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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

GEOTAB INC. AND GEOTAB USA, INC.,
Petitioners,

v.

FRACTUS, S.A.
Patent Owner.

Case No. IPR2025-00929

Patent No. 8,810,458

**PETITION FOR *INTER PARTES* REVIEW
UNDER 35 U.S.C. §§ 311-319 AND 37 C.F.R. § 42.1 *et seq.***

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EXHIBIT LIST

Exhibit	Description
1001	U.S. Patent No. 8,810,458 (“the ’458 patent”)
1002	Prosecution History of U.S. Patent No. 8,810,458
1003	Declaration of David M. Pozar, Ph.D. (“Pozar”)
1004	Curriculum Vitae of David M. Pozar
1005	K-L Wong, J-H Chou, S-W Su, and C-M Su. “Isolation between GSM/DCS and WLAN Antennas in a PDA Phone,” <i>Microwave and Optical Technology Letters</i> , volume 45, no. 4, 2005, pp. 347-352 (“Wong”)
1006	Declaration of James L. Mullins, Ph.D.
1007	Curriculum Vitae of James L. Mullins
1008	U.S. Patent App. Pub. No. 2009/0002248 to Zhao et al. (“Zhao”)
1009	ETSI TS 145 005 V4.3.0 Technical Specification: Digital cellular telecommunications system (Phase 2+); Radio transmission and reception (3GPP TS 45.005 version 4.3.0 Release 4), 2001
1010	Plaintiff’s Disclosure of Asserted Claims and Infringement Contentions Against Geotab Pursuant to Local Patent Rules 3-1 and 3-2, <i>Fractus, S.A. v. Geotab Inc.</i> , No. 2-24-cv-01008 (E.D. Tex.), served Mar. 12, 2025.
1011	G-Y Lee and K-L Wong. “Quad-Band Internal Monopole Mobile-Phone Antenna,” <i>Microwave and Optical Technology Letters</i> , volume 40, no. 5, 2004, pp. 359-361 (“Lee”)
1012	U.S. Patent App. Pub. No. 2006/0082503 to Gaucher et al. (“Gaucher”)
1013	U.S. Patent App. Pub. No. 2004/0113848 to Gaucher et al. (“Gaucher848”)
1014	WIPO Publication No. WO 2006/040609 to Zhao et al.
1015	Overall Revision of the Rules Regarding Industrial Scientific and Medical (ISM) Equipment, 50 Fed. Reg. 36061, 36069 (Sep. 5, 1985) (codified at 47 C.F.R. §18.301)
1016	’458 patent Claim Limitation Comparison Chart

Exhibit	Description
1017	IEEE Std. 802.11a-1999, Supplement to the IEEE Standard for Information Technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Specific requirements— Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications: High-speed Physical Layer in the 5 GHz Band (Dec. 30, 1999)
1018	IEEE Std. 802.11b-1999, Supplement to the IEEE Standard for Information Technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Specific requirements— Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications: Higher-Speed Physical Layer Extension in the 2.4 GHz Band (Jan. 20, 2000)
1019	IBM Hardware Announcement: New IBM ThinkPad T42 notebooks feature new fingerprint and Intel PRO/Wireless technologies (Jan. 11, 2005)
1020	IEEE Std. 802.11g-2003, 802.11g IEEE Standard for Information technology—Telecommunications and information exchange between systems—Local and metropolitan area networks—Specific requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications, Amendment 4: Further Higher Data Rate Extension in the 2.4 GHz Band (June 27, 2003)
1021	ZigBee Specification (Jun. 27, 2005)
1022	Specification of the Bluetooth System version 2.0, volume 2 (issued Nov. 4, 2004)
1023	Wi-Fi Alliance Press Release, “Wi-Fi Celebrates Its Third Birthday” (Apr. 7, 2003) (Wayback Machine copy dated Sep. 28, 2003)
1024	U.S. Patent App. Pub. No. 2002/0021250 to Asano et al. (“Asano”)
1025	Y.J. Wang et al., “Novel Microstrip-Monopole-Integrated Ultra-Wideband Antenna for Mobile UWB Devices,” in <i>Radio and Wireless Conference, 2003. RAWCON’03. Proceedings</i> , IEEE, 2003, pp. 87-90.
1026	Excerpts from James et al., <i>Mathematics Dictionary</i> (Chapman & Hall, 5th ed. 1992)
1027	Excerpts from Pozar, <i>Microwave Engineering</i> (John Wiley & Sons, Inc., 3rd ed. 2005)

Exhibit	Description
1028	Dialogue Flybook User's Manual rev. 1.02 (2003)
1029	U.S. Patent No. 5,596,401 to Kusuzawa
1030	U.S. Patent No. 6,624,789 to Kangasvieri et al.
1031	Unlicensed NII Devices in the 5 GHz Frequency Range, 63 Fed. Reg. 40831, 40836-40837 (July 31, 1998) (codified at 47 C.F.R. §15.407)
1032	U.S. Patent App. Pub. No. 2004/0121828 to Wang et al. ("Wang")
1033	U.S. Patent No. 6,728,555 to Pirilä et al.
1034	U.K. Patent App. Pub. No. GB 2336019 to Berg et al. ("Berg")
1035	Smith, "Dialogue demos 'total wireless' sub-notebook" (The Register, Jun. 2, 2004)
1036	K-L Wong, J-H Chou, S-W Su, and C-M Su. "Isolation between GSM/DCS and WLAN Antennas in a PDA Phone," <i>Microwave and Optical Technology Letters</i> , volume 45, no. 4, 2005, pp. 347-352 (color version)

MANDATORY NOTICES

A. Real Party-In-Interest – §42.8(b)(1)

Geotab Inc. and Geotab USA, Inc. are the real parties-in-interest.

B. Related Matters – §42.8(b)(2)

1. United States Patent & Trademark Office

U.S. Patent No. 8,810,458 (“the ’458 patent”) issued from Application Serial No. 13/718,348. Other United States patents in the ’458 patent’s priority chain include U.S. Patent Nos. 8,362,960 and 8,115,686.

2. U.S. District Court for the Eastern District of Texas

The ’458 patent is asserted in (i) *Fractus, S.A. v. Geotab Inc.*, No. 2:24-cv-01008 (E.D. Tex.) (“the Texas Litigation”); and (ii) *Fractus, S.A. v. Verizon Connect Inc. et al.*, No. 2:24-cv-01009 (E.D. Tex.) (the “Verizon Litigation”).

C. Counsel and Service Information – §§42.8(b)(3) and (4)

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A power of attorney is submitted with the Petition. Counsel for Petitioner consents to service of all documents via electronic mail.

Petitioners request IPR of claims 1-10 and 12-19 of U.S. Patent No. 8,810,458 (EX1001, “the ’458 patent”).

I. INTRODUCTION

The ’458 patent concerns a wireless “portable device,” *e.g.*, cellphone or laptop computer. Each claim recites a “device” comprising three components—a ground plane and two antennas. One antenna supports standardized cellular communication; the other supports standardized “wireless connectivity”—through, *e.g.*, a wireless local area network (WLAN) or Bluetooth. All of this was known.

The patent is based on the idea that isolation between two antennas improves when they are positioned further apart. The claims recite antennas using a mishmash of different frequencies, placed at a hodge-podge of positions.

Optimizing cellular and WLAN antenna isolation in a wireless device by properly choosing the antenna placement was routine. Wong studies precisely this issue. **Ground 1A** shows that Wong, in view of Lee’s cellular antenna, renders obvious claims 1-9 and 12-13. **Ground 1B** shows that Wong alone renders obvious claims 14-15 and 17-19.

Ground 2 shows that Gaucher, describing cellular and WLAN antenna placement in a laptop, renders obvious claims 1-10 and 12-13.

Ground 3 shows that Zhao, describing cellular and ultra-wideband antenna placement in mobile devices, renders obvious claims 14-18.

II. STANDING CERTIFICATION

The '458 patent is available for IPR. Petitioners are not barred or estopped from requesting IPR of the '458 patent. 37 C.F.R. §42.104(a).

III. UNPATENTABILITY GROUNDS

Petitioners request cancellation of the following claims. Pre-AIA law applies because the '458 patent application was filed before March 16, 2013.

Ground	Reference(s)	Claims	Basis
1A	Wong+Lee	1-9, 12-13	§103
1B	Wong	14-15, 17-19	§103
2	Gaucher	1-10, 12-13	§103
3	Zhao	14-18	§103

The '458 patent claims priority to Provisional Application Serial No. 60/702,205, filed July 25, 2005, and to a European application filed July 21, 2005. In litigation Patent Owner alleges an earliest conception-based priority date of “June 2005.” EX1010, 4. These references are prior art under pre-AIA §102 even assuming the alleged June 2005 priority date:

Reference	Published	Priority	Prior Art
Wong (EX1005)	No later than 2005-04-26	n/a	§102(a)
Lee (EX1011)	No later than 2004-02-24	n/a	§102(b)
Gaucher (EX1012)	2006-04-20	2004-10-18	§102(e)
Zhao (EX1008)	2009-01-01	2004-10-13	§102(e)

Wong, an article in a journal from an established publisher, was published (is prior art) under pre-AIA 35 U.S.C. §102(a) when received by subscribers (shortly after mailing the week of April 11, 2005, and no later than April 26, 2005 when marked received by subscriber Linda Hall Library), and when cataloged in that library (May 1, 2005). EX1006, ¶77; *id.*, ¶¶33-77; *VidStream v. Twitter*, 981 F.3d 1060, 1065 (Fed. Cir. 2020) (“When there is an established publisher there is a presumption of public accessibility as of the publication date.”); *Nichols Inst. Diagnostics v. Scantibodies Clinical Lab.*, 195 F. App’x 947, 950-951 (Fed. Cir. 2006) (journal article was prior art based on mailing to subscribers and availability in library, putting it “directly into the hands of the interested public”).

Lee, in the same journal, is prior art under pre-AIA 35 U.S.C. §102(b) as of the date when received by subscribers (shortly after mailing the week of February 2, 2004, and no later than February 24, 2004 when marked received by subscriber Linda Hall Library) and when cataloged in that library (March 1, 2004). EX1006, ¶122; *id.*, ¶¶78-122.

Gaucher’s October 18, 2004 filing date makes it prior art under pre-AIA 35 U.S.C. §102(e). *Lynk Labs, Inc. v. Samsung Elecs. Co., Ltd.*, 125 F.4th 1120 (Fed. Cir. 2025).

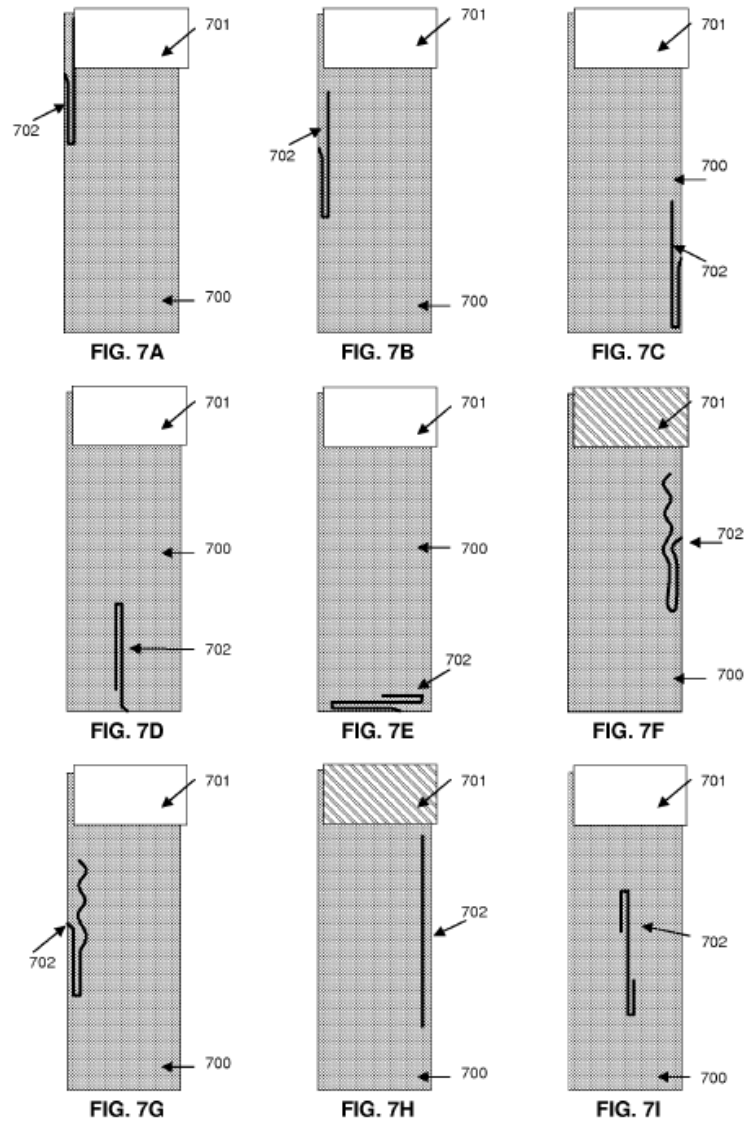
Zhao is pre-AIA 35 U.S.C. §102(e) prior art based on its publication, its October 13, 2004 filing date (PCT No. PCT/IB04/03343), and the PCT application's designation of the United States and English publication. EX1014.

IV. THE '458 PATENT¹

The '458 patent concerns wireless portable devices (*e.g.*, mobile phones, laptops) having multiple antennas for receiving and transmitting electromagnetic signals in different frequency bands. 1:30-43. The device includes a first antenna (“mobile antenna”) supporting cellular communications and a second antenna (“wireless connectivity antenna”) supporting wireless connectivity services (*e.g.*, WLAN, Bluetooth). 1:37-40, 9:26-58. The patent purports to provide good isolation between the antennas by appropriately choosing the placement and orientation of each in relation to the device's printed circuit board (PCB). 1:44-50.

Figures 7A-7I (below) illustrate “top views” of the mobile antenna (701) and wireless connectivity antenna (702) at various locations on the device's PCB. 15:13-16, 18:29-35.

¹ Emphasis added unless otherwise indicated. Section IV citations are to EX1001.



In this perspective, mobile antenna 701 is at the top edge of the PCB while wireless connectivity antenna 702 is placed at different locations on the PCB. The '458 patent states it is preferable to keep the separation between the antennas as large as possible to maximize isolation between them. 18:31-35. For example, Figure 7C purportedly yields better isolation than Figure 7A because it provides larger antenna separation. 18:35-38.

A. Challenged Claims

The '458 patent has 20 claims. Claims 1, 8, and 14 are independent. All claims concern a “portable device.” Appendix A provides a claim list.

Claim 1 recites a “*wireless handheld or portable device*” having a ground plane and two antennas. A “*first antenna*” is “*configured to transmit and receive*” in “*at least three frequency bands*” ([1.c]) “*used for mobile communication services*” ([1.d]), *e.g.*, cellular communications. A “*second antenna*” is configured to “*receive*” in “*at least one frequency band*” ([1.e]) that is “*used for wireless connectivity*” ([1.f])—*e.g.*, WLAN, Bluetooth. Remaining limitations concern the placement of the antennas relative to the ground plane.

Claims 8 and 14 include additional limitations on antenna placement. Dependent claims further limit antenna frequency coverage, placement, or form.

B. Prosecution History

During prosecution, the Examiner allowed claims 41-54 (issued claims 1-13) without rejection, but rejected claims 55-60. EX1002, 487-490.

In response, applicants amended claim 55 to include, *inter alia*, Limitations [14.k]-[14.l]: “*the second antenna is inscribed in a second rectangular area; a sum of a length and a width of the second rectangular area is smaller than a quarter of an operating wavelength of the second antenna.*” EX1002, 503-511. The Examiner then allowed claims 55-60 (issued claims 14-20). EX1002, 523-525.

C. Person of Ordinary Skill in the Art (“POSA”)

A POSA would have had 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, or, alternatively, a master’s degree in electrical engineering (or similar discipline) and at least two years of similar experience. EX1003 (“Pozar”), ¶¶38-48.

V. CLAIM INTERPRETATION

Claim terms are construed herein according to their ordinary meaning in light of the specification and file history. 37 C.F.R. §42.100(b). Because the Petition’s prior art discloses each claim element under any plausible construction, no outer-boundary constructions are necessary. *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017).

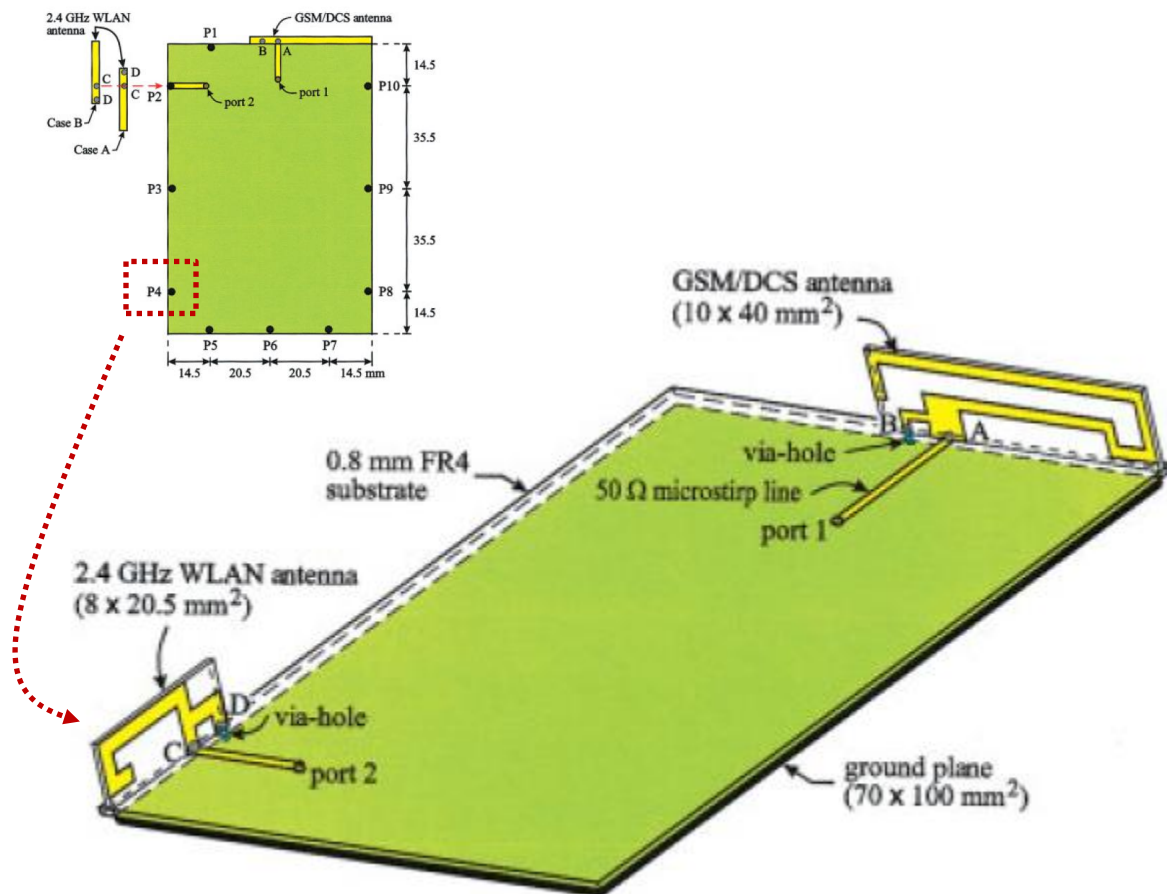
VI. GROUND 1A: WONG+LEE RENDERS OBVIOUS CLAIMS 1-9, 12-13

A. References

1. Wong (EX1005)

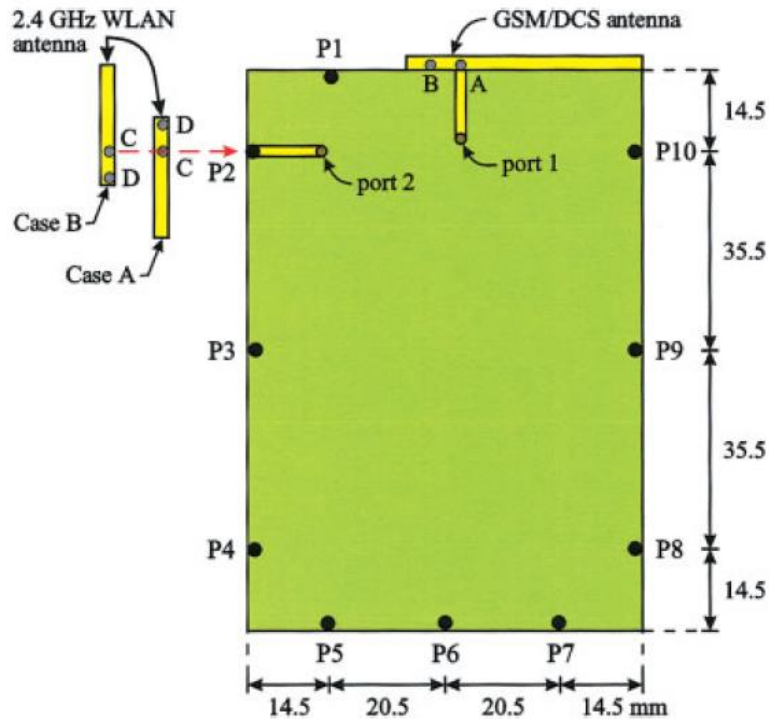
Wong studies the isolation between a Global System for Mobile Communications (GSM)/Digital Cellular System (DCS) antenna and a WLAN antenna positioned on a system circuit board (*e.g.*, PCB) comprising a ground plane. Wong, 347-351. Both antennas are designed to be concealed inside a personal digital assistant (PDA) phone’s casing. Wong, 347-348.

Wong evaluates antenna isolation by fixing a GSM/DCS antenna at a system circuit board's top edge and varying the WLAN antenna position (*e.g.*, P1-P10) along the board's boundary. Wong, Figs. 1-2, 348-350.²



Wong, Figure 1(a) (annotated, Fig. 2 inset)

² EX1036 is a colorized version of EX1005. Pozar, ¶52, n.1. Throughout the Petition colorized Wong figures are reproduced from EX1036.

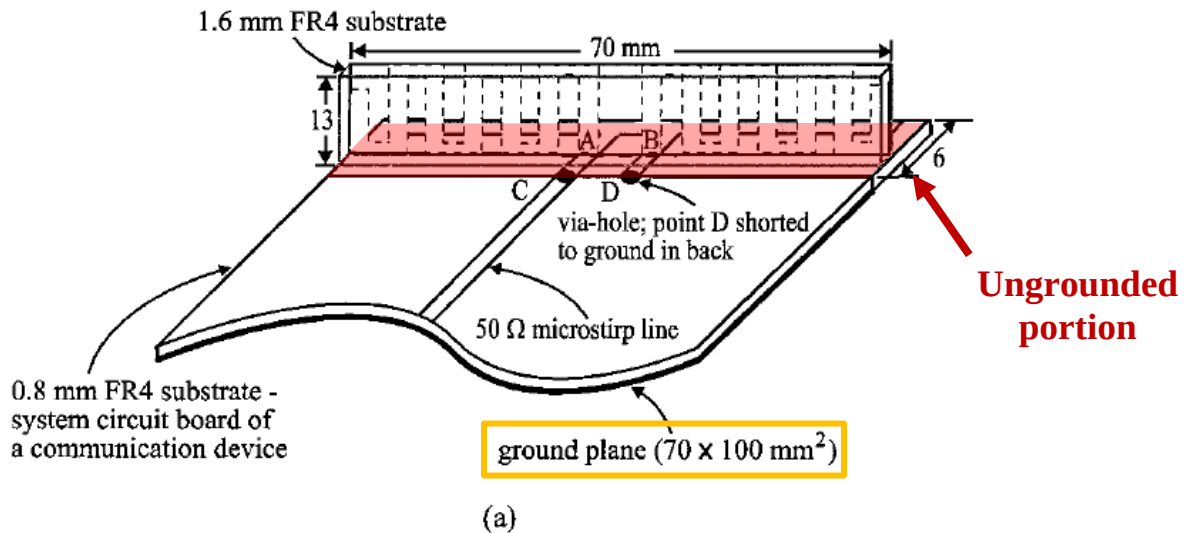


Wong, Figure 2

2. Lee (EX1011)

Lee describes a quad-band monopole antenna, designed to be placed within the casing of a mobile device. Lee, 359. The quad-band antenna can transmit and receive at 824-967 MHz and 1707-2000 MHz. Lee, Fig. 2, 359; Pozar, ¶¶54-56. These frequencies encompass ranges for several standard cellular communication bands: 824-894 MHz (AMPS or GSM850), 880-960 MHz (extended GSM), 890-960 MHz (standard GSM900), 1710-1880 MHz (GSM1800 or DCS1800), and 1850-1990 MHz (PCS1900). Lee, 359; EX1009, 9.

Lee mounts the quad-band antenna on an FR4 substrate—a dielectric material commonly used for PCBs (*e.g.*, EX1014, [0038])—that Lee uses for a “system circuit board of a communication device.” Lee, Fig. 1(a) (annotated below), 359; Pozar, ¶57. Lee shows a $70 \times 106 \text{ mm}^2$ substrate: the FR4 material beneath the quad-band antenna is an ungrounded $70 \times 6 \text{ mm}^2$ region adjacent to a $70 \times 100 \text{ mm}^2$ region having a ground plane disposed on the substrate surface opposing the antenna, *e.g.*, the “bottom” layer in Figure 1(a)’s perspective. Lee, Fig. 1(a) (annotated below), 359. Pozar, ¶57.



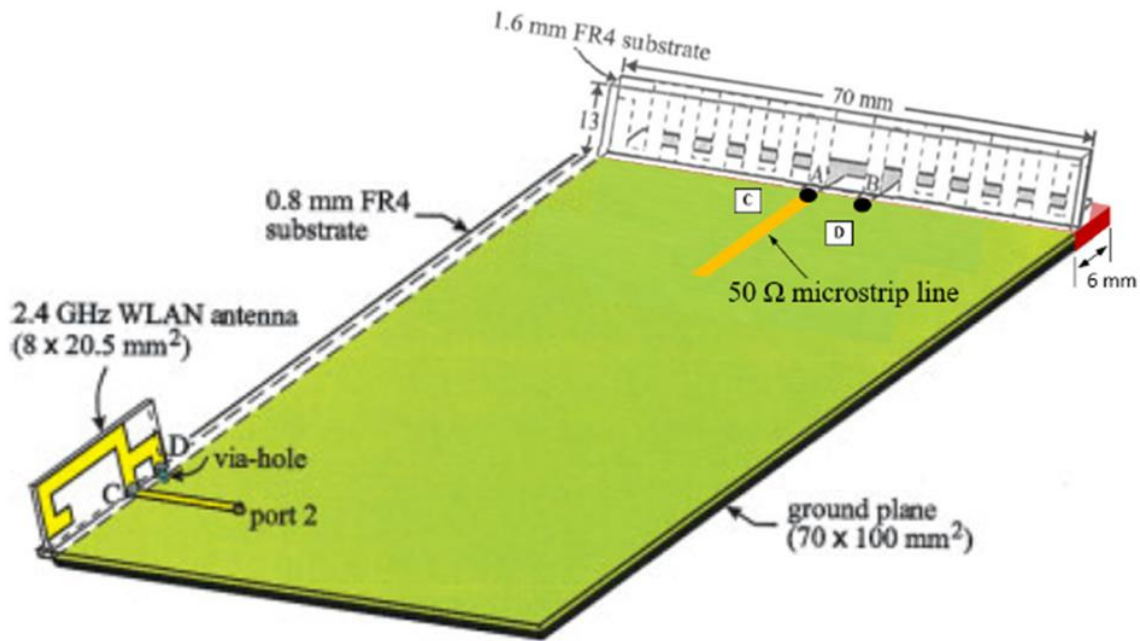
B. Wong+Lee

1. Combination

Both Wong and Lee disclose ground planes and antennas for use in a handheld mobile device such as a PDA phone.

Although Wong focuses on evaluating isolation between two antennas at different locations on the PCB, rather than describing other PDA phone components in detail, Wong gave POSAs reason to use the described antennas and ground plane in a PDA phone. Wong, 347 (“The isolation performances of GSM/DCS and WLAN antennas **embedded in a PDA phone**... are studied. The two (GSM/DCS and WLAN) antennas... are mounted... **to perform as internal antennas for the PDA phone.**”); Pozar, ¶59.

Similarly, although Lee does not describe other mobile phone components in detail, it too explains that its antennas are intended as internal components in a mobile phone. Lee, 361 (“A novel quad-band **internal monopole mobile-phone antenna** for AMPS, GSM, DCS, and PCS operations has been proposed.”). Thus, POSAs would have had reason to use the components described in Wong and Lee disposed internally within a PDA phone. Pozar, ¶60.



Wong+Lee

In Wong in view of Lee (“Wong+Lee”), as depicted above, a POSA would have replaced Wong’s GSM/DCS antenna with Lee’s quad-band antenna near the “top” edge of the system circuit board (in Figure 1(a)’s perspective view) as Wong teaches. The Wong+Lee system circuit board thus includes Lee’s 70mm×6mm substrate portion—without a ground plane—extending Wong’s 70mm×100mm FR4 section with a ground plane backing. Pozar, ¶61. The resulting combination provides the relative antenna placement described in Wong, using Lee’s quad-band antenna. Pozar, ¶61.

2. Reasons to Combine

POSAs would have had reason to substitute Lee’s quad-band antenna for Wong’s GSM/DCS antenna. Pozar, ¶62.

