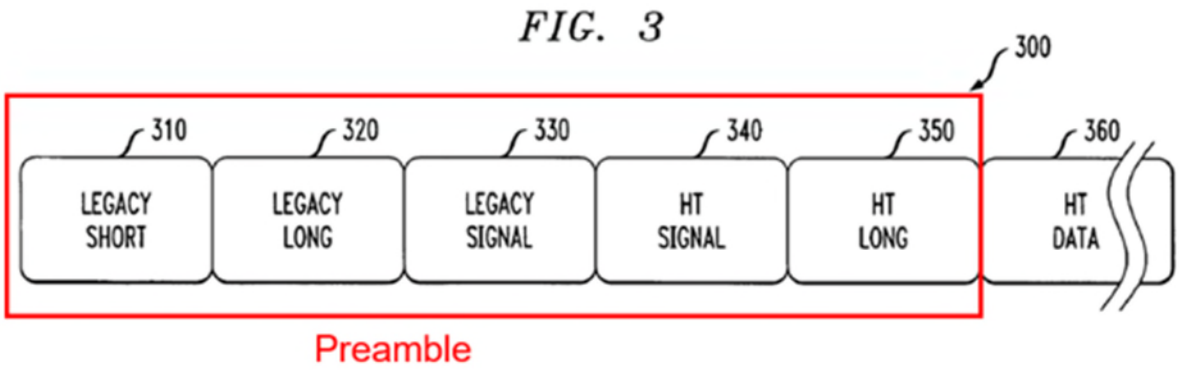
349. Mujtaba further discloses a conventional packet format for IEEE 802.11 with a preamble followed by a payload containing data and one or more pilot tones. *Id*. Fig.2, at [0018]. According to Mujtaba, each preamble contains "all relevant information|" such as "synchronization information" that is needed to decode the payload. *Id*.

350. Mujtaba also discloses a packet format for 802.11n including a preamble which is illustrated in the following figure. *Id*. Fig. 3.



Ex. 1010, Fig. 3 (annotated)
Mujtaba's Packet Format

351. According to Mujtaba, the preamble 300 includes a legacy short training symbol 310, a legacy long training symbol 320, a legacy SIGNAL field 330, a high throughput (HT) SIGNAL field 340, an HT long training symbol 350 followed by a HT data field (payload) 360. *Id*. at [0019]. Mujtaba further explains that the HT SIGNAL field 340 (the claimed non-data section) may convey to the receiver the number of pilot tones (the claimed mapping information) and the HT

SIGNAL field 340 can be encoded with a value indicating whether two, four, or six pilot tones were employed. *Id*.

352. A POSA would have understood from the teachings of Mujtaba that the preamble including the signal field (the claimed non-data section) in both the legacy and HT fields are non-data fields. A POSA would have also understood from the teachings of Mujtaba that the "relevant information" in the signal field (the claimed non-data section) indicating data rate, coding rate, modulation level, synchronization, and the number of pilot symbols (the claimed mapping information) in the data field (the claimed second section) is the information that may be used to identify the "division" or "structure" of the data field, including the mapping of data onto sub-carriers. Thus, Mujtaba discloses claim 45.

353. In addition to Mujtaba's teachings, Trainin also discloses a preamble in the legacy format in accordance with 802.11a and such preamble has a "legacy signal field 213" (the claimed non-data section) that is used to identify the type of modulation scheme used and the legacy signal field may include information such as the data rate and the length of the subsequent data portion (the claimed mapping information). Trainin, at [0030], Fig. 2.

354. A POSA would have understood from the teachings of Trainin that the preamble including the signal field in both the legacy and HT fields are non-data fields. A POSA would have also understood from the teachings of Trainin

that both the legacy signal and HT signal fields in the preamble (the claimed non-data section) carry the information may be used to identify the "division" or "structure" of the data field (the claimed mapping information). Thus, the combination of Mujtaba and Trainin discloses claim 45. This implementation would have been within a POSA's level of ordinary skill.

2. Motivation to Combine

355. In my opinion, a POSA would have been motivated to combine Mujtaba with Trainin.

356. First, Syed Aon Mujtaba, the name inventor of Mujtaba, is listed as a co-author of the Joint proposal. *Compare* Joint Proposal, at 5 *with* Mujtaba, cover. In addition, both Solomon B. Trainin and Assaf Kasher, the named inventors in Trainin, are also listed as co-authors of the Joint Proposal. *Compare* Joint Proposal, at 1, 4 and 6 *with* Training, cover. A POSA would be aware that ideas contributed by a member of a standard task group may also be reflected in patent filings.

357. Second, the '096 Patent discloses that "the placement of the pilot symbols in a first region…may be the same as that in the prior art[]" and "the placement of the pilot symbols in a second region…supporting lower mobility may be the same or denser than the that in the prior art[.]" '096 Patent, at 7:61-8:1. The '096 Patent explains that "the new OFDMA system supporting high mobility

may use more denser pilot placement with more pilot symbols for increasing accuracy of the channel estimation." *Id*. at 8:4-6. A POSA would have understood from the teachings of the '096 Patent that the denser pilot symbols improve channel estimation for its "new OFDM system supporting high mobility."

358. The '096 Patent, however, does not specifically disclose what parameters that may impact accuracy of channel estimation. By contrast, Mujtaba specifically discloses various parameters that may affect channel estimation including "the delay spread of a channel, the signal to noise ratio (SNR) at the receiver, and the number of antennas at the receiver." Mujtaba, at [0006].

359. In addition, Mujtaba specifically teaches that "a number of pilot tones are embedded in the OFDM data symbols to estimate the phase noise and residual frequency offset." *Id*., at [0005]. Mujtaba explains that "[p]hase noise at the local oscillators of the transmitter and receiver creates a common phase error (CPE) at the FFT output that generally needs to be corrected for every OFDM symbol[]" and "[r]esidual frequency offset at the input of the FFT also creates CPE." *Id*. A POSA would have understood that common phase error (CPE) estimation is an essential component of channel estimation. *Id*. at [0004]-[0005](stating that preamble helps receiver estimate "the frequency offset between the transmitter and receiver, and correct for the frequency offset prior to FFT demodulation " and

further states that "[r]esidual frequency offset at the input of the FFT also creates CPE.").

360. Having taught that the number of pilot symbols affects the various parameters for channel estimation, Mujtaba also explains pros and cons when varying the number of pilot symbols. One the one hand, Mujtaba explains that "the accuracy of the CPE estimation increases with the number of pilots, thereby reducing the packet error rate, and increasing the reliability of the transmission." *Id*. at [0006], [0021]. On the other hand, Mujtaba also explains that "[a] greater number of pilots, however, reduces the effective data rate, since actual data is now replaced by pilots (which are known at both the transmitter and the receiver)." *Id*.

361. A POSA would have been motivated to combine Mujtaba and Trainin. First, Mujtaba's system teaches increasing number of pilots for transmission in a packet format including legacy fields and HT fields in accordance with 802.11n. Trainin also teaches a mixed-mode transmission, including legacy transmission and HT transmission, which is also in accordance with 802.11n. Thus, both Mujtaba and Trainin are in the same field of endeavor.

362. Furthermore, Trainin expressly teaches that "the traffic that may be carried via links 128, 138, and 148 may include packets, frames, or other collections of signals and/or data, such as, *e.g.*, media access controller (MAC) protocol data units (MPDUs) and/or physical layer (PHY) protocol data units

(PPDUs)." Trainin at [0020]. A POSA would have understood from Trainin's teachings of using an uplink and a downlink to carry out wireless communications in packets or frames of physical layer (PHY) protocol data units (PPDUs). A POSA would also have understood from the teachings of Mujtaba that the legacy field (the claimed first section) and the HT field (the claimed section section) are nothing more than a PPDU packet or frame. Mujtaba at [0018] (stating that a typical packet format for an exemplary IEEE 802.11 is PLCP Protocol Data Units (PPDU).).

363. Additionally, a POSA would have understood that the combination is simply the combination of prior art elements (Mujtaba's packet format in 802.11n and Trainin's short guard interval in 802.1n) according to known methods to yield predictable results. A POSA would have understood that the results of the combination would have been predictable and there would be a reasonable expectation of success in the combination because Mujtaba explicitly teaches that increasing the number of pilot symbols in the improves channel estimation (Mujtaba at [0006], [0021]; *see also* Mujtaba II, at [0004], [0015], [0017], [0020] (disclosing wireless communication system in accordance with 802.11a/g standard with four pilot symbols employed to transmit data in OFDM symbols.)), and Trainin explicitly explains that "[l]inks 128, 138, and 148 may each include a downlink and an uplink, **as are known in the art[,]**" and such combination simply

"**make up a transmission of wireless signals**." Trainin at [0020] (emphasis added). Thus, the combination of Trainin and Mujtaba simply constitutes a conventional wireless transmission system.

