

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Reexam of: U.S. Patent No. §
8,738,103 to Puente Baliarda et al.

U.S. Patent 8,738,103 §

Issue Date: May 7, 2014 §

Filing Date: December 21, 2006 §

For: Multiple-Body-Configuration §
Multimedia and Smartphone
Multifunction Wireless Devices

REQUEST FOR EX PARTE REEXAMINATION OF U.S. PATENT 8,738,103

Mailstop “*Ex Parte* Reexam”
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Dear Commissioner:

Pursuant to the provisions of 35 U.S.C. §§ 301-307, requestor hereby requests an *ex parte* reexamination of claims 12 and 15 (the “Challenged Claims”) of U.S. Patent No. 8,738,103 (the “’103 patent,” Ex. 1001), which issued on May 27, 2014 from U.S. Patent Application No. 11/614,429 (the “’429 Application”), filed on December 21, 2006. The ’103 patent is currently purportedly assigned to Fractus, S.A. (“Patent Owner”) according to the assignment record in the U.S. Patent and Trademark Office (“USPTO”).

Ex Parte Patent Reexamination Filing Requirements

Pursuant to 37 C.F.R. § 1.510(b)(2), reexamination of the Challenged Claims of the '103 patent is requested, and a detailed explanation of the pertinence and manner of applying the cited references to the Challenged Claims is provided in section VI of this Request. In addition, for each statement of the Patent Owner and accompanying information submitted pursuant to § 1.501(a)(2) that is relied upon in the detailed explanation, the Request explains how that statement is being used to determine the proper meaning of a patent claim in connection with the prior art applied to that claim and how each relevant claim is being interpreted.

Pursuant to 37 C.F.R. § 1.510(b)(3), copies of every patent or printed publication relied upon or referred to in the statement pointing out each substantial new question of patentability or in the detailed explanation of the pertinence and manner of applying the cited references are provided as Exhibits to this Request. Requester also includes an Information Disclosure Statement listing all documents on the Exhibit List Below.

Pursuant to 37 C.F.R. § 1.510(b)(4), a copy of the '103 Patent is provided as Ex. 1001 of this Request, along with a copy of any disclaimer, certificate of correction, and reexamination certificate issued corresponding to the patent.

Pursuant to 37 C.F.R. § 1.510(b)(5), the attached Certificate of Service indicates that a copy of this Request, in its entirety, has been served on Patent

Owner at the following address of record for Patent Owner, in accordance with 37 C.F.R. § 1.33(c):

27896 – EDELL, SHAPIRO & FINNAN, LLC
9801 Washingtonian Blvd.
Suite 750
Gaithersburg, MD 20878
UNITED STATES

Pursuant to 37 C.F.R. § 1.510(b)(6), requester hereby certifies that the statutory estoppel provisions of 35 U.S.C. § 315(e)(1) and 35 U.S.C. § 325(e)(1) do not prohibit requester from filing this *ex parte* patent reexamination request.

Also submitted herewith is the fee set forth in 37 C.F.R. § 1.20(c)(1).

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<u>Exhibit</u>	<u>Description</u>
Ex. 1001	U.S. Patent No. 8,738,103 (“103 patent”)
Ex. 1002	Declaration of Manos M. Tentzeris Ph. D.
Ex. 1003	U.S. Patent No. 6,239,765 to Johnson <i>et al.</i> (“Johnson”)
Ex. 1004	U.S. Patent Application Publication No. 2007/0238483 to Boireau <i>et al.</i> (“Boireau”)
Ex. 1005	U.S. Patent Application Publication No. 2003/0189522 to Zeilinger (“Zeilinger”)
Ex. 1006	U.K. Patent Application Publication No. GB 2416625A to Langley <i>et al.</i> (“Langley”)
Ex. 1007	Excerpt of File History (U.S. Patent Application No. 11/614,429) of U.S. Patent No. 8,738,103 (excerpted due to file size)
Ex. 1008	ETSI TS 136 104 V8.8.0 (2010-02) Technical Specification
Ex. 1009	Rohde & Schwarz, LTE Release 9, Technology Introduction White Paper, 1MA191
Ex. 1010	Manos Tentzeris Curriculum Vitae
Ex. 1011	Certificate of Correction to U.S. Patent No. 8,738,103
Ex. 1012	Claim Construction Order, <i>Fractus, S.A. v. ADT LLC</i> , 2:22-cv-412 (E.D. Tex., Feb. 25, 2024)
Ex. 1013	ETSI TS 125 101 V6.7.0 (2005-03) Technical Specification

I. IDENTIFICATION OF PATENT AND CLAIMS FOR WHICH REEXAMINATION IS REQUESTED

In accordance with 35 U.S.C. § 311 and 35 C.F.R § 1.913, reexamination is requested for claims 12 and 15 of the '103 patent in view of the following references:

- **Ex. 1003 (U.S. Patent No. 6,239,765 to Johnson et al.)("Johnson"):** Johnson was filed on August 24, 1999 and published May 29, 2001. Johnson is prior art to the '103 patent under pre-AIA 35 U.S.C. § 102(a)-(b) because it published before the earliest alleged priority date (Dec. 21, 2006) of the '103 patent.
- **Ex. 1004 (U.S. Patent Application Publication No. 2007/0238483 to Boireau et al.)(" Boireau"):** Boireau was filed in the U.S. on April 5, 2006. Boireau is prior art to the '103 patent under pre-AIA 35 U.S.C. § 102(e) because it was filed in the United States before the earliest alleged priority date (Dec. 21, 2006) of the '103 patent.
- **Ex. 1005 (U.S. Patent Application Publication No. 2003/0189522 to Zeilinger)("Zeilinger"):** Zeilinger was filed on April 4, 2003 and published October 9, 2003. Zeilinger is prior art to the '103 patent under pre-AIA 35 U.S.C. § 102(a)-(b) because it published before the earliest alleged priority date (Dec. 21, 2006) of the '103 patent.
- **Ex. 1006 (U.K. Patent Application Publication No. GB 2416625A to Langley et al.)("Langley"):** Langley was filed on July 22, 2004 and published January 2, 2006. Langley is prior art to the '103 patent under pre-AIA 35 U.S.C. § 102(a), (e) because it published before the earliest alleged priority date (Dec. 21, 2006) of the '103 patent.

In accordance with 37 C.F.R. § 1.915(b)(2), the above patents and printed publications are cited in the Form PTO-SB/08, and, pursuant to 37 C.F.R. § 1.915(b)(4), a copy of each is submitted herewith. Furthermore, each piece of prior art relied upon in this request was not considered by the Office during the original prosecution of the '103 patent.

Also, this Request is supported by the declaration of Dr. Manos M. Tentzeris (Ex. 1002), marking another difference between this reexamination and the prosecution of the '103 patent.

II. BACKGROUND

A. Explanation of Claimed Subject Matter

The '103 patent, titled "Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices," generally describes "A multifunction wireless device having at least one of multimedia functionality and smartphone functionality, the multifunction wireless device including an upper body and a lower body, the upper body and the lower body being adapted to move relative to each other in at least one of a clamshell, a slide, and a twist manner. The multifunction wireless device further includes an antenna system disposed within at least one of the upper body and the lower body and having a shape with a level of complexity of an antenna contour defined by complexity factors F21 having a value of at least 1.05 and not greater than 1.80 and F32 having a value of at least 1.10 and not greater than 1.90." Ex. 1001 at Abstract.

The '103 patent is directed to “[a] multifunction wireless device” which “includes an antenna system.” *Id.* at Abstract. The '103 patent teaches that a “multifunction wireless device . . . advantageously comprises five functional blocks: display 11, processing module 12, memory module 13, communication module 14, and power management module 15.” *Id.* at 8:13-17. The specification then provides the following description: (1) the display can include “a touch screen with a size of at least half of the overall device,” *Id.* at 9:13-14; (2) “[t]he processing module 12, that is the microprocessor or CPU,” *Id.* at 8:21-22; (3) the memory module is one of the blocks; (4) “[t]he antenna system [is] within the communication module 14,” *Id.* at 8:47; and (5) “[t]he MFWD 100 has a single source of energy and it is the power management module 15,” *Id.* at 8:26-28.

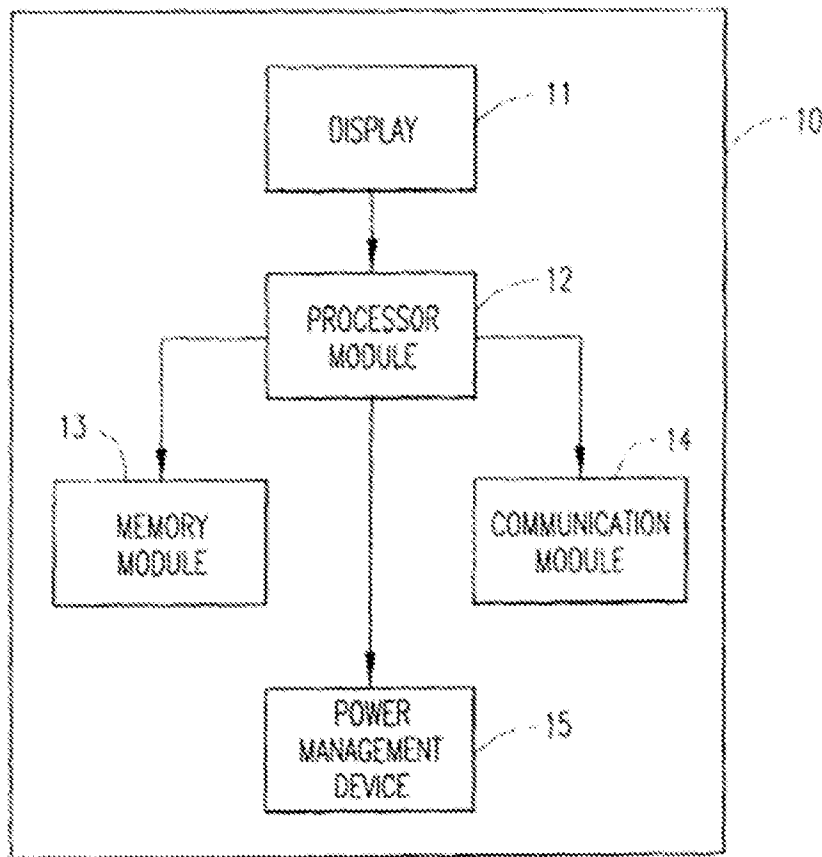


FIG. 1A

Id., at FIG. 1A.

The '103 patent then describes the antenna system within the handheld multifunction wireless device. The antenna system includes a ground plane with a “ground plane rectangle . . . defined as being the minimum-sized rectangle that encompasses the ground plane of the antenna system included in the PCB of the MFWD 100 that comprises the feeding means responsible for the operation of the antenna system in its lowest frequency band. That is, the ground plane rectangle is

a rectangle whose edges are tangent to at least one point of the ground plane.” *Id.* at 14:4-11.

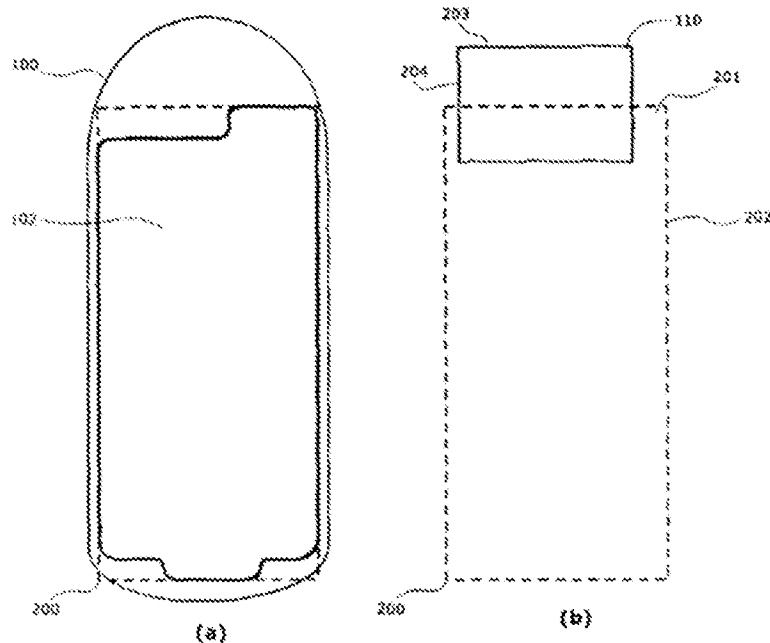


FIG. 2

Id. at FIG. 2.

The antenna system of the '103 patent “has a structure able to support different radiation modes so that the antenna system can operate with good performance and reduced size in the communication standards allocated in multiple frequency bands within at least three different regions of the electromagnetic spectrum.” *Id.* at 11:27-31. At least one of these regions may be used by a 4G communication standard. *Id.* at 24:27-30. The antenna contour, “i.e., its peripheral both internally and externally, can comprise straight segments,

curved segments or a combination thereof.” *Id.* at 14:60-62. The ’103 patent discloses that it is possible to require a minimum amount of segments in a contour and that “[p]ossible values for the minimum number of segments of a subset include 5, 6, 7, 8, 10, 12, 14, 16, 18, 20, 25, 30, 35, 40, 45 and 50.” *Id.* at 15:41-43.

The ’103 patent further discloses “[a]n antenna box for the MFWD 100 is herein defined as being the minimum-sized parallelepiped of square or rectangular faces that completely encloses the antenna volume of space and wherein each one of the faces of the minimum-sized parallelepiped is tangent to at least one point of the volume. Moreover, each possible pair of faces of the minimum-size parallelepiped shares an edge forming an inner angle of 90°.” *Id.* at 11:5-12. Within the antenna box is an antenna rectangle “defined as being the orthogonal projection of the antenna box along the normal to the face with the largest area of the antenna box.” *Id.* at 13:56-58. The ’103 patent also discloses that “in some examples the length of the antenna contour is larger than 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 12, 15, 20, 25, 30, 40 or more times the length of the diagonal of the antenna rectangle or less than any of those values.” *Id.* at 16:14-17.

The ’103 patent issued with 20 claims, including independent claims 1, 6, 12, and 16. Independent claim 12 and dependent claim 15 (depending from independent claim 12) are challenged in this Request. Claims 12 and 15 of the ’103 patent are reproduced below.

12. A handheld multifunction wireless device having at least one of multimedia functionality and smartphone functionality, the handheld multifunction wireless device comprising:

a touch screen;

a processing module; a memory module;

a communication module;

a power management module;

an antenna system within the handheld multifunction wireless device and comprising:

a ground plane layer;

a first antenna element configured to simultaneously support radiation modes for first, second, and third frequency bands, the first frequency band being contained within a first frequency region of an electromagnetic spectrum, the second frequency band being contained within a second frequency region of the electromagnetic spectrum that is higher in frequency than the first frequency region, the third frequency band of operation being used by a 4 G communication standard, wherein a perimeter of the first antenna element defines a first antenna contour comprising at least thirty-five segments, the first antenna element defining an antenna box, an orthogonal projection of the antenna box along a normal to a face with a largest area of the antenna box defining an antenna rectangle, wherein a length of the first antenna contour is greater than four times a diagonal of the antenna rectangle; and

a second antenna element configured to operate in at least one frequency band used by a 4 G communication standard, wherein a perimeter of the second antenna element defines a second antenna contour comprising at least twenty segments.

15. The handheld multifunction wireless device according to claim 12, wherein the ground plane layer defines a ground plane rectangle, the projection of the antenna rectangle on the ground plane rectangle partially overlapping the ground plane rectangle.

Requester contends that all of the claim elements of claims 12 and 15 of the '103 patent are disclosed in the prior art, as discussed in detail below.

B. State of the Technology

The field of endeavor of the invention of the '103 patent is a multifunction wireless device and antenna designs for such devices. Ex. 1001 at 1:29-38.

As of 2006, the 4G standards had not yet been formally defined. The ITU (International Telecommunication Union) first defined 4G standards in 2008. The 4G standards were defined in the 3GPP Release 8 that was released in 2008, with the first commercial deployment in 2009.

The 4G standard continued to be updated in future releases. For example, 3GPP TS (Technical Specification) Version 8.8.0 of Release 8, dated February 2010, indicates frequency ranges including 900 MHz (e.g., 880-915 MHz) and between 1805 MHz - 2400 MHz inclusive, with additional frequencies. Ex. 1008 at 13-14. Further references discussing 3GPP Release 9 (2011) also list 4G frequency ranges including 900 MHz (e.g., 880-915 MHz) and between 1805 - 2400 MHz (1.8 - 2.4 GHz) inclusive, with additional frequencies. Ex. 1009 at 32-33.

It is important to note that the 3GPP Release 8 was not promulgated as of 2006. Of course, later releases (such as Release 9) were also not promulgated as of 2006.

The problem purportedly solved by the '103 patent, the need for antennas systems with both a small form factor and multi-band capability (Ex. 1001, 3:28-33, 5:1-26), was well-known and well-understood in the prior art. Wireless devices that incorporated multi-band capabilities, including those that employed two antennas, were also well-known. *See generally* Johnson (Ex. 1003), Zeilinger (Ex. 1005), Boireau (Ex. 1004), Langley (Ex. 1006). Market forces had begun driving mobile telephones to include three-band antenna systems as early as 2002. Ex. 1005 at Abstract.

As explained by Langley (Ex. 1006), a 2004 UK patent publication, the need for compact multi-band antennas for use in wireless devices was a well-known problem: "[c]apacity constraints and different bandwidth allocations in different countries have resulted in the use of a variety of frequency bands. To deal with these multiple bands, mobile telephones and base stations that are capable of operating in two or three frequency bands have been developed." Ex. 1006 at 2:8-11. The trade-off between antenna size and performance was also well-known: "[h]owever, there remains a need for a compact and efficient multi-band antenna." *Id.* at 2:21-22.

A 2003 U.S. patent publication, Zeilinger (Ex. 1005), disclosed a multiple frequency band antenna capable of operating in at least three distinct preselected frequency bands. Ex. 1005 at Abstract. "With the advent of digital signal

transmission systems used in mobile telephones, other frequency bands are being utilized for communication. These bands are separated and are utilized for different communications application ... [e]ach of these bands offers certain advantages and it is desirable to utilize mobile telephones that operate reliably within all such bands. Important to this operation are effective antennas.” *Id.* at ¶[0004]. Further, Zeilinger provided “a tri-band antenna for use with mobile telephones that is capable of operating in at least three distinct preselected frequency bands.” Ex. 1005 at ¶[0011].

Johnson (Ex. 1003), a U.S. Patent issued in 2001, disclosed a multi-antenna, multi-band "planar conformal element which is installed within the housing of a wireless device and closely-spaced to the printed circuit board and antenna feedpoint of the wireless device.” Ex. 1003 at 2:6-9.

Boireau (Ex. 1004), a 2007 U.S. patent publication disclosed a mobile computing device utilizing multiple communications transceivers for increased functionality. Ex. 1004 at ¶[0001].

As illustrated above, the prior art disclosed numerous examples of compact, multi-band wireless antenna systems in a wireless device, and the advantages of compact, multi-band antenna systems were well known.

C. Person of Ordinary Skill in the Art

A person of ordinary skill in the art (POSITA) as of the earliest claimed priority date of July 18, 2006, is a person with at least a bachelor's degree in electrical engineering, computer science, or a similar degree and at least four years of experience in applied electromagnetics with an emphasis on antennas.

Alternatively, the person of ordinary skill in the art would have a master's degree in electrical engineering (or similar discipline) and at least two years of similar experience. Ex. 1002 at ¶28.

III. SUBSTANTIAL NEW QUESTION OF PATENTABILITY

As shown below, requester submits that the prior art references cited herein raise a new “substantial question of patentability” because the teaching of the (prior art) patents and printed publications is such that a reasonable examiner would consider the teaching to be important in deciding whether or not the claim is patentable.” See MPEP § 2242(1). For example, the references discussed below, when considered as an ordered combination, teach each element of the claims. Further, the combination of references submitted herein were never applied in an Office Action during prosecution of the 103 Patent; the “same question of patentability as to the claim has not been decided by the Office in an earlier concluded examination or review of the patent” (see MPEP § 2642(I)A.(B)) at least because there is no evidence that the combinations of art

referenced in this request was considered by the Office during prosecution of the '103 patent.

Requester's Section 103 obviousness grounds rely on the combined teachings of the prior art and not on a physical incorporation of elements. *See In re Mouttet*, 686 F.3d 1322, 1332, 103 U.S.P.Q.2d 1219, 1225-26 (Fed. Cir. 2012).

Requester also cites to additional prior art as evidence of the background knowledge of a POSITA and to provide contemporaneous context to support requester's assertions regarding what a POSITA would have understood from the prior art. *See Yeda Rsch. v. Mylan Pharms. Inc.*, 906 F.3d 1031, 1041-42, 128 U.S.P.Q.2d 1314, 1322 (Fed Cir. 2018) (affirming the use of “supporting evidence relied upon to support the challenge” (quoting 37 C.F.R. 42.104(b))); *see also K/S HIMPP v. Hear-Wear Techs., LLC*, 751 F.3d 1362, 1365-66, 110 U.S.P.Q.2d 2027, 2029-31 (Fed. Cir. 2014).

A. Summary of Original Prosecution

The application from which the '103 patent issued was filed on December 21, 2006 and assigned U.S. Patent Application No. No. 11/614,429. During prosecution, the applicant filed 27 different Information Disclosure Statements (“IDS”) that identified hundreds of potential prior art references.

On August 16, 2010, the examiner issued a non-final office action that rejected original claims 1-3, 6-9, 11, 14, and 20 as being unpatentable over the

combination of U.S. Patent No. 7,548,915 to Ramer *et al.* (“Ramer”) and U.S. Patent Application Publication No. 2004/0119644 to Baliarda *et al.* (“Baliarda”). Ex. 1007 at 10. Claims 12 and 13 were rejected as being unpatentable over a combination of Ramer, Baliarda, and U.S. Patent No. 7,183,983 to Ozden (“Ozden”). *Id.* at 22. Claims 16-19 were rejected as being unpatentable over the combination of Ramer, Baliarda, and U.S. Patent Application Publication No. 2002/0175211 to Dominquez *et al.* (“Dominquez”). *Id.* at 26. Claims 10 and 15 were rejected as being unpatentable over the combination of Ramer, Baliarda, and U.S. Patent Application No. 2007/0229383 to Koyanagi *et al.* (“Koyanagi”). *Id.* at 30. On February 11, 2011, Applicant responded and made no amendments nor cancelations to any of their claims. *Id.* at 36.

On March 7, 2011, the examiner issued a final rejection maintaining the original rejections based on the various combinations of Ramer, Baliarda, Ozden, Dominquez, and Koyanagi. *Id.* at 48-77. Applicant requested continued examination on March 21, 2011. *Id.* at 155. Examiner issued a final rejection on May 27, 2011. *Id.* at 156-184.

On November 23, 2011, applicant filed a request for continued examination and amended the independent claims 1, 16, 18, and 20. *Id.* at 186-192. Examiner issued a non-final rejection on March 19, 2013, which stated that claims 1-3, 6-9, 11-14, and 20 were unpatentable over U.S. Patent No. 6,989,794 to Tran (“Tran”)

in view of Ramer. *Id.* at 203. Claims 4-5 were rejected as being unpatentable over Tran in view of Ramer and Dominquez. *Id.* at 212. Claims 10 and 15 were rejected as being unpatentable over Tran in view of Ramer and Koyanagi. *Id.* at 213. Claim 16 was rejected as unpatentable over Tran in view of Dominquez. *Id.* at 215. Claim 17 was rejected as being unpatentable over Tran in view of Dominquez and Ramer. *Id.* at 217. Claims 18-19 were rejected as being unpatentable over U.S. Patent No. 6,476,769 to Lehtola (“Lehtola”) in view of Ramer and Dominquez. *Id.* at 218.

On July 17, 2013, Applicant canceled claims 1-20 and added claims 21-40. *Id.* at 221-227. Examiner responded that the amendment was non-responsive and withdrew new claims 21-40 from consideration as being directed to a non-elected invention. *Id.* at 228-231. Applicant responded on November 13, 2013, by amending claims 1-5 and 16-20, canceling claims 6-15, and adding claims 21-30. *Id.* at 232-242. A notice of allowance was issued on January 8, 2014. Ex. 1007 at 243-250.

B. Identification of Litigation, Inter Partes Review, and Reexamination Proceedings

It is Requester’s understanding that the ’103 Patent is subjection to one pending District Court litigation – *Fractus, S.A. v. ADT LLC*, 2:22-cv-412 (E.D. Tex.), filed October 21, 2022. A previous proceeding, *Fractus, S.A. v. Vivint, Inc.*,

2:22-cv-00413(E.D. Tex.), filed October 21, 2022 appears to have been dismissed. Requestor is not aware of any other litigation related to the '103 Patent.

An *inter partes* review (“IPR”) proceeding was filed by Petitioner, *Vivint*, on October 24, 2023. See IPR2024-00087, Paper 2. The 00087 Petition challenged the patentability of claims 12 and 15 based on the combination of Johnson and Boireau and Zeilinger and Boireau. See *id.* Shortly after filing and prior to Patent Owner filing a substantive response and before any decision by the PTAB, the parties jointly moved to terminate the IPR on February 15, 2024. See IPR2024-00087, Paper 12. The PTAB terminated the IPR without evaluating the merits of the IPR on February 20, 2024. See IPR2024-00087, Paper 12.

Requester is not aware of any reexaminations that have been filed against the '103 Patent. However, a related patent, Patent No. 11,349,200, is currently the subject of reexamination no. 90/019,275. As of the date of this filing, a reexamination related to the 200 patent has been ordered based on the Langley reference, which is cited herein, in combination with other references.

C. 35 U.S.C. § 325(d) does not prevent grant of this reexamination

Under *Advanced Bionics* factors, the Board should not deny institution under §325(d). *Advanced Bionics, LLC v. MED-EL Elektromedizinische Geräte GmbH*, No. IPR2019-01469, Paper 6 (P.T.A.B. Feb. 13, 2020), at 7 (precedential).

The Office has held that the first prong of *Advanced Bionics* is not met where “neither [the combination references] nor similar prior art was before the examiner and ... the prosecution history does not include any overlapping arguments directed to this prior art.” *Godbersen-Smith Constr. Co. v. Guntert & Zimmerman Const. Div., Inc.* No. IPR2021-00050, Paper 24 (P.T.A.B. May 7, 2021), at 19–21. And in such a case, the Board “need not address part two of the analysis.” *Id.* at 21.

Here, at least one cited reference was not evaluated during prosecution or during any proceeding before the office – Langley. *See* Ground 3. In addition, while references Johnson, Boireau, and Zeilinger were presented in a prior IPR proceeding, the earlier IPR proceeding was not evaluated on the merits because it was terminated shortly after filing and before the Board issued a decision. As such, there is no evidence that the Examiner or the Board has evaluated any of Langley, Johnson, Boireau, or Zeilinger. In addition, the cited references are not cumulative of what was considered during prosecution. Indeed, and by way of example, at least Johnson and Zeilinger discloses an antenna element with at least 35 segments.

Because the first prong is not met, the Office need not move to the second. *See Oticon Med. AB v. Cochlear Ltd.*, No. IPR2019-00975, Paper 15 (P.T.A.B. Oct. 16, 2019), at 20.

Even if the Office were to consider the second prong of *Advanced Bionics*, Requester has demonstrated a substantial new question of patentability herein based on references that were not before the Examiner. As such, the Examiner could not have presented the grounds herein and, thus, “errored.” In view of the strength of the grounds herein, 35 U.S.C. § 325(d) does not prevent grant of this reexamination.

IV. CLAIM CONSTRUCTION

The Challenged Claims should be given their broadest reasonable interpretation (“BRI”). MPEP § 2258.I.G (citing *In re Yamamoto*, 740 F.2d 1569, 222 USPQ 934 (Fed. Cir. 1984)); 37 C.F.R. § 1.555. Under this standard, “[t]he Patent and Trademark Office . . . determines the scope of claims in patent applications not solely on the basis of the claim language, but upon giving claims their broadest reasonable construction in light of the specification as it would be interpreted by one of ordinary skill in the art.” *Phillips v. AWH Corp.*, 415 F.3d 1303, 1316, 75 USPQ2d 1321, 1329 (Fed. Cir. 2005) (quotation and citation omitted). “Because applicant has the opportunity to amend the claims during prosecution, giving a claim its broadest reasonable interpretation will reduce the possibility that the claim, once issued, will be interpreted more broadly than is justified.” MPEP § 2111 (citing *In re Yamamoto*, 740 F.2d at 1571). Even if this patent were to expire during the reexamination, there are no terms that would

require additional construction under the standard applied by the district courts.

See Ex. 1012.

V. STATEMENTS ESTABLISHING A REASONABLE LIKELIHOOD THAT REQUESTER WILL PREVAIL WITH RESPECT TO THE CHALLENGED CLAIMS UNDER 35 U.S.C. § § 102 AND 103

Under pre-AIA 35 U.S.C. §§ 102 and 103, Requester contends that claims 12 and 15 of the '103 patent are obvious in view of the prior art cited herein, either alone or in combination. The below paragraphs are included as introductory statements of requester's positions related to the SNQ and will be explained further in the discussion included in Section VI of this Request.

Moreover, as is further explained below, none of the references cited herein were before the Examiner during prosecution. It therefore logically follows that none of the combinations presented below were before the Examiner during prosecution. Also, this Request is supported by the declaration of Dr. Manos M. Tentzeris (Ex. 1002), marking another difference between this reexamination and the prosecution of the '103 patent.

A. U.S. Patent No. 6,239,765 to Johnson et al.

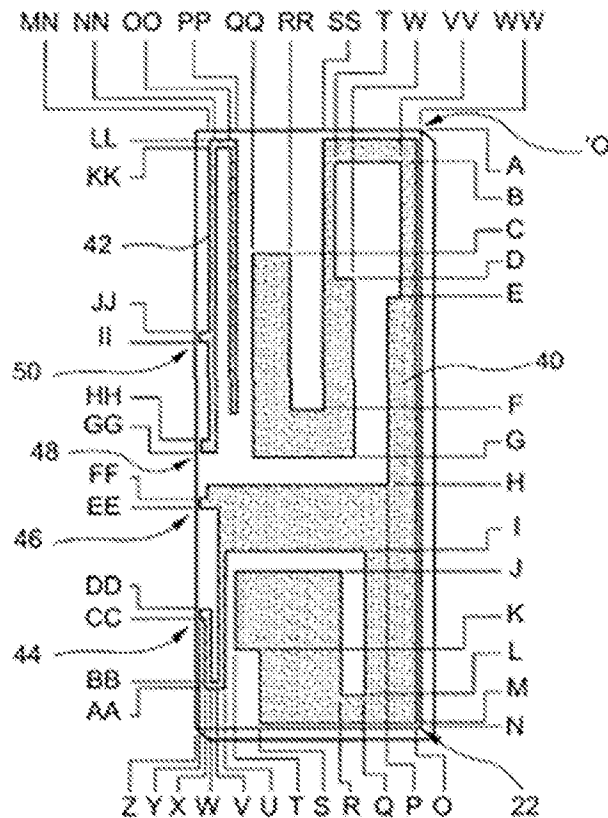
There is a reasonable likelihood that requester will prevail with respect to the claims challenged based on Johnson under 35 U.S.C. § 103. *See* 35 U.S.C. §§ 312 and 313. Johnson was filed on August 24, 1999, and published May 29, 2001, and thus is prior art under pre-AIA 35 U.S.C. § 102(a). Johnson was not cited

during original prosecution of the '103 patent and teaches or at least suggests (alone or in combination with other references cited herein) all claim features that the Examiner determined to be lacking in the prior art references cited during original prosecution of the '103 patent.

For example, Johnson is directed to “[a]n asymmetric dipole antenna assembly . . . provided for wireless communications devices.” Ex. 1003 at Abstract. Johnson “replaces the external wire antenna of a wireless communication device with a planar conformal element which is installed within the housing of a wireless device.” *Id.* at 2:5-9. This means that in Johnson, “an internal antenna . . . can easily fit inside the housing of a wireless transceiver such as a cellphone.” *Id.* at 2:21-22.

Johnson teaches an “antenna assembly of FIG. 9 [that] depicts a tri-band antenna assembly 20 functioning across a cellular band (880-960 MHz.), a PCS band (1710-1880 MHz.) and the BLUETOOTH™ band (2.4-2.5 GHz.)” *Id.* at 5:37-40. As described below, the Johnson antenna alone or as modified in view of the references cited and/or the POSITA, discloses, teaches, or suggests, the antenna elements of the claims.

FIG. 9



Id. at FIG. 9.

These features of Johnson correspond to the very elements in the independent claim that the applicant alleged to be novel, e.g., the first conductor 40 may correspond to the first antenna element of claim 12 and the second conductor 42 may correspond with the second antenna element of claim 12. Furthermore, as will be discussed in detail in the following section of this request, Johnson

discloses, teaches, suggests and/or makes obvious, alone or in combination with other references cited herein, all elements of claims 12 and 15 of the '103 patent.

B. U.S. Patent Application Publication No. 2007/0238483 to Boireau et al.

There is a reasonable likelihood that requester will prevail with respect to the claims challenged based on Boireau under 35 U.S.C. § 103. *See* 35 U.S.C. §§ 312 and 313. Boireau was filed in the US on April 5, 2006, published October 11, 2007, and thus is prior art under pre-AIA 35 U.S.C. § 102(e). Boireau was not cited during original prosecution of the '103 patent and teaches or at least suggests (alone or in combination with other references cited herein) all claim features that the Examiner determined to be lacking in the prior art references cited during original prosecution of the '103 patent.