Wong's GSM/DCS antenna covers two cellular bands—GSM 900 (890–960 MHz) and DCS1800 (1710–1880 MHz)—used in Europe. Wong, 347; Gaucher, [0030]. POSAs knew that international variation in standard communication frequencies made deploying devices for wireless wide area networks (WWAN) problematic. Gaucher, [0028]. This made it desirable to provide devices capable of operating in the four most popular frequency bands: **AMPS/GSM850 (824–894 MHz)** and **PCS1900 (1850–1990 MHz)** for North America, and **GSM900 (880–960 MHz)** and **DCS1800 (1710–1880 MHz)** for Europe. Gaucher, [0030]; Pozar, ¶63.

POSAs would have had reason to replace Wong's dual-band GSM/DCS antenna with Lee's quad-band antenna in order to cover AMPS/PCS bands in North America, thereby extending the PDA phone capability and providing a device capable of operating in both North America and Europe. Lee, 359; Gaucher, [0030]. POSAs would have regarded Lee's quad-band antenna as a natural extension of Wong's dual-band GSM/DCS antenna. Pozar, ¶64.

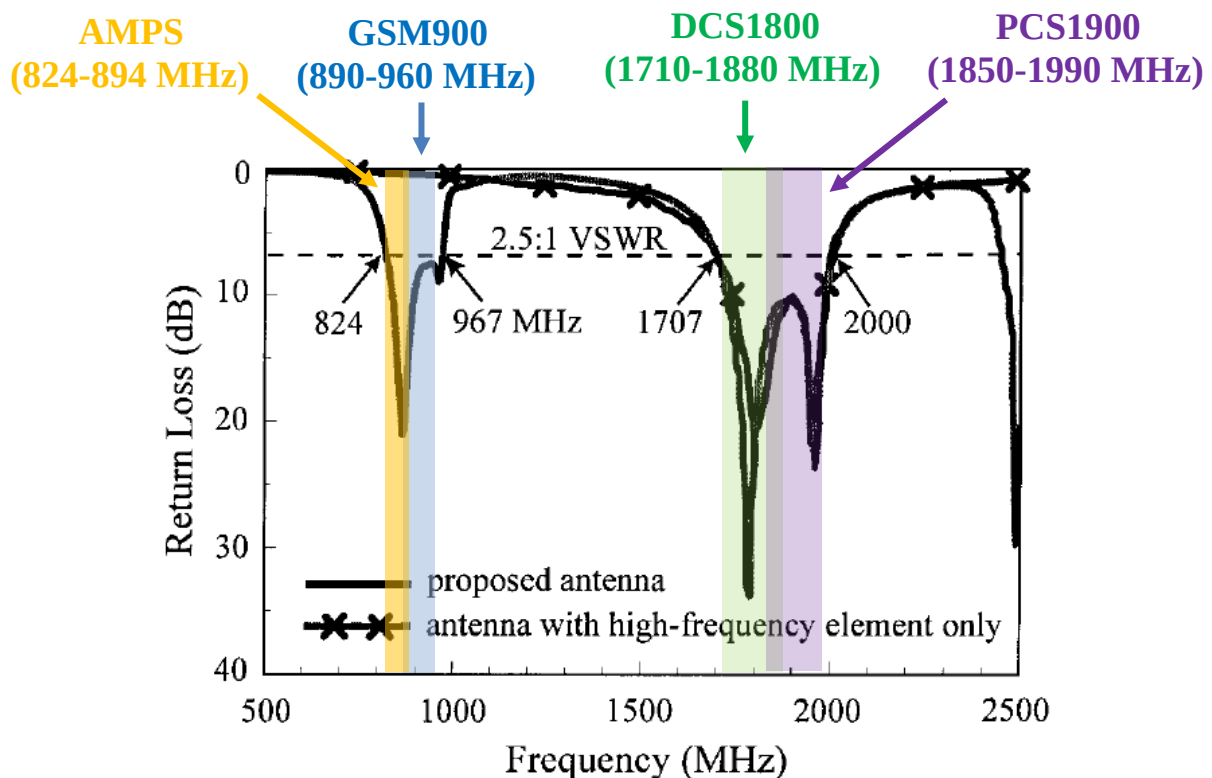
Lee's disclosure overlaps with Wong's disclosure, (and the two share a common co-author, Kin-Lu Wong). For instance, Lee's quad-band antenna operates with a ground plane identical in size to Wong's 70×100 mm² ground plane. Wong, 348; Lee, 359. Lee describes its 70×106mm² FR4 board as compatible with practical mobile phones. Lee, 359.

POSAs would have sized Wong+Lee's PDA at roughly the same dimensions as its system circuit board because it was conventional for a wireless device's system circuit board (*e.g.*, PCB) to have dimensions commensurate with the device's housing, *e.g.*, filling the available planar space within the device. *E.g.*, EX1032, Fig. 5 (mobile telephone 100, PCB 10), [0058]; EX1033, Fig. 6 (frame 602, PCB 603), 4:16-26; EX1034, Figs. 1, 3, 3:20-22 ("a circuit board assembly 302 of FIG. 3 is positioned in the front housing portion 106 [of the electronic device]"), 6:13-15 ("device 100... is suitable for portable or handheld operation"); Pozar, ¶65.

Wong+Lee would have used known components (Wong's system circuit board, ground plane and WLAN antenna, and Lee's quad-band antenna), in a PDA phone (as motivated by both Wong and Lee, *supra* §VI.B) according to their conventional uses, with predictable results. Pozar, ¶66. Wong+Lee would have used Lee's quad-band antenna instead of Wong's dual-band GSM/DCS antenna to obtain the predictable result of a PDA phone with quad-band cellular capabilities that could operate in both North America and Europe. Pozar, ¶66; *KSR Int'l v. Teleflex*, 550 U.S. 398, 416-417 (2007).

3. Reasonable Expectation of Success

POSAs would have had a reasonable expectation of success in replacing Wong's dual-band GSM/DCS antenna with Lee's quad-band antenna. Both can be used in cellular phones, and both are disposed proximate a ground plane with an area of $70 \times 100 \text{ mm}^2$. Wong, 348; Lee, 359; Pozar, ¶67. Lee's quad-band antenna supports bandwidths sufficient to “**cover the required bandwidths of the [AMPS]/GSM and DCS/PCS bands.**” Lee, Fig. 2 (“proposed antenna” response annotated below), 360-361; Pozar, ¶¶67-68.



Because Lee’s quad-band antenna uses a PCB with the same ground plane area shown in Wong, and because Lee’s quad-band antenna covers the desired frequency bands, POSAs would have had a reasonable expectation of success in replacing Wong’s dual-band GSM/DCS antenna with Lee’s quad-band antenna to provide a PDA phone with Lee’s quad-band coverage and Wong’s WLAN coverage. Pozar, ¶69.

C. Analysis

1. Claim 1

a. Preamble

1.PRE	A wireless handheld or portable device comprising:
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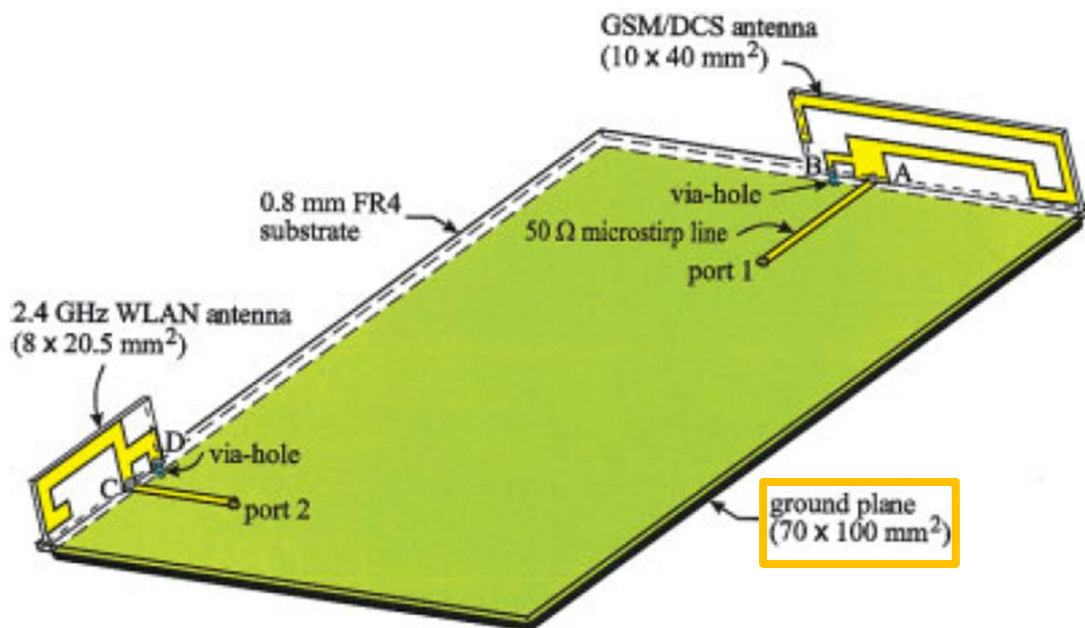
Wong+Lee meets [1.PRE] because its PDA phone is a “*wireless handheld or portable device*” and Wong+Lee meets the remaining limitations of claim 1 as shown below. *Supra* §VI.B (discussing Wong+Lee); Wong, 347; Lee, 359; Pozar, ¶70.

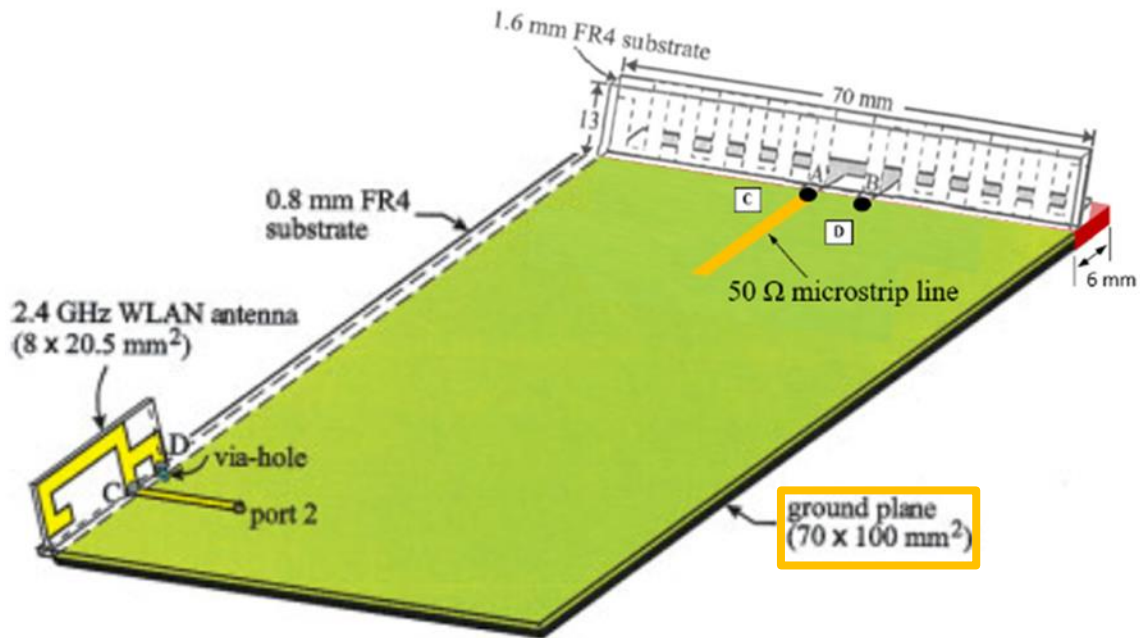
Wong+Lee’s PDA phone is *wireless* because it supports cellular/WLAN dual-network operations with internal antennas. Pozar, ¶71. Further, Wong+Lee is *handheld* and *portable* because PDA phones were known to be sized and configured to be held and carried in a user’s hand. Pozar, ¶71.

b. Limitation [1.a]

1.a	a ground plane;
-----	-----------------

Wong+Lee meets [1.a] because it uses Wong's ground plane, having "a reasonable size for practical PDA phones." Wong, 348, Fig. 1(a) (annotated below); Pozar, ¶72.



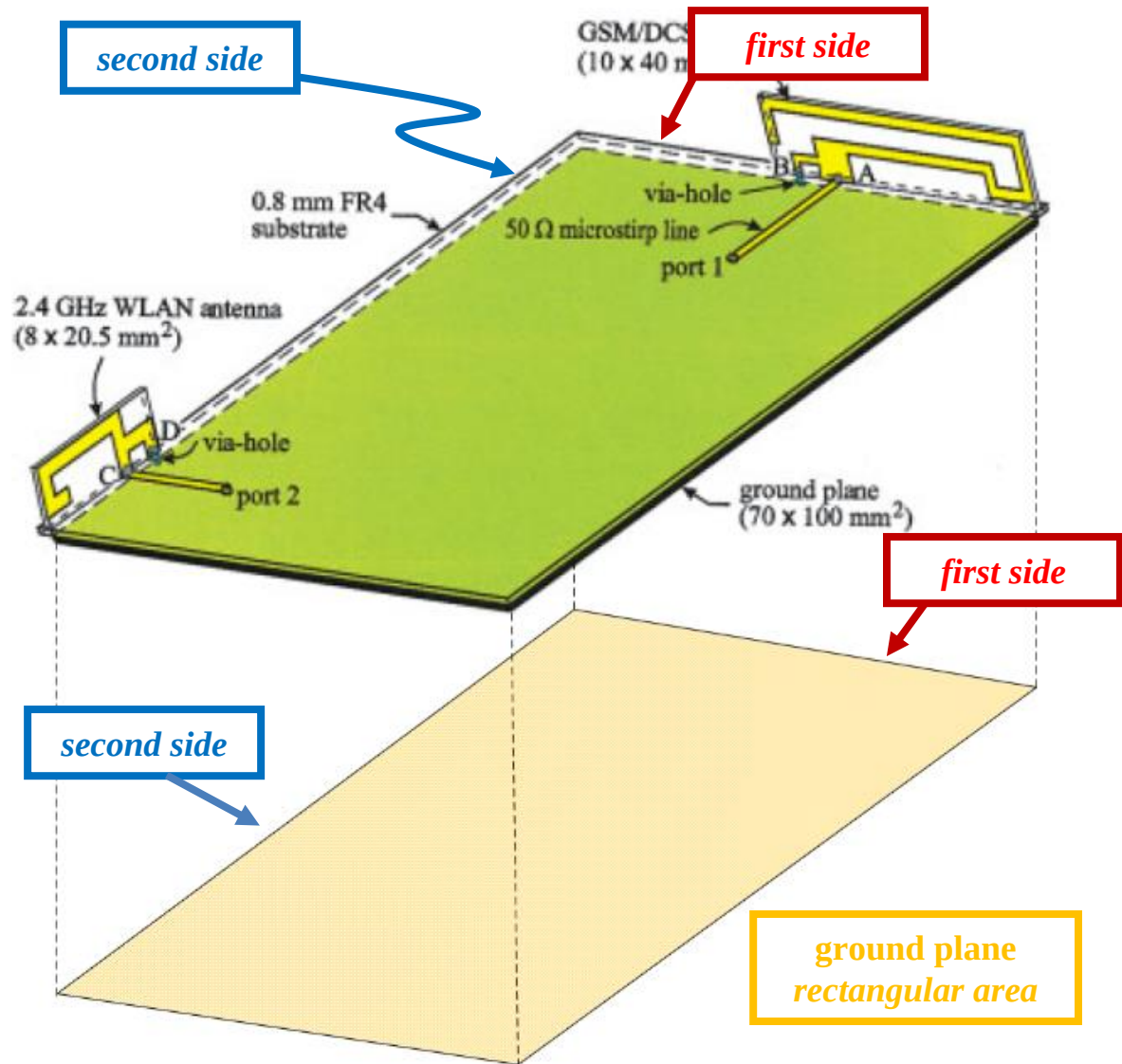


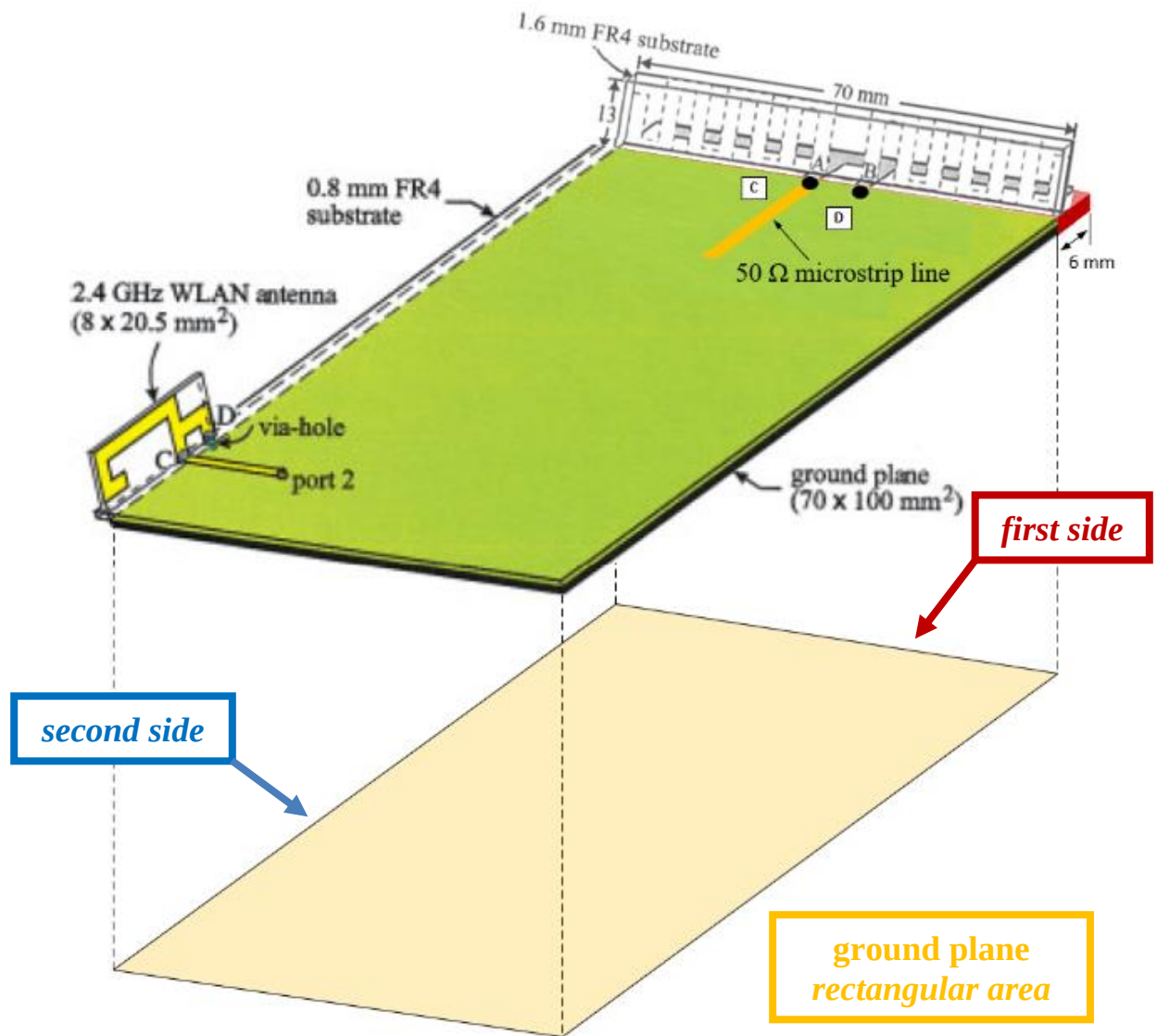
Wong+Lee

c. Limitation [1.b]

1.b	the ground plane is inscribed in a rectangular area comprising a first side and a second side, a length of the second side being greater than a length of the first side;
-----	---

Wong+Lee meets [1.b] because Wong's ground plane is a layer of Wong's PCB having a rectangular shape ("*is inscribed in a rectangular area*") with sides of 70mm ("*first side*") and 100mm ("*second side*"). Wong, 348, Fig. 1(a) (annotated below). The second side's length (100mm) is greater than the first side's length (70mm). Pozar, ¶73.





Wong+Lee

d. Limitation [1.c]

1.c	a first antenna configured to transmit and receive electromagnetic waves corresponding to at least three frequency bands;
-----	---

Wong+Lee meets [1.c] because Lee’s quad-band antenna (“*first antenna*”) supports *four* frequency bands (“*at least three frequency bands*”) for cellular communication—three of which (GSM850 [AMPS]³, GSM900, PCS1900) match bands described in the ’458 patent itself. Lee, 359 (“the proposed antenna has wide impedance bandwidths for both its two operating frequencies, thus making the antenna capable of **quad-band** operation in the advanced mobile phone system (APMS [sic], **824–894 MHz**), GSM (**890–960 MHz**), DCS (**1710–1880 MHz**), and PCS (**1850–1990 MHz**) bands.”); EX1001, 2:4-7 (“these handheld devices also operate in at least one frequency band [of] GSM (**GSM850, GSM900**,... or **PCS1900**...)”); Pozar, ¶74.

Radio transmissions on these frequencies are “electromagnetic waves,” which Lee’s quad-band antenna is configured to both transmit and receive because GSM850, GSM900, DCS1800, and PCS1900 bands comprise frequencies for uplink and downlink communication. EX1009, 9; Pozar, ¶¶75-76.

³ GSM850 and AMPS [Advanced Mobile Phone System] both use 824-894 MHz. EX1009, 9; EX1030, 6:22-25.

e. Limitation [1.d]

1.d	the at least three frequency bands being used for mobile communication services;
-----	--

Wong+Lee meets [1.d] because the frequencies utilized by Lee's quad-band antenna are all "*for mobile communication services.*" EX1001, 9:26-37 (confirming that "GSM850, GSM900, GSM1800... [and] PCS1900" are all for "mobile communication services").⁴

f. Limitations [1.e]-[1.f]

1.e	a second antenna configured to receive electromagnetic waves corresponding to at least one frequency band;
1.f	the at least one frequency band being used for wireless connectivity services;

i. "*frequency band... corresponding to*"

Claim 7 depends from claim 1 and states that "***the at least one frequency band*** used for wireless connectivity services ***corresponds to*** at least one wireless connectivity service selected from the group comprising: Bluetooth[], IEEE 802.11a, IEEE 802.11b, IEEE 802.11g, WLAN, WiFi,... ZigBee...." These "wireless connectivity service[s]" use a subset of frequencies within standard Industrial, Scientific, and Medical ("ISM") bands. For example, IEEE Std.

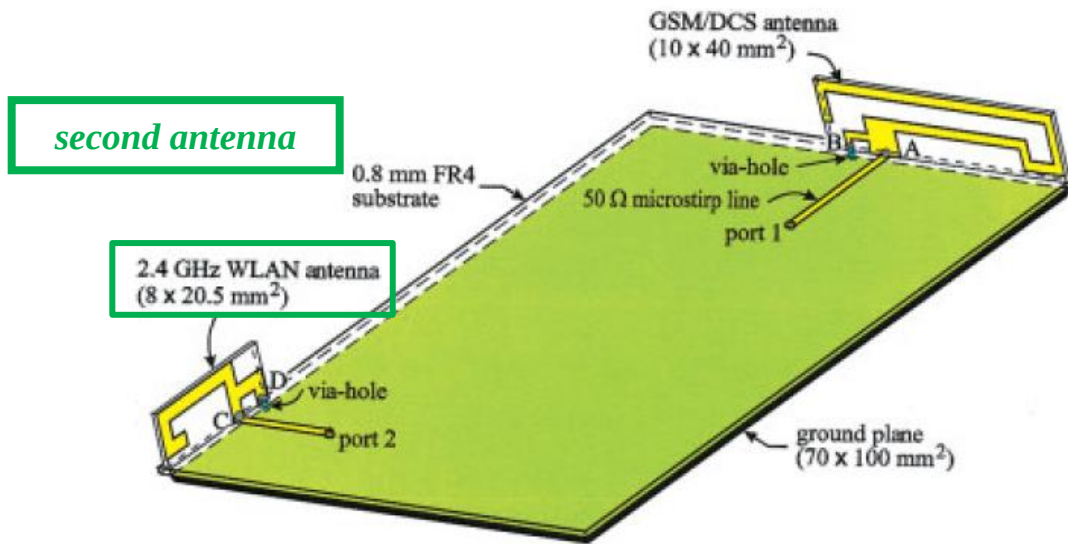
⁴ These correspond to bands in Lee. *Supra* §VI.C.1.d ([1.c]); Pozar, ¶¶54-56, 74-76.

802.11b (“802.11b”) operates in the 2.4 GHz ISM band (2400-2500 MHz). EX1015, 50 Fed. Reg. 36061, 36069-36070 (Sep. 5, 1985); EX1018, 11 (IEEE Std. 802.11b-1999 WLAN operates in “the 2.4 GHz band designated for ISM applications”); EX1001, 9:55-57 (discussing ISM). In North America, 802.11b channels can occupy 2400-2472 MHz, while in Europe 802.11b channels can occupy 2400-2483.5 MHz. EX1018, 49-50, Figs. 142, 144. Therefore, [1.e] is met by an antenna supporting a “wireless connectivity service” that uses a subset of frequencies in (“*corresponding to*”) “*at least one frequency band.*” Pozar, ¶78.

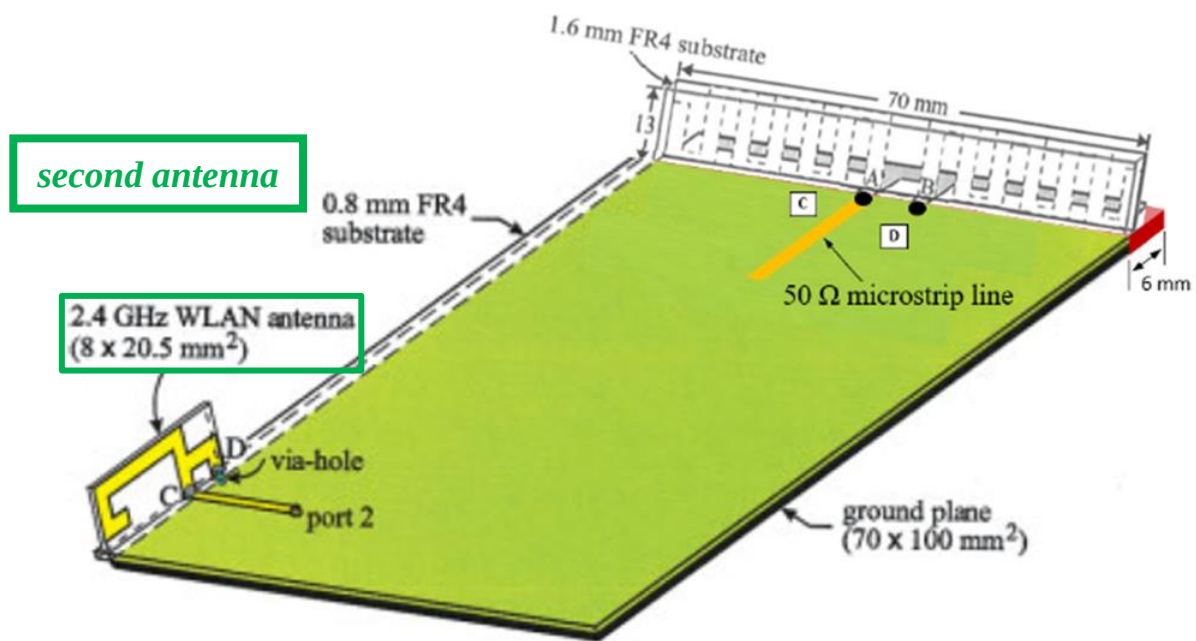
ii. Analysis

Wong+Lee meets [1.e] and [1.f] because Wong’s WLAN antenna (“*second antenna*”) is “one WLAN antenna for 2.4-GHz (2400–2484 MHz) WLAN operation.” Wong, 347. Wong’s WLAN antenna is “*configured to receive electromagnetic waves*” at these frequencies because this is required for WLAN operation, which Wong’s WLAN antenna does. Wong, 347, Fig. 1(a) (annotated below). POSAs would have understood that Wong’s “2.4-GHz... WLAN operation” meant operation at 2400-2484 MHz within (“*corresponding to*”) the 2.4 GHz ISM band. Wong, 347; Pozar, ¶79.

WLAN operation is a “wireless connectivity service” meeting [1.f]. *Supra* §VI.C.1.f.i; EX1001, 25:13-19, claim 7; Pozar, ¶80.



Wong Fig. 1(a) (annotated)



Wong+Lee

g. Limitation [1.g]

1.g	the first antenna extends in a direction substantially parallel to the first side;
-----	--

i. “*substantially parallel to the first side*”

The '458 specification states that “[i]n this document, an antenna or the slot of a slot antenna ***is considered to extend (to be oriented) in the direction*** corresponding to the general longitudinal axis of symmetry of the smallest rectangle in which the radiating element of the antenna can be inscribed.”

EX1001, 10:38-42. Figure 7(c) shows a first antenna extending in a direction substantially parallel to the first side of the ground plane. EX1001, Figure 7(c) (annotated below).

