

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.

PTAB Case No. IPR2024-00364
Patent No. 8,265,096 B2

**DECLARATION OF BRANIMIR VOJCIC, D.SC., IN SUPPORT OF
UNM RAINFOREST INNOVATIONS' PRELIMINARY RESPONSE**

I, Dr. Branimir Vojcic, under the penalty of perjury under the laws of the United States, declare that the following is true and correct based on the best of my ability.

Date: 13 May 2024

Signed: 
Branimir Vojcic, Ph.D.

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1. I have been retained by Key IP Law Group PLLC, as an independent technical expert in the *Inter Partes* Review between UNM Rainforest Innovations (“UNM”), and Panasonic Automotive Systems Co., Ltd. (“Panasonic”), PTAB Case No. IPR2024-00364 involving U.S. Patent No. 8,265,096 (“the ’096 patent”).

2. I am being compensated for my work as a technical expert at my customary rate of \$725 per hour. My compensation does not in any way depend on the outcome of this review, and I have no personal interest in the outcome of this review.

I. QUALIFICATIONS

3. I am an expert in wireless technology and other telecommunications areas. I am an Emeritus Professor of Engineering and Applied Science at The George Washington University, where I have been a member of the faculty since September 1991. In addition, I have served as a consultant for a number of companies in the wireless communications industry in various technology areas. I have also served on numerous committees and as a reviewer and editor for several journals, conferences, and organizations.

4. I received my Diploma of Engineering, Master of Science, and Doctor of Science degrees in Electrical Engineering from the University of Belgrade in Yugoslavia in 1981, 1986, and 1989, respectively. The primary focus of my Doctor of Science studies was on Code Division Multiple Access (CDMA) and spread spectrum communications technologies.

5. In 1991, I joined The George Washington University as an Assistant Professor and was promoted to Associate Professor and Professor in 1997 and 2000, respectively. From 2001 to 2004, I served as Chairman of the Electrical and Computer Engineering Department at The George Washington University and retired in 2015. During my tenure at The George Washington University, I have taught many different courses on communications theory and networks, wireless communications, CDMA, and I have been a course director for a number of courses in communications. I have supervised students mostly in the areas of wireless communications and CDMA (including IS-95, CDMA2000, WCDMA/HSDPA/HSUPA) and OFDM/LTE and have been a thesis director for a number of Doctor of Science candidates, who now have successful careers in academia, industry, and government.

6. My research in the areas I just mentioned has been supported by the communications industry and various government agencies, such as the Advanced Research Project Agency (ARPA), the National Science Foundation (NSF), and the National Security Agency (NSA). Much of this research concerns communications theory, performance evaluation, modeling of wireless networks, multi-user detection, adaptive antenna arrays, and ad-hoc networks.

7. I have authored and co-authored a number of journal and conference papers, contributed to various books, and co-authored a textbook on CDMA, entitled

The CDMA2000 System for Mobile Communications, Prentice Hall, 2004. I have also served as a co-editor of a book on wireless communications, entitled *Multiaccess, Mobility, and Teletraffic in Wireless Communications*, Volume III, Kluwer Academic Publishers, Norwell, Massachusetts, 1998. My CV includes a detailed listing of my publications. See Attachment A.

8. I have also received awards for my work. For example, in 1995, I received the prestigious National Science Foundation Faculty Early CAREER Development Award. The award is given annually by the NSF to a select number of young professors nationwide to promote excellence in teaching and research.

9. I have served as a consultant for numerous companies in the wireless communications industry in technology areas, including the areas of 2G/3G/4G mobile technologies, Wireless LANs, new generation broadcast systems, advanced mobile satellite systems and other aspects of modern communication systems. I have also taught academic courses as well as short courses for the industry and government on various aspects of communications in the areas of 2G, 2.5G, 3G, and 4G cellular standards, such as CDMA2000 1xRTT, CDMA2000 Evolution Data Optimized (EVDO), Wideband Code Division Multiple Access (WCDMA), and LTE.

10. I am a Senior Member of the IEEE and was an Associate Editor for IEEE Communications Letters and the Journal on Communications and Networks. I have

served as a member of technical program committees, as a session organizer for many technical conferences and workshops, and as a reviewer of technical papers for many journals and conferences.

11. I am a co-inventor on about 20 patents; some representative examples include: U.S. Patent No. 6,523,147, entitled “*Method and Apparatus for Forward Error Correction Coding for an AM In-Band On-Channel Digital Audio Broadcasting System*,” U.S. Patent No. 8,595,590 B1, entitled “*Systems and Methods for Encoding and Decoding Check-Irregular Non-Systematic IRA Codes*,” and applications including “*Joint Source-Channel Decoding with Source Sequence Augmentation*,” U.S. 20140153654 A1, June 5, 2014, “*Systems and Methods for Advanced Iterative Decoding and Channel Estimation of Concatenated Coding Systems*,” U.S. 20140153625 A1, June 5, 2014, “*Advanced Decoding of High/Medium/Low Density Parity Check Codes*,” PCT/US13/72883, and International Application Number PCT/CA01/01488, entitled “*Multi-User Detector For Direct Sequence - Code Division Multiple Access (DS/CDMA) Channels*.”

12. Over the last several years, I have evaluated many, on the order of hundreds, of patents that are essential or potentially essential to wireless standards for various clients. These evaluations typically include, for example, analyzing whether the patent claims read on the relevant standard, considering the importance of the technological inventions claimed, analyzing how such claimed inventions

compare to other similar patents in the field, searching for and reviewing potential prior art, reviewing and analyzing the prosecution histories of patents relevant to potential claim construction, infringement, or related issues, reviewing and analyzing the working group documents related to the relevant standard in relation to the claimed invention, and considering whether there are available alternatives to the claimed inventions.

13. A copy of my CV is attached as Attachment A.

II. BASES OF OPINIONS

14. The basis and reasoning of my opinions include my education, training, and experience as an engineer, including my decades of experience in telecommunications. In conducting my analysis and forming my opinions, I have considered the materials listed below:

- a. U.S. Patent No. 8,265,096 to Yan-Xiu Zheng, *et al.*, filed July 7, 2008, and issued on Sep. 11, 2012, its provisional applications, and its file history;
- b. Panasonic's petition (Paper 1, "Petition") and any materials referenced therein relevant to my analysis; specifically including the declaration of Dr. Hansen (EX1002, "Hansen");

- c. IEEE 802.11-05/1102r4, “Wireless LANs Joint Proposal: High throughput extension to the 802.11 Standard: PHY” (“*Joint Proposal*”) (EX1008)
- d. U.S. Pub. No. 2006/0072529 (“*Mujtaba*”) (EX1010)
- e. U.S. Pub. No. 2007/0204052 (“*Trainin*”) (EX1011)
- f. Relevant materials from *STC.UNM v. Apple Inc.*, No. 1-20-cv-00351 (W.D. Tex. Apr. 9, 2020), including the Claim Construction Order, ECF No. 69;
- g. and any other materials referenced herein.

15. I have previously rendered an opinion regarding the '096 patent in the IPR2021-00375 by Qualcomm. In conducting my analysis and forming my opinions in the context of that proceeding, I have considered these additional materials:

- a. Qualcomm’s Petition for *Inter Partes* Review, PTAB Case No. IPR2021-00375, and all its relevant technical exhibits;
- b. Declaration of Dr. Sumit Roy (“Roy”) supporting Qualcomm’s petition;
- c. U.S. Pub. No. 2009/0067377 A1 (“*Talukdar*”);
- d. U.S. Pub. No. 2007/0155387 A1 (“*Li*”); and
- e. U.S. Pub. No. 2007/0104174 A1 (“*Nystrom*”).

16. My opinions in this declaration are based on the understanding of a person of ordinary skill in the art at the time of the invention of the claims in the '096 patent.

17. In assessing the level of skill of a person of ordinary skill in the art, I have considered the type of problems encountered in the art, the prior solutions to those problems found in the prior art references, the rapidity with which innovations are made, the sophistication of the technology, the level of education of active workers in the field, and my own experience working with those of skill in the art at the time of the invention.

18. A person of ordinary skill in the art ("POSITA") at the time of the filing of the '096 patent would typically have at least a MS Degree in Computer Engineering or Electrical Engineering, or equivalent work experience, along with at least 1 year of experience related specifically to wireless communications, including MIMO and OFDM.

19. I am very familiar with this level of skill. Over my decades of experience, I have supervised and worked with engineers in this field having at least the level of skill identified above.

III. LEGAL FRAMEWORK

A. *Claim Construction*

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

21. I understand that a claim term that does not use the word “means” is presumed not to be a means-plus-function term. I understand that a term that does not use the word “means” would be construed as a means-plus-function term if it does not describe structure to a POSITA. Conversely, I understand that if a term describes structure to a POSITA, it is not a means-plus-function term.

