

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

RESMED CORP.,
Petitioner,

v.

FRACTUS, S.A.,
Patent Owner.

Case No. IPR2026-00341
Patent No. 8,362,960

EXPERT DECLARATION OF HOSSEIN HASHEMI, Ph.D.

I, Hossein Hashemi, Ph.D., do hereby declare as follows:

I. Introduction

1. I am a Professor of Electrical Engineering at the University of Southern California (“USC”).

2. I have been retained by Edell, Shapiro and Finnan, LLC (hereinafter “the Edell Firm”), to provide various opinions regarding U.S. Patent No. 8,362,960 (“the ‘960 Patent”). I understand that my declaration is being submitted in connection with a Patent Owner Preliminary Response in an inter partes review of the ‘960 Patent. Unless otherwise noted, the statements made herein are based on my personal knowledge and, if called to testify with regards to this declaration, I could and would do so competently and truthfully.

3. I have been retained in this matter by the Edell Firm as a technical expert in the field of electrical engineering, particularly within the context of antenna design and operation in multifunction wireless devices. I am being compensated for my work in this matter at my usual and customary rate of \$760.00 per hour. I have no personal or financial stake or interest in the outcome of the inter partes review or any related action. My compensation in no way depends upon my testimony or the outcome of the inter partes review.

4. I have been advised that the Edell Firm represents Fractus, S.A. (hereinafter “Patent Owner”) in this matter and that Resmed Corp. (hereinafter

“Petitioner”) has petitioned for inter partes review of the ‘960 Patent. I have no personal or financial stake or interest in Patent Owner, Petitioner, or the ‘960 Patent.

5. I reserve the right to supplement and/or amend my opinions in this declaration based on future positions taken by Petitioner or its expert, additional documents, testimony or other information provided by Petitioner or its witnesses, any actions from the Patent Trial and Appeal Board (“Board”), or as otherwise necessary.

II. Qualifications

6. My qualifications for forming the opinions set forth in this expert report are summarized here and explained in more detail in my *curriculum vitae* which is attached as Exhibit A to this Declaration. Exhibit A includes a full list of my publications and other professional contributions and achievements, and a list of the cases in which I have testified at deposition, hearing, or trial.

7. I am currently the Ming Hsieh Electro-Physics Professor of Electrical and Computer Engineering, and a Co-Director of the Ming Hsieh Institute at USC. I received my Bachelor of Science degree in Electronics Engineering from Sharif University of Technology in 1997. I received my Master’s degree in Electronics Engineering from Sharif University of Technology in 1999. I received my Master’s degree and Ph.D. in Electrical Engineering from the California Institute of Technology in 2001 and 2003, respectively.

8. From 1997 to 1999 I was a radiofrequency integrated circuit design engineer at Keresem Communications Research. I became an Assistant Professor of Electrical Engineering at USC in October 2003 and remained in that position until May 2009. From November 2007 to May 2009, I also occupied the Gordon S. Marshall Early Career Chair at USC. In May 2009 I became a tenured Associate Professor of Electrical Engineering at USC and remained in that position until my promotion to Professor in December 2014, a title I have held since then.

9. I have over 25 years of industry and academic experience. In particular, I have experience with antennas and electromagnetic technologies including designing, simulating, taping out, and measuring complex electromagnetic structures spanning frequency ranges of 100 MHz – 170 GHz, as well as infrared frequencies (1550nm wavelength), and demonstrating numerous phased arrays (multi-antenna systems) spanning radiofrequency to infrared frequencies.

10. I have been privileged to receive a number of awards and honors throughout my career. These include:

- Fellow, Optica 2023
- Fellow, Institute of Electrical and Electronics Engineers (IEEE) - 2019
- Winner, Nokia Bell Labs Prize - 2016
- Outstanding Young Engineer Award of the IEEE Microwave Theory and Techniques Society (MTT-S) - 2015
- Distinguished Lecturer, IEEE Solid State Circuits Society 2013 – 2014

- Distinguished Scholar for “Outstanding Achievement in Advancement of Engineering,” Association of Professors and Scholars of Iranian Heritage -2011
- Inaugural Winner, Maseeh Entrepreneurship Prize Competition, USC - 2011
- NSF CAREER Award - 2009
- USC Viterbi School of Engineering Junior Faculty Research Award - 2008
- DARPA Young Faculty Award - 2008
- Lewis Winner Award for Outstanding Paper, IEEE International Solid-State Circuits Symposium (ISSCC) - 2007
- Best Paper Award, IEEE Journal of Solid-State Circuits - 2004
- Charles Lee Powell Foundation Research Award - 2004
- Young Scholar Award, Association of Professors and Scholars of Iranian Heritage - 2003
- Graduate Fellowship Award, Intel Foundation - 2002
- Outstanding Student Designer Award, Analog Devices - 2001
- Outstanding Accomplishment Award, von Brimmer foundation - 2000
- Engineering and Applied Science Division Fellowship, California Institute of Technology - 1999
- Ranked first in Ph.D. EE qualifying exam, California Institute of Technology - 2000
- Ninth place out of 300,000 in national qualifying exam for undergraduate studies – 1993

11. I have co-authored two books and over 125 peer-reviewed journal and conference papers. I have also spoken at numerous invited workshops, talks and short courses. Many of these relate directly or indirectly to antennas, antenna arrays and various modes of wireless communication and electronics design.

12. I am the named inventor on 15 United States Patents, including patents related to antenna technology, including U.S. Patent Nos. 10,615,949 (Hybrid-based cancellation in presence of antenna mismatch) and 8,203,484 (Path-sharing transceiver architecture for antenna arrays).

III. Legal Standards

13. While I am not an attorney, I have been informed by counsel of certain legal principles I should apply in reaching my opinions in this matter. Also, as an inventor, expert witness and otherwise in the course of my work, I have experience studying and analyzing patents and patent claims from the perspective of a person of ordinary skill in the art (POSITA or “skilled artisan”).

A. Claim Construction

14. I understand that claim terms are to be interpreted from the point of view of a POSITA at the time of the invention. I further understand that claim terms are generally to be given their ordinary meaning, considered in light of the claim

language, patent specification, and prosecution history. I further understand that a patentee may act as its own lexicographer and depart from the ordinary and customary meaning by defining a term with reasonable clarity, deliberateness, and precision, but that there is a presumption that a claim term carries its ordinary and customary meaning.

B. Person of Ordinary Skill in the Art

15. I understand that a person of ordinary skill in the art is a hypothetical person who is presumed to have known the relevant art at the time of the invention. He or she is a person of ordinary creativity who understands the scientific and engineering principles applicable to the pertinent art. I am familiar with the knowledge and capabilities of one of ordinary skill in the art in the field of the '960 Patent at the time of invention.

16. I understand that whether a patent claim would have been obvious is determined from the point of view of a person of ordinary skill in the art at the time of the invention. I have applied this standard in my analysis.

C. Validity

17. I understand that for an *inter partes* review to be instituted, Petitioner must show that there is a reasonable likelihood that they will prevail with respect to

at least one of the claimed challenged in the petition. I understand that Petitioner bears the burden of proving any instituted grounds of invalidity by a preponderance of the evidence. I understand that a “preponderance” means “more likely than not.” I understand that general and conclusory assertions, without underlying factual evidence, may not support a conclusion that something is “more likely than not.” Rather, the preponderance of the evidence standard requires that a reasonable finder of fact be convinced that the existence of a specific material fact is more probable than the non-existence of that fact. The preponderance of the evidence standard does not support speculation regarding specific facts and is instead focused on whether the evidence more likely than not demonstrates the existence or non-existence of specific material facts. Here, I understand that Petitioner has argued that the claims at issue are obvious over different grounds, two grounds applying a combination of two or more references, and third ground based on a parent application to the ‘960 Patent.