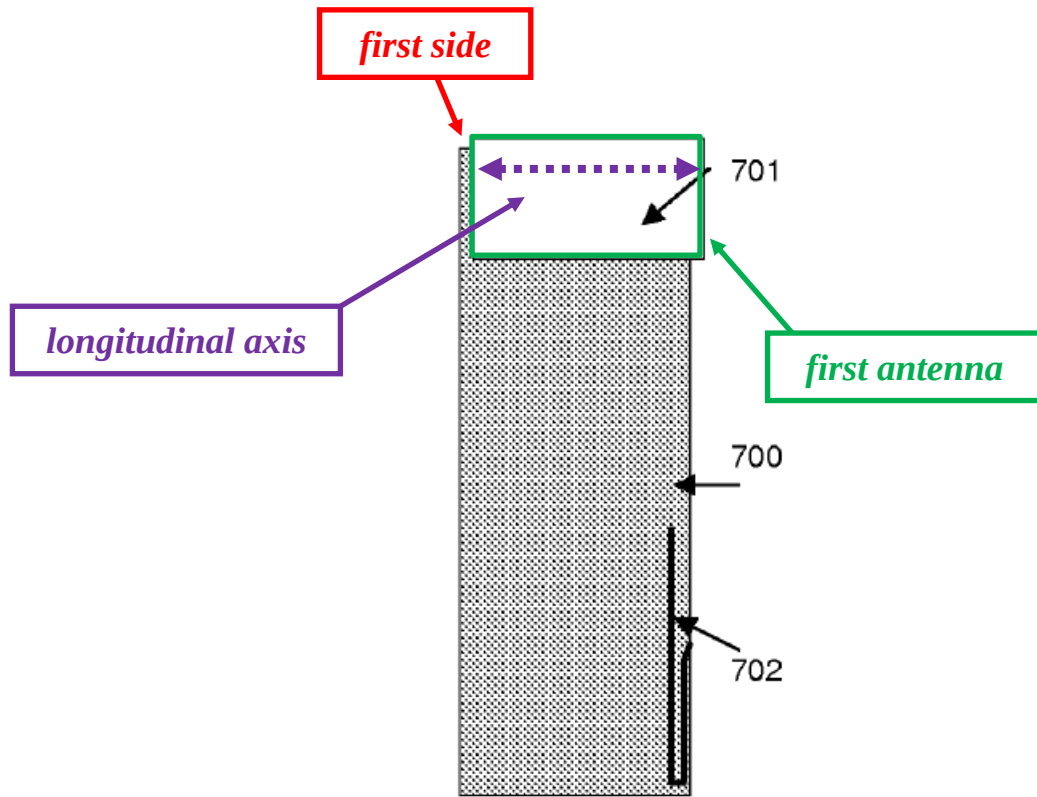
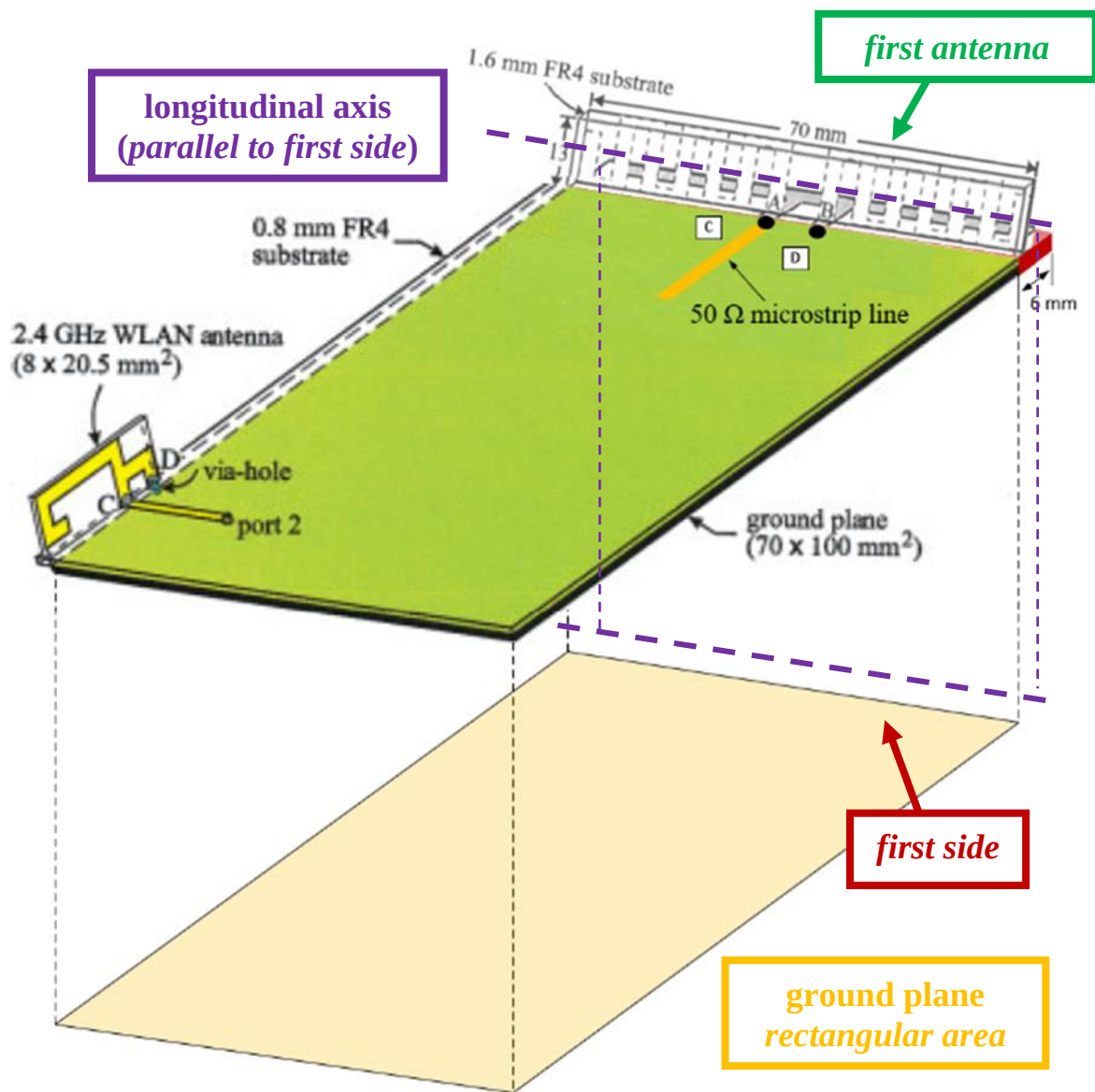


FIG. 7C

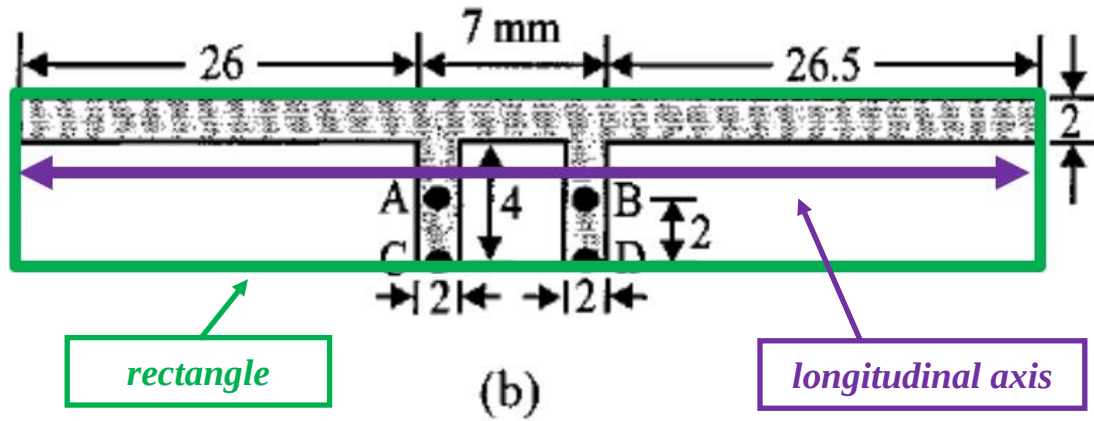
ii. Analysis

Wong+Lee meets [1.g] because Lee's quad-band antenna ("*first antenna*") extends in a direction parallel to the first side of Wong's ground plane. Pozar, ¶82.

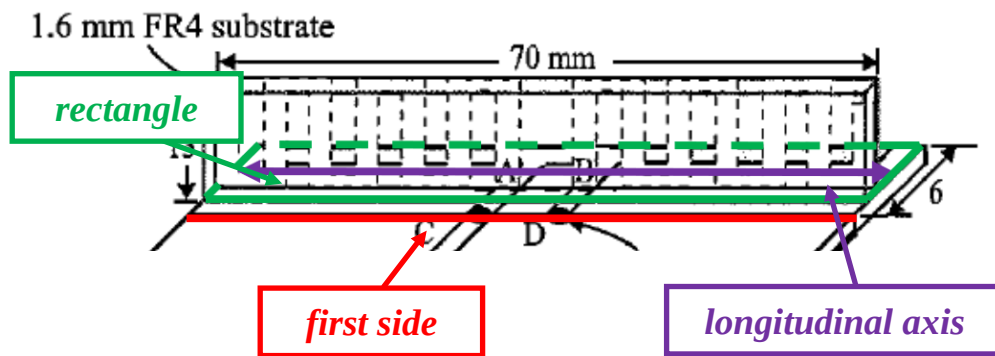


Wong+Lee

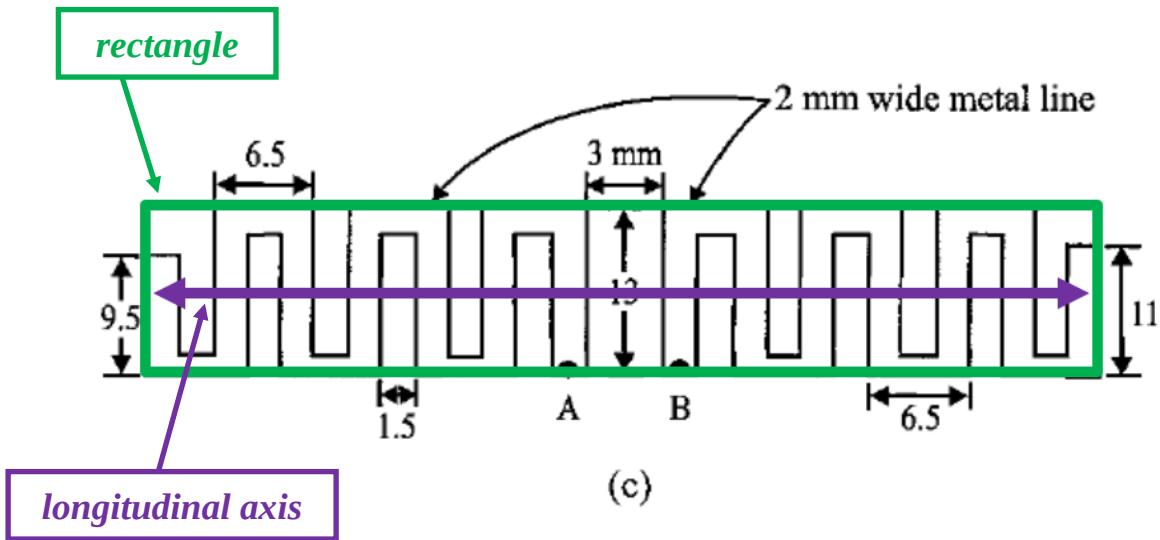
Lee's quad-band antenna includes two radiating monopole elements (for high and low frequencies). Lee, 359. Lee's high-frequency monopole element can be inscribed in a 6mm×59.5mm rectangle parallel to the ground plane. Lee, Fig. 1(b) (annotated below); Pozar, ¶¶83-84.



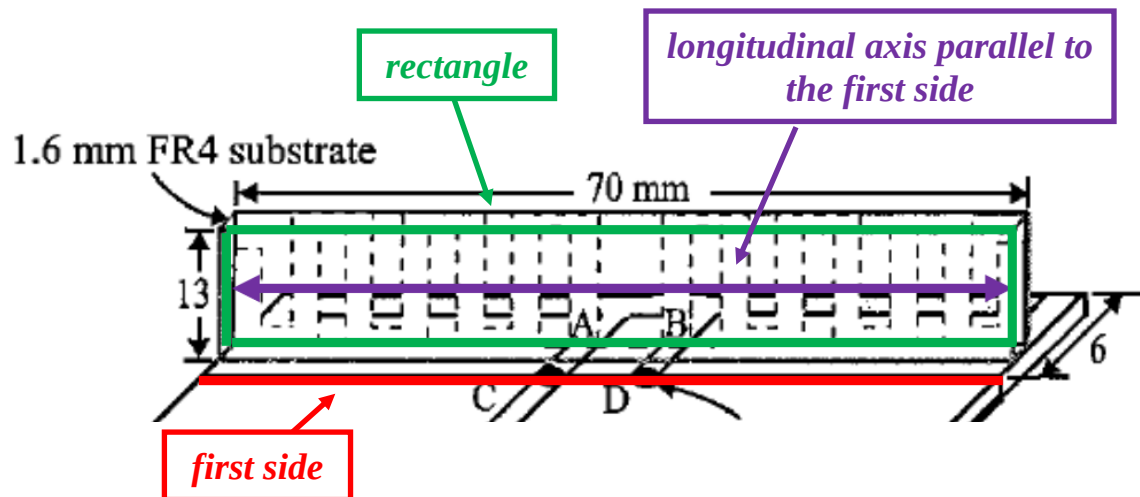
The rectangle's longitudinal axis is parallel to the first side of Lee's ground plane. Lee, Figure 1(a) (annotated below); Pozar, ¶85.



Lee's low-frequency monopole element can be inscribed in a 13mm×55mm rectangle perpendicular to the ground plane. Lee, Fig. 1(c) (annotated below); Pozar, ¶86.

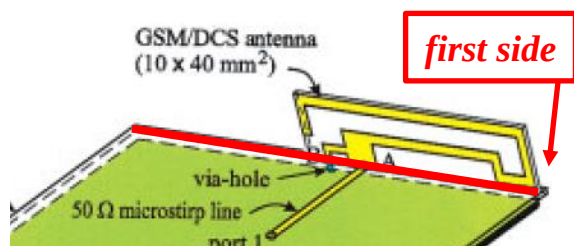


The rectangle's longitudinal axis is parallel to the first side of Lee's ground plane. Lee, Fig. 1(a) (annotated below); Pozar, ¶87.

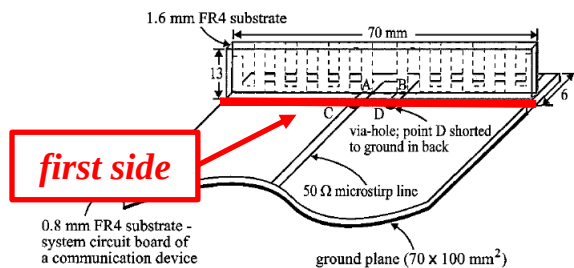


In short, the longitudinal axis for each rectangle inscribing a monopole element is parallel to the first side of Lee's ground plane.

Lee's quad-band antenna and Wong's dual-band GSM/DCS antenna are each located at a top edge ("first side") of a ground plane. Wong, Fig. 1(a) (annotated detail below); Lee Fig. 1(a) (annotated detail below).

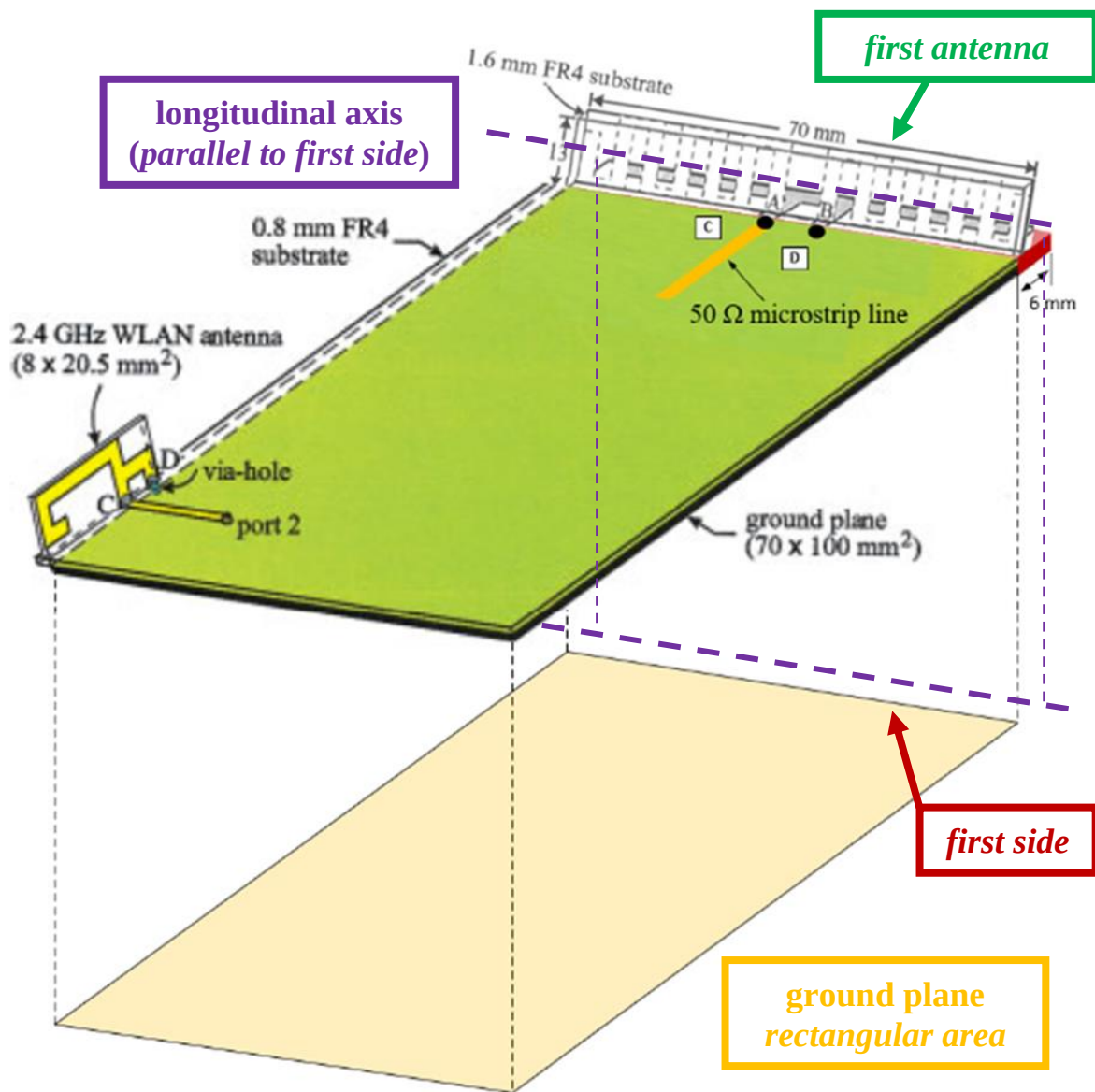


Wong, Fig. 1(a) (annotated detail)



Lee, Fig. 1(a) (annotated detail)

As shown below, Wong+Lee preserves the orientation of Lee's antenna relative to the ground plane so that the longitudinal axes of Lee's quad-band antenna's monopole elements extend in a direction substantially parallel to the first side of Wong's ground plane for the same reasons just explained. Pozar, ¶90.



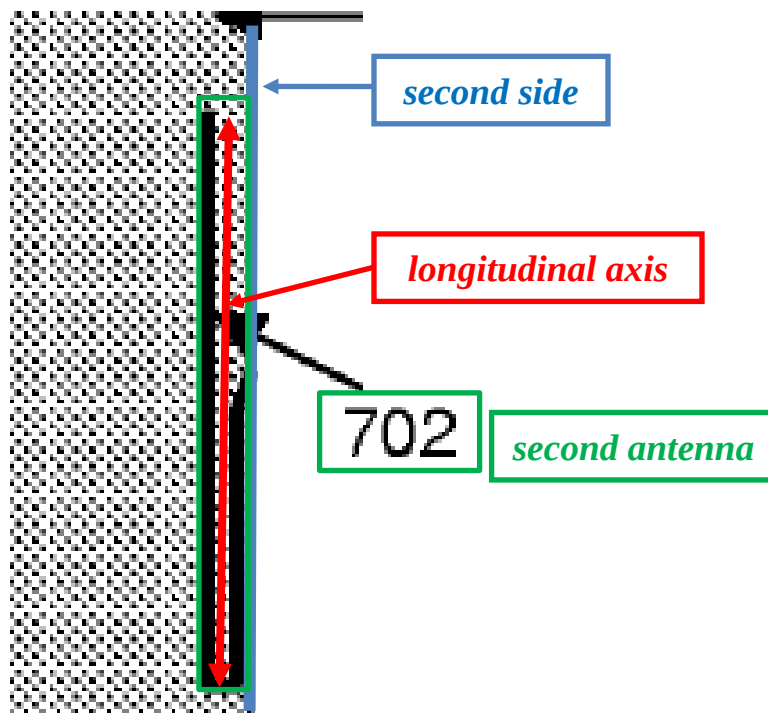
Wong+Lee

h. Limitation [1.h]

1.h	the second antenna extends in a direction substantially parallel to the second side;
-----	--

i. “substantially parallel to the second side”

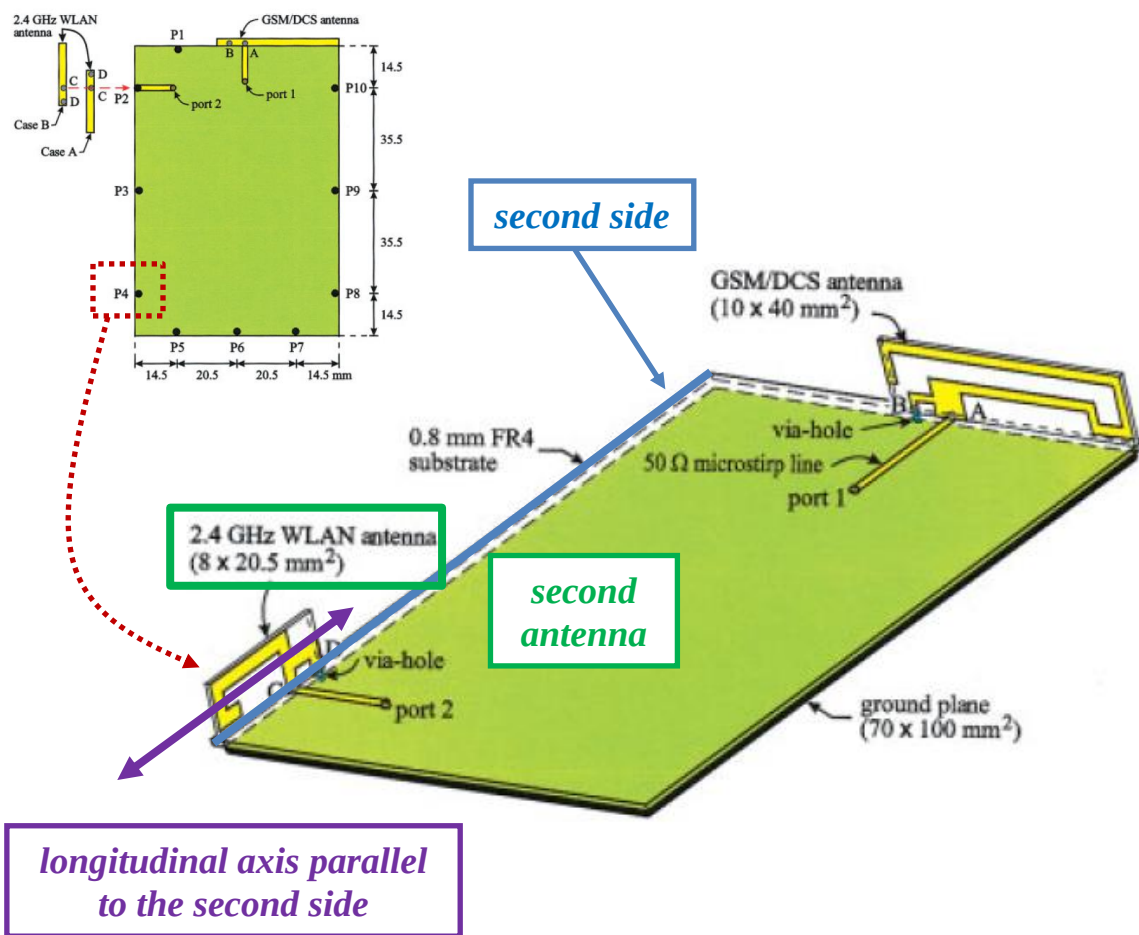
Consistent with the definition at 10:38-42, '458 patent Figure 7(c) depicts a second antenna extending in a direction substantially parallel to the second side of the ground plane. EX1001, Figure 7(c) (annotated below). The second antenna is inscribed in a rectangle having a longitudinal axis that is parallel to the second side. EX1001, Figure 7(c) (annotated below); Pozar, ¶91.



ii. Analysis

Wong+Lee meets [1.h] because Wong's WLAN antenna—when positioned at P4 in Wong's Figure 2 (below inset to Wong's Figure 1(a))—extends in a direction substantially parallel to the long axis ("*second side*") of the ground plane. Wong, Fig. 2; Pozar, ¶92.

Wong's WLAN antenna can be inscribed in an 8mm×20.5mm rectangle perpendicular to the ground plane. The rectangle's longitudinal axis of symmetry is parallel to the longer arm of the WLAN antenna; thus it is parallel to the second side of the ground plane. Wong, 348, Fig. 1(a) (annotated below); Pozar, ¶93.



Wong, Fig. 1(a) (annotated, with Fig. 2 inset)

i. Limitation [1.i]

1.i	the first antenna is arranged substantially close to the first side; and
-----	--

i. “*substantially close to the first side*”

Figures 7(a) through 7(i) show the first antenna arranged in the same location, proximate the first side of the ground plane. Figure 7(c) (annotated below) is exemplary. Pozar, ¶94.

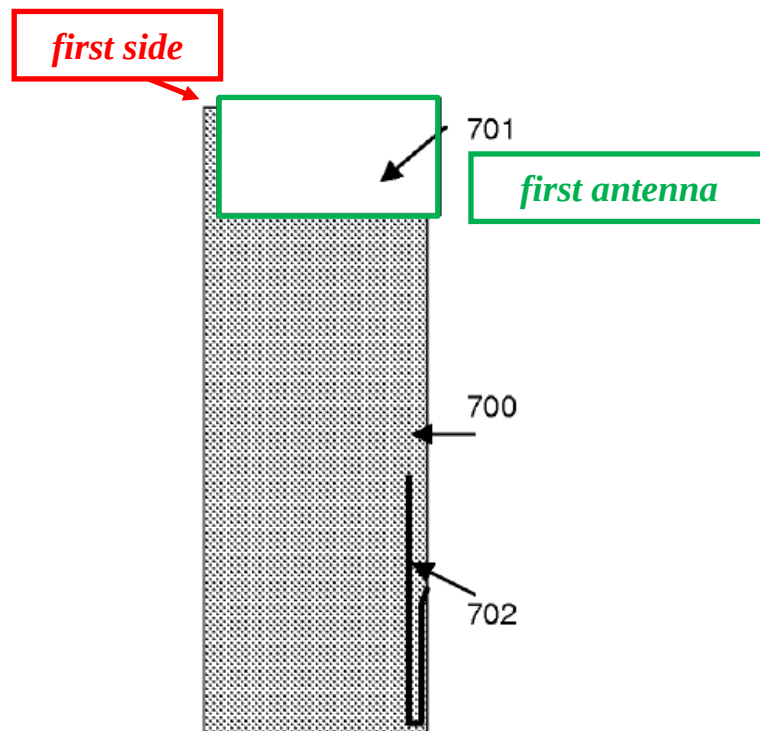
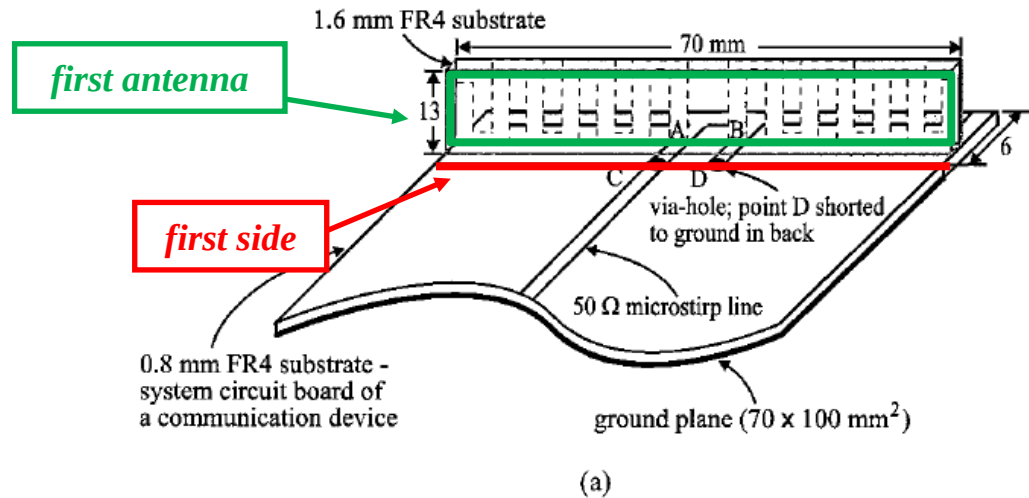


FIG. 7C

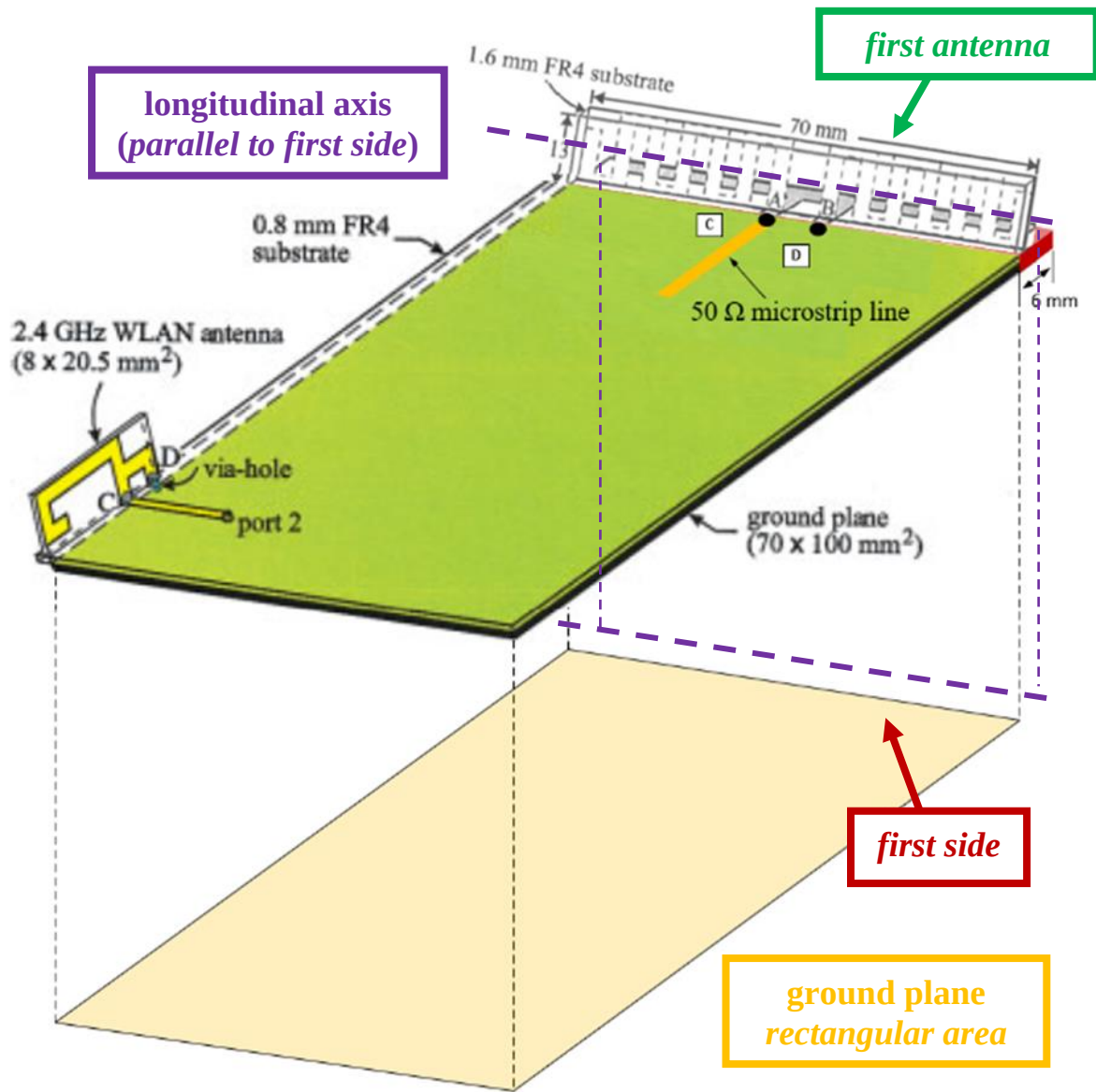
ii. Analysis

Lee’s quad-band antenna (“*first antenna*”) is disposed at and abuts the top edge of the first side of a system circuit board just like Wong’s. Lee, 359 (“The quad-band monopole antenna... **protrudes from the top edge of the system**

ground plane”), Fig. 1(a) (annotated below); Wong, 348 (“the GSM/DCS antenna is arranged to be **fixed at the top edge of the system circuit board**”), Figs. 1(a), 2. In Wong+Lee, Lee’s quad-band antenna would thus be at least as close to the first side as the first antenna in the patent’s Figures 7(a)-7(i). Pozar, ¶95.