For example, Boireau is directed to “[a] mobile computing device [that] may comprise an antenna, a switch to couple to the antenna, and multiple transceivers to couple to the switch.” Ex. 1004 at Abstract. Boireau discloses a “wireless device 100 may comprise a mobile computing device. A mobile computing device may include any computing device with a self-contained power source, such as a battery, for example.” *Id.* at ¶[0018]. Boireau further discloses that “mobile computing device 100 may be implemented as a combination handheld computer and mobile telephone, sometimes referred to as a smart phone.” *Id.* at ¶[0019]. The

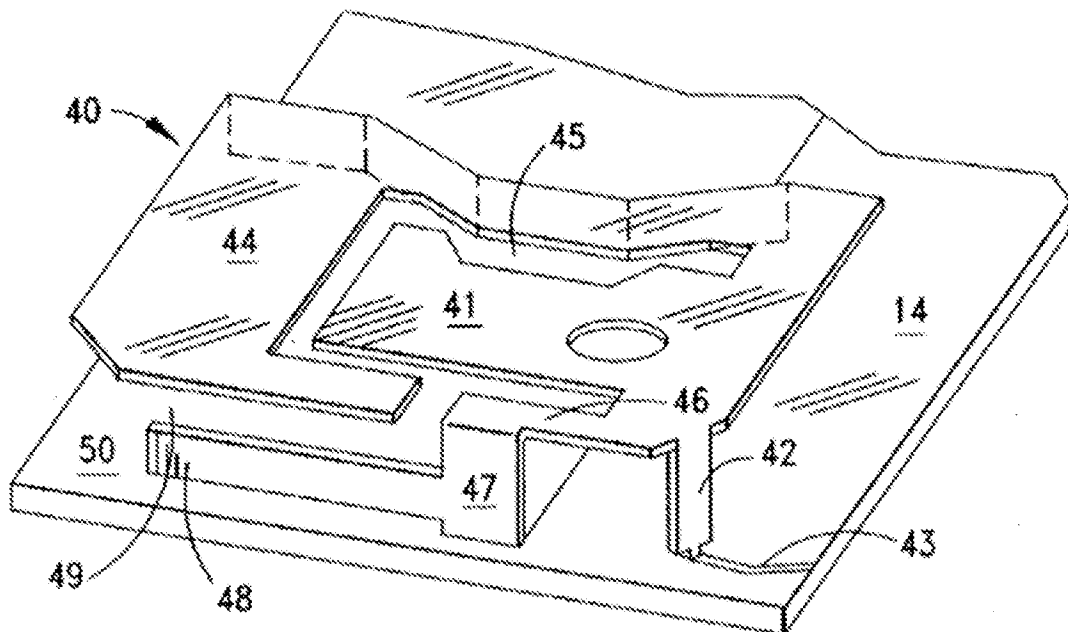
These features of Boireau correspond to the very elements in the independent claim that the applicant alleged to be novel. For example, the mobile computing device of Boireau corresponds to the handheld multifunction wireless device having at least one of multimedia functionality and smartphone functionality of claim 12. *Id.* at ¶[0018]. In addition, Boireau discloses support for a handheld multifunction wireless device having multiple internal antennas configured to support simultaneous multi-band functionality. *Id.* at ¶¶[0025],[0026],[0039]. Furthermore, as will be discussed in detail in the following section of this request, Boireau discloses, teaches, suggests and/or makes obvious, alone or in combination with other references cited herein, all elements of claims 12 and 15 of the '103 patent.

C. U.S. Patent Application Publication No. 2003/0189522 to Zeilinger

There is a reasonable likelihood that requester will prevail with respect to the claims challenged based on Zeilinger under 35 U.S.C. § 103. *See* 35 U.S.C. §§ 312 and 313. Zeilinger was filed in the US on April 4, 2003, published October 9, 2003, and thus is prior art under pre-AIA 35 U.S.C. § 102(a)-(b). Zeilinger was not cited during original prosecution of the '103 patent and teaches or at least suggests (alone or in combination with other references cited herein) all claim features that the Examiner determined to be lacking in the prior art references cited during original prosecution of the '103 patent.

For example, Zeilinger is directed to “[a] multiple frequency band antenna [that] is capable of operating in at least three distinct preselected frequency bands.” Ex. 1005, Abstract. It is an object of Zeilinger “to provide in one embodiment of the invention, a tri-band antenna for use with mobile telephones that is capable of operating in at least three distinct preselected frequency bands.” Ex. 1005 at ¶[0011]. Zeilinger teaches an “antenna [that] will fit into the top portion of the internal cavity of the telephone housing 10.” *Id.* at ¶[0029].

FIG. 3



Id. at FIG. 3.

In addition, Zeilinger teaches use of a second antenna element, “FIG. 1 illustrates a mobile telephone housing 10 which is exemplary of the environment in which antennas of the present invention are used... *One or more printed circuit boards 14, 20* may be provided and supported within the cavity 12. Integrated circuits 15 in the form of chips 16 that power different aspects of the telephone may be supported on the circuit boards 14 and terminated to various circuits thereon.” *Id.* 1005 at ¶[0024] (emphasis added). As described in Zeilinger, both the PCB 14, and the PCB 20 are configured to support an antenna. *Id.* at FIG. 3; *Id.* at ¶[0034].

These features of Zeilinger correspond to the very elements in the independent claim that the applicant alleged to be novel. For example, the multiple frequency band antenna of Zeilinger corresponds to the first antenna element of claim 12 of the ’103 patent. In addition, Zeilinger discloses support for a second element positioned within the housing of the mobile device. *Id.* at ¶[0024]. Furthermore, as will be discussed in detail in the following section of this request, Zeilinger discloses, teaches, suggests and/or makes obvious, alone or in combination with other references cited herein, all elements of claims 12 and 15 of the ’103 patent.

D. U.K. Patent Application Publication No. GB 2416625A to Langley et al.¹

There is a reasonable likelihood that requester will prevail with respect to the claims challenged based on Langley under 35 U.S.C. § 103. *See* 35 U.S.C. §§ 312 and 313. Langley was filed on July 22, 2004 and published January 2, 2006, and thus is prior art under pre-AIA 35 U.S.C. § 102(a),(e). Langley was not cited during original prosecution of the '103 patent and teaches or at least suggests (alone or in combination with other references cited herein) all claim features that the Examiner determined to be lacking in the prior art references cited during original prosecution of the '103 patent.

For example, Langley disclosed a compact and efficient multi-element, multi-band antenna that operates on five frequency bands. Ex. 1006 at Fig. 1, 2:24-26, 4:29-7, 8:8-13. As Langley explains, the need for a compact, efficient multi-band antenna was well-known and well-understood. *Id.* at 2:21-22. “The invention [of Langley] provides a compact and efficient multi-band antenna capable of supporting a variety of frequency bands for cellular telecommunications and wireless connectivity.” *Id.* at 3:4-6. Langley teaches the use of its disclosed

¹ In a reexamination in a related patent, 90/019,275, the Examiner found a substantial new question of patentability in view of Langley. Order Granting Request for Ex Parte Reexamination, 90/019,275, January 10, 2024.

antennas in connection with wireless devices, including mobile phones known to have multimedia functionality or smartphone functionality. *Id.* at 1:3-5.

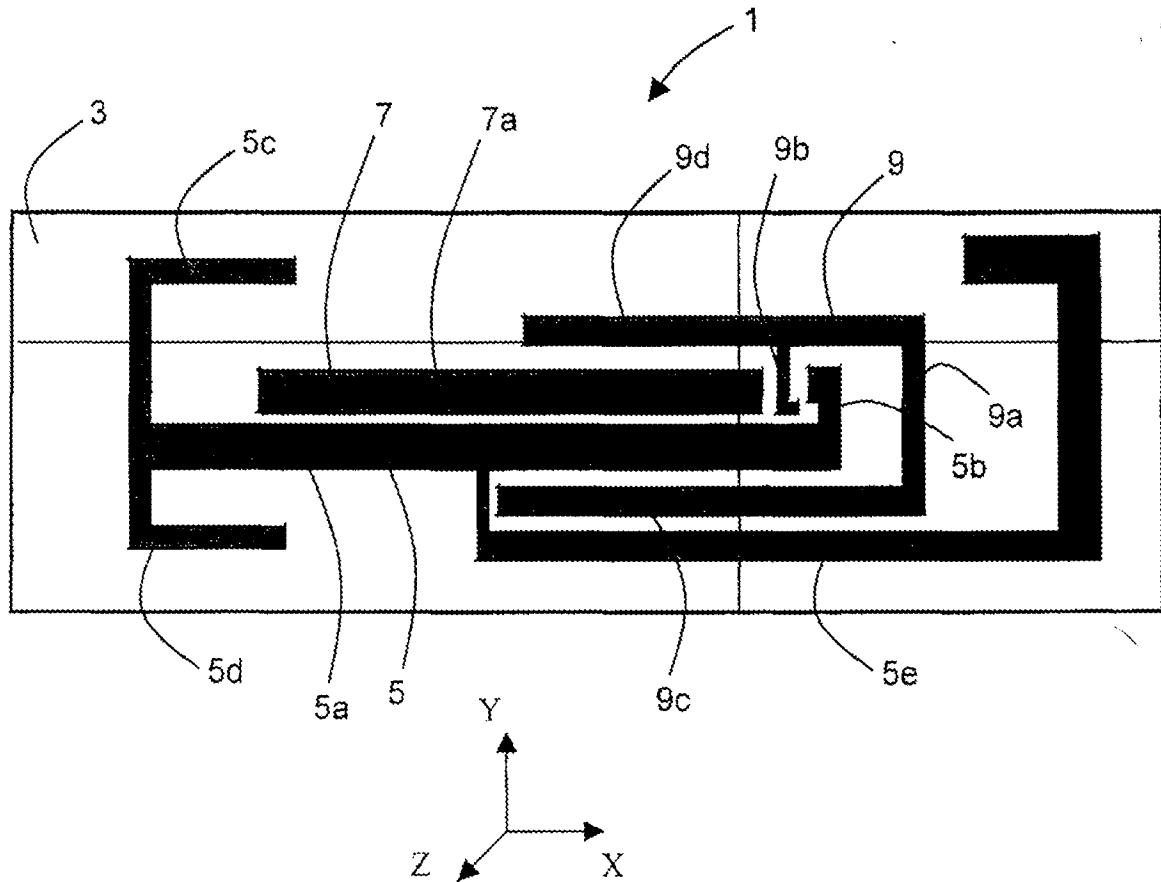


Fig. 1

These features of Langley correspond to the very elements in the independent claim that the applicant alleged to be novel. For example, the multi-band antenna of Langley corresponds to the first antenna element and/or second antenna element of claim 12 of the '103 patent. Furthermore, as will be discussed in detail in the following section of this request, Zeilinger discloses, teaches,

suggests and/or makes obvious, alone or in combination with other references cited herein, all elements of claims 12 and 15 of the '103 patent.

VI. PROPOSED CLAIM REJECTIONS

Claims 12 and 15 of the '103 patent are obvious under 35 U.S.C. § 103 in view of several different prior art references cited herein, which were not previously considered by the examiner during the prosecution of the '103 patent.

A. Ground 1: Claims 12 and 15 of the '103 patent are invalid as obvious under 35 U.S.C. § 103(a) over Boireau in view of Zeilinger, and thus Boireau in view of Zeilinger present a Substantial New Question of Patentability.

1. The combination of Boireau and Zeilinger presents a substantial new question of patentability

The combination of Boireau and Zeilinger presents a substantial new question of patentability because the combination discloses or suggests each and every limitation of claims 12 and 15 of the '103 patent to include those that have been alleged to be novel. *See* Ground 1, *infra*; Ex. 1002 at ¶¶69-170. In fact, the combined system of Boireau and Zeilinger relies on the smart phone of Boireau along with the antennas of Zeilinger. *See* Ground 1, *infra*. Indeed, Zeilinger discloses or suggests an antenna of at least 35 segments and having a design that meets the elements of claims 12 and 15. *See e.g.*, Ex. 1005 at FIG. 2; *see also* Ex. 1002 at ¶¶140-143.

For at least these reasons, the additional argument and citations set forth below in Ground 1, the rationale for combination, and the supporting testimony of Dr. Manos M. Tentzeris (Ex. 1002), the combination of Boireau and Zeilinger presents a substantial new question of patentability as to claims 12 and 15. *See* Ground 1, *infra*; Ex. 1002 at ¶¶69-170.

2. Rationale for the combination of Boireau and Zeilinger

Boireau in view of Zeilinger renders obvious claims 12 and 15 of the '103 patent. According to MPEP §2143(0), a claim would have been obvious if (1) there is some teaching, suggestion, or motivation, in the references themselves to modify the prior art device or method and (2) there was a reasonable expectation of success. This rationale is flexible, and an explicit suggestion to combine is not necessary. *Id.*

A person of ordinary skill in the art would have been motivated to apply the multi-band antenna of Zeilinger to the smart phone of Boireau because the Zeilinger antenna advantageously provides multiple wireless bands, is compact, and provides flexibility for the operator of the Boireau device. Ex. 1005 at ¶[0002]; *see also* Ex. 1002 at ¶122-124.

Boireau discloses the need to reduce the overall number of antennas while still allowing for an antenna array with multiple different antennas. Ex. 1004 at ¶[0026]; *see also* Ex. 1002 at ¶71. Boireau contemplates that such antennas may be

internal antennas. *Id.* at ¶[0025]; *see also* Ex. 1002 at ¶71. Indeed, Boireau discloses that relying on a shared antenna array “architecture may reduce or obviate the need for mobile computing device 100 to include an antenna or antenna array for each transceiver 308-1-n, and the corresponding cost and complexity associated with each additional antenna or antenna array.” *Id.* at ¶[0037]; *see also* Ex. 1002 at ¶71. Further, Boireau contemplates that the “entire antenna array may be shared between and among transceivers 308-1-n of transceiver module 304.” *Id.* at ¶[0048]; *see also* Ex. 1002 at ¶71.

Boireau discloses the need for antenna support for at least three bands. Ex. 1002 at ¶72. That is, Boireau specifically requires operation in at least five bands and, thus, teaches or suggests antennas that support at least five bands. Ex. 1004 at ¶[0061]; *see also* Ex. 1002 at ¶72. For example, Boireau discloses an embodiment that has at least “transceivers 308-1, 308-2 [that] may be arranged to perform data communications in accordance with a different set of wireless communications protocols and techniques” and “radio sub-system 202 and/or transceiver module 304 may include a third transceiver primarily directed to voice communications, such as a cellular radiotelephone system transceiver (e.g., GSM transceiver, UMTS transceiver, CDMA transceiver, and so forth).” Ex. 1004 at ¶[0039]; *see also* Ex. 1002 at ¶72. Boireau discloses that “radio sub-system 202 may include various other transceivers and accompanying antennas, such as one or more cellular

radiotelephone system transceivers (e.g., GSM, UMTS, or CDMA transceivers), a GPS transceiver, and so forth” and notes in Tables 8-10 that the Boireau system must allow for at least five bands (e.g., 869-894 MHz, 925-960MHz, etc.) to co-exist. Ex. 1004 at ¶[0061]; *see also* Ex. 1002 at ¶72.

TABLE 8

Max. Noise (dBm/Hz)					
	Freq (MHz)	w/ BPF*	at PA Output**	At 8686 Output	
Maximum	869-894	-164	-119	-119	Continuous
TX	925-960	-164	-119	-119	Mode Tx at
Wideband	1565-1585	-164	-124	-124	54 Mbps
Noise	1805-1880	-164	-124	-129	Power = 15
	1920-1990	-164	-124	-134	dBm***
	2110-2170	-164	-124	-144	

Id. at Table 8.

Finally, Boireau Figure 4 contemplates a cellular transceiver that communicates on multiple bands (e.g., at least five bands) and addresses “transceiver and/or antenna interference” between these multiple bands further confirming to the skilled artisan that Boireau suggests at least five bands (e.g., 850,

400

GSM / UMTS band	Typical GSM / UMTS Sensitivity	SNR Req.	Noise Floor	Margin	Required System Noise	Antenna Coupling	Allowed WLAN noise @Antenna	Actual PA noise @16 dBm	Filter Min. Req.
	QAM (200 KHz, 5 MHz)	dB	dBm/Hz	dB	dBm/Hz	dB	dBm/Hz	dBm/Hz	dB
850.0	-106.5	7.0	-166.5	5.0	-171.5	-10.0	-161.5	-147.0	14.5
900.0	-108.5	7.0	-168.5	5.0	-173.5	-10.0	-163.5	-149.0	15.5
PCS	-106.5	7.0	-166.5	5.0	-171.5	-10.0	-161.5	-137.0	24.5
PCS	-108.5	7.0	-168.5	5.0	-173.5	-10.0	-163.5	-139.0	28.5
UMTS	-112.0	-18.0	-168.0	5.0	-173.0	-10.0	-163.0	-117.0	46.0

900, DCS, PCS, UTMS) because it contemplates interference between at least these bands. Ex. 1004 at ¶[0061]; *see also* Ex. 1002 at ¶72.

Ex. 1004 at Figure 4.

Although the design and dimensions of antenna(s) would be obvious to the person of ordinary skill in the art, Boireau does not specifically disclose the design and dimensions of the antenna(s) that are used to implement each of its disclosed and/or required bands. Ex. 1002 at ¶74. As such, the skilled artisan would turn to references that disclosed antennas that provided support in desired bands, such as the antenna in Zeilinger. Ex. 1002 at ¶74. The Zeilinger antennas provide support for the multiple suggested and/or desired bands while providing a compact and efficient antenna array. Ex. 1002 at ¶74. Specifically, Zeilinger discloses “a multiple band antenna for use in small, internal spaces, such as those encountered in mobile telephones, and which operates in multiple frequency bands.” Ex. 1005 at ¶[0007]; *see also* Ex. 1002 at ¶74. Further, Zeilinger discloses “a low cost multiple band antenna having a small form factor and which is capable of operating in three distinct frequency bands so as to operate in GSM900 frequency band (from 880 to 960 Megahertz), the GSM1800 frequency band (from 1710-1889 Megahertz) and the PCT-GSM 1900 frequency band (also referred to as the UMTS Band extending from 1900 to 2170 Megahertz).” Ex. 1005 at ¶[0008]; *see*

also Ex. 1002 at ¶75. As such, Zeilinger provides specific reasons to implement its antennas. *KSR Int'l Co. v. Teleflex*, 550 U.S. 398 (2007); MPEP 2143.I; *see also* Section II.B (explaining the well-known need for antennas systems with both a small form factor and multi-band capability).

The implementation of the Zeilinger antennas is also a simple substitution of one known element for another. Ex. 1002 at ¶76. As is described below, Boireau discloses a device which is the same as the device claimed in claim 12 but for the specific antenna element design. *See supra*. That said, Boireau recited and suggested the need to have antennas that support multiple bands. Ex. 1004 at ¶¶[0061]-[0062]. As is described herein, the person of skill in the art would have implemented the antenna components of Zeilinger. *see also* Ex. 1002 at ¶78. Zeilinger is directed to “[a] multiple frequency band antenna [that] is capable of operating in at least three distinct preselected frequency bands.” Ex. 1005, Abstract. Indeed, the substitution of the Zeilinger antenna for the disclosed antenna components in Boireau obtains the predictable result of increasing the number of wireless bands as well as implementing the bands contemplated by Boireau. *See supra*; *see also see also* Ex. 1002 at ¶76.

The implementation of the Zeilinger antenna is also a design choice that could be readily implemented by a person of ordinary skill in Boireau. *See In re Kuhle*, 526 F.2d 553, 555 (CCPA 1975) (“design choice may be an acceptable

rationale for an obviousness rejection when a claimed product merely arranges known elements in a configuration recognized as functionally equivalent to a known configuration.”). As mentioned above, there is explicit motivation for implementing the Zeilinger antennas. In addition, the implementation allows for the benefit of having shared antennas that are compact and efficient. Ex. 1002 at ¶77. Here, the person of ordinary skill in the art would have recognized that the arrangement relying on the Zeilinger antennas is a design choice that implements and is a functional equivalent of the antennas and the required band support disclosed in Boireau. Ex. 1002 at ¶77. Further, the person of ordinary skill in the art would have had a reasonable expectation of success given that the Zeilinger antenna is designed for use in mobile phones. Ex. 1002 at ¶78. Further Boireau provides for the ability for multiple bands to be operating at the same time. Ex. 1004 at ¶¶[0061-0062]; *see also* Ex. 1002 at ¶78. As such, the skilled artisan would have expected the antenna of Zeilinger to be operable in the Boireau system. Ex. 1002 at ¶78.

As such, the modification of Zeilinger to include those features of Boireau would have been easily and predictably accomplished. Thus, based on the rational set forth in MPEP §2143(0), it would have been obvious to apply the multi-band antenna of Zeilinger to the smart phone of Boireau.

3. Claim 12

- i) **“A handheld multifunction wireless device having at least one of multimedia functionality and smartphone functionality, the handheld multifunction wireless device comprising:”
(preamble)**

Zeilinger teaches “a handheld multifunction wireless device having at least one of multimedia functionality and smartphone functionality, the handheld multifunction wireless device comprising.” Ex. 1002 at ¶¶79-80. Zeilinger teaches “FIG. 1 illustrates a mobile telephone housing 10 which is exemplary of the environment in which antennas of the present invention are used. As is known, the telephone housing 10 is formed from suitable plastic in the form of a hollow shell 11 having an internal cavity 12 surrounded by exterior sidewalls 13a, 13b. One or more printed circuit boards 14, 20 may be provided and supported within the cavity 12. Integrated circuits 15 in the form of chips 16 that power different aspects of the telephone may be supported on the circuit boards 14 and terminated to various circuits thereon.” Ex. 1005 at ¶[0024]; *see also* Ex. 1002 at ¶81.

Boireau also teaches “a handheld multifunction wireless device having at least one of multimedia functionality and smartphone functionality, the handheld multifunction wireless device comprising.” Ex. 1004 at FIG. 1; *see also* Ex. 1002 at ¶82. For example, the following figures and the corresponding written

description disclose a handheld multifunction wireless device having at least one of multimedia functionality and smartphone functionality:

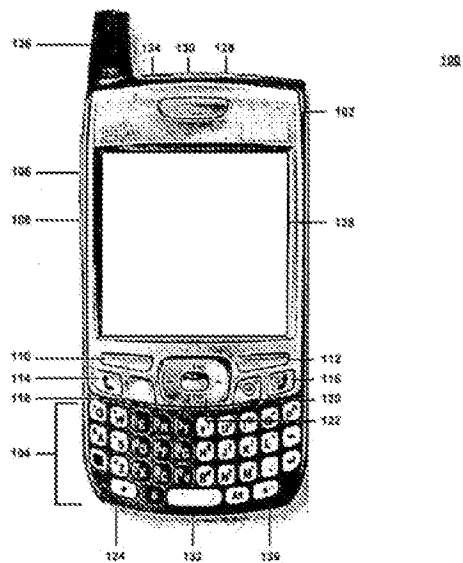


FIG. 1

Ex. 1004 at FIG. 1 (illustrating a smart phone).

Boireau teaches that “FIG. 1 illustrates one embodiment of a wireless device 100. Wireless device 100 may comprise any device having a wireless transceiver arranged to communicate over one or more portions of a radio-frequency (RF) spectrum. In one embodiment, for example, wireless device 100 may comprise a mobile computing device.” *Id.* at ¶[0018]; *see also* Ex. 1002 at ¶83. Boireau further discloses that “mobile computing device 100 may be implemented as a combination handheld computer and mobile telephone, sometimes referred to as a **smart phone**.” Ex. 1004 at ¶[0019] (emphasis added). The mobile computing

device of Boireau may include a “display 138 [that] may be implemented as an additional I/O device, such as a touch screen, touch panel, touch screen panel, and so forth” *Id.* at ¶[0023]. Boireau includes several multi-media functions to include applications, such as “office suites, business software, educational software, databases, communications software, computer games, and so forth. *Id.* at ¶[0065]. In addition, Boireau contemplates audio over a headset as well as other multimedia streaming. *Id.* at ¶¶ [0090] – [0091].

As set forth above, a person of ordinary skill would have had reason to combine Boireau and Zeilinger to improve antenna geometry for small devices. Ex. 1005 at ¶[0002]; Ex. 1004 at ¶[0001]; *see* Rationale for combination, *supra*; *see also* Ex. 1002 at ¶84. In addition, there would have had a reasonable expectation of success in combining Boireau and Zeilinger because Boireau and Zeilinger both involve antenna designs within wireless devices and therefore are analogous art directed to the same field of endeavor as the ’103 patent. *See id.*; *see also* Ex. 1002 at ¶85.

Thus, a person of ordinary skill would find this limitation disclosed in the teachings of Boireau and Zeilinger and their incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention.

ii) “a touch screen;”

As set forth above, Zeilinger teaches use of its disclosed antennas in connection with wireless devices, including mobile phones, which were known to have touch screens. Ex. 1002 at ¶88.

Boireau additionally discloses this claim limitation. Boireau teaches that “[m]obile computing device 100 may comprise various input/output (I/O) devices. Such as an alphanumeric keyboard, alphanumeric keypad, numeric keys, keys, buttons, switches, rocker switches, multi-directional rocker switches, a microphone, an audio headset, a camera, ***a touch-sensitive display screen***, a stylus, and so forth.” Ex. 1004 at ¶[0021]; *see also* Ex. 1002 at ¶89 (emphasis added). Therefore, a person of ordinary skill would find that Boireau discloses a touch screen. Ex. 1002 at ¶90.

A person of ordinary skill would have found it obvious to combine the teachings of Boireau with those of Zeilinger because it was obvious to use the antennas of Zeilinger with any of a variety of mobile phones at the time, including those with a touch screen as disclosed by Boireau and further Boireau specifically contemplated antennas covering multiple bands, such as those disclosed in Zeilinger. *see* Rationale for combination, *supra*; *see also* Ex. 1002 at ¶90.

iii) “a processing module;”

Zeilinger teaches use of its disclosed antennas in connection with wireless devices, including mobile phones, which were known to have processors. Thus, a

person of ordinary skill in the art would find this limitation disclosed in the teachings of Zeilinger and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶92.

Regardless, Boireau discloses “a processing module.” Boireau teaches that “[h]ousing 102 may be used to encapsulate various internal components for mobile computing device 100, such as *a processor*, a memory, one or more transceivers, one or more printed circuit board (PCB), one or more antennas, a stylus, and so forth.” Ex. 1004 at ¶[0020]; *see also* Ex. 1004 at ¶[0036]; *see also* Ex. 1002 at ¶93. The ’103 patent defines a “processing module” as a “microprocessor or CPU.” Ex. 1001 at 8:21-22. Therefore, according to the definition set forth in the ’103 patent, Boireau’s “processor” is a processing module. Ex. 1002 at ¶94.

Thus, a person of ordinary skill in the art would have found it obvious to combine the teachings of Boireau with those of Zeilinger because they would have found it obvious to use the antennas of Zeilinger with any of a variety of mobile phones at the time, which included processors, such as the mobile phone of Boireau. *See* Rationale for combination, *supra*; *see also* Ex. 1002 at ¶95-96.

iv) “a memory module;”

As set forth above, Zeilinger teaches use of its disclosed antennas in connection with wireless devices, including mobile phones, which were known to

have memory. Thus, a person of ordinary skill in the art would have found this limitation disclosed in the teaching of Zeilinger and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶98.

Boireau also teaches that “[h]ousing 102 may be used to encapsulate various internal components for mobile computing device 100, such as a processor, *a memory*, one or more transceivers, one or more printed circuit board (PCB), one or more antennas, a stylus, and so forth.” Ex. 1004 at ¶[0020] (emphasis added) *see also* Ex. 1004 at ¶[0041]; *see also* Ex. 1002 at ¶99. Additionally, for the same reasons as described above, a person of ordinary skill in the art would have found it obvious to combine the teachings of Boireau with those of Zeilinger because it was obvious to use the antennas of Zeilinger with any of a variety of mobile phones at the time, which included memory, such as those disclosed by Boireau. *See* Rationale for combination, *supra*; *see also* Ex. 1002 at ¶¶100-101.

v) “a communication module;”

Boireau and Zeilinger teach this feature for at least the following reasons. As set forth above, Zeilinger teaches use of its disclosed antennas in connection with wireless devices, including mobile phones, which were known to have antennas for communication. Ex. 1002 at ¶103.

For example, Zeilinger teaches, “[w]ith the advent of digital signal transmission systems used in mobile telephones, other frequency bands are being utilized for communication. These bands are separated and are utilized for different communications application, for example, the go anywhere aspect of the PCS (“Personal Communication Services”) band, the GSM band that is widely used in Europe and other bands. Each of these bands offers certain advantages and it is desirable to utilize mobile telephones that operate reliably within all such bands. Important to this operation are effective antennas.” Ex. 1005 at ¶[1004]; *see also* Ex. 1002 at ¶104.. Thus, a person of ordinary skill in the art would find this disclosed in the teachings of Zeilinger and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention.

Additionally, Boireau discloses this feature. Boireau teaches that “[h]ousing 102 may be used to encapsulate various internal components for mobile computing device 100, such as a processor, a memory, one or more transceivers, one or more printed circuit board (PCB), one or more antennas, a stylus, and so forth.” Ex. 1004 at ¶[0020]. Boireau explains “mobile computing device 100 may include a **radio sub-system 202** connected via bus 204 to a processing sub-system 206. Radio sub-system 202 may perform voice and/or data communications operations on behalf of mobile computing device 100.” Ex. 1004 at ¶[0028] (emphasis added); *see also*

Ex. 1002 at ¶105. Further, “Radio sub-system 202 may perform voice and/or data communication operations for mobile computing device 100. For example, radio sub-system 202 may be arranged to communicate voice information and/or data information over one or more assigned frequency bands of a wireless shared media.” Ex. 1004 at ¶[0030]. Finally, “radio sub-system 202 may implement a shared antenna architecture for multiple transceivers used to implement voice and/or data communications as previously described.” Ex. 1004 at ¶[0035]; *see also* Ex. 1002 at ¶105. Boireau also teaches a “transceiver module 304 [that] may include multiple transceivers and associated hardware and/or software components implemented in a single integrated package or module, such as on the same die, package or PCB. Transceiver module 304 may be implemented using a single chip, multiple chips, or a system on a chip (SoC) solution, as desired for a given set of performance and design constraints.” Ex. 1004 at ¶[0036]; *see also* Ex. 1002 at ¶105. Thus, a person of ordinary skill in the art would find this disclosed in the teachings of Boireau and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶106.

vi) “a power management module;”

The ’103 patent describes the power management module as the “single source of energy” for the MFWD (wireless device). Ex. 1001 at 8:26-28. As set

forth above, Zeilinger teaches use of its disclosed antennas in connection with wireless devices, including mobile phones, which were known to have energy sources for operation. Ex. 1002 at ¶109. Thus, a person of ordinary skill in the art would find this disclosed in the teachings of Zeilinger and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶111.

Additionally, Boireau discloses this feature. Boireau teaches that “[m]obile computing device 100 also may comprise a rechargeable battery, such as a removable and rechargeable lithium ion battery, and an alternating current (AC) adapter.” Ex. 1004 at ¶[0022]; *see also* Ex. 1002 at ¶110. Boireau further discloses: “mobile computing device 100 may further include a ***power management sub-system 208***. Power management sub-system 208 may manage power for mobile computing device 100, including radio sub-system 202, processing sub-system 206, and other elements of mobile computing device 100. For example, power management sub-system 208 may include one or more batteries to provide direct current (DC) power, and one or more AC interfaces to draw power from an AC power source, such as a standard AC main power supply.” Ex. 1004 at ¶[0029] (emphasis added); *see also* Ex. 1002 at ¶110. Additionally, for the same reasons as described above, a person of ordinary skill in the art would have found it obvious to combine the teachings of Boireau with those of Zeilinger because it was obvious

to use the antennas of Zeilinger with any of a variety of mobile phones at the time, which included power management modules (e.g, batteries) as disclosed by Boireau. *See* Rationale for combination, *supra*; *see also* Ex. 1002 at ¶112. Thus, a person of ordinary skill in the art would find this limitation disclosed in the teachings of Boireau and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶112.

vii) “an antenna system within the handheld multifunction wireless device and comprising:”

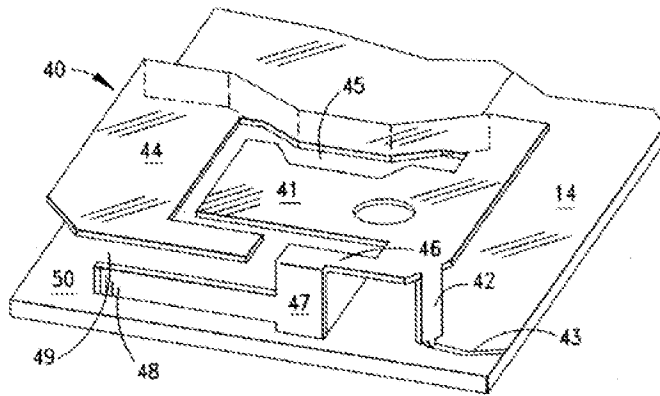
Zeilinger teaches “an antenna system within the handheld multifunction wireless device and comprising.” Ex. 1002 at ¶114. For example, Zeilinger teaches, “FIG. 1 illustrates a mobile telephone housing 10 which is exemplary of the environment in which antennas of the present invention are used. As is known, the telephone housing 10 is formed from suitable plastic in the form of a hollow shell 11 having an internal cavity 12 surrounded by exterior sidewalls 13a, 13b. One or more printed circuit boards 14, 20 may be provided and supported within the cavity 12. Integrated circuits 15 in the form of chips 16 that power different aspects of the telephone may be supported on the circuit boards 14 and terminated to various circuits thereon.” Ex. 1005 at ¶[0024]; *see also* Ex. 1002 at ¶114. Thus, Zeilinger discloses an antenna system within the handheld multifunction wireless

at ¶118.



Ex. 1005 at FIG. 2.

FIG. 3



Ex. 1005 at FIG. 3.

Boireau also discloses this limitation. Boireau teaches that “[m]obile computing device 100 may comprise an antenna system including one or more antennas.” Ex. 1004 at ¶[0025]; *see also* Ex. 1002 at ¶116.

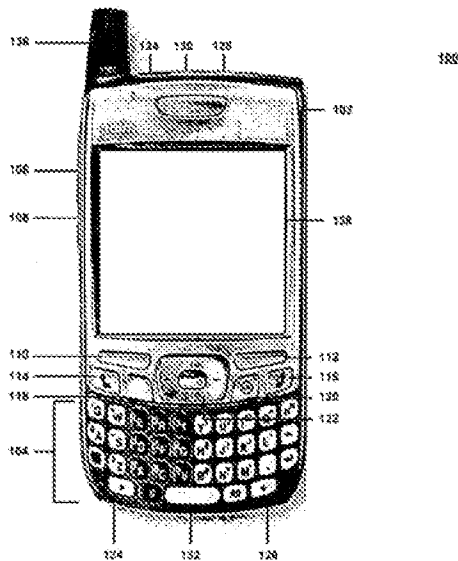


FIG. 1

Ex. 1004 at FIG. 1.

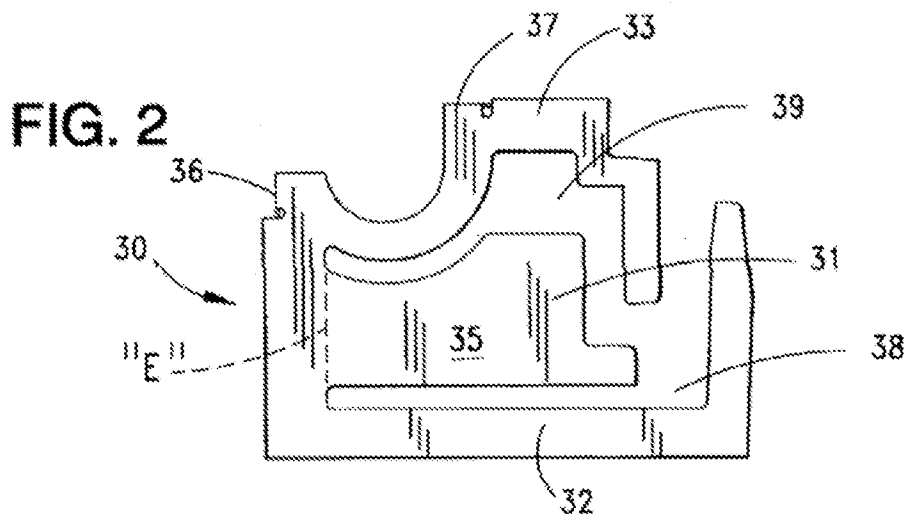
Boireau further teaches “antenna 318 may be implemented alone, or as part of a broader antenna system (e.g., antenna 136) or antenna array for mobile computing device 100.” Ex. 1004 at ¶[0048]; *see also* Ex. 1002 at ¶117. Thus, Boireau discloses an antenna system within the handheld multifunction wireless device and a person of ordinary skill in the art would find this disclosed in the teachings of Boireau and its incorporated disclosures taken as a whole, or in

combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶118.