18. I also understand that, in performing a proper invalidity analysis, an expert must do more than simply provide quotes from the evidentiary record along with conclusory allegations of unpatentability. To the contrary, an expert’s conclusions regarding unpatentability must be supported by actual analysis and

reasoning set forth in the expert declaration, such that the theoretical and factual foundation for the expert's conclusions can be properly evaluated.

19. I understand that a patent claim may be found unpatentable as obvious under 35 U.S.C. § 103 only if the Board establishes by a preponderance of the evidence that, as of the priority date, the subject matter of the claim, considered as a whole, would have been obvious to a person having ordinary skill in the field of the technology (the "art") to which the claimed subject matter belongs.

20. I understand that the analysis of whether a claim is obvious depends on a number of necessary factual inquiries, for example, (1) the scope and content of the prior art; (2) the differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) objective evidence of non-obviousness.

21. I understand that the claimed invention must be considered as a whole in analyzing obviousness or non-obviousness. In determining the differences between the prior art and the claimed invention, the question under the obviousness inquiry is not whether the differences themselves would have been obvious, but whether the claimed invention as a whole would have been obvious. Relatedly, I understand that it may be appropriate to consider whether there is evidence of a

“teaching, suggestion, or motivation” to combine the prior art teachings in the prior art, the nature of the problem to be solved, or the knowledge of a person having ordinary skill in the art. I further understand arguments in support of obviousness cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.

22. I understand that one indicator of non-obviousness is when prior art “teaches away” from combining certain known elements. For example, a prior art reference teaches away from the patent’s particular invention if it leads in a different direction or discourages a combination with another reference, recommends steps that would not likely lead to the patent’s result, or otherwise indicates that a seemingly inoperative device would be produced.

23. I understand that an obviousness determination also requires that a person of ordinary skill in the art would have had a reasonable expectation of success in making any modifications to the cited references.

24. I further understand that certain objective indicia (sometimes called “secondary considerations”) can be important evidence regarding whether a patent is nonobvious, including the existence of a long-felt but unsolved need, unexpected

results, commercial success, copying, and industry acceptance or praise. Evidence of such objective indicia must be considered when present. It is generally an error to reach a conclusion on obviousness before considering the evidence of such secondary considerations, and then evaluating the latter solely in terms of whether it may fill any gaps in the initial conclusion on obviousness. On the other hand, such evidence is not a requirement for patentability, and the absence of such evidence is a neutral factor in the obviousness analysis.

25. I understand that the obviousness analysis cannot be based on “hindsight.” The skilled artisan must view prior art at the time of the invention and without using the disclosure of the subject patent as a guide.

26. To the extent Petitioner argues a prior art reference anticipates the claimed invention of the ‘960 Patent, a prior art reference must be enabled to anticipate a patent. That is, I understand that the prior art reference’s description must be such that a person of ordinary skill in the field of the invention can practice the subject matter based on the reference without undue experimentation.

IV. Materials Reviewed

27. In forming the opinions offered in this Declaration I reviewed and considered as appropriate the following materials: the ‘960 Patent and its

prosecution history, the Petition, the Expert Declaration of Manos M. Tentzeris, Ph.D. (Ex. 1003), and the remaining exhibits to the Petition and any additional materials cited herein.

V. Background

A. Person of Ordinary Skill in the Art

28. I understand that Petitioner has relied upon the following definition of a POSITA utilized by Fractus in prior litigation involving the ‘960 Patent:

[A] an undergraduate degree in electrical engineering or a related field, and at least two years of experience in antenna design or related technologies. Ex. 1003 ¶¶ 21-23.3 Additional education could substitute for practical experience, and vice versa. Id.

Petition at 15.

29. For the purpose of forming my opinions as set forth in this Declaration, I have applied this definition of a POSITA.

B. Overview of the ‘960 Patent

30. U.S. Patent No. 8,362,960 (the “‘960 Patent”) addresses the difficulty of integrating multiple antennas into compact handheld devices while maintaining adequate isolation between them. The patent explains that handheld devices increasingly required separate antennas for cellular and other wireless services, but

that simply separating the antennas was often impractical because of the limited PCB area available. The '960 Patent identifies antenna placement and orientation relative to the PCB ground plane as techniques for reducing electromagnetic coupling between the antennas. '960 Patent at 1:39-50; 2:54-65. In particular, the patent teaches that good isolation can be achieved by deliberately selecting the antennas' orientations and antenna types based on the currents they excite in the common ground plane, rather than relying principally on physical separation. '960 Patent at 1:39-50;9:54-10:30.

31. Claim 1 captures this concept through a handheld device that includes a particular geometric arrangement of two antennas relative to a substantially rectangular ground plane. The first antenna is configured to transmit and receive in at least three mobile-communication frequency bands and extends substantially parallel to a first side of the ground plane, while the second antenna operates in at least one frequency band and extends substantially parallel to a second side. Critically, the first antenna is positioned near a short side of the ground plane, and the first and second sides of the ground plane are substantially orthogonal. '960 Patent at 24:19-37 (claim 1). Thus, claim 1 does not merely recite two antennas incorporated into the same handheld device; it specifies their respective orientations

with reference to the geometry of the common ground plane, producing an orthogonal antenna arrangement tied to the physical structure of the device.

32. The specification of the '960 Patent explains the technical significance of this arrangement in terms of antenna isolation. The patent teaches selecting antenna orientation relative to the PCB so as to minimize coupling, including orienting antennas according to the directions of currents induced in the ground plane. '960 Patent at 9:37-10:30. The inventive focus of claim 1 can therefore be understood as the deliberate spatial and directional coordination of the two antennas with the rectangular ground plane – one antenna near a short side, with the antennas extending parallel to substantially orthogonal sides – rather than merely trying to physically separate as much as possible multiple antennas in the same handheld device.

C. Claim Construction

33. For purposes of this declaration, I give all claim terms their ordinary and customary meaning of the terms and I believe that no express construction of any claim terms is necessary to assess the validity of the challenged claims.. I reserve, however, the right to provide different and additional opinions on claim construction if an IPR is instituted.

D. Overview of the Cited Art

1. Chiba

34. U.S. Patent No. 6,195,048 (“Chiba,” EX1006), entitled “Multifrequency Inverted F-Type antenna,” is directed to a multifrequency inverted F-type antenna intended principally for use as an internal antenna in small, thin radio communication terminals, particularly portable telephones. The patent expressly identifies its objective as providing an antenna capable of sending and receiving radio waves in multiple frequency bands without increasing the antenna’s size by incorporating all antenna functionality into in a single, compact antenna structure. Chiba at 1:1-5, 30-35, 45-52, 2:34-36.

35. Chiba identifies a problem with prior approaches for achieving this multiband operation. To accommodate two different frequency bands, one prior arrangement placed two single-frequency inverted F-type antennas adjacent to one another, with each antenna having its own ground connection, feeding point, and coaxial feed. Chiba explains that this arrangement increases the required installation area because two separate antennas must be accommodated, and therefore, is a “problem.” Chiba at 1:45-65; 2:1-25. An example of such a “problem” arrangement is illustrated in FIG. 2 of Chiba, reproduced below.