364. It was known in the art to use downlink and uplink for wireless data transmission. *See* Kim, at [0005], [0020] (teaching that RF (radio frequency) channels used by a transmitter to communicate with a receiver are downlink channels, RF (radio frequency) channels used by a receiver to communicate with a transmitter are uplink channels in an MIMO system in accordance with 802.11n.); Yang (Ex. 1033) at 6 (teaching that uplink (UL) transmissions are those from stations to the AP, and downlink (DL) transmissions are those from the AP to stations in the IEEE 802.11n wireless network.).

D. <u>Claim 46</u>

365. Claim 46 is disclosed by the combination of Mujtaba and Trainin and a POSA would have been motivated to combine them. Claim 46 depends on independent claim 44 and recites that "wherein the non-data section comprises at least one of a preamble, a frame control header 60 (FCH), a burst, and a map of at least one of the first section and the second section."

366. I understand that the phrase "at least one of […] and […]" in this limitation has been construed as "[…] and/or […]". Claim 46 includes two occurrences of this language. In the last clause of claim 46—"a map of at least one

of the first section and the second section"—the "at least one of" language applies to only two items, the first section" and the second section, and operates as shorthand for "and/or."

367. The "at least one of" language in claim 46 applies to six items, the "preamble," the "frame control header 60 (FCH)," the "burst," the "map," the "first section" and the "second section," and operates as shorthand for "and/or." This claim 46 therefore requires, for example, a non-data section that comprises preamble, frame control header 60 (FCH), burst, or map for the first section or the second section. The language is also found in the first clause of claim 46: "the non-data section comprises at least one of a preamble, a frame control header (FCH), a burst, and a map." The disjunctive construction ("and/or") is correct for each occurrence of the "at least one of" clauses in claim 46, meaning that claim 46 requires that the non- data section comprises a preamble, a frame control header (FCH), a burst, *or* a map (or a preamble, a frame control header (FCH), a burst, and a map) of the first section and/or the second section.

368. The '096 Patent states that "[t]he DL sub-frame 16 may include a preamble 10-1, a frame control header (FCH) 11, a downlink map (DL-MAP) 12, a downlink burst (DL burst#1) 13 and a data region (DATA) 14-1." *Id*. 1:46-57, Figure 1 (annotated).

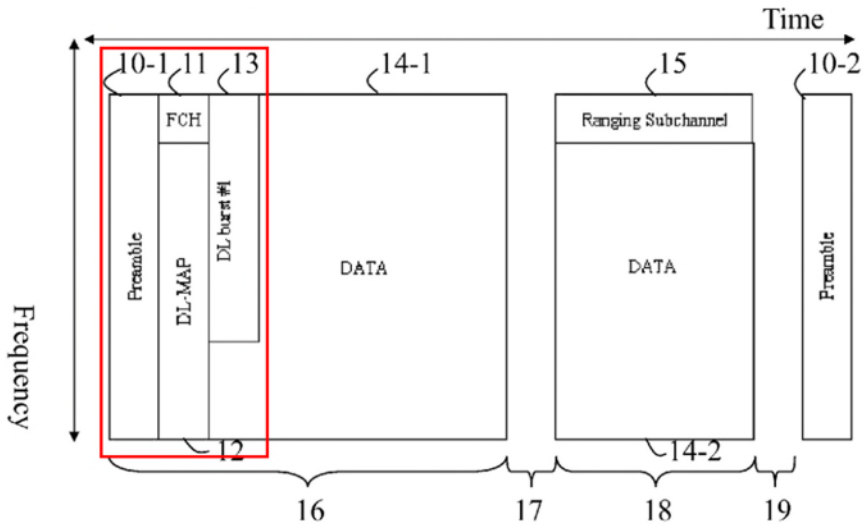


FIG. 1 (Prior Art)

Ex. 1001, Fig. 1 (annotated)

369. The '096 Patent further states, that "DATA 40-3 of the DL sub-frame 16-2 for the new system under high mobility may be divided based on the mapping information" and such "mapping information" may be defined in "DL-MAP11.[11]" *Id*. 5:18-24, Fig.4. From the teachings of the '096 Patent, a POSA would have understood that the recited "map" in claimed 46 refers to "DL-MAP12" field (the claimed non-data section) carrying a certain type of information for the receiver to understand the "division" or "structure" of data in the "DATA" field.

[11] This is a typo; the cite should be DL-MAP 12 as shown in Figure 3.

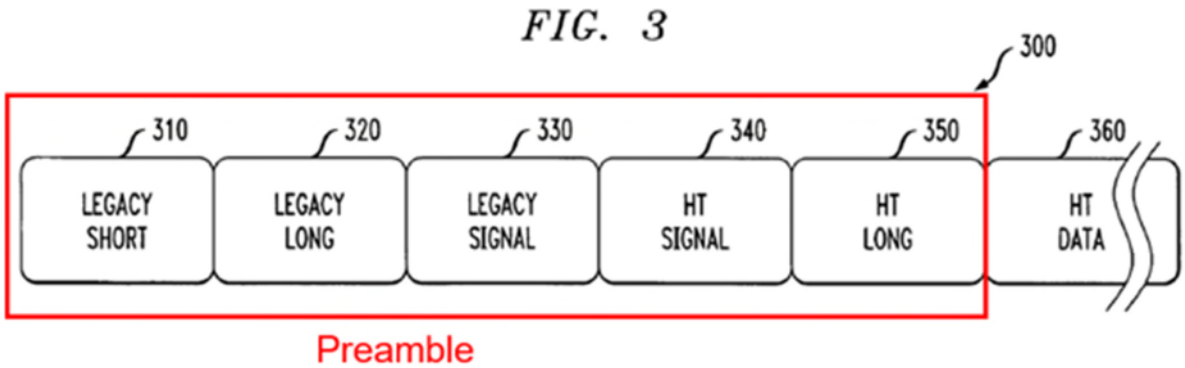
1. Scope and Content of the Prior Art

370. The combination of Mujtaba and Trainin discloses claim 46. First, Mujtaba generally discloses a data packet format with a preamble including "SIGNAL field" followed by a payload for carrying data. Mujtaba, at [0015], Fig.3. Mujtaba explains that the signal field (the claimed non-data section) may carry information indicating the number of pilots to the receiver and some other information indicating data rate, coding rate and modulation level (the claimed map). *Id*. at [0015].

371. Mujtaba further discloses that the data is mapped as part of the process of transmission. Mujtaba, [0016], Fig. 1. Mujtaba notes that "encoded and interleaved bits are then mapped onto subcarriers (tones) at stage 130 and form a frequency domain OFDM symbol." *Id*.

372. Mujtaba also discloses a conventional packet format for IEEE 802.11 with a preamble followed by a payload containing data and one or more pilot tones. *Id*. Fig.2, at [0018]. According to Mujtaba, each preamble contains "all relevant information|" such as "synchronization information" (the claimed map) that is needed to decode the payload. *Id*.

373. Mujtaba also discloses a packet format for 802.11n including a preamble which is illustrated in the following figure. *Id*. Fig. 3.



Ex. 1010, Fig. 3 (annotated)
Mujtaba's Packet Format

374. According to Mujtaba, the preamble 300 includes a legacy short training symbol 310, a legacy long training symbol 320, a legacy SIGNAL field 330, a high throughput (HT) SIGNAL field 340, a HT long training symbol 350 followed by a HT data field (payload) 360. *Id*. at [0019]. Mujtaba further explains that the HT SIGNAL field 340 (the claimed non-data section) in the HT field (the claimed second section) can convey to the receiver the number of pilot tones and the HT SIGNAL field 340 (the claimed map) can be encoded with a value indicating whether two, four, or six pilot tones were employed (the claimed map). *Id*.

375. A POSA would have understood from the teachings of Mujtaba that the preamble including the signal field (the claimed non-data section) in both the legacy field (the claimed first section) and the HT field (the claimed second section) are non-data fields. A POSA would have also understood from the

teachings of Mujtaba that the "relevant information" in the signal fields indicating data rate, coding rate, modulation level, synchronization, and the number of pilot symbols in the data field (the claimed map) is the information that is used to identify the "division" or "structure" of the data field. Furthermore, a POSA would have understood from the teachings of Mujtaba that modulation involves mapping and so modulation information would include information related to how data is mapped to sub-carriers. Thus, Mujtaba discloses the element of claim 46.

376. In addition to Mujtaba's teachings, Trainin also discloses a preamble in the legacy field (the claimed first section) in accordance with 802.11a and such preamble has a "legacy signal field 213" (the claimed non-data section) that is used to identify the type of modulation scheme used, and may include information such as the data rate and the length of the subsequent data portion (the claimed map). Trainin, at [0030], Fig. 2.