(a)
Lee Fig. 1(a) (annotated)



Wong+Lee

Therefore, Wong+Lee's quad-band antenna ("first antenna") is arranged substantially close to the first side. Pozar, ¶96.

j. Limitation [1.j]

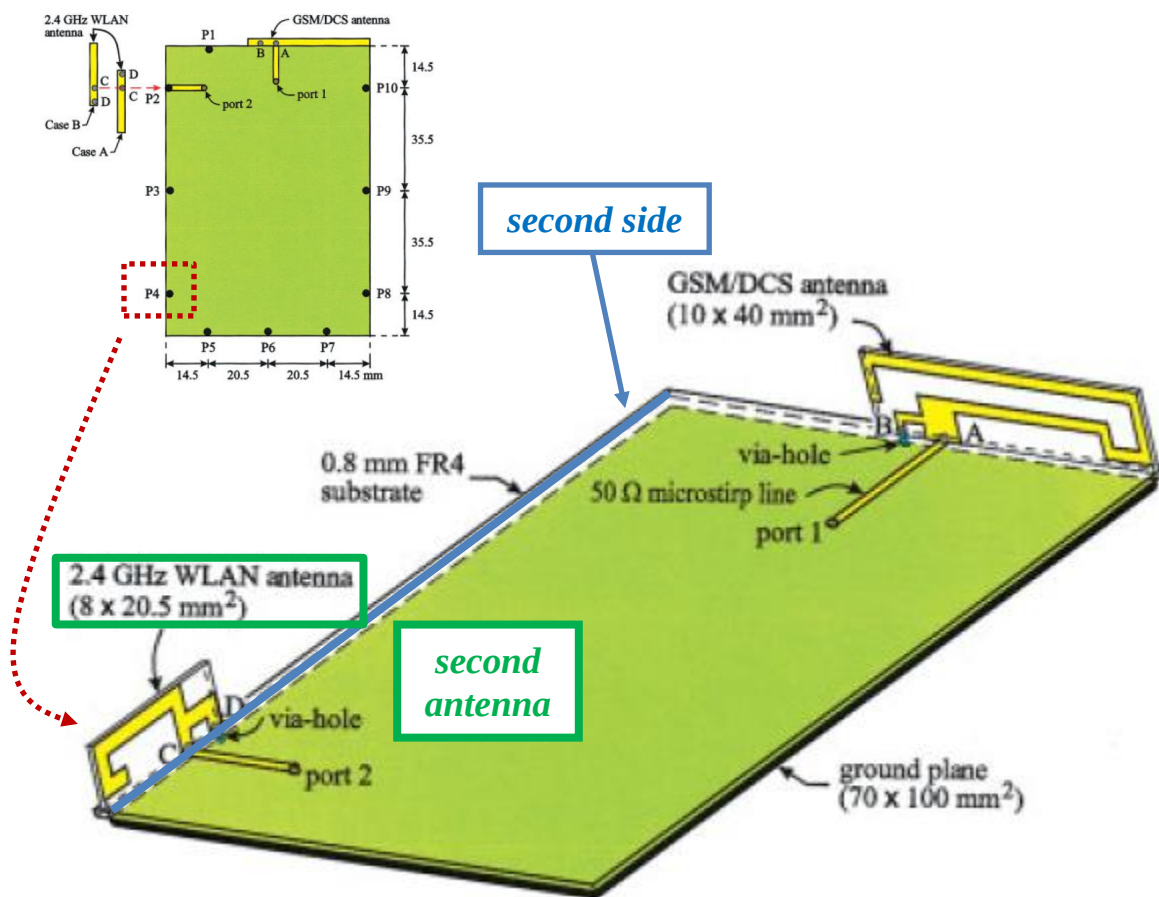
1.j	the first antenna and the second antenna are located internally within the wireless handheld or portable device.
-----	--

Wong+Lee meets [1.j] because it locates Wong’s WLAN antenna (“*second antenna*”) and Lee’s quad-band antenna (“*first antenna*”) within its PDA phone (“*wireless handheld or portable device*”). *Supra* §VI.B.1 (combination); Wong, 347-348 (“Both the GSM/DCS and WLAN ***antennas... can be concealed within the casing of a PDA phone for operation as internal antennas***”); Lee, 359 (“The quad-band monopole antenna is... very promising ***as an internal antenna, built-in within the device’s casing***”). POSAs would have located Wong’s WLAN antenna and Lee’s quad-band antenna inside a wireless handheld or portable device to achieve what Wong and Lee describe. Pozar, ¶¶97-98.

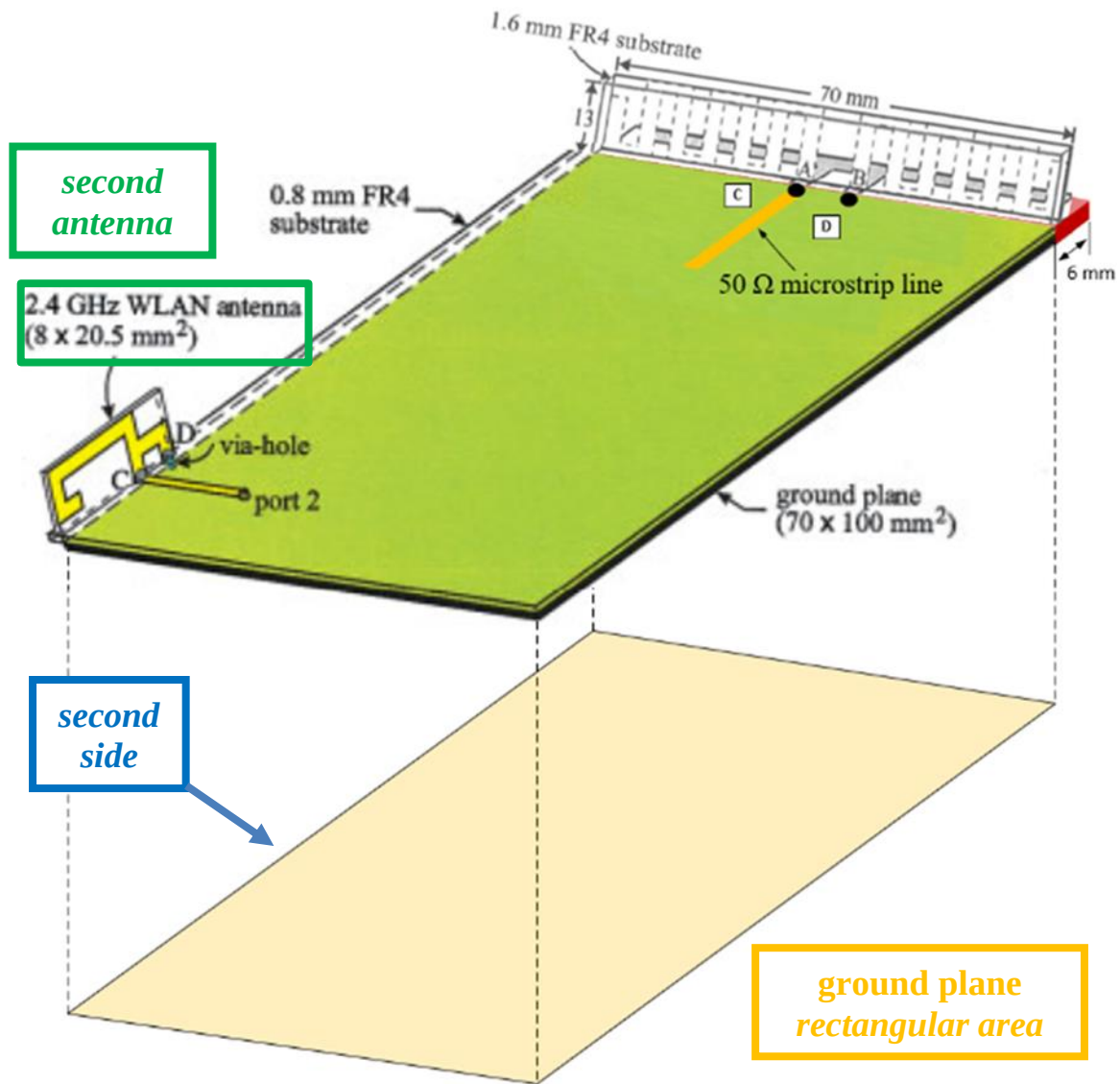
2. Claim 2

2	[Claim 1’s device], wherein the second antenna is arranged substantially close to the second side.
---	--

Wong+Lee meets claim 2 because Wong’s WLAN antenna (“*second antenna*”) is positioned at the edge of the ground plane rectangle’s long side (“*second side*”). Wong, 348 (WLAN antenna positioned “along the boundary of the system ground plane”). Pozar, ¶99.



Wong, Figure 1(a) (annotated, with Fig. 2 inset)



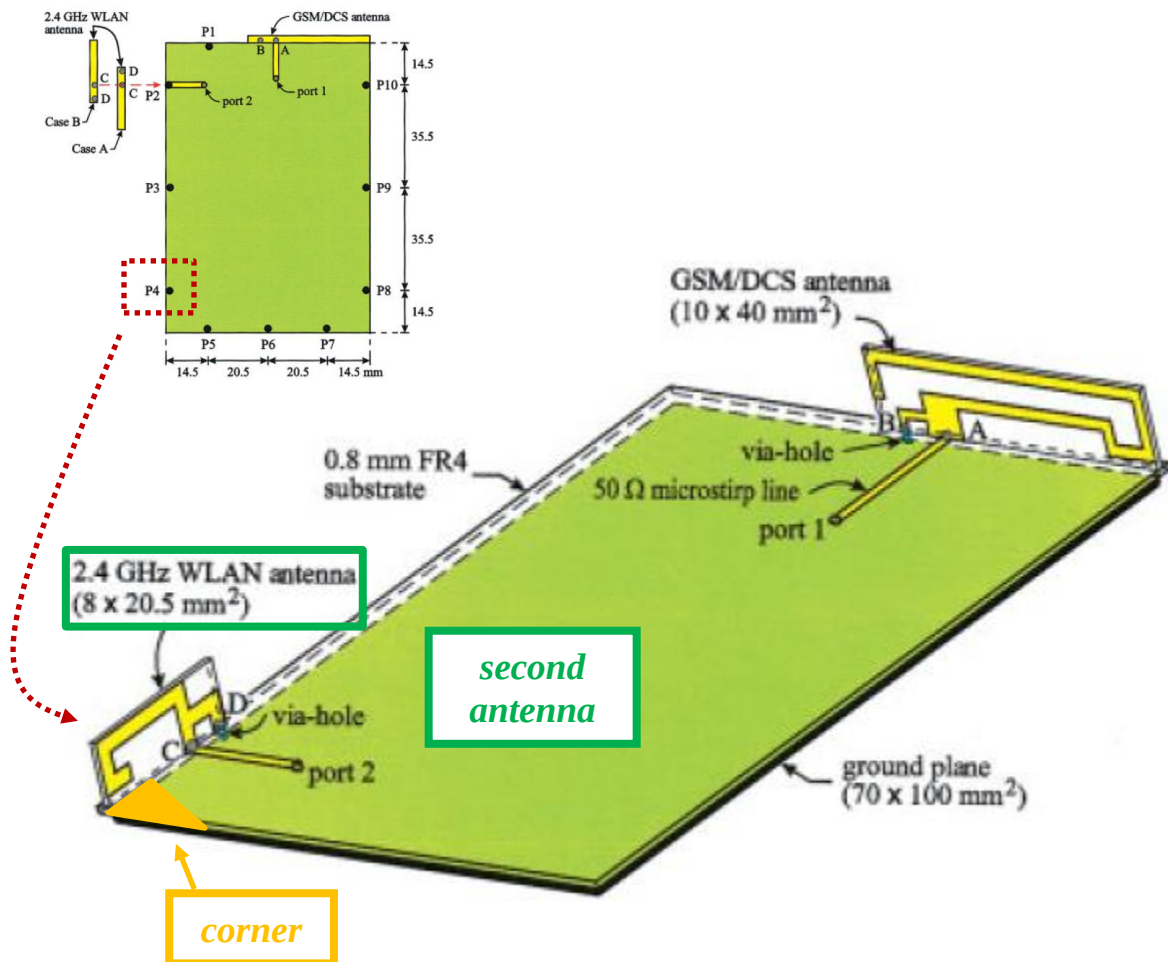
Wong+Lee

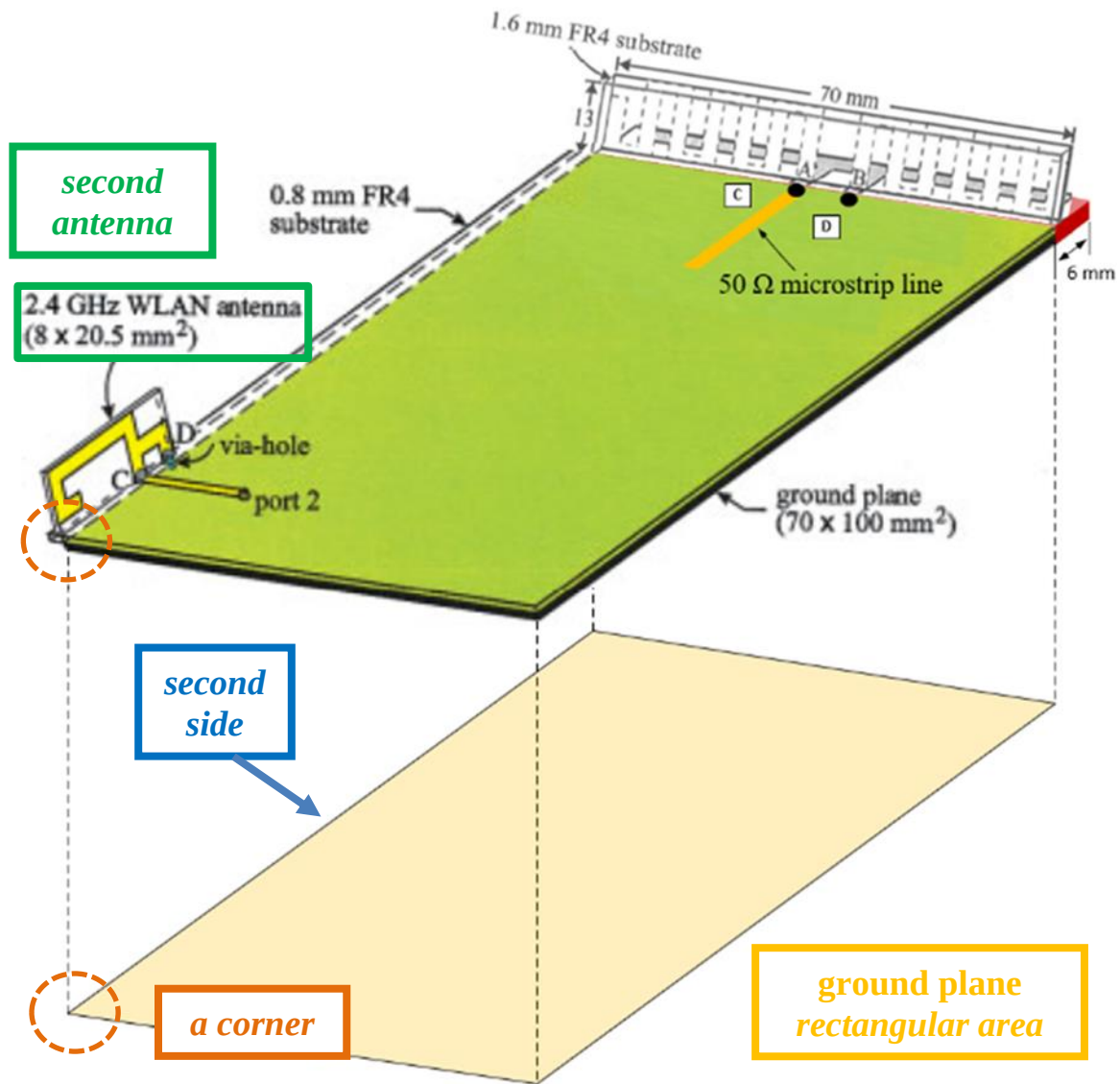
Wong's WLAN antenna is thus at least as close to the second side as the antenna 702 depicted in Figure 7(c) of the '458 patent, which extends into the ground plane. Therefore, Wong+Lee's WLAN antenna is *arranged substantially close to the second side*. Pozar, ¶100.

3. Claim 3

3	[Claim 2's device], wherein the second antenna is arranged substantially close to a corner of the rectangular area.
---	---

Wong+Lee meets claim 3 because Wong's WLAN antenna ("second antenna") is positioned substantially close to the lower-left corner of the ground plane's rectangular area. Wong, Fig. 1(a) (annotated below, with Fig. 2 inset); Pozar, ¶101.





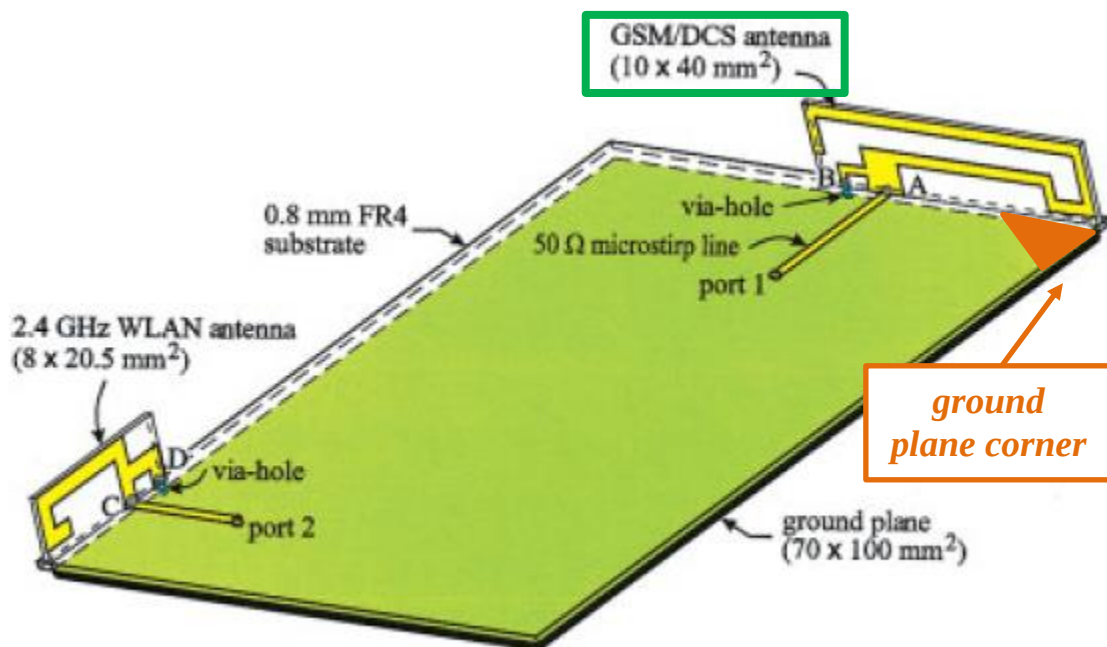
Wong+Lee

Wong's WLAN antenna is at least as close to the lower-left corner of Wong's ground plane as the antenna 702 depicted in Figure 7(c) of the '458 patent is to the lower-right corner of the ground plane. Pozar, ¶102.

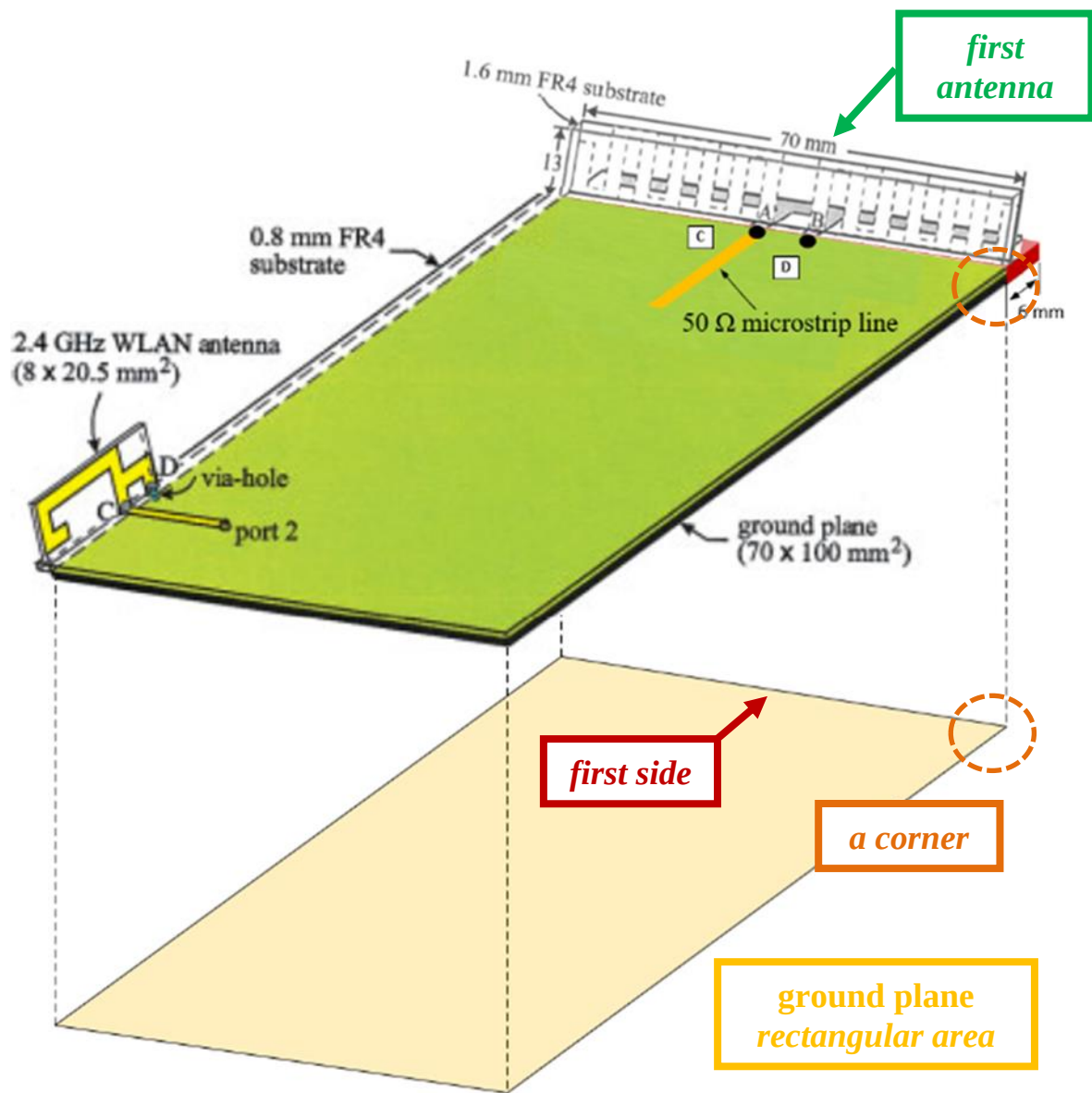
4. Claim 4

4	[Claim 1's device], wherein the first antenna is arranged substantially close to a corner of the rectangular area.
---	--

Wong+Lee meets claim 4 because, in Wong+Lee, Lee's quad-band antenna ("first antenna") is located substantially close to the top-right corner of the ground plane just like Wong's in Wong Figure 1(a). Wong, Fig. 1(a) (annotated below). In Wong+Lee, Lee's quad-band antenna would thus be at least as close to the top-right corner as the first antenna in the patent's Figures 7(a)-7(i) is to the top-left corner of the ground plane. Pozar, ¶103.



Wong, Fig. 1(a) (annotated)



Wong+Lee

5. Claim 5

5	[Claim 1's device], wherein the first antenna is an antenna selected from the group comprising: a monopole antenna, an inverted-F antenna, a patch antenna, and a planar inverted-F antenna.
---	--

Wong+Lee meets claim 5 because Lee's quad-band antenna ("first antenna") is a monopole antenna. Lee, 359 ("A novel internal **monopole** antenna")

suitable for applications in AMPS/GSM/DCS/PCS quad-band mobile phones is presented.”).

6. Claim 6

6	[Claim 5’s device], wherein the second antenna is an antenna selected from the group comprising: a monopole antenna, an inverted-F antenna, a patch antenna, and a planar inverted-F antenna.
---	---

Wong+Lee meets claim 6 because Wong’s WLAN antenna (“*second antenna*”) is a planar inverted-F antenna (PIFA). Wong, 347 (“Both the GSM/DCS and **WLAN antennas are printed PIFAs** with compact sizes.”); EX1001, 2:43 (PIFA is a “planar inverted-F antenna”).

7. Claim 7

7	[Claim 1’s device], wherein the at least one frequency band used for wireless connectivity services corresponds to at least one wireless connectivity service selected from the group comprising: Bluetooth™, IEEE802.11a, IEEE802.11b, IEEE802.11g, WLAN, WiFi, UWB, ZigBee, GPS, Galileo, SDARs, XDARS, WiMAX, DAB, FM, DVB-H, and DMB.
---	---

Wong+Lee meets claim 7 because Wong’s WLAN antenna (“*second antenna*”) is a WLAN antenna that uses frequencies corresponding to the 2.4 GHz ISM band as explained *supra* §VI.C.7 ([1.e]-[1.f]). Wong, 347 (“For this application, it is required that a PDA phone be equipped with... one WLAN antenna for 2.4-GHz (2400–2484 MHz) WLAN operation.”).

8. Claim 8

a. Limitations [8.PRE]-[8.c], [8.j]

Wong+Lee meets Limitations [8.PRE]-[8.c] and [8.j] for the reasons it meets the corresponding limitations below. EX1016, 1; Pozar, ¶107.

Limitation	Corresponding Limitation	Discussion <i>supra</i>
[8.PRE]	[1.PRE]	§VI.C.1.a
[8.a]	[1.a]	§VI.C.1.b
[8.b]	[1.c]	§VI.C.1.d
[8.c]	[1.d]	§VI.C.1.e
[8.j]	[1.j]	§VI.C.1.j

Wong+Lee meets the remaining limitations of claim 8 as follows.

b. Limitation [8.d]

8.d	a second antenna configured to operate in at least one frequency band;
-----	--

Limitation [8.d] is broader than [1.e] because it recites “**configured to operate in** at least one frequency band” instead of “**configured to receive electromagnetic waves corresponding to** at least one frequency band.”