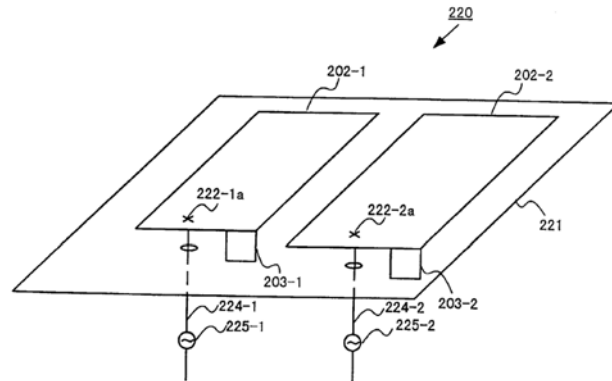


FIG. 22

36. Chiba addresses this problem by incorporating multiple resonant antenna structures into a single emission-conductor arrangement. In the principal embodiment, a cut-out is formed in an emission conductor that has one end connected to a ground conductor through a short-circuit plate. The cut-out creates a first emission conductor 12-1 and a second emission conductor 12-2, each having a different resonant length, and therefore, resonating at a different frequency band, as illustrated in FIG. 1, reproduced below.

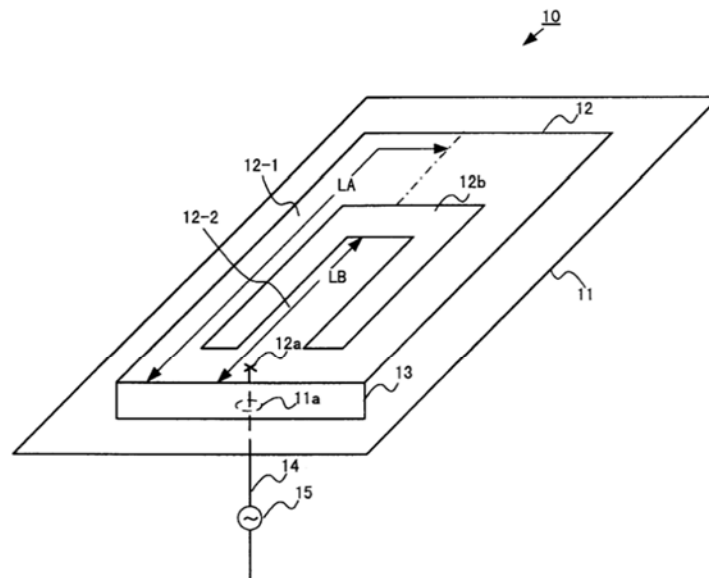


FIG. 1

37. Chiba explains that the first frequency band is determined by the shape and resonance length of the first emission conductor, while the second frequency band is determined by the shape and resonance length of the second emission conductor. The two resonances therefore permit the single antenna structure to receive and transmit radio waves in two different frequency bands. Chiba at 5:1-25; 6:1-20.

38. Chiba specifically identifies a portable telephone antenna implementing two systems – GSM and PHS – as an example, with the antenna configured to operate in the 800 MHz GSM band and the 1.9 GHz PHS band, as

illustrated in FIG. 3. Thus, the disclosure demonstrates that the invention is intended to allow one physical antenna structure to perform the function that otherwise might require two separate single-frequency antennas. Chiba at 6:20-55.

39. Chiba further emphasizes that the multiband capability is achieved without the increase in installation area or installation volume that the prior art solution of using a second antenna would require. The patent reports that its first embodiment can have substantially the same installation area and height as a conventional single-frequency inverted F-type antenna, while providing the additional resonance needed for the second frequency band.

40. The disclosed embodiments extend this concept beyond two bands: Chiba describes configurations having three resonant conductors for three frequency bands and expressly states that four or more frequency bands can be accommodated by forming additional emission conductors. The central purpose and design principle of Chiba is providing operation in multiple frequency-bands by using a single compact antenna structure, rather than the use of multiple physically separate antennas. Chiba at 6:20-40; 10:1-35; 14:35-55.

2. Kangasvieri

41. U.S. Patent Publication No. 2003/0193437 (“Kangasvieri,” EX1005), entitled “Method and System for Improving Isolation in Radio-Frequency Antennas,” is directed to improving isolation between separate transmit and receive antennas that operate in the same frequency band. For example, as illustrated in FIG. 2 from the reference, reproduced below, antenna 22 (annotated in green) is a receive antenna in a particular frequency band and antenna 24 (annotated in yellow) is the corresponding transmit antenna in that same frequency band.

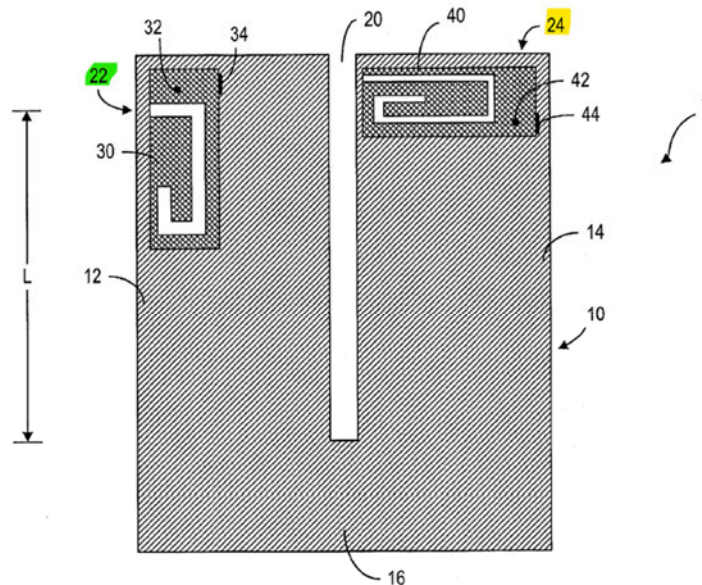


FIG. 2

42. Kangasvieri is particularly concerned with mobile terminals in which separate antennas are used for transmission and reception, including in PCS-band

systems. It explains that, in a full-duplex system, the transmit and receive frequency bands can be sufficiently close that conventional duplex filters must be relatively large, which increases signal-path losses and makes it difficult to reduce the thickness of a mobile phone. The stated objective is, therefore, to provide an antenna structure that does not require a large volume while improving isolation between the transmit and receive antennas. Kangasvieri at ¶¶ [0001]-[0004].

43. Kangasvieri identifies the common ground plane used by the separate transmit and receive antennas as the principal source of the isolation problem. Specifically, Kangasvieri explains that, for a PIFA, signal power supplied to a radiating element also produces current in the ground plane through the grounding structure. When the transmit and receive antennas share that ground plane, power supplied to the transmit antenna can consequently appear at the receive antenna through the ground plane, thereby reducing isolation between the two antennas. This problem is particularly relevant to systems such as CDMA IS-95, GSM-1900, and WCDMA-1900, where the transmit and receive operating ranges are relatively close within the overall PCS frequency band. Kangasvieri at ¶¶ [0063]-[0065].

44. The principal solution proposed by Kangasvieri is to place a slot or cut in the common ground plane between the transmit and receive antennas. The two

antennas are positioned over respective sections of the ground plane, with the slot separating those sections while a connecting portion can maintain their physical connection. The effective length of the slot is selected to be approximately one-quarter wavelength of the operating frequency band. An example of such an arrangement is illustrated in FIG. 2 from the publication, reproduced above.

45. According to Kangasvieri, this configuration causes the conducted power traveling through the ground plane to undergo approximately a 180-degree phase shift relative to the power radiated through the air from the transmit antenna. The radiated and conducted signals, therefore, tend to compensate for one another at the receive antenna, reducing the coupled signal and thereby improving isolation between the separate transmit and receive antennas. Kangasvieri at ¶¶ [0004], [0010]-[0011], [0064]-[0065].

46. Kangasvieri also addresses mobile terminals operating in multiple frequency bands, while preserving the fundamental transmit/receive isolation technique. For example, a third antenna 26 may operate in a lower frequency band while the first and second antennas form the transmit/receive pair in a higher band, as illustrated in FIG. 3a.