A person of ordinary skill would have found it obvious to combine the teachings of Boireau with those of Zeilinger because it would have been known and understood to use the antennas of Zeilinger with any of a variety of mobile phones at the time, including those with a touch screen as disclosed by Boireau and further Boireau specifically contemplated antennas that covering multiple bands, such as those disclosed in Zeilinger. *See* Rationale for combination, *supra*.

viii) “a ground plane layer;”

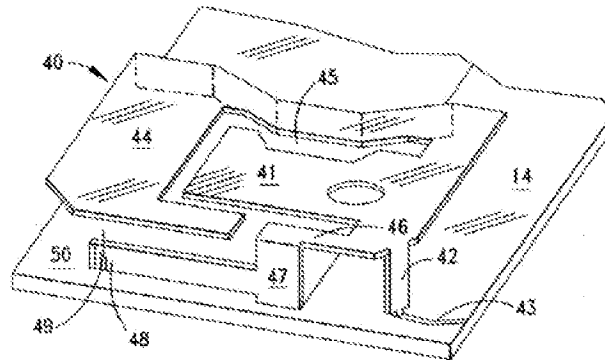
Zeilinger explains that “[a] second leg portion 37 is provided and it also is angled with respect to the radiating elements 31-33. This leg portion is electronically connected to a ground plane of the telephone 10, which can be a separate component, or it can be formed on one of the circuit boards 14.” Ex. 1005, ¶[0028]; *see also* Ex. 1002 at ¶120.



Ex. 1005 at FIG. 2.

Also, “[i]n this instance, the third radiator communicates directly with the ground pin 47 and extends in a direction between the two radiating elements and a ground plane 50 that is either formed on the surface of the circuit board 14 or formed as a layer of the circuit board.” Ex. 1005 at ¶[0033]; *see also* Ex. 1002 at ¶120.

FIG. 3

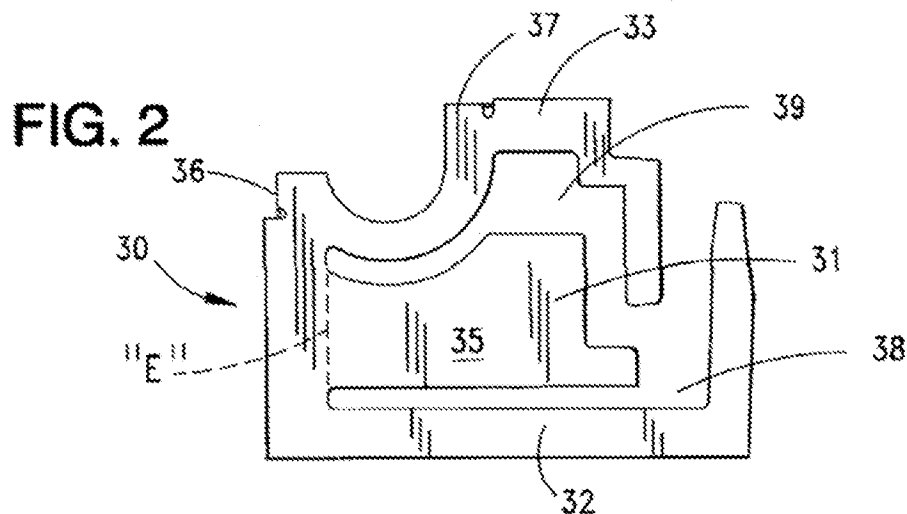


Ex. 1005 at FIG. 3.

Thus, a person of ordinary skill in the art would find this limitation disclosed in the teachings of Zeilinger and its disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. *See* Rationale for combination, *supra*; *see also* Ex. 1002 at ¶121.

- ix) **“a first antenna element configured to simultaneously support radiation modes for first, second, and third frequency bands,”**

Zeilinger discloses a tri-band antenna. Ex. 1005 at ¶[0011] (“[a] further object of the present invention is to provide in one embodiment of the invention, a tri-band antenna for use with mobile telephones that is capable of operating in at least *three distinct preselected frequency bands*. . .” (emphasis added)); *see also* Ex. 1002 at ¶123.



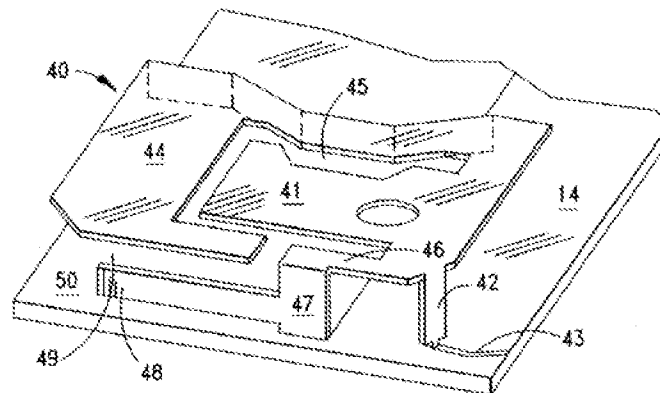
Ex. 1005 at FIG. 2.

Specifically, Zeilinger teaches that “the radiating element 38 [sic, 33] drives the PCS frequency band, while the second radiating element 32 drives the GSM900 frequency band. The third radiating element improves the bandwidth of the antenna by driving the PCN frequency band of the antenna.” Ex. 1005 at ¶[0029]; *see also* Ex. 1002 at ¶123.

Zeilinger further teaches “[t]he antenna 40 has a first, or base radiator 41 that is in communication with a feed pin, or leg 42 that is connected to a feed circuit 43 of the circuit board 14. A second radiator 44 is provided and takes the form of a conductive branch that extends around a portion of the perimeter of the first radiator 41, shown in FIG. 3 as extending around portions of three sides of the perimeter of the first radiator 41. A slot 45 formed therein defines a space between the first and second radiators 41, 44. An extension portion of the antenna serves to communicate a ground pin, or leg 47 with a first and second radiators. A third

radiator 48 is provided and it extends horizontally spaced apart from the first and second radiators, 41, 44, as in the antenna 30 of FIG. 2, but it lies in a vertical plane rather than the common horizontal plane in which the first and second radiators 41, 44 lie.” *Id.* at ¶[0032]-[0033]; *see also* Ex. 1002 at ¶123. A person of ordinary skill in the art would understand that each radiator (e.g., radiator 41, radiator 44, radiator 48) simultaneously supports an individual radiation mode. Ex. 1002 at ¶123.

FIG. 3



Ex. 1005 at FIG. 3.

Thus, a person of ordinary skill in the art would find this limitation disclosed in the teachings of Zeilinger and its incorporated disclosures taken as a whole. Ex. 1002 at ¶124.

- x) **“the first frequency band being contained within a first frequency region of an electromagnetic spectrum,”**

Zeilinger discloses “It is therefore a general object of the present invention to provide a low cost multiple band antenna having a small form factor and which is capable of operating in three distinct frequency bands so as to operate in GSM900 frequency band (from 880 to 960 Megahertz), the GSM1800 frequency band (from 1710-1889 Megahertz) and the PCT-GSM 1900 frequency band (also referred to as the UMTS Band extending from 1900 to 2170 Megahertz).” Ex. 1005 at ¶[0008]; *see also* Ex. 1002 at ¶126.

Zeilinger further teaches, “FIG. 6 illustrates a VSWR plot of the antenna 30 of FIGS. 2 and 4, with the third radiating element 33 in place. Two peaks are shown on the plot and the second peak, “B”, shown to the right of FIG. 6) is wider than the second peak, “B”, to the right of FIG. 5. This is because the third radiating element causes a third peak, or spike close to the second one and the two radiating elements cooperatively combine to form a single, wider peak, or Spike. In FIG. 6, the first peak “A”, as defined by markers 1 and 2 provide an effective bandwidth from 880 to 960 MHZ at 6 dB, while the second peak “B”, as defined by markers 3 and 5, provide an effective bandwidth from 1710 to 1990 MHz, thereby effectively encompassing both the GSM 1800 and 1900 bands (and the PCS band).” Ex. 1005 at ¶[0031]; *see also* Ex. 1002 at ¶127. As such, Zeilinger discloses the GSM900 frequency band (*i.e.*, the first frequency band being contained within a first frequency region of an electromagnetic spectrum). Ex. 1002 at ¶127.

Thus, a person of ordinary skill in the art would find this limitation disclosed in the teachings of Zeilinger and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶128.

- xi) **“the second frequency band being contained within a second frequency region of the electromagnetic spectrum that is higher in frequency than the first frequency region,”**

Zeilinger discloses “It is therefore a general object of the present invention to provide a low cost multiple band antenna having a small form factor and which is capable of operating in three distinct frequency bands so as to operate in GSM900 frequency band (from 880 to 960 Megahertz), the GSM1800 frequency band (from 1710-1889 Megahertz) and the PCT-GSM 1900 frequency band (also referred to as the UMTS Band extending from 1900 to 2170 Megahertz).” Ex. 1005 at ¶[0008]; *see also* Ex. 1002 at ¶130.

Zeilinger further teaches, “FIG. 6 illustrates a VSWR plot of the antenna 30 of FIGS. 2 and 4, with the third radiating element 33 in place. Two peaks are shown on the plot and the second peak, “B”, shown to the right of FIG. 6) is wider than the second peak, “B”, to the right of FIG. 5. This is because the third radiating element causes a third peak, or spike close to the second one and the two radiating elements cooperatively combine to form a single, wider peak, or Spike. In FIG. 6,

the first peak “A”, as defined by markers 1 and 2 provide an effective bandwidth from 880 to 960 MHz at 6 dB, while the second peak “B”, as defined by markers 3 and 5, provide an effective bandwidth from 1710 to 1990 MHz, thereby effectively encompassing both the GSM 1800 and 1900 bands (and the PCS band).” Ex. 1005 at ¶[0031]; *see also* Ex. 1002 at ¶131. As such, Zeilinger discloses the GSM1800 frequency band (*i.e.*, the second frequency band) being contained within a second frequency region of an electromagnetic spectrum and at a frequency of 1710 MHz to 1889 MHz. Ex. 1005 at ¶[0008]; *see also* Ex. 1002 at ¶131.

Thus, a person of ordinary skill in the art would find this feature disclosed in the teachings of Zeilinger and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention; Ex. 1002 at ¶132.

**xii) “the third frequency band of operation
being used by a 4 G communication
standard,”**

As set forth above, in connection with the disclosures cited for the first and second frequency band, Zeilinger discloses a “Tri-Band Antenna” and thus, this limitation. Ex. 1005 at ¶¶[0030]-[0031]; *see also* Ex. 1002 at ¶134.

Additionally, Zeilinger discloses, “It is therefore a general object of the present invention to provide a low cost multiple band antenna having a small form factor and which is capable of operating in three distinct frequency bands so as to

operate in GSM900 frequency band (from 880 to 960 Megahertz), the GSM1800 frequency band (from 1710-1889 Megahertz) and the PCT GSM 1900 frequency band (also referred to as the UMTS Band extending from 1900 to 2170 Megahertz).” Ex. 1005 at ¶[0008]; *see also* Ex. 1002 at ¶135.

Zeilinger further teaches, “FIG. 6 illustrates a VSWR plot of the antenna 30 of FIGS. 2 and 4, with the third radiating element 33 in place. Two peaks are shown on the plot and the second peak, “B”, shown to the right of FIG. 6) is wider than the second peak, “B”, to the right of FIG. 5. This is because the third radiating element causes a third peak, or spike close to the second one and the two radiating elements cooperatively combine to form a single, wider peak, or Spike. In FIG. 6, the first peak “A”, as defined by markers 1 and 2 provide an effective bandwidth from 880 to 960 MHZ at 6 dB, while the second peak “B”, as defined by markers 3 and 5, provide an effective bandwidth from 1710 to 1990 MHz, thereby effectively encompassing both the GSM 1800 and 1900 bands (and the PCS band).” Ex. 1005 at ¶[0031]; *see also* Ex. 1002 at ¶136. Additionally, Zeilinger discloses, “It is therefore a general object of the present invention to provide a low cost multiple band antenna having a small form factor and which is capable of operating in three distinct frequency bands so as to operate in GSM900 frequency band (from 880 to 960 Megahertz), the GSM1800 frequency band (from 1710-1889 Megahertz) and

the PCT GSM 1900 frequency band (also referred to as the UMTS Band extending from 1900 to 2170 Megahertz).” Ex. 1005 at ¶[0008]; *see also* Ex. 1002 at ¶136.

As such, Zeilinger discloses the PCT GSM 1900 frequency band (also referred to as the UMTS Band extending from 1900 to 2170 Megahertz). (*i.e.*, the third frequency band of operation being used by a 4 G communication standard) Ex. 1002 at ¶136. The person of ordinary skill in the art would have understood that the PCT GSM 1900 frequency band was a band “being used by a 4 G communication standard.” *See* Section I.B *infra*; *see also supra*; *see also* Ex. 1002 ¶136.

The ’103 patent includes “3G and other advanced services for instance HSDPA, WiBro, WiFi, WiMax, UWB or other high speed wireless standards,” as among those referred to by the ’103 patent as “4G services” and “might require operation in additional frequency bands corresponding to said 4G standards (for instance, bands within the frequency region 2-11 GHz and some of its sub-regions such as for instance 2-11 GHz, 3-10 GHz, 2.4-2.5 GHz and 5-6 GHz or some other bands).” Ex. 1001, 24:22-30; *see also* Ex. 1002 ¶137. This definition by the ’103 patent is inconsistent with the traditional applications of the “4G” moniker, which does not include, for example, 3G or WiFi. Ex. 1002 ¶137. In view of the definition provided by the ’103 patent, the antennas taught by Zeilinger are configured to transmit and receive in 4G bands (e.g., the PCT GSM 1900

frequency band (also referred to as the UMTS Band extending from 1900 to 2170 Megahertz)). Ex. 1005, ¶[0008]; *see also* Ex. 1002 ¶137.

While the definition provided by the '103 patent is inconsistent with traditional applications of the “4G” moniker, the '103 patent definition of 4G may be relied upon given that 4G standards had not been formally defined as of the earliest claimed priority date of the '103 patent (September 2006). Ex. 1002 ¶138. The ITU (International Telecommunication Union) first defined 4G standards in 2008. Ex. 1002 ¶138. The 4G standards were defined in the 3 GPP Release 8 that was released in 2008, with the first commercial deployment in 2009. Ex. 1002 ¶138. The 3GPP Release 8, released two years after the priority date of the '103 patent, included frequency bands of 900 MHz (e.g., 880-915 MHz) and between 1805 MHz – 2400 MHz inclusive. Ex. 1008 at 13-14; Ex. 1009 at 32-33. Ex. 1002 ¶136.

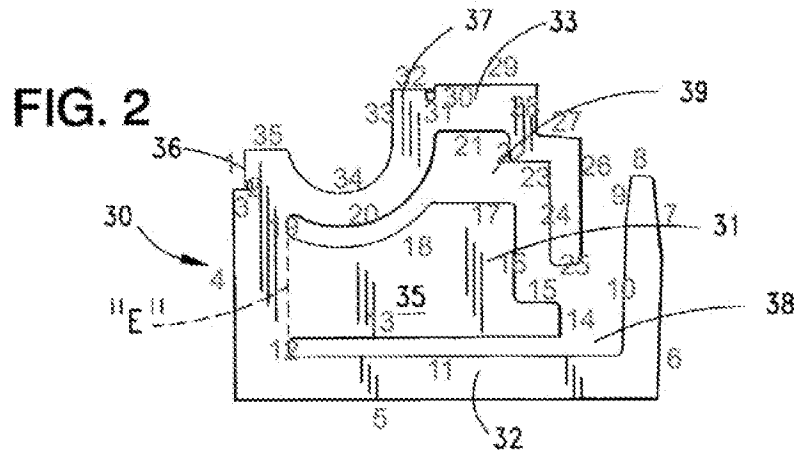
Regardless, the tri-band antenna taught by Zeilinger is capable of operating in three distinct frequency bands: the GSM900 frequency band (from 880 to 960 Megahertz), the GSM1800 frequency band (from 1710-1889 Megahertz), and the PCT GSM 1900 frequency band (also referred to as the UMTS Band extending from 1900 to 2170 Megahertz). Ex. 1005, ¶[0008]; *see also* Ex. 1002 at ¶139. The PCT GSM 1900 frequency band (also referred to as the UMTS Band) extending from 1900 to 2170 Megahertz falls within the 4G 1805 MHz – 2400 MHz

inclusive band. Ex. 1002 at ¶139. Moreover, a person of ordinary skill in the art would have readily understood that the frequency bands of Zeilinger could be readily tuned to provide coverage for 4G wireless standards bands, and a person of ordinary skill in the art would have understood that it was advantageous for the wireless device to operate in 4G wireless standards bands. Ex. 1002 at ¶139. Thus, whether 4G standards are defined by the '103 patent, or the 3 GPP Release 8, a person of ordinary skill in the art would find this feature disclosed in the teachings of Zeilinger and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶139.

xiii) “wherein a perimeter of the first antenna element defines a first antenna contour comprising at least thirty-five segments,”

The '103 patent discloses that “[a]long the contour different segments can be identified e.g. by a corner between two segments, wherein the corner is given by a point on the contour where no unique tangent can be identified. At the corners the contour has an angle. The segments next to a corner may be straight or curved or one straight and the other curved. Further, segments may be separated by a point where the curvature changes from left to right or from right to left. In a sine curve, for example such points are given where the curve intersects the horizontal axis (x-axis, abscissa, $\sin(x)=0$).” Ex. 1001 at 15:4-13; *see also* Ex. 1002 at ¶141. Based

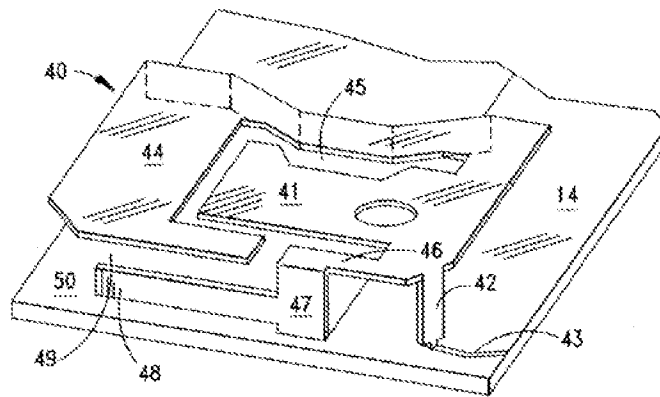
on this definition, the first antenna contour as shown above in FIG. 2 has at least 35 segments. Ex. 1002 at ¶142.



Ex. 1005 at FIG. 2 (annotated).

The contour shown in Figure 3 has even more segments. Ex. 1002 at ¶142.

FIG. 3



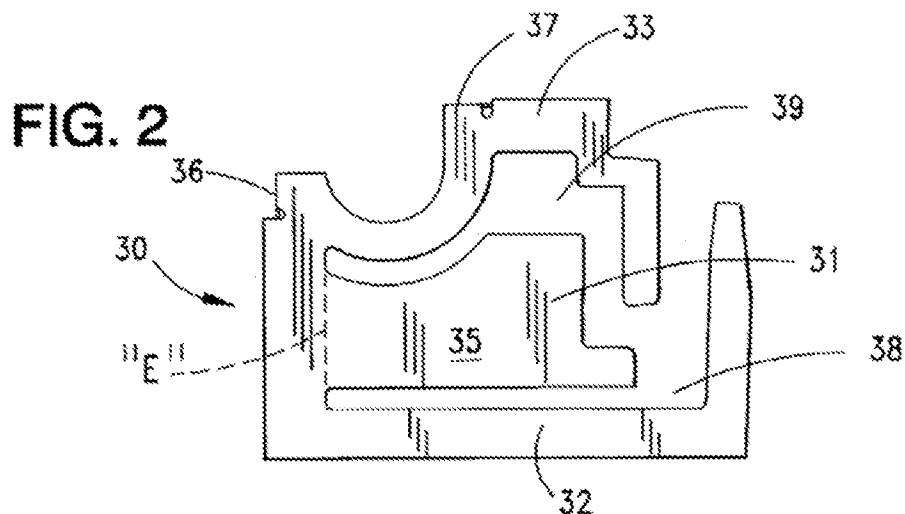
Ex. 1005 at FIG. 3.

Thus, a person of ordinary skill in the art would find this feature disclosed in the teachings of Zeilinger and its incorporated disclosures taken as a whole. Ex. 1002 at ¶143.

xiv) “the first antenna element defining an antenna box, an orthogonal projection of the antenna box along a normal to a face with a largest area of the antenna box defining an antenna rectangle,”

The '103 patent states that “[a]n antenna box for the MFWD 100 is herein defined as being the minimum-sized parallelepiped of square or rectangular faces that completely encloses the antenna volume of space and wherein each one of the faces of the minimum-sized parallelepiped is tangent to at least one point of the volume.” Ex. 1001 at 11:5-12. Further, the '103 patent states that “an antenna rectangle is defined as being the orthogonal projection of the antenna box along the normal to the face with largest area of the antenna box.” Ex. 1001 at 13:56-58.

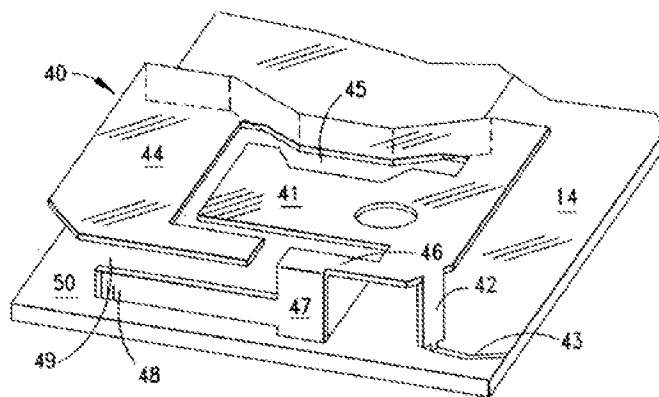
Figure 2 shows a planar view of the antenna that, by definition, forms an antenna box (e.g., the rectangular face that encloses the antenna shown below) and an antenna rectangle. Ex. 1002 at ¶145. From the view of FIG. 2, the antenna rectangle being an orthogonal projection of the antenna box along a normal to a face with a largest area would be a rectangle encompassing the outer limits of the antenna 30. Ex. 1002 at ¶145.



Ex. 1005 at FIG. 2.

Similarly, Figure 3 shows a perspective view for which the top face is the largest area. Ex. 1002 at ¶146. An antenna box encompassing the entirety of the antenna 40 and an antenna rectangle being the orthogonal projection of the antenna box from the top surface. Ex. 1002 at ¶146.

FIG. 3

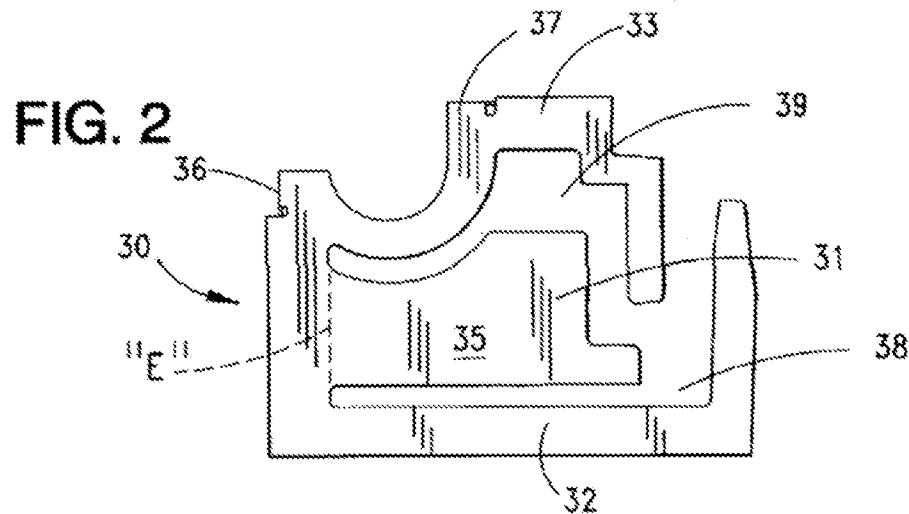


Ex. 1005 at FIG. 3.

Thus, a person of ordinary skill in the art would find this limitation disclosed in the teachings of Zeilinger and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶147.

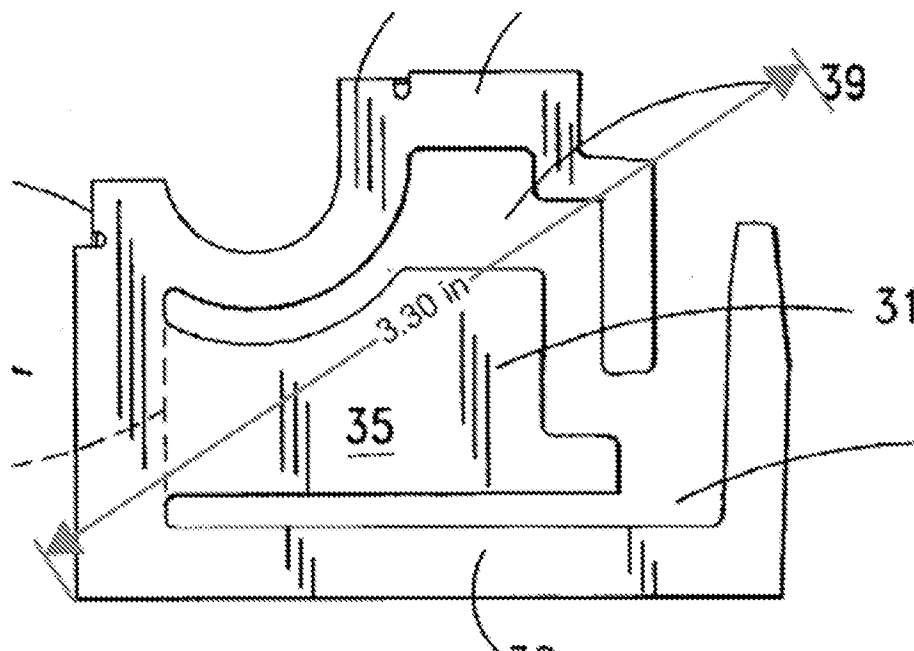
xv) “wherein a length of the first antenna contour is greater than four times a diagonal of the antenna rectangle; and”

Zeilinger teaches “wherein a length of the first antenna contour is greater than four times a diagonal of the antenna rectangle.” A POSITA would have understood that the “length of the first antenna contour is greater than four times a diagonal of the antenna rectangle” relates to miniaturization. Ex. 1002 at ¶148. In particular, the ability to have long segments to support lower frequencies as well as the ability to support multiple bands. Ex. 1002 at ¶148. Indeed, the POSITA would understand that a perimeter of a square would already be 2.83 (e.g., $2 \times \sqrt{2}$) times longer than the diagonal of the square indicating that the amount of miniaturization required by the claim is minimal and, thus, obvious. Ex. 1002 at ¶148. Regardless, Zeilinger discloses or suggests this limitation. Ex. 1002 at ¶148.

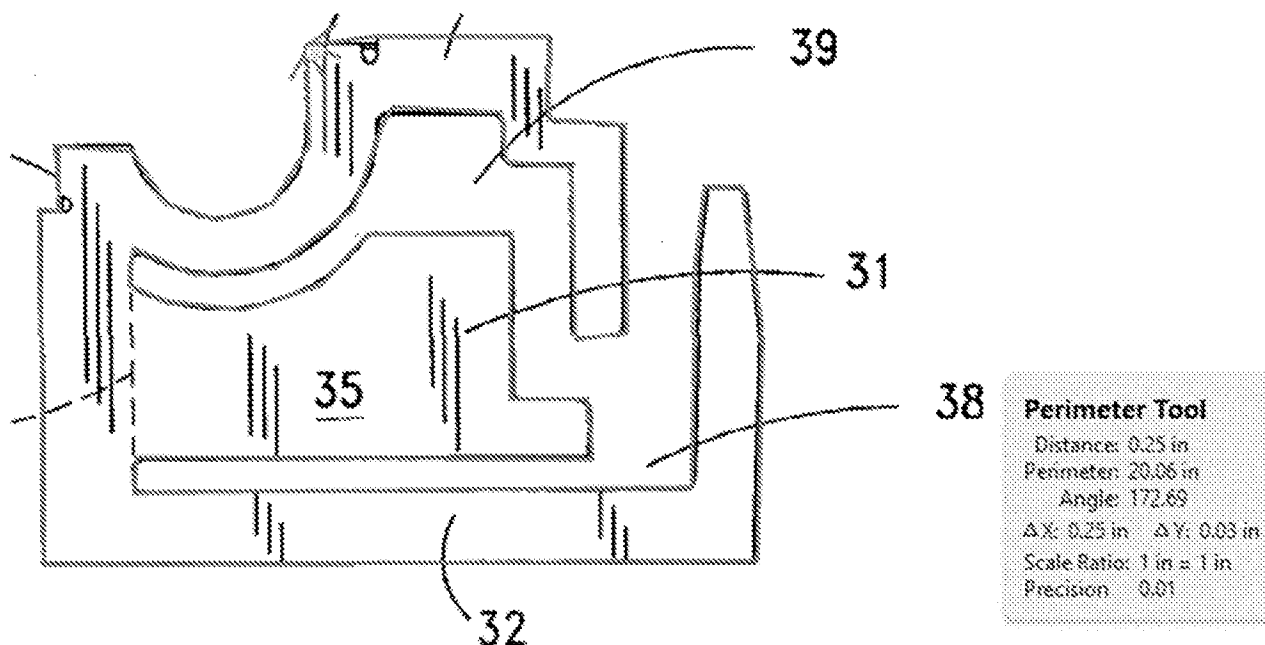


Ex. 1005 at FIG. 2.

Although the figures are not necessarily intended to be to exact scale, the disclosure of Zeilinger makes clear that the length of the contour is greater than four times the diagonal. *See, e.g., Krippelz v. Ford Motor Co.*, 667 F.3d 1261, 1269 (Fed. Cir. 2012) (finding a patent drawing to plainly show a lamp “adjacent to a window”); *Cummins-Allison Corp. v. SBM Co.*, 484 F. App’x 499, 507 (Fed. Cir. 2012) (“As long as a person of skill in the art could derive the claimed dimensions from the patent’s disclosure, there is no additional requirement that the specification must explicitly disclose the precise proportions or particular sizes.”). Measurements of the figures using the measurement tools of PDF software, are at least useful to show that that length of the contour is greater than four times the diagonal. Specifically, PDF measurement tools shows that measuring the lengths of the segments in the figures reveals that the perimeter is greater than 4X the diagonal of the antenna rectangle.



As shown in the annotated FIG. 2 above, the diagonal of the antenna rectangle of FIG. 2 is approximately 3.30 inches (or units of length) such that four times the diagonal is 13.2 units of length. Ex. 1002 at ¶151.



The length of the contour of FIG. 2 is approximately 20 units of length using the same scale as was used to measure the diagonal, which is more than four times the diagonal (13.2). Ex. 1002 at ¶152.

Similarly, based on the additional segments and overall structure of the antenna in FIG. 3, the length of the contour in Figure 3 is almost certainly longer than that of Figure 2. Ex. 1002 at ¶153. Thus, assuming a similarly sized antenna rectangle and corresponding diagonal length for the contour in Figure 3, the diagonal contour length of FIG. 3 also exceeds four times the diagonal of the antenna box. Ex. 1002 at ¶153.

Finally, the '103 patent does not include any teachings as to the importance of "length of the first antenna contour is greater than four times a diagonal of the antenna rectangle." In fact, the '103 patent merely provides a laundry list of distances without identifying any particular benefit of one distance over another. As such, the person of skill in the art would have found the claimed distance and ratio to be a design choice and thus, obvious. *Airlite Plastics Co. v. Plastilite Corp.*, 526 F.2d 1078, 1082 (8th Cir. 1975) (claims obvious where difference over prior art limited to "form, proportions, or size").

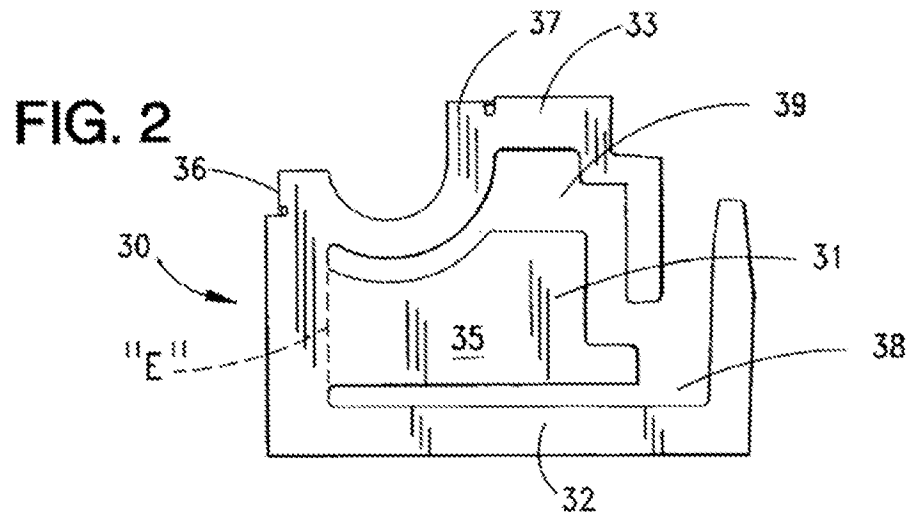
Thus, a person of ordinary skill in the art would find this limitation disclosed in the teachings of Zeilinger and its incorporated disclosures taken as a whole, or at least obvious in view of its teachings. Ex. 1002 at ¶154.

xvi) “a second antenna element configured to operate in at least one frequency band used by a 4 G communication standard, wherein a perimeter of the second antenna element defines a second antenna contour comprising at least twenty segments.”