Wong+Lee thus meets [8.d], for the same reasons it meets [1.e]. *Supra* §VI.C.1.f; Pozar, ¶108.

c. Limitation [8.e]

8.e	the first antenna extends in a direction substantially parallel to a first side of the portable device;
-----	---

Wong+Lee meets [8.e] because Lee’s quad-band antenna (“*first antenna*”) extends in a direction parallel to the short edge (*first side*) of the system circuit board (and hence of the portable device sized commensurate with the PCB). *Supra* §§VI.B (combination), VI.C.1.g ([1.g]); Lee, Fig. 1(a); Pozar, ¶109.

d. Limitation [8.f]

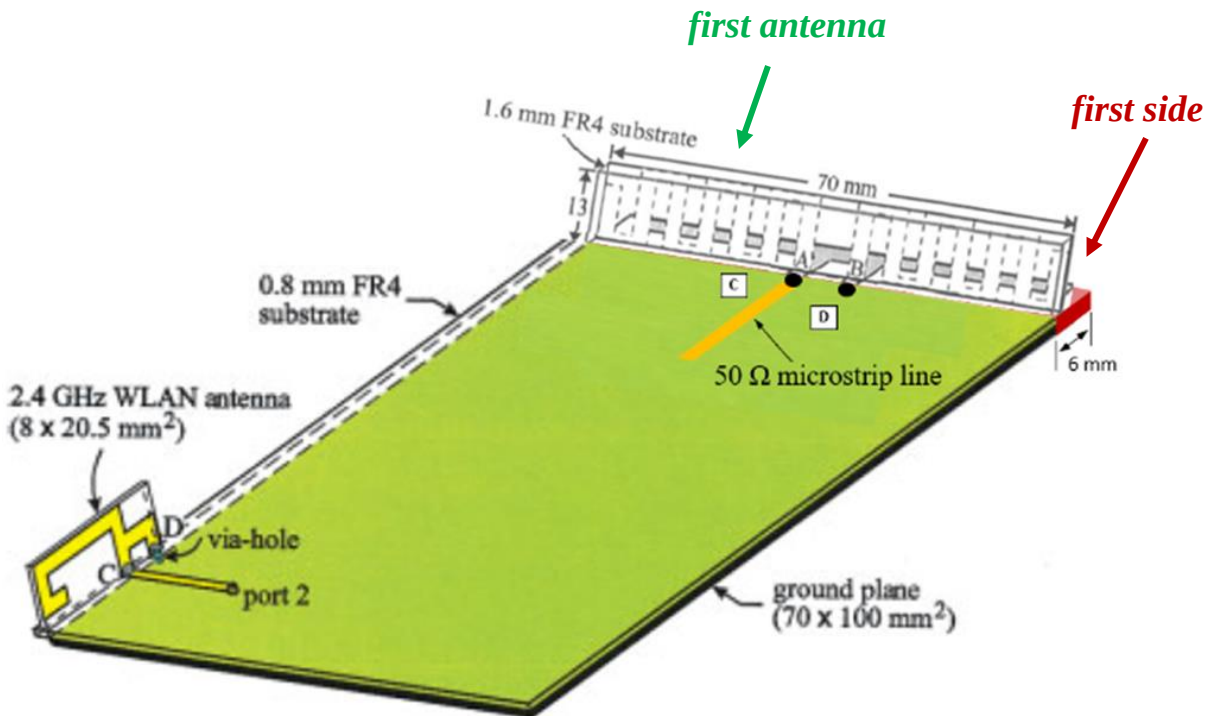
8.f	a length of a second side of the portable device is greater than a length of the first side of the portable device;
-----	---

Wong+Lee meets [8.f] because it uses Wong’s ground plane having a second side (100mm) and a first side (70mm). *Supra* §VI.C.1.c ([1.b]); Wong, 348, Fig. 1(a). Wong+Lee adds another 6mm length to Wong’s 100mm long substrate, beyond the region backed by Wong’s ground plane. *Supra* §VI.C.1.c ([1.b]). Thus, the resulting ground plane edges (and hence the sides of the Wong+Lee “portable device” containing and commensurate with PCB dimensions) satisfy the requirement that *a length of the second side* [106mm] *is greater than a length of the first side* [70mm]. *Supra* §VI.B (combination); Pozar, ¶111.

e. Limitation [8.g]

8.g	the first antenna is arranged substantially close to the first side of the portable device;
-----	---

Wong+Lee meets [8.g] because Lee's quad-band antenna ("first antenna") is disposed at the same location as Wong's GSM/DCS antenna, and the horizontal monopole element spans the 6mm ungrounded substrate portion to the top edge of the ground plane. *Supra* §VI.B (combination). The "portable device" is commensurate with Wong+Lee's PCB dimensions, and the short edge near the top of the ground plane is the *first side*. *Id.*; *supra* §VI.C.1.i ([1.i]); Pozar, ¶112.



Wong+Lee

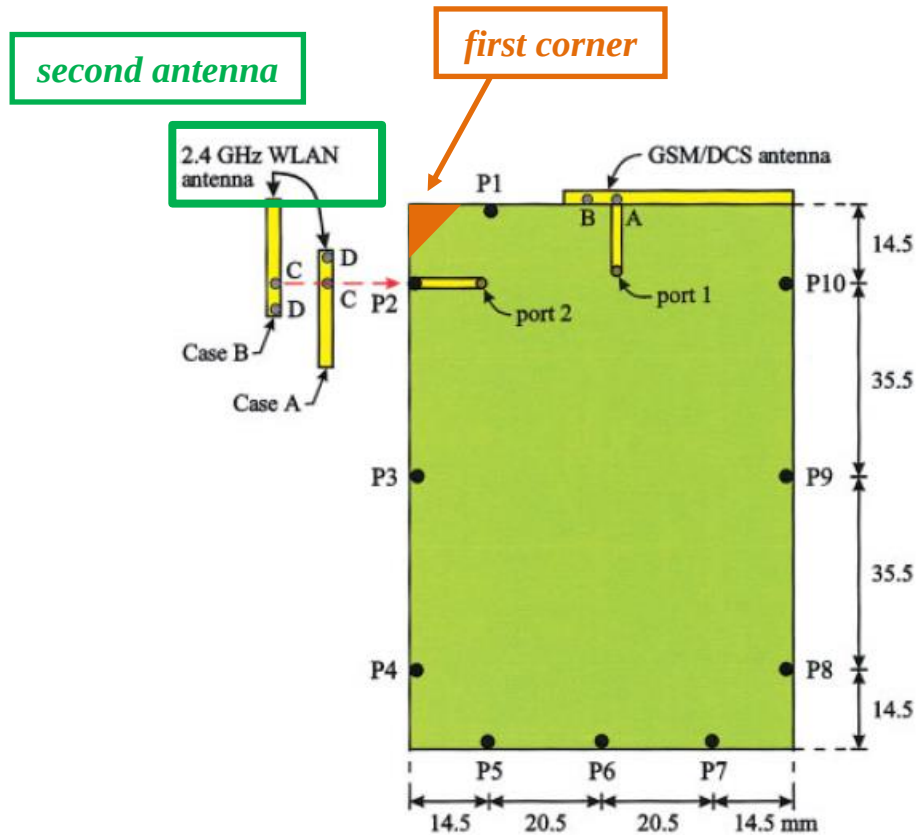
f. Limitation [8.h]

8.h	the second antenna is arranged substantially close to a first corner of the portable device;
-----	--

Wong+Lee meets [8.h] because Wong describes a WLAN antenna (“*second antenna*”) position at P2, proximate the upper left corner of the ground plane.

Wong, Fig. 2 (annotated below).

In Wong’s “Case B,” the WLAN antenna is positioned adjacent the “*first corner*.” When located at Position P2, Wong’s WLAN antenna is at least as close to the upper left corner as, for example, antenna 702 in Figure 7(a) of the ’458 patent is to the corresponding corner. Pozar; ¶114.



Wong, Figure 2 (annotated)

Wong+Lee's portable device is sized commensurate with the 106mm×70mm PCB. *Supra* §VI.B (combination). Thus, in Wong+Lee, the “first corner” is laterally displaced 6 mm from Wong's configuration, so that the WLAN antenna is positioned at $\left(\frac{6}{106}\right) = 5.7\%$ of the length of the long axis (second side) from the device's corner. This is “substantially close” as claimed. Pozar, ¶115.

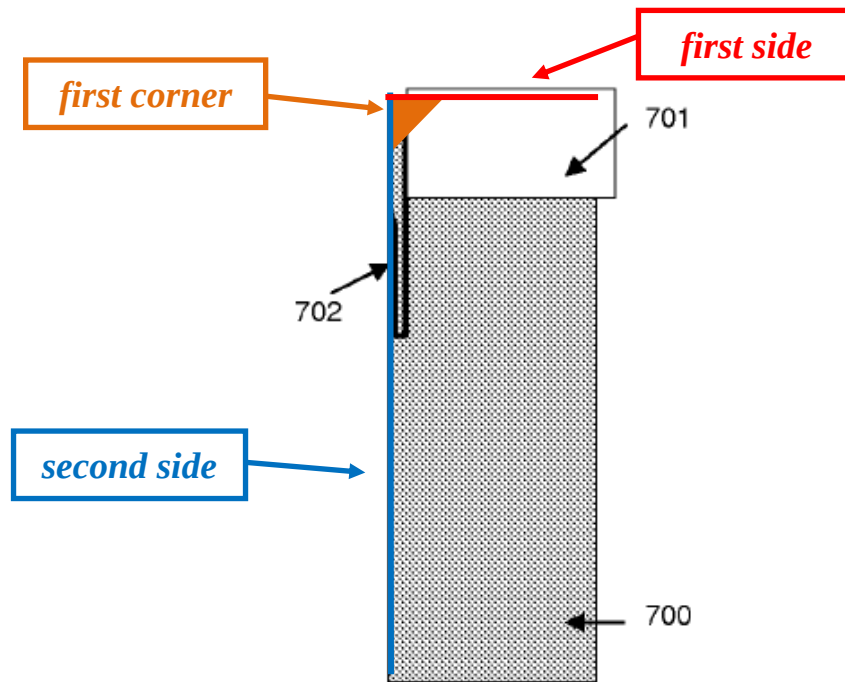


FIG. 7A

'458 patent, Figure 7(a) (annotated)

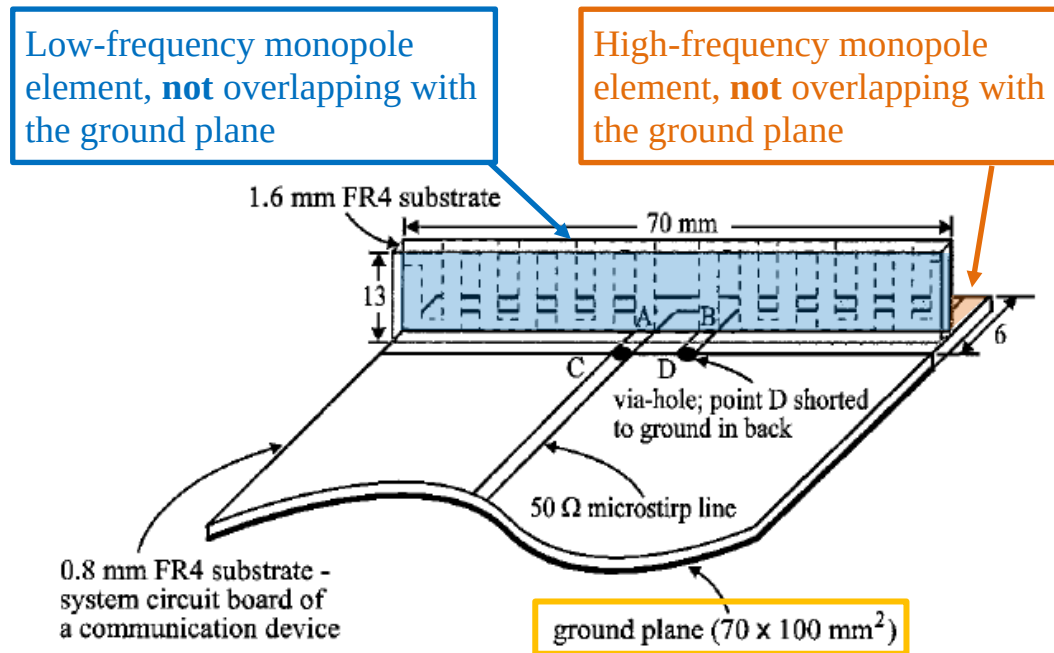
9. Claim 9

9	[Claim 8's device], wherein a portion of an orthogonal projection of the first antenna on a plane containing the ground plane does not overlap with the ground plane.
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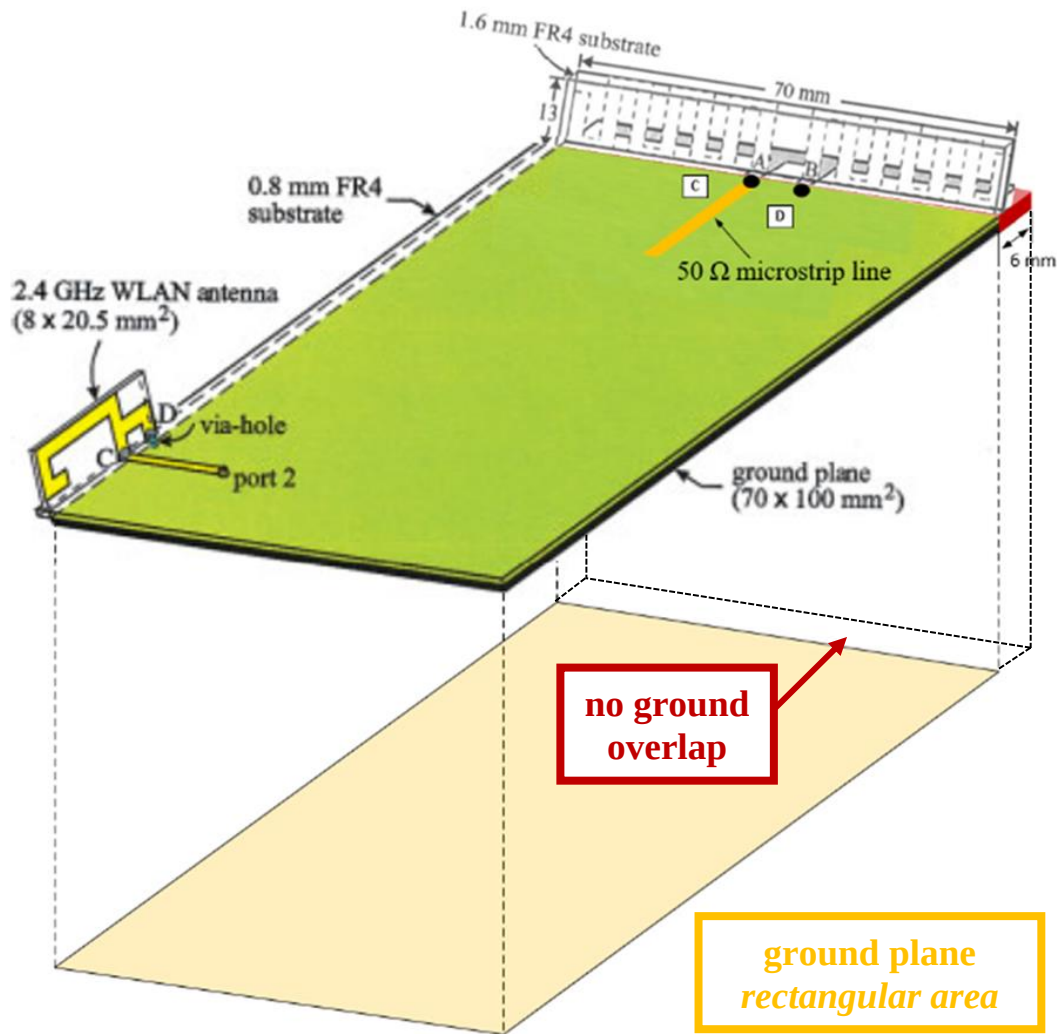
The '458 patent teaches: "In some examples, the fraction of the projection of the slot occupied by ground plane will be **less than**, or approximately equal to... 5% of the projection of the slot on the PCB." EX1001, 11:6-9. Thus, the '458 patent contemplates an overlap of less than 5%, including no overlap.

Lee's quad-band antenna has an orthogonal projection, on the plane that contains the ground plane, that does not overlap with the ground plane because the antenna is disposed on a portion of the substrate not backed by the ground plane.

Lee, 359, Figure 1(a) (annotated below); Pozar, ¶118.



In Wong+Lee, Lee's quad-band antenna ("*first antenna*") likewise has an orthogonal projection "*on a plane containing the ground plane*" that does not overlap with the ground plane, meeting claim 9. Pozar, ¶119.



Wong+Lee

10. Claims 12-13

Wong+Lee meets the additional limitations in claims 12 and 13 for the reasons it meets claims 5 (*supra* §VI.C.1.a) and 6 (*supra* §VI.C.1.b). EX1016, 2-3; *supra* §VI.B (combination); Pozar, ¶120.

VII. GROUND 1B: WONG RENDERS OBVIOUS CLAIMS 14-15, 17-19

A. Wong

As discussed *supra* §VI.B, POSAs would have had reasons to incorporate Wong's teachings into a PDA phone. POSAs would have found it obvious to equip the PDA phone with a system circuit board and antennas designed in accordance with Wong's teachings. *Id.* POSAs would have found it obvious to use Wong's GSM/DCS antenna and Wong's WLAN antenna as internal antennas within the PDA phone to achieve what Wong describes. *Id.*; Wong, 347; Pozar, ¶121.

B. Analysis

1. Claim 14

a. Limitations [14.PRE]-[14.a], [14.o]

Wong meets Limitations [14.PRE]-[14.a] and [14.o] for the reasons Wong+Lee (relying on Wong's disclosure) meets the corresponding limitations below. EX1016, 5; Pozar, ¶122.

Limitation	Corresponding Limitation	Discussion <i>supra</i>
[14.PRE]	[1.PRE]	§VI.C.1.a
[14.a]	[1.a]	§VI.C.1.b
[14.o]	[1.j]	§VI.C.1.j

Wong meets the remaining limitations in claim 14 as follows.

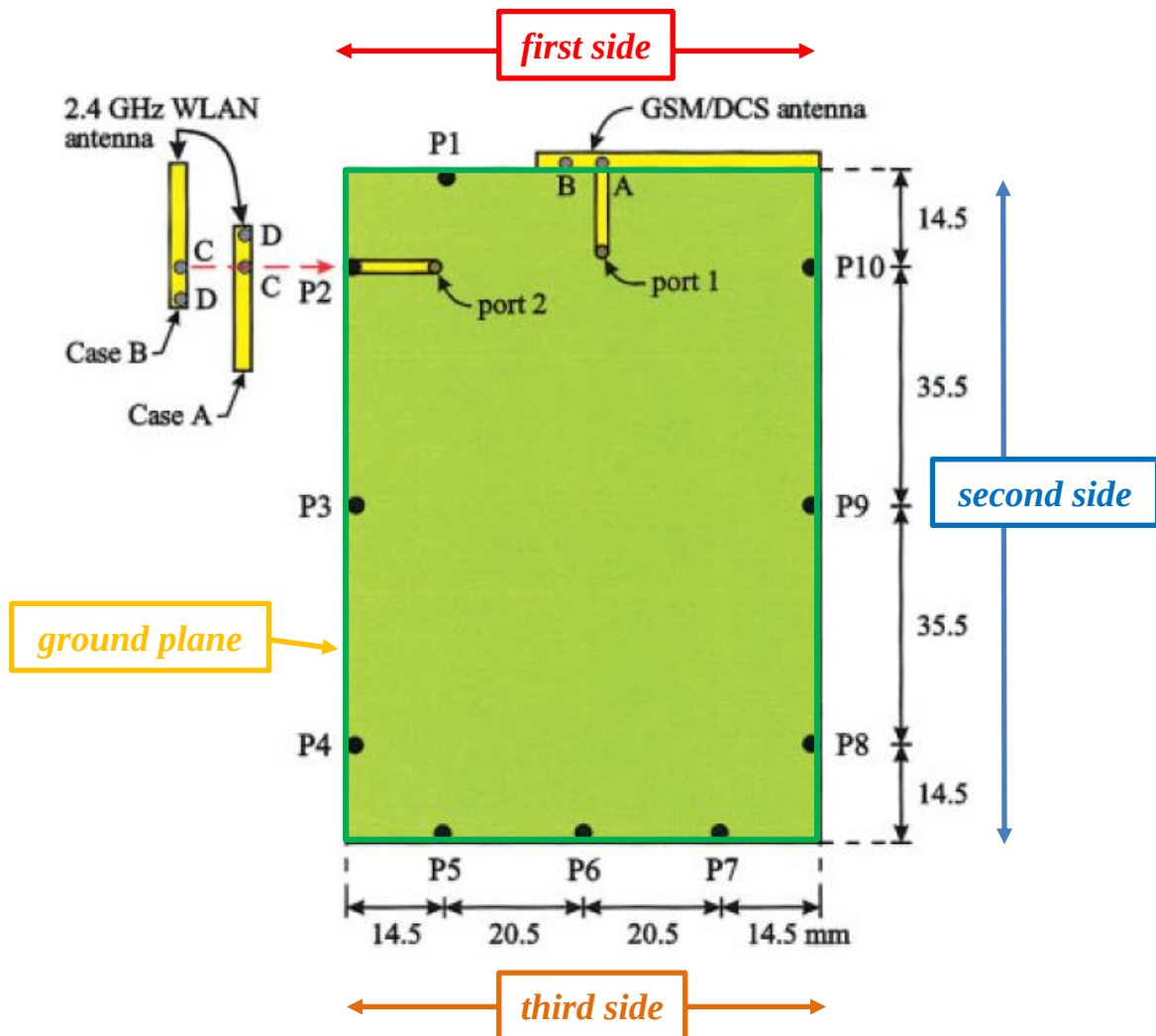
b. Limitation [14.b]

14.b	the ground plane is inscribed in a first rectangular area comprising a first side, a second side and a third side, a length of the second side being greater than a length of the first side and a length of the third side;
------	--

Wong's ground plane is inscribed in a 100mm×70mm rectangular area.

Supra §VI.C.1.c ([1.b]). The second side is 100mm; the first and third sides are 70mm. Wong, 348. The second side is longer than the first and third sides.

Wong, Figure (2) (annotated below); Pozar, ¶123.



c. Limitation [14.c]

14.c	a first antenna configured to transmit and receive electromagnetic waves corresponding to at least two frequency bands;
------	---

Wong meets [14.c] because Wong's GSM/DCS antenna is operable to transmit and receive in the GSM900 (890–960 MHz) and DCS1800 (1710–1880 MHz) frequency bands. Wong, 347.

Transmissions on these bands utilize electromagnetic waves. *Supra* §VI.C.1.f ([1.e]-[1.f]). Wong's GSM/DCS antenna is *configured to transmit and receive electromagnetic waves corresponding to at least two frequency bands* because, as discussed *supra* §VI.C.1.d (Limitation [1.c]), the GSM900 and DCS1800 bands both encompass uplink (transmit) and downlink (receive) communication. EX1009, 9; Pozar, ¶¶124-125.

d. Limitation [14.d]

14.d	the at least two frequency bands being used for mobile communication services;
------	--

Wong meets [14.d] because, as discussed *supra* §VI.C.1.e (Limitation [1.d]), the GSM900 (890–960 MHz) and DCS1800 (1710–1880 MHz) bands support cellular communications as used by mobile devices. Wong, 347.

e. Limitation [14.e]

14.e	a second antenna configured to operate in at least one frequency band;
------	--

Wong meets [14.e] for the reasons discussed *supra* §VI.C.8.b ([8.d]).

Wong, 347-348.

f. Limitation [14.f]

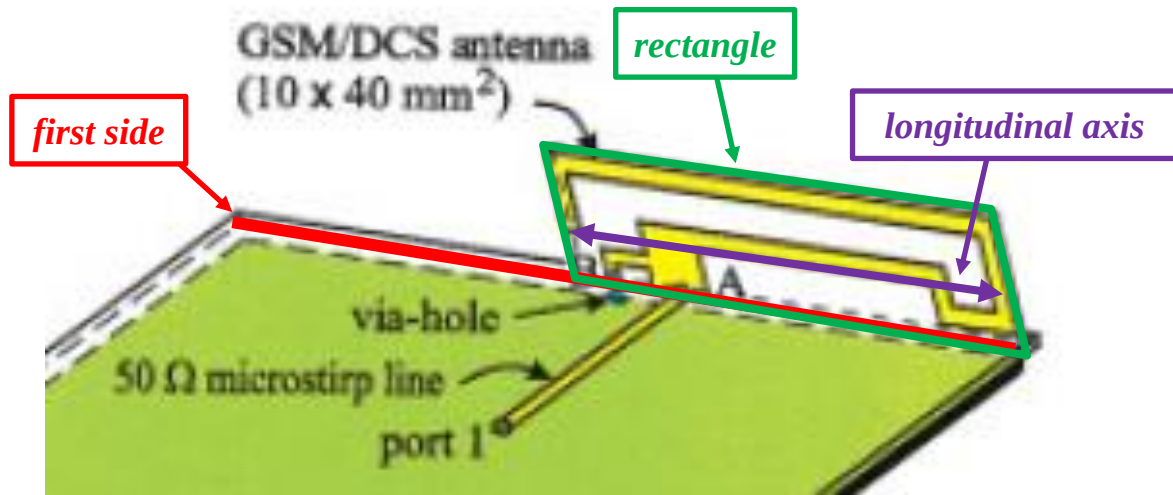
14.f	the at least one frequency band being different from the at least two frequency bands;
------	--

Wong meets [14.f] because Wong’s WLAN antenna operates in the 2.4 GHz ISM band (2400–2500 MHz), which is different from the GSM (890–960 MHz) and DCS (1710–1880 MHz) bands. Wong, 347-348; Pozar, ¶128.

g. Limitation [14.g]

14.g	the first antenna extends in a direction substantially parallel to the first side;
------	--

Wong meets [14.g] because the GSM/DCS antenna can be inscribed in a rectangle having a longitudinal axis parallel to a short edge (*first side*) of Wong’s ground plane. Wong, Figure 1(a) (annotated detail below); Pozar, ¶129; *supra* §VI.C.1.g ([1.g]).



h. Limitation [14.h]

14.h	the first antenna is proximate to the first side;
------	---

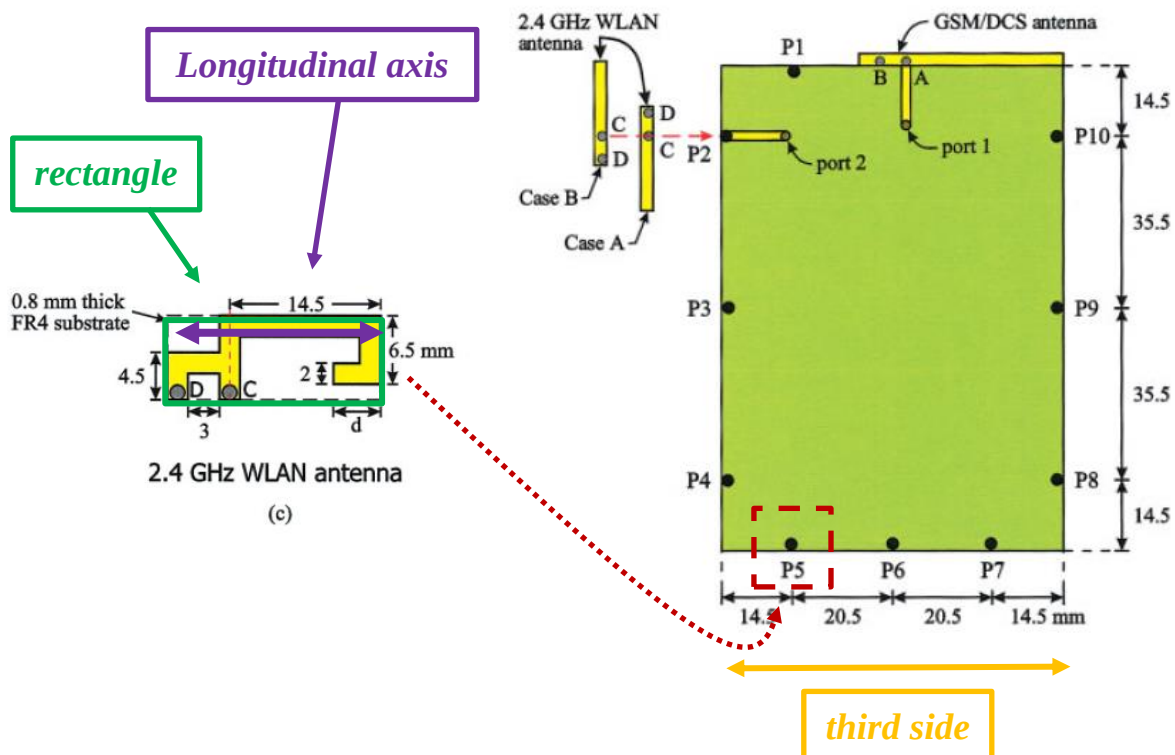
Wong meets [14.h] because the GSM/DCS antenna (“*first antenna*”) is “arranged to be fixed at the top edge of the system circuit board” (*i.e.*, the first side of the ground plane, as discussed *supra* §VII.B.1.b (Limitation [14.b])). Wong, 348; Pozar, ¶130.

i. Limitation [14.i]

14.i	the second antenna extends in a direction substantially parallel to the third side;
------	---

Wong meets [14.i] because the WLAN antenna, when positioned at location P5 of Figure 2, “*extends in a direction substantially parallel to*” the ground plane rectangle’s third side. Wong, Fig. 2 (annotated below with Fig. 1(c) inset); Pozar, ¶131.