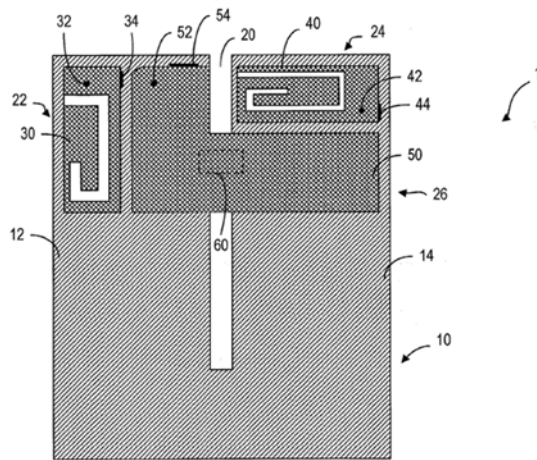
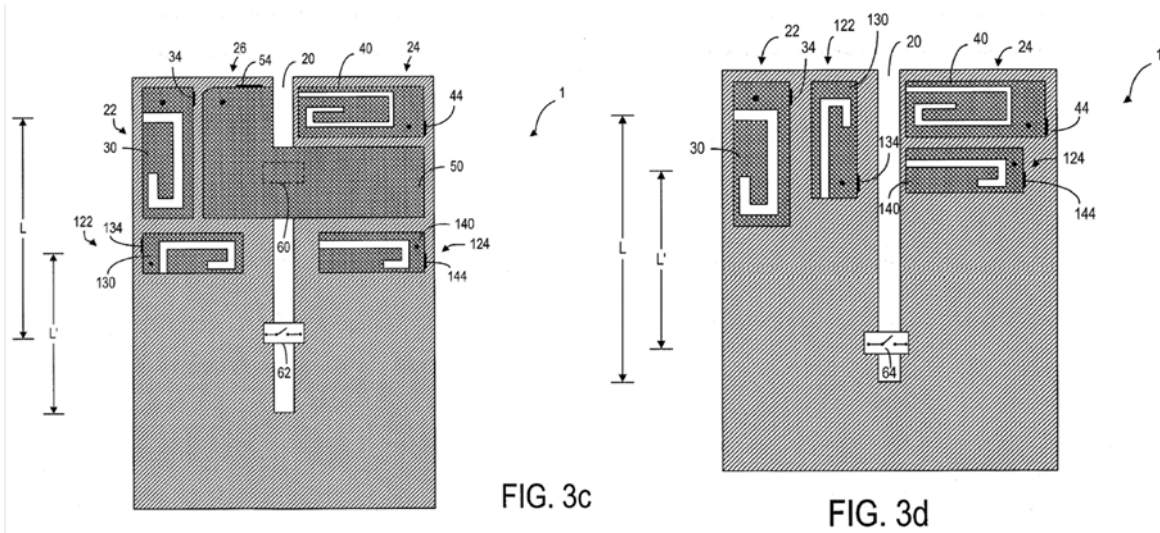


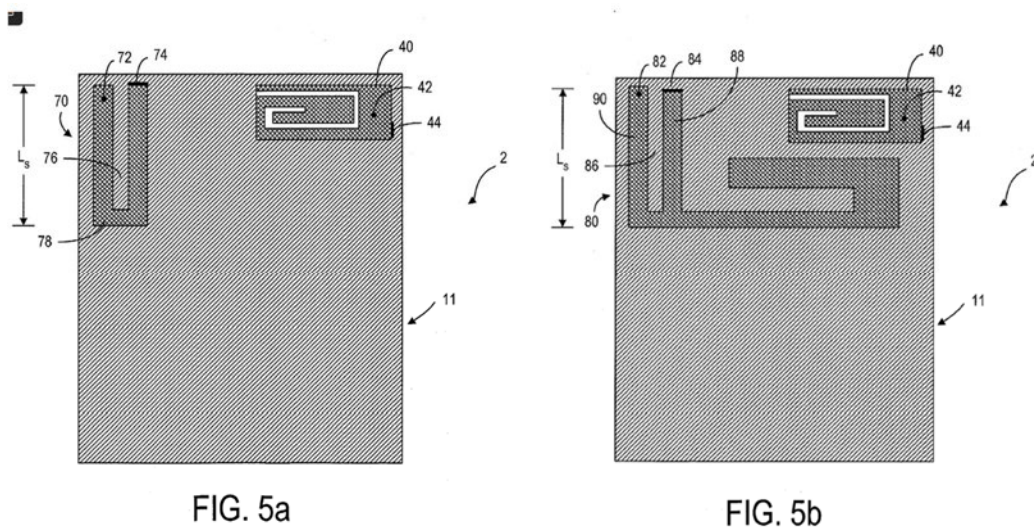
FIG. 3a

47. In this embodiment, a switch 60 positioned across the ground-plane slot can electrically connect or separate the two ground-plane sections depending on the operating band: the switch is closed for the lower-frequency transceiver antenna and opened when the higher-frequency transmit/receive pair is being used.

48. Kangasvieri further discloses multiple transmit/receive antenna pairs sharing the same ground plane. In these arrangements, the effective length of the slot can be changed with switches 62/64 so that the slot can present a length of approximately one-quarter wavelength at the operating frequency for all of the transmit/receive pairs, as illustrated in FIGs. 3c and 3d. Kangasvieri at ¶¶ [0066]-[0069].



49. Finally, Kangasvieri discloses an alternative way of achieving the same basic isolation objective without relying on a slot in the common ground plane. In this embodiment, illustrated in FIGs. 5a and 5b, one antenna is a slot antenna 70/80 and the other is a PIFA 40.



50. A slot is formed in the radiating element of the slot antenna so that the feed line and grounding strip are effectively separated by approximately one-half wavelength. This configuration causes the signal supplied to the slot antenna to experience approximately a 180-degree phase shift before being coupled to the ground plane, thereby producing the phase relationship used to improve isolation. Kangasvieri expressly contemplates that either antenna can serve as the transmitter while the other serves as the receiver in the example of FIG. 5a and further describes a dual-band slot antenna that can cover the PCS transmit band while also covering transmission and reception in another band such as GSM 850, as illustrated in FIG. 5b.

51. As the discussion above illustrates, it is my opinion that the POSITA would understand that Kangasvieri's central purpose is to permit separate transmit and receive antennas operating in the same frequency band to coexist while achieving improved isolation in a compact antenna structure. Kangasvieri at ¶¶ [0071]-[0073]; claims 13-21.

3. Inoue and Vance

52. The preliminary response accompanying this declaration is focused on the validity of independent claim 1 of the '960 Patent under Ground 1. Therefore, I

do not characterize Inoue (EX1009) and Vance (EX1007), which are relied upon only in Grounds 2 and 3.

VI. Ground 1 – The Proposed Combination Is Contrary to the Teachings of Kangasvieri and Chiba

A. The Proposed Combination is Contrary to the Teachings of Kangasvieri

53. The “primary object” of Kangasvieri is “to provide an antenna structure having a transmit antenna and a receive antenna, wherein the isolation between the transmit and receive antennas is improved.” Kangasvieri at ¶ [0004]. It is my opinion that the proposed combination of Ground 1 destroys this “primary object” by eliminating the separation transmit and receive antennas, and replacing them with a single copy of Chiba’s multiband antenna which sends and receives at all its operating frequencies. Petition at 24-26. It is further my opinion that the proposed combination would not have been obvious to the POSITA at the time of invention.

54. Kangasvieri’s “primary object” of “provid[ing] an antenna structure having a transmit antenna and a receive antenna, wherein the isolation between the transmit and receive antennas is improved” is reflected throughout the embodiments relevant to the Petition. In the FIG. 2 embodiment, antenna 24 (annotated in yellow below) is used for reception or transmission and antenna 22 (annotated in green) is

used for the other of transmission or reception in the PCS band. Kangasvieri at ¶ [0065]. In the FIG. 5b embodiment, dual-band slot antenna 80 (annotated in green) covers PCS transmission and another lower band, such as GSM 850, while PIFA 40 (annotated in yellow) covers PCS reception. Kangasvieri at ¶ [0072]. In each instance, the second antenna has a defined role in a transmit-and-receive pair for the same general operating band.