22. I understand that a patent has several components, including an abstract, drawings, a written description detailing different embodiments of the invention (*i.e.*, the specification), and numbered claims at the end of the patent. It is the numbered claims that define metes and bounds of the properties that the patentee has the right to exclude other from infringing.

B. *Validity*

23. I understand that a patent, once issued or granted, is entitled to a presumption of validity. However, this presumption can be overcome by clear and convincing evidence to the contrary. Validity is routinely challenged post-issuance, and courts often invalidate the patent, on the ground that the patent fails to meet one

or more statutory requirements, *e.g.*, by claiming a non-patentable subject matter, such as an abstract idea, in violation of 35 U.S.C. § 101; by being not novel and anticipated by prior art under § 102; by being obvious in view of prior art under § 103; and/or lacking sufficient disclosures or being indefinite, in violation of § 112.

1. Anticipation

24. I understand that section 102 first defines “prior art” that would anticipate and, thus, invalidate the patent. The term “prior art” is a patent term of art for the technology that was known or used before the priority date of the patent, which is typically the filing date of the patent application. However, I understand that, to the extent a provisional patent application properly discloses and supports the claimed subject matter, the priority date of the claims is the filing date of the provisional application, which is considered the invention date. Thus, if the subject matter of the invention was already patented or described in a printed publication anywhere in the world before the invention claimed in the patent, such prior art would invalidate the patent. 35 U.S.C. § 102(a) (pre-AIA).

25. Anticipation is a technical defense. A patent claim is anticipated and therefore invalid under 35 U.S.C. §102, only if: a single prior art reference discloses, either expressly or inherently, each and every element of the claimed invention arranged exactly as they are arranged in the claim. If even a single element or step recited by the claim is not disclosed in exactly the same way, arranged as in the

claim, there is no anticipation. In addition, the reference must enable one of skill in the art to practice an embodiment of the claimed invention without undue experimentation.

26. For an element to be present in a reference through inherency, the evidence must be clear and convincing that the missing element is necessarily present in the thing described in the reference, and that it would be so recognized by persons of ordinary skill. That means that inherency cannot be established by probabilities or possibilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient. If, however, the disclosure is sufficient to show that the natural result flowing from the operation as taught would result in the performance of the questioned function, that disclosure could be inherent.

2. Obviousness

27. I understand that § 103 is broader than § 102 in a sense that § 103 forbids issuance of a patent even if “the invention is not identically disclosed or described as set forth in section 102, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.” 35 U.S.C. § 103(a) (pre-AIA).

28. I understand that to measure obviousness under § 103, a court determines “the scope and content of the prior art,” ascertains “differences between the prior art

and the claims at issue,” and resolves “the level of ordinary skill in the pertinent art.” *Graham v. John Deere Co.*, 383 U.S. 1, 17 (1966). Secondary considerations such as “commercial success, long felt but unsolved needs, failure of others . . . might be utilized to give light to the circumstances surrounding the origin of the subject matter sought to be patented.” *Id.* at 17-18; see *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 415 (2007) (“Graham set forth a broad inquiry and invited courts, where appropriate, to look at any secondary considerations that would prove instructive.”).

29. It is my understanding that the information that is used to evaluate whether an invention is new and not obvious is generally referred to as “prior art.” Prior art generally includes U.S. and foreign patents and U.S. and foreign printed publications (*e.g.*, published patent applications (before issued as a patent), books, journal publications, presentation files, posters, articles on websites, product manuals, etc.) that existed before the earliest filing date (the “effective filing date”) of the claims in the patent. A patent will be prior art if it was filed before the effective filing date of the claimed invention, while a printed publication will be prior art if it was publicly available before that date.

30. I understand that, in addition to the patents and printed publications, a product used in public or on sale in the U.S. more than one year prior to the effective filing date of a patent can be prior art to that patent. I understand that a product is considered “on sale” when (i) the product embodying the invention is offered for

commercial sale, and (ii) the invention was ready for patenting. An invention is shown to be “ready for patenting” when there is proof of a reduction to practice or proof that prior to the critical date the inventor had prepared drawings or other descriptions of the invention that were sufficiently specific to enable a person skilled in the art to practice the invention.

31. It is my understanding that a claimed invention is not patentable if it would have been obvious to a person of ordinary skill in the field of the invention at the time the invention was made.

32. It is my understanding that the following standards govern the determination of whether a claim in a patent is obvious. I have applied these standards in my evaluation.

33. It is my understanding that to find a claim in a patent obvious, one must make certain findings regarding the claimed invention and the prior art. Specifically, the obviousness question requires consideration of four factors (although not necessarily in the following order):

- a. the scope and content of the prior art;
- b. the differences between the prior art and the claims at issue;
- c. the knowledge of a person of ordinary skill in the pertinent art; and
- d. whatever objective factors indicating obviousness or non-obviousness may be present in any particular case.

34. It is my understanding that the obviousness inquiry should not be done in hindsight, but must be done using the perspective of a person of ordinary skill in the relevant art as of the effective filing date of the patent claim. The prohibition against using hindsight applies to both the invention and the identification of the problem that the invention solves.

35. It is my understanding that the obviousness inquiry may also consider certain objective indicia of non-obviousness. Such objective factors indicating obviousness or non-obviousness may include: commercial success of products covered by the patent claims; a long-felt need for the invention; failed attempts by others to make the invention; copying of the invention by others in the field; unexpected results achieved by the invention; praise of the invention by the infringer or others in the field; the taking of licenses under the patent by others; expressions of surprise by experts and those skilled in the art at the making of the invention; and the patentee proceeded contrary to the accepted wisdom of the prior art.

36. It is my understanding that the fact finder must determine whether potential evidence of secondary considerations is relevant. With respect to evidence offered for each secondary consideration, the fact finders must ascertain whether there is a nexus between the claimed invention and the evidence establishing the secondary consideration (commercial success, industry praise, etc.) and determine the

probative value of secondary-considerations evidence for rebutting a prima facie case of obviousness.

37. I understand that the obviousness analysis requires a comparison of the properly construed claim language to the prior art on a limitation-by-limitation basis. Obviousness relies on an expansive and flexible approach using common sense. Patents may not claim nothing more than combinations of known elements driven by non-innovative factors such as market demands. Only if a person of ordinary skill in the art can implement the claimed invention as a predictable variation of a known invention without undue experimentation, it is obvious. Also, “hindsight” reconstruction cannot be used to combine references together to reach a conclusion of obviousness.

38. It is my understanding that exemplary rationales that may support a conclusion of obviousness include:

- 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 known techniques to improve similar devices (methods or products) in the same way;

- d. applying a known technique to a known device (method or product) ready for improvement to yield predictable results;
- e. “obvious to try,” *i.e.*, choosing from a finite number of identified, predictable solutions with a reasonable expectation of success;
- f. known work in one field of endeavor may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations would have been predictable to one of ordinary skill in the art; and
- g. some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention.

39. Thus, when considering a prior art reference for purposes of an obviousness analysis, the reference must be taken for everything it teaches.

40. I understand that a claim might be obvious over a single reference, without the need to combine references, if the elements of the claim that are not found explicitly or inherently in the reference can be supplied by the knowledge of one skilled in the art, including the common sense of one of skill in the art.

41. An obviousness evaluation can also be based on a combination of multiple prior art references. The prior art references themselves may provide a suggestion, motivation, or reason to combine, but other times the nexus linking two or more

prior art references is simple common sense. I further understand that an obviousness analysis recognizes that market demand, rather than scientific literature, often drives innovation, and that a motivation to combine references may be supplied by the direction of the marketplace.

42. I understand that practical and common-sense considerations should guide a proper obviousness analysis, because familiar items may have obvious uses beyond their primary purposes. A person of ordinary skill in the art looking to overcome a problem will often be able to fit the teachings of multiple publications together like pieces of a puzzle. An obviousness analysis, therefore, considers the inferences and creative steps that a person of ordinary skill in the art would employ under the circumstances.

43. I understand that a particular combination may be proven obvious merely by showing that it was obvious to try the combination. For example, when there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp because the result is likely the product not of innovation but of ordinary skill and common sense which led to a reasonable expectation of success.

44. It is my understanding that the combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable

results. When a work is available in one field of endeavor, design incentives and other market forces can prompt variations of it, either in the same field or a different one.

45. I understand that when a patent simply arranges old elements with each performing the same function it had been known to perform and yields no more than one of ordinary skill in the art would reasonably expect from such an arrangement, the combination is obvious. A proper obviousness analysis focuses on what was known or obvious to a person of ordinary skill in the art, not just the patentee. Accordingly, any need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed.

46. In sum, it is my understanding that prior art teachings are properly combined where a person of ordinary skill in the art, having the understanding and knowledge reflected in the prior art and motivated by the general problem facing the inventor, would have been led to make the combination of elements recited in the claims. Under this analysis, the prior art references, or any need or problem known in the relevant field at the time of the invention, can provide a reason for combining the elements of multiple prior art references in the claimed manner. But, as stated previously, I understand that “hindsight” reconstruction cannot be used to combine references together to reach a conclusion of obviousness.