377. A POSA would have understood from the teachings of Trainin that the preamble including the signal field (the claimed non-data section) in both the legacy and HT fields (the claimed first and second sections) are non-data fields. A POSA would have also understood from the teachings of Trainin that both the legacy signal and HT signal fields (the claimed non-data section) in the legacy and HT fields (the claimed first and second sections) carry the information that may be

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used to identify the "division" or "structure" of the data field (the claimed map). Thus, the combination of Mujtaba and Trainin discloses claim 46.

2. Motivation to Combine

378. In my opinion, a POSA would have been motivated to combine Mujtaba with Trainin.

379. First, Syed Aon Mujtaba, the name inventor of Mujtaba, is listed as a co-author of the Joint proposal. *Compare* Joint Proposal, at 5 *with* Mujtaba, cover. In addition, both Solomon B. Trainin and Assaf Kasher, the named inventors in Trainin, are also listed as co-authors of the Joint Proposal. *Compare* Joint Proposal, at 1, 4 and 6 *with* Training, cover. A POSA would be aware that ideas contributed by a member of a standard task group may also be reflected in patent filings.

380. Second, the '096 Patent discloses that "the placement of the pilot symbols in a first region…may be the same as that in the prior art[]" and "the placement of the pilot symbols in a second region…supporting lower mobility may be the same or denser than the that in the prior art[.]" '096 Patent, at 7:61-8:1. The '096 Patent explains that "the new OFDMA system supporting high mobility may use more denser pilot placement with more pilot symbols for increasing accuracy of the channel estimation." *Id*. at 8:4-6. A POSA would have understood

from the teachings of the ’096 Patent that the denser pilot symbols improve channel estimation for its “new OFDM system supporting high mobility.”

381. The ’096 Patent, however, does not specifically disclose what parameters that may impact accuracy of channel estimation. By contrast, Mujtaba specifically discloses various parameters that may affect channel estimation including “the delay spread of a channel, the signal to noise ratio (SNR) at the receiver, and the number of antennas at the receiver.” Mujtaba, at [0006].

382. In addition, Mujtaba specifically teaches that “a number of pilot tones are embedded in the OFDM data symbols to estimate the phase noise and residual frequency offset.” *Id*., at [0005]. Mujtaba explains that “[p]hase noise at the local oscillators of the transmitter and receiver creates a common phase error (CPE) at the FFT output that generally needs to be corrected for every OFDM symbol[]” and “[r]esidual frequency offset at the input of the FFT also creates CPE.” *Id*. A POSA would have understood that common phase error (CPE) estimation is an essential component of channel estimation. *Id*. at [0004]-[0005](stating that preamble helps receiver estimate “the frequency offset between the transmitter and receiver, and correct for the frequency offset prior to FFT demodulation ” and further states that “[r]esidual frequency offset at the input of the FFT also creates CPE.”).

383. Having taught that the number of pilot symbols affects the various parameters for channel estimation, Mujtaba also explains pros and cons when varying the number of pilot symbols. One the one hand, Mujtaba explains that "the accuracy of the CPE estimation increases with the number of pilots, thereby reducing the packet error rate, and increasing the reliability of the transmission." *Id*. at [0006], [0021]. On the other hand, Mujtaba also explains that "[a] greater number of pilots, however, reduces the effective data rate, since actual data is now replaced by pilots (which are known at both the transmitter and the receiver)." *Id*.

384. A POSA would have been motivated to combine Mujtaba and Trainin. First, Mujtaba's system teaches increasing number of pilots for transmission in a packet format including legacy fields and HT fields in accordance with 802.11n. Trainin also teaches a mixed-mode transmission, including legacy transmission and HT transmission, which is also in accordance with 802.11n. Thus, both Mujtaba and Trainin are in the same field of endeavor.

385. Furthermore, Trainin expressly teaches that "the traffic that may be carried via links 128, 138, and 148 may include packets, frames, or other collections of signals and/or data, such as, *e.g.*, media access controller (MAC) protocol data units (MPDUs) and/or physical layer (PHY) protocol data units (PPDUs)." Trainin at [0020]. A POSA would have understood from Trainin's teachings of using an uplink and a downlink to carry out wireless communications

in packets or frames of physical layer (PHY) protocol data units (PPDUs). A POSA would also have understood from the teachings of Mujtaba that the legacy field (the claimed first section) and the HT field (the claimed section section) are nothing more than a PPDU packet or frame. Mujtaba at [0018] (stating that a typical packet format for an exemplary IEEE 802.11 is PLCP Protocol Data Units (PPDU).).

386. Additionally, a POSA would have understood that the combination is simply the combination of prior art elements (Mujtaba's packet format in 802.11n and Trainin's short guard interval in 802.1n) according to known methods to yield predictable results. A POSA would have understood that the results of the combination would have been predictable and there would be a reasonable expectation of success in the combination because Mujtaba explicitly teaches that increasing the number of pilot symbols in the improves channel estimation (Mujtaba at [0006], [0021]; *see also* Mujtaba II, at [0004], [0015], [0017], [0020] (disclosing four pilot symbols employed to transmit data the legacy 802.11 system.)), and Trainin explicitly explains that "[l]inks 128, 138, and 148 may each include a downlink and an uplink, **as are known in the art[,]**" and such combination simply "**make up a transmission of wireless signals**." Trainin at [0020] (emphasis added). Thus, the combination of Trainin and Mujtaba simply constitutes a conventional wireless transmission system.

387. It was known in the art to use downlink and uplink for wireless data transmission. *See* Kim, at [0005], [0020] (teaching that RF (radio frequency) channels used by a transmitter to communicate with a receiver are downlink channels, RF (radio frequency) channels used by a receiver to communicate with a transmitter are uplink channels in an MIMO system in accordance with 802.11n.); Yang (Ex. 1033) at 6 (teaching that uplink (UL) transmissions are those from stations to the AP, and downlink (DL) transmissions are those from the AP to stations in the IEEE 802.11n wireless network.).

E. <u>Claim 47</u>

388. Claim 47 is disclosed by the combination of Mujtaba and Trainin and a POSA would have been motivated to combine them. Claim 47 depends on claim 46 and recites that "wherein the second section follows the first section in at least one of time sequence and frequency spectrum."

389. I understand that the phrase "at least one of […] and […]" in this limitation has been construed as "[…] and/or […]". The "at least one of" language in claim 47 applies to only two items, the "time sequence" and the "frequency spectrum," and operates as shorthand for "and/or." This claim 47 therefore requires that the second section follows the first section in time sequence *or* frequency spectrum (or the second section follows the first section in time sequence *and* frequency spectrum). This construction is consistent with the

specification, because the '096 Patent discloses embodiments in which the second section follows the first section in the time sequence. '096 Patent, Figs. 3 and 4 (Zones 2 and 3 carrying data for a new, higher-mobility system ("second section") follow Zone 1, which carries data for an old system ("first section"), in the time sequence).

1. Scope and Content of the Prior Art

390. The combination of Mujtaba and Trainin discloses the element of claim 47. Specifically, Trainin discloses wireless communication system where two different modulation schemes or frame formats coexist. Trainin, Abstract, at [0020].

391. Trainin further explains that the co-existing two different modulation schemes for frame format are high-throughput (HT) modulation scheme such as a multiple-input-multiple-output (MIMO) orthogonal frequency division multiplexing (OFDM) modulation scheme in accordance with 802.11n, and orthogonal frequency division multiplexing (OFDM) in accordance with the 802.11a standard, or any other standard that may have a lower throughput than that of the first modulation scheme. *Id*. at [0024], [0025].

392. Trainin also discloses a packet frame in the following figure including a legacy preamble (*i.e.*, 802.11a) and an HT preamble (802.11n) following by data fields. *Id*. at [0024], Fig. 2 (excerpted and color-coding added).

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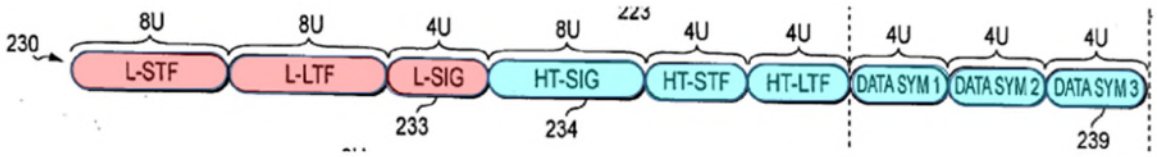

Ex. 1011, Fig. 2 (excerpted and color-coding added)
Trainin's Mixed Mode Frame Format

393. As shown in Figure 2, each field in the legacy field and the HT field (the claimed first and second sections) is positioned within the frame time (the claimed time sequence). For example, L-STF, L-LTF and L-SIG in the legacy field (the claimed first section) are assigned with 8 microseconds, 8 microseconds and 4 microseconds, respectively. *Id*. Following the legacy field (the claimed first section) within the frame time, HT-SIG, HT-STF and HT-LTF in the HT field (the claimed second section) are assigned with 8 microseconds, 4 microseconds and 4 microseconds, respectively.