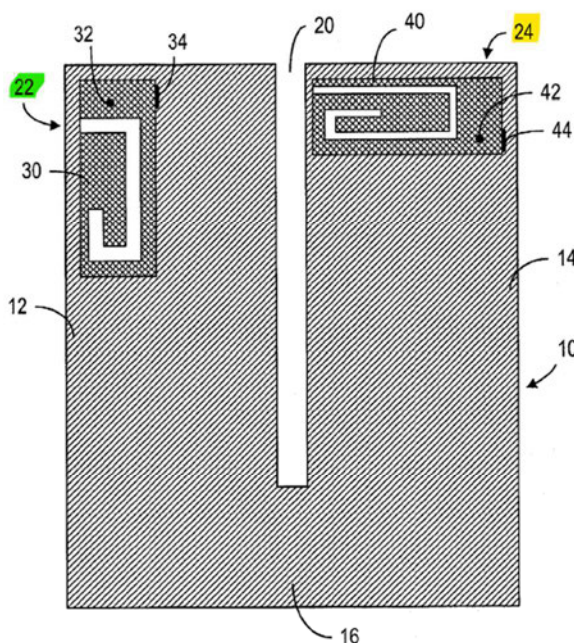


FIG. 2

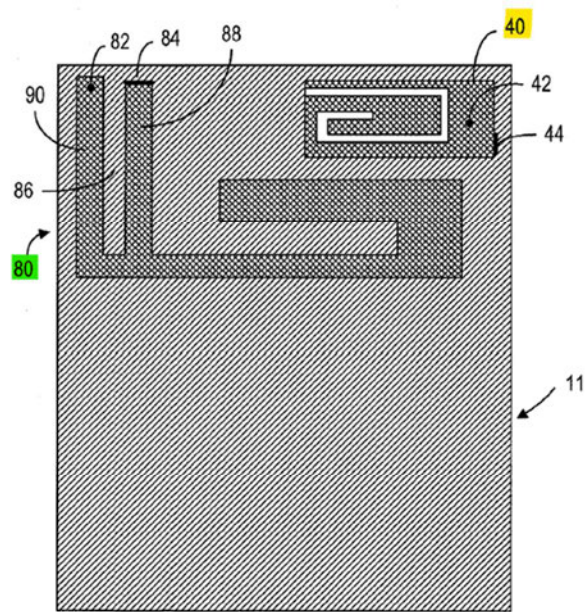


FIG. 5b

55. Kangasvieri's isolation solution follows from that division of transmit and receive functions onto two separate antennas. Kangasvieri explains that power supplied to a PIFA produces current not only in the radiating element but also in the

shared ground plane. Kangasvieri at ¶ [0063]. When separate transmit and receive antennas share that ground plane, conducted power from the transmit antenna can appear at the receive antenna and reduce isolation. Kangasvieri at ¶¶ [0063]-[0065]. Kangasvieri therefore introduces a slot or a corresponding phase-shifting arrangement to reduce coupling between the separate antennas. Kangasvieri at ¶¶ [0010]-[0011], [0064]-[0065]. The second antenna exists only because the disclosed terminal assigns transmission and reception in the relevant band to different antennas and then addresses the isolation problem that arrangement creates.

56. Therefore, it is my opinion that the Petition's proposed substitution improperly ignores the "primary object" of Kangasvieri. Specifically, the Petition replaces Kangasvieri's first antenna, which only transmits or receives at its intended frequency band, with a multiband Chiba antenna. Petition at 26 ("Thus, as discussed below, A POSITA would have been motivated to replace the first antenna with Chiba's antenna in Kangasvieri's mobile terminal."). The Petition itself repeatedly asserts that Chiba's multifrequency antenna transmits and receives in each of the three frequency bands at which it operates. Petition at 24-26. Accordingly, the Petition specifically relies on Chiba's antenna's capability of "sending and receiving" in the frequency bands in which it operates. Petition at 26; Chiba at 6:51-

62, 9:41-58. It is my opinion that once the replacement is made, however, the resulting device no longer addresses Kangasvieri's "primary object" of "provid[ing] an antenna structure having a transmit antenna and a receive antenna, wherein the isolation between the transmit and receive antennas is improved."

57. It is my opinion that Kangasvieri's treatment of the GSM 850 band in its FIG. 5b embodiment would have reinforced this point to the POSITA. In FIG. 5b, antenna 80 can operate in the PCS transmit band and transmit and receive in a lower band such as GSM 850. Antenna 40 covers PCS reception. Kangasvieri at ¶ [0072]. Kangasvieri does not add another GSM 850 antenna where the multiband antenna already supplies send and receive operation in that lower band. Rather, Kangasvieri adds a separate antenna only where a separate PCS receive path is needed. Thus, when one antenna already supplies the relevant transmit and receive operation in a band, Kangasvieri does not teach retaining an additional antenna for that same operation. Applied to the Petition's premise that Chiba transmits and receives in all its operating bands, it is my opinion that the POSITA would apply Kangasvieri's own design approach and eliminate the separate second receive antenna.

58. Further, it is my opinion that the Petition's assertion that the second antenna remains "consistent with Kangasvieri's disclosure" (Petition at 30) is contrary to the understanding of the POSITA. Mere physical retention does not make the proposed configuration consistent with Kangasvieri's primary object, which is to separate transmit and receive functions and improve isolation between them. The Petition instead proposes eliminating this separation. Once the separation is eliminated, it is my opinion that retaining the second antenna is no longer consistent with the Kangasvieri disclosure. Further, as illustrated in the embodiments of FIGs. 3a and 5b of Kangasvieri, when an antenna is included that provides both transmission and reception functionality, a separate transmit-only or receive-only antenna is not provided in the arrangement. Accordingly, it is my opinion that the POSITA would actually consider the inclusion of the second Kangasvieri antenna in the combination as inconsistent with the Kangasvieri disclosure.

B. The Proposed Combination is Contrary to the Teachings of Chiba

59. The POSITA would understand that the primary object of Chiba is to address the space and volume required by multiple single-frequency antennas by utilizing a single multiband antenna that provides transmission and reception at all its operating frequencies. Chiba at 2:33-45. For example, Chiba describes a prior art

arrangement in which two inverted-F antennas are placed next to one another on a common ground conductor. Each antenna has its own radiating conductor, ground connection, feeding point, and coaxial feeding line. Chiba at 1:45-2:25, Fig. 22 (reproduced below). Chiba identifies the resulting installation area as a “problem” because the device must accommodate two physically separate antenna structures, which increases size of the antenna structure. Chiba at 1:59-2:25.