Zeilinger teaches “a second antenna element configured to operate in at least one frequency band used by a 4 G communication standard, wherein a perimeter of the second antenna element defines a second antenna contour comprising at least twenty segments.” Ex. 1002 at ¶155. For example, “FIG. 1 illustrates a mobile telephone housing 10 which is exemplary of the environment in which antennas of the present invention are used. As is known, the telephone housing 10 is formed from suitable plastic in the form of a hollow shell 11 having an internal cavity 12 surrounded by exterior sidewalls 13a, 13b. *One or more printed circuit boards 14, 20* may be provided and supported within the cavity 12. Integrated circuits 15 in the form of chips 16 that power different aspects of the telephone may be supported on the circuit boards 14 and terminated to various circuits thereon.” Ex. 1005 at ¶[0024] (emphasis added). As described in Zeilinger, both the PCB 14, and the PCB 20 are configured to support an antenna. Ex. 1005 at FIG. 3; Ex. 1005 at ¶[0034]; *see also* Ex. 1002 at ¶156. That is, Zeilinger contemplates multiple circuit boards and, thus, multiple antennas. Ex. 1002 at ¶156. Thus, a person of ordinary skill in the art would have understood that a first antenna element may be

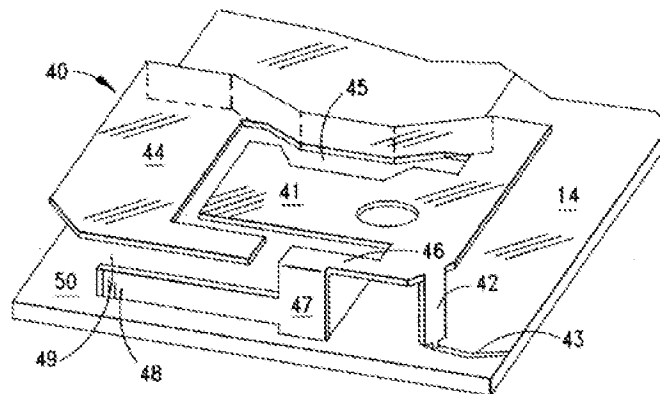
positioned on the first PCB 14 and a second antenna element may be positioned on the second PCB 20. Ex. 1002 at ¶156.

Further, Zeilinger discloses at least two distinct antennas with contours of at least 20 segments and that operate in the disclosed frequency bands used by a 4 G communication standard. *See* Section xii, *supra*; *see also* Ex. 1002 at ¶157.



Ex. 1005 at FIG. 2.

FIG. 3



Ex. 1005 at FIG. 3.

Thus, a person of ordinary skill in the art would have known that a second antenna element (e.g., antenna 30, antenna 40) may be positioned within the mobile telephone housing 10 of Zeilinger. Ex. 1002 at ¶158. That is, as described above, the person of ordinary skill in the art would have known to include a second antenna element (e.g., antenna 30, antenna 40) in the housing of Zeilinger device so as to enable the additional bands disclosed by Boireau. *See* Rationale to combine, *supra*; *see also* Ex. 1002 at ¶158.

Boireau also teaches this limitation. Ex. 1002 at ¶159. For example, the following figures and accompanying written description disclose an antenna system within the handheld multifunction wireless device:

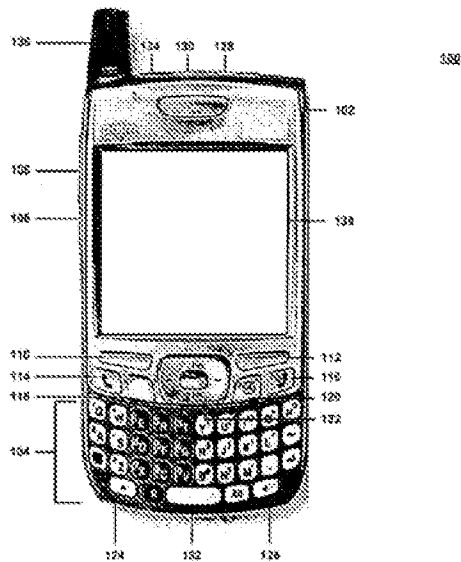


FIG. 1

Ex. 1004 at FIG. 1.

Boireau teaches that “[m]obile computing device 100 may comprise an antenna system including one or more antennas.” Ex. 1004 at ¶[0025]. Boireau also teaches “antenna 318 may be implemented alone, or as part of a broader antenna system (e.g., antenna 136) or antenna array for mobile computing device 100.” Ex. 1004 at ¶[0048].

As described above, a person of ordinary skill in the art would have had reason to add one or more Zeilinger antennas to Boireau to provide support for the multiple suggested and/or desired bands while providing a compact and efficient antenna array. Ex. 1002 at ¶161. Boireau discloses the need to reduce the overall number of antennas but still allow for an antenna array with multiple different antennas. Ex. 1004 at ¶[0026]. Boireau discloses that “radio sub-system 202 may include various other transceivers and accompanying antennas, such as one or more cellular radiotelephone system transceivers (e.g., GSM, UMTS, or CDMA transceivers), a GPS transceiver, and so forth” and notes in Tables 8-10 that the Boireau system must allow for at least five bands (e.g., 869-894 MHz, 925-960MHz, etc.) to co-exist. Ex. 1004 at ¶[0061]. Boireau Figure 4 further contemplates a cellular transceiver that communicates on multiple bands and addresses “transceiver and/or antenna interference” further confirming to the person of ordinary skill in the art that Boireau suggests at least five bands (e.g., 850, 900, DCS, PCS, UTMS). Ex. 1004 at ¶[0062]. Finally, Boireau does not

specifically disclose the antenna(s) that are used to implement each of its disclosed bands. As such, the person of ordinary skill in the art would turn to the Zeilinger antennas, and in this case would rely on at least two Zeilinger antennas, to provide support for the multiple suggested and/or desired bands while providing a compact and efficient antenna array. Ex. 1002 at ¶161. Relatedly, Zeilinger discloses “a multiple band antenna for use in small, internal spaces, such as those encountered in mobile telephones and which operates in multiple frequency bands.” Ex. 1005 at ¶[0007]. As shown in FIG. 2 and FIG. 3 Zeilinger discloses at least two distinct antennas with contours of at least 20 segments and that operate in the disclosed frequency bands used by a 4 G communication standard. Ex. 1002 at ¶161. Each antenna providing a unique and novel structure. Ex. 1002 at ¶161.

Therefore, a person of ordinary skill in the art would have found it obvious to implement the antennas of Zeilinger alone, or as part of a broader antenna system or array for the mobile computing devices of Boireau. *See* Rationale for combination, *supra*; *see also* Ex. 1002 at ¶162. Accordingly, a person of ordinary skill in the art would find this limitation disclosed in the teachings of Zeilinger or Boireau and their incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶163.

4. Claim 15

- i) “The handheld multifunction wireless device according to claim 12,”**

See claim 12 above.

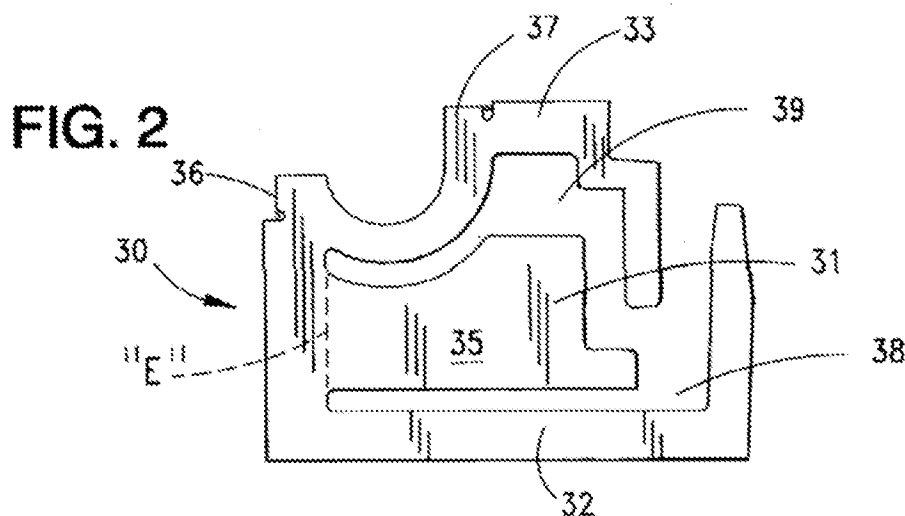
- ii) **“wherein the ground plane layer defines a ground plane rectangle, the projection of the antenna rectangle on the ground plane rectangle partially overlapping the ground plane rectangle.”**

The concept of overlap between the ground plane and an antenna is not new. Ex. 1002 at ¶164. The '103 Patent concedes that a feature of so-called “patch antennas” is that there is an overlap between the antenna and the ground-plane. In particular, the 103 patent states, “[f]or those antennas which in their physical properties come quite close to patch antennas namely those with an overlap between the antenna and the ground-plane (patch-like antennas), a value of F being higher than 1.45, 1.47, 1.50, or 1.60 turns out to be a good measure for an antenna to provide an expected improved bandwidth or gain with respect to a patch antenna without any complexity in at least one of the frequency bands.” Ex. 1001, Col. 21, lines 25-32 (emphasis added); *see also* Ex. 1002 at ¶164.

The Johnson and Zeilinger references further support this assertion. For example, the Johnson reference describes patch antennas that “[t]ypically consists of a planar dielectric material having a resonant structure one major surface of the dielectric and a second ground plane structure disposed on the opposite major surface.” Ex. 1003, Col. 1, lines 58-63; *see also* Ex. 1002 at ¶164. Zeilinger is directed to “an improved PIFA (planar inverted-F antenna),” a known variant of a

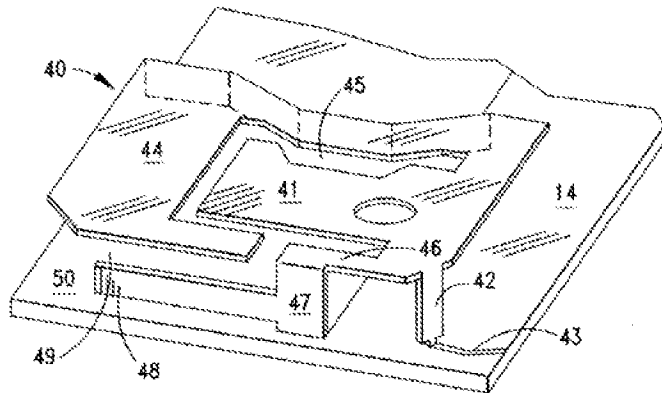
patch antenna, that includes “a horizontal radiating element interposed between the PIFA and an associated ground plane, the horizontal radiating element being connected to either the ground pins or the feed pin of the PIFA.” Ex. 1005, para [009].

Regardless, Zeilinger teaches these features for at least the following reasons. Zeilinger explains, “FIG. 3 illustrates another embodiment of a PIFA antenna 40 of the present invention with the antenna 40 being shown mounted to a circuit board 14.” Ex. 1005 at ¶[0032]. Also, “[i]n this instance, the third radiator communicates directly with the ground pin 47 and extends in a direction between the two radiating elements and a ground plane 50 that is either formed on the surface of the circuit board 14 or formed as a layer of the circuit board.” *Id.* at ¶[0033].



Ex. 1005 at FIG. 2.

FIG. 3



Ex. 1005 at FIG. 3.

According to the '103 patent, “a ground plane rectangle is defined as being the minimum-sized rectangle that encompasses the ground plane of the antenna system....” Ex. 1001 at 14:4-6. As shown in FIG. 3 of Zeilinger, the ground plane rectangle encompasses the ground plane 50 formed on the surface of the circuit board 14 or formed as a layer of the circuit board. Ex. 1002 at ¶165.

As further disclosed by the '103 patent “[a]n antenna box for the MFWD 100 is herein defined as being the minimum-sized parallelepiped of square or rectangular faces that completely encloses the antenna volume of space and wherein each one of the faces of the minimum-sized parallelepiped is tangent to at least one point of the volume. Moreover, each possible pair of faces of the minimum-size parallelepiped shares an edge forming an inner angle of 90°.” Ex. 1001 at 11:5-12. Within the antenna box is an antenna rectangle “defined as being the orthogonal projection of the antenna box along the normal to the face with the

largest area of the antenna box.” *Id.* at 13:56-58. As depicted in FIG. 3, the antenna rectangle is defined by the antenna box comprising the antenna 40. Ex. 1002 at ¶167.

Similarly, the antenna 30 of FIG. 2 may be mounted to a ground plane layer. Ex. 1002 at ¶168. “As illustrated in FIG. 2, the antenna 30 includes a large central portion 35 that serves as the first radiating element, or main radiator, of the antenna 30. This first radiating element 31 communicates with an edge portion 36 which serves as an angled leg (not shown) that extends crosswise, or offset, from it down to an attachment point on a circuit board 14 of the telephone 10.” Ex. 1005 at ¶[0027]. As depicted in FIG. 2, the antenna rectangle is defined by the antenna box comprising the antenna 30. Ex. 1002 at ¶168.

Both the antenna 30 of FIG. 2 and the antenna 40 of FIG. 3 are mounted to a PCB 14, 20 comprising a ground plane formed on the surface of the circuit board or formed as a layer of the circuit board. Ex. 1002 at ¶169. Accordingly, Figures 2-3 of Zeilinger show an antenna with an antenna rectangle that when projected on the ground plane at least partially overlaps the ground plane rectangle. Ex. 1002 at ¶169. Thus, a person of ordinary skill in the art would find this feature disclosed in the teachings of Zeilinger and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶170.

B. Ground 2: Claims 12 and 15 of the '103 patent are invalid as obvious under 35 U.S.C. § 103(a) over Boireau in view of Zeilinger and further in view of Langley, and thus Boireau in view of Zeilinger and further in view of Langley present a Substantial New Question of Patentability.

1. The combination of Boireau, Zeilinger, and Langley presents a substantial new question of patentability

The combination of Boireau, Zeilinger, and Langley presents a substantial new question of patentability because the combination discloses or suggests each and every limitation of claims 12 and 15 of the '103 patent to include those that have been alleged to be novel. *See* Ground 2, *infra*; Ex. 1002 at ¶¶171-275. In fact, the combined system of Boireau, Zeilinger, and Langley relies on the smart phone of Boireau along with the antennas of Zeilinger and Langley. *See* Ground 2, *infra*. Indeed, Zeilinger discloses or suggests an antenna of at least 35 segments. *See e.g.*, Ex. 1005 at FIG. 2; *see also* Ex. 1002 at ¶¶140-143. Further, Langley discloses an antenna element having at least twenty segments and configured to operate in at least one frequency band used by a 4G communication standard. *See e.g.*, Ex. 1006 at Fig. 1; *see also* Ex. 1002 at ¶¶252-268.

For at least these reasons, and in view of the additional argument and citations set forth below in Ground 2, the rationale for combination, and the supporting testimony of Dr. Manos M. Tentzeris (Ex. 1002), the combination of

Boireau, Zeilinger, and Langley presents a substantial new question of patentability as to claims 12 and 15. *See* Ground 1, *infra*; Ex. 1002 at ¶¶171-275.

2. Rationale for the combination of Boireau, Zeilinger, and Langley

Boireau in view of Zeilinger and further in view of Langley renders obvious claims 12 and 15 of the '103 patent. According to MPEP §2143(0), a claim would have been obvious if (1) there is some teaching, suggestion, or motivation, in the references themselves to modify the prior art device or method and (2) there was a reasonable expectation of success. This rationale is flexible, and an explicit suggestion to combine is not necessary. *Id.*

A person of ordinary skill in the art would have been motivated to apply the multi-band antenna of Zeilinger and the multiband antenna of Langley to the smart phone of Boireau because the Zeilinger and Langley antennas advantageously provide multiple wireless bands, are compact, and provide flexibility for the operator of the Boireau device. Ex. 1005 at ¶[0002]; Ex. 1006 at ¶[0016]; *see also* Ex. 1002 at ¶122-124.

Boireau discloses the need to reduce the overall number of antennas while still allowing for an antenna array with multiple different antennas. Ex. 1004 at ¶[0026]; *see also* Ex. 1002 at ¶173. Boireau contemplates that such antennas may be internal antennas. Ex. 1004 at ¶[0025]; *see also* Ex. 1002 at ¶173. Indeed, Boireau discloses that relying on a shared antenna array “architecture may reduce

or obviate the need for mobile computing device 100 to include an antenna or antenna array for each transceiver 308-1-n, and the corresponding cost and complexity associated with each additional antenna or antenna array.” Ex. 1004 at ¶[0037]; *see also* Ex. 1002 at ¶173. Further, Boireau contemplates that the “entire antenna array may be shared between and among transceivers 308-1-n of transceiver module 304.” Ex. 1004 at ¶[0048]; *see also* Ex. 1002 at ¶173.

Boireau discloses the need for antenna support for at least three bands. Ex. 1002 at ¶174. That is, Boireau specifically requires operation in at least five bands and, thus, teaches or suggests antennas that support at least five bands. Ex. 1004 at ¶[0061]; *see also* Ex. 1002 at ¶174. For example, Boireau discloses an embodiment that has at least “transceivers 308-1, 308-2 [that] may be arranged to perform data communications in accordance with a different set of wireless communications protocols and techniques” and “radio sub-system 202 and/or transceiver module 304 may include a third transceiver primarily directed to voice communications, such as a cellular radiotelephone system transceiver (e.g., GSM transceiver, UMTS transceiver, CDMA transceiver, and so forth).” Ex. 1004 at ¶[0039]; *see also* Ex. 1002 at ¶174. Boireau discloses that “radio sub-system 202 may include various other transceivers and accompanying antennas, such as one or more cellular radiotelephone system transceivers (e.g., GSM, UMTS, or CDMA transceivers), a GPS transceiver, and so forth” and notes in Tables 8-10 that the Boireau system

must allow for at least five bands (e.g., 869-894 MHz, 925-960MHz, etc.) to co-exist. Ex. 1004 at ¶[0061]; *see also* Ex. 1002 at ¶174.

TABLE 8

Max Noise (dBm/Hz)					
	Freq (MHz)	w/ BPF*	@ PA Output**	At 8500	
Maximum	869-894	-164	-119	-119	Continuous
TX	925-960	-164	-119	-119	Mod Tx at
Wideband	1365-1385	-164	-124	-124	54 Mbps
Noise	1805-1880	-164	-124	-129	Power = 15
	1920-1990	-164	-124	-134	dBm***
	2110-2170	-164	-124	-144	

Id. at Table 8.

Finally, Boireau Figure 4 contemplates a cellular transceiver that communicates on multiple bands (e.g., at least five bands) and addresses “transceiver and/or antenna interference” between these multiple bands further confirming to the skilled artisan that Boireau suggests at least five bands (e.g., 850, 900, DCS, PCS, UMTS) because it contemplates interference between at least these bands. Ex. 1004 at ¶[0061]; *see also* Ex. 1002 at ¶174.

400

GSM / UMTS band	Typical GSM / UMTS Sensitivity	SNR Req.	Noise Floor	Margin	Required System Noise	Antenna Coupling	Allowed WLAN noise @Antenna	Actual PA noise @15 dBm	Filter Min. Req.
	dBm (200 KHz, 5 MHz)	dB	dBm/Hz	dB	dBm/Hz	dB	dBm/Hz	dBm/Hz	dB
850.0	-108.5	7.0	-165.5	5.0	-171.5	-10.0	-181.5	-147.0	14.5
900.0	-108.5	7.0	-168.5	5.0	-171.5	-10.0	-181.5	-146.0	15.5
DCS	-108.5	7.0	-165.5	5.0	-171.5	-10.0	-181.5	-137.0	24.5
PCS	-108.5	7.0	-165.5	5.0	-171.5	-10.0	-181.5	-133.0	28.5
UMTS	-119.0	-18.0	-168.0	5.0	-173.0	-10.0	-183.0	-117.0	48.0

Ex. 1004 at Figure 4.

Although the design and dimensions of antenna(s) would be obvious to the person of ordinary skill in the art, Boireau does not specifically disclose the design and dimensions of the antenna(s) that are used to implement each of its disclosed and/or required bands. Ex. 1002 at ¶176. As such, the skilled artisan would turn to references that disclosed antennas that provided support in desired bands, such as the antennas in Zeilinger and Langley. Ex. 1002 at ¶176. The Zeilinger and Langley antennas provide support for the multiple suggested and/or desired bands while providing a compact and efficient antenna array. Ex. 1002 at ¶176. Specifically, Zeilinger discloses “a multiple band antenna for use in small, internal spaces, such as those encountered in mobile telephones, and which operates in multiple frequency bands.” Ex. 1005 at ¶[0007]; *see also* Ex. 1002 at ¶176. Further, Zeilinger discloses “a low cost multiple band antenna having a small form factor and which is capable of operating in three distinct frequency bands so as to operate in GSM900 frequency band (from 880 to 960 Megahertz), the GSM1800 frequency band (from 1710-1889 Megahertz) and the PCT-GSM 1900 frequency band (also referred to as the UMTS Band extending from 1900 to 2170 Megahertz).” Ex. 1005 at ¶[0008]; *see also* Ex. 1002 at ¶75. Langley discloses a similar improved antenna that is compact and efficient. Ex. 1006 at 2:21-22, 3:4-6; *see also* Ex. 1002 at ¶176. Langley also explains that its multi-band antenna offers “near independent control of the different bands” by tuning its multiple limbs and

fingers. Ex. 1006 at 3:8-10; *see also* Ex. 1002 at ¶176. As such, Zeilinger and Langley provide specific reasons to implement its antennas. *KSR Int'l Co. v. Teleflex*, 550 U.S. 398 (2007); MPEP 2143.I; *see also* Section II.B (explaining the well-known need for antennas systems with both a small form factor and multi-band capability).

Further, Langley's antenna provides additional bands, such as Bluetooth, Hiperlan 1/2 and DECT. Ex. 1006 at 8:8-8:15; *see also* Ex. 1002 at ¶177. Indeed, Langley provides support from 0.5GHZ to 6GHZ and, thus, supplements the antenna of Zeilinger. Ex. 1006 at 8:8-25; *see also* Ex. 1002 at ¶177. As such, between the two antennas, the combination allows for an increased number of wireless bands that the antenna system, the antenna system in Boireau, covers. Ex. 1002 at ¶177. Indeed, such antennas operate in the bands contemplated by Boireau. Ex. 1002 at ¶177.

The implementation of the Zeilinger and Langley antennas is also a simple substitution of one known element for another. Ex. 1002 at ¶178. As is described below, Boireau discloses a device which is the same as the device claimed in claim 12 but for the specific antenna element design. *See supra*. That said, Boireau recited and suggested the need to have antennas that support multiple bands. Ex. 1004 at ¶¶[0061]-[0062]. As is described herein, the person of skill in the art would have implemented the antenna components of Zeilinger and/or Langley. Ex. 1002

at ¶178. Zeilinger is directed to “[a] multiple frequency band antenna [that] is capable of operating in at least three distinct preselected frequency bands.” Ex. 1005, Abstract. Langley is directed to “a multi-band antenna for use with mobile communications equipment operating on a plurality of frequency bands.” Ex. 1066 at 1:4-5. Indeed, the substitution of the Zeilinger antenna and the Langley antenna for the disclosed antenna components in Boireau obtains the predictable result of increasing the number of wireless bands as well as implementing the bands contemplated by Boireau. *See supra*; *see also* Ex. 1002 at ¶178. As explained, both Zeilinger and Langley provide additional non-overlapping bands. *See supra*; *see also* Ex. 1002 at ¶178.

The implementation of the Zeilinger and Langley antennas is also a design choice that could be readily implemented by a person of ordinary skill in the art in Boireau. *See In re Kuhle*, 526 F.2d 553, 555 (CCPA 1975) (“design choice may be an acceptable rationale for an obviousness rejection when a claimed product merely arranges known elements in a configuration recognized as functionally equivalent to a known configuration.”). As mentioned above, there is explicit motivation for implementing the Zeilinger and Langley antennas. In addition, the implementation allows for the benefit of having shared antennas that are compact and efficient. Ex. 1002 at ¶179. Further, the person of ordinary skill in the art would have had a reasonable expectation of success given that the Zeilinger and

Langley antennas are designed for use in mobile phones. Ex. 1002 at ¶179. Further Boireau provides for the ability for multiple bands to be operating at the same time while making use of antennas of different shapes to accomplish this goal. Ex. 1004 ¶[0061-62]; *see also* Ex. 1002 at ¶179. As such, the person of ordinary skill in the art would have expected the antennas of Zeilinger and Langley to be operable in the Boireau system. Ex. 1002 at ¶180.

As such, the modification of Zeilinger to include those features of Boireau would have been easily and predictably accomplished. Thus, based on the rational set forth in MPEP §2143(0), it would have been obvious to apply the multi-band antenna of Zeilinger to the smart phone of Boireau.

3. Claim 12

- ii) **“A handheld multifunction wireless device having at least one of multimedia functionality and smartphone functionality, the handheld multifunction wireless device comprising:”
(preamble)**

Zeilinger teaches “a handheld multifunction wireless device having at least one of multimedia functionality and smartphone functionality, the handheld multifunction wireless device comprising.” Ex. 1004 at ¶181. Zeilinger teaches “FIG. 1 illustrates a mobile telephone housing 10 which is exemplary of the environment in which antennas of the present invention are used. As is known, the telephone housing 10 is formed from suitable plastic in the form of a hollow shell

11 having an internal cavity 12 surrounded by exterior sidewalls 13a, 13b. One or more printed circuit boards 14, 20 may be provided and supported within the cavity 12. Integrated circuits 15 in the form of chips 16 that power different aspects of the telephone may be supported on the circuit boards 14 and terminated to various circuits thereon.” Ex. 1005 at ¶[0024].

Boireau also teaches “a handheld multifunction wireless device having at least one of multimedia functionality and smartphone functionality, the handheld multifunction wireless device comprising.” Ex. 1004 at FIG. 1; *see also* Ex. 1002 at ¶82. For example, the following figures and the corresponding written description disclose a handheld multifunction wireless device having at least one of multimedia functionality and smartphone functionality:

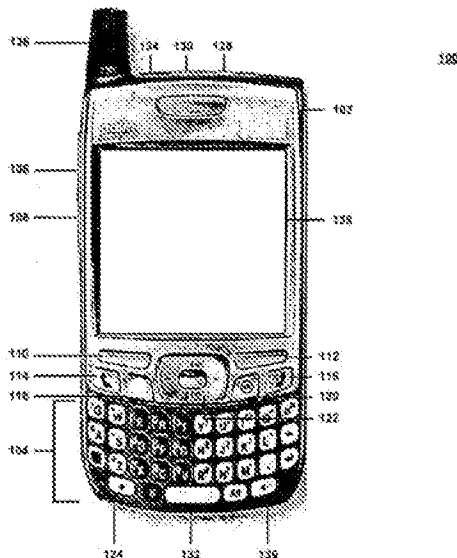


FIG. 1

Ex. 1004 at FIG. 1 (illustrating a smart phone).

Boireau teaches that “FIG. 1 illustrates one embodiment of a wireless device 100. Wireless device 100 may comprise any device having a wireless transceiver arranged to communicate over one or more portions of a radio-frequency (RF) spectrum. In one embodiment, for example, wireless device 100 may comprise a mobile computing device.” *Id.* At ¶[0018] ; *see also* Ex. 1002 at ¶186. Boireau further discloses that “mobile computing device 100 may be implemented as a combination handheld computer and mobile telephone, sometimes referred to as a **smart phone**.” Ex. 1004 At ¶[0019] (emphasis added). The mobile computing device of Boireau may include a “display 138 [that] may be implemented as an additional I/O device, such as a touch screen, touch panel, touch screen panel, and so forth” *Id.* At ¶[0023]. Boireau includes several multi-media functions to include applications, such as “office suites, business software, educational software, databases, communications software, computer games, and so forth. *Id.* At ¶[0065]. In addition, Boireau contemplates audio over a headset as well as other multimedia streaming. *Id.* At ¶¶ [0090] – [0091].

As set forth above, a person of ordinary skill would have had reason to combine Boireau and Zeilinger because both references and the ’103 patent had a motivation to improve antenna geometry for small devices. Ex. 1005 at ¶[0002]; Ex. 1004 at ¶[0001] ; *see* Rationale for combination, *supra*; *see also* Ex. 1002 at

¶187. In addition, there would have had a reasonable expectation of success in combining Boireau and Zeilinger because Boireau and Zeilinger both involve antenna designs within wireless devices and therefore are analogous art directed to the same field of endeavor as the '103 patent *See id.*; *see also* Ex. 1002 at ¶187.

Thus, a person of ordinary skill would find this limitation disclosed in the teachings of Boireau and Zeilinger and their incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1004 at ¶188.

ii) “a touch screen;”

As set forth above, Zeilinger teaches use of its disclosed antennas in connection with wireless devices, including mobile phones, which were known to have touch screens. Ex. 1002 at ¶189.

Boireau additionally discloses this claim limitation. Boireau teaches that “[m]obile computing device 100 may comprise various input/output (I/O) devices. Such as an alphanumeric keyboard, alphanumeric keypad, numeric keys, keys, buttons, switches, rocker switches, multi-directional rocker switches, a microphone, an audio headset, a camera, ***a touch-sensitive display screen***, a stylus, and so forth.” Ex. 1004 at ¶[0021] (emphasis added); *see also* Ex. 1002 at ¶190.

Therefore, a person of ordinary skill would find that Boireau discloses a touch screen. Ex. 1002 at ¶191.

A person of ordinary skill would have found it obvious to combine the teachings of Boireau with those of Zeilinger because it was obvious to use the antennas of Zeilinger with any of a variety of mobile phones at the time, including those with a touch screen as disclosed by Boireau and further Boireau specifically contemplated antennas covering multiple bands, such as those disclosed in Zeilinger. *See* Rationale for combination, *supra*; *see also* Ex. 1002 at ¶191. *See* Rationale to Combine, *supra*.

iii) “a processing module;”

Zeilinger and Langley each teach the use of their disclosed antennas in connection with wireless devices, including mobile phones, which were known to have processors. Thus, a person of ordinary skill in the art would find this limitation disclosed in the teachings of Zeilinger, Langley, and their incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶192

Boireau additionally discloses “a processing module.” Boireau teaches that “[h]ousing 102 may be used to encapsulate various internal components for mobile computing device 100, such as **a processor**, a memory, one or more transceivers, one or more printed circuit board (PCB), one or more antennas, a stylus, and so forth.” Ex. 1004 at ¶[0020] (emphasis added) *see also* Ex. 1004 at ¶[0041]; *see also* Ex. 1002 at ¶193. The ’103 patent defines a “processing module” as a

“microprocessor or CPU.” Ex. 1001 at 8:21-22. Therefore, according to the definition set forth in the ’103 patent, Boireau’s “processor” is a processing module.

Thus, a person of ordinary skill in the art would have found it obvious to combine the teachings of Boireau with those of Zeilinger and Langley because they would have found it obvious to use the antennas of Zeilinger and Langley with any of a variety of mobile phones at the time, which included processors, such as the mobile phone of Boireau. *See* Rationale for combination, *supra*; *see also* Ex. 1002 at ¶¶194-195.

iv) “a memory module;”

Zeilinger and Langley each teach “a memory module.” As set forth above, Zeilinger and Langley each teach use of their disclosed antennas in connection with wireless devices, including mobile phones, which were known to have memory. Thus, a person of ordinary skill in the art would have found this limitation disclosed in the teachings of Zeilinger, Langley, and their incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶196.

Boireau also teaches that “[h]ousing 102 may be used to encapsulate various internal components for mobile computing device 100, such as a processor, *a memory*, one or more transceivers, one or more printed circuit board (PCB), one or

more antennas, a stylus, and so forth.” Ex. 1004 at ¶[0041]; *see also* Ex. 1002 at ¶197. Additionally, for the same reasons as described above, a person of ordinary skill in the art would have found it obvious to combine the teachings of Boireau with those of Zeilinger and/or Langley because it was obvious to use the antennas of Zeilinger and Langley with any of a variety of mobile phones at the time, which included memory, such as the mobile phone of Boireau. *See* Rationale for combination, *supra*; *see also* Ex. 1002 at ¶198.

v) “a communication module;”

Zeilinger teaches “a communication module.” Boireau and Zeilinger teach this feature for at least the following reasons. As set forth above, Zeilinger teaches use of its disclosed antennas in connection with wireless devices, including mobile phones, which were known to have antennas for communication. Ex. 1002 at ¶199.

For example, Zeilinger teaches, “[w]ith the advent of digital signal transmission systems used in mobile telephones, other frequency bands are being utilized for communication. These bands are separated and are utilized for different communications application, for example, the go anywhere aspect of the PCS (“Personal Communication Services”) band, the GSM band that is widely used in Europe and other bands. Each of these bands offers certain advantages and it is desirable to utilize mobile telephones that operate reliably within all such bands. Important to this operation are effective antennas.” Ex. 1005 at ¶[1004]; *see also*

Ex. 1002 at ¶201. Thus, a person of ordinary skill in the art would find this disclosed in the teachings of Zeilinger and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention.

Additionally, Langley discloses this feature. Ex. 1002 at ¶202. For example, Langley, disclosed a compact and efficient multi-element, multi-band antenna that operates on five frequency bands and is operable in a mobile device. Ex. 1006 at 1:6-11, 2:24-26, 4:29-7, 8:8-13. As Langley explains, the need for a compact, efficient multi-band antenna was well-known and well-understood. Ex. 1006 at 2:21-22. “The invention [of Langley] provides a compact and efficient multi-band antenna capable of supporting a variety of frequency bands for cellular telecommunications and wireless connectivity.” Ex. 1006 at 3:4-6. Langley discloses that the antenna invention of Langley operates on five frequency bands. Ex. 1006 at 4:29-5:7. The antennas of Figure 2 (embodiment example 1) and Figure 13 (embodiment example 2) are two examples of the invention of Langley, and therefore these two antennas operate on five frequency bands. See Ex. 1006 at 5: 12-6: 13. Thus, a person of ordinary skill in the art would find this feature disclosed in the teachings of Langley and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶204.

Additionally, Boireau discloses this feature. Boireau teaches that “[h]ousing 102 may be used to encapsulate various internal components for mobile computing device 100, such as a processor, a memory, one or more transceivers, one or more printed circuit board (PCB), one or more antennas, a stylus, and so forth.” Ex. 1004 at ¶[0020]. Boireau explains “mobile computing device 100 may include a **radio sub-system 202** connected via bus 204 to a processing sub-system 206. Radio sub-system 202 may perform voice and/or data communications operations on behalf of mobile computing device 100.” Ex. 1004 at ¶[0028] (emphasis added) ; *see also* Ex. 1002 at ¶203. Further, “Radio sub-system 202 may perform voice and/or data communication operations for mobile computing device 100. For example, radio sub-system 202 may be arranged to communicate voice information and/or data information over one or more assigned frequency bands of a wireless shared media.” Ex. 1004 at ¶[0030]. Finally, “radio sub-system 202 may implement a shared antenna architecture for multiple transceivers used to implement voice and/or data communications as previously described.” Ex. 1004 at ¶[0035].