394. From the teachings of Trainin, a POSA would have understood that the transmission in the HT field (the claimed second section) follows the transmission in the legacy field (the claimed first section) in time sequence. Thus, the combination of Mujtaba and Trainin discloses claim 47.

2. <u>Motivation to Combine</u>

395. In my opinion, a POSA would have been motivated to combine Mujtaba with Trainin.

396. First, Syed Aon Mujtaba, the name inventor of Mujtaba, is listed as a co-author of the Joint proposal. *Compare* Joint Proposal, at 5 *with* Mujtaba, cover. In addition, both Solomon B. Trainin and Assaf Kasher, the named inventors in Trainin, are also listed as co-authors of the Joint Proposal. *Compare* Joint Proposal, at 1, 4 and 6 *with* Training, cover. A POSA would be aware that ideas contributed by a member of a standard task group may also be reflected in patent filings.

397. Second, the '096 Patent discloses that "the placement of the pilot symbols in a first region…may be the same as that in the prior art[]" and "the placement of the pilot symbols in a second region…supporting lower mobility may be the same or denser than the that in the prior art[.]" '096 Patent, at 7:61-8:1. The '096 Patent explains that "the new OFDMA system supporting high mobility may use more denser pilot placement with more pilot symbols for increasing accuracy of the channel estimation." *Id*. at 8:4-6. A POSA would have understood from the teachings of the '096 Patent that the denser pilot symbols improve channel estimation for its "new OFDM system supporting high mobility."

398. The '096 Patent, however, does not specifically disclose what parameters that may impact accuracy of channel estimation. By contrast, Mujtaba specifically discloses various parameters that may affect channel estimation

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including "the delay spread of a channel, the signal to noise ratio (SNR) at the receiver, and the number of antennas at the receiver." Mujtaba, at [0006].

399. In addition, Mujtaba specifically teaches that "a number of pilot tones are embedded in the OFDM data symbols to estimate the phase noise and residual frequency offset." *Id*., at [0005]. Mujtaba explains that "[p]hase noise at the local oscillators of the transmitter and receiver creates a common phase error (CPE) at the FFT output that generally needs to be corrected for every OFDM symbol[]" and "[r]esidual frequency offset at the input of the FFT also creates CPE." *Id*. A POSA would have understood that common phase error (CPE) estimation is an essential component of channel estimation. *Id*. at [0004]-[0005](stating that preamble helps receiver estimate "the frequency offset between the transmitter and receiver, and correct for the frequency offset prior to FFT demodulation " and further states that "[r]esidual frequency offset at the input of the FFT also creates CPE.").

400. Having taught that the number of pilot symbols affects the various parameters for channel estimation, Mujtaba also explains pros and cons when varying the number of pilot symbols. One the one hand, Mujtaba explains that "the accuracy of the CPE estimation increases with the number of pilots, thereby reducing the packet error rate, and increasing the reliability of the transmission." *Id*. at [0006], [0021]. On the other hand, Mujtaba also explains that "[a] greater

number of pilots, however, reduces the effective data rate, since actual data is now replaced by pilots (which are known at both the transmitter and the receiver)." *Id*.

401. A POSA would have been motivated to combine Mujtaba and Trainin. First, Mujtaba's system teaches increasing number of pilots for transmission in a packet format including legacy fields and HT fields in accordance with 802.11n. Trainin also teaches a mixed-mode transmission, including legacy transmission and HT transmission, which is also in accordance with 802.11n. Thus, both Mujtaba and Trainin are in the same field of endeavor.

402. Furthermore, Trainin expressly teaches that "the traffic that may be carried via links 128, 138, and 148 may include packets, frames, or other collections of signals and/or data, such as, *e.g.*, media access controller (MAC) protocol data units (MPDUs) and/or physical layer (PHY) protocol data units (PPDUs)." Trainin at [0020]. A POSA would have understood from Trainin's teachings of using an uplink and a downlink to carry out wireless communications in packets or frames of physical layer (PHY) protocol data units (PPDUs). A POSA would also have understood from the teachings of Mujtaba that the legacy field (the claimed first section) and the HT field (the claimed section section) are nothing more than a PPDU packet or frame. Mujtaba at [0018] (stating that a typical packet format for an exemplary IEEE 802.11 is PLCP Protocol Data Units (PPDU).).

403. Additionally, a POSA would have understood that the combination is simply the combination of prior art elements (Mujtaba's packet format in 802.11n and Trainin's short guard interval in 802.1n) according to known methods to yield predictable results. A POSA would have understood that the results of the combination would have been predictable and there would be a reasonable expectation of success in the combination because Mujtaba explicitly teaches that increasing the number of pilot symbols in the improves channel estimation (Mujtaba at [0006], [0021]; *see also* Mujtaba II, at [0004], [0015], [0017], [0020] (disclosing four pilot symbols employed to transmit data the legacy 802.11 system.)), and Trainin explicitly explains that "[l]inks 128, 138, and 148 may each include a downlink and an uplink, **as are known in the art[,]**" and such combination simply "**make up a transmission of wireless signals**." Trainin at [0020] (emphasis added)

404. It was known in the art to use downlink and uplink for wireless data transmission. *Seeo* Kim, at [0005], [0020] (teaching that RF (radio frequency) channels used by a transmitter to communicate with a receiver are downlink channels, RF (radio frequency) channels used by a receiver to communicate with a transmitter are uplink channels in an MIMO system in accordance with 802.11n.); Yang, at 6 (teaching that uplink (UL) transmissions are those from stations to the

AP, and downlink (DL) transmissions are those from the AP to stations in the IEEE 802.11n wireless network.).

F. Claim 49

405. Claim 49 is disclosed by the combination of Mujtaba and Trainin and a POSA would have been motivated to combine them. Claim 49 depends on independent claim 44 and recites that "wherein each of the first section and the second section carries at least one of uplink and downlink data."

406. I understand that the phrase "at least one of […] and […]" in this limitation has been construed as "[…] and/or […]". The "at least one of" language in claim 49 applies to only two items, uplink and downlink data, and operates as shorthand for "and/or." This construction is consistent with the specification, which describes embodiments where each of the first and second sections carries only uplink or down-link data (*e.g.*, the first section carries only downlink data, and the second section also carries only downlink data).

407. For example, the specification discloses an OFDMA frame structure in which sections 40-1 and 40-3 (a "first section" and "second section," respectively) carry downlink data only for the old and new systems; and sections 44-1 and 44-3 (also a "first section" and "second section," respectively) carry uplink data only for the old and new systems. '096 Patent at Fig. 4 and 4:39-5:40. This claim requires that each of the first section and the second section carries uplink *or*

downlink data (or that each of the first section and the second section carries uplink *and* downlink data).

1. Scope and Content of the Prior Art

408. The combination of Mujtaba and Trainin discloses claim 49. As I have described above, it is my opinion that a POSA would find each element of claim 44 disclosed by and present in the Joint Proposal. *Supra* § XI(B). I understand that a POSA is considered to have in his or her possession that which is in the prior art and that would include the Joint Proposal among additional and inherent well-known teachings in the art.

409. To the extent Patent Owner may argue that Mujtaba does not explicitly teach claim 49, the combination of Mujtaba with Trainin discloses all elements of claim 49, and a POSA would have been motivated to incorporate Trainin's teachings of using downlink and uplink for communicating network traffic between a transmitter and a receiver in a wireless communication network in accordance with the IEEE 802.11 family (*e.g.*, 802.11a and 802.11n) into the wireless communication in the Mixed Mode packet format specified in the Joint Proposal, which is designed to make the wireless communication compatible with both the legacy 802.11a transmission and the high throughput (HT) transmission (*i.e.*, 802.11n).

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410. I understand that the phrase "at least one of […] and […]" in this limitation has been construed as "[…] and/or […]". The "at least one of" language in claim 49 applies to only two items, uplink and downlink data, and operates as shorthand for "and/or." This construction is consistent with the specification, which describes embodiments where each of the first and second sections carries only uplink or down-link data (*e.g.*, the first section carries only downlink data, and the second section also carries only downlink data). For example, the specification discloses an OFDMA frame structure in which sections 40-1 and 40-3 (a "first section" and "second section," respectively) carry downlink data only for the old and new systems; and sections 44- 1 and 44-3 (also a "first section" and "second section," respectively) carry uplink data only for the old and new systems. '096 Patent, 4:39-5:40, Fig. 4. This claim requires that each of the first section and the second section carries uplink *or* downlink data (or that each of the first section and the second section carries uplink *and* downlink data).