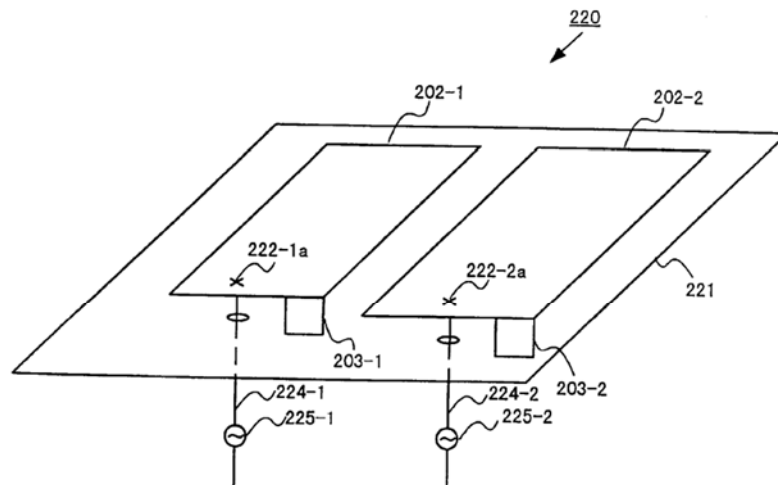


FIG. 22

60. Chiba solves this problem by integrating multiple resonant paths operating over different frequency bands into a single antenna structure. In its principal dual-band embodiment, a cut-out forms first and second emission conductors with different resonant lengths, both associated with the same antenna

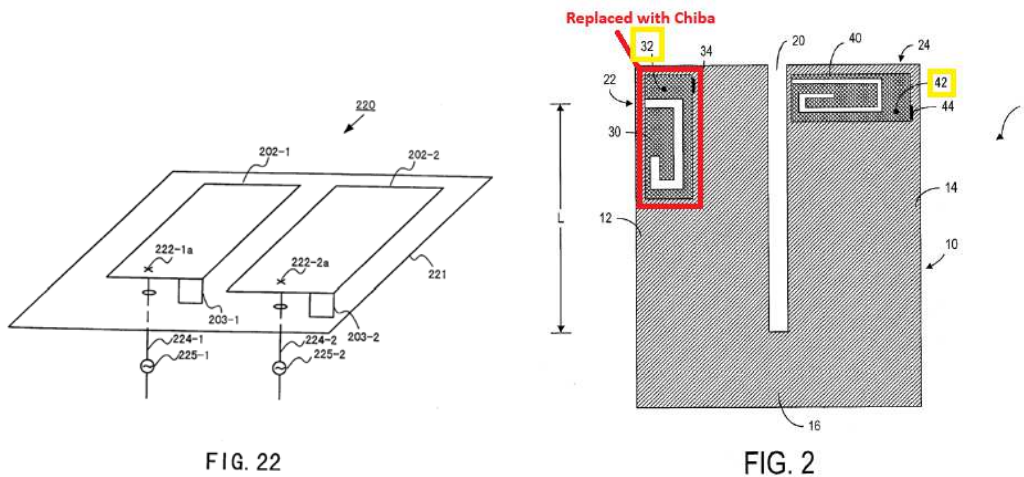
and supplied through a single feeding point. Chiba at 5:1-6:20. Chiba explains that this structure can provide the two resonances without materially increasing the installation area or height relative to a conventional single-frequency inverted-F antenna. Chiba at 6:20-40. Its specific example applies that integrated antenna to GSM and PHS operation in a portable telephone. Chiba at 6:40-62.

61. Chiba extends the same design principle to three or more bands. FIG. 14 includes first, second, and third emission conductors that resonate in respective frequency bands, with power supplied through a single feeding point. Chiba at 9:41-58. Chiba states that this arrangement provides three frequency bands “without increasing either the installation area or installation volume.” Chiba at 10:1-6. The reference further contemplates additional conductors for four or more bands. Chiba at 10:7-35. Accordingly, it is my opinion that the POSITA would understand that Chiba’s central teaching is to consolidate multiple frequency capabilities into a single compact, commonly fed antenna rather than using separate antennas for functions that the integrated antenna can perform.

62. The Petition relies on Chiba’s goal of providing multiband operation as a purported motivation to modify Kangasvieri. It is my opinion, however, that in so doing it creates a combination that runs contrary to Chiba’s primary object.

Specifically, the proposed combination replaces Kangasvieri's first antenna with Chiba's three-band antenna and retains Kangasvieri's separately fed second antenna. Petition at 26-30. The resulting arrangement places multiple antennas with separate feed points on a common ground plane. That is precisely the type of arrangement Chiba identifies as a "problem" to be addressed by its multiband antenna. Chiba at 1:45-2:25, Fig. 22. In essence, the Petition creates the very problem Chiba sought to solve, recreating the "problem" of Chiba's FIG. 22. Therefore, it is my opinion that the combination of Kangasvieri and Chiba proposed in the Petition would not have been obvious to the POSITA at the time of invention.

63. It is further my opinion that Chiba discourages the use of multiple physically separate, separately fed antennas where the relevant frequency-band functionality can instead be consolidated into its single multiband antenna. Chiba specifically identifies the increased installation area associated with the prior two-antenna approach as a problem and solves that problem by integrating the relevant resonant functions into one antenna structure. Under the Petition's premise that the substituted Chiba antenna already supplies the relevant transmit-and-receive functionality, retaining an additional Kangasvieri antenna for overlapping functionality runs contrary to that design teaching.



64. It is also my opinion that the combination in the Petition is even more problematic than the arrangement in FIG. 22 of Chiba because, unlike in Kangasvieri's arrangements or Chiba's FIG. 22 arrangement, the second antenna provides no additional functionality in the combination. If the Chiba antenna supplies transmission and reception in all its operating bands, retaining a separate transmit antenna adds a second radiating structure and feed without adding any additional functionality. The remaining antenna therefore adds the very space, material, and structural complexity that Chiba's integrated approach is designed to avoid without any additional function or benefit identified by the Petition..

VII. Ground 1 – The Petition Does Not Provide a Rational Underpinning for the Proposed Combination

65. It is my understanding that Petitioner bears the burden of explaining the reason a POSITA would have combined these references and this includes providing

a rationale for why the combination would retain a redundant and unnecessary feature. The Petition fails this test as the only stated motivation it articulates concerns replacement of Kangasvieri's first antenna, but provides no explanation for why the POSITA would keep the second antenna from Kangasvieri. The Petition reasons that Chiba's multifrequency PIFA would increase the number of supported communication bands without enlarging the first antenna's volume or the device's ground-plane footprint. Petition at 27-28. It also points to an industry demand for smaller handsets capable of supporting multiple standards. Petition at 27-28; EX1003 ¶¶ 27, 79. While those statements may describe a reason to consider a compact multiband antenna, they do not explain why the modified device would retain Kangasvieri's second antenna after the now-included Chiba antenna is said to perform both transmission and reception in the operating bands. Because the Petition fails to provide any rationale for the inclusion of the redundant second antenna of Kangasvieri, it is my opinion that the Petition fails its burden of providing a rationale for the combination.

66. Further, the Petition does not identify any technical function performed by the retained second antenna that is not already attributed to the substituted Chiba antenna. The Petition merely states that the Chiba substitution "does not eliminate

or materially alter” the second antenna, which “remains present in the combined system and continues to operate in at least one frequency band.” Petition at 29-30. It further states that replacing the first antenna would not affect the structure or operation of the second antenna. Petition at 29-30. A POSITA, however, would not choose to keep it given the teachings of the references. With Chiba’s antenna replacing Kangasvieri’s first antenna, Kangasvieri’s second antenna no longer has a function. A POSITA pursuing the compactness rationale articulated by the Petition would therefore have had reason to remove, rather than retain, the additional antenna absent some countervailing benefit. The Petition identifies no such benefit.

VIII. Ground 1 – The Retention of Kangasvieri’s Second Antenna Reflects Impermissible Hindsight

67. It is my opinion that the absence of a functional reason for the second antenna also reveals that hindsight, not obviousness, dictated the Petition’s combination of Kangasvieri and Chiba. Claim 1 requires a first antenna that transmits and receives in at least three mobile-communication bands and a second antenna that operates in at least one band, with the two antennas extending in specified directions relative to orthogonal sides of the ground plane. The Petition uses Chiba to obtain the first antenna’s three-band transmit-and-receive capability

and uses Kangasvieri to preserve the second antenna and the claimed geometry. Petition at 20-37.