Although Wong does not show the WLAN antenna's orientation when positioned at P5, POSAs would have understood that the WLAN antenna would be orientated so that both feeding point C and shorting point D were fixed at the system circuit board's lower edge (the “*third side*” in annotated Figure 2 below). With that orientation, the WLAN antenna can be inscribed in a rectangle having a longitudinal axis that is parallel to the third side of Wong's ground plane. Wong, Figs. 1(c), 2 (annotated below); Pozar, ¶132.



j. Limitation [14.j]

14.j	the second antenna is proximate to the third side;
------	--

Wong meets [14.j] because the WLAN antenna at location P5 is fixed at the system circuit board's lower edge, as discussed *supra* §VII.B.1.i ([14.i]), which is “*proximate to the third side.*” Wong, Fig. 2; Pozar, ¶133.

k. Limitation [14.k]

14.k	the second antenna is inscribed in a second rectangular area;
------	---

Wong meets [14.k] because the WLAN antenna is inscribed in a rectangular area. *Supra* §VII.B.1.i ([14.i]).

l. Limitation [14.l]

14.l	a sum of a length and a width of the second rectangular area is smaller than a quarter of an operating wavelength of the second antenna;
------	--

Wong meets [14.l] because the rectangular area inscribing the WLAN antenna is 8mm×20.5mm (Wong, 348), so “*a sum of a length and a width of the second rectangular area*” is **28.5mm**. Pozar, ¶135.

An “operating wavelength” (λ , in mm) of an antenna depends on its operating frequency, as follows:

$$\lambda = \frac{c}{f},$$

where c = speed of light in vacuum ($\approx 3 \times 10^{11}$ mm/sec), and f = frequency (Hz).

EX1027, 15-16; Pozar, ¶136 (citing corroborating EX1029, 6:27-29). Thus, 1/4 of the WLAN antenna's operating wavelengths at 2400-2484 MHz (Wong, 347) are:

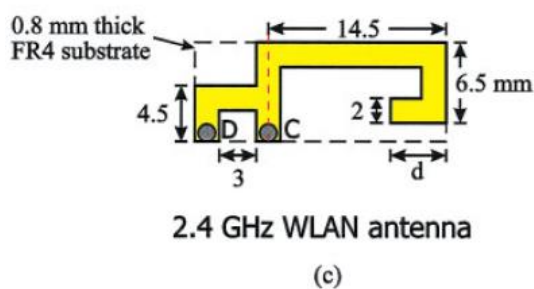
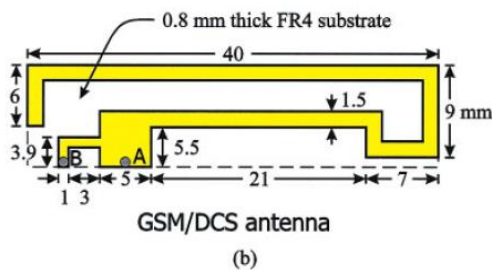
Frequency (MHz)	Wavelength (mm)	1/4 Wavelength (mm)
2400-2484	120.8-125.0	30.2-31.25

Wong meets [14.1] because 28.5mm is less than 30.2 mm.

m. Limitation [14.m]

14.m	a geometry of the first antenna being different than a geometry of the second antenna;
------	--

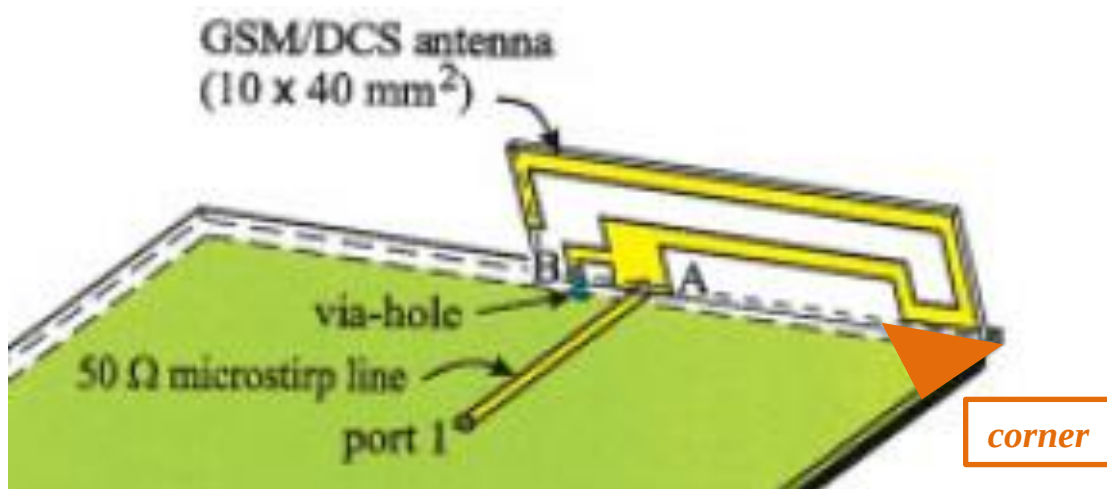
Wong meets [14.m] because the GSM/DCS antenna's geometry is “different” from the WLAN antenna's geometry. Wong, Figs. 1(b)-(c) (below); Pozar, ¶137.



n. Limitation [14.n]

14.n	at least one of the first antenna and the second antenna is proximate to a corner of the first rectangular area; and
------	--

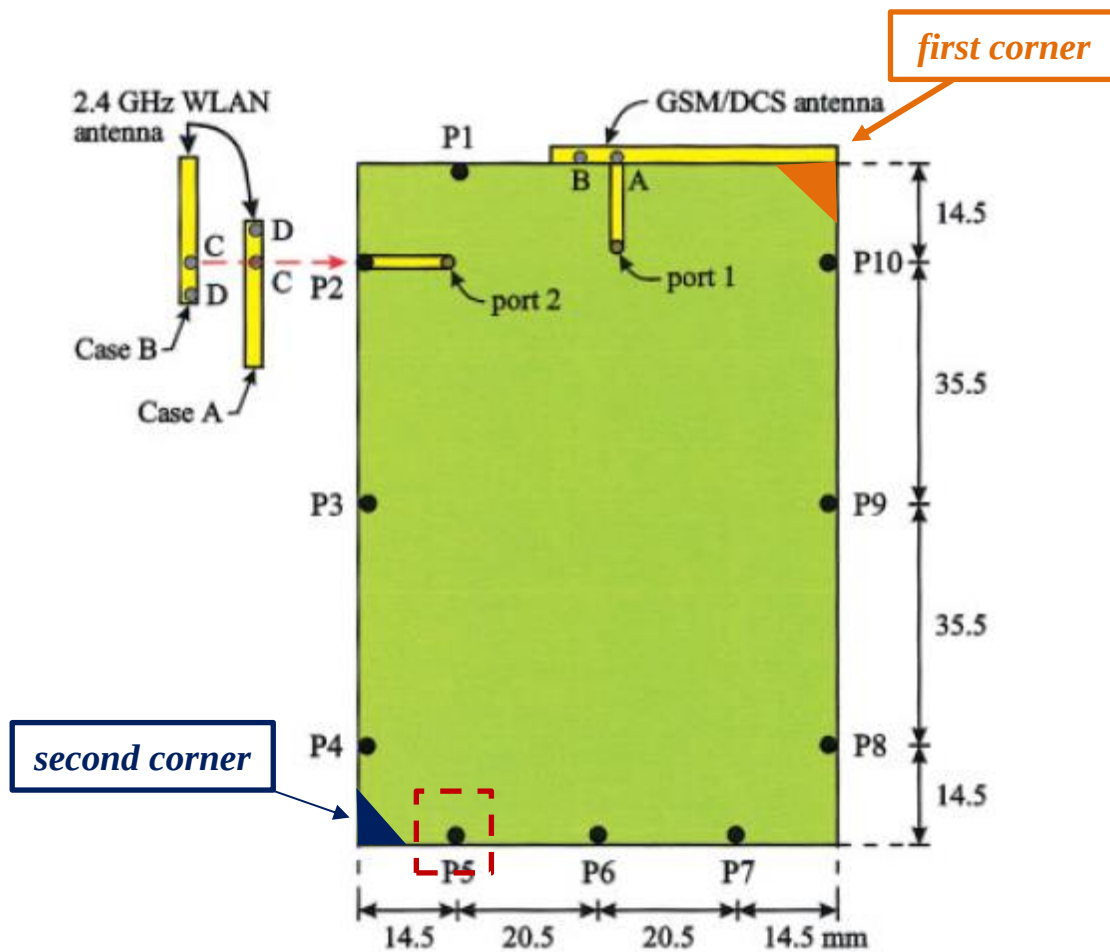
Wong meets [14.n] because Wong's GSM/DCS antenna is "*proximate to a corner*" of the rectangular area inscribing Wong's ground plane. Wong, Fig. 1(a) (annotated detail below). Pozar, ¶138.



2. Claim 15

15	[Claim 14's device], wherein the first antenna is proximate to a first corner of the first rectangular area and the second antenna is proximate to a second corner of the first rectangular area.
----	---

Wong meets claim 15 because, as discussed *supra* §VII.B.1.n ([14.n]), the GSM/DCS antenna is proximate to a first corner of the rectangular area inscribing Wong's ground plane. When positioned at P5 the WLAN antenna is proximate to a "second corner" of the rectangular area. *Supra* §VI.C.3 (claim 3); Wong, Figure 2 (annotated below); Pozar, ¶139.



3. Claims 17, 19

Wong meets claims 17 and 19 for the reasons Wong+Lee meets the corresponding claims below. EX1016, 3-4; Pozar, ¶140.

Claim	Corresponding Claim	Discussion <i>supra</i>
17	7	§VI.C.1.a
19	6	§VI.C.1.b

4. Claim 18

18	[Claim 14's device], wherein the first antenna is an antenna selected from the group comprising: a monopole antenna, an inverted-F antenna, a patch antenna, and a planar inverted-F antenna.
----	---

Wong meets claim 18 because Wong's GSM/DCS antenna is a planar inverted-F antenna (PIFA). Wong, 347 ("Both the **GSM/DCS** and WLAN **antennas are printed PIFAs** with compact sizes."); *supra* §VI.C.6 (claim 6).

VIII. GROUND 2: GAUCHER RENDERS OBVIOUS CLAIMS 1-10, 12-13

A. Gaucher (EX1012)

Gaucher discloses "a laptop computer 300" comprising "a plurality of multiband antennas 310, 320" (*i.e.*, *first antenna 320* and *second antenna 310*) "mounted to" the laptop display's metal support frame 355. Gaucher, [0025], [0032], Fig. 3 (annotated below). The laptop's support frame 355 "is used as a *ground plane* for the antennas." Gaucher, [0032].

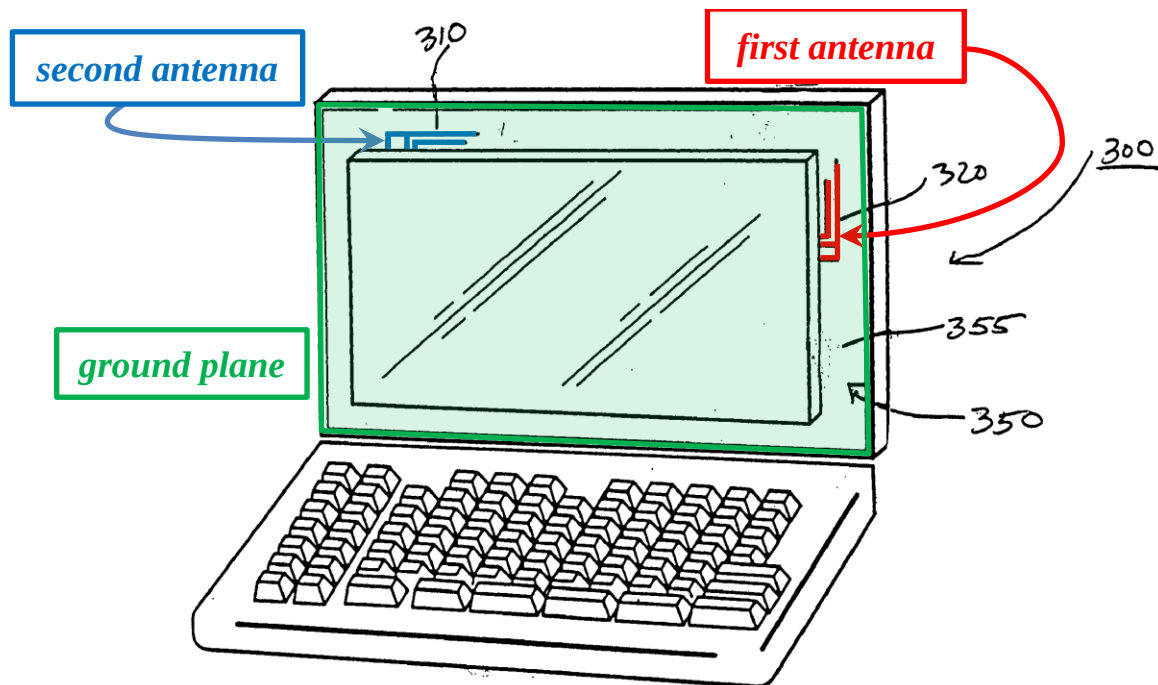


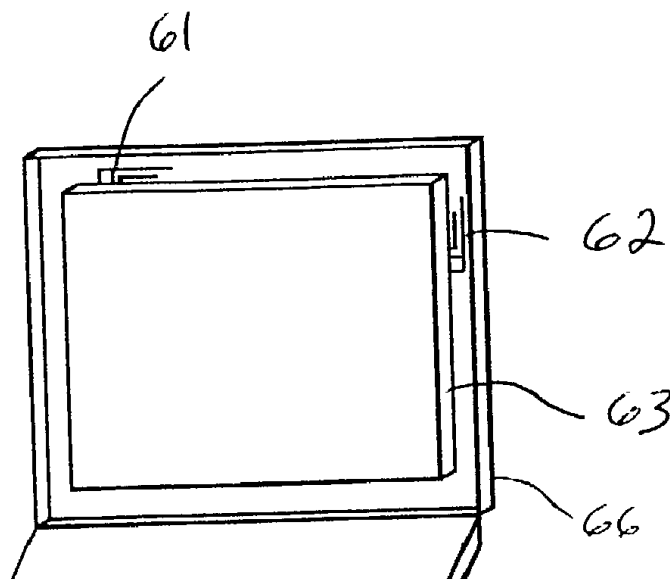
FIG. 3

Both antennas are mounted such that “the plane of each... is substantially parallel to the plane, or along the plane, of the metal support frame 355.” Gaucher, [0025].

Gaucher also teaches that it was beneficial to improve existing laptops with multiband “WLAN” capabilities (*e.g.*, “working at 2.4 GHz and 5 GHz”) to include a multiband antenna that supports “WWAN” capabilities (*e.g.*, “cell phone connections” at 800 MHz and 1800 MHz). Gaucher, [0026]-[0030] (“[I]t would be advantageous in wireless applications to increase the mobility of the laptop computers” by integrating “wireless wide area network (WWAN) connectivity often used in cell phone connections on the road.”); Pozar, ¶143.

To this end, Gaucher says its laptop embodiments “include extensions of the dual-band and tri-band integrated antenna designs described in” several incorporated patent applications, including Serial No. 10/318,816 (published as Gaucher848 (EX1013)). Gaucher, [0024], [0030]. *Arbutus Biopharma v. ModernaTX*, 65 F.4th 656, 662–63 (Fed. Cir. 2023) (“When a reference or material from various documents is incorporated, they are effectively part of the host document as if they were explicitly contained therein.”) (cleaned up); *Telemac Cellular v. Topp Telecom*, 247 F.3d 1316, 1329 (Fed. Cir. 2001) (similar). POSAs would have thus been motivated to look to Gaucher’s incorporated references for examples of laptops and antennas to understand Gaucher’s teachings. Pozar, ¶144.

Incorporated Gaucher848 discloses a similar laptop embodiment with two multiband WLAN “antennas (61, 62) mounted to a metallic support frame (63) of the laptop display unit” where “the plane of each... antenna (61, 62) is substantially parallel to the plane of the display frame (63).” Gaucher848, [0009]-[0011], [0049], [0056]; *compare* Gaucher848, Fig. 6a (below detail) *with* Gaucher, Fig. 3.



Gaucher848 expands on Gaucher’s disclosure, teaching that WLAN antenna 61 (*i.e.*, antenna 310) “can be located on the right side of the upper portion of the frame (63) (as opposed to the left side of the upper portion of the frame as shown)” and that antenna 62 (*i.e.*, antenna 320) can be positioned on the left side, rather than the right side, of the display frame (63). Gaucher848, [0049].

1. Gaucher’s WWAN Antenna

Gaucher discloses a quadband WWAN (cellular) antenna “covering the four most popular [cellular] frequency bands, namely,” 824-894 MHz (AMPS/GSM850), 880-960 MHz (GSM900), 1710-1880 MHz (GSM1800), and 1850-1990 MHz (PCS1900). Gaucher, [0030], [0046], Figs. 5A-B; EX1009, 9; EX1001, 2:4-10 (defining “GSM850, GSM900, GSM1800... PCS1900” as “mobile communication services”); *see also supra* §VI.A.1 (Wong) (discussing GSM/DCS overlapping frequency bands).

2. Gaucher848's WLAN Antenna

Incorporated Gaucher848 discloses “various embedded tri-band antennas” that “operate in the 2.4-2.5 GHz, 5.15-5.35 GHz and 5.47-5.85 GHz bands” used for WLAN communication standards. Gaucher, [0024], [0026]; Gaucher848, [0008]-[0009], [0011], [0056], Figs. 8, 9, 10; EX1001, 9:46-60 (defining “wireless connectivity standards” as “allocated in one or more frequency bands,” *e.g.*, the “2.4 GHz ISM band (2400-2500 MHz), or 5.7 GHz ISM band (5650-5925 MHz)”); EX1017, 3 (defining “wireless LAN” using “the 5.15–5.25, 5.25–5.35 and 5.725–5.825 GHz unlicensed national information infrastructure (U-NII) bands, as regulated in the United States by the Code of Federal Regulations, Title 47, Section 15.407.”); EX1018, 11 (describing use of “the 2.4 GHz band designated for ISM applications.”); EX1015, 36069-36070 (defining 2.4-2.5 GHz for use by “ISM equipment”).

3. Gaucher's WWAN+WLAN Laptop Embodiment

As discussed *supra* §VIII.A, Gaucher teaches various embodiments of “integrated multiband antenna frameworks” mounted “on a laptop display unit.” Gaucher, [0025], [0030], Fig. 3. These “antenna frameworks” include “dual-band and tri-band integrated antenna designs described in” both Gaucher (WWAN antenna) and incorporated Gaucher848 (WLAN antenna). Gaucher, [0030]; Pozar, ¶149.

POSAs would have found it obvious to implement Gaucher Figure 3's laptop with both WWAN and WLAN antennas. Gaucher identifies a known problem: laptops "equipped with integrated wireless local area network (WLAN)" were "increasingly being used on the road and away from the hot spot locations." Gaucher, [0026]-[0027]. According to Gaucher, it would have been "advantageous in wireless applications to increase the mobility of the laptop computers" by including its "quadband antenna covering the four most popular" frequency bands to integrate "wireless wide area network (WWAN) connectivity often used in cell phone connections on the road." Gaucher, [0027], [0030]; Pozar, ¶150.

POSAs would thus have found it obvious to implement Gaucher's laptop with both WWAN and WLAN antennas to expand user wireless connectivity. Gaucher recognized the user need for such laptops prior to June 2005, and laptops supporting both WWAN and WLAN were in the market prior to June 2005, *e.g.*, the Dialogue Flybook. EX1035 (press release describing public demonstration of Dialogue Flybook in June 2004); EX1028, 13-15, (Flybook manual showing cellular and Bluetooth/WLAN capabilities). Thus, POSAs would have understood Gaucher's disclosure to teach a laptop embodiment including one WWAN antenna (*e.g.*, 320, 62) arranged on the display frame's right or left side and one WLAN antenna (*e.g.*, 310, 61) arranged on the frame above the display. Pozar, ¶151. This embodiment renders claims 1-8, 10, and 12-13 obvious, as shown below.

B. Analysis

1. Claim 1

a. Preamble

1.PRE	A wireless handheld or portable device comprising:
-------	--

If [1.PRE] is limiting, Gaucher meets it because Gaucher teaches “a laptop computer 300” shown in Figure 3 (below). Gaucher, [0025]. Gaucher’s laptop computer 300 is a “*portable device*.” Gaucher, [0001] (describing “portable devices such as laptop computers and cellular phones”). Per the ’458 patent, a laptop is also a “*handheld device*.” EX1001, 1:34-41, 8:39-47.

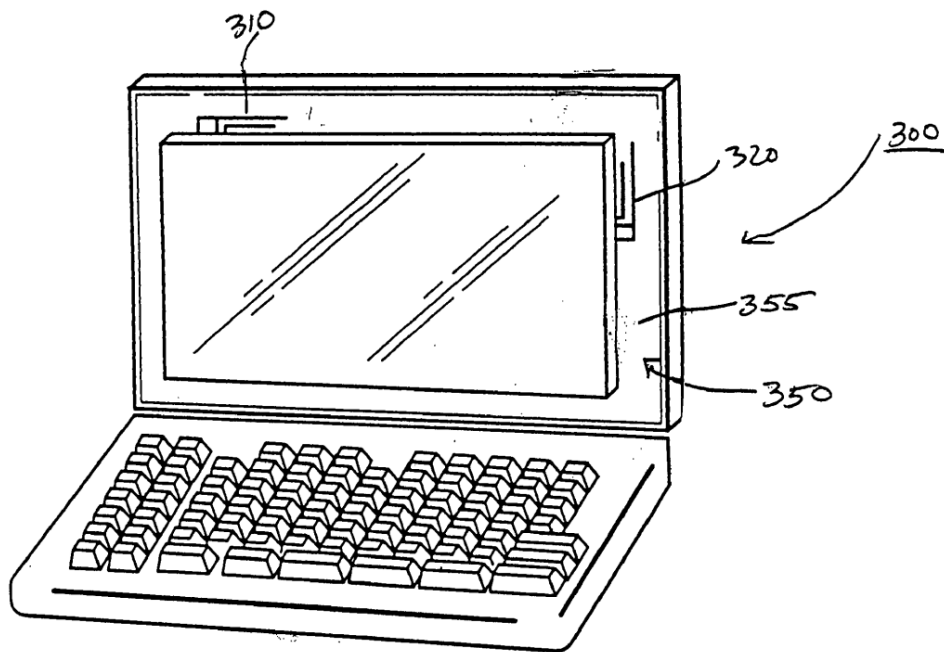


FIG. 3

Gaucher's laptop is *a wireless handheld/portable device* because it includes “a plurality of multiband antennas 310, 320 mounted on the support frame 355 of the laptop display unit 350” and it was known that laptops like Gaucher's were “used on the road and away from [WLAN] hot spot locations.” Gaucher, [0025]-[0027].

b. Limitation [1.a]

1.a	a ground plane;
-----	-----------------

Gaucher's laptop includes *a ground plane* implemented as “support frame 355 of the laptop display unit 350.” Gaucher, [0025]. According to Gaucher, “the metal frame of the display unit is used as *a ground plane* for the antennas,” *e.g.*, “multiband antennas 310, 320 mounted on the support frame 355.” Gaucher, [0025], [0032], Fig. 3 (annotated below); Pozar, ¶154.

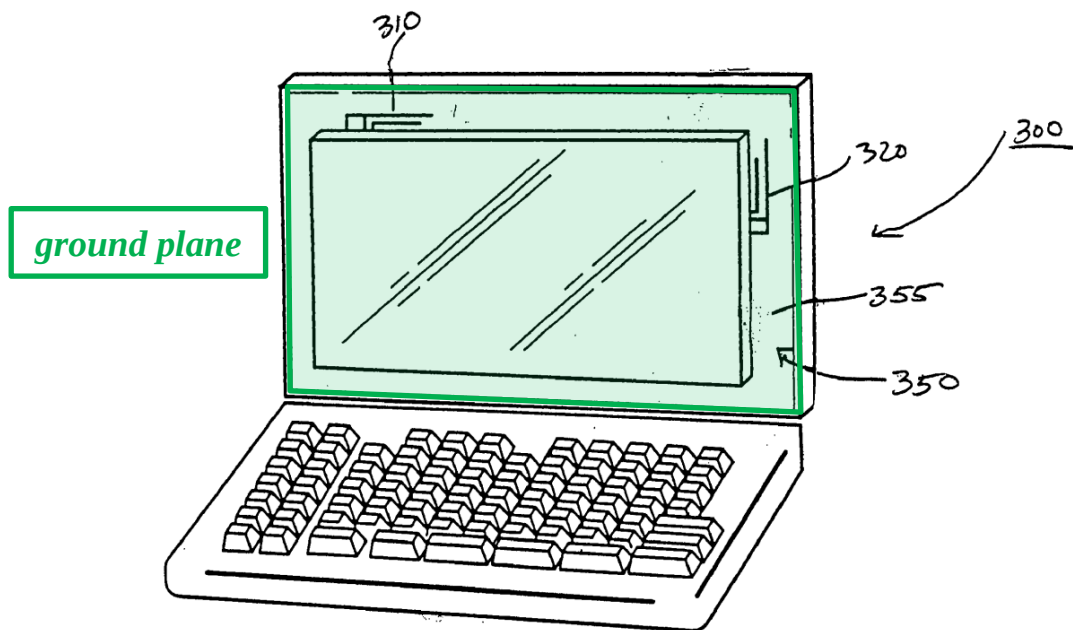


FIG. 3

c. Limitation [1.b]

1.b	the ground plane is inscribed in a rectangular area comprising a first side and a second side, a length of the second side being greater than a length of the first side;
-----	---

In Gaucher's Figure 3 (annotated below), **support frame 355** (*the ground plane*) *inscribes an area* supporting a *rectangular* laptop display like the display in Application No. 09/076,557 (published as Asano (EX1024)) where "display panel 13" is "a plate approximately **rectangular**." Asano, [0083]; Gaucher, [0024] (incorporating Asano by reference); Pozar, ¶155.

While Gaucher does not provide the display frame's dimensions, such rectangular laptops were conventional, *e.g.*, the IBM ThinkPad T42 (EX1019) having a *rectangular* support frame where a *length of the second side* (approximately 12.2 in) is *greater than a length of a first side* (approximately 10.0 in) for a 14.1 in display. EX1019, 7; Pozar, ¶156; see also EX1028, 22 (describing the Dialogue Flybook supporting a 1024×600 resolution, 8.9 in. display).

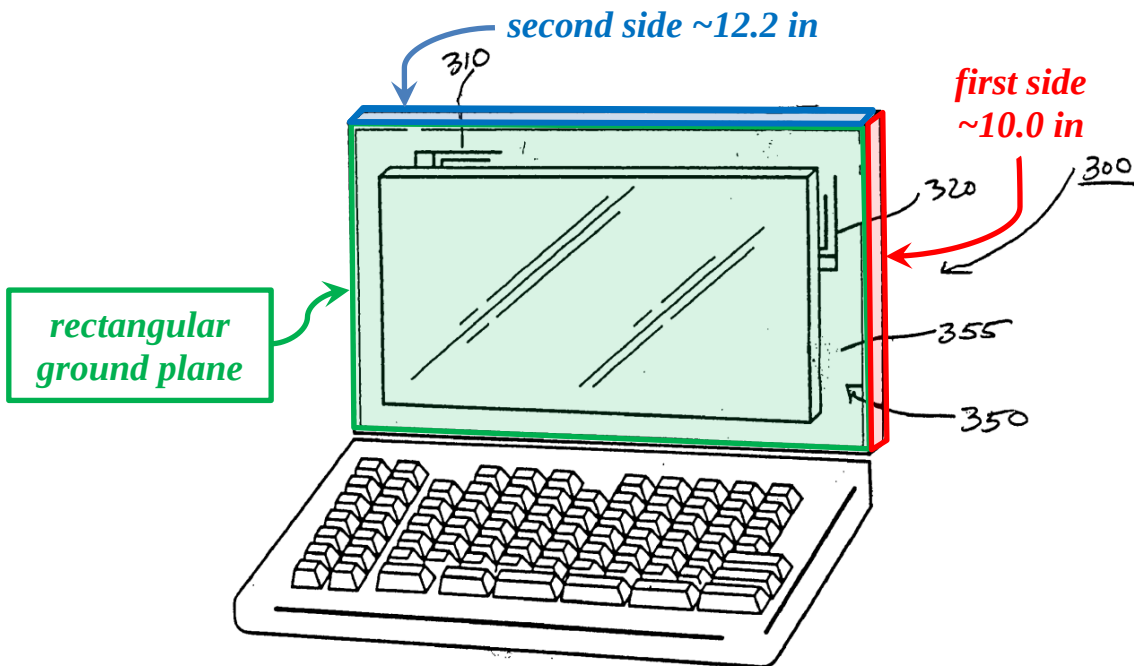


FIG. 3

d. Limitation [1.c]

1.c	a first antenna configured to transmit and receive electromagnetic waves corresponding to at least three frequency bands;
-----	---

Gaucher's laptop computer 300 includes "a plurality of multiband antennas 310, 320 mounted on the support frame 355 of the laptop display unit 350."

Gaucher, [0025], Fig. 3 (annotated below). Multiband antenna 320 is a *first antenna*. Pozar, ¶157.