Boireau also teaches a “transceiver module 304 [that] may include multiple transceivers and associated hardware and/or software components implemented in a single integrated package or module, such as on the same die, package or PCB. Transceiver module 304 may be implemented using a single chip, multiple chips, or a system on a chip (SoC) solution, as desired for a given set of performance and

design constraints.” *Id.* at ¶[0036]. Thus, a person of ordinary skill in the art would find this disclosed in the teachings of Boireau and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶204.

vi) “a power management module;”

Zeilinger and Langley teach “a power management module.” Ex. 1002 at ¶210. The ’103 patent describes the power management module as the “single source of energy” for the MFWD (wireless device). Ex. 1001 at 8:26-28. As set forth above, Zeilinger and Langley teach use of their disclosed antennas in connection with wireless devices, including mobile phones, which were known to have energy sources for operation. Ex. 1002 at ¶207. Thus, a person of ordinary skill in the art would find this limitation disclosed in the teachings of Zeilinger, Langley, and their incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶210.

Additionally, Boireau discloses this feature. Boireau teaches that “[m]obile computing device 100 also may comprise a rechargeable battery, such as a removable and rechargeable lithium ion battery, and an alternating current (AC) adapter.” Ex. 1004 at ¶[0022]. Boireau further discloses: “mobile computing device 100 may further include a ***power management sub-system 208***. Power management sub-system 208 may manage power for mobile computing device

100, including radio sub-system 202, processing sub-system 206, and other elements of mobile computing device 100. For example, power management sub-system 208 may include one or more batteries to provide direct current (DC) power, and one or more AC interfaces to draw power from an AC power source, such as a standard AC main power supply.” *Id.* at ¶[0029] (emphasis added).

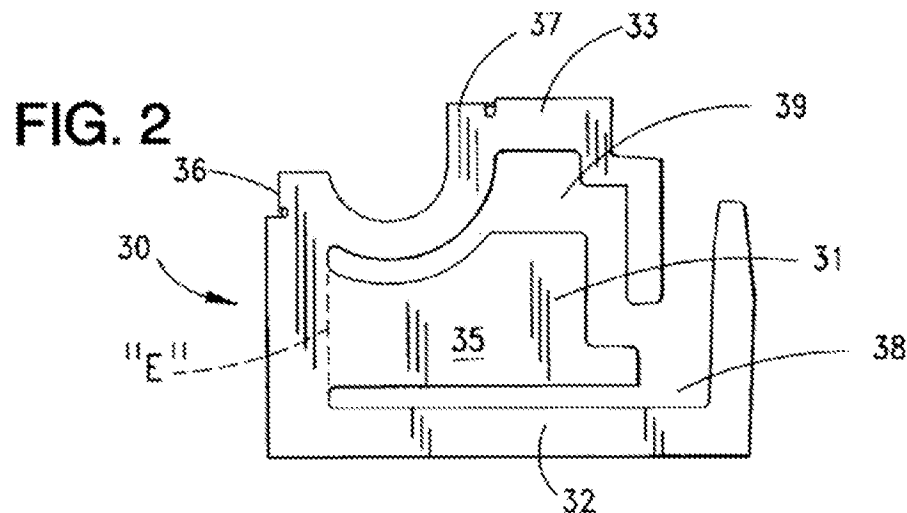
Additionally, for the same reasons as described above, a person of ordinary skill in the art would have found it obvious to combine the teachings of Boireau with those of Zeilinger because it was obvious to use the antennas of Zeilinger with any of a variety of mobile phones at the time, which included power management modules (e.g, batteries) as disclosed by Boireau. *See* Rationale for combination, *supra*.

Thus, a person of ordinary skill in the art would find this limitation disclosed in the teachings of Boireau and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶210.

vii) “an antenna system within the handheld multifunction wireless device and comprising:”

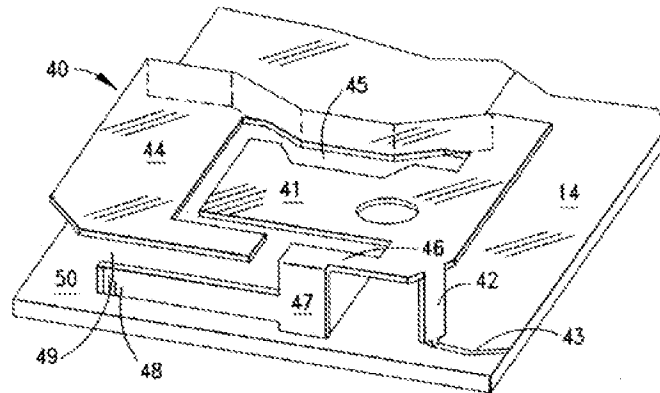
Zeilinger teaches “an antenna system within the handheld multifunction wireless device and comprising.” Ex. 1002 at ¶212. For example, Zeilinger teaches, “FIG. 1 illustrates a mobile telephone housing 10 which is exemplary of the environment in which antennas of the present invention are used. As is known,

the telephone housing 10 is formed from suitable plastic in the form of a hollow shell 11 having an internal cavity 12 surrounded by exterior sidewalls 13a, 13b. One or more printed circuit boards 14, 20 may be provided and supported within the cavity 12. Integrated circuits 15 in the form of chips 16 that power different aspects of the telephone may be supported on the circuit boards 14 and terminated to various circuits thereon.” Ex. 1005 at ¶[0024]. Thus, Zeilinger discloses an antenna system within the handheld multifunction wireless device and a person of ordinary skill in the art would find this disclosed in the teachings of Zeilinger and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶212.



Ex. 1005 at FIG. 2.

FIG. 3



Ex. 1005 at FIG. 3.

Langley also discloses this limitation. Ex. 1002 at ¶213. For example, Langley, disclosed a compact and efficient multi-element, multi-band antenna that operates on five frequency bands and is operable in a mobile device. Ex. 1006 at 1:6-11, 2:24-26, 4:29-7, 8:8-13. As Langley explains, the need for a compact, efficient multi-band antenna was well-known and well-understood. Ex. 1006 at 2:21-22. "The invention [of Langley] provides a compact and efficient multi-band antenna capable of supporting a variety of frequency bands for cellular telecommunications and wireless connectivity." Ex. 1006 at 3:4-6. Langley discloses that the antenna invention of Langley operates on five frequency bands. Ex. 1006 at 4:29-5:7. The antennas of Figure 2 (embodiment example 1) and Figure 13 (embodiment example 2) are two examples of the invention of Langley, and therefore these two antennas operate on five frequency bands. *See* Ex. 1006 at 5: 12-6: 13; *see also* Ex. 1002 at ¶213. Thus, Langley discloses an antenna system

within the handheld multifunction wireless device and a person of ordinary skill in the art would find this disclosed in the teachings of Langley and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶217.

Boireau also discloses this limitation. Ex. 1002 at ¶214. Boireau teaches that “[m]obile computing device 100 may comprise an antenna system including one or more antennas.” Ex. 1004 at ¶[0025].

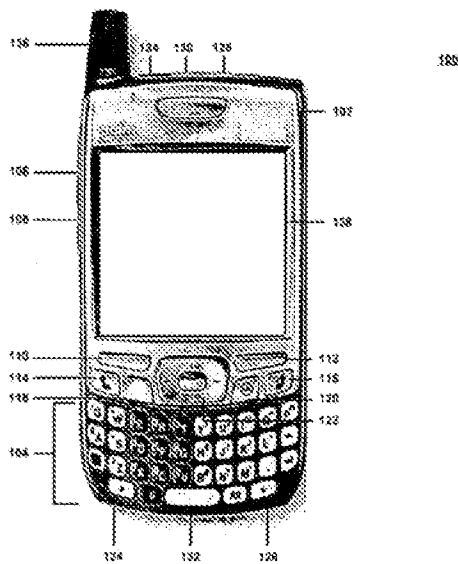


FIG. 1

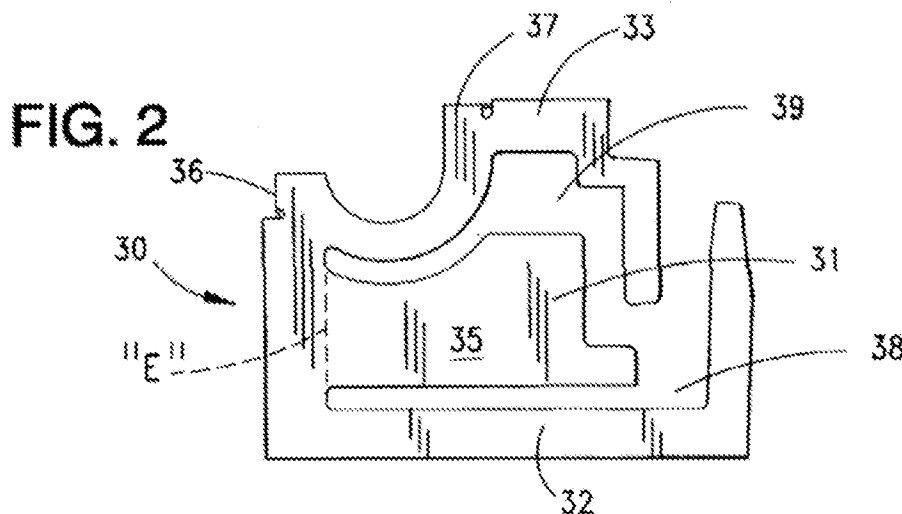
Ex. 1004 at FIG. 1.

Boireau further teaches “antenna 318 may be implemented alone, or as part of a broader antenna system (e.g., antenna 136) or antenna array for mobile

computing device 100.” Ex. 1004 at ¶[0048]. Thus, Boireau discloses an antenna system within the handheld multifunction wireless device and a person of ordinary skill in the art would find this disclosed in the teachings of Boireau and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶217.

viii) “a ground plane layer;”

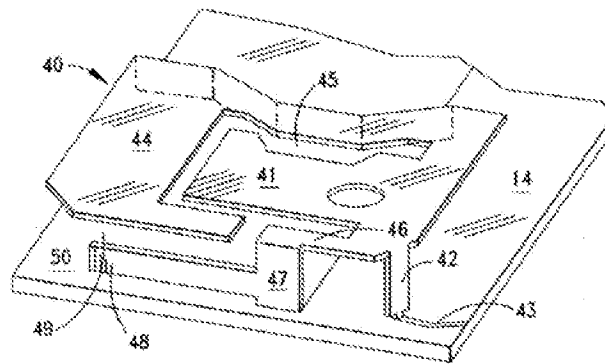
Zeilinger explains that “[a] second leg portion 37 is provided and it also is angled with respect to the radiating elements 31-33. This leg portion is electronically connected to a ground plane of the telephone 10, which can be a separate component, or it can be formed on one of the circuit boards 14.” Ex. 1005, ¶[0028]; *see also* Ex. 1002 at ¶219.



Ex. 1005 at FIG. 2.

Also, “[i]n this instance, the third radiator communicates directly with the ground pin 47 and extends in a direction between the two radiating elements and a ground plane 50 that is either formed on the surface of the circuit board 14 or formed as a layer of the circuit board.” Ex. 1005 at ¶[0033].

FIG. 3



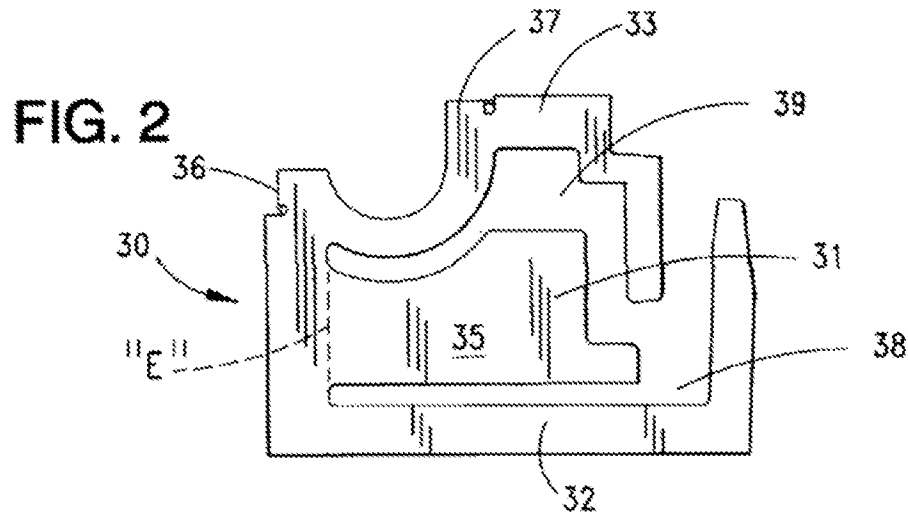
Ex. 1005 at FIG. 3.

Thus, a person of ordinary skill in the art would find this limitation disclosed in the teachings of Zeilinger and its disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. *See* Rationale for combination, *supra*; *see also* Ex. 1002 at ¶220.

ix) “a first antenna element configured to simultaneously support radiation modes for first, second, and third frequency bands,”

Zeilinger discloses a tri-band antenna. Ex. 1005 at ¶[0011] (“[a] further object of the present invention is to provide in one embodiment of the invention, a

tri-band antenna for use with mobile telephones that is capable of operating in at least *three distinct preselected frequency bands*. . .” (emphasis added)).



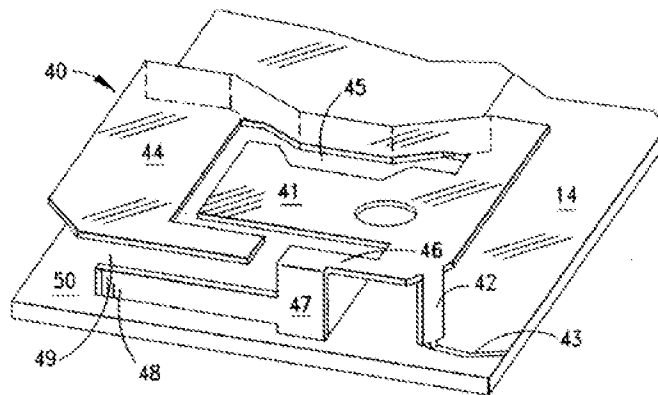
Ex. 1005 at FIG. 2.

Specifically, Zeilinger teaches that “the radiating element 38 [sic, 33] drives the PCS frequency band, while the second radiating element 32 drives the GSM900 frequency band. The third radiating element improves the bandwidth of the antenna by driving the PCN frequency band of the antenna.” Ex. 1005 at ¶[0029]; *see also* Ex. 1004 at ¶222.

Zeilinger further teaches “[t]he antenna 40 has a first, or base radiator 41 that is in communication with a feed pin, or leg 42 that is connected to a feed circuit 43 of the circuit board 14. A second radiator 44 is provided and takes the form of a conductive branch that extends around a portion of the perimeter of the first radiator 41, shown in FIG. 3 as extending around portions of three sides of the perimeter of the first radiator 41. A slot 45 formed therein defines a space between

the first and second radiators 41, 44. An extension portion of the antenna serves to communicate a ground pin, or leg 47 with a first and second radiators. A third radiator 48 is provided and it extends horizontally spaced apart from the first and second radiators, 41, 44, as in the antenna 30 of FIG. 2, but it lies in a vertical plane rather than the common horizontal plane in which the first and second radiators 41, 44 lie.” *Id.* at ¶[0032]-[0033]; *see also* Ex. 1002 at ¶222. A person of ordinary skill in the art would understand that each radiator (e.g., radiator 41, radiator 44, radiator 48 simultaneously supports an individual radiation mode. Ex. 1002 at ¶222.

FIG. 3



Ex. 1005 at FIG. 3.

Thus, a person of ordinary skill in the art would find this limitation disclosed in the teachings of Zeilinger and its incorporated disclosures taken as a whole. Ex. 1002 at ¶223.

x) “the first frequency band being contained within a first frequency region of an electromagnetic spectrum,”

Zeilinger discloses “It is therefore a general object of the present invention to provide a low cost multiple band antenna having a small form factor and which is capable of operating in three distinct frequency bands so as to operate in GSM900 frequency band (from 880 to 960 Megahertz), the GSM1800 frequency band (from 1710-1889 Megahertz) and the PCT-GSM 1900 frequency band (also referred to as the UMTS Band extending from 1900 to 2170 Megahertz).” Ex. 1005 at ¶[0008].

Zeilinger further teaches, “FIG. 6 illustrates a VSWR plot of the antenna 30 of FIGS. 2 and 4, with the third radiating element 33 in place. Two peaks are shown on the plot and the second peak, “B”, shown to the right of FIG. 6) is wider than the second peak, “B”, to the right of FIG. 5. This is because the third radiating element causes a third peak, or spike close to the second one and the two radiating elements cooperatively combine to form a single, wider peak, or Spike. In FIG. 6, the first peak “A”, as defined by markers 1 and 2 provide an effective bandwidth from 880 to 960 MHZ at 6 dB, while the second peak “B”, as defined by markers 3 and 5, provide an effective bandwidth from 1710 to 1990 MHz, thereby effectively encompassing both the GSM 1800 and 1900 bands (and the PCS band).” Ex. 1005 at ¶[0031]. As such, Zeilinger discloses the GSM900 frequency band (*i.e.*, the first

frequency band being contained within a first frequency region of an electromagnetic spectrum). Ex. 1002 at ¶225.

Thus, a person of ordinary skill in the art would find this limitation disclosed in the teachings of Zeilinger and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶226.

xi) “the second frequency band being contained within a second frequency region of the electromagnetic spectrum that is higher in frequency than the first frequency region,”

Zeilinger discloses “It is therefore a general object of the present invention to provide a low cost multiple band antenna having a small form factor and which is capable of operating in three distinct frequency bands so as to operate in GSM900 frequency band (from 880 to 960 Megahertz), the GSM1800 frequency band (from 1710-1889 Megahertz) and the PCT-GSM 1900 frequency band (also referred to as the UMTS Band extending from 1900 to 2170 Megahertz).” Ex. 1005 at ¶[0008].

Zeilinger further teaches, “FIG. 6 illustrates a VSWR plot of the antenna 30 of FIGS. 2 and 4, with the third radiating element 33 in place. Two peaks are shown on the plot and the second peak, “B”, shown to the right of FIG. 6) is wider than the second peak, “B”, to the right of FIG. 5. This is because the third radiating

element causes a third peak, or spike close to the second one and the two radiating elements cooperatively combine to form a single, wider peak, or Spike. In FIG. 6, the first peak “A”, as defined by markers 1 and 2 provide an effective bandwidth from 880 to 960 MHz at 6 dB, while the second peak “B”, as defined by markers 3 and 5, provide an effective bandwidth from 1710 to 1990 MHz, thereby effectively encompassing both the GSM 1800 and 1900 bands (and the PCS band).” Ex. 1005 at ¶[0031]. As such, Zeilinger discloses the GSM1800 frequency band (*i.e.*, the second frequency band) being contained within a second frequency region of an electromagnetic spectrum and at a frequency of 1710 MHz to 1889 MHz. *Id.* at ¶[0008]; *see also* Ex. 1002 at ¶229.

Thus, a person of ordinary skill in the art would find this feature disclosed in the teachings of Zeilinger and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶230.

xii) “the third frequency band of operation being used by a 4 G communication standard,”

As set forth above, in connection with the disclosures cited for the first and second frequency band, Zeilinger discloses a “Tri-Band Antenna” and thus, this limitation. Ex. 1005 at ¶¶[0030]-[0031].

Additionally, Zeilinger discloses, “It is therefore a general object of the present invention to provide a low cost multiple band antenna having a small form factor and which is capable of operating in three distinct frequency bands so as to operate in GSM900 frequency band (from 880 to 960 Megahertz), the GSM1800 frequency band (from 1710-1889 Megahertz) and the PCT GSM 1900 frequency band (also referred to as the UMTS Band extending from 1900 to 2170 Megahertz).” Ex. 1005 at ¶[0008].

Zeilinger further teaches, “FIG. 6 illustrates a VSWR plot of the antenna 30 of FIGS. 2 and 4, with the third radiating element 33 in place. Two peaks are shown on the plot and the second peak, “B”, shown to the right of FIG. 6) is wider than the second peak, “B”, to the right of FIG. 5. This is because the third radiating element causes a third peak, or spike close to the second one and the two radiating elements cooperatively combine to form a single, wider peak, or Spike. In FIG. 6, the first peak “A”, as defined by markers 1 and 2 provide an effective bandwidth from 880 to 960 MHZ at 6 dB, while the second peak “B”, as defined by markers 3 and 5, provide an effective bandwidth from 1710 to 1990 MHz, thereby effectively encompassing both the GSM 1800 and 1900 bands (and the PCS band).” Ex. 1005 at ¶[0031]. Additionally, Zeilinger discloses, “It is therefore a general object of the present invention to provide a low cost multiple band antenna having a small form factor and which is capable of operating in three distinct frequency bands so as to

operate in GSM900 frequency band (from 880 to 960 Megahertz), the GSM1800 frequency band (from 1710-1889 Megahertz) and the PCT GSM 1900 frequency band (also referred to as the UMTS Band extending from 1900 to 2170 Megahertz).” Ex. 1005, ¶[0008].

As such, Zeilinger discloses the PCT GSM 1900 frequency band (also referred to as the UMTS Band extending from 1900 to 2170 Megahertz). (*i.e.*, the third frequency band of operation being used by a 4 G communication standard). Ex. 1002 at ¶233.

The ’103 patent includes “3G and other advanced services for instance HSDPA, WiBro, WiFi, WiMax, UWB or other high speed wireless standards,” as among those referred to by the ’103 patent as “4G services” and “might require operation in additional frequency bands corresponding to said 4G standards (for instance, bands within the frequency region 2-11 GHz and some of its sub-regions such as for instance 2-11 GHz, 3-10 GHz, 2.4-2.5 GHz and 5-6 GHz or some other bands).” Ex. 1001, 24:22-30. This definition by the ’103 patent is inconsistent with the traditional applications of the “4G” moniker, which does not include, for example, 3G or WiFi. Ex. 1002 at ¶234. In view of the definition provided by the ’103 patent, the antennas taught by Zeilinger are configured to transmit and receive in 4G bands (e.g., the PCT GSM 1900 frequency band (also referred to as the

UMTS Band extending from 1900 to 2170 Megahertz)). Ex. 1005, ¶[0008]; *see also* Ex. 1002 at ¶234.

While the definition provided by the '103 patent is inconsistent with traditional applications of the "4G" moniker, the '103 patent definition of 4G may be relied upon given that 4G standards had not been formally defined as of the earliest claimed priority date of the '103 patent (September 2006). Ex. 1002 at ¶235. The ITU (International Telecommunication Union) first defined 4G standards in 2008. Ex. 1002 at ¶235. The 4G standards were defined in the 3 GPP Release 8 that was released in 2008, with the first commercial deployment in 2009. Ex. 1002 at ¶235. The 3 GPP Release 8, released two years after the priority date of the '103 patent, included frequency bands of 900 MHz (e.g., 880-915 MHz) and between 1805 MHz – 2400 MHz inclusive. Ex. 1008 at 13-14; Ex. 1009 at 32-33. Ex. 1002 at ¶235.

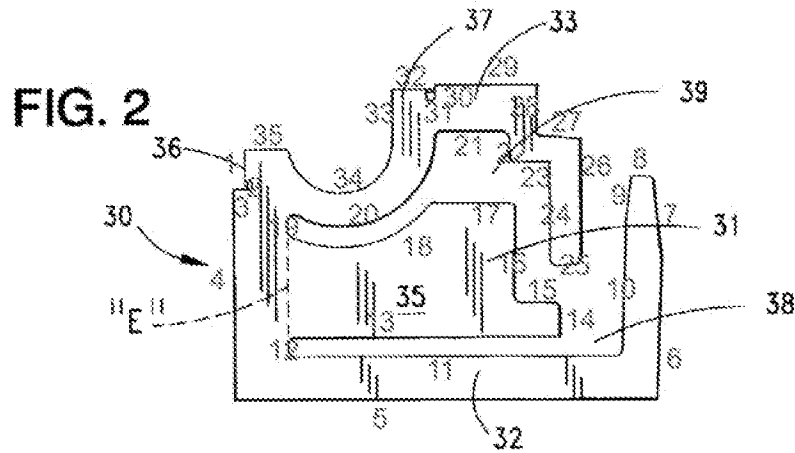
Regardless, the tri-band antenna taught by Zeilinger is capable of operating in three distinct frequency bands: the GSM900 frequency band (from 880 to 960 Megahertz), the GSM1800 frequency band (from 1710-1889 Megahertz), and the PCT GSM 1900 frequency band (also referred to as the UMTS Band extending from 1900 to 2170 Megahertz). Ex. 1005, ¶[0008]; *see also* Ex. 1002 at ¶236. The PCT GSM 1900 frequency band (also referred to as the UMTS Band) extending from 1900 to 2170 Megahertz falls within the 4G 1805 MHz – 2400 MHz

inclusive band. Ex. 1002 at ¶236. Moreover, a person of ordinary skill in the art would have readily understood that the frequency bands of Zeilinger could be readily tuned to provide coverage for 4G wireless standards bands, and a person of ordinary skill in the art would have understood that it was advantageous for the wireless device to operate in 4G wireless standards bands. Ex. 1002 at ¶236. Thus, whether 4G standards are defined by the '103 patent, or the 3 GPP Release 8, a person of ordinary skill in the art would find this feature disclosed in the teachings of Zeilinger and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶236.

xiii) “wherein a perimeter of the first antenna element defines a first antenna contour comprising at least thirty-five segments,”

The '103 patent discloses that “[a]long the contour different segments can be identified e.g. by a corner between two segments, wherein the corner is given by a point on the contour where no unique tangent can be identified. At the corners the contour has an angle. The segments next to a corner may be straight or curved or one straight and the other curved. Further, segments may be separated by a point where the curvature changes from left to right or from right to left. In a sine curve, for example such points are given where the curve intersects the horizontal axis (x-axis, abscissa, $\sin(x)=0$).” Ex. 1001 at 15:4-13; *see also* Ex. 1002 at ¶238. Based

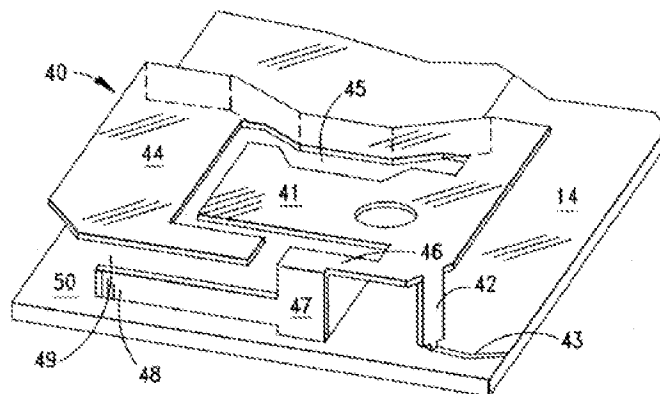
on this definition, the first antenna contour as shown above in FIG. 2 has at least 35 segments. Ex. 1002 at ¶239.



Ex. 1005 at FIG. 2 (annotated).

Based on this definition, the first antenna contour as shown above in FIG. 2 has at least 35 segments. The contour shown in Figure 3 has even more segments.

FIG. 3



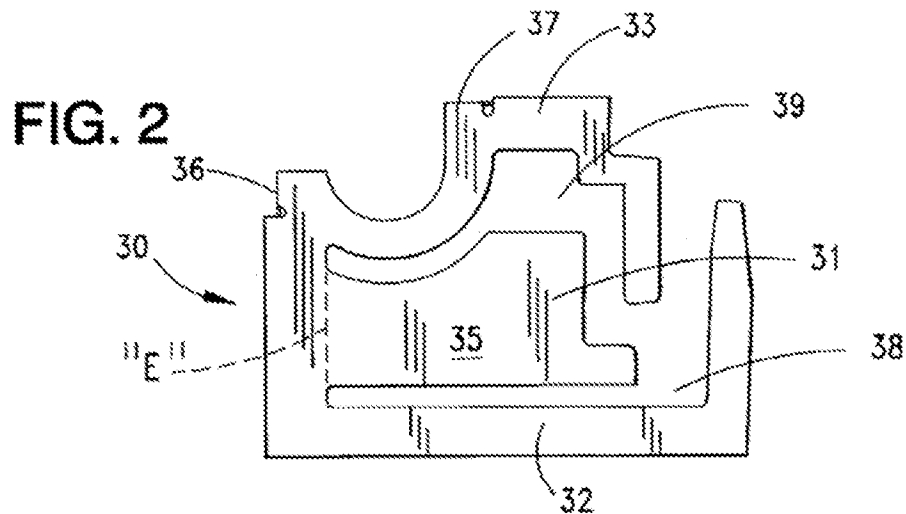
Ex. 1005 at FIG. 3.

Thus, a person of ordinary skill in the art would find this feature disclosed in the teachings of Zeilinger and its incorporated disclosures taken as a whole. Ex. 1002 at ¶240.

xiv) “the first antenna element defining an antenna box, an orthogonal projection of the antenna box along a normal to a face with a largest area of the antenna box defining an antenna rectangle,”

The '103 patent states that “[a]n antenna box for the MFWD 100 is herein defined as being the minimum-sized parallelepiped of square or rectangular faces that completely encloses the antenna volume of space and wherein each one of the faces of the minimum-sized parallelepiped is tangent to at least one point of the volume.” Ex. 1001 at 11:5-12. Further, the '103 patent states that “an antenna rectangle is defined as being the orthogonal projection of the antenna box along the normal to the face with largest area of the antenna box.” Ex. 1001 at 13:56-58.

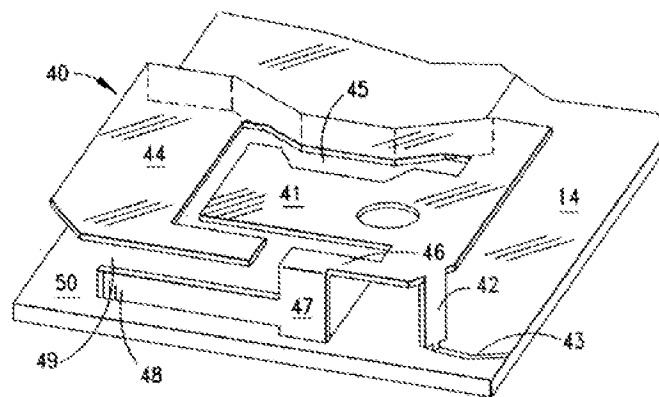
Figure 2 shows a planar view of the antenna that, by definition, forms an antenna box and an antenna rectangle. Ex. 1002 at ¶242. From the view of FIG. 2, the antenna rectangle being an orthogonal projection of the antenna box along a normal to a face with a largest area would be a rectangle encompassing the outer limits of the antenna 30. Ex. 1002 at ¶242.



Ex. 1005 at FIG. 2.

Similarly, Figure 3 shows a perspective view for which the top face is the largest area. Ex. 1002 at ¶243. An antenna box encompassing the entirety of the antenna 40 and an antenna rectangle being the orthogonal projection of the antenna box from the top surface. Ex. 1002 at ¶243.

FIG. 3

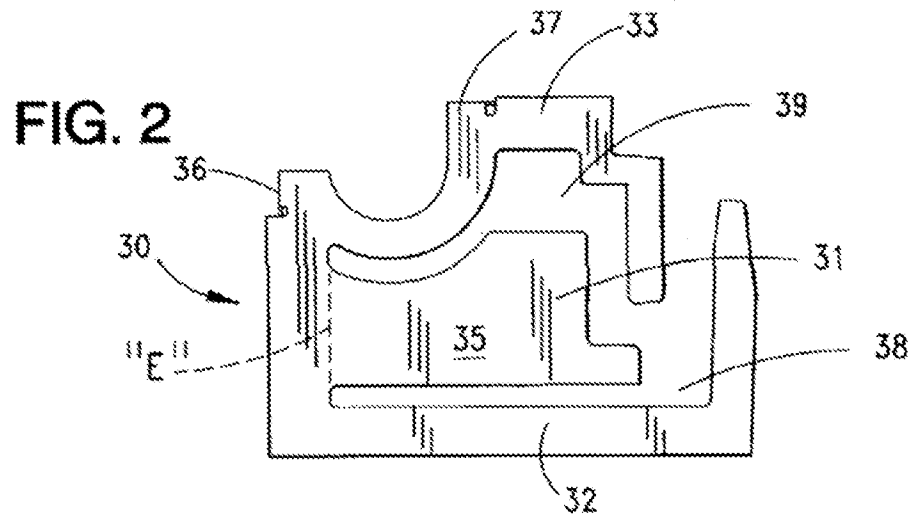


Ex. 1005 at FIG. 3.

Thus, a person of ordinary skill in the art would find this limitation disclosed in the teachings of Zeilinger and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶244.

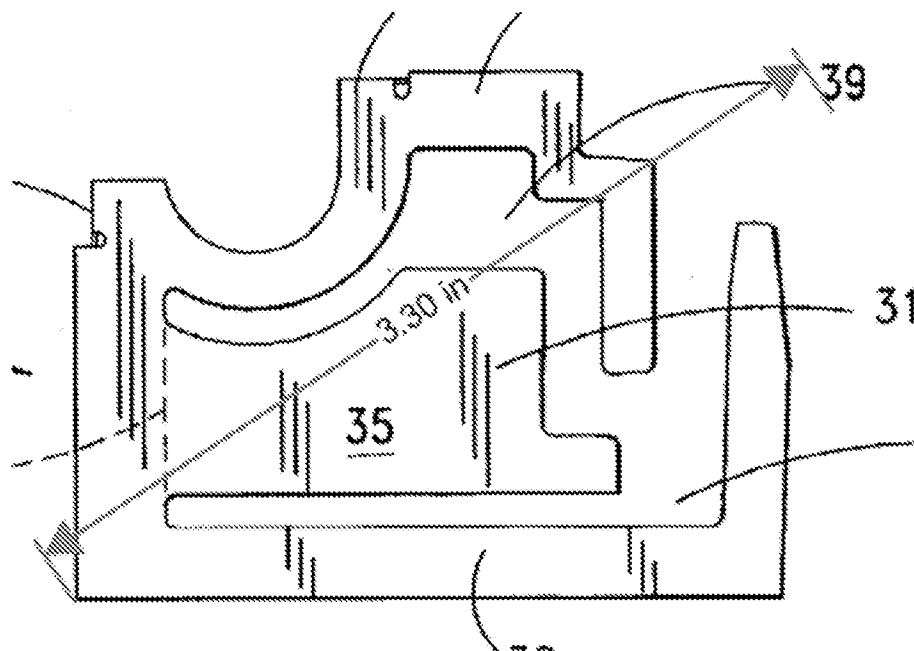
xv) “wherein a length of the first antenna contour is greater than four times a diagonal of the antenna rectangle; and”

Zeilinger teaches “wherein a length of the first antenna contour is greater than four times a diagonal of the antenna rectangle.” A POSITA would have understood that the “length of the first antenna contour is greater than four times a diagonal of the antenna rectangle” relates to miniaturization. Ex. 1002 at ¶245. In particular, the ability to have long segments to support lower frequencies as well as the ability to support multiple bands. Ex. 1002 at ¶245. Indeed, the POSITA would understand that a perimeter of a square would already be 2.83 (e.g., $2 \times \sqrt{2}$) times longer than the diagonal of the square indicating that the amount of miniaturization required by the claim is minimal and, thus, obvious. Ex. 1002 at ¶245. Regardless, Zeilinger discloses or suggests this limitation.