IV. THE '096 PATENT (EX1001]

A. *Technical Background*

47. The invention of the '096 patent relates to methods for constructing frame structures in orthogonal frequency-division multiple access (OFDMA) systems. EX1001, 1:16-19. “Orthogonal Frequency Division Multiple Access (OFDMA) is a multiple access scheme for transmitting data in different subcarriers in a channel, wherein the data may come from different users and may be transmitted in disjoint subsets of sub-channels in a transmission bandwidth.” *Id.* 1:22-24.

48. The '096 patent first describes the prior art. *Id.*, Figs 1 (illustrating an OFDMA frame structure under the IEEE 802.16 standard) and 2 (illustrating a placement of guiding signals (or pilot symbols) 24-1 for time-domain and frequency-domain OFDMA signals under the IEEE 802.16 standard).

49. “Referring to FIG. 2, upper and lower frequency bands may serve as guard bands 22-1 and 22-2, respectively, which may not be used to carry information.” *Id.* 1:61-63. “The placement of information may include a first part and a second part. For example, the first part of the placement includes a preamble 10'-1 having a fixed length, and the second part of the placement includes data and guard intervals between an upper row and a lower row of the data interlaced with the pilot symbols 24-1, represented by blocks marked with 'X'.” *Id.*, 1:63-2:2.

50. Then, '096 patent illustrates problems faced by the prior art, including that: “[i]n some applications such placement of information may be inflexible to bandwidth scaling due to the fixed-length preambles 10'-1 and/or 10'-2 and the often unusable guard bands 22-1 and 22-2. Moreover, the placement 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. Moreover, the limitation on pilot symbol placement may cause channel estimation error at a receiving end because of insufficient information provided for channel estimation.” *Id.*, 2:2-14.

51. The invention of the '096 patent directly addresses these problems. For example, the '096 patent discloses “a method for constructing a frame structure for data transmission, the method comprising generating a first section comprising data configured in a first format compatible with a first communication system, generating a second section following the first section comprising data configured in a second format compatible with a second communication system, wherein the second format is different from the first format, 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 combining the first section, the second section and the at least one non-data section to form the frame structure.” *Id.*, at 2:18-30.

The patent further details other examples of its invention. *Id.*, 2:31-54, 2:55-67, 3:1-13, and 3:14-32.

52. The invention of the '096 patent enables “data of an old orthogonal frequency-division multiple access (OFDMA) system (hereinafter a legacy system) and data of a new OFDMA system to co-exist in an OFDMA frame by changing a frame structure of the OFDMA frame.” *Id.*, 4:21-25. The new system has the advantages of allowing larger bandwidth, higher mobility, and may use updated transmission technology while maintaining backward compatibility. *Id.*, 4:26-30.

B. Challenged Claims

1. Claim 8

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

- a.** generating a first section comprising data configured in a first format compatible with a first communication system using symbols;
- 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,
- c.** wherein the first communication system's symbols and the second communication system's symbols co-exist in one transmission scheme and
- d.** wherein the second communication system has pilot symbols that are denser than those in the first communication system;
- 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; and
- f.** combining the first section, the second section and the at least one non-data section to form the frame structure.

2. Claim 44

44. A method of constructing a frame structure for data transmission, the method comprising:

- a.** generating a first section comprising data configured in a first format compatible with a first communication system using symbols;
- 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,
- c.** wherein the first communication system's symbols and the second communication system's symbols co-exist in one transmission scheme and
- d.** wherein the second format is compatible with the second communication system configured to support higher mobility than the first communication system,
- e.** wherein each symbol in the second communication system has a shorter symbol period than that in the first communication system;
- f.** wherein the second communication system has pilot symbols that are denser than those in the first communication system; and
- 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
- h.** combining the first section, the second section and the at least one non-data section to form the frame structure.

3. Claim 45

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.

4. Claim 46

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.

5. Claim 47

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

6. Claim 49

49. The method of claim 44, wherein each of the first section and the second section carries at least one of uplink and downlink data.

7. Claim 50

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

C. Priority Date

53. The '096 patent derives priority from two related provisional applications. Specifically, provisional application No. 60/929,798, filed on Jul. 12, 2007, and provisional application No. 60/973,157, filed on Sep. 17, 2007. I have specifically reviewed the provisional applications to determine whether the subject matter claimed in the '096 patent is disclosed therein. Although it is my opinion that the claimed subject matter is in fact disclosed in the original provisional patent applications, I understand that Petitioner alleges that the *Joint Proposal* was published on January 14, 2006 (EX1008); that *Mujtaba* was filed on September 9, 2005, and published on April 6, 2006 (EX1010); and that *Trainin* was filed on February 24, 2006, and published on August 30, 2007 (EX1011). Paper 1 at 5. For my analysis in this declaration only, and without forming an opinion as to their accuracy, I have accepted these priority dates. My technical analysis therefore relies on citations to the specification of the '096 patent. However, I reserve the right to

update my analysis with citations to the relevant provisional applications in the event that I am informed later that the priority dates asserted by Petitioner are not accurate.

V. CLAIM CONSTRUCTIONS

A. “at least one of [...] and [...]”

54. I understand that the litigants in *UNM Rainforest Innovations v. Apple Inc.*, No. 1-20-cv-00351 (W.D. Tex.) agreed that the claim term “at least one of [...] and [...]” should be construed as “[...] and/or [...].” EX1005 (Apple Claim Construction Order). I have applied this construction.

B. “symbol period”

55. I understand that the litigants in *UNM Rainforest Innovations v. Apple Inc.*, No. 1-20-cv-00351 (W.D. Tex.) agreed that the claim term “symbol period” should be construed as “the time it takes to transmit one symbol.” EX1011 (Apple Claim Construction Order). I have applied this construction.

C. District Court Constructions

56. I understand that the Court in *UNM Rainforest Innovations v. Apple Inc.*, No. 1-20-cv-00351 (W.D. Tex.) construed a number of claim terms. EX1011 (Apple Claim Construction Order). I have applied the court’s constructions, which are replicated here.

Term	Construction
Whether the preambles for all asserted claims are limiting	Each preamble is limiting

“frame structure”	“a single structure comprising one or more frames, wherein each frame may have one or more subframes”
“symbol”	Plain-and-ordinary meaning, wherein the plain-and-ordinary meaning means “a transmissible unit of information”
“pilot symbols that are denser than”	“more pilot symbols per unit time than, wherein a unit time is the symbol period of the first communication system”
“[first & second] communication system”	Construction for “communication system”: 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”	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”	Data: Plain-and-ordinary meaning Non-data: Plain-and-ordinary meaning
“support higher mobility than”	Not indefinite. “support higher relative velocity between a transmitter and a receiver than”

VI. VALIDITY ANALYSIS

57. I understand that Panasonic argues the following grounds of obviousness:

Ground	Allegation of Invalidity	Claims
1	Anticipation by the <i>Joint Proposal</i> (EX1008)	8, 44–47, 50
2	Obviousness over the <i>Joint Proposal</i> and <i>Trainin</i>	49
3	Anticipation by <i>Mujtaba</i> (EX1010)	8
4	Obviousness over <i>Mujtaba</i> and <i>Trainin</i> (EX1011)	8, 44-47, 49-50

58. Below is my analysis of the asserted prior art references and my opinion as to what they do and do not disclose.

A. Ground 1: The Joint Proposal versus Claims 8, 44-47, And 50.

1. Claim 8

A method of constructing a frame structure for data transmission.

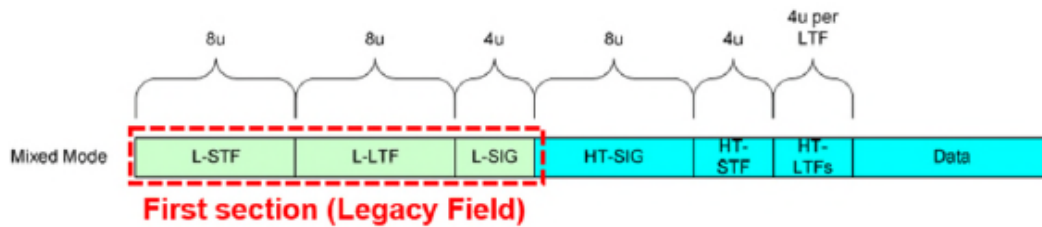
a) Claim 8[a]: generating a first section comprising data configured in a first format compatible with a first communication system using symbols

59. Petitioner and Dr. Hansen identify the “legacy field (the claimed first section) consisting of . . . a legacy signal field (L-SIG) (the claimed data configured a first format).” Paper 1 at 25; Hansen¶180.

60. In my opinion, the legacy signal field (L-SIG) is not “data” as that term is used in the ’096 patent. A POSITA would understand that the L-SIG field contains control information used to decode packets in legacy format. The actual “data” as that term is used in the ’096 patent is sent in the “Data” section of the mixed mode packet. However, the *Joint Proposal* does not send data to a first and second system in the same frame structure, only to one of them in one frame, either to legacy or HT.