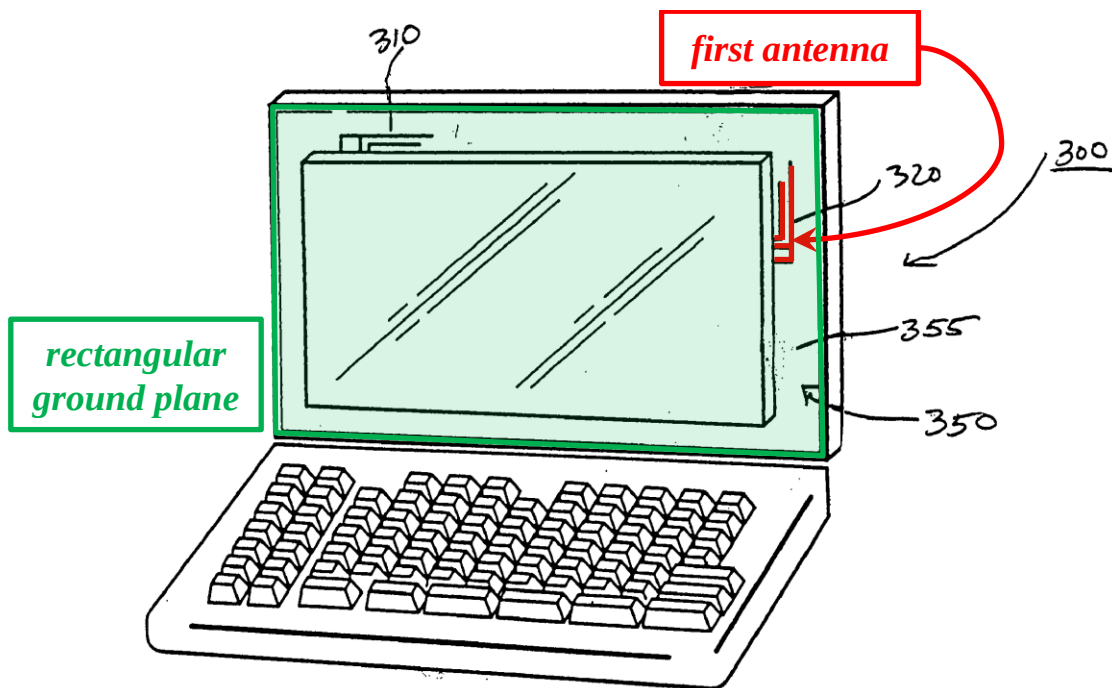


FIG. 3

Gaucher's **antenna 320** can be "a compact-sized *quadband antenna* covering the four most popular frequency bands, namely, 824-894 MHz [e.g., GSM850]... 880-960 MHz [e.g., GSM900 / extended GSM900]... 1710-1880 MHz [e.g., GSM1800 or DCS1800]... and 1850-1990 MHz [e.g., PCS1900]...." Gaucher, [0030]. A POSA would have understood that "covering" these frequency bands means the antenna supports both uplink and downlink communications (*i.e., transmit and receive*), as discussed *supra* §VI.C.1.d (Ground 1A, [1.c]). EX1009, 9; Pozar, ¶158. Gaucher's antenna 320 (*i.e., a first antenna*), implemented as a quadband antenna, is thus "*configured to transmit and receive electromagnetic waves corresponding to at least three frequency bands.*"

e. Limitation [1.d]

1.d	the at least three frequency bands being used for mobile communication services;
-----	--

According to the '458 patent, a "*frequency band being used for mobile communication services*" includes GSM850, GSM900, GSM1800, and PCS1900. EX1001, 2:4-10. GSM850 operates in the 824-894 MHz frequency range, GSM900 operates in the 890-960 MHz range, GSM1800 operates in the 1710-1880 MHz range, and PCS1900 operates in the 1850-1990 MHz range. EX1009, 9; EX1001, 9:26-43 (defining "mobile or cellular communication standards" as operating in, *e.g.*, "the 810 MHz-960 MHz" or "1710 MHz-1990 MHz" regions).

As discussed *supra* §0 ([1.c]), Gaucher’s antenna 320 implementing the quadband antenna *transmits and receives* in “the four most popular frequency bands” in 2004 for mobile communications, *i.e.*, 824-894 MHz (GSM850), 890-960 MHz (GSM900), 1710-1880 MHz (GSM1800), and 1850-1990 MHz (PCS1900). Gaucher, [0030]; EX1009, 9; Pozar, ¶160. Thus, implementing Gaucher’s antenna 320 as a quadband antenna is “*a first antenna configured to transmit and receive*” in “*at least three frequency bands being used for mobile communication services.*” Pozar, ¶160.

f. Limitation [1.e]

1.e	a second antenna configured to receive electromagnetic waves corresponding to at least one frequency band;
-----	--

As discussed *supra* §0 ([1.c]), Gaucher’s laptop computer 300 includes “a plurality of multiband antennas 310, 320 mounted on the support frame 355 of the laptop display unit 350,” where antenna 320 is *a first antenna*. Gaucher, [0025], Fig. 3 (annotated below). Multiband antenna 310 is *a second antenna*. Pozar, ¶161.

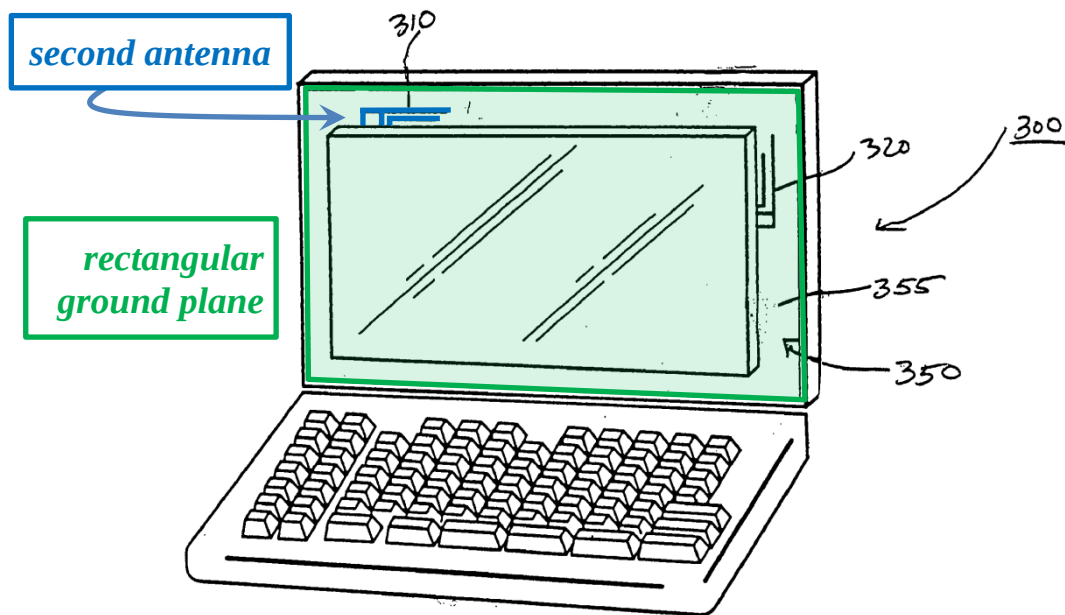


FIG. 3

Antenna 310 can be “integrated antenna designs described in the above-incorporated patent applications and patents,” such as the tri-band antenna described in Gaucher848 that “operate[s] in the 2.4-2.5 GHz, 5.15-5.35 GHz and 5.47-5.85 GHz bands.” Gaucher, [0030], [0024] (incorporating Gaucher848 by reference); Gaucher848, [0011]; *supra* §VIII.A.2 (Gaucher848). Gaucher848’s antenna *receives electromagnetic waves, e.g.*, when operating an 802.11b wireless connectivity service that transmits and receives data in the 2.4–2.84 GHz range to “provide up to 11 Mbps data rate.” EX1018, 41, 51; Gaucher848, [0009], [0013]. Likewise, when operating an 802.11a service, Gaucher848’s antenna transmits and receives data in the 5.15–5.25, 5.25–5.35 and 5.725–5.825 GHz ranges. EX1017,

3-4, 24, Fig. 118 (transmitter and receiver block diagram); Gaucher848, [0009], [0013]; Pozar, ¶162.

Gaucher’s antenna 310 (*second antenna*) implemented as Gaucher848’s tri-band antenna, is thus “*a second antenna configured to receive electromagnetic waves corresponding to at least one frequency band.*” Pozar, ¶163.

g. Limitation [1.f]

1.f	the at least one frequency band being used for wireless connectivity services;
-----	--

Gaucher meets [1.f] in at least four ways.

As discussed *supra* §§VIII.A.2 (Gaucher848), VIII.B.1.f (Limitation [1.e]), Gaucher’s [antenna 310](#) implemented as Gaucher848’s tri-band wireless antenna is “*a second antenna*” included in Gaucher’s laptop 300 that “operate[s] in the 2.4-2.5 GHz, 5.15-5.35 GHz and 5.47-5.85 GHz bands.” Gaucher, [0030], [0024], [0026]; Gaucher848, [0008]-[0009], [0011], [0056], Figs. 9, 10.

i. 2.4 GHz ISM band

According to the ’458 patent, a “*frequency band being used for wireless connectivity services*” includes “WLAN or Bluetooth” services that operate, *e.g.*, in the “2.4 GHz ISM band (2400-2500 MHz).” EX1001, 2:16-20, 9:46-60. Thus, Gaucher’s [antenna 310](#) (*i.e.*, *a second antenna*) implemented as Gaucher848’s tri-

band antenna operating in the 2.4 GHz ISM frequency band meets Limitation [1.f].
Pozar, ¶166.

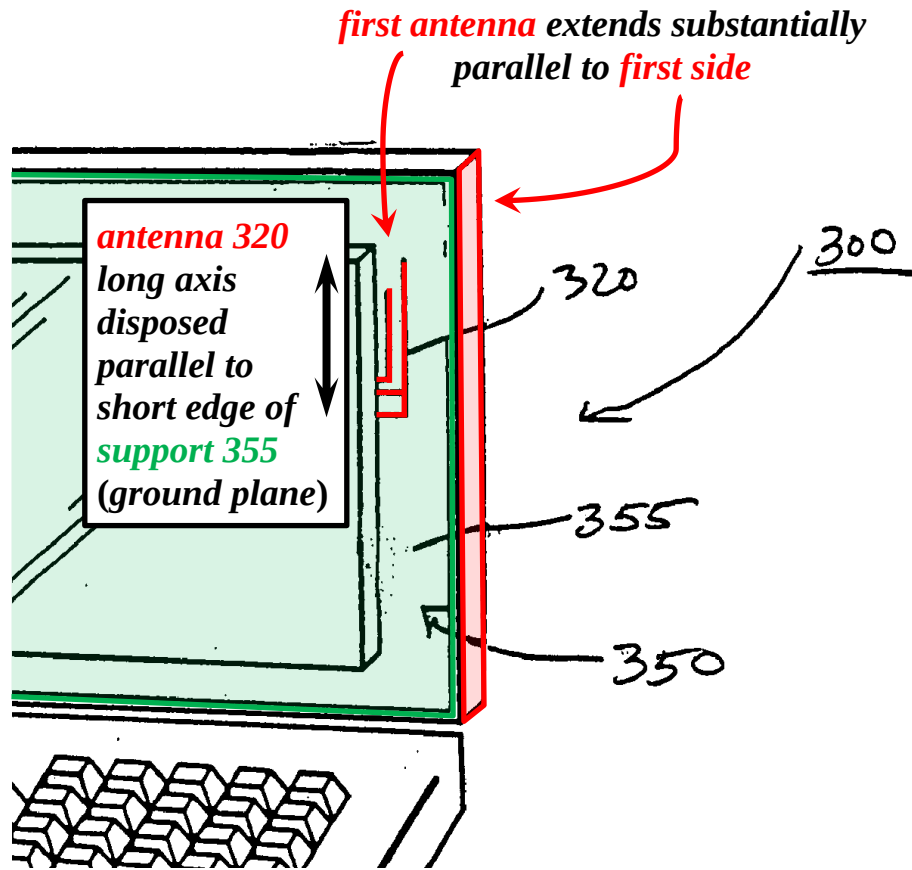
ii. 5 GHz ISM bands

IEEE Std. 802.11a defines the high-speed physical layer for Wireless LAN in “the 5.15–5.25, 5.25–5.35 and 5.725–5.825 GHz ***unlicensed national information structure (U-NII) bands***, as regulated in the United States by the Code of Federal Regulations, Title 47, Section 15.407.” EX1017 (802.11a-1999), 3; EX1031, 63 Fed. Reg. 40831, 40836-40837 (July 31, 1998). As Gaucher’s tri-band antenna, Gaucher’s antenna 310 works in each of these three bands and, for each, separately meets Limitation [1.f]. Pozar, ¶167.

h. Limitation [1.g]

1.g	the first antenna extends in a direction substantially parallel to the first side;
-----	--

Gaucher meets [1.g] because antenna 320 (*first antenna*) is “mounted to the metal support frame 355... ***substantially parallel to the plane***, or along the plane, ***of the metal support frame 355***,” as shown in Figure 3 (annotated detail below). Gaucher, [0025], Fig. 3. Antenna 320 has a long axis that, when the antenna is so mounted, is disposed *substantially parallel* to the right-short side (*first side*) of metal support frame 355 (e.g., *ground plane*, Limitation [1.a]-[1.b]), thus meeting Limitation [1.g]. Gaucher, [0025], Fig. 3; Pozar, ¶168.



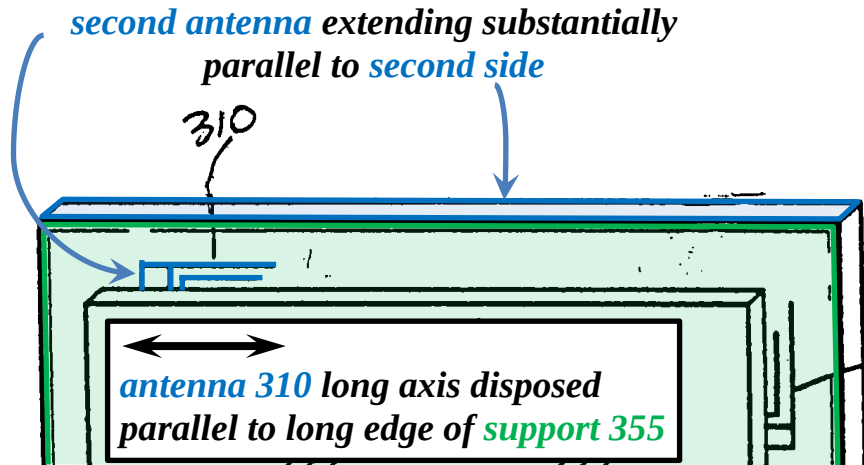
i. Limitation [1.h]

1.h	the second antenna extends in a direction substantially parallel to the second side;
-----	--

Gaucher meets [1.h] because antenna 310 (second antenna) is “mounted to the metal support frame 355...*substantially parallel to the plane*, or along the plane, *of the metal support frame 355*,” as shown in Figure 3 (annotated detail below). Gaucher, [0025], Fig. 3. Like antenna 320, antenna 310 has a long axis that, when mounted to metal support 355 as shown in Figure 3 and described in Gaucher, is disposed *substantially parallel* to the top-long side (second side) of

support 355 (*ground plane*, Limitation [1.a]-[1.b]), thus meeting Limitation [1.h].

Gaucher, [0025], Fig. 3; Pozar, ¶169.



j. Limitation [1.i]

1.i	the first antenna is arranged substantially close to the first side; and
-----	--

The '458 specification describes "component 2210" as "***substantially close*** to a corner" of a "shorter edge[]" of PCB 2300[.]" EX1001, 23:45-52. The '458 patent never identifies Figure 23C as drawn to scale or quantifies a measurement for "***substantially close.***"

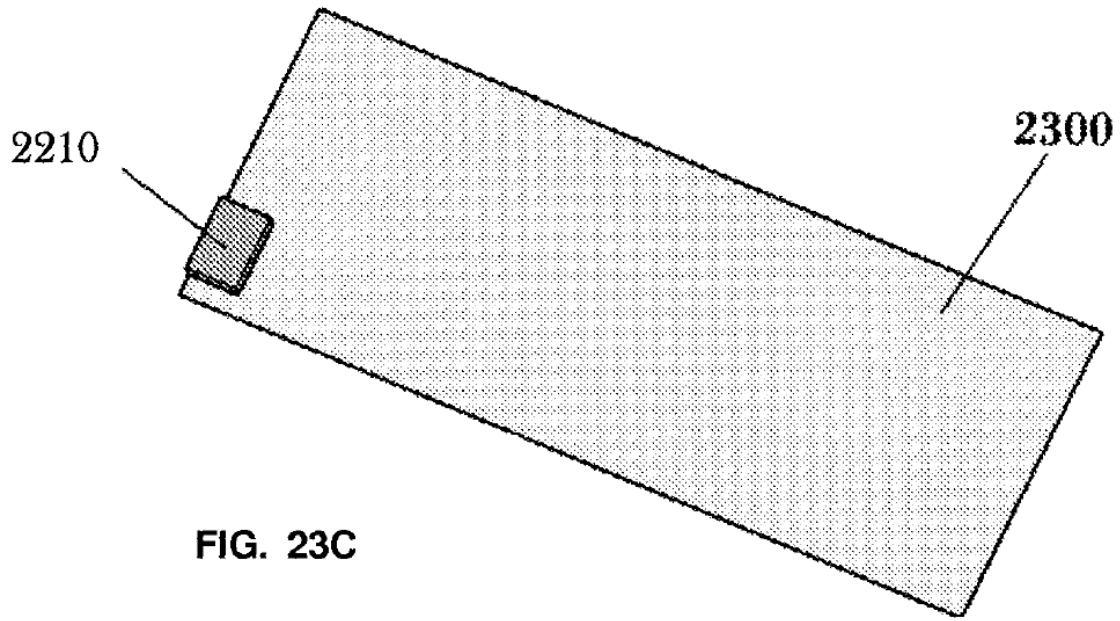
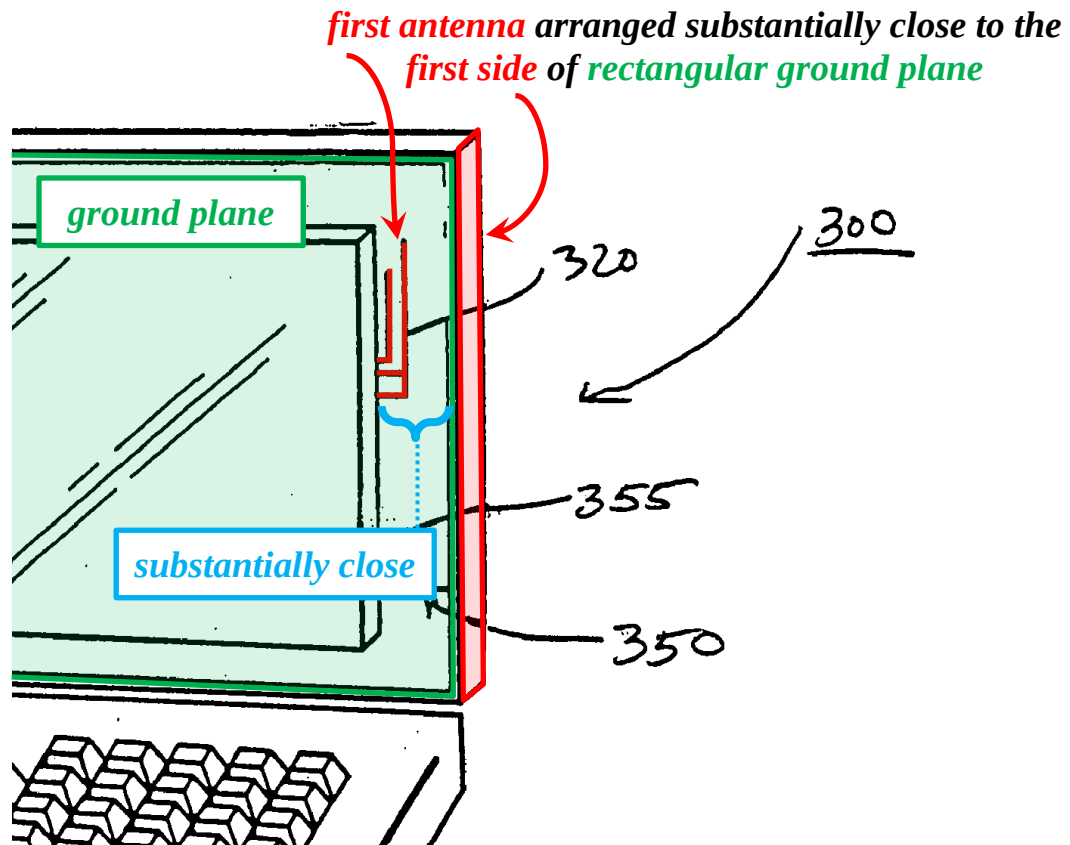


FIG. 23C

Gaucher meets [1.i] because **antenna 320** (*first antenna*) is “embedded... on a laptop display unit” by being “mounted to the metal **support frame 355**” between the edge of the display and the right side (*first side*) of the support frame, as shown in Figure 3 (annotated detail below). Gaucher, [0025], Fig. 3; Pozar, ¶171.



k. Limitation [1.j]

1.j	the first antenna and the second antenna are located internally within the wireless handheld or portable device.
-----	--

Gaucher teaches that its antenna 310 (i.e., *the second antenna*) and antenna 320 (i.e., *the first antenna*) are both “embedded antennas on a laptop display unit” by being “mounted on the support frame 355 of the laptop display unit 350.”

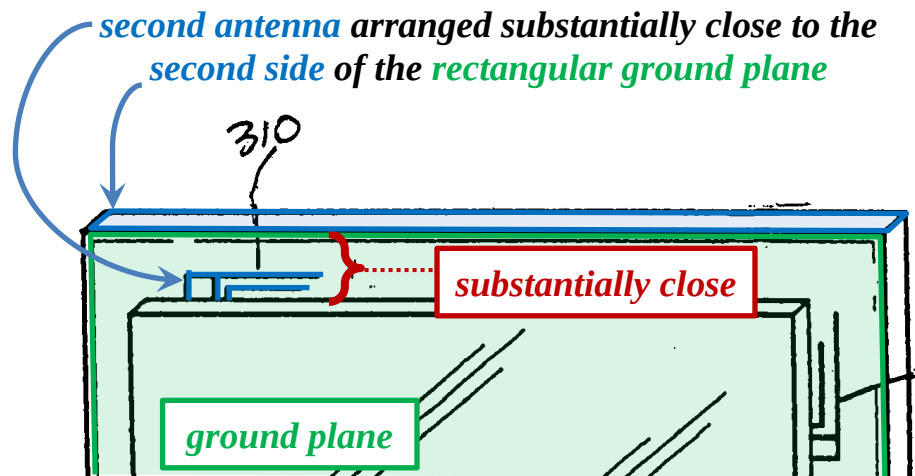
Gaucher, [0025], Fig. 3. Since Gaucher’s antennas are both “embedded” on the support frame, they are both “*located internally within the wireless handheld or portable device.*” Pozar, ¶172.

2. Claim 2

2	[Claim 1's device], wherein the second antenna is arranged substantially close to the second side.
---	--

As explained for Limitation [1.i], the '458 specification never quantifies “*substantially close*.” *Supra* §VIII.B.1.j (Limitation [1.i]).

Gaucher meets claim 2 because, antenna 310 is “embedded... on a laptop display unit” by being “mounted to the metal support frame 355” between the display’s top edge and the top-edge (*second side*) of the support frame, “[a]s shown in Figure 3” (annotated detail below). Gaucher, [0025], Fig. 3; Pozar, ¶174.



3. Claim 3

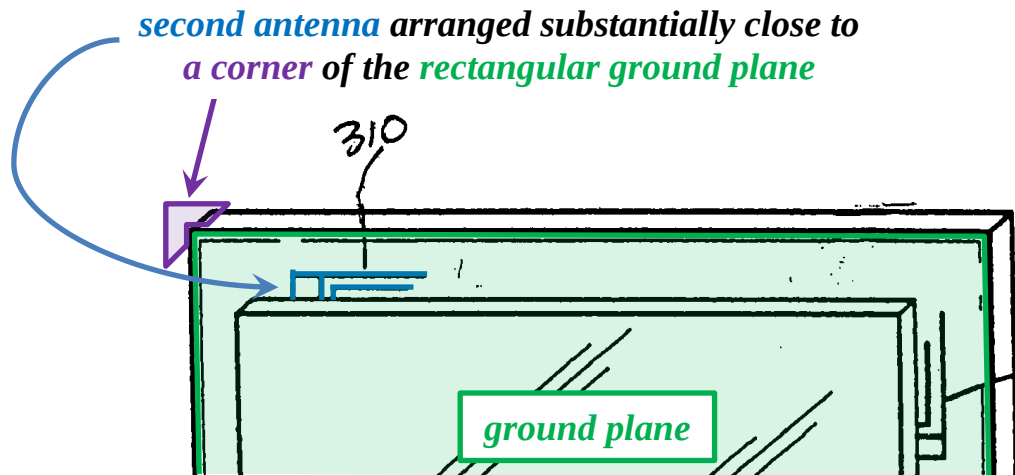
3	[Claim 2's device], wherein the second antenna is arranged substantially close to a corner of the rectangular area.
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As explained for limitation [1.i], the '458 patent never quantifies “*substantially close*.” *Supra* §VIII.B.1.j (Limitation [1.i]).

Gaucher's antenna 310 is shown in Figure 3 as mounted *substantially close* to the *second side* (e.g., top side) of support frame 355 (defining a ground plane rectangle). Gaucher, [0025], [0030], [0032], Fig. 3; *supra* §VIII.B.2 (Claim 2).

Gaucher's Figure 3 (annotated detail below) depicts antenna 310 arranged *substantially close* to the *top-left corner* of support frame 355's rectangular area.

Pozar, ¶176.

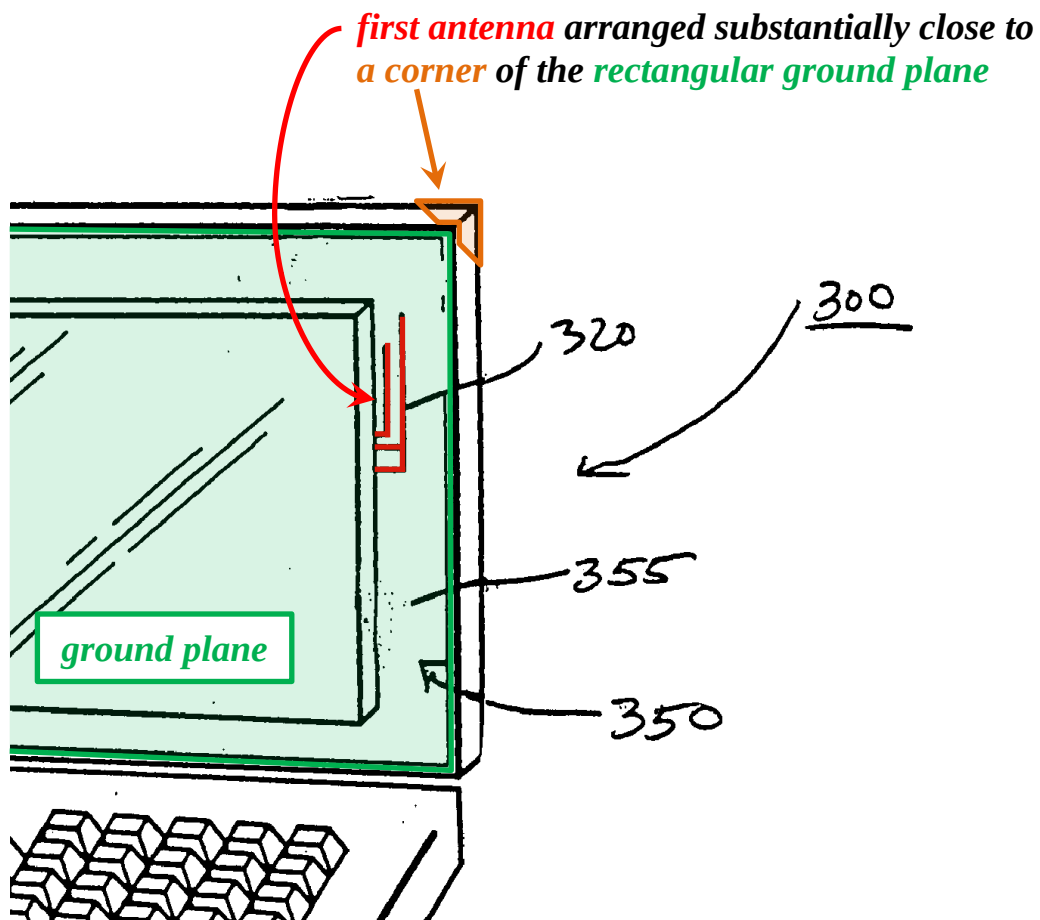


4. Claim 4

4	[Claim 1's device], wherein the first antenna is arranged substantially close to a corner of the rectangular area.
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As explained for limitation [1.i], the '458 patent never quantifies “*substantially close*.” *Supra* §VIII.B.1.j ([1.i]).

Gaucher's **antenna 320** is shown in Figure 3 as mounted *substantially close* to the **first side** (e.g., right side) of **support frame 355** (defining a ground plane rectangle). Gaucher, [0025], [0030], [0032], Fig. 3; *supra* §VIII.B.1.j (Limitation [1.i]). Gaucher's Figure 3 (annotated detail below), **antenna 320** is arranged *substantially close* to the **top-right corner** of **support frame 355's** rectangular area. Pozar, ¶178.