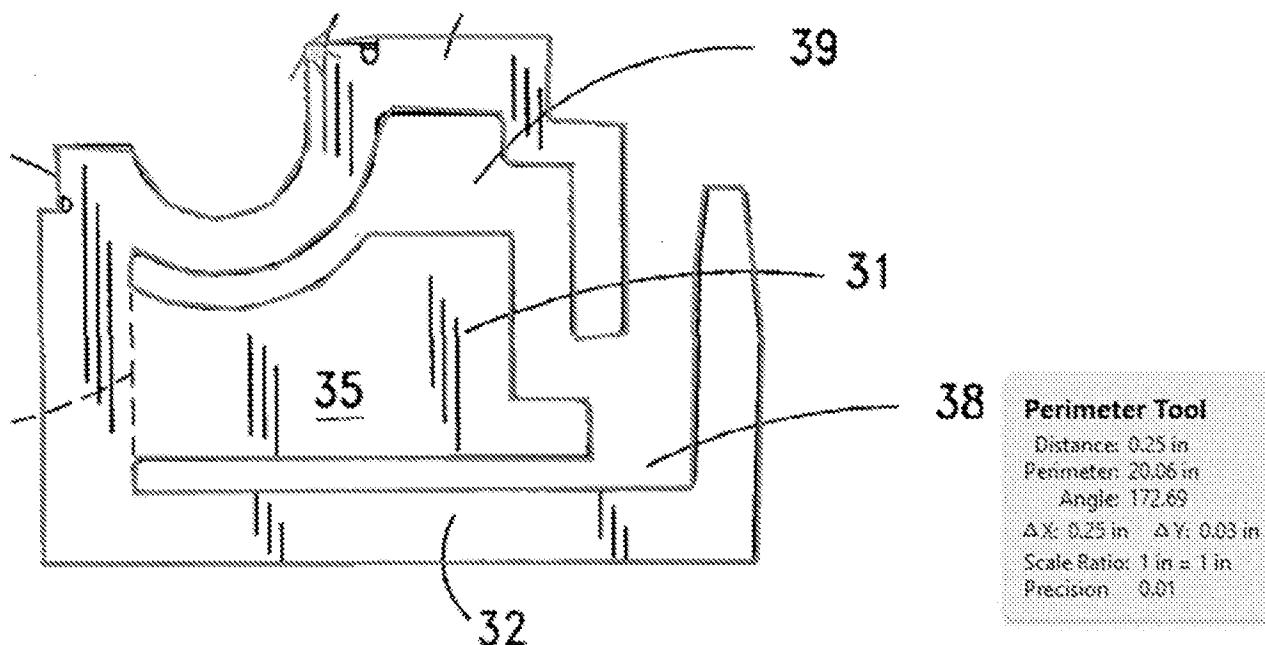


Ex. 1005 at FIG. 2.

Although the figures are not necessarily intended to be to exact scale, the disclosure of Zeilinger makes clear that the length of the contour is greater than four times the diagonal. *See, e.g., Krippelz v. Ford Motor Co.*, 667 F.3d 1261, 1269 (Fed. Cir. 2012) (finding a patent drawing to plainly show a lamp “adjacent to a window”); *Cummins-Allison Corp. v. SBM Co.*, 484 F. App’x 499, 507 (Fed. Cir. 2012) (“As long as a person of skill in the art could derive the claimed dimensions from the patent’s disclosure, there is no additional requirement that the specification must explicitly disclose the precise proportions or particular sizes.”). Measurements of the figures using the measurement tools of PDF software, are at least useful to show that that length of the contour is greater than four times the diagonal. Specifically, PDF measurement tools shows that measuring the lengths of the segments in the figures reveals that the perimeter is greater than 4X the diagonal of the antenna rectangle.



As shown in the annotated FIG. 2 above, the diagonal of the antenna rectangle of FIG. 2 is approximately 3.30 inches (or units of length) such that four times the diagonal is 13.2 units of length. Ex. 1002 at ¶248.



The length of the contour of FIG. 2 is approximately 20 units of length using the same scale as was used to measure the diagonal, which is more than four times the diagonal (13.2). Ex. 1002 at ¶249.

Similarly, based on the additional segments and overall structure of the antenna in FIG. 3, the length of the contour in Figure 3 is almost certainly longer than that of Figure 2. Ex. 1002 at ¶250. Thus, assuming a similarly sized antenna rectangle and corresponding diagonal length for the contour in Figure 3, the diagonal contour length of FIG. 3 also exceeds four times the diagonal of the antenna box. Ex. 1002 at ¶250.

Finally and additionally, the '103 patent does not include any teachings as to the importance of “length of the first antenna contour is greater than four times a diagonal of the antenna rectangle.” In fact, the '103 patent merely provides a laundry list of distances without identifying any particular benefit of one distance over another. As such, the person of skill in the art would have found the claimed distance and ratio to be a design choice and thus, obvious. *Airlite Plastics Co. v. Plastilite Corp.*, 526 F.2d 1078, 1082 (8th Cir. 1975) (claims obvious where difference over prior art limited to “form, proportions, or size”).

Thus, a person of ordinary skill in the art would find this limitation disclosed in the teachings of Zeilinger and its incorporated disclosures taken as a whole, or at least obvious in view of its teachings. Ex. 1002 at ¶251.

- xvi) “a second antenna element configured to operate in at least one frequency band used by a 4 G communication standard, wherein a perimeter of the second antenna element defines a second antenna contour comprising at least twenty segments.”**

As described above the in the rationale to combine section, the person of ordinary skill in the art would have implemented Langley in Boireau and Langley discloses the second claimed antenna element. *See* Rationale for combination, *supra*. Langley teaches “a second antenna element configured to operate in at least one frequency band used by a 4 G communication standard, wherein a perimeter of the second antenna element defines a second antenna contour comprising at least twenty segments.” Ex. 1002 at ¶253-261. The antenna of Langley used with Boireau and Zeilinger corresponds to the second antenna element configured to operate in at least one frequency band used by a 4 G communication standard, wherein a perimeter of the second antenna element defines a second antenna contour comprising at least twenty segments. Ex. 1002 at ¶253-261. Langley discloses an antenna that is configured to provide operation on five frequency bands, which exceeds the required at least three frequency bands. Ex. 1006 at 4:29-5:7; *see also* Ex. 1002 at ¶253. The antennas of Figure 2 (embodiment example 1) and Figure 13 (embodiment example 2) are two examples of the invention of Langley, and therefore these two antennas operate on five frequency bands. *See Id.*

at 5: 12-6: 13; *see also* Ex. 1002 at ¶254. Langley explains that the antenna shown in Figure 13 is an example of the invention, which is an antenna that operates on five bands. *Id.* at 5:12-6:13; *see also* Ex. 1002 at ¶255. Example frequency bands for which the Langley antenna operates are disclosed on the chart below:

System	Frequency Band
GSM 900	890 – 960 MHz
DCS1800	1710 – 1880 MHz
DECT	1900 MHz
UMTS	1920 – 2170 MHz
Bluetooth	2400 – 2483.5 MHz
Hiperlan 1/2	5150– 5725 MHz

Id. at 8:12-13.

As Langley explains, “[c]overage of these commercially useful frequency bands is provided by the Invention within the following three frequency bands, for which the measured return loss is less than -10dB.” Ex. 1006 at 8:14-16. Generally, as a person of ordinary skill in the art would have understood, a return loss of 10 or more on a negative scale for a particular frequency band indicates a commercially useful antenna for that frequency band. Ex. 1002 at ¶257. Langley summarizes the frequency bands covered by the antenna of example 1 as follows:

Frequency band (MHz)	Bandwidth	System covered
885 – 973	88 MHz	GSM900
1530 – 2590	1060 MHz	DCS1800 UMTS Bluetooth DECT
4630 – 5970	1340 MHz	Hiperlan 1 Hiperlan 2

Ex. 1006 at 8.

Langley explains that antennas of the invention (of which the antennas of example 1 (shown by Figure 2 of Langley) and example 2 (shown by Figure 13 of Langley are two embodiments)) preferably cover frequencies of 900MHz, 1800MHz, 2000MHz, 2400MHz and 5400MHz." *Id.* at 4:29-32. Langley explains that "[a]nother aspect of the invention provides an antenna for use with five separate frequency bands, comprising the antenna described above." *Id.* at 4:29-30.

Langley discloses an antenna configured to provide operation in at least three frequency bands being used by 4G communication standards. Ex. 1002 at ¶261. Three frequencies in the above charts (*Id.* at p.8; 8:12-13) fall within the 2-11 GHz range that is identified by the '103 Patent as being used by 4G standards: 1920-2170 Mhz, which overlaps the 2-11 GHz range; 2400-2483.5 MHz and 5150-5725 MHz, both of which fall within the 2-11 GHz range. Ex. 1002 at ¶261. Also, based on the disclosure of frequencies in which the antenna of Langley preferably

operates as disclosed above, at least three of the wireless bands (2000MHz, 2400MHz and 5400MHz) in which the antenna of Langley operates fall within the range of 2-11 GHz that the '103 Patent explains is a range that is used by 4G communications standards. *See* Ex. 1001 at 25:14-23; Ex. 1006 at 4:29-32. A person of ordinary skill in the art would have understood the plain and ordinary meaning of “frequency bands being used by 4G communication standards” to include at least three of the frequency ranges that the antenna of Langley is disclosed to cover. Ex. 1002 at ¶261.

The '103 patent includes “3G and other advanced services for instance HSDPA, WiBro, WiFi, WiMax, UWB or other high speed wireless standards,” as among those referred to by the '103 patent as “4G services” and “might require operation in additional frequency bands corresponding to said 4G standards (for instance, bands within the frequency region 2-11 GHz and some of its sub-regions such as for instance 2-11 GHz, 3-10 GHz, 2.4-2.5 GHz and 5-6 GHz or some other bands).” Ex. 1001, 24:22-30; *see also* Ex. 1002 at ¶262. This definition by the '103 patent is inconsistent with the traditional applications of the “4G” moniker, which does not include, for example, 3G or WiFi. Ex. 1002 at ¶262. In view of the definition provided by the '103 patent, the antennas taught by Langley are configured to transmit and receive in 4G bands (e.g., the PCT GSM 1900

frequency band (also referred to as the UMTS Band extending from 1900 to 2170 Megahertz)). Ex. 1005 at ¶[0008].

While the definition provided by the '103 patent is inconsistent with traditional applications of the "4G" moniker, the '103 patent definition of 4G may be relied upon given that 4G standards had not been formally defined as of the earliest claimed priority date of the '103 patent (September 2006). Ex. 1002 at ¶263. The ITU (International Telecommunication Union) first defined 4G standards in 2008. Ex. 1002 at ¶263. The 4G standards were defined in the 3GPP Release 8 that was released in 2008, with the first commercial deployment in 2009. Ex. 1002 at ¶263. The 3 GPP Release 8, released two years after the priority date of the '103 patent, included frequency bands of 900 MHz (e.g., 880-915 MHz) and between 1805 MHz – 2400 MHz inclusive. Ex. 1008 at 13-14; Ex. 1009 at 32-33. Ex. 1002 at ¶263.

Regardless, the multi-band antenna taught by Langley is capable of operating in in three bands, 900MHz, 2000MHz, 2400MHz, that fall within these ranges. Ex. 1006 at 4:29-32. Moreover, a person of ordinary skill in the art would have readily understood that the frequency bands of Langley could be readily tuned to provide coverage for 4G wireless standards bands, and a person of ordinary skill in the art would have understood that it was advantageous for the wireless device to operate in 4G wireless standard bands. Ex. 1002 at ¶264. Thus,

whether 4G standards are defined by the '103 patent, or the 3 GPP Release 8, a person of ordinary skill in the art would find this feature disclosed in the teachings of Langley and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶264.

Langley further discloses at least two antenna embodiments that include at least 20 segments. Ex. 1002 at ¶265. Langley discloses the antenna of example 1 (shown in Figure 2 of Langley) and the antenna of example 2 (shown in Figure 13 of Langley), each of which, when calculations are performed using the procedure set forth in the '103 patent, have a contour with at least 20 segments. Ex. 1006 at 5:15-16, 6:12-13, 6:21-7:33, 10:2-4 (generally describing the two embodiments represented by these figures). The antenna of the embodiment of example 1 of Langley (shown in Figures 1 and 2 of Langley, reproduced below, which have been faded to show annotations) discloses at least 25 segments in the antenna contour, as shown in the annotated version of figure 1 below. Ex. 1002 at ¶266. (Figure 2 is Figure 1 with dimensioning).

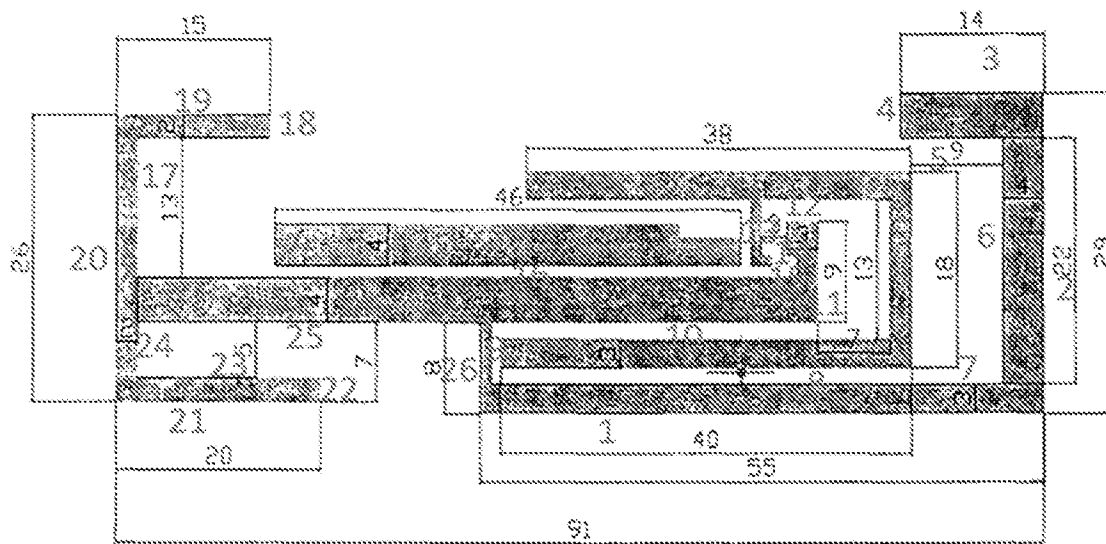
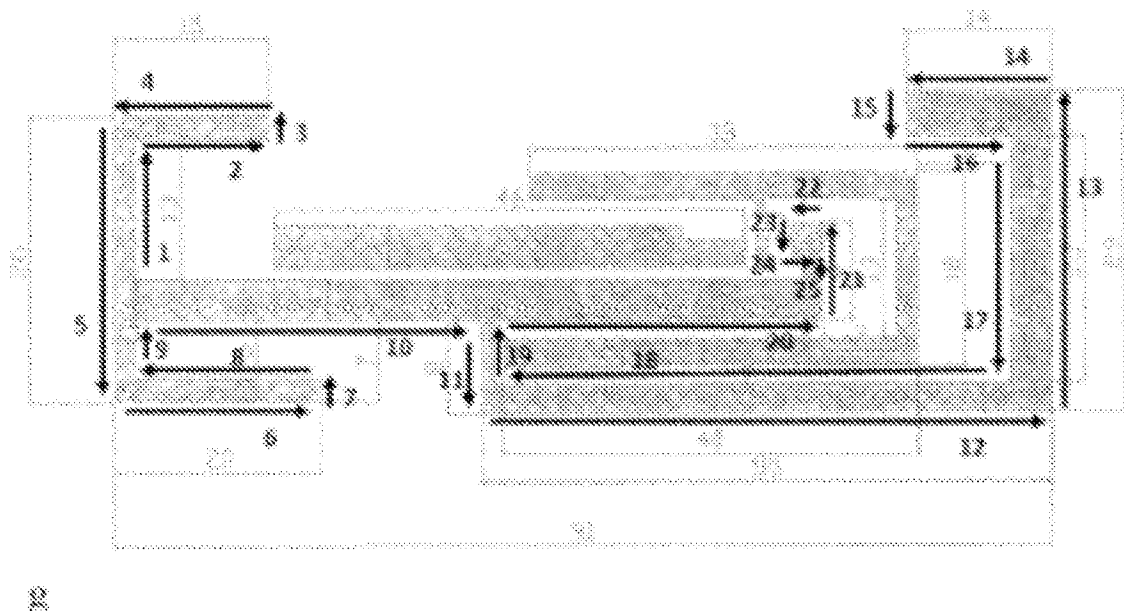


Fig. 13

Ex. 1006 at Fig. 13 (annotated).

The antenna of the embodiment of example 2 of Langley (shown in Figure 13, faded to show annotations) also discloses at least 20 segments in the antenna contour as shown in the annotated version of Figure 13 below. Ex. 1002 at ¶267.



Accordingly, a person of ordinary skill in the art would find this feature disclosed in the teachings of Langley and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶268.

4. Claim 15

- i) **“The handheld multifunction wireless device according to claim 12,”**

See claim 12 above.

- ii) **“wherein the ground plane layer defines a ground plane rectangle, the projection of the antenna rectangle on the ground plane rectangle partially overlapping the ground plane rectangle.”**

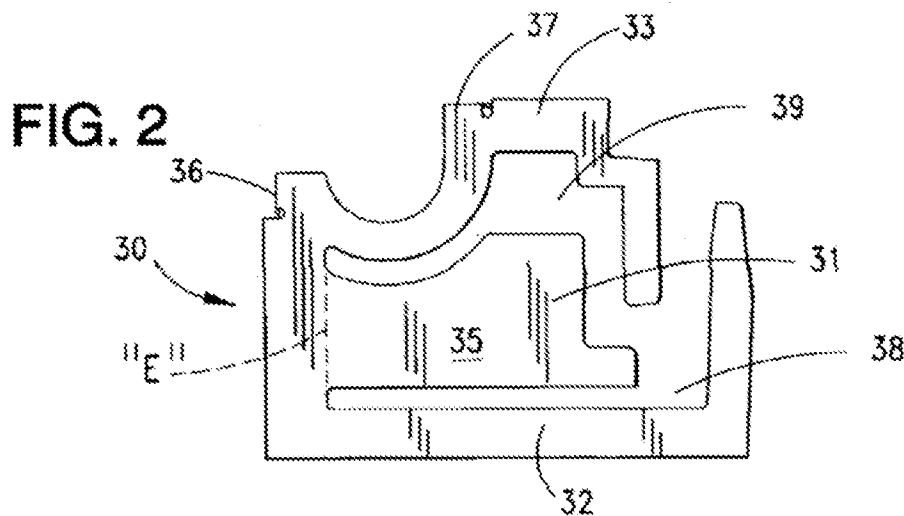
The concept of overlap between the ground plane and an antenna is not new. Ex. 1002 at ¶269. The '103 Patent concedes that a feature of so-called “patch

antennas” is that there is an overlap between the antenna and the ground-plane. In particular, the 103 patent states, “[f]or those antennas which in their physical properties come quite close to patch antennas namely those with an overlap between the antenna and the ground-plane (patch-like antennas), a value of F being higher than 1.45, 1.47, 1.50, or 1.60 turns out to be a good measure for an antenna to provide an expected improved bandwidth or gain with respect to a patch antenna without any complexity in at least one of the frequency bands.” Ex. 1001, Col. 21, lines 25-32 (emphasis added); *see also* Ex. 1002 at ¶269.

The Johnson and Zeilinger references further support this assertion. For example, the Johnson reference describes patch antennas that “[t]ypically consists of a planar dielectric material having a resonant structure one major surface of the dielectric and a second ground plane structure disposed on the opposite major surface.” Ex. 1003, Col. 1, lines 58-63; *see also* Ex. 1002 at ¶269. Zeilinger is directed to “an improved PIFA (planar inverted-F antenna),” a known variant of a patch antenna, that includes “a horizontal radiating element interposed between the PIFA and an associated ground plane, the horizontal radiating element being connected to either the ground pins or the feed pin of the PIFA.” Ex. 1005, para [009].

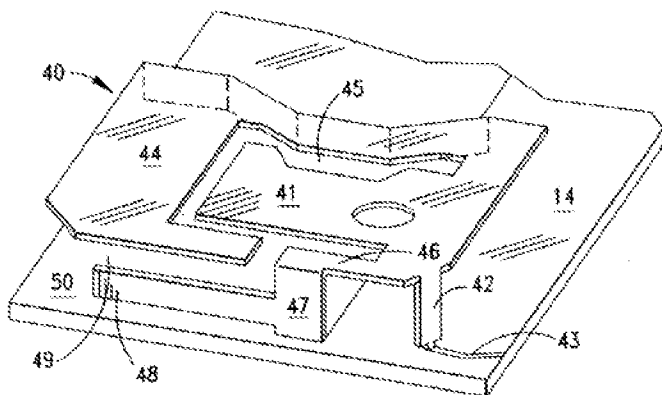
Regardless, Zeilinger teaches these features for at least the following reasons. Zeilinger explains, “FIG. 3 illustrates another embodiment of a PIFA

antenna 40 of the present invention with the antenna 40 being shown mounted to a circuit board 14.” Ex. 1005 at ¶[0032]. Also, “[i]n this instance, the third radiator communicates directly with the ground pin 47 and extends in a direction between the two radiating elements and a ground plane 50 that is either formed on the surface of the circuit board 14 or formed as a layer of the circuit board.” *Id.* at ¶[0033].



Ex. 1005 at FIG. 2.

FIG. 3



Ex. 1005 at FIG. 3.

According to the '103 patent, “a ground plane rectangle is defined as being the minimum-sized rectangle that encompasses the ground plane of the antenna system....” Ex. 1001 at 14:4-6. As shown in FIG. 3 of Zeilinger, the ground plane rectangle encompasses the ground plane 50 formed on the surface of the circuit board 14 or formed as a layer of the circuit board. Ex. 1002 at ¶271.

As further disclosed by the '103 patent “[a]n antenna box for the MFWD 100 is herein defined as being the minimum-sized parallelepiped of square or rectangular faces that completely encloses the antenna volume of space and wherein each one of the faces of the minimum-sized parallelepiped is tangent to at least one point of the volume. Moreover, each possible pair of faces of the minimum-size parallelepiped shares an edge forming an inner angle of 90°.” Ex. 1001 at 11:5-12. Within the antenna box is an antenna rectangle “defined as being the orthogonal projection of the antenna box along the normal to the face with the largest area of the antenna box.” *Id.* at 13:56-58. As depicted in FIG. 3, the antenna rectangle is defined by the antenna box comprising the antenna 40. Ex. 1002 at ¶272.

Similarly, the antenna 30 of FIG. 2 may be mounted to a ground plane layer. Ex. 1002 at ¶273. “As illustrated in FIG. 2, the antenna 30 includes a large central portion 35 that serves as the first radiating element, or main radiator, of the antenna

30. This first radiating element 31 communicates with an edge portion 36 which serves as an angled leg (not shown) that extends crosswise, or offset, from it down to an attachment point on a circuit board 14 of the telephone 10.” Ex. 1005 at ¶[0027]. As depicted in FIG. 2, the antenna rectangle is defined by the antenna box comprising the antenna 30. Ex. 1002 at ¶273.

Both the antenna 30 of FIG. 2 and the antenna 40 of FIG. 3 are mounted to a PCB 14, 20 comprising a ground plane formed on the surface of the circuit board or formed as a layer of the circuit board. Ex. 1002 at ¶274. Accordingly, Figures 2-3 of Zeilinger show an antenna with an antenna rectangle that when projected on the ground plane at least partially overlaps the ground plane rectangle. Ex. 1002 at ¶274. Thus, a person of ordinary skill in the art would find this feature disclosed in the teachings of Zeilinger and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶275.

C. Ground 3: Claims 12 and 15 of the '103 patent are invalid as obvious under 35 U.S.C. § 103(a) over Johnson in view of Boireau, and thus Johnson in view of Boireau present a Substantial New Question of Patentability.

1. The combination of Johnson and Boireau presents a substantial new question of patentability

The combination of Johnson and Boireau presents a substantial new question of patentability because the combination discloses or suggests each and every limitation of claims 12 and 15 of the '103 patent to include those that have been alleged to be novel. *See* Ground 3, *infra*; Ex. 1002 at ¶¶276-394. In fact, the combined system of Boireau and Zeilinger relies on the smart phone of Boireau along with the antennas of Johnson. *See* Ground 3, *infra*. Indeed, Johnson discloses or suggests at least a tri-band antenna of at least 35 segments. *See e.g.*, Ex. 1003 at FIG. 9.

For at least these reasons, the additional argument and citations set forth below in Ground 3, the rationale for combination, and the supporting testimony of Dr. Manos M. Tentzeris (Ex. 1002), the combination of Johnson and Boireau presents a substantial new question of patentability as to claims 12 and 15. *See* Ground 3, *infra*; Ex. 1002 at ¶¶276-394.

2. Rationale for the combination of Johnson and Boireau

Johnson in view of Boireau renders obvious claims 12 and 15 of the '103 patent. According to MPEP §2143(0), a claim would have been obvious if (1) there is some teaching, suggestion, or motivation, in the references themselves to modify the prior art device or method and (2) there was a reasonable expectation of

success. This rational is flexible, and an explicit suggestion to combine is not necessary. *Id.*

A person of ordinary skill in the art would have been motivated to combine the multi-band antenna of Johnson and the mobile computing device of Boireau to allow for a combined device that implements a multi-band antenna that is compact and allows for the communication of multiple bands. Ex. 1003 at 2:5-9, FIG 6, 7, 9; Ex. 1004 at ¶[0016]; *see also* Ex. 1002 at ¶277. A person of ordinary skill in the art would have had reason to combine Johnson and Boireau because both references explicitly provide motivation to create a smaller antenna system while still enhancing wireless connectivity. Ex. 1002 at ¶277. Indeed, both references recognize the need for enhancing connectivity while reducing size. Ex. 1003 at 1:13–30; Ex. 1004 at ¶¶ [0001], [0027]; *see also* Ex. 1002 at ¶277. Indeed, by the earliest priority date of the '103 patent, it was well known that antennas for mobile devices needed to have a small form factor and multi-band capability. *See e.g.*, Section II(B), *supra*; *see also* Ex. 1002 at ¶277. Indeed, it was considered advantageous, desirable, and necessary to have antennas that could be disposed inside a mobile device and capable of operating on multiple bands. *Id.*

In addition, a person of ordinary skill in the art would have been motivated to include smartphone features and functions of Boireau. Ex. 1002 at ¶277. Specifically, Boireau discloses a mobile computing device that it characterizes as a

smart phone. Ex. 1004 at ¶[0019]; *see also* Ex. 1002 at ¶278. Specifically, a Palm® Treo™ smart phone. Ex. 1004 at ¶[0019]; *see also* Ex. 1002 at ¶278. Such smart phones were known at the time of the earliest priority date of the '103 patent and possessed features such as a touch screen, keyboard, etc. Ex. 1004 at ¶[0021]; *see also* Ex. 1002 at ¶278. In addition, such a device was capable of communicating over wireless networks. Ex. 1004 at ¶[0033]; *see also* Ex. 1002 at ¶278. Finally, such smart phones included applications, such as “office suites, business software, educational software, databases, communications software, computer games, and so forth.” Ex. 1004 at ¶[0065]; *see also* Ex. 1002 at ¶278. A person of ordinary skill in the art would have looked to include such functionality as it simplified daily life and allowed for computing operations while on the go. Ex. 1002 at ¶278.

Further, Boireau contemplates operation across multiple systems to include: “GSM with General Packet Radio Service (GPRS) systems (GSM/GPRS), CDMA/1xRTT systems, Enhanced Data Rates for Global Evolution (EDGE) systems, Evolution Data Only or Evolution Data Optimized (EV-DO) systems, Evolution For Data and Voice (EV-DV) systems, High Speed Downlink Packet Access (HSDPA) systems, High Speed Uplink Packet Access (HSUPA), and so forth.” Ex. 1004 at ¶[0032]; *see also* Ex. 1002 at ¶279. Moreover, Boireau contemplates a shared antenna that operates on multiple of these bands. Ex. 1004 at ¶[0027]; *see also* Ex. 1002 at ¶279. The multi-band antenna of Johnson operates in

at least three bands and those bands include the bands contemplated by Boireau. Ex. 1003 at 5:36:39; Ex. 1004 at Tables 8-10; *see also* Ex. 1002 at ¶279. Indeed, by providing the compact antenna of Johnson in Boireau, the person of ordinary skill in the art would have understood that the combined device would have advantageous access to additional wireless bands noted by Boireau all while minimizing space requirements. Ex. 1002 at ¶279.

The implementation of the Johnson antennas is also a simple substitution of one known element for another. Ex. 1002 at ¶280. As is described below, Boireau discloses a device which is the same as the device claimed in claim 12 but for the specific antenna element design. *See supra*. That said, Boireau recited and suggested the need to have antennas that support multiple bands. Ex. 1004 at ¶¶[0061]-[0062]. As is described herein, the person of skill in the art would have implemented the antenna components of Johnson. *see also* Ex. 1002 at ¶78. disclosed a multi-antenna, multi-band "planar conformal element which is installed within the housing of a wireless device and closely-spaced to the printed circuit board and antenna feedpoint of the wireless device." Ex. 1003 at 2:6-9; Ex. 1002 at ¶280. Indeed, the substitution of the Johnson antenna for the disclosed antenna components in Boireau obtains the predictable result of increasing the number of wireless bands as well as implementing the bands contemplated by Boireau. *See supra; see also see also* Ex. 1002 at ¶280.

Finally, a person of ordinary skill in the art would have found it obvious to try the antenna of Johnson in the system of Boireau. *See* Rationale for combination, *supra*.; *see also* Ex. 1002 at ¶281. As outlined in Section II(B), *supra*, there was a known problem in the field related to the need for compact multi-band antennas. As the field was developing, there were not many compact multi-band antennas that could be used with mobile devices. Ex. 1002 at ¶281. Johnson, however, was one of them as Johnson specifically discloses a multi-band antenna in a mobile device. Ex. 1003 at 2:6-9; *see also* Ex. 1002 at ¶281. There would have been a reasonable expectation of success in combining Johnson and Boireau because Johnson and Boireau both involve antenna designs within wireless devices and therefore are analogous art directed to the same field of endeavor as the '103 patent. Ex. 1003 at 1:13–30; Ex. 1004 at ¶[0001]; *see also* Ex. 1002 at ¶282. Indeed, the antenna of Johnson is designed for operation in devices such as the device disclosed by Boireau.

3. Claim 12

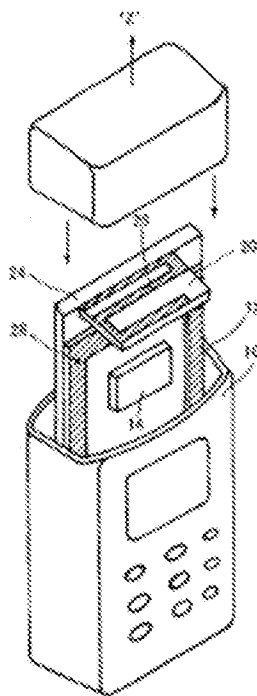
- i) **“A handheld multifunction wireless device having at least one of multimedia functionality and smartphone functionality, the handheld multifunction wireless device comprising:”
(preamble)**

The combination of Johnson and Boireau teach “a handheld multifunction wireless device having at least one of multimedia functionality and smartphone

functionality, the handheld multifunction wireless device comprising....” Ex. 1002 at ¶285, ¶291. Johnson explains that “[t]he present invention replaces the external wire antenna of a wireless communication device with a planar conformal element which is installed within the housing of a wireless device and closely-spaced to the printed circuit board and antenna feedpoint of the wireless device. Electrical connection to the wireless device’s main PWB may be achieved through automated production equipment, resulting in cost effective assembly and production. Electrical performance of the internal (embedded) antenna in wireless systems is nominally equal to that of a conventional wire antenna.” Ex. 1003 at 2:5–14. Johnson further explains that “[a]n asymmetric dipole antenna assembly is provided for wireless communications devices and includes separate upper and lower conductor traces and a low impedance feedpoint at the junction of the conductor traces.” *Id.* at Abstract. A person of ordinary skill in the art would have recognized that the wireless communication device shown and described in Johnson can function as a handheld multifunction wireless device, such as a mobile phone. Ex. 1002 at ¶285.

Johnson also discloses “single or multiple frequency wireless communication devices, for instance devices operating over the GPS (1575 MHz), cellular telephone (824-890 MHz and 860-890 MHz), PCS device (1710-1880 MHz, 1750-1870 MHz, and 1850-1990 MHz), cordless telephone (902-928 MHz),

or BLUETOOTH™ specification (2.4-2.5 GHz.) frequency ranges.” *Id.* at 3:49-55. The frequency ranges that are enabled by the antenna of Johnson allow the wireless communication device to perform multimedia and/or smartphone functionality for “known wireless communication devices,” which the ’103 patent admits included smartphones with multimedia capabilities. See Ex. 1003 at 1:20-23; Ex. 1001 at 1:19-35.



Ex. 1003 at FIG. 1.

Thus, a person of ordinary skill in the art would find this limitation disclosed in the teaching of Johnson and its incorporated disclosures taken as a whole. Ex. 1002 at ¶287.

Likewise, Boireau also teaches “a handheld multifunction wireless device having at least one of multimedia functionality and smartphone functionality, the handheld multifunction wireless device comprising.” Ex. 1004 at FIG. 1; *see also* Ex. 1002 at ¶290. For example, the following figures and the corresponding written description disclose a handheld multifunction wireless device having at least one of multimedia functionality and smartphone functionality:

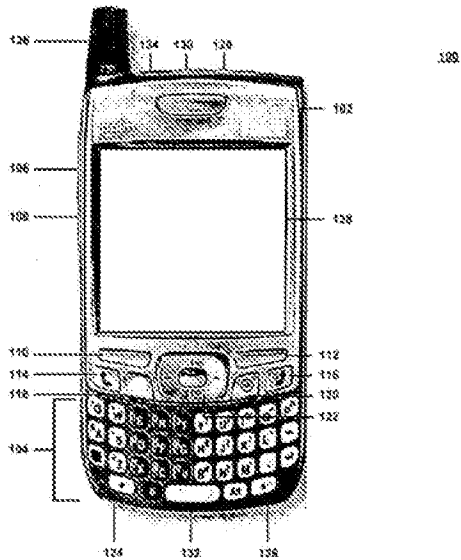


FIG. 1

Ex. 1004 at FIG. 1.