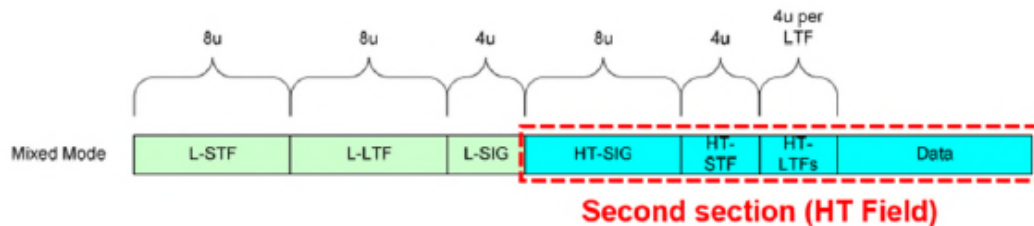
61. Notably, although there are two headers (legacy and HT) there is only one data section. That is because the mixed mode packet of the *Joint Proposal* transmits data only in one format at a time—either “legacy” or “HT.” It does not send data in both legacy format and HT format at the same time, in a single frame structure, as claimed in the ’096 patent.

62. This is visually apparent when comparing the annotated illustrations in the Petition:



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

Petition at 67.



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

Petition at 68.

63. It appears that the Petitioner identifies L-SIG in green as “data” in the legacy section but does not identify the corresponding HT-SIG field as “data” in the HT section. Instead, Petitioner identifies the HT-SIG field as non-data (Paper 1 at 77) and the “Data” field as the data (Paper 1 at 68). A POSITA would not interpret the *Joint Proposal* so inconsistently. Further, the HT data is not always present because the mixed mode packet transmits only legacy data or HT data at a time.

Thus, when legacy data is being transmitted, no HT data is being transmitted, and vice versa.

b) 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

64. Petitioner and Dr. Hansen identify the “Data” field in the HT section as the claimed data. Paper 1 at 68 (“a data field (data) (the claimed data configured in a second format).”) However, as explained regarding element 8[a] above, the HT data is not always present because the mixed mode packet transmits data only in one format at a time—either legacy or HT. Thus, when legacy data is being transmitted, no HT data is being transmitted, and vice versa.

65. Both the Petition (Paper 1 at 26–27 (*citing* Hansen¶180)) and Dr. Hansen’s declaration (Hansen¶180) identify the “second communication system” as 802.11n. However, the 802.11n version of the 802.11 standard was not released until approximately 2009. See, e.g., <https://standards.ieee.org/beyond-standards/the-evolution-of-wi-fi-technology-and-standards/> (“IEEE 802.11n™, or Wi-Fi 4, was introduced in 2009 to support the 2.4 GHz and 5GHz frequency bands). This date comports with my personal knowledge of the evolution of the 802.11 standard. Therefore, the *Joint Proposal* could not have referred to the 802.11n version of the WiFi standard. Indeed, the *Joint Proposal* does not reference 802.11n and Dr. Hansen provides no citation to the *Joint Proposal* for this proposition (Hansen¶180).

Additionally, the pages of the *Joint Proposal* are labelled “pre 11n product specification,” indicating that it is not referring to the 802.11n version of the standard, but instead an unofficial earlier “pre 11n” product specification. Dr. Hansen did not provide a comparison of the *Joint Proposal* and the 802.11n standard to show that the *Joint Proposal* is the same as the 802.11n standard.

66. In my opinion, the *Joint Proposal* does not disclose the 802.11n second communications system identified as the HT communications system by Petitioner and Dr. Hansen.

c) Claim 8[d]: “wherein the second communication system has pilot symbols that are denser than those in the first communication system”

67. Petitioner and Dr. Hansen do not support their assertion that the *Joint Proposal* specifies that the short guard interval (T_{GIS}) is only employed in the HT transmission. Petition at 30, Hansen¶192. The supporting citation to the *Joint Proposal* (56:1-6) indicates only that the “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” and that “short GI shall not be used in GF 5 mode when the MCS indicates a single spatial stream.” *Id.*

1 4.7.5 Transmission with a short guard interval

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

Id. This citation is silent as to whether or not the *Joint Proposal* contemplates using the short guard interval in the Legacy mode. Indeed, since the *Joint Proposal* explicitly states when the short guard interval shall not be used, it is my opinion that the *Joint Proposal* does not disclose that short guard interval is affirmatively not used in the Legacy system. Notably, there is no indication in the Petition or by Dr. Hansen that the *Joint Proposal* reflects any official 802.11 standard.

68. Dr. Hansen further cites section 4.8 of the *Joint Proposal*, titled “Legacy Duplicate Transmission” in support. Hansen¶192 (*citing Joint Proposal* 56:7–13). However, this section relates only to the “Legacy duplicate transmission,” which is used “to transmit to legacy 802.11a devices that may be present in either the upper and lower channels of the 40MHz channel.” *Joint Proposal* 56:8–9. It does not address whether or not the *Joint Proposal* contemplates using the short guard interval in the regular legacy mode. Again, since the *Joint Proposal* otherwise explicitly indicates when the short guard intervals shall not be used, it is my opinion that the *Joint Proposal* does not affirmatively disclose that a short guard interval is not used in the legacy system.

69. Dr. Hansen’s statement referring only to legacy 802.11a systems (Hansen¶193) is speculation since the *Joint Proposal* does not affirmatively indicate which legacy system is referenced. Guard intervals can differ in the various 802.11 versions, and it is not necessarily true that legacy systems have longer guard

intervals. For example, the newer version 802.11ax supports longer guard intervals up to 3.2 μ s.

70. If the short guard interval were used in the Legacy system as well as the HT system, the pilot symbol density would be the same even by Petitioner's theory. If the short guard interval were used in the Legacy system but not in the HT system, the pilot symbol density would be less by Petitioner's theory.

71. For these reasons, in my opinion, the Petitioner has not shown that the *Joint Proposal* anticipates Claim 8 of the '096 patent.

2. Claim 44

A method of constructing a frame structure for data transmission.

72. Since claim 44 has several of the same limitations as claim 8, Petitioner incorporates its discussion of limitations 8[pre]-8[f] regarding limitations 44[pre]-44[c] and 44[f]-44[h]. I therefore incorporate my response concerning these limitations as well. Petitioner only separately addresses limitations 44[d] and 44[e].

a) Claim 44[d]: “wherein the second format is compatible with the second communication system configured to support higher mobility than the first communication system”

73. Petitioner argues that “the characteristic 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.’” However,

the *Joint Proposal* does not address “higher mobility” at all. The *Joint Proposal* refers only to “high throughput,” and does not support that “high throughput” necessarily equates to “higher mobility.” A POSITA would understand that “higher throughput” can be attained in any number of ways, which would not necessarily support “higher mobility.” Indeed, in many instances, these are competing objectives and increasing throughput would not facilitate higher mobility. For example, increasing pilot density decreases the data rate and therefore reduces throughput. Since the *Joint Proposal* focuses on “higher throughput,” it teaches away from modifications that decrease throughput, such as increasing pilot density for example.

74. In summary, the *Joint Proposal*’s references to “higher throughput” cannot be equated with a disclosure of “higher mobility.”

b) Claim 44[e]: “wherein each symbol in the second communication system has a shorter symbol period than that in the first communication system”

75. Petitioner refers only to its discussion of claim element 8[d]. I therefore incorporate my response thereto.

3. 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.

76. Claim 45 is patentable and not anticipated by the *Joint Proposal* because it depends on Claim 44, which is not disclosed by the *Joint Proposal*.

4. 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.

77. Claim 46 is patentable and not anticipated by the *Joint Proposal* because it depends on Claim 44, which is not disclosed by the *Joint Proposal*.

5. 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.

78. Claim 47 is patentable and not anticipated by the *Joint Proposal* because it depends on Claim 46 which depends on Claim 44, which is not disclosed by the *Joint Proposal*.

6. Claim 50

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

79. Claim 50 is patentable and not anticipated by the *Joint Proposal* because it depends on Claim 44, which is not disclosed by the *Joint Proposal*.

80. Further, since the mixed mode frame structure carries only data in the legacy format or the HT format but not both, when the frame carries only legacy data but not HT data, the second section does not carry mapping information for data in the second section.

B. Ground 2: The Joint Proposal And Trainin versus Claim 49

1. Claim 49

The method of claim 44, wherein each of the first section and the second section carries at least one of uplink and downlink data.

81. Claim 49 is patentable and not anticipated by the *Joint Proposal* because it depends on Claim 44, which is not disclosed by the *Joint Proposal*.