411. First, Trainin discloses a wireless local area network (WLAN) communication system. U.S. Pub. No. 2007/0204052A1, (Ex.1011, "Trainin"), at [0012]. Trainin explains that its system includes "modems, mobile units (MU), access points (AP), wireless transmitters/receivers, and the like." *Id*. Trainin defines that "AP" means "a basic service set (BSS) provider such as an access

point (AP) 110," and "STA" means "one or more wireless mobile units such as a station (STA), for example stations 120, 130, and 140." *Id*. at [0019].

412. Trainin also teaches that "AP 110 and one or more of STA 120, 130, and 140 may communicate network traffic over a shared access medium using one or more wireless links, *e.g.,* links 128, 138, and 148, respectively[]" and such "[l]inks 128, 138, and 148 may each include **a downlink and an uplink, as are known in the art**." *Id*. at [0020](emphasis added). Trainin further teaches that "the traffic that may be carried via links 128, 138, and 148 may include packets, frames, or other collections of signals and/or data, such as, *e.g.,* media access controller (MAC) protocol data units (MPDUs) and/or physical layer (PHY) protocol data units (PPDUs), that may make up a transmission of wireless signals." *Id*.

413. According to Trainin, "MAC1114 of AP110, may perform functionality related to the **data link layer** of the open systems interconnect (OSI) model, **as known in the art**, and prepare data for transmission by the PHY, *e.g.,* PHY 113." *Id*. at [0034] (emphasis added). Training further teaches that "the MAC functionality may include delimiting frames, inserting MAC headers, error detection and/or correction functionality, and controlling access to the physical medium." *Id*. According to Trainin, "[t]he PHY, *e.g.,* PHY 113, may include

circuitry for encoding, transmission, reception, and decoding of wireless signals, packets, and/or frames, as part of the physical layer of the OSI model." *Id*.

414. A POSA would understand that the teachings of Trainin using a downlink and an uplink for data transmission between a transmitter and a receiver could be used to transmit data in Mujtaba's packet format including a legacy field for the legacy transmission and an HT field for the HT transmission. To combine Trainin with Mujtaba, a POSA would understand that Mujtaba's legacy field (the claimed first section) for the legacy transmission via Trainin's downlink and uplink constitutes the claimed "first section" carrying the claimed "at least one of uplink and downlink data." *Id*. In addition, to combine Trainin with Mujtaba, a POSA would understand that Mujtaba's HT field (the claimed second section) for the HT transmission via Trainin's downlink and uplink constitutes the claimed "second section" carrying the claimed "at least one of uplink and downlink data." *Id*.

2. <u>Motivation to Combine</u>

415. In my opinion, a POSA would have been motivated to combine Mujtaba with Trainin.

416. First, Syed Aon Mujtaba, the name inventor of Mujtaba, is listed as a co-author of the Joint proposal. *Compare* Joint Proposal, at 5 *with* Mujtaba, cover. In addition, both Solomon B. Trainin and Assaf Kasher, the named inventors in Trainin, are also listed as co-authors of the Joint Proposal. *Compare* Joint

Proposal, at 1, 4 and 6 *with* Training, cover. A POSA would be aware that ideas contributed by a member of a standard task group may also be reflected in patent filings.

417. Second, the ’096 Patent discloses that “the placement of the pilot symbols in a first region…may be the same as that in the prior art[]” and “the placement of the pilot symbols in a second region…supporting lower mobility may be the same or denser than the that in the prior art[.]” ’096 Patent, at 7:61-8:1. The ’096 Patent explains that “the new OFDMA system supporting high mobility may use more denser pilot placement with more pilot symbols for increasing accuracy of the channel estimation.” *Id*. at 8:4-6. A POSA would have understood from the teachings of the ’096 Patent that the denser pilot symbols improve channel estimation for its “new OFDM system supporting high mobility.”

418. The ’096 Patent, however, does not specifically disclose what parameters that may impact accuracy of channel estimation. By contrast, Mujtaba specifically discloses various parameters that may affect channel estimation including “the delay spread of a channel, the signal to noise ratio (SNR) at the receiver, and the number of antennas at the receiver.” Mujtaba, at [0006].

419. In addition, Mujtaba specifically teaches that “a number of pilot tones are embedded in the OFDM data symbols to estimate the phase noise and residual frequency offset.” *Id*. at [0005]. Mujtaba explains that “[p]hase noise at the local

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oscillators of the transmitter and receiver creates a common phase error (CPE) at the FFT output that generally needs to be corrected for every OFDM symbol[]" and "[r]esidual frequency offset at the input of the FFT also creates CPE." *Id*. A POSA would have understood that common phase error (CPE) estimation is an essential component of channel estimation. *Id*. at [0004]-[0005](stating that preamble helps receiver estimate "the frequency offset between the transmitter and receiver, and correct for the frequency offset prior to FFT demodulation " and further states that "[r]esidual frequency offset at the input of the FFT also creates CPE.").

420. Having taught that the number of pilot symbols affects the various parameters for channel estimation, Mujtaba also explains pros and cons when varying the number of pilot symbols. One the one hand, Mujtaba explains that "the accuracy of the CPE estimation increases with the number of pilots, thereby reducing the packet error rate, and increasing the reliability of the transmission." *Id*. at [0006], [0021]. On the other hand, Mujtaba also explains that "[a] greater number of pilots, however, reduces the effective data rate, since actual data is now replaced by pilots (which are known at both the transmitter and the receiver)." *Id*.

421. A POSA would have been motivated to combine Mujtaba and Trainin. First, Mujtaba's system teaches increasing number of pilots for transmission in a packet format including legacy fields and HT fields in accordance with 802.11n.

Trainin also teaches a mixed-mode transmission, including legacy transmission and HT transmission, which is also in accordance with 802.11n. Thus, both Mujtaba and Trainin are in the same field of endeavor.

422. Furthermore, Trainin expressly teaches that "the traffic that may be carried via links 128, 138, and 148 may include packets, frames, or other collections of signals and/or data, such as, *e.g.*, media access controller (MAC) protocol data units (MPDUs) and/or physical layer (PHY) protocol data units (PPDUs)." Trainin at [0020]. A POSA would have understood from Trainin's teachings of using an uplink and a downlink to carry out wireless communications in packets or frames of physical layer (PHY) protocol data units (PPDUs). A POSA would also have understood from the teachings of Mujtaba that the legacy field (the claimed first section) and the HT field (the claimed section section) are nothing more than a PPDU packet or frame. Mujtaba at [0018] (stating that a typical packet format for an exemplary IEEE 802.11 is PLCP Protocol Data Units (PPDU).).

423. Additionally, a POSA would have understood that the combination is simply the combination of prior art elements (Mujtaba's packet format in 802.11n and Trainin's short guard interval in 802.1n) according to known methods to yield predictable results. A POSA would have understood that the results of the combination would have been predictable and there would be a reasonable

expectation of success in the combination because Mujtaba explicitly teaches that increasing the number of pilot symbols in the improves channel estimation (Mujtaba at [0006], [0021]; *see also* Mujtaba II, at [0004], [0015], [0017], [0020] (disclosing four pilot symbols employed to transmit data the legacy 802.11 system.)), and Trainin explicitly explains that "[l]inks 128, 138, and 148 may each include a downlink and an uplink, **as are known in the art[,]**" and such combination simply "**make up a transmission of wireless signals**." Trainin at [0020] (emphasis added). Thus, the combination of Trainin and Mujtaba simply constitutes a conventional wireless transmission system.

424. It was known in the art to use downlink and uplink for wireless data transmission. *See* Kim, at [0005], [0020] (teaching that RF (radio frequency) channels used by a transmitter to communicate with a receiver are downlink channels, RF (radio frequency) channels used by a receiver to communicate with a transmitter are uplink channels in an MIMO system in accordance with 802.11n.); Yang, at 6 (teaching that uplink (UL) transmissions are those from stations to the AP, and downlink (DL) transmissions are those from the AP to stations in the IEEE 802.11n wireless network.).

G. <u>Claim 50</u>

425. Claim 50 is disclosed by the combination of Mujtaba and Trainin and a POSA would have been motivated to combine them. Claim 50 depends on

independent claim 44 and recites that "wherein the second section carries mapping information for data in the second section."

1. Scope and Content of the Prior Art

426. Because the "mapping information" recited in claim 50 is the same limitation as the "mapping information" recited in claim 45, it is my opinion that claim 50 is disclosed by the combination of Mujtaba with Trainin for the same reasons given regarding the unpatentability of claim 45. *Supra* § XIV(C).