68. Under the Petition's proposed mapping, once Chiba is substituted as proposed, the Petition identifies no remaining communication function that requires the second Kangasvieri antenna. Per the Petition, Chiba's multiband antenna transmits and receives in all its operating bands. Petition at 24-26. Kangasvieri's remaining antenna supplies only reception in one of the operating bands. Kangasvieri at ¶¶ [0065], [0072]. The Petition identifies no added function or benefit produced by maintaining both antennas. The second antenna brings burdens of an additional antenna structure: it occupies space on or near the ground plane, requires a separate feed, introduces matching and coupling considerations, and constrains the physical arrangement of the terminal. Chiba's discussion of multiple separately fed antennas confirms the installation-area consequence and considers this a "problem" to be solved. Chiba at 1:45-2:25.

69. A designer following the references' stated goals would instead have reason to remove that redundancy. *See* Section VI, above. Further, the Petition's own compactness rationale emphasizes adding additional frequencies while preserving a small form factor. Petition at 27-28. Each of those considerations points toward

using only the multiband antenna's available functions, not toward also including a second antenna that duplicates them.

70. Petitioner's expert describes the relevant industry demands in the same terms. The declaration states that the drive toward smaller, more feature-rich handsets created demand for compact internal antennas capable of covering multiple frequency bands simultaneously. EX1003 at ¶¶ 27, 79, 166. That observation supports the use of an integrated multiband antenna. It does not supply a reason to add or retain a redundant antenna. To the contrary, an extra antenna with no identified additional function consumes the limited space that the asserted industry trend sought to conserve.

71. The Petition does not confront this tension. It does not weigh any benefit of the second antenna against the costs of keeping it, because it does not identify a benefit. It does not explain why Chiba's asserted receive capability would go unused, why a separate receive path would nevertheless be selected, or why the compactness advantages it attributes to Chiba would be pursued in a configuration that preserves unnecessary hardware. It simply states that the second antenna remains. Petition at 30.

72. The Petition identifies no technical reason for retaining the second antenna after making its proposed substitution. In contrast, the technical considerations identified in the Petition and the cited references—particularly compactness, elimination of unnecessary antenna structures, and multiband consolidation—favor removing the additional antenna. The Petition’s unexplained retention of that antenna therefore appears to result from the need to reproduce claim 1’s two-antenna arrangement rather than from the technical rationale articulated in the references. In my opinion, this is evidence that hindsight influenced the proposed combination.

IX. Ground 1 – The Petition Does Not Establish a Reasonable Expectation of Success

73. It is my understanding that a proposed combination of references or a modification of a reference requires a reasonable expectation of success. Contrary to the conclusory assertions in the Petition (*see* Petition at 28), it is my opinion that the Petition has not met this burden to the satisfaction of the POSITA. Specifically, it is my opinion that the references themselves, and Kangasvieri in particular, illustrate the challenges with Ground 1’s proposed combinations, challenges that the Petition does not address.

74. The Petition makes the conclusory statement that substituting Chiba's multiband antenna for Kangasvieri's first antenna would have required "little to no structural redesign" because both antennas share a planar inverted-F structure. Petition at 27-28. It then characterizes the result as predictable and concludes that a person of ordinary skill would have had a reasonable expectation of success. Petition at 27-28. That analysis treats the common "PIFA" label as sufficient to establish electrical and physical interchangeability. Kangasvieri's own disclosure shows why more analysis is required to prove to the POSITA that there was a reasonable expectation of successfully combining the references as proposed in the Petition.

75. Kangasvieri expressly states that "[t]he radiating characteristics of a planar inverted-F antenna (PIFA) depend on the ground plane as well as on the antenna element itself." Kangasvieri at ¶ [0063] (emphasis added). Kangasvieri also explains that power supplied to the antenna produces current in the ground plane through the grounding structure. Kangasvieri at ¶ [0063]. That current can travel through the shared ground plane and appear in the other antenna, reducing isolation. Kangasvieri at ¶¶ [0063]-[0065]. Kangasvieri's slot, connecting section, and antenna placement are therefore not incidental supports for a generic PIFA. They are part of the electrical structure that governs current paths, coupling, and isolation.

76. Chiba's three-band antenna is also more than a generic PIFA. Its FIG. 14 embodiment uses three emission conductors with different shapes and resonant lengths to establish three frequency bands. Chiba at 9:41-58. The conductors share a single feeding point, and their relationship to the disclosed ground conductor forms part of the multiband antenna. Chiba at 9:41-10:6. Each resonant path must operate at its intended frequency and with suitable matching for the antenna to provide the three-band capability on which the Petition relies.

77. The proposed substitution places those multiple resonant paths into a different ground-plane environment. In Kangasvieri's FIG. 2 embodiment, slot 20 divides the ground plane into sections joined by connecting section 16. Kangasvieri at ¶¶ [0064]-[0065]. The slot length and current path are chosen to produce the phase relationship used to reduce coupling at the relevant band. Kangasvieri at ¶¶ [0064]-[0065]. A multiband antenna operating at different frequencies will interact with the ground plane at those different frequencies. Kangasvieri's express statement that the ground plane affects radiating characteristics would indicate to the POSITA that some analysis of the effect of this new ground plane on the radiating characteristics of the Chiba antenna is needed. The POSITA would not conclude simply because

one PIFA is replacing another that resonances, matching, and performance would remain as intended.

78. The POSITA would have readily understood that attempting to replace one of Kangasvieri's antennas with Chiba's multiband antenna presents a number of difficult technical considerations. Chiba's resonant branches would produce frequency-dependent ground currents. Those currents would encounter Kangasvieri's slot and connecting section, whose impedance and electrical effect vary with frequency. Changes in the return path could shift resonance or matching. These points follow from the references' disclosed dependence on the ground plane and their use of frequency-specific resonant lengths and current paths. Kangasvieri at ¶¶ [0063]-[0065]; Chiba at 9:41-10:6. They are not answered by simply observing that both structures may be categorized as PIFAs.

79. The Petition provides no analysis of these interactions. It does not identify which Chiba dimensions would be retained, how the three resonant paths would be tuned on Kangasvieri's ground plane, whether slot 20 would remain configured for the relevant operating band, or how the remaining second antenna would affect the combined system. It also does not explain whether modifications needed to preserve Chiba's three resonances would alter the location, footprint, or

orientation that the Petition relies on for claim 1. Instead, it assumes that the first antenna can be replaced with little or no redesign and that the rest of the device will remain materially unchanged. Petition at 27-36. Where the primary reference expressly teaches that antenna performance depends on the interaction between the antenna and the ground plane, a shared “PIFA” label does not establish predictable operation. A POSITA would expect some account of the ground-plane interaction, tuning, or necessary redesign to support the conclusion that Chiba’s antenna could replace Kangasvieri’s first antenna with little to no redesign.

80. The Petition’s expectation-of-success analysis is also incomplete because it assumes that the second antenna will continue to operate unaffected. Petition at 29-30. Kangasvieri explains that antennas sharing a ground plane interact through ground currents. Kangasvieri at ¶¶ [0063]-[0065]. Replacing one antenna with a three-band structure changes the excitation presented to that shared ground plane. The Petition does not explain why those changes would leave the second antenna’s operation and the intended isolation behavior materially unchanged. Its conclusion therefore conflicts with the very coupling mechanism that Kangasvieri describes.

81. Therefore, it is my opinion that the Petition does not substantiate its assertion that the substitution would require little or no redesign or would predictably preserve the necessary operation. The references establish that the ground plane, slots, current paths, resonant lengths, and antenna interaction matter for how the antennas operates. The Petition does not even consider, much less analyze, how these considerations would affect the proposed combination. Therefore, the Petition has not established to the satisfaction of the POSITA that the proposed combination could be implemented with a reasonable expectation of success.