2. Motivation to Combine

82. The *Joint Proposal* does not identify any problem that would have motivated a POSITA to incorporate the teachings of *Trainin*. The *Joint Proposal* is a proposed standard entitled “IEEE P802.11 Wireless LANs” that defines the wireless device communications. No indication is given in the reference or otherwise that any known problem existed, or that any issue needed to be addressed. Petitioner does not identify any problem faced by the *Joint Proposal*, nor a desirable solution offered by *Trainin*. *Trainin* is focused on wireless transmission with frame alignment by calculating a transmission time that aligns an interframe space start time of the first and second modulation schemes. *Trainin* at Abstract. The Petitioner did not point to anything in the *Joint Proposal* that would hint at such a problem.

Therefore, in my opinion, insufficient evidence supports that a POSITA in possession of both references would have been motivated to combine these references to arrive at the claims of the '096 Patent.

83. Further, since the *Joint Proposal* was presumably a preliminary standard proposal, a POSITA would understand that it cannot simply be modified.

84. But even if the *Joint Proposal* and *Trainin* are combined, *Trainin* uses substantively same disclosures as in the *Joint Proposal* and neither reference would invalidate claim 44 as I discussed above with respect to the *Joint Proposal*. Therefore, a combination of the *Joint Proposal* and *Trainin* cannot invalidate Claim 49 that depends on Claim 44.

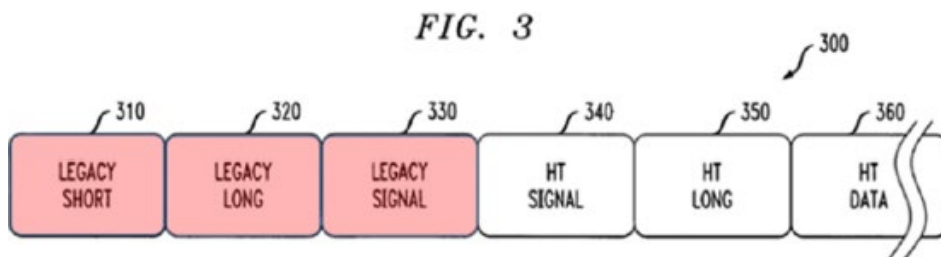
C. Ground 3: *Mujtaba* versus Claim 8

1. Claim 8

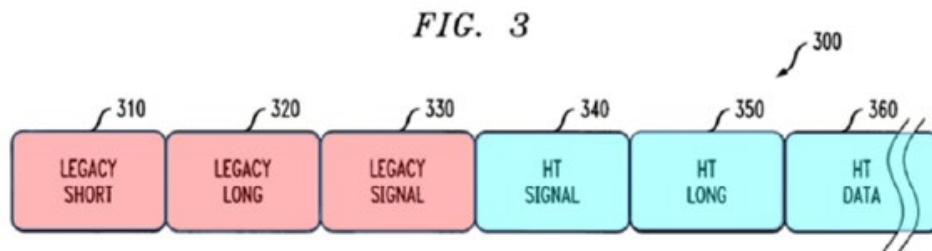
A method of constructing a frame structure for data transmission.

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

85. Although citing the same mixed mode format, Petitioner and Dr. Hansen identify the payload as the data in this instance. Paper 1 at 49 (“payload (*i.e.*, data)”). However, they identify the same payload data (360) as the data of the second section. (Paper 1 at 51). This is visually apparent in the below figures:



Paper 1 at 49 (annotating *Mujtaba* Fig. 3).



Paper 1 at 51 (same).

86. *Mujtaba* does not have a disclosure of two payloads in a frame, all embodiments include a single payload (data). In reference to FIG.3, *Mujtaba* teaches that preamble 300 includes fields 310, 320, 330, 340, and 350, and that the packet includes the preamble and “HT data field (payload).” EX1010 at [0019].

87. That is, *Mujtaba* teaches that the embodiment of FIG.3 is used for the HT transmission that includes HT data 360.

88. I understand that Petitioner map “a first section comprising data ...” to the legacy field (310, 320, and 330). (“A POSA would understand from *Mujtaba* that

the legacy field (the claimed first section) carries information in the legacy format (the claimed first format) that enables payload (*i.e.*, data) to be compatible with legacy devices (the claimed first communication system). Ex. 1002 ¶271.”). This is incorrect as *Mujtaba* does not disclose the transmission of legacy data, only HT data, as explained above. Therefore, the Petitioner failed to show that *Mujtaba* discloses “generating a first section comprising data configured in a first format compatible with a first communication system using symbols.”

89. In my opinion, the same payload (data) field in *Mujtaba* cannot be both the data of the first section in a first format and the data of the second section in a second format. This contrasts with Claim 8 which requires that both sections comprise data.

90. Notably, there are two headers (legacy and HT) but only one data section. That is because the mixed mode packet transmits data only in one format at a time—either “legacy” or “HT.” It does not send data in both legacy format and HT format at the same time, in a single frame structure, as claimed in the ’096 patent. Therefore, in my opinion, the mixed mode packet does not disclose this claim element, 8[a].

91. Petitioner did not argue that it would be obvious to introduce a second payload with data and pilots into the frame structure of Figure 3, such that both legacy and HT transmissions can occur in the same frame structure. And a POSITA would not understand such extension of *Mujtaba* to be obvious.

b) 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,

92. Petitioner and Dr. Hansen identify the “Data” field in the HT section as the claimed data. Paper 1 at 68 (“a data field (data) (the claimed data configured in a second format).”) However, as explained regarding element 8[a] above, the HT data is not always present because the mixed mode packet transmits data only in one format at a time—either legacy or HT. Thus, when legacy data is being transmitted, no HT data is being transmitted, and vice versa. In my opinion, the same payload data field cannot be both, the data of the first section in a first format and the data of the second section in a second format.

93. Petitioner further states that “*Mujtaba* discloses ‘constructing’ a packet format for 802.11n by combining the legacy field (310, 320, 330) with the HT field (340, 350, in one packet format.” Paper 1 at 48, EX1002¶267. Notably, Petitioner refers only to the 802.11n communication system, which uses both the legacy and HT fields. Petitioner then identifies “legacy devices” as the claimed first communication system (Paper 1 at 49–50), and “HT devices” as the claimed second communication system. (Paper 1 at 49–50). In my opinion, both “legacy devices” and “HT devices” are using the same communication system, 802.11n. Petitioner does not support its assertion that there are two communications systems.

94. The '096 patent, on the other hand, considers a single version of a wireless protocol standard one communication system. For example, the '096 patent references two versions of the WiMAX standard as “IEEE standard 802.16e (‘legacy system’ hereafter) and IEEE standard 802.16m (‘new system’ hereafter)”. The '096 patent would therefore consider the 802.11n version of the WiFi standard a single communication system, and a POSITA would understand that the legacy devices and HT devices identified by Petitioner are both using the same communications system (802.11n).

c) Claim 8[d]: “wherein the second communication system has pilot symbols that are denser than those in the first communication system”

95. As I explained above, *Mujtaba* does not disclose a frame structure which would support the transmission of data of the first and the second communication system, much less that the second communication system has pilots that are denser than those in the first communication system.

96. *Mujtaba* has only two embodiments. The FIG.2 embodiment can only carry data of one non-HT system, and the FIG. 3 embodiment explicitly carries only HT-data. There is no description of a system or a frame structure that would support the transmission of data of a first and a second communication in a single frame structure. In *Mujtaba*, pilots are embedded in data and there is data/payload for only one communication system.

97. Therefore, *Mujtaba* cannot anticipate 8[d]. In attempting to prove that *Mujtaba* teaches 8[d], Petitioner made multiple misrepresentations of *Mujtaba* and/or incorrect statements.

98. Petitioner states, “thus, a POSA would understand from *Mujtaba*’s teachings that if four pilot symbols are used in the legacy transmission and six pilot symbols are used in the HT transmission with a guard interval, 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). Ex. 1002 ¶289.” I disagree for multiple reasons.

99. As I explained above, there is no disclosure or provision in *Mujtaba* that would enable transmissions of legacy data/pilots and HT data/pilots in a single frame structure, and a POSITA’s understanding would be the same, contrary to Petitioner’s statement. A POSITA would understand from *Mujtaba* that information about the selected number of pilot tones can be carried in the signal field of the preamble in prior art 802.11 systems of the embodiment of FIG. 2 (*see e.g. Mujtaba* at [0008] and [0018]), or in the signal field of the HT preamble in the HT system of FIG.3 embodiment (*see e.g. Mujtaba* at [0015] and [0019]), but in both cases, prior art and HT, there would be only one payload transmission that includes data with embedded pilots. Petitioner incorrectly interprets *Mujtaba*.