2. Motivation to Combine

427. In my opinion, a POSA would have been motivated to combine Mujtaba with Trainin.

428. First, Syed Aon Mujtaba, the name inventor of Mujtaba, is listed as a co-author of the Joint proposal. *Compare* Joint Proposal, at 5 *with* Mujtaba, cover. In addition, both Solomon B. Trainin and Assaf Kasher, the named inventors in Trainin, are also listed as co-authors of the Joint Proposal. *Compare* Joint Proposal, at 1, 4 and 6 *with* Training, cover. A POSA would be aware that ideas contributed by a member of a standard task group may also be reflected in patent filings.

429. Second, the '096 Patent discloses that "the placement of the pilot symbols in a first region…may be the same as that in the prior art[]" and "the placement of the pilot symbols in a second region…supporting lower mobility may

be the same or denser than the that in the prior art[.]" '096 Patent, at 7:61-8:1. The '096 Patent explains that "the new OFDMA system supporting high mobility may use more denser pilot placement with more pilot symbols for increasing accuracy of the channel estimation." *Id*. at 8:4-6. A POSA would have understood from the teachings of the '096 Patent that the denser pilot symbols improve channel estimation for its "new OFDM system supporting high mobility."

430. The '096 Patent, however, does not specifically disclose what parameters that may impact accuracy of channel estimation. By contrast, Mujtaba specifically discloses various parameters that may affect channel estimation including "the delay spread of a channel, the signal to noise ratio (SNR) at the receiver, and the number of antennas at the receiver." Mujtaba, at [0006].

431. In addition, Mujtaba specifically teaches that "a number of pilot tones are embedded in the OFDM data symbols to estimate the phase noise and residual frequency offset." *Id*., at [0005]. Mujtaba explains that "[p]hase noise at the local oscillators of the transmitter and receiver creates a common phase error (CPE) at the FFT output that generally needs to be corrected for every OFDM symbol[]" and "[r]esidual frequency offset at the input of the FFT also creates CPE." *Id*. A POSA would have understood that common phase error (CPE) estimation is an essential component of channel estimation. *Id*. at [0004]-[0005](stating that preamble helps receiver estimate "the frequency offset between the transmitter and

receiver, and correct for the frequency offset prior to FFT demodulation " and further states that "[r]esidual frequency offset at the input of the FFT also creates CPE.").

432. Having taught that the number of pilot symbols affects the various parameters for channel estimation, Mujtaba also explains pros and cons when varying the number of pilot symbols. One the one hand, Mujtaba explains that "the accuracy of the CPE estimation increases with the number of pilots, thereby reducing the packet error rate, and increasing the reliability of the transmission." *Id*. at [0006], [0021]. On the other hand, Mujtaba also explains that "[a] greater number of pilots, however, reduces the effective data rate, since actual data is now replaced by pilots (which are known at both the transmitter and the receiver)." *Id*.

433. A POSA would have been motivated to combine Mujtaba and Trainin. First, Mujtaba's system teaches increasing number of pilots for transmission in a packet format including legacy fields and HT fields in accordance with 802.11n. Trainin also teaches a mixed-mode transmission, including legacy transmission and HT transmission, which is also in accordance with 802.11n. Thus, both Mujtaba and Trainin are in the same field of endeavor.

434. Furthermore, Trainin expressly teaches that "the traffic that may be carried via links 128, 138, and 148 may include packets, frames, or other collections of signals and/or data, such as, *e.g.*, media access controller (MAC)

protocol data units (MPDUs) and/or physical layer (PHY) protocol data units (PPDUs)." Trainin at [0020]. A POSA would have understood from Trainin's teachings of using an uplink and a downlink to carry out wireless communications in packets or frames of physical layer (PHY) protocol data units (PPDUs). A POSA would also have understood from the teachings of Mujtaba that the legacy field (the claimed first section) and the HT field (the claimed section section) are nothing more than a PPDU packet or frame. Mujtaba at [0018] (stating that a typical packet format for an exemplary IEEE 802.11 is PLCP Protocol Data Units (PPDU).).

435. Additionally, a POSA would have understood that the combination is simply the combination of prior art elements (Mujtaba's packet format in 802.11n and Trainin's short guard interval in 802.1n) according to known methods to yield predictable results. A POSA would have understood that the results of the combination would have been predictable and there would be a reasonable expectation of success in the combination because Mujtaba explicitly teaches that increasing the number of pilot symbols in the improves channel estimation (Mujtaba at [0006], [0021]; *see also* Mujtaba II, at [0004], [0015], [0017], [0020] (disclosing four pilot symbols employed to transmit data the legacy 802.11 system.)), and Trainin explicitly explains that "[l]inks 128, 138, and 148 may each include a downlink and an uplink, **as are known in the art[,]**" and such

combination simply "**make up a transmission of wireless signals**." Trainin at [0020] (emphasis added). Thus, the combination of Trainin and Mujtaba simply constitutes a conventional wireless transmission system.

436. It was known in the art to use downlink and uplink for wireless data transmission. *See* Kim, at [0005], [0020] (teaching that RF (radio frequency) channels used by a transmitter to communicate with a receiver are downlink channels, RF (radio frequency) channels used by a receiver to communicate with a transmitter are uplink channels in an MIMO system in accordance with 802.11n.); Yang, at 6 (teaching that uplink (UL) transmissions are those from stations to the AP, and downlink (DL) transmissions are those from the AP to stations in the IEEE 802.11n wireless network.).

XV. SECONDARY CONSIDERATION

437. At this time, after review of the documents and materials cited herein, such as the prosecution history of the '096 Patent, I have found no evidence of secondary considerations or objective factors of non-obviousness, and it is my opinion that claims 8, 44-47 and 49-50 of the '096 Patent are obvious over the prior art. And to the extent Patent Owner alleges secondary considerations in this proceeding, it is my opinion that they would not outweigh the strong evidence of obviousness of the '096 Patent Challenged Claims, as set forth herein. I have been informed that if Patent Owner presents in this proceeding evidence of objective

factors that it argues support a finding of non-obviousness, I may be asked to review such evidence and to formulate an opinion and reserve the right to address any such evidence and/or arguments that Patent Owner may raise in this regard.

XVI. CONCLUSION

438. In summary, I have concluded that each limitation of the Challenged Claims is invalid as anticipated and/or obvious under 35 U.S.C. §§ 102, 103 in light of the prior art references and the knowledge of one of ordinary skill in the art, as described in this declaration.

439. Furthermore, I have used my background and experience in forming my opinions that claims 8, 44-47and 49-50 are unpatentable as being anticipated and/or obvious over the prior art.

440. To the extent it is it is argued that any further disclosure is required for a limitation in claims, 8, 44-47and 49-50 than I have identified above, a POSA would have found that limitation obvious to include based on the same disclosure and analysis I have identified above. I reserve the right to supplement my opinions in the future to respond to any arguments that Patent Owner or its expert(s) may raise, and to take into account new information as it becomes available to me.

I hereby declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct, and that all statements made of my own knowledge are true and that all statements made on information and belief are believed to be true. I understand that willful false statements and the like are punishable by fine or imprisonment, or both (18 U.S.C. § 1001).

Executed on January 17, 2024

Dr. Christopher J. Hansen, Ph.D.

Exhibit 1002
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IPR2024-00364
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CHRISTOPHER J. HANSEN

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Los Altos, CA 94024

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I. SUMMARY

- Senior electrical engineer - 20 years in industry plus Ph.D. (UCLA 1997).
- Named inventor on more than 125 issued patents, including many standards essential patents for 802.11/Wi-Fi and Bluetooth.
- Technical skills encompass wireless network physical layer (PHY) design, systems engineering, communication theory, integrated circuit (IC) design, signal processing, RF/microwave systems, intellectual property, and standardization.
- Experience with multiple successful product developments (802.11 WLAN chipsets and cellular base-station systems), research in new technologies (802.11n MIMO and 60 GHz), and leading standards bodies (IEEE 802.11, Bluetooth SIG, Wireless Gigabit Alliance).

II. EXPERIENCE

Covariant Corporation, Los Altos, California
President August 2013 – present

- Consulting in wireless communication systems, signal processing and intellectual property.
- Recent clients include Octoscope, Google, and Peraso Technologies.

Apple, Cupertino, California
Senior Wireless System Architect June 2012 – July 2013

- Analysis of 802.11 wireless networks for iOS products.