X. Ground 1 – The Petition Does Not Set Forth Ground 1 With the Required Particularity

82. It is my understanding that a petition for *inter partes* review must identify in writing and with particularity each challenged claim, the grounds on which the challenge is based, and the evidence supporting those grounds. It is my opinion that the Petition fails in this requirement.

83. First, the Petition fails to indicate which three frequency bands the Chiba antenna operates in the proposed combination. *See* Petition at 20-29. Specifically, Chiba discloses embodiments that operate in the GSM and PHS. Chiba at 6:51-62. Kangasvieri discloses antennas that operate in the PCS band. Kangasvieri at ¶¶ [0065], [0072]. There is overlap between the PCS band and the

PHS band, around 1.9 GHz (*see* Chiba at 6:60-61, FIG. 5; Kangasvieri at ¶ [0065]), but the Petition never explains if it is utilizing, for example, a Chiba antenna that operates over the PCS band. Someone reading the Petition is left to guess whether or not the Chiba antenna operates in the same band as the Kangasvieri antenna that it replaces. For completeness, I note that a combination of Kangasvieri and Chiba would be non-obvious regardless, rendering the Kangasvieri system inoperable at its intended band on one hand and providing a completely vestigial antenna on the other, as discussed above.

84. The Petition also does not consistently identify a single Kangasvieri embodiment that is being relied upon in the combination. It relies extensively on FIG. 2 to identify the substantially rectangular ground plane and the directions in which the first and second antennas extend. Petition at 18-21, 29-37.

85. At the same time, the Petition invokes Kangasvieri's multiband disclosure associated with FIG. 5b. Petition at 21, 29. In that embodiment, dual-band slot antenna 80 covers PCS transmission and another lower band such as GSM 850, while PIFA 40 covers PCS reception. Kangasvieri at ¶ [0072]. FIG. 5b is not simply another view of the FIG. 2 device. It uses a different antenna configuration and arrangement, and it does not include the same slot 20 and ground-plane

configuration on which the Petition relies elsewhere. The Petition does not say whether Chiba replaces antenna 22 in FIG. 2, antenna 80 in FIG. 5b, or a construct assembled from features of both embodiments.

86. That ambiguity affects more than nomenclature. The reason for the second antenna, the identity of the transmit and receive functions, the type of the first antenna, and the ground-plane structure differ across the cited embodiments. A substitution into FIG. 2 must account for slot 20 and the current paths that Kangasvieri describes. A substitution into FIG. 5b must account for replacing a dual-band slot antenna rather than the FIG. 2 PIFA shown in the Petition's placement analysis. If the Petition proposes a hybrid, it must identify which features are combined and why a person of ordinary skill would have assembled them. The Petition does none of those things.

87. The Petition's allusions to the embodiment of Kangasvieri's FIG. 5b, and antenna 80 in particular, is especially problematic. Antenna 80 in FIG. 5b is a slot antenna, not a PIFA. Kangasvieri at ¶ [0072] ("a dual-band slot antenna 80 is used to carry out the dual-band function."). The Petition, however, argues that "A POSITA would have had reason to substitute Kangasvieri's PIFA with Chiba's similarly sized multifrequency PIFA as the first antenna." Petition at 28. In other

words, the Petition's obviousness rationale is dependent on both antennas being PIFAs. The Petition nevertheless relies on slot antenna 80 in explaining how Kangasvieri discloses the "first antenna" of claim 1:

Kangasvieri further teaches a multiple frequency band antenna system that is configured to transmit and receive electromagnetic wave signals. Ex. 1003 ¶ 67. For example, Kangasvieri teaches that "[a]dvantageously, **the first antenna (80)** is a *multiple-band antenna operating in at least a first frequency band and a second frequency band* different from the first frequency band."

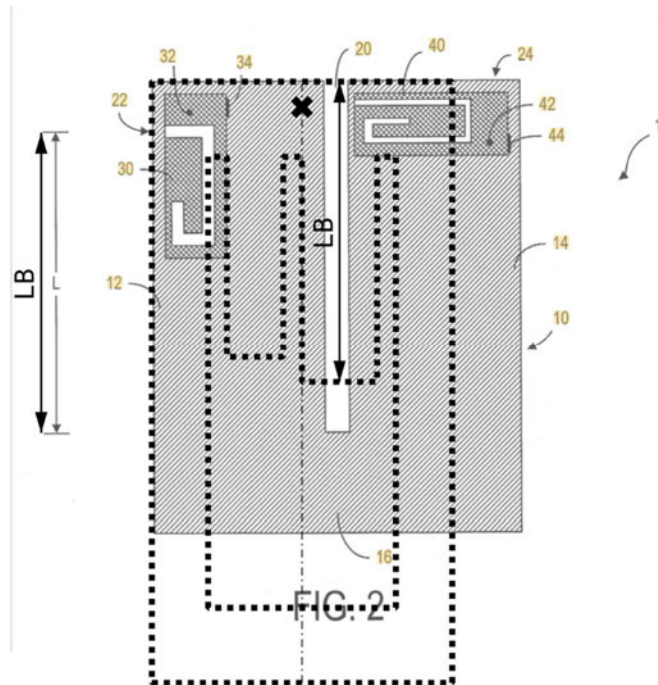
Petition at 21 (bold added, italics original).

88. Because the Petition never explains with particularity which of Kangasvieri's first antennas is being replaced by the Chiba antenna, it would be unclear to the POSITA whether or not the Petition's purported obviousness rationale is even applicable.

89. The Petition also fails to define the physical placement of Chiba's antenna. It repeatedly asserts that Chiba's multifrequency PIFA has essentially the same footprint as Kangasvieri's first antenna and would be placed in nearly the same location and orientation. Petition at 27-28, 31-36. This is, however, a poor

assumption. It is my opinion that the POSITA could actually derive from the references that the Chiba footprint is substantially different from those of Kangasvieri's antennas.

90. Specifically, Chiba explains that its length "LB" is about one quarter of the wavelength of its emission conductor's operating wavelength at the second frequency band. Kangasvieri explains that its length "L" is also one quarter of the wavelength of its operating frequency. Both Kangasvieri and Chiba operate at approximately 1900 MHz, and therefore, "L" Kangasvieri will be approximately equal to "LB" in Chiba. As illustrated below, matching "LB" from Chiba to "L" from Kangasvieri shows that the POSITA may derive from the references' figures that Chiba's multifrequency PIFA has a very different footprint than Kangasvieri's first antenna.



91. The missing placement analysis is particularly important because antenna size and orientation cannot be separated from frequency and ground-plane interaction. Lower operating frequencies generally require longer resonant paths, and Chiba obtains those paths through the geometry of its emission conductors. Chiba at 5:1-6:20. Kangasvieri states that PIFA characteristics depend on the ground plane. Kangasvieri at ¶ [0063]. Therefore, it is my opinion that the Petition cannot establish the claim's relative-direction limitations merely by placing a label for Chiba's antenna over Kangasvieri's original antenna and assuming the same footprint and orientation.

92. The Petition also fails to explain how the three-band antenna would be oriented while preserving each relevant structure. These omissions prevent a meaningful evaluation of whether the proposed combination actually satisfies claim 1.

XI. Grounds 2 and 3

93. It is my understanding that the Petition also proposes additional invalidity grounds directed to only dependent claims which add the Inoue and Vance references to the combination of Kangasvieri and Chiba. It is my opinion that Inoue and Vance do not remedy the above-described deficiencies in the combination of Kangasvieri and Chiba proposed in the Petition. Therefore, it is my opinion that these grounds also fail to meet the relevant standard for institution of an *inter partes* review proceeding.

I declare under penalty of perjury that the foregoing is true and correct.

Date: September 23, 2026

By: 
Hossein Hashemi, Ph.D.