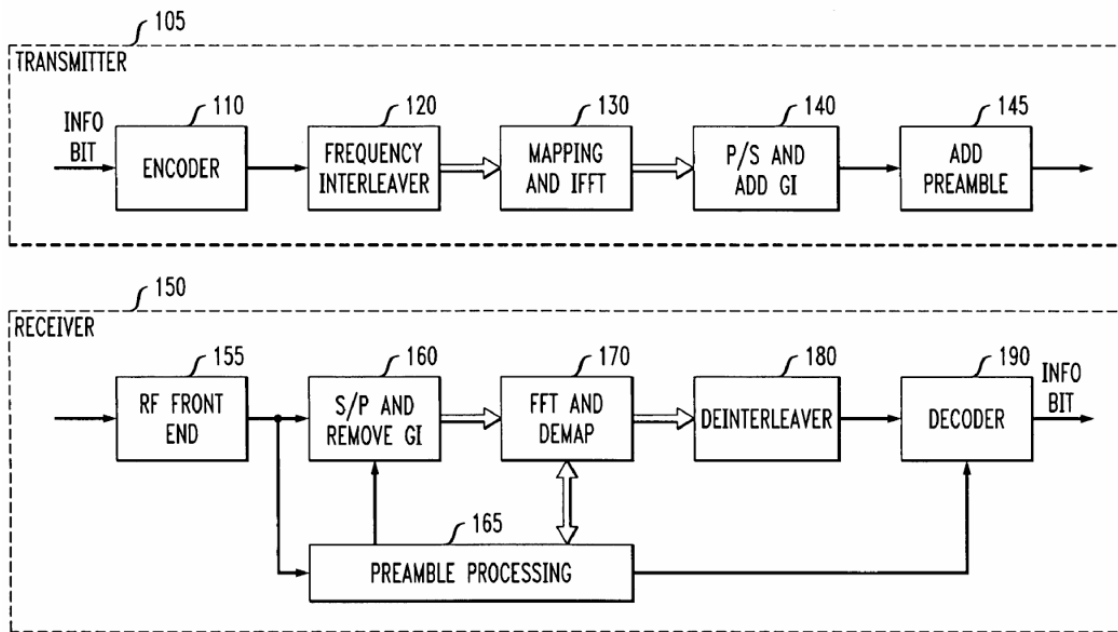
100. Petitioner further states, “As Dr. Hansen confirms, *Mujtaba* discloses (1) OFDM symbols are transmitted in a guard interval and (2) legacy transmission and HT transmission can be carried out with the same or different numbers of pilot, respectively, and (3) the HT transmission can have two, four, or six pilot symbols. Ex. 1002 ¶288.” I disagree, as this is an incorrect characterization of *Mujtaba* by Dr. Hansen and Petitioner.

101. Regarding “(1) OFDM symbols are transmitted in a guard interval” above, Dr. Hansen (Ex. 1002 ¶288) incorrectly interprets *Mujtaba*. *Mujtaba* states explicitly, “The frequency domain OFDM signal is translated to the time domain by an inverse Fourier transform (IFFT) during stage 130. At stage 140, the data is serialized and a guard interval is added to each OFDM symbol.” *Mujtaba* at [0016]. That is, in the time domain “a guard interval is added to each OFDM symbol.” *Mujtaba* does not disclose that OFDM symbols are transmitted in a guard interval. A POSITA would understand that OFDM symbols are not transmitted in guard intervals because guard intervals are removed prior to demodulating OFDM symbols.

[0017] At the receiver side 150, the received signal is initially processed by the RF front end 155, and then ***the serial data is parallelized and the guard interval is removed at stage 160***. The time domain signal is translated to the frequency domain using an FFT 170 and the subcarriers are demapped to encoded and interleaved bits. Meanwhile, the preamble is processed at stage 165. The interleaved bits are deinterleaved at stage 180 and decoded at stage 190 to provide the transmitted information bits.

FIG. 1

PRIOR ART



Mujtaba at [0017] and FIG. 1.

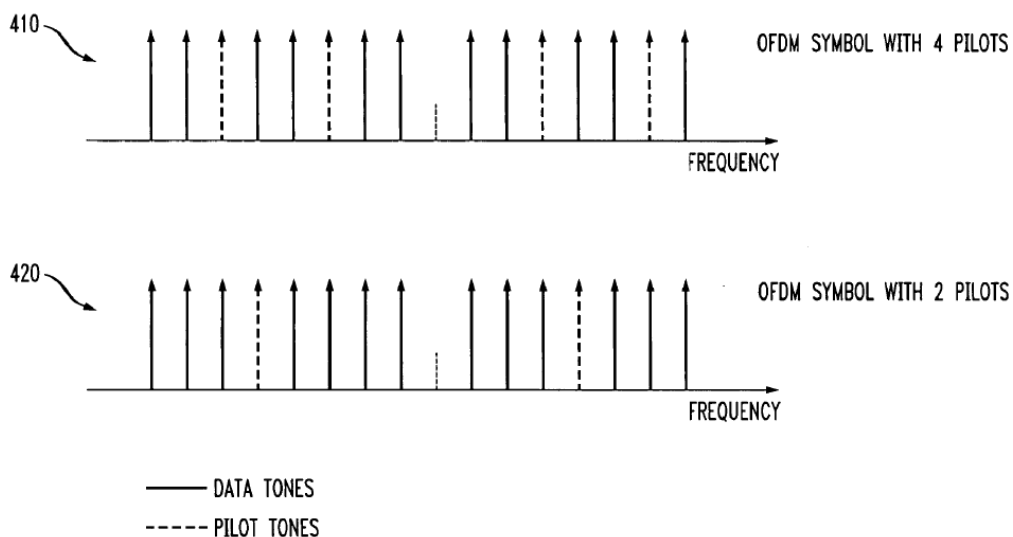
102. The statement “(2) legacy transmission and HT transmission can be carried out with the same or different numbers of pilot, respectively,” is correct on the surface, but it is incorrect if it is meant to imply that legacy transmission and HT transmission can be carried in the same frame structure. A POSITA would not understand that both the legacy data/pilot and HT data/pilot transmissions can occur in a single frame structure, as I already explained above.

103. Further, the purpose of the HT (High Throughput) field is to facilitate high throughput transmissions. But *Mujtaba* teaches throughout that—all other things being equal—increasing the number of pilot symbols decreases the data rate and throughput. *Mujtaba* at [0006], [0021], [0022]. Therefore, *Mujtaba* does not teach

that the number of pilot symbols in the high throughput (HT) section should be increased. Instead, *Mujtaba* teaches that the number of pilot signals in the high throughput section should be less.

104. *Mujtaba* also teaches that the optimal number of pilot symbols depends on the channel characteristics. *Mujtaba* at [0006] (“The number of pilots needed to meet a certain packet error rate (PER) at the receiver is a function of several parameters, such as the delay spread of the channel, the signal to noise ratio (SNR) at the receiver, and the number of antennas at the receiver.”). Therefore, for good channel conditions such as when high throughput can be achieved, *Mujtaba* shows using less pilot symbols to increase the data rate. This is shown in *Mujtaba* Fig. 4.

FIG. 4



Mujtaba Fig. 4 (OFDM symbol with 4 pilots has only 11 data symbols, while OFDM symbol with only 2 pilots has 13 data symbols—and thus higher throughput—all other things being equal).

105. Therefore, Petitioner’s statement “These teachings demonstrate to a POSA that the pilot symbols in the HT transmission are denser than the pilot symbols in the legacy transmission,” is conclusory and based on previous incorrect statements. In my opinion, Petitioner failed to show that *Mujtaba* teaches 8[d].

d) *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*

106. Petitioner makes a conclusory statement about *Mujtaba* teaching 8[e]. As I explained above, *Mujtaba* does not teach transmitting the first and second sections, whereby both sections comprise data.

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

107. Petitioner is making a conclusory statement “A POSA would understand from the teachings of *Mujtaba* that the packet format shown in Figure 3 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). Ex. 1010, [0018], Figure 3 (color-coding

added); Ex. 1002 ¶295.” I disagree because this statement is based on an improper interpretation of *Mujtaba*.

108. As I explained above, *Mujtaba* does not teach transmitting the first and second sections both comprising data, as required by 8. In my opinion Petitioner failed to show that 8[f] is disclosed in *Mujtaba*.

109. For these reasons, in my opinion, the Petitioner has not shown that *Mujtaba* anticipates Claim 8 of the '096 patent.

D. Ground 4: *Mujtaba* and *Trainin* versus Claims 8, 44-47, 49-50

1. Claim 8

A method of constructing a frame structure for data transmission.

110. Petitioner relies primarily on *Mujtaba* for claim 8. Paper 1 at 59-61. I therefore incorporate my discussion of claim 8 in the context of *Mujtaba* above.

111. Petitioner further notes that *Trainin* discloses a mixed mode packet format with a shortened guard interval which “is only available in the HT transmission.” However, as explained regarding the *Joint Proposal*, Petitioner does not identify any support in *Trainin* that the shortened guard interval is not available in the legacy packet format. Further as explained regarding the *Joint Proposal*, the guard interval does not contain pilot symbols and should therefore not be considered in the measurement of pilot density. The '096 patent confirms that the guard bands are typically unusable, and should therefore not be considered. '096 patent, 2:3–6.