Broadcom Corporation, Sunnyvale, California

Associate Technical Director, Office of the CTO	March 2011 – May 2012
Senior Principal Scientist, Office of the CTO	March 2007 - March 2011
Principal Scientist, Office of the CTO	March 2006 - March 2007
Engineering Manager, Wireless LAN Business Unit	June 2004 - March 2006
Senior Staff Scientist, Wireless LAN Business Unit	January 2000 - June 2004

- Analysis and development of new wireless networking technologies for application to WiGig (60 GHz wireless), WirelessHD, Bluetooth, Wimedia Ultrawideband, IEEE 802.11, and 802.15 systems. Investigation of inter-networking, antenna systems, beamforming techniques, signal processing and advanced devices employing multiple wireless technologies.
- Secretary, board member, and vice chair of the Technical Working Group of the Wireless Gigabit Alliance.
- Vice chair of the IEEE 802.11ad (60 GHz MAC/PHY) task group.
- Developed BT/802.11 technology and co-chaired the Bluetooth SIG 802.11 AMP (Alternate MAC/PHY) Study Group. The resulting specification was the hallmark feature of the Bluetooth 3.0 release.
- Developed significant intellectual property related to wireless networks and contributed to the management of company patent portfolio through patent review committee.
- Project manager and lead physical layer (PHY) systems engineer for 802.11n proposal to the IEEE. Key elements of this proposal and further contributions became the basis of the IEEE 802.11n standard including MIMO-OFDM physical layer and enhanced MAC layer for higher throughput wireless networks. Made contributions in the areas of preamble design, advanced channel coding, MIMO-OFDM, channel estimation, and multiple antenna beamforming. (See: https://en.wikipedia.org/wiki/IEEE_802.11n-2009)
- Led Broadcom effort to standardize power control and dynamic frequency selection for wireless networks in IEEE 802.11 Task Group H. Proposal is now part of 802.11h standard. (See: https://en.wikipedia.org/wiki/IEEE_802.11h-2003)
- System engineering for 802.11a/b/g wireless local area network chipsets, including analysis of radio and base-band dsp architectures for the physical layer design. Developed signal processing algorithms, channel models, radio system models, and laboratory radios.
- Designed and developed MATLAB and bit accurate C models for the physical layers of 802.11 WLAN chipsets. These included models for equalizers, convolutional coders/decoders, beamforming, nonlinear distortion in radio transceivers, and radio channels.
- Analyzed and debugged first silicon versions of commercially successful 802.11a/b/g integrated circuit products.
- Developed radar detection and dynamic frequency selection hardware and software for 802.11a chipsets to meet ETSI (European) and FCC (U.S.) regulations.

Excess Bandwidth Corporation (now **Conexant**), Santa Clara, California
Principal Systems Engineer 1998–1999

- System engineering and architecture for HDSL2/G.shdsl digital subscriber line modems, including MATLAB and C code to simulate equalizers, error correcting codes, timing recovery, digital phase locked loops, waiting time jitter, and performance in crosstalk.
- Developed DSP software in C and assembler (TI C6x) for prototype HDSL2/G.shdsl modem. Implemented modules for adaptive equalization, timing recovery, and activation frame handshake.

Amati Communications Corporation (now **Texas Instruments**)
San Jose, California
Senior Research Engineer 1997-1998

- Developed, analyzed, and implemented advanced equalizer training algorithms for discrete multi-tone (DMT) based asymmetric digital subscriber line (ADSL) models.

AT&T Bell Laboratories, Whippany, New Jersey
Member of Technical Staff 1990-1992

- Developed RF and analog circuit designs for AT&T Autoplex 1000 fiber optic micro-cell radio transceiver.
- Managed testing group and developed test program for high power 900 MHz feed-forward linear amplifier used in cellular telephone base stations.

MIT Lincoln Laboratory, Lexington, Massachusetts
Member of Technical Staff 1989-1990

- Developed signal processing software and RF hardware for experimental X-band and Ka-band radar.
- Conducted radar measurements at Lincoln Laboratory sites in Lexington, MA and Kwajalein Atoll, U.S. Marshall Islands.

III. LITIGATION EXPERIENCE

- NXP B.V. v. Broadcom Corp., No. 5:14-cv-826 (N.D. Cal.). Retained on behalf of Broadcom.

- Linex Techs., Inc. v. Hewlett-Packard Co. et al., No. 4:13-cv-00159 (N.D. Cal.). Retained on behalf of Broadcom.

- TomTom Int'l, B.V. v. Broadcom Corp., No. 8:14-cv-475 (C.D. Cal.). Retained on behalf of Broadcom.

- Certain Electronics Products, Including Products with Near-Field Communication ("NFC") System-Level Functionality and/or Battery Power-Up Functionality, Components Thereof, and Products Containing Same, No. 337-TA-950 (ITC). Retained on behalf of Dell.

- NXP B.V. et al. v. Dell Inc., No. 1:15-cv-00146 (D. Del.). Retained on behalf of Dell.

- California Institute of Tech. v. Broadcom Ltd. et al., No. 2:16-cv-3714 (C.D. Cal.). Retained on behalf of Broadcom. Deposed.

- Nokia Techs. Oy et al. v. Apple Inc., Nos. 2:16-cv-1440, 2:16-cv-1441 (E.D. Tex.). Retained on behalf of Apple Inc.

- Certain Electronic Devices, Including Mobile Phones, Tablet Computers, and Components Thereof, Nos. 337-TA-1038, 337-TA-1039 (ITC). Retained on behalf of Apple Inc.

IV. EDUCATION

Ph.D., Electrical Engineering 1997
University of California, Los Angeles
Dissertation: *Probing Techniques for Multiuser Channels with Power Control*
Research Area: Wireless and Digital Communications
Advisor: Gregory J. Pottie

M.S., Electrical Engineering 1989
University of Massachusetts, Amherst
Concentration: Signal Processing and Microwave Systems

B.S., Electrical Engineering 1987
Rensselaer Polytechnic Institute

V. HONORS AND AFFILIATIONS

- Institute of Electrical and Electronics Engineers (IEEE) Senior Member.
- Member, Society for Industrial and Applied Mathematics.
- Reviewer, IEEE Communications Magazine, 2014 - present.
- Board of Directors, PATCA - Professional and Technical Consultants Association, Silicon Valley, 2007 - present.
- Vice Chair, IEEE 802.11ad Task Group, 2011-2012.
- Secretary, Wireless Gigabit Alliance, 2010-2012.
- Rockwell graduate fellowship recipient, UCLA, 1992-1996.
- Eta Kappa Nu, Electrical Engineering Honor Society, Rensselaer Polytechnic Institute, 1987.

VI. SKILLS

- Architecture and analysis of wireless digital communication systems, including 802.11a/b/g/n/ac/ad/ax/ay, Bluetooth, Wimedia UWB, WirelessHD, and WiGig.
- DSP Programming (TI TMS320C62x and 320C5x) in C and assembler and general programming in C++, C, MATLAB, and Python.
- RF/microwave/mmwave laboratory and over-the-air channel measurements.
- Extra class Amateur Radio license (W6COV) and Commercial General Radiotelephone license.

VII. PUBLICATIONS

C. J. Hansen, "Internetworking with Bluetooth Low Energy", ACM GetMobile, Vol 19, Issue #2, April 2015.

C. J. Hansen, "WiGig – Multigigabit Wireless Communication in the 60 GHz Band", IEEE Communications Magazine, December 2011.

C. J. Hansen and G. J. Pottie, "A Distributed Access Algorithm for Cellular Personal Communication Systems with Channel Partitioning", IEEE Transactions on Vehicular Technology, January 1999.

C. J. Hansen and G. J. Pottie, "Distributed Access Control in Wireless and Wireline Systems," International Symposium on Information Theory, Whistler, B.C., 1995.

C. J. Hansen, C. C. Wang, and G. J. Pottie, "Distributed Dynamic Channel Resource Allocation in Wireless Communication Systems", Asilomar Conference on Signals, Systems, and Computers, 1994.