Boireau teaches that “FIG. 1 illustrates one embodiment of a wireless device 100. Wireless device 100 may comprise any device having a wireless transceiver arranged to communicate over one or more portions of a radio-frequency (RF) spectrum. In one embodiment, for example, wireless device 100 may comprise a

mobile computing device.” *Id.* at ¶[0018]. Boireau further discloses that “mobile computing device 100 may be implemented as a combination handheld computer and mobile telephone, sometimes referred to as a **smart phone**.” *Id.* at ¶[0019] (emphasis added). The mobile computing device of Boireau may include a “display 138 [that] may be implemented as an additional I/O device, such as a touch screen, touch panel, touch screen panel, and so forth” *Id.* at ¶[0023]. Boireau includes several multi-media functions to include applications, such as “office suites, business software, educational software, databases, communications software, computer games, and so forth. *Id.* at ¶[0065]. In addition, Boireau contemplates audio over a headset as well as other multimedia streaming. *Id.* at ¶¶ [0090] – [0091].

As set forth above, a person of ordinary skill would have had reason to combine Johnson and Boireau to include smartphone features and functions of Boireau in Johnson. Ex. 1003 at 2:5-9, FIG 6, 7, 9; Ex. 1004 at ¶[0016]; *see* Rationale for combination, *supra*; *see also* Ex. 1002 at ¶293. In addition, there would have been an expectation of success in combining Johnson and Boireau because Johnson and Boireau both involve antenna designs within wireless devices and therefore are analogous art directed to the same field of endeavor as the ’103 patent. Ex. 1003 at 1:13–30; Ex. 1004 at ¶[0001]. Thus, a person of ordinary skill would find this limitation disclosed in the teachings of Johnson and Boireau and

their incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶290.

ii) “a touch screen;”

As set forth above, Johnson teaches use of its disclosed antennas in connection with wireless devices, including mobile phones, which were known to have touch screens. Ex. 1002 at ¶296.

Boireau discloses this claim limitation. Boireau teaches that “[m]obile computing device 100 may comprise various input/output (I/O) devices. Such as an alphanumeric keyboard, alphanumeric keypad, numeric keys, keys, but tons, switches, rocker switches, multi-directional rocker switches, a microphone, an audio headset, a camera, *a touch-sensitive display screen*, a stylus, and so forth.” Ex. 1004 at ¶[0021] (emphasis added). Therefore, a person of ordinary skill would find that Boireau discloses a touch screen. Ex. 1002 at ¶296.

A person of ordinary skill would have found it obvious to combine the teachings of Boireau with those of Johnson because it was obvious to use the antennas of Johnson with any of a variety of mobile phones at the time, including those with a touch screen as disclosed by Boireau. *See* Rationale for combination, *supra*; *see also* Ex. 1002 at ¶296.

iii) “a processing module;”

Johnson explains that “[t]he present invention replaces the external wire antenna of a wireless communication device with a planar conformal element

which is installed within the housing of a wireless device and closely-spaced to the printed circuit board and antenna feedpoint of the wireless device. Electrical connection to the wireless device's main PWB may be achieved through automated production equipment, resulting in cost effective assembly and production.

Electrical performance of the internal (embedded) antenna in wireless systems is nominally equal to that of a conventional wire antenna.” Ex. 1003 at 2:6–14.

Johnson further discloses “an antenna assembly for a wireless communication device, such as a cellular telephone.” *Id.* at 1:11-17. The ’103 patent defines the processing module to be “the microprocessor or CPU.” Ex. 1001 at 8:20-21.

Johnson teaches use of its disclosed antennas in connection with wireless communication devices, including mobile phones, which were known to have processors. Ex. 1002 at ¶299.

Regardless, Boireau discloses “a processing module.” Boireau teaches that “[h]ousing 102 may be used to encapsulate various internal components for mobile computing device 100, such as **a processor**, a memory, one or more transceivers, one or more printed circuit board (PCB), one or more antennas, a stylus, and so forth.” Ex. 1004 at ¶[0020] (emphasis added) *see also* ¶[0036]. The ’103 patent defines a “processing module” as a “microprocessor or CPU.” Ex. 1001 at 8:21-22. Therefore, according to the definition set forth in the ’103 patent, Boireau’s “processor” is a processing module. Ex. 1002 at ¶¶302-303.

Thus, a person of ordinary skill in the art would have found it obvious to combine the teachings of Boireau with those of Johnson because they would have found it obvious to use the antennas of Johnson with any of a variety of mobile phones at the time, which included processors, such as the mobile phone of Boireau. *See* Rationale for combination, *supra*; *see also* Ex. 1002 at ¶303.

iv) “a memory module;”

The ’103 patent does not describe the “memory module,” but Johnson discloses this claim limitation. Ex. 1002 at ¶304. Johnson explains that “[t]he present invention replaces the external wire antenna of a wireless communication device with a planar conformal element which is installed within the housing of a wireless device and closely-spaced to the printed circuit board and antenna feedpoint of the wireless device. Electrical connection to the wireless device’s main PWB may be achieved through automated production equipment, resulting in cost effective assembly and production. Electrical performance of the internal (embedded) antenna in wireless systems is nominally equal to that of a conventional wire antenna.” Ex. 1003 at 2:6–14. Johnson further discloses “an antenna assembly for a wireless communication device, such as a cellular telephone.” *Id.* at 1:11-17. A person of ordinary skill in the art would have understood a cellular telephone to include a memory module, including the cellular telephone disclosed in Johnson. Ex. 1002 at ¶306.

Boireau also teaches that “[h]ousing 102 may be used to encapsulate various internal components for mobile computing device 100, such as a processor, **a memory**, one or more transceivers, one or more printed circuit board (PCB), one or more antennas, a stylus, and so forth.” Ex. 1004 at ¶[0020] (emphasis added) *see also* ¶[0041]. Additionally, for the same reasons as described above, a person of ordinary skill in the art would have found it obvious to combine the teachings of Boireau with those of Johnson because it was obvious to use the antennas of Johnson with any of a variety of mobile phones at the time, which included memory, such as those disclosed by Boireau. *See* Rationale for combination, *supra*; *see also* Ex. 1002 at ¶308.

v) “a communication module;”

The ’103 patent states that the communications module is, for example, an antenna. Ex. 1001 at 8:47. Johnson explains “[a]n asymmetric dipole antenna assembly is provided for wireless communications devices and includes separate upper and lower conductor traces and a low impedance feedpoint at the junction of the conductor traces.” Ex. 1003 at Abstract. Johnson also explains that “[t]he present invention replaces the external wire antenna of a wireless communication device with a planar conformal element which is installed within the housing of a wireless device and closely-spaced to the printed circuit board and antenna feedpoint of the wireless device. Electrical connection to the wireless device’s

main PWB may be achieved through automated production equipment, resulting in cost effective assembly and production. Electrical performance of the internal (embedded) antenna in wireless systems is nominally equal to that of a conventional wire antenna.” *Id.* at 2:6–14. Johnson further discloses a transceiver 14, the purpose of which is to carry out wireless communications. *Id.* at 2:50-54. A person of ordinary skill in the art would have understood that the purpose of a transceiver is to carry out wireless communications. Ex. 1002 at ¶314. Thus, a person of ordinary skill in the art would have understood that Johnson’s disclosure of a wireless device, an antenna, and a transceiver includes a communication module to carry out wireless communication. Ex. 1002 at ¶315.

In addition, Johnson explains “an internal antenna that can easily fit inside the housing of a wireless transceiver such as a cellphone.” Ex. 1003 at 2:21-22. A person of ordinary skill in the art would have known that a cellphone at the time had a communication module including a wireless transceiver. Ex. 1002 at ¶316. Thus, a person of ordinary skill in the art would find this limitation disclosed in the teachings of Johnson and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶317.

Additionally, Boireau discloses this feature. Boireau teaches that “[h]ousing 102 may be used to encapsulate various internal components for mobile computing

device 100, such as a processor, a memory, one or more transceivers, one or more printed circuit board (PCB), one or more antennas, a stylus, and so forth.” Ex. 1004 at ¶[0020]. Boireau explains “mobile computing device 100 may include a **radio sub-system 202** connected via bus 204 to a processing sub-system 206. Radio sub-system 202 may perform voice and/or data communications operations on behalf of mobile computing device 100.” Ex. 1004 at ¶[0028] (emphasis added). Further, “Radio sub-system 202 may perform voice and/or data communication operations for mobile computing device 100. For example, radio sub-system 202 may be arranged to communicate voice information and/or data information over one or more assigned frequency bands of a wireless shared media.” Ex. 1004 at ¶[0030]. Finally, “radio sub-system 202 may implement a shared antenna architecture for multiple transceivers used to implement voice and/or data communications as previously described.” Ex. 1004 at ¶[0035]. Boireau also teaches a “transceiver module 304 [that] may include multiple transceivers and associated hardware and/or software components implemented in a single integrated package or module, such as on the same die, package or PCB. Transceiver module 304 may be implemented using a single chip, multiple chips, or a system on a chip (SoC) solution, as desired for a given set of performance and design constraints.” *Id.* at ¶[0036]. Thus, a person of ordinary skill in the art would find this disclosed in the teachings of Boireau and its incorporated disclosures taken as a whole, or in

combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶3179.

vi) “a power management module;”

The '103 patent describes the power management module as the “single source of energy” for the MFWD (wireless device). Ex. 1001 at 8:26-28. As set forth above, Johnson teaches use of its disclosed antennas in connection with wireless communication devices, including cellphones, which were known to have energy sources for operation. Ex. 1002 at ¶321. Thus, a person of ordinary skill in the art would find this disclosed in the teachings of Johnson and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶323.

Additionally, Boireau discloses this feature. Boireau teaches that “[m]obile computing device 100 also may comprise a rechargeable battery, such as a removable and rechargeable lithium ion battery, and an alternating current (AC) adapter.” Ex. 1004 at ¶[0022]. Boireau further discloses: “mobile computing device 100 may further include a *power management sub-system 208*. Power management sub-system 208 may manage power for mobile computing device 100, including radio sub-system 202, processing sub-system 206, and other elements of mobile computing device 100. For example, power management sub-system 208 may include one or more batteries to provide direct current (DC)

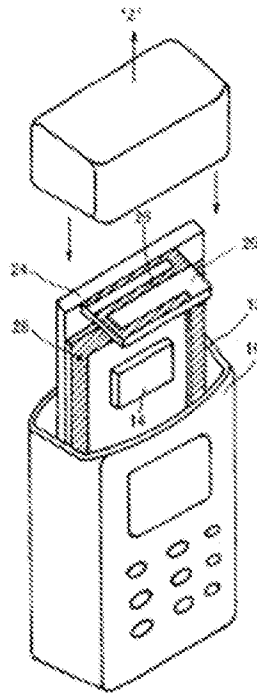
power, and one or more AC interfaces to draw power from an AC power source, such as a standard AC main power supply.” *Id.* at ¶[0029] (emphasis added).

Additionally, for the same reasons as described above, a person of ordinary skill in the art would have found it obvious to combine the teachings of Boireau with those of Johnson because it was obvious to use the antennas of Johnson with any of a variety of mobile phones at the time, which included power management modules (e.g., batteries) as disclosed by Boireau. *See* Rationale for combination, *supra*. Thus, a person of ordinary skill in the art would find this limitation disclosed in the teachings of Boireau and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶324.

vii) “an antenna system within the handheld multifunction wireless device and comprising:”

Johnson teaches “[a]n asymmetric dipole antenna assembly is provided for wireless communications devices and includes separate upper and lower conductor traces and a low impedance feedpoint at the junction of the conductor traces.” Ex. 1003 at Abstract. Johnson also teaches “an internal antenna that can easily fit inside the housing of a wireless transceiver such as a cellphone.” *Id.* at 2:21-22. A person of ordinary skill in the art would have understood that, at the time of invention, a multifunction wireless device would include cellphones. Ex. 1002 at

¶327. Johnson discloses an antenna system within a multifunction wireless device because the antenna fits inside the housing of the cellphone disclosed in Johnson. Ex. 1002 at ¶327. Thus, a person of ordinary skill in the art would find this feature disclosed in the teachings of Johnson and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶328.



Ex. 1003 at FIG. 1.

Boireau also discloses this limitation. Boireau teaches that “[m]obile computing device 100 may comprise an antenna system including one or more antennas.” Ex. 1004 at ¶[0025].

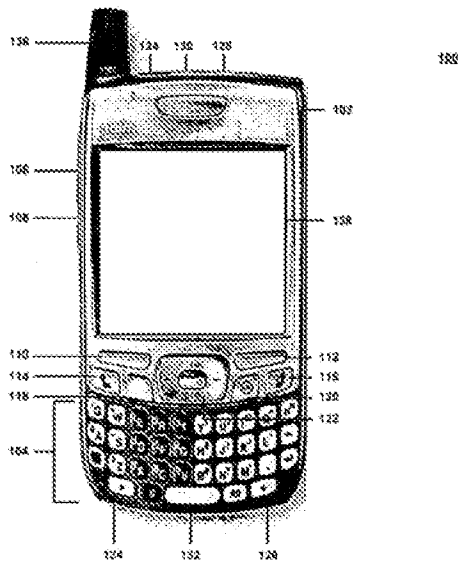


FIG. 1

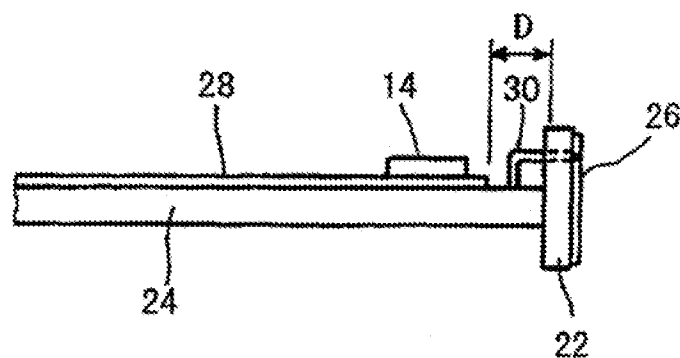
Ex. 1004 at FIG. 1.

Boireau further teaches “antenna 318 may be implemented alone, or as part of a broader antenna system (e.g., antenna 136) or antenna array for mobile computing device 100.” Ex. 1004 at ¶[0048]. Thus, Boireau discloses an antenna system within the handheld multifunction wireless device and a person of ordinary skill in the art would find this disclosed in the teachings of Boireau and its

incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶329.

viii) “a ground plane layer;”

Johnson explains that “[t]he present invention provides an antenna assembly including a first planar element having a conductive trace, and at least one conductive member disposed near the first element to jointly form an asymmetrical dipole antenna. The resonant frequency range of the dipole is primarily determined by the dimensions of the conductive trace on the first planar element, which may be selected to exhibit $\frac{1}{4}$ wave resonance. The elongate second element has a minimum electrical length dimension of $\frac{1}{4}$ wavelength at the lowest frequency of operation, and may consist solely of the ground traces of the printed wiring board(s) of a wireless transceiver such as a cellular telephone.” Ex. 1003 at 2:32–42.



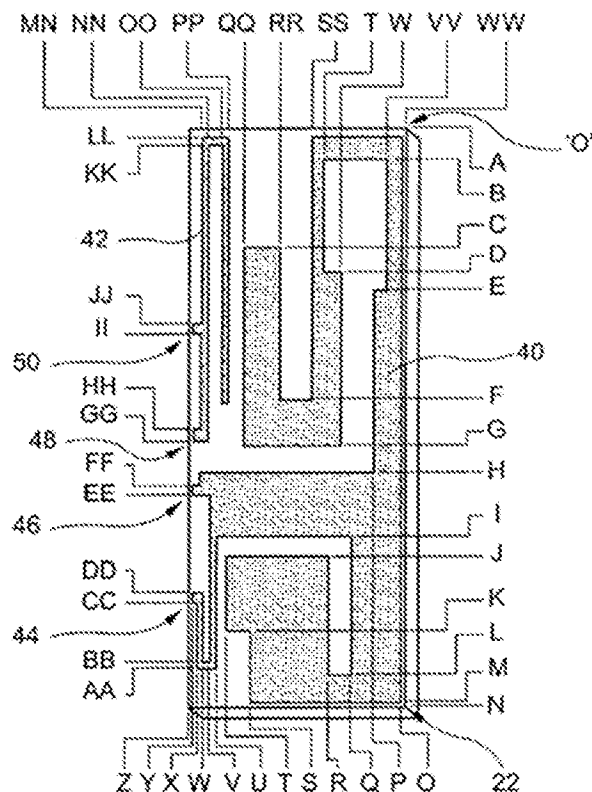
Id. at FIG. 2.

Johnson explains that “[t]he conductor trace 26 is disposed upon a single major surface of the first planar element 22 and is operatively coupled to the transceiver electronics 14 of the second planar element 24 via a feedpoint 32. One end 34 of the conductive trace 26 is coupled to the second conductive trace 28 (the ground plane of the second planar element 24) via leads 36 or other electrical connection.” *Id.* at 4:55-62. As understood by one of ordinary skill in the art, the ground plane layer refers to the structure proximate the antenna assembly and configured to serve as a reflecting surface for waves transmitted by the antenna assembly. Ex. 1002 at ¶333. A person of ordinary skill in the art would have understood that the ground plane layer includes a grounding element (e.g., planar element 24) with the conductive elements (e.g., conductor trace 26) integrated within the grounding element. Ex. 1002 at ¶333. Both the conductive elements and the grounding elements are necessary for the operation of the ground plane layer. Ex. 1002 at ¶333. The grounding elements providing necessary support and/or electrical ground to the conductive elements. Ex. 1002 at ¶333. Johnson further references “[t]he connections between the **ground plane 24** and signal feed 32 may be achieved via plated through-holes in the first planar element 22.” *Id.* at 4:65-67 (emphasis added). Thus, a person of ordinary skill in the art would find the ground plane layer disclosed in the teachings of Johnson and its incorporated disclosures taken as a whole. Ex. 1002 at ¶334.

ix) “a first antenna element configured to simultaneously support radiation modes for first, second, and third frequency bands,”

Johnson explains that “FIG. 9 illustrates a front elevational view of a tri-band antenna assembly according to the present invention,” Ex. 1003 at 3:33–34. Johnson also teaches that “FIG. 9 illustrates another embodiment of the present invention. The antenna assembly of FIG. 9 depicts a tri-band antenna assembly 20 functioning across a cellular band (880-960 MHz), a PCS band (1710-1880 MHz) and the BLUETOOTH™ band (2.4-2.5 GHz.). Cellular and PCS band operation is effected through first conductor trace 40. BLUETOOTH™ band operation is effected through conductor trace 42.”² *Id.* at 5:35–42.

² Under the broadest reasonable interpretation of the claims, both conductor trace 40 and 42 render obvious the first antenna element. That said, this section further explains that the teachings of Johnson explicitly contemplate additional modifications to conductor trace 40 to support additional bands. *See* Ex. 1003 at 3:45-62.



Id. at FIG 9.

Johnson further teaches “[r]eferring now to the drawings, wherein like numerals depict like parts throughout, preferred embodiments of an antenna assembly 20 according to the present invention are illustrated in FIGS. 1-12. The antenna assembly 20 may implemented within single or multiple frequency wireless communication devices, for instance devices operating over the GPS (1575 MHz), cellular telephone (824-890 MHz and 860---890 MHz), PCS device (1710-1880 MHz, 1750-1870 MHz, and 1850-1990 MHz), cordless telephone

(902-928 MHz), or BLUETOOTH™ specification (2.4-2.5 GHz.) frequency ranges. Those skilled in the relevant arts may appreciate that principles of the present invention are equally applicable for antenna assemblies operating at alternative frequency ranges. In alternative embodiments, the dimensions of the antenna assembly 20 may be scaled in proportion to provide operation at other frequencies, including frequencies in the 800 MHz. to 3,000 MHz. range. Such modifications are considered within the scope of the applicant's claims.” Ex. 1003 at 3:45-62. Johnson thus teaches that conductive trace 40 can operate in at least two but certainly more frequency bands.

As a specific example, the conductor trace 40 depicted in FIG. 9 is configured to simultaneously support at least cellular and PCS band operation. As understood by a person of ordinary skill in the art, cellular and PCS band operation include multiple radiation modes. Ex. 1002 at ¶338. For example, the person of ordinary skill in the art would understand that the teaching of cellular band operation specifically includes radiation modes within the 824-890 MHz band, the 860-890 MHz band, and the 902-928 MHz band, thus allowing for operation in at least three bands. Ex. 1002 at ¶338. In addition, cellular band operation may include radiation modes in any cellular frequency band, for example, any frequency bands utilized by 3G, 3.5G, 4G, 4G LTE, etc. Ex. 1002 at ¶338. A person of ordinary skill in the art would have understood that the 3G standard

implemented at least six bands, for example, bands at 1920 MHz – 1980 MHz; 1850 MHz – 1910 MHz; 1710 MHz – 1785 MHz; 1710 MHz – 1755 MHz; 824 MHz – 849 MHz; and 830 MHz – 840 MHz (only uplink frequencies shown). Ex. 1013 at 12; *see also* Ex. 1002 at ¶338. Similarly, PCS band operation may include radiation modes within multiple frequency bands, for example, the 1710-1880 MHz frequency band, the 1750-1870 MHz frequency band, and the 1850-1990 MHz frequency band among others. Ex. 1003 at 3:52-53; *see also* Ex. 1002 at ¶338.

There simply can be no dispute that tri-band antennas were well known to the POSITA. *See* Section II(B), *supra*; *see also* Ex. 1005 at ¶[0004] stating “With the advent of digital signal transmission systems used in mobile telephones, other frequency bands are being utilized for communication. These bands are separated and are utilized for different communications application ... [e]ach of these bands offers certain advantages and it is desirable to utilize mobile telephones that operate reliably within all such bands. Important to this operation are effective antennas...”; *see also* Ex. 1005 at ¶[0004] providing “a tri-band antenna for use with mobile telephones that is capable of operating in at least three distinct preselected frequency bands.” Ex. 1005 at ¶[0011]; *see also* Ex. 1002 at ¶[0065].

To restate, the person of ordinary skill in the art would understand that conductor trace 40 alone provides operation in at least three bands. Ex. 1002 at

¶339. As stated above, the disclosure of operation in cellular and PCS band operation teaches the person of ordinary skill in the art that the antenna would operate in multiple bands throughout the cellular and PCS bands. Ex. 1002 at ¶339. In addition, Johnson specifically discloses that “the dimensions of the antenna assembly 20 may be scaled in proportion to provide operation at other frequencies, including frequencies in the 800 MHz. to 3,000 MHz. range. Such modifications are considered within the scope of the applicant's claims.” *See* Ex. 1003 at 3:45-62. As such, Johnson teaches that conductor trace 40 in the antenna assembly 20 would be modified to operate at any bands in the 800 MHz to 3,000 MHz range. Ex. 1002 at ¶339. As described above in Section II(B), *supra*, a person of ordinary skill in the art would have understood the market demand for tri-band and/or greater operation antennas. *See also* Ex. 1005 at ¶¶[0004],[0011]. For example, Boireau explains “[w]ith the advent of digital signal transmission systems used in mobile telephones, other frequency bands are being utilized for communication. These bands are separated and are utilized for different communications application, for example, the go anywhere aspect of the PCS (“Personal Communication Services”) band, the GSM band that is widely used in Europe and other bands. Each of these bands offers certain advantages and it is desirable to utilize mobile telephones that operate reliably within all such.” Ex. 1004 at ¶[0004].

Indeed, the 4G standard simply represents a next generation communication protocol for wireless communication devices. It would have been obvious to one of skill in the art to implement support for frequency bands utilized by the next generation communication protocol. Ex. 1002 at ¶340. Further, Johnson teaches, “[t]hose skilled in the relevant arts may appreciate that principles of the present invention are equally applicable for antenna assemblies operating at alternative frequency ranges. In alternative embodiments, the dimensions of the antenna assembly 20 may be scaled in proportion to provide operation at other frequencies, including frequencies in the 800 MHz. to 3,000 MHz. range. Such modifications are considered within the scope of the applicant’s claims.” Ex. 1003 at 3:45-62. Thus, Johnson teaches a person of ordinary skill would have found it obvious to scale antenna elements to provide functionality at other frequency ranges, for example, frequency bands operating in the 800 MHz to 3,000 MHz range. Ex. 1002 at ¶358.

Thus, the market demands may dictate the need to support various frequency bands at various global locations. Ex. 1002 at ¶340. In addition, various services may be offered at different frequency bands (e.g., GPS, Bluetooth, WiFi, cellular telephone, etc.). Ex. 1003 at 3:49-55. A person of ordinary skill in the art would have been motivated to optimize the Johnson antenna to support each of the bands demanded by the market. Ex. 1002 at ¶340.

Additionally, Boireau contemplates multiband operation. For example, as depicted in FIG. 4 of Boireau five frequency bands (850.0, 900.0, DCS, PCS, UMTS) are simultaneously received by the one or more antennas (e.g., antenna 318). The signals received across the five frequency bands may be filtered by filter 316 according to the filter table 400 to reduce interference between the frequency bands. Ex. 1002 at ¶341.

Thus, a person of ordinary skill in the art would find that Johnson teaches or suggests a first antenna element (e.g., conductor trace 40) providing simultaneous support for first, second, and third radiation modes. Ex. 1002 at ¶342.

x) “the first frequency band being contained within a first frequency region of an electromagnetic spectrum,”

Johnson explains that “FIG. 9 illustrates another embodiment of the present invention. The antenna assembly of FIG. 9 depicts a tri-band antenna assembly 20 functioning across a cellular band (880-960 MHz.), a PCS band (1710-1880 MHz.) and the BLUETOOTH™ band (2.4-2.5 GHz.). Cellular and PCS band operation is effected through first conductor trace 40. BLUETOOTH™ band operation is effected through conductor trace 42.” *Id.* at 5:35–42. As described above with respect to the “first antenna element configured to simultaneously support radiation modes for first, second, and third frequency bands,” conductor trace 40 supports at least three bands. *See supra*. The conductor trace 40 is configured to operate in a

first frequency band corresponding to any of the frequency bands associated with cellular band operation and/or any of the frequency bands associated with PCS band operation. Ex. 1002 at ¶345. As understood by a person of ordinary skill in the art the first frequency band may be contained within any frequency region associated with the supported frequency band. Ex. 1002 at ¶341. For example, cellular band operation may be contained in any frequency region associated with the frequency bands utilized by 3G, 3.5G, 4G, 4G LTE, etc., such as the frequency region 824-890 MHz, the frequency region 860-890 MHz, the frequency region 902-928 MHz. Ex. 1002 at ¶345. Similarly, PCS band operation may be contained within any frequency region associated with the frequency bands for PCS band operation, such as the frequency region 1710-1880 MHz, the frequency region 1750-1870 MHz frequency band, and the 1850-1990 MHz frequency region. Ex. 1003 at 3:52-53. Thus, the first frequency band may be configured to operate, for example, on a cellular band between 824 MHz and 890 MHz (e.g., first frequency region of an electromagnetic spectrum).

Thus, a person of ordinary skill in the art would find this limitation disclosed in the teachings of Johnson and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶346.

- xi) “the second frequency band being contained within a second frequency**

**region of the electromagnetic spectrum
that is higher in frequency than the first
frequency region,”**

Johnson explains that “FIG. 9 illustrates another embodiment of the present invention. The antenna assembly of FIG. 9 depicts a tri-band antenna assembly 20 functioning across a cellular band (880-960 MHz.), a PCS band (1710- 1880 MHz.) and the BLUETOOTH™ band (2.4-2.5 GHz.). Cellular and PCS band operation is effected through first conductor trace 40. BLUETOOTH™ band operation is effected through conductor trace 42.” Ex. 1003 at 5:35–42. As a described above with respect to the “first antenna element configured to simultaneously support radiation modes for first, second, and third frequency bands,” conductor trace 40 supports at least three bands. *See supra*. The conductor trace 40 is configured to operate in a second frequency band corresponding to any of the frequency bands associated with cellular band operation and/or any of the frequency bands associated with PCS band operation. Ex. 1002 at ¶349. The second frequency band may be contained within any frequency region operating at a higher frequency than the first be contained within a second frequency region associated with a range of frequencies higher than the frequency region associated with the first frequency band. Ex. 1002 at ¶39. For example, any frequency bands utilized by 3G, 3.5G, 4G, 4G LTE, etc., such as the frequency region 824-890 MHz, the frequency region 860-890 MHz, the frequency region 902-928 MHz; or

any frequency bands utilized for PCS band operation, such as the frequency region 1710-1880 MHz, the frequency region 1750-1870 MHz frequency band, and the 1850-1990 MHz frequency region. Ex. 1002 at ¶349. As a specific example, the first frequency band may be associated with the frequency region 824 MHz – 890 MHz and the second frequency band may be associated with the frequency region 1710 MHz – 1880 MHz. Ex. 1002 at ¶349.

Thus, a person of ordinary skill in the art would find this limitation disclosed in the teachings of Johnson and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶350.

xii) “the third frequency band of operation being used by a 4 G communication standard,”

Johnson explains that “FIG. 9 illustrates another embodiment of the present invention. The antenna assembly of FIG. 9 depicts a tri-band antenna assembly 20 functioning across a cellular band (880-960 MHz.), a PCS band (1710- 1880 MHz.) and the BLUETOOTH™ band (2.4-2.5 GHz.). Cellular and PCS band operation is effected through first conductor trace 40. BLUETOOTH™ band operation is effected through conductor trace 42.” *Id.* at 5:35–42.

As a described above with respect to the “first antenna element configured to simultaneously support radiation modes for first, second, and third frequency

bands,” conductor trace 40 supports at least three bands. *See supra*. A person of ordinary skill in the art would have recognized that Johnson’s antenna systems are designed to support a third frequency band to be used by a 4G communication standard as described in the ’103 patent.

The ’103 patent includes “3G and other advanced services for instance HSDPA, WiBro, WiFi, WiMax, UWB or other high speed wireless standards,” as among those referred to by the ’103 patent as “4G services” and “might require operation in additional frequency bands corresponding to said 4G standards (for instance, bands within the frequency region 2-11 GHz and some of its sub-regions such as for instance 2-11 GHz, 3-10 GHz, 2.4-2.5 GHz and 5-6 GHz or some other bands).” Ex. 1001, 24:22-30. The ’103 patent further states that “4G” includes technologies such as 3G, WiFi, WiMax “or other high speed wireless standards.” *Id.* The definition of 4G according to the ’103 patent is inconsistent with the traditional applications of the “4G” moniker, which do not include, for example, 3G or WiFi. As described in the ’103 patent, the broad definition of “4G” may include “wireless connectivity to other wireless devices or networks through a wireless system such as for instance WiFi (IEEE802 .11 standards), Bluetooth, ZigBee, UWB in some additional frequency regions such as for instance an ISM band (for instance around 430 MHz or 868 MHz, or within 902-928 MHz or in the

2400-2480 MHz range, or in the 5.1-5.9 GHz frequency range or a combination of them). *Id.* at 9:64-10:3.

As described above, Johnson explicitly lists the cellular band, operating at 880 MHz – 960 MHz, as supported by the first conductor trace 40. Ex. 1003 at 5:35-42. Thus, the antennas taught by Johnson support third frequency band of operation configured to transmit and receive such high speed signals as required by the broad definition of 4G in the '103 patent. Ex. 1002 at ¶354.

While the definition provided by the '103 patent is inconsistent with traditional applications of the “4G” moniker, the '103 patent definition of 4G may be relied upon given that 4G standards had not been formally defined as of the earliest claimed priority date of the '103 patent (September 2006). Ex. 1002 at ¶355. The ITU (International Telecommunication Union) first defined 4G standards in 2008. *See* Section II(B) *supra*. The 4G standards were defined in the 3 GPP Release 8 that was released in 2008, with the first commercial deployment in 2009. *See* Section II(B) *supra*. The 3 GPP Release 8, released two years after the priority date of the '103 patent, included frequency bands of 900 MHz (e.g., 880-915 MHz) and between 1805 MHz – 2400 MHz inclusive. Ex. 1008 at 13-14; Ex. 1009 at 32-33. *See* Section II(B) *supra*.

According to the 3 GPP Release 8, even if the cellular bands of Johnson were limited to the radiation modes explicitly enumerated (e.g., the 824-890 MHz

band, the 860-890 MHz band, and the 902-928 MHz band), the third frequency band may be configured to operate in a frequency band of operation used by a 4G communication standard (e.g., the 860-890 MHz cellular band, the 902-928 MHz cellular band, the 1710-1880 MHz PCS band, the 1750-1870 MHz PCS band, or the 1850-1990 MHz PCS band). Ex. 1002 at ¶356. Thus, the first antenna element of Johnson supports transmission within a third frequency band of operation being used by a 4G communication standard. Ex. 1002 at ¶356.

In addition, Johnson teaches “[r]eferring now to the drawings, wherein like numerals depict like parts throughout, preferred embodiments of an antenna assembly 20 according to the present invention are illustrated in FIGS. 1-12. The antenna assembly 20 may implemented within single or multiple frequency wireless communication devices, for instance devices operating over the GPS (1575 MHz), cellular telephone (824-890 MHz and 860---890 MHz), PCS device (1710-1880 MHz, 1750-1870 MHz, and 1850-1990 MHz), cordless telephone (902-928 MHz), or BLUETOOTH™ specification (2.4-2.5 GHz.) frequency ranges. Those skilled in the relevant arts may appreciate that principles of the present invention are equally applicable for antenna assemblies operating at alternative frequency ranges. In alternative embodiments, the dimensions of the antenna assembly 20 may be scaled in proportion to provide operation at other frequencies, including frequencies in the 800 MHz. to 3,000 MHz. range. Such

modifications are considered within the scope of the applicant's claims." Ex. 1003 at 3:45-62.

Thus, Johnson further teaches scaling a first antenna element to provide functionality at other frequency ranges such that a person of ordinary skill in would have at least found it obvious to scale the antenna elements taught by Johnson to support frequencies in the 800 MHz to 3,000 MHz range. The 800 MHz to 3,000 MHz range includes the 4G frequency bands. Ex. 1002 at ¶358.