112. Moreover, as I explained above, *Mujtaba* does not transmit data and pilots in the guard interval, as the guard interval is simply added to the OFDM symbol. The guard interval is removed before demodulation and decoding of the OFDM symbol. Thus, any discussion of how the length of the guard interval affects the density of pilots is irrelevant and leads to incorrect conclusions.

113. Petitioner further identifies the legacy transmission as the claimed first communication system and the HT transmission as the claimed second communication system. For the reasons stated regarding *Mujtaba* (incorporated here), a POSITA would not consider that the legacy and HT data transmission occur in a single frame structure.

114. Petitioner does not specifically identify where in the combination of *Mujtaba* and *Trainin* the remaining elements of claim 8 are disclosed, such that there is nothing for me to rebut. Petitioner thus fails to present even a *prima facie* case that all elements of claim 8 are present in this combination beyond the argument it raised regarding *Mujtaba* alone, which I address above.

2. Claim 44

A method of constructing a frame structure for data transmission.

115. Regarding Claim 44, Petitioner incorporates its discussion of claim 8. I therefore incorporate my response thereto. Petitioner only separately addresses limitation 44[d] and limitation 44[e], which I address below.

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

116. Petitioner states that a POSITA would understand 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.” Paper 1 at 61. I disagree. While it is true that a higher mobility system may have ‘shorter symbol period’ and ‘denser pilot symbols,’ this is not an absolute requirement. These two concepts only represent two of many possible options to achieve and support higher mobility.

117. Petitioner again argues that the characteristic 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.’ However, neither *Mujtaba* nor *Trainin* directly address “higher mobility.” The references refer only to “high throughput,” and do not support that “high throughput” necessarily equates to “higher mobility.” A POSITA would understand that “higher throughput” can be attained in any number of ways, which would not necessarily support “higher mobility.” Indeed, in many instances, these are competing objectives and increasing throughput would not facilitate higher mobility. For

example, increasing pilot density decreases the data rate and therefore reduces throughput. Since both *Mujtaba* and *Trainin* focus on “higher throughput,” it teaches away from modifications that decrease throughput, such as increasing pilot density for example.

118. In summary, *Mujtaba* and *Trainin* references to “higher throughput” cannot be equated with a disclosure of “higher mobility.”

3. 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.

119. Claim 45 is patentable and not rendered obvious by the combination of *Mujtaba* and *Trainin* because it depends on Claim 44, which is not disclosed by the combination of *Mujtaba* and *Trainin*.

4. 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.

120. Claim 46 is patentable and not rendered obvious by the combination of *Mujtaba* and *Trainin* because it depends on Claim 44, which is not disclosed by the combination of *Mujtaba* and *Trainin*.

5. 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.

121. Claim 47 is patentable and not rendered obvious by the combination of *Mujtaba* and *Trainin* because it depends on Claim 46 which depends on Claim 44, which is not disclosed by the combination of *Mujtaba* and *Trainin*.

6. Claim 49

The method of claim 44, wherein each of the first section and the second section carries at least one of uplink and downlink data.

122. Claim 49 is patentable and not rendered obvious by the combination of *Mujtaba* and *Trainin* because it depends on Claim 44, which is not disclosed by the combination of *Mujtaba* and *Trainin*.

7. Claim 50

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

123. Claim 50 is patentable and not rendered obvious by the combination of *Mujtaba* and *Trainin* because it depends on Claim 44, which is not disclosed by the combination of *Mujtaba* and *Trainin*.

124. Further, since the mixed mode frame structure carries only data in the legacy format or the HT format but not both, when the frame carries only legacy

data but not HT data, the second section does not carry mapping information for data in the second section.

8. Motivation to Combine

125. Petitioner states that “*Mujtaba* explicitly teaches that increasing the number of pilot symbols improves channel estimation.” Paper 1 at 58. But Petitioner does not identify a problem identified by *Mujtaba* or that *Mujtaba* was facing that was solved or even addressed by *Trainin*. Petitioner does not claim or support that *Trainin* provides any benefit to channel estimation, and Petitioner does not identify any other problem in *Mujtaba* that would have motivated a POSITA to incorporate the teachings of *Trainin*.

126. Petitioner further states that “*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.’” Paper 1 at 59. But Petitioner does not identify a problem identified by *Trainin* or that *Trainin* was facing that was solved or even addressed by *Mujtaba*. Petitioner does not claim or support that *Mujtaba* provides any benefit to downlink or uplink transmissions, and Petitioner does not identify any other problem in *Trainin* that would have motivated a POSITA to incorporate the teachings of *Mujtaba*.

127. *Trainin* is focused on wireless transmission with frame alignment by calculating a transmission time that aligns an interframe space start time of the first

and second modulation schemes. *Trainin* at Abstract. The Petitioner did not point to anything in the *Joint Proposal* that would hint at such a problem. Therefore, in my opinion, insufficient evidence supports that a POSITA in possession of both references would have been motivated to combine these references to arrive at the claims of the '096 Patent.

128. *Mujtaba* is focused on varying the number of pilot tones in a multiple antenna communication system. *Mujtaba* at abstract. *Mujtaba* teaches that “data is transmitted in a multiple antenna communication system 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.” *Id.* Further, *Mujtaba* teaches that “the 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* thus seeks to solve the problem of providing an optimal balance between channel estimation and throughput. This is not a problem identified by *Trainin*, which instead focuses on calculating a transmission time that aligns an interframe space start time of the first and second modulation schemes. *Trainin* at Abstract. The Petitioner did not point to anything in *Mujtaba* aimed at that problem. Therefore, in my opinion, insufficient evidence supports that a POSITA in possession of both references would have been motivated to combine these references to arrive at the claims of the '096 Patent.

129. *Mujtaba* further teaches away from increasing the number of pilot symbols in the HT (high throughput) transmission. The purpose of the HT field is to facilitate high throughput. *Mujtaba* teaches throughout that increasing the number of pilot symbols decreases throughput:

[0006] 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).

[0021] The present invention allows the increased accuracy provided by a greater number of pilots to be balanced against the resulting reduction in data rate. As previously indicated, 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. 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).

[0022] From an efficiency perspective, the lowest number of pilots to achieve the desired robustness is desirable. In other words, from an efficiency perspective, data should be transmitted on as many tones as possible.

130. *Mujtaba* at [0006], [0021], and [0022]. A POSITA would understand that more pilot signals would inherently decrease throughput and would therefore not be motivated to combine *Mujtaba*'s teaching of the possibility of more pilot symbols in the HT scenario.

131. But even if *Mujtaba* and *Trainin* are combined, *Trainin* uses substantively the same disclosures as in *Mujtaba* and neither reference would invalidate the

challenged claims as I discussed above. Therefore, a combination of the *Mujtaba* and *Trainin* cannot invalidate the challenged claims.

E. The Asserted Prior Art Is Cumulative Of The Previous Art

1. *Mujtaba* is cumulative of *Nystrom*

132. A prior petitioner asserted *Nystrom* (EX2004 (previously IPR2021-00375, EX1017)) against the '096 patent. *Nystrom* refers to U.S. Patent Application 2007/0104174 A1 entitled “Method And Apparatus For Allocating A Pilot Signal Adapted To The Channel Characteristics.” *Mujtaba* is cumulative of *Nystrom*. Both references disclose use of various pilot structures in various circumstances, but stress that the number of pilot symbols should be as small as possible to avoid unnecessary overhead. Thus, like *Mujtaba*, *Nystrom* also teaches away from increasing the number of pilot symbols, *i.e.*, *Nystrom* also teaches that less pilot symbols are better, *i.e.*, to avoid “pilot pollution.” The below table cross references the relevant disclosures:

<i>Mujtaba</i>	<i>Nystrom</i>
<i>Mujtaba</i> and <i>Nystrom</i> both teach varying pilot structures	
“Data is transmitted in a multiple antenna communication system by <u>selecting a number of pilot tones to be employed to transmit the data</u> ; and transmitting an indication of the selected number of pilot tones in a preamble of a packet containing the data.” <i>Mujtaba</i> at abstract.	<i>Nystrom</i> concerns a “ <u>set of different pilot structures[,] designed for use in different environments</u> and/or different user behaviors that are expected to occur in a cell.” EX2004, <i>Abstract</i> . <i>Nystrom</i> thus attempts to adapt pilot structure to the particular radio