VIII. PATENTS

Named inventor on the following United States patents:

US Patent Number	***Patent Title***
10,015,741	System and method for low power signaling in a wireless local area network
9,960,865	Filtering of Wi-Fi physical layer measurements
9,949,227	Location determination
9,680,563	System and method for partial bandwidth communication
9,596,637	Dynamically adapting wireless communication
9,826,373	WLAN transmitter having high data throughput
9,622,216	Method and system for low rate MAC/PHY for 60 GHz transmission
9,516,483	Wireless communication between stations of differing protocols
9,356,673	Communication device incorporating beamforming handshaking
9,344,535	Multiple protocol wireless communications in a WLAN
9,307,350	Protocol adaptation layer for wireless communications
9,300,368	Method and system for 60 GHz antenna adaptation and user coordination based on base station beacons
9,247,439	High data throughput wireless local area network receiver
9,241,331	Method and system for optimal beamforming in wireless networks
9,198,035	Simple pairing to generate private keys for different protocol communications
9,130,705	Transmitting high rate data within a MIMO WLAN
9,104,569	Method and apparatus for signal detection and decoding
9,037,092	Method, apparatus and computer program for determining whether a received signal comprises a first signal component

9,025,491	High speed data transmission utilizing a high frequency physical layer for a wireless personal area network device
8,996,949	Encoding system and method for a transmitter in wireless communications
8,965,431	Multimode control device for allocating resources to communication devices that use differing protocols and methods for use therewith
8,964,895	WLAN transmitter having high data throughput
8,964,521	Method and system for compromise greenfield preambles for 802.11N
8,954,111	Method and wireless device for reducing power consumption by transferring servicing of a SIM channel to a first radio system and at least partially shutting down a second radio system of the wireless device
8,929,317	Transmission of wide bandwidth signals in a network having legacy devices
8,917,676	Device and method for transmitting long training sequence for wireless communications
8,909,272	Control device for allocating resources to communication devices that use differing protocols and methods for use therewith
8,897,320	High data throughput WLAN frame format
8,892,056	Protocol adaptation layer for wireless communications
8,891,642	Mixed mode preamble for MIMO wireless communications
8,805,277	Method and system for Bluetooth 802.11 alternate MAC/PHY (AMP) transmit power control (TPC)
8,804,685	Dual mode operation in a wireless network
8,774,327	Adjustable RF receiver
8,750,252	Long training sequence method and device for wireless communications
8,743,994	Feedback of channel information in a closed loop beamforming wireless communication system
8,737,189	Method and system for compromise greenfield preambles for 802.11n
8,725,101	Wireless device and method of operation
8,644,770	Protocol adaptation layer for wireless communications
8,644,284	Dual mode operation in a wireless network
8,638,263	Platform enhancements for planar array antennas
8,634,777	Pairing with directional code sequence
8,630,367	Signaling format for wireless communications
8,620,368	Method and system for 60 GHz antenna adaptation and user coordination based on base station beacons
8,611,821	Communication device that detects and adapts to the presence of other devices and methods for use therewith

8,588,283	Method and system for frame formats for MIMO channel measurement exchange
8,577,416	Transceiver with plural space hopping array antennas and methods for use therewith
8,576,695	Preamble formats for MIMO wireless communications
8,553,659	Method and system for optimal beamforming in wireless networks
8,548,087	Long training sequence for MIMO WLAN systems
8,520,669	High data throughput wireless local area network receiver
8,437,419	Method and system for frame formats for MIMO channel measurement exchange
8,437,362	Asymmetrical MIMO wireless communications
8,407,556	LDPC (low density parity check) coding and interleaving implemented in MIMO communication systems
8,406,204	Transmission of wide bandwidth signals in a network having legacy devices
8,385,844	Transceiver with plural space hopping phased array antennas and methods for use therewith
8,369,784	High speed data transmission utilizing a high frequency physical layer for a wireless personal area network device
8,363,642	High data throughput wireless local area network receiver
8,351,399	MIMO wireless communication greenfield preamble formats
8,345,732	Feedback of channel information in a closed loop beamforming wireless communication system
8,320,877	Method and system for 60 GHz location determination and coordination of WLAN/WPAN/GPS multimode devices
8,284,867	Mixed mode preamble for MIMO wireless communications
8,284,651	Preamble formats for MIMO wireless communications
8,265,185	Method and system for encoding a signal for wireless communications
8,254,407	Asymmetrical MIMO wireless communications
8,233,565	Method and system for high speed wireless data transmission between communication devices
8,213,395	Method and system for dual mode operation in wireless networks
8,195,092	Method and system for utilizing a high frequency PHY layer for high speed data transmission between wireless devices
8,190,162	Radar detection circuit for a WLAN transceiver
8,184,679	RF transceiver having adaptive modulation
8,176,380	Algebraic construction of LDPC (low density parity check) codes with corresponding parity check matrix having CSI (cyclic shifted identity) sub-matrices
8,175,542	Transceiver with plural space hopping phased array antennas and methods for use therewith

8,170,504	Modified preamble for programmable transmitter
8,170,496	Transceiver with space hopping phased array antenna and methods for use therewith
8,170,495	Collaborative pairing transceiver with space hopping phased array antenna and methods for use therewith
8,169,998	Method and system for an AD HOC wireless network with master control of network parameters
8,144,798	Long training sequence for MIMO WLAN systems
8,126,425	Method and system for 60 GHZ location determination based on varying antenna direction and coordination of WLAN/WPAN/GPS multimode devices
8,095,162	Control device for allocating resources to communication devices that use differing protocols and methods for use therewith
8,094,749	Signaling format for wireless communications
8,089,890	Transmitting high rate data within a MIMO WLAN
8,085,871	Adaptive modulation in a multiple input multiple output wireless communication system with optional beamforming
8,081,926	Method and system for multisession communication using multiple physical (PHY) layers
8,081,104	Radar detection circuit for a WLAN transceiver
8,077,810	Apparatus for high data throughput reception in a WLAN
8,059,740	WLAN transmitter having high data throughput
8,041,333	Method and system for 60 GHz antenna adaptation and user coordination based on base station beacons
8,032,167	Multimode control device for allocating resources to communication devices that use differing protocols and methods for use therewith
8,031,806	Mixed mode preamble for MIMO wireless communications
7,995,667	Reduced latency concatenated reed solomon-convolutional coding for MIMO wireless LAN
7,991,056	Method and system for encoding a signal for wireless communications
7,991,009	Preamble formats for MIMO wireless communications
7,978,729	High data throughput WLAN frame format
7,974,591	Modified preamble for programmable transmitter
7,957,450	Method and system for frame formats for MIMO channel measurement exchange
7,940,751	Personal area network data encapsulation in WLAN communications
7,924,943	Method and system for optional closed loop mechanism with adaptive modulations for multiple input multiple output (MIMO) wireless local area network (WLAN) system
7,920,526	Long training sequence method and device for wireless communications

7,912,449	Method and system for 60 GHz location determination and coordination of WLAN/WPAN/GPS multimode devices
7,894,852	Channel reciprocity matrix determination in a wireless MIMO communication system
7,873,022	Multiple input multiple output wireless local area network communications
7,865,142	Method and system for multisession bluetooth communication using multiple physical (PHY) layers
7,840,184	Method and system for utilizing a 60 GHZ PHY layer for high speed data transmission between bluetooth devices
7,826,547	Mixed mode preamble for MIMO wireless communications
7,801,098	Parallel MAC/PHY for enhanced transmission rate in a wireless network
7,796,696	Asymmetrical multiple stream wireless communication using STBC
7,773,565	MIMO wireless communication greenfield preamble formats
7,746,886	Asymmetrical MIMO wireless communications
7,702,291	Radar detection from pulse record with interference
7,701,382	Radar detection circuit for a WLAN transceiver
7,680,059	Multiple protocol wireless communications in a WLAN
7,617,439	Algebraic construction of LDPC (Low Density Parity Check) codes with corresponding parity check matrix having CSI (Cyclic Shifted Identity) sub-matrices
7,593,692	Radar detection circuit for a WLAN transceiver
7,590,429	RF transceiver configuring for a MIMO communication
7,590,189	Signaling format for wireless communications
7,586,881	MIMO wireless communication greenfield preamble formats
7,583,933	Dynamic frequency selection in a wireless communication network
7,570,619	Long training sequence method and device for wireless communications
7,564,914	Method and system for frame formats for MIMO channel measurement exchange
7,558,537	Modified preamble for programmable transmitter
7,555,053	Long training sequence for MIMO WLAN systems
7,539,501	High data throughput wireless local area network receiver
7,516,390	LDPC (Low Density Parity Check) coding and interleaving implemented in MIMO communication systems
7,502,408	RF transceiver having adaptive modulation
7,466,773	WLAN receiver having an iterative decoder
7,444,134	Device and method for transmitting long training sequence for wireless communications
7,423,989	Preamble formats for MIMO wireless communications
7,417,974	Transmitting high rate data within a MIMO WLAN

7,400,643	Transmission of wide bandwidth signals in a network having legacy devices
7,330,501	Orthogonal normalization for a radio frequency integrated circuit
7,324,785	Transmit power control of wireless communication devices
7,269,430	Frame format for high data throughput wireless local area network transmissions
7,242,961	Channel reciprocity matrix determination in a wireless MIMO communication system
7,233,773	Configuring a MIMO communication
7,162,204	Configurable spectral mask for use in a high data throughput wireless communication
7,158,759	Dynamic frequency selection in a wireless communication network
7,020,220	Digital estimation and correction of I/Q mismatch in direct conversion receivers