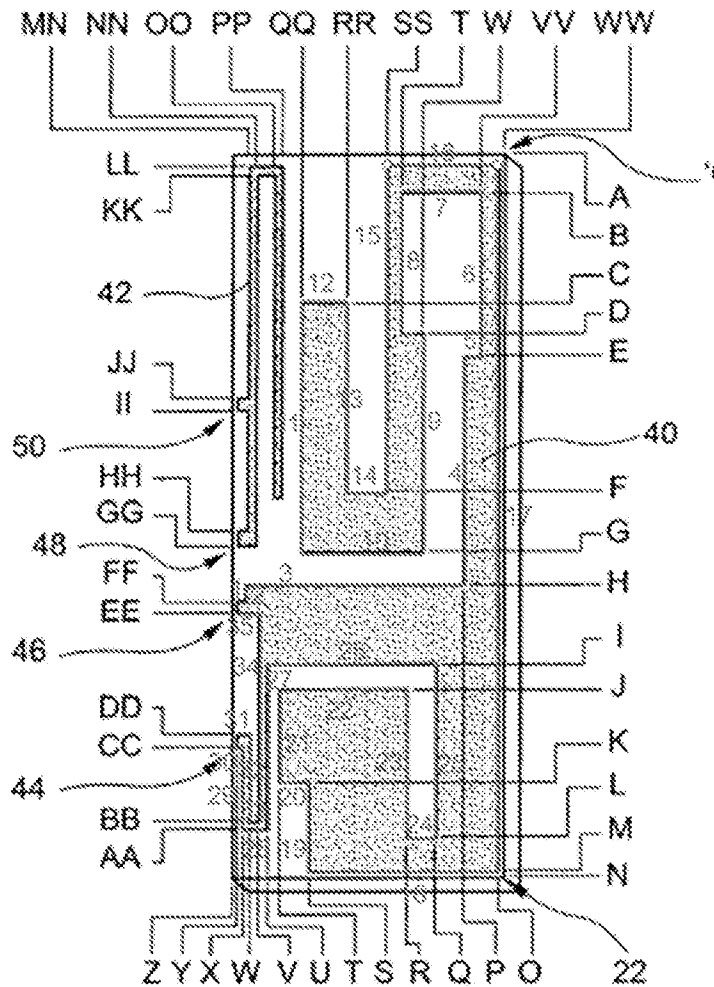
Further, the third frequency band of operation of the Johnson antenna supports cellular and PCS band operation. Ex. 1003 at 5:36-42. As understood by a person of ordinary skill in the art, cellular and PCS band operation may include a number of radiation modes that fall within the broad definition of cellular band and PCS band. Ex. 1002 at ¶359. For example, cellular band operation as understood by a person of ordinary skill in the art may include radiation modes in any cellular frequency band, for example, any frequency bands utilized by 3G, 3.5G, 4G, 4G LTE, etc. Ex. 1002 at ¶359. Similarly, PCS band operation may include radiation modes within multiple frequency bands, for example, the 1710-1880 MHz frequency band, the 1750-1870 MHz frequency band, and the 1850-1990 MHz frequency band among others. Ex 1003 3:52-53; *see also* Ex. 1002 at ¶359.

Thus, a person of ordinary skill in the art would find the antennas taught by Johnson and its incorporated disclosures taken as a whole, or in combination with

the state of the art at the time of the alleged invention are configured to transmit and receive such high speed signals within the broad scope of “4G” provided in the ’103 patent. Ex. 1002 at ¶360. In addition, the antennas taught by Johnson and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention are configured to transmit and receive such high speed signals within the scope of the definition of 3 GPP Release 8, released two years after the priority date of the ’103 patent. Ex. 1002 at ¶360.

xiii) “wherein a perimeter of the first antenna element defines a first antenna contour comprising at least thirty-five segments,”

The ’103 patent states that “[a]long the contour different segments can be identified e.g., by a corner between two segments, wherein the corner is given by a point on the contour where no unique tangent can be identified.” Ex. 1003 at 15:4-7. Thus, Johnson discloses this claim limitation. For example, the following figures and their corresponding written description disclose a perimeter of the first antenna element defining a first antenna contour comprising at least thirty-five segments:

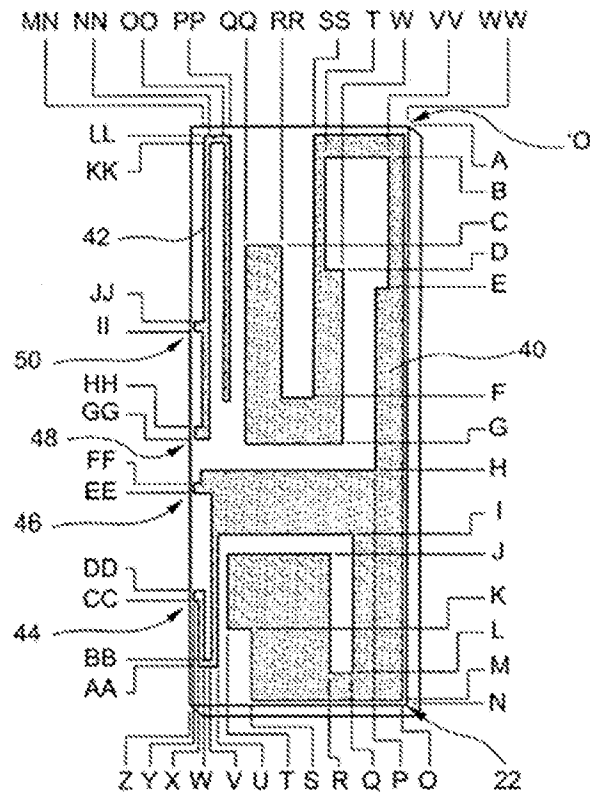


Ex. 1003 at FIG 9 (annotations added); *see also* Ex. 1002 at ¶363.

The segments of the perimeter of the first antenna element are shown in red in the annotated figure above. Each red segment is added up for a total of at least thirty-five segments. Thus, a person of ordinary skill in the art would find this disclosed in the teachings of Johnson and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶363.

- xiv) “the first antenna element defining an antenna box, an orthogonal projection of the antenna box along a normal to a face with a largest area of the antenna box defining an antenna rectangle,”**

The '103 patent states that “[a]n antenna box for the MFWD 100 is herein defined as being the minimum-sized parallelepiped of square or rectangular faces that completely encloses the antenna volume of space and wherein each one of the faces of the minimum-sized parallelepiped is tangent to at least one point of the volume.” Ex. 1001 at 11:5-12. Further, the '103 patent states that “an antenna rectangle is defined as being the orthogonal projection of the antenna box along the normal to the face with largest area of the antenna box.” Ex. 1001 at 13:56-58.



Ex. 1003 at FIG 9.

Figure 9 of Johnson, shown above depicts a view of an antenna. An antenna box as defined by the '103 patent is the minimum-sized parallelepiped of square or rectangular faces that completely encloses the antenna volume of space (e.g., antenna 20). The antenna rectangle is defined as being an orthogonal projection of the antenna box along a normal to a face with a largest area. Ex. 1001 at 13:56-58. The depicted face in FIG. 9 being the face with the largest area. Thus, a person of ordinary skill in the art would find this feature disclosed in the teachings of

Johnson and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶366.

xv) “wherein a length of the first antenna contour is greater than four times a diagonal of the antenna rectangle; and”

A person of ordinary skill in the art would have understood that the “length of the first antenna contour is greater than four times a diagonal of the antenna rectangle” relates to miniaturization. Ex. 1002 at ¶368. In particular, the ability to have long segments to support lower frequencies as well as the ability to support multiple bands. Ex. 1002 at ¶368. Indeed, the person of ordinary skill in the art would understand that a perimeter of a square would already be 2.83 (e.g., $2 \times \sqrt{2}$) times longer than the diagonal of the square indicating that the amount of miniaturization required by the claim is minimal and, thus, obvious. Ex. 1002 at ¶368. Regardless, Johnson discloses or suggests this limitation.

Regardless, Johnson teaches “wherein a length of the first antenna contour is greater than four times a diagonal of the antenna rectangle.” Dimensions for preferred embodiments of the antenna assembly of FIG. 10 of Johnson are included in Table 1. Horizontal and vertical dimensions are measured with respect to origin point ‘O’.

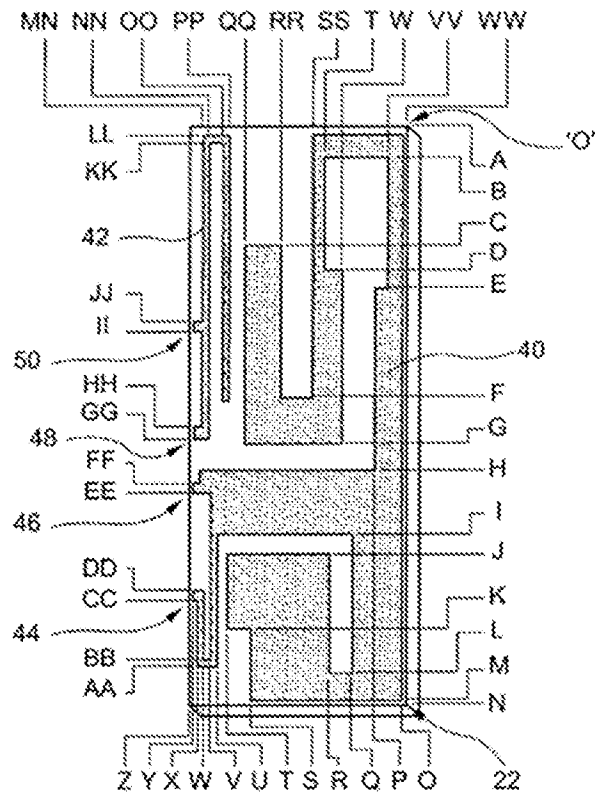
TABLE 1

Posiles	Distance from Origin Point 'O' (Inches)
A	0.000
B	.075-1.505
C	.305-7.747
D	.365-9.271
E	.415-10.541
F	.703-17.856
G	.820-20.828
H	.885-22.479
I	1.046-28.619
J	1.080-27.432
K	1.890-33.020
L	1.415-35.941
M	1.485-37.719
N	1.530-38.100
O	.015-.381

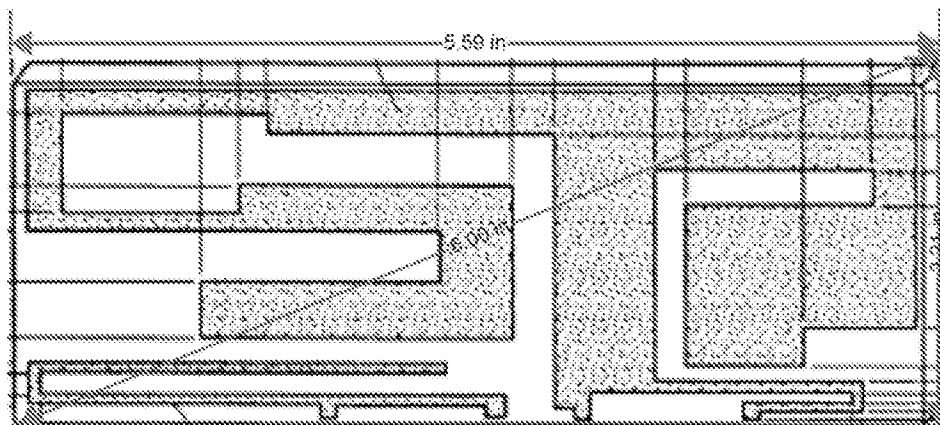
TABLE 1-continued

Position	Distance from Origin Point 'O' (Inches)
P	.105-2.467
Q	.151-3.835
R	.215-5.406
S	.425-10.779
T	.484-12.294
U	.520-13.437
V	.544-13.818
W	.559-14.198
X	.574-14.580
Y	.585-14.860
Z	.600-15.240
AA	1.400-34.560
BB	1.505-35.178
CC	1.227-31.166
DD	1.200-30.591
EE	.993-24.206
FF	.928-23.571
GG	.877-20.500
HH	.792-19.863
I	.505-13.513
J	.807-12.878
KK	.640-1.018
LL	.015-.381
MM	.560-14.224
NN	.546-13.843
OO	.515-13.081
PP	.800-12.700
QQ	.480-11.430
RR	.360-9.144
SS	.280-7.112
TT	.246-6.223
UU	.193-4.902
VV	.075-1.505
WW	0.000

Ex. 1003 at 5:35-6:33.

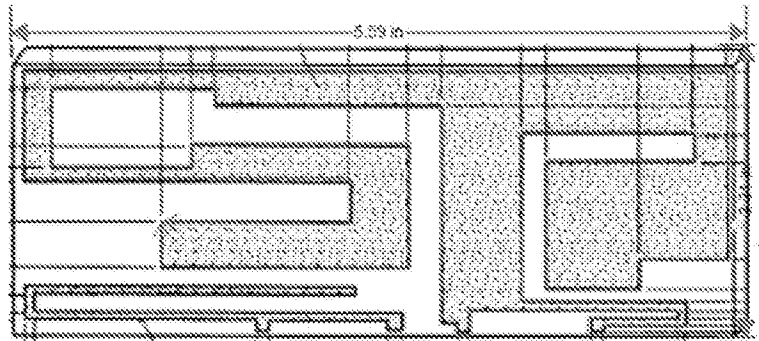


Ex. 1003 at FIG. 9.



Ex. 1003 at FIG 9 (annotated showing a diagonal (D) of 6 such that four times D is 24). As described above, a contour that is four times the diagonal requires a

minimal amount of miniaturization as the contour of a square would already be 2.83 (e.g., $2 \times \sqrt{2}$) times longer than the diagonal of the square. As FIG. 9 illustrates the Johnson antenna depicts significant miniaturization. As can be seen below in addition to multiple folds, the antenna element of Figure 9 includes a segment that traverses the entire width along the top. It is clear from the figure that there is a substantial number of horizontal and vertical segments that together add up to more than four times the diagonal.



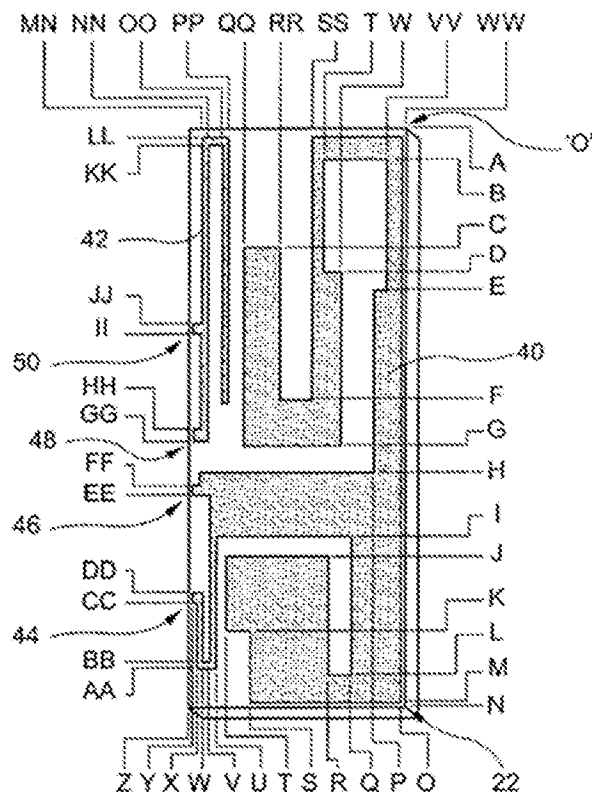
Ex. 1003 at FIG 9 (cropped and annotated, showing a length of Contour 1 as 35.05).

Using the dimensions of FIG. 9 provided in Johnson, the annotated figures show that the contour associated with conductive trace 40 is more than four times the diagonal of the antenna rectangle. Ex. 1002 at ¶369. Thus, a person of ordinary skill in the art would find this disclosed in the teachings of Johnson and its incorporated disclosures taken as a whole, or at least obvious in view of its

teachings, or in combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶370.

xvi) “a second antenna element configured to operate in at least one frequency band used by a 4 G communication standard, wherein a perimeter of the second antenna element defines a second antenna contour comprising at least twenty segments.”

Johnson explains that “FIG. 9 illustrates a front elevational view of a tri-band antenna assembly according to the present invention.” Ex. 1003 at 3:33–34. Johnson also teaches that “FIG. 9 illustrates another embodiment of the present invention. The antenna assembly of FIG. 9 depicts a tri-band antenna assembly 20 functioning across a cellular band (880-960 MHz), a PCS band (1710-1880 MHz) and the BLUETOOTH™ band (2.4-2.5 GHz.). Cellular and PCS band operation is effected through first conductor trace 40. BLUETOOTH™ band operation is effected through conductor trace 42.” *Id.* at 5:35–42.



Id. at FIG 9.

As a specific example, the conductor trace 42 depicted in FIG. 9 is configured to support the range of frequencies falling within the BLUETOOTH™ band (2.4-2.5 GHz) of operation. *Id.* at 5:35–42.

The '103 patent includes “3G and other advanced services for instance HSDPA, WiBro, WiFi, WiMax, UWB or other high speed wireless standards,” as among those referred to by the '103 patent as “4G services” and “might require operation in additional frequency bands corresponding to said 4G standards (for

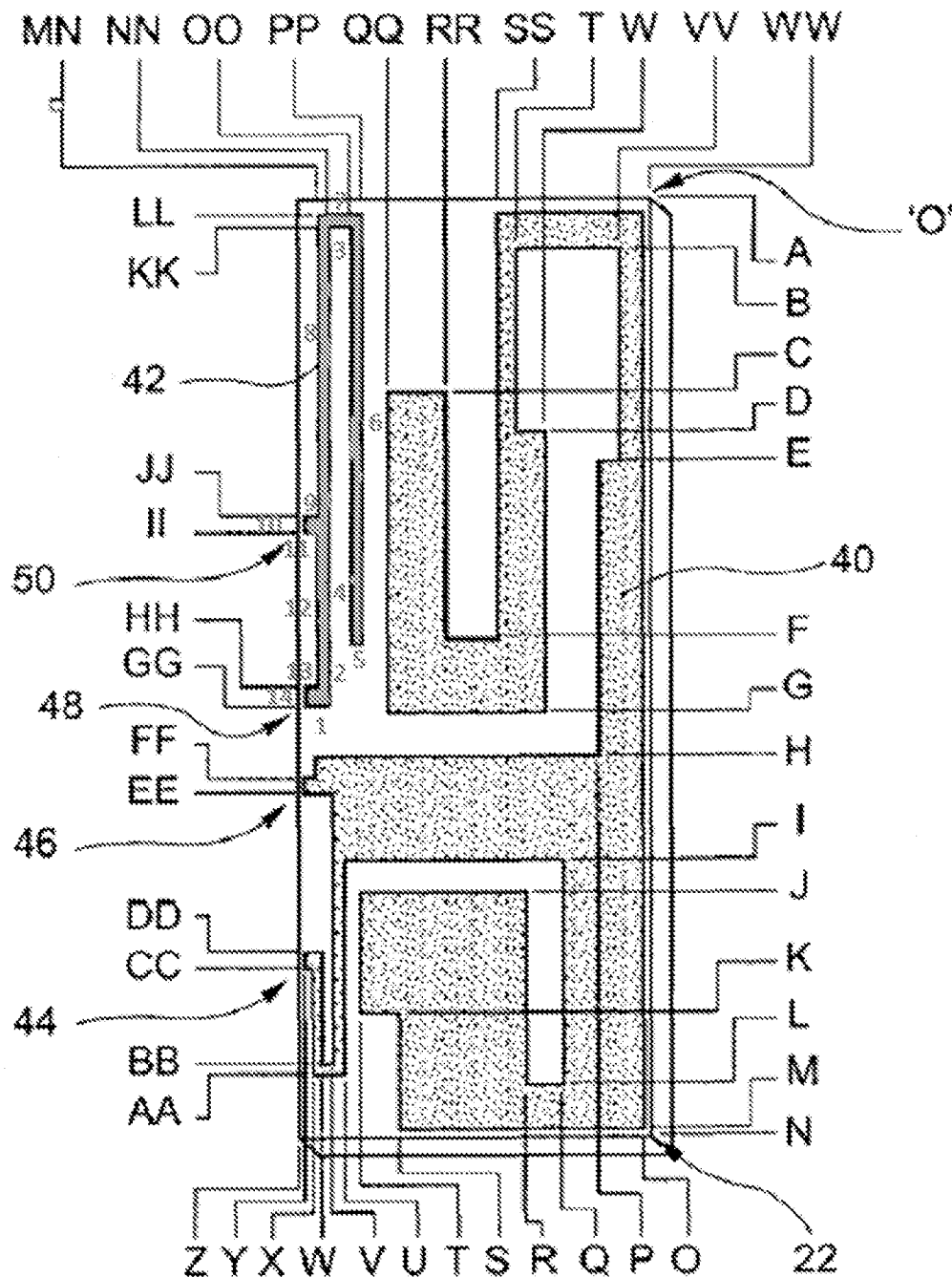
instance, bands within the frequency region 2-11 GHz and some of its sub-regions such as for instance 2-11 GHz, 3-10 GHz, 2.4-2.5 GHz and 5-6 GHz or some other bands).” Ex. 1001, 24:22-30. Ex. 1002 at ¶374. Thus, a person of ordinary skill in the art would understand that the BLUETOOTH™ band (2.4-2.5 GHz) of the second antenna element of Johnson supports transmission within at least one frequency band used by a 4G communication standard as defined by the ’103 patent. Ex. 1002 at ¶375.

With regard to “a perimeter of the second antenna element defines a second antenna contour comprising at least twenty segments,” the ’103 patent describes “[t]he antenna contour of the antenna system is a set of joint and/or disjoint segments comprising: the perimeter of one or more antenna elements placed in the antenna rectangle, the perimeter of closed slots and/or closed apertures defined within the antenna elements, and/or the orthogonal projection onto the antenna rectangle of perimeters of antenna elements, or perimeters of or parts of antenna elements that are placed in the antenna box but not in the antenna rectangle.” Ex. 1001 at 14:48-59.

As defined by the ’103 patent, “[t]he angles at corners or curved segments increase the degree of convolution of the curves formed by the segments of each of said subsets leading to an antenna contour that is geometrically rich in at least one of edges, angles, corners or discontinuities, when considered at different levels of

detail. *Id.* at 15:36-41. As understood by a person of ordinary skill in the art, segments of an antenna element provide additional degrees of freedom in the design of an antenna element. Ex. 1002 at ¶377. In addition, segments of an antenna element enable optimization during the design of an antenna element based on specific characteristics of the antenna element. Ex. 1002 at ¶377. Thus, it would be obvious for a person of ordinary skill in the art to add additional segments to an antenna element in an instance in which the addition of segments would be beneficial to the particular antenna element. Ex. 1002 at ¶377. Adding additional segments to a functional antenna is thus, a mere optimization to provide additional degrees of freedom and performance. Ex. 1002 at ¶377. Johnson disclosed conductor trace 42 that is configured to operate in at least the Bluetooth band. Ex. 1003 at 5:41-42. As illustrated, conductive trace 40 includes at least 14 segments.

FIG. 9



Id. at FIG. 9 (annotated).

The person of ordinary skill in the art would have understood that the difference between including at least 14 segments and 20 segments was minimal and it would have been obvious to the person of ordinary skill in the art to add additional segments as necessary to improve antenna performance. *See In re Kuhle*, 526 F.2d 553, 555 (CCPA 1975) (“design choice may be an acceptable rationale for an obviousness rejection when a claimed product merely arranges known elements in a configuration recognized as functionally equivalent to a known configuration.”). Indeed, the ’103 patent does not include any teachings as to the importance of “twenty segments.” In fact, the ’103 patent merely provides a laundry list of segment numbers without identifying any particular benefit of one number over another. As such, the person of skill in the art would have found the claimed distance and ratio to be a design choice and thus, obvious. *Airlite Plastics Co. v. Plastilite Corp.*, 526 F.2d 1078, 1082 (8th Cir. 1975) (claims obvious where difference over prior art limited to “form, proportions, or size”).

The use of segments and the use of an increased number of segments is not new. As evidenced throughout Johnson, antenna traces are disclosed as having at least 35 segments (Figure 9, conductive trace 40), and at least 28 segments. (Figure 6, conductive trace 26). Moreover, the ’103 patent discloses nothing critical or unexpected with regard to the number of segments. In fact, the ’103 patent suggests that there is no specific benefit of a minimum number of segments as it

provides a broad disclosure, specifically “15, 20, 25, 30, 35, 40, 45, 50 or more segments” without identifying any benefit or unexpected result for any particular value. Ex. 1001 at 16:4-6.

Johnson, however, is not limited to a conductive trace that includes 14 segments. For example, Johnson discloses a “conductive trace 26 includes both a high- and low-frequency band resonant portion 26 d, e” in Figure 6. Ex. 1003 at 5:19-21. Conductive trace 26 functions across multiple frequency bands, to include high frequency bands. *Id.* Conductive trace 26 comprises 28 segments. As a result, and to achieve additional freedom and ability to optimize, the person of ordinary skill in the art would have modified conductor trace 42 with conductive trace 26. Ex. 1002 at ¶380.

The claimed “at least twenty segments” would have been obvious in view of Johnson’s disclosures of the varying number of segments from 14 segments to 28 segments. Such overlap of the number of segments in antenna designs establishes a *prima facie* case of obviousness. *In re Wertheim*, 541 F. 2d 257, 267 (C.C.P.A. 1976). Indeed, claims can be rendered obvious even when claimed ranges or optimizations are similar (e.g., 14 segments to 20 segments) especially when there is no specific benefit for the range espoused in the specification. *See, e.g., In re Brandt*, 886 F.3d 1171, 1177 (Fed. Cir. 2018) (finding that the claimed range of “less than 6 pounds per cubic foot” and the prior-art range of “between 6 lbs./ft³

and 25 lbs./ft³ [we]re so mathematically close that the examiner properly rejected the claims as *prima facie* obvious”). Given the lack of criticality of the number of segments, the claimed “at least twenty segments” would have been obvious. *In re Peterson*, 315 F.3d 1325, 1330 (Fed. Cir. 2003) (“The normal desire of scientists or artisans to improve upon what is already generally known provides the motivation to determine where in a disclosed set of percentage ranges is the optimum combination of percentages.”).

Finally, Johnson teaches “[r]eferring now to the drawings, wherein like numerals depict like parts throughout, preferred embodiments of an antenna assembly 20 according to the present invention are illustrated in FIGS. 1-12... Those skilled in the relevant arts may appreciate that principles of the present invention are equally applicable for antenna assemblies operating at alternative frequency ranges. In alternative embodiments, the dimensions of the antenna assembly 20 may be scaled in proportion to provide operation at other frequencies, including frequencies in the 800 MHz. to 3,000 MHz. range. Such modifications are considered within the scope of the applicant’s claims.” *Id.* at 3:45-62. Thus, Johnson further teaches scaling a second antenna element (conductor trace 42) to provide functionality at other frequency ranges such that a person of ordinary skill in the art would have at least found it obvious to scale the antenna elements taught

by Johnson to support frequencies in the 800 MHz to 3,000 MHz range and would include the requisite segments to allow for those frequencies. Ex. 1002 at ¶381.

The person of ordinary skill in the art would have incorporated the antenna of Figure 6 and/or modified conductive trace 42 so as to benefit from the additional functionality contemplated by Johnson. Ex. 1002 at ¶382. Thus, a person of ordinary skill in the art would at least find a second antenna contour comprising at least twenty segments obvious based on the teachings of Johnson and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶383.

4. Claim 15

i) “The handheld multifunction wireless device according to claim 12,”

1. See Claim 12 above.

ii) “wherein the ground plane layer defines a ground plane rectangle, the projection of the antenna rectangle on the ground plane rectangle partially overlapping the ground plane rectangle.”

The concept of overlap between the ground plane and an antenna is not new. Ex. 1002 at ¶385. The '103 Patent concedes that a feature of so-called “patch antennas” is that there is an overlap between the antenna and the ground-plane. In particular, the 103 patent states, “[f]or those antennas which in their physical properties come quite close to patch antennas namely those with an overlap

between the antenna and the ground-plane (patch-like antennas), a value of F being higher than 1.45, 1.47, 1.50, or 1.60 turns out to be a good measure for an antenna to provide an expected improved bandwidth or gain with respect to a patch antenna without any complexity in at least one of the frequency bands.” Ex. 1001, Col. 21, lines 25-32 (emphasis added); *see also* Ex. 1002 at ¶385.

The Johnson and Zeilinger references further support this assertion. For example, the Johnson reference describes patch antennas that “[t]ypically consists of a planar dielectric material having a resonant structure one major surface of the dielectric and a second ground plane structure disposed on the opposite major surface.” Ex. 1003, Col. 1, lines 58-63; *see also* Ex. 1002 at ¶385. Zeilinger is directed to “an improved PIFA (planar inverted-F antenna),” a known variant of a patch antenna, that includes “a horizontal radiating element interposed between the PIFA and an associated ground plane, the horizontal radiating element being connected to either the ground pins or the feed pin of the PIFA.” Ex. 1005, para [009].

Regardless, Johnson teaches these features for at least the following reasons. Johnson discloses “the antenna assembly 20 includes first and second planar elements 22, 24 disposed in substantially perpendicular relationship. A first conductor trace 26 is disposed upon the first planar element 22, and a second conductor trace 28 is disposed upon the second planar element 24. The first

conductor trace 26 is operatively coupled to the transceiver signal input/output componentry 14 via connection 30.” Ex. 1003 at 4:7–17. “[T]he second conductor trace 28 is the printed ground plane circuit of the transceiver 14.” *Id.* at 4:24-25. As understood by a person of ordinary skill in the art, the ground plane layer includes both the conductive elements (e.g., conductor trace 26) and the grounding elements (e.g., planar element 24). Ex. 1002 at ¶387. As shown in Figs 2-4, the antenna element may be placed in a variety of configurations with respect to the ground plane layer, including those where the projection of the antenna rectangle formed by the first element on the ground plane rectangle partially overlaps the ground plane rectangle. Ex. 1003 at FIG 2 – FIG. 4; *see also* Ex. 1002 at ¶387. For example, “[i]n FIG. 2, portions of the first planar element 22 are disposed relative both major surfaces of the second planar element 24 (a “T” shaped configuration), as opposed to FIG. 3, where the first planar element 22 extends from one major surface of the second planar element 24 (an “L” shaped configuration). Ex. 1003 at 4:41-46.

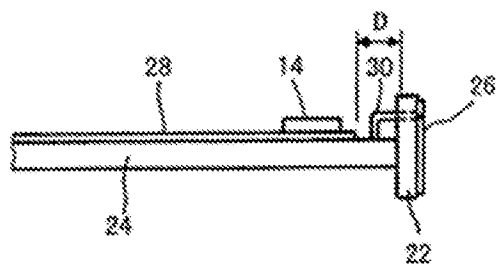


FIG. 2

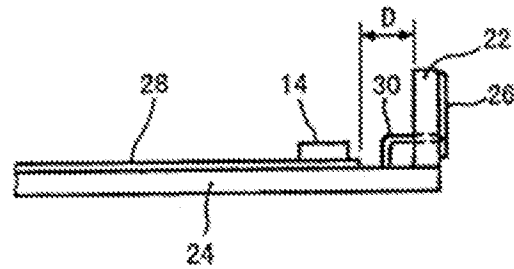


FIG. 3

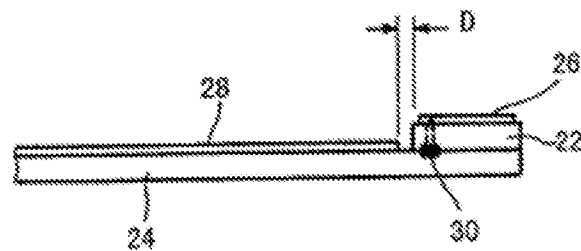


FIG. 4

Additionally, “FIG. 4 illustrates another embodiment of assembly 20 wherein the first and second planar elements 22, 24 are disposed in parallel orientation. The isolation distance D is approximately 1 millimeter (at 900 MHz.). The first conductive trace 26 may be operatively coupled to the transceiver 14 through known surface mount interconnections 30.” Ex. 1003 at 4:47-53.

As disclosed by the ’103 patent “[a]n antenna box for the MFWD 100 is herein defined as being the minimum-sized parallelepiped of square or rectangular faces that completely encloses the antenna volume of space and wherein each one of the faces of the minimum-sized parallelepiped is tangent to at least one point of

the volume. Moreover, each possible pair of faces of the minimum-size parallelepiped shares an edge forming an inner angle of 90°.” Ex. 1001 at 11:5-12. Within the antenna box is an antenna rectangle “defined as being the orthogonal projection of the antenna box along the normal to the face with the largest area of the antenna box.” *Id.* at 13:56-58.

As depicted in FIG. 4, the antenna rectangle is defined by the antenna box comprising the conductor tape 26 together with the planar element 22. The antenna rectangle being defined by the face with the largest area of the antenna box (e.g., the face of the planar element 22 interfacing with the planar element 24). In addition, the '103 patent discloses a “ground plane rectangle . . . defined as being the minimum-sized rectangle that encompasses the ground plane of the antenna system included in the PCB of the MFWD 100 that comprises the feeding means responsible for the operation of the antenna system in its lowest frequency band. That is, the ground plane rectangle is a rectangle whose edges are tangent to at least one point of the ground plane.” *Id.* At 14:4-11. As depicted in FIG. 4, the ground plane rectangle is defined by the ground plane comprising both the conductor trace 28 and the planar element 24. Ex. 1002 at ¶393.

A person of ordinary skill in the art would have understood that “the projection of the antenna rectangle on the ground plane rectangle partially overlapping the ground plane rectangle” is a common feature of planar antennas.

Ex. 1002 at ¶394. Indeed, the person of ordinary skill in the art would have understood that when relying on planer or PIFA antennas in small spaces, such as in a mobile device, overlap would be expected. Ex. 1002 at ¶394. Such overlap is illustrated in Figure 12 (below). In Figure 12, the tab 61 of the antenna (e.g., planer element 22) is connected to the ground trace 28, demonstrating the claimed overlap.

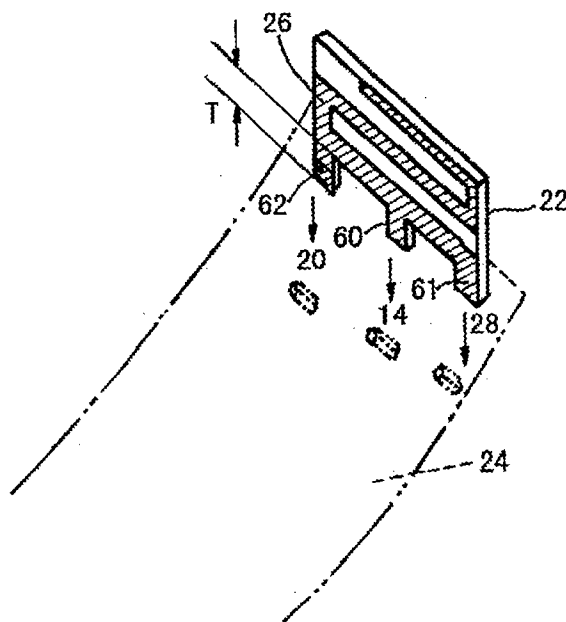


FIG. 12

Ex. 1003, Figure 12.

Thus, a person of ordinary skill in the art would find the antenna rectangle defined by the antenna box comprising the conductor tape 26 together with the planar element 22 and the ground plane comprising both the conductor trace 28 and the planar element 24. Thus, the antenna rectangle overlaps with the ground plane rectangle as defined by the '103 patent. Further, a person of ordinary skill in

the art would find this limitation disclosed in the teachings of Johnson and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1002 at ¶395.

VII. CONCLUSION

Requester requests the Office to issue an office action rejecting the Challenged Claims based on Grounds 1-3 described above. Payment is made for the Ex Parte Reexamination fee of \$12,600 under 37 C.F.R. § 1.20(c)(1) via the USPTO patent electronic filing system.

Please direct all correspondence in this matter to the undersigned.

Respectfully submitted,

/Rodney C. LeRoy/

Reg. No. [[53,205]]

Law Office of Rodney LeRoy

335 Walk Circle

Santa Cruz, CA 95060

Date: April 30, 2024