	conditions for a given user. EX2004, <i>Abstract</i> .
<i>Mujtaba and Nystrom address the same problem of pilot overhead</i>	
[0021] 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).	[006] The pilot overhead can indeed be substantial. This reduces data capacity in the own cell and furthermore increases the interference to the neighboring cells (so called 'pilot pollution').
<i>Mujtaba and Nystrom teach different pilot configurations for different channel parameters</i>	
<i>Mujtaba</i> discloses that “the 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.” <i>Mujtaba</i> at abstract. <i>Mujtaba</i> thus seeks to solve the problem of providing an <u>optimal balance between channel estimation and throughput</u> .	<i>Nystrom</i> teaches two embodiments to accomplish this, one in which “the entire resource space is provided with different pilot structures in different parts (110A-D) in advance and allocation of resources to the users are then performed in order to match estimated radio conditions to the provided pilot structure.” <i>Nystrom</i> at abstract and [0011]. In the second, “allocation is performed first, and then the actual pilot structure is adapted within the allocated resource space area <u>to suit the environmental conditions</u> .” <i>Nystrom</i> at abstract.
<i>Mujtaba and Nystrom both teach away from denser pilot symbols</i>	
[0006] <u>A greater number of pilots, however, reduces the effective data rate</u> , since actual data is now replaced by pilots (which are known at both the transmitter and the receiver). [0021] A greater number of pilots, however, reduces the effective data	[006] Such systems must design their pilot structure according to the worst-case scenario so that detection becomes possible even under the worst possible conditions. Such a pilot structure gives rise to a substantial pilot overhead and is indeed necessary in these worst-case scenarios. However, whenever the

rate, since actual data is now replaced by the pilots (which are known at both the transmitter and the receiver). [0022] From an efficiency perspective, the lowest number of pilots to achieve the desired robustness is desirable. In other words, from an efficiency perspective, data should be transmitted on as many tones as possible.	situation is better than the worst case, which typically is the case most of the time, the pilot structure is unnecessarily extensive, giving an unnecessary pilot overhead for most users. <u>The pilot overhead can indeed be substantial. This reduces data capacity in the own cell and furthermore increases the interference to the neighboring cells (so called 'pilot pollution').</u> “[009] The main problems with existing solutions are that pilot structures are either not at all suitable for considerably changing radio conditions or that they are designed for worst cases which in turn results in vast pilot overhead and ‘pilot pollution’.”
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133. Therefore, *Mujtaba* is cumulative of *Nystrom*’s relevant disclosures.

2. *Trainin* is cumulative of *Talukdar*

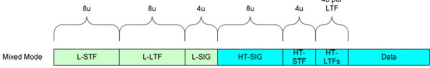
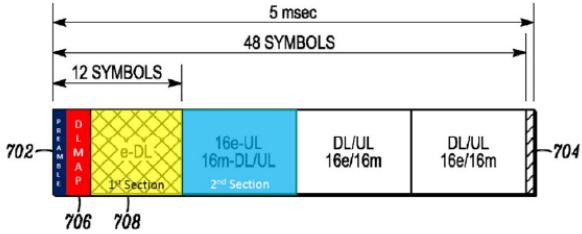
134. A prior petitioner asserted *Talukdar* (EX2002 (previously IPR2021-00375, EX1012)) against the ’096 patent. *Talukdar* refers to U.S. Patent Application 2009/0067377 A1 entitled “Medium Access Control Frame Structure In Wireless Communication System.” *Talukdar* concerns a “wireless communication infrastructure entity configured to allocate radio resources, in a radio frame, to a wireless terminal compliant with a first protocol and to a wireless terminal compliant with a second protocol.” *Trainin* is cumulative of these aspects of *Talukdar*. Both references disclose wireless communications using downlink and uplink structures.

<i>Trainin</i>	<i>Talukdar</i>
<i>Trainin</i> discloses that wireless communication in the mixed mode packet between a transmitter and a receiver can be carried out via wireless links such as a downlink and an uplink. <i>Trainin</i> at [0020], [0034]. The teachings of <i>Trainin</i> 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 <i>Joint Proposal</i>. Petitioner's claim that <i>Trainin</i>'s downlink and uplink constitutes the claimed "first section" carrying the claimed "at least one of uplink and downlink data."	<i>Talukdar</i> disclosed an "16e-UL / 16m-DL/UL" sub-block. <i>Talukdar</i>'s hybrid frame included an "16e-UL / 16m-DL/UL" section containing uplink or downlink traffic that was configured for an 802.16(m) unit. <i>Talukdar</i> disclosed that the sub-blocks following the e-DL section in the hybrid frame could be "a combination of 802.16(e) and 802.16(m) regions (DL or UL)." <i>Talukdar</i>, [0051]. Prior Petitioner claimed that in Figure 7, the sub-block following the e-DL section could be a "16m-DL" block, carrying downlink data for an 802.16(m) remote unit, or a "16m-UL" block, carrying uplink data from an 802.16(m) unit. <i>Talukdar</i>, Fig. 7. <i>Talukdar</i> described the "e-DL" traffic resource region 708 as carrying downlink data and the "16e-UL / 16m-DL/UL" traffic section as carrying either uplink or downlink data.

135. Therefore, the relevant uplink/downlink aspects of *Trainin* are cumulative of *Talukdar*'s relevant uplink / downlink disclosures.

3. The *Joint Proposal* Is Cumulative of *Talukdar*

136. The relevant disclosures in the *Joint Proposal* are further removed from the '096 Patent than the disclosures of *Talukdar*, which the Board already considered. In relevant part, these disclosures are cumulative of *Talukdar*'s disclosures, as detailed below.

<i>The Joint Proposal – current allegations</i>	<i>Talukdar – prior allegations</i>
Both disclose a hybrid frame format	
In Figure 1, the <i>Joint Proposal</i> discloses a Mixed Mode packet format by combining the legacy field consisting of the L-STF, L-LTF and L-SIG fields with the HT field consisting of the HT-SIG, HT-STF and HT-LTFs fields and the Data field that could be used for data transmission.  Ex. 1008, Figure 1 (excerpted) Joint Proposal's Mixed Mode Packet Format <i>Joint Proposal</i> Fig. 1	<i>Talukdar</i> disclosed a hybrid frame (or h-frame) for data transmission that supported both 802.16(e) and 802.16(m) remote units. “FIG. 7 is a hybrid frame 700, also referred to as a HEM-I frame, having equal size sub-blocks designed to serve both 802.16(e) and 802.16(m) data traffic in the same 5 msec interval.” <i>Talukdar</i>, [0051].  FIG. 7 <i>Talukdar</i> Fig. 7.
Both are alleged to have a first communication system	
The <i>Joint Proposal</i> teaches that the Mixed Mode packet format includes a legacy field (the claimed first section) consisting of a legacy short training field (LSTF), a legacy long training field (L-LTF) and a legacy signal field (L-SIG) (the claimed data configured a first format). Paper 1 at 25.	<i>Talukdar</i> disclosed that “the first communication system’s symbols and the second communication system’s symbols co-exist[ed] in one transmission scheme” because symbols for the 802.16(e) and 802.16(m) remote units—contained within the “e-DL” and “16e-UL / 16m-DL/UL” sections, respectively—co-existed in hybrid frame 700. IPR2021-00375, Paper 1 at 39.
Both are alleged to have a second communication system	
The <i>Joint Proposal</i> teaches that the packet format further includes an	<i>Talukdar</i> disclosed a “second communication system configured to

HT field (the claimed second section), which follows the legacy field (the claimed first section) and consists of a signal field (HT-SIG), an HT short training field (HTSTF), an HT long training field (HT-LTFs) and a data field (data) (the claimed data configured in a second format). Paper 1 at 26.	support higher mobility than the first communication system” because wireless system 100 included an 802.16(m) mobile remote unit. IPR2021-00375, Paper 1 at 40.
Both disclose two sections in a packet	
Figure 1 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. Paper 1 at 28.	<i>Talukdar</i> disclosed symbols for the 802.16(e) and 802.16(m) remote units—contained within the “e-DL” and “16e-UL / 16m-DL/UL” sections, respectively—co-existed in hybrid frame 700. IPR2021-00375, Paper 1 at 61.

137. Therefore, the arguments made by Panasonic regarding the *Joint Proposal* are cumulative of the arguments considered by the Board in the prior IPR regarding *Talukdar*.

VII. CONCLUSION

138. My opinions are subject to change or revision. I may acquire additional opinions regarding arguments Petitioner, or its expert, may present, information I may receive in the future, or additional work I may perform. Based on the analysis I have conducted and for the reasons set forth herein, I have preliminarily reached the conclusions and opinions in this declaration.

139. In the event of a hearing or trial in this matter, I may create and/or use various exhibits for the purposes of demonstrating my testimony as discussed in this declaration. I have not yet created, directed the creation of, or selected any demonstrative exhibits for this purpose.

140. For at least the reasons stated herein, it is my expert opinion that Petitioner's references do not disclose or suggest all elements of any claim of the '096 patent. Thus, I understand that Defendant's expert witness fails to establish a *prima facie* case of obviousness. My review of the references, the combinations of references, and the materials I have considered leave me with the opinion that the patent claims are valid over the prior art. In reaching my opinions, and in stating the basis of my opinions, I have provided representative reasons why the asserted claims are not disclosed by the cited references. I may not have provided every reason why the asserted claims are not invalid over the references (including combinations) as many are self-evidently trivial and make-weight. I therefore reserve the right to supplement my opinion and provide additional bases for my opinions, as necessary, particularly if Petitioner raises new arguments or interpretations, or if any other new information becomes available to me during this proceeding.