5. Claim 5

5	[Claim 1's device], wherein the first antenna is an antenna selected from the group comprising: a monopole antenna, an inverted-F antenna, a patch antenna, and a planar inverted-F antenna.
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As discussed *supra* §0 (Limitation [1.c]), Gaucher's **antenna 320** implemented as Gaucher's quadband antenna is *the first antenna*. Gaucher, [0025], [0030], Fig. 3. According to Gaucher, one implementation of the quadband antenna is an "*inverted-F antenna*" which "provide[s] many advantages such as smaller antenna size, low manufacturing costs, compatibility with standard industrial laptop/display architectures, reliable performance and the like." *Id.*, [0032].

6. Claim 6

6	[Claim 5's device], wherein the second antenna is an antenna selected from the group comprising: a monopole antenna, an inverted-F antenna, a patch antenna, and a planar inverted-F antenna.
---	---

Gaucher's **antenna 310** implemented as Gaucher848's tri-band antenna is *the second antenna*. *Supra* §VIII.B.1.f (Limitation [1.e]); Gaucher, [0024]-[0026], [0030], Fig. 3; Gaucher848, [0008]-[0009], [0056], Figs. 9, 10. Gaucher848 explains that one implementation of the tri-band antenna is an "*inverted-F antenna*." Gaucher848, [0049].

7. Claim 7

7	[Claim 1's device], wherein the at least one frequency band used for wireless connectivity services corresponds to at least one wireless connectivity service selected from the group comprising: Bluetooth™, IEEE802.11a, IEEE802.11b, IEEE802.11g, WLAN, WiFi, UWB, ZigBee, GPS, Galileo, SDARs, XDARS, WiMAX, DAB, FM, DVB-H, and DMB.
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Gaucher848's tri-band antenna "operate[s] in the 2.4-2.5 GHz, 5.15-5.35 GHz and 5.47-5.85 GHz bands." Gaucher, [0030], [0024], [0026]; Gaucher848, [0008]-[0009], [0011], [0056], Figs. 9, 10.

At least IEEE Std. 802.11b, IEEE Std. 802.11g, Bluetooth, and Zigbee each use the 2.4 GHz ISM band (2400-2500 MHz). EX1018 (802.11b), 41, 49-51; EX1020 (802.11g), 15; EX1021 (Zigbee), 17; EX1022 (Bluetooth), 27-29; EX1001, 2:16-20, 9:46-60. At least IEEE Std. 802.11a uses the "5.15–5.25, 5.25–5.35 and 5.725–5.825 GHz *unlicensed national information infrastructure (UNII) bands*" (*supra* §VIII.B.1.g ([1.f])); EX1017 (802.11a), 3-4), *each* of which is supported by Gaucher848's tri-band antenna. Gaucher848, [0011]. WLAN networks based on IEEE Std 802.11 (including, e.g., 802.11a, 802.11b, 802.11g) are known as "Wi-Fi." EX1023 (Wi-Fi Alliance). Gaucher thus separately meets claim 7 for at least each of these "wireless connectivity services" (e.g., 802.11a, 802.11b, 802.11g, WLAN, Wi-Fi, Bluetooth, Zigbee). Pozar, ¶182; EX1001,

2:16-20, 9:46-60 (describing using the 2.4 GHz ISM band for wireless connectivity services like WLAN, IEEE 802.11b, and Bluetooth).

8. Claim 8

a. Limitations [8.PRE]-[8.c], [8.j]

Gaucher meets Limitations [8.PRE]-[8.c] and [8.j] for the reasons it meets the corresponding limitations below. EX1016, 1; Pozar, ¶183.

Limitation	Corresponding Limitation	Discussion <i>supra</i>
[8.PRE]	[1.PRE]	§VIII.B.1.a
[8.a]	[1.a]	§VIII.B.1.b
[8.b]	[1.c]	§0
[8.c]	[1.d]	§VIII.B.1.e
[8.j]	[1.j]	§VIII.B.1.k

Gaucher meets the remaining limitations in claim 8 as follows.

b. Limitation [8.d]

8.d	a second antenna configured to operate in at least one frequency band;
-----	--

Gaucher meets [8.d] because antenna 310 (Gaucher848’s tri-band antenna) *operates in at least one frequency band, e.g., “operate[s] in the 2.4-2.5 GHz, 5.15-5.35 GHz and 5.47-5.85 GHz bands.”* Gaucher, [0030], [0024] (incorporating Gaucher848 by reference); Gaucher848, [0008]-[0009], [0011], [0041], [0056], Figs. 9, 10; EX1017 (802.11a-1999), 3; EX1018 (802.11b), 41, 51; *supra* §VIII.B.1.f ([1.e]); Pozar, ¶184.

c. Limitation [8.e]

8.e	the first antenna extends in a direction substantially parallel to a first side of the portable device;
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Gaucher meets [8.e] because, as explained *supra* §VIII.B.1.h ([1.g]) and as “FIG. 3 shows,” antenna 320 is disposed with a long axis “*substantially parallel*” to a *first side* of laptop 300’s support frame 355. Gaucher, [0025] (“antennas 310, 320 are mounted to the metal support frame 355, wherein the plane of each...is substantially parallel to the plane, or along the plane, of the metal support frame 355.”), [0032], Fig. 3. Figure 3 further shows that the “*first side*” of support frame 355—and the long axis of antenna 320 when so mounted—is also *substantially parallel* to the *first side* of Gaucher’s laptop (*portable device*). Gaucher, Fig. 3; Pozar, ¶185; *supra* §VIII.B.1.h ([1.g]).

d. Limitation [8.f]

8.f	a length of a second side of the portable device is greater than a length of the first side of the portable device;
-----	---

Gaucher meets [8.f] because, as explained in [1.b], *supra* §VIII.B.1.c, Figure 3 shows support frame 355 supporting a rectangular display where the *second side* of the frame is longer than the *first side*. Gaucher, [0025], [0032], Fig. 3; Asano, [0083]; EX1019, 7. Thus, Figure 3 shows the same relationship for the laptop lid containing the display frame, wherein the top-side (*second side*) is longer than the right-side (*first side*). Pozar, ¶186; *supra* §VIII.B.1.c.

e. Limitation [8.g]

8.g	the first antenna is arranged substantially close to the first side of the portable device;
-----	---

Gaucher meets [8.g] because as explained *supra* §VIII.B.1.j ([1.i]), Figure 3 shows that antenna 320 (*first antenna*) is disposed “*substantially close*” to a “*first side*” of frame 355. Gaucher, Fig. 3. Figure 3 further shows that the “*first side*” of frame 355 extends to the “*first side*” of the laptop lid, so that antenna 320 is also disposed *substantially close to the first side* of laptop 300 (e.g., *portable device*). Gaucher, [0025], [0032], Fig. 3; Pozar, ¶187.

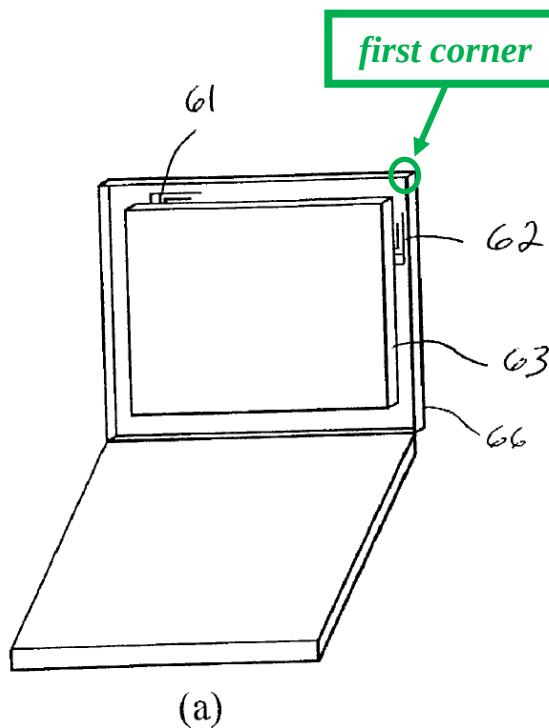
f. Limitation [8.h]

8.h	the second antenna is arranged substantially close to a first corner of the portable device;
-----	--

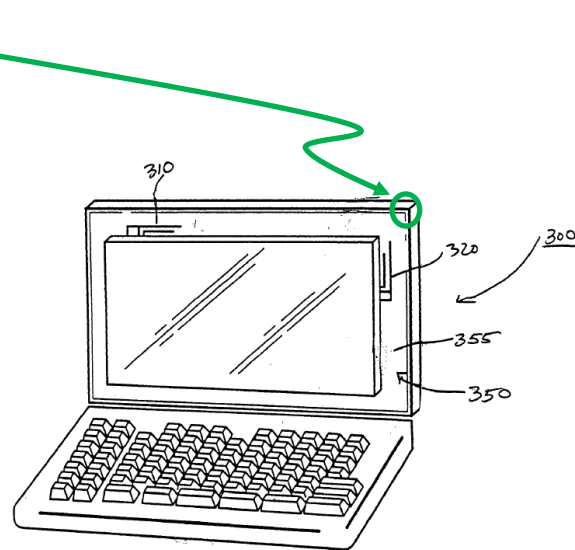
Gaucher meets [8.h] because as explained *supra* §VIII.B.3 (claim 3), Gaucher’s Figure 3 shows that **antenna 310** (*the second antenna*) is arranged *substantially close to the top-left corner* of **support frame 355’s** rectangular area. Figure 3 also shows that frame 355 extends to edge—and each corner—of the laptop cover, e.g., “*corner of the portable device.*” Gaucher, Fig. 3; Pozar, ¶188.

As discussed *supra* §§VIII.B.1.f ([1.e]), VIII.B.8.b ([8.d]), **antenna 310** is implemented using Gaucher848’s tri-band antenna. POSAs would have known that antenna 310 could be disposed “*substantially close*” to the **top-right** corner of the laptop display, which is also a corner of “*the portable device.*” Pozar, ¶189.

Gaucher848 explains that the tri-band antenna mounted on the top-side of the support frame is not limited to a left-side-placement, but can also “be located on the right side of the upper portion of the frame (63) (as opposed to the left side of the upper portion of the frame as shown).” Gaucher848, [0049], *cf.* Fig. 6(a) (showing a similar laptop/antenna configuration as Gaucher’s Figure 3 with antenna 61 on “left side”). Pozar, ¶190

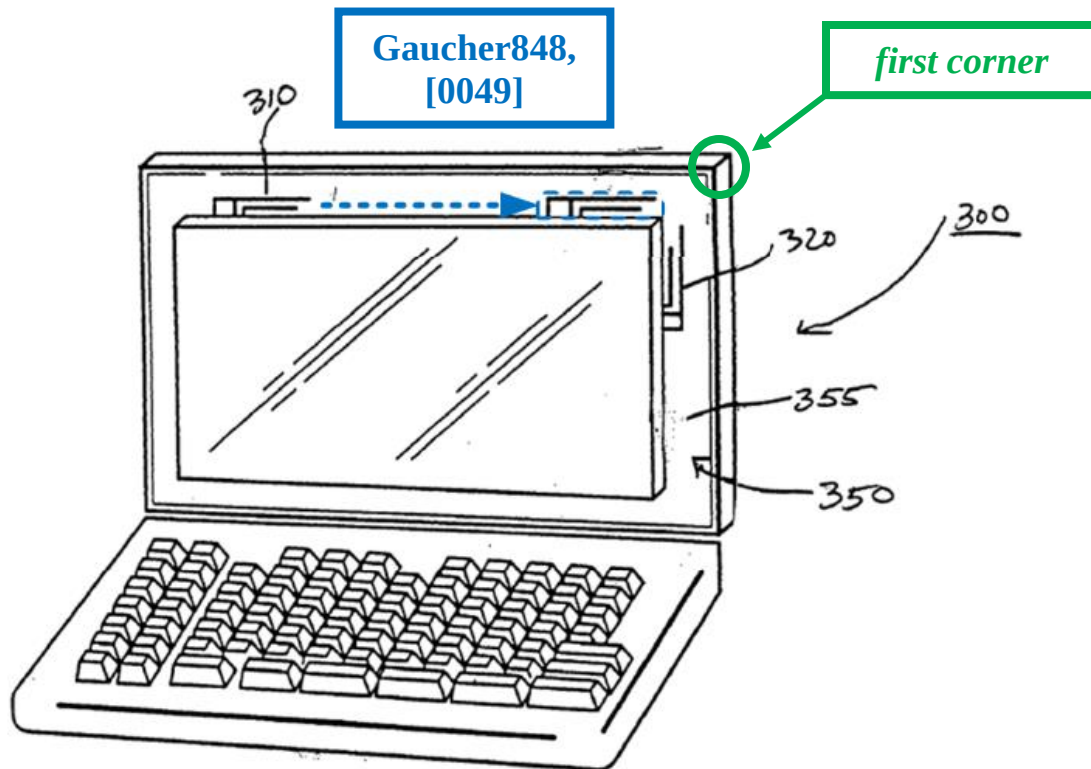


(a)
Gaucher848, Fig. 6(a)



Gaucher, Fig. 3

Thus, rearranging antenna 310 (*second antenna*) in Gaucher’s Figure 3 from the upper-left portion to the upper-right portion of support frame 355, as Gaucher848 specifically teaches as an option for its tri-band antenna, is *the second antenna... arranged substantially close to the top-right corner of the portable device*. Pozar, ¶191.



g. Limitation [8.i]

8.i	the first corner of the portable device corresponding to a first end of the first side with an end of the second side of the portable device; and
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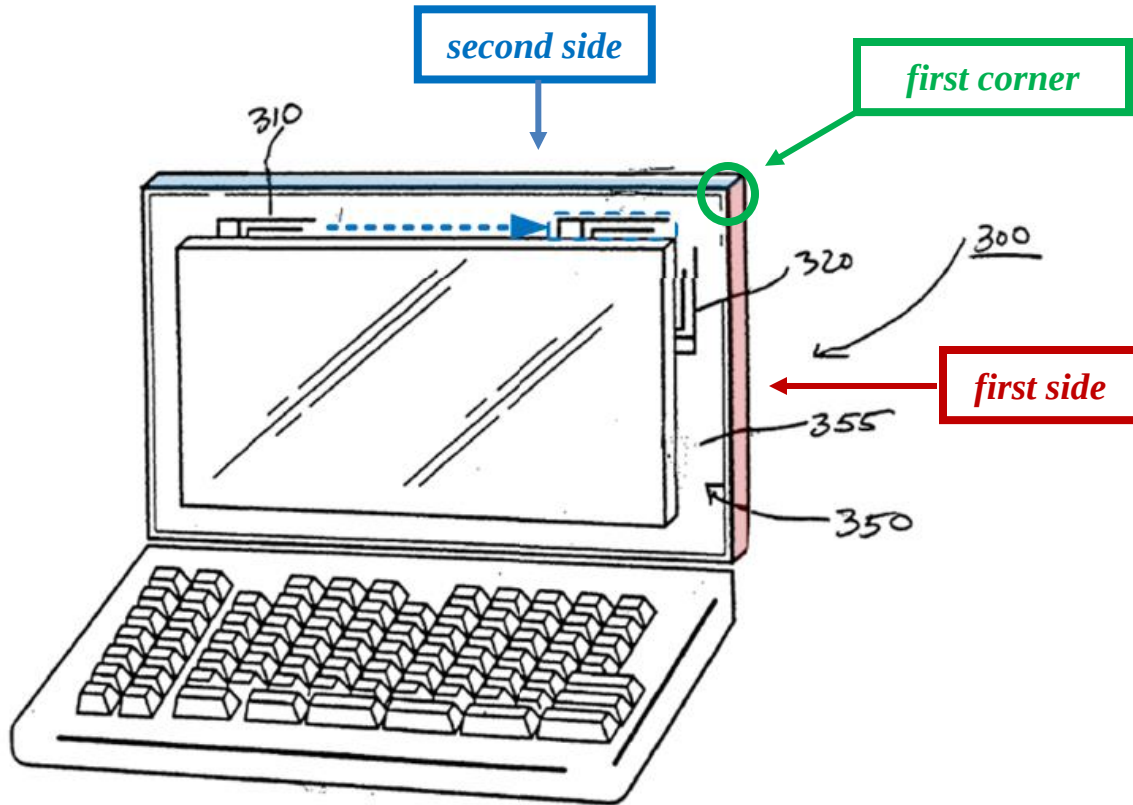
Gaucher meets [8.i] because as shown in Figure 3, laptop 300 (*portable device*) has a *first side*—the lid’s right side—and a *second side*—the lid’s top side.

This conforms to the *first/second side* of frame 355 as discussed *supra*

§§VIII.B.1.h ([1.g]), VIII.B.8.c ([8.e]): the *first side* is the right side where

Gaucher’s *antenna 320* is located, while the *second side* is the upper-side, as Figure 3 shows that frame 355 has sides coterminous with the laptop (e.g., *portable device*) sides. Gaucher, Fig. 3; Gaucher848, [0049]; *supra* §VIII.B.8.f ([8.h]).

Pozar, ¶192.



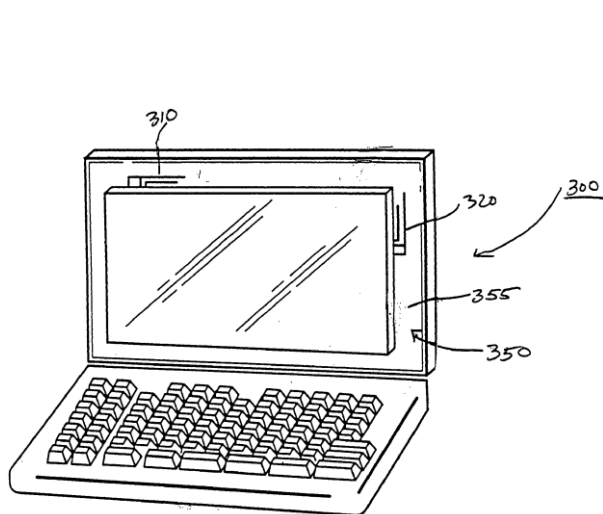
The laptop's "first corner" is the top right corner as shown in Figure 3, which coincides with the right corner of upper-side (i.e., the *second side*) of *support frame 355* when Gaucher's *antenna 310* is implemented as Gaucher848's tri-band antenna and located on the upper-right portion of the support frame, as taught in Gaucher848. Gaucher848, [0049]; *supra* §VIII.B.8.f ([8.h]). This meets [8.i]. Pozar, ¶193.

9. Claim 9

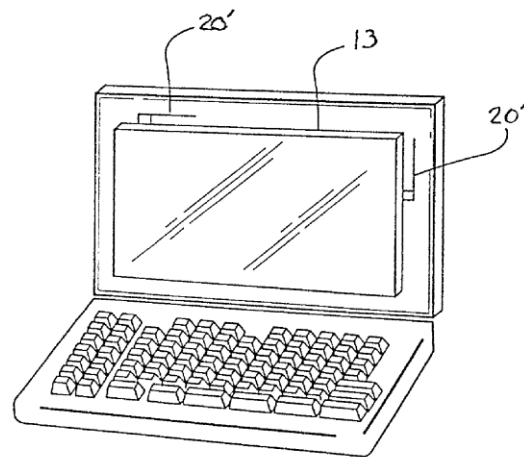
9	[Claim 8's device], wherein a portion of an orthogonal projection of the first antenna on a plane containing the ground plane does not overlap with the ground plane.
---	---

As explained for limitations [1.g] and [8.g], Gaucher teaches that *first antenna 320* is “mounted to the metal support frame 355... substantially parallel to the plane, or along the plane, of the metal support frame 355.” Gaucher, [0025], Fig. 3; *supra* §§VIII.B.1.h ([1.g]), VIII.B.8.e ([8.g]).

Gaucher also incorporates-by-reference Application No. 09/876,557 (published as Asano (EX1024)) describing a laptop embodiment with two inverted-F antennas “disposed in the plane of the display” like Gaucher’s laptop. Gaucher, [0024]-[0025], Fig. 3; Asano, [0058], Fig. 3E; Pozar, ¶195.

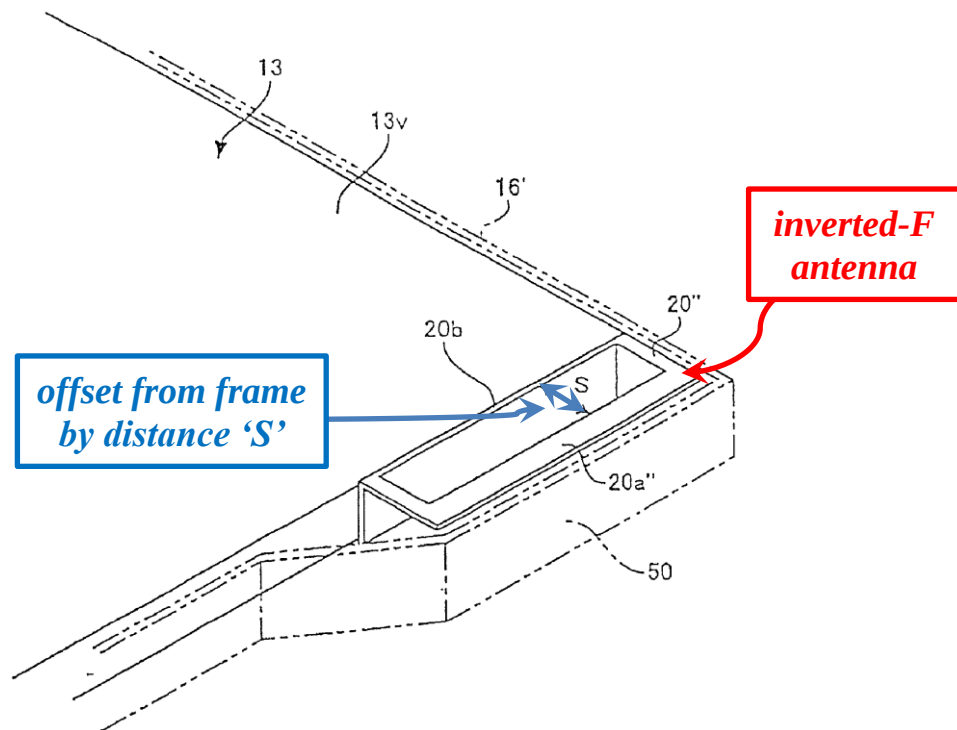


Gaucher, Fig. 3



Asano, Fig. 3E

Asano teaches in Figure 16 that when using an inverted-F antenna (e.g., antennas 320, 20') "located in a plane approximately parallel to the... display panel," as in the laptops above, the antenna's "radiator portion... may be located... **at a distance more than a predetermined dimension *S* from the** portion made of conductive material such as the **frame 13A**" (e.g., Gaucher's support frame 355). Asano, [0131]-[0132], Fig. 16 (annotated below); Pozar, ¶196.



In applying this teaching to Gaucher's laptop, POSAs would have understood that Figure 16 represents an angled-view of an "orthogonal projection" of the inverted-F antenna (e.g., Gaucher's antenna 320 discussed in limitations [1.c], [1.g], [8.b], [8.g]) "on a plane containing the ground plane" (e.g., Gaucher's support frame 355 discussed in limitations [1.a]-[1.b] and [8.a]). Gaucher, [0025],

[0032]. Gaucher’s antenna 320 (*first antenna*) moved a predetermined distance ‘S’ (as shown in Figure 16 above) therefore yields “*a portion of an orthogonal projection of the first antenna... not overlap[ping]*” Gaucher’s support frame 355 (*ground plane*). Pozar, ¶197.

10. Claim 10

10	[Claim 8’s device], wherein the second antenna is substantially close to the first side of the portable device and extends in a direction substantially parallel to the first side of the portable device.
----	--

As discussed *supra* §VIII.B.8.f (Limitation [8.h]), Gaucher’s antenna 310 (i.e., *the second antenna*) can be arranged in the upper-right portion of support frame 355 (Gaucher848, [0049]) in the same way that antenna 310 is “*substantially close to the*” left side support frame 355, as shown in Gaucher’s Figure 3 and discussed *supra* §VIII.B.3 (Claim 3). When antenna 310 is located on the upper-right portion of support frame 355 as taught by Gaucher848, it “*is substantially close to the first side*” (i.e., right side) “*of the portable device.*” Pozar, ¶198.

11. Claims 12-13

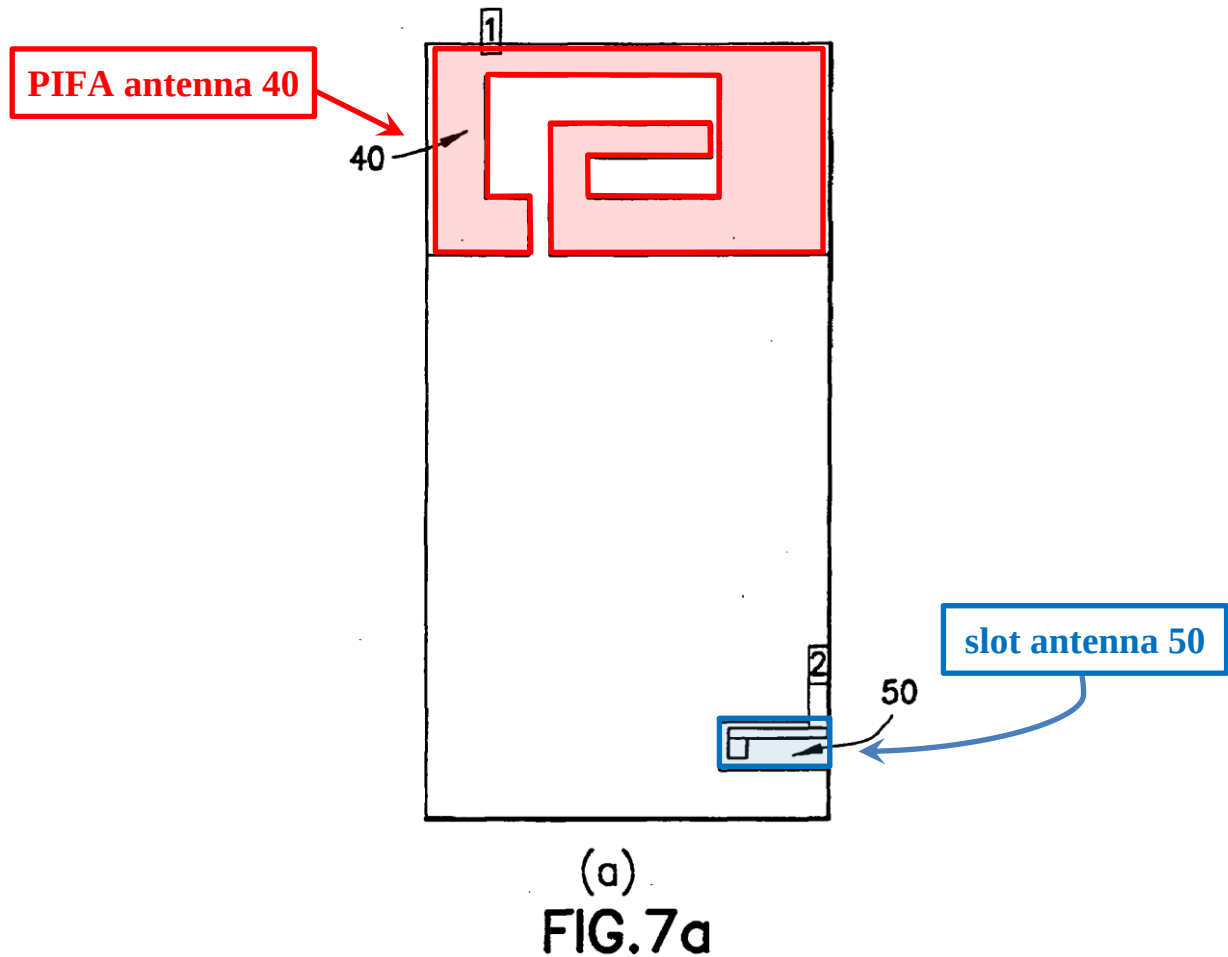
Gaucher meets the additional limitations in claims 12 and 13 for the same reasons it meets claims 5 (*supra* §VIII.B.5) and 6 (*supra* §VIII.B.6), respectively. EX1016, 2-3; Pozar, ¶199.

IX. GROUND 3: ZHAO RENDERS OBVIOUS CLAIMS 14-18

A. Zhao (EX1008)

Zhao discloses wireless ultra-wideband (“UWB”) communication systems comprising a quarter-wavelength slot UWB antenna integrated on a 40mm×80mm PCB conventional for “mobile handsets.” Zhao, [0002] (describing “UWB-equipped mobile devices”), [0004] (describing UWB designs for mobile terminals comprising mobile handsets), [0007], [0031] (describing UWB antenna “integrated on a PCB of a mobile terminal”), [0038]. Zhao thus motivates the use of its described antennas and ground plane on a conventional mobile device. Zhao, [0002], [0004]; Pozar, ¶200.

Zhao also discloses placing a “dual-band PIFA antenna 40” along with the “quarter-wavelength slot UWB antenna 50” on the PCB as in, *e.g.*, Figure 7a (annotated detail below). Zhao, [0035], [0038], [0042], [0044], [0046] (“The locations of the dual-band PIFA antenna 40 and the quarter-wavelength slot UWB antenna 50 are shown in FIG. 7a....”), Fig. 7a.



Antenna 40 is “a conventional dual band PIFA GSM antenna (working at frequencies of 0.9 GHz and 1.8 GHz).” Zhao, [0044], [0046], Fig. 7b (showing antenna 40’s return loss (denoted S11)). **Antenna 50** is a 12.75 mm×4 mm (maximum) L-shaped slot antenna “preferably operat[ing] in the... 3.1 GHz to 4.9 GHz” ultra-wide band (“UWB”) frequency range used for “short-range,” “higher-data-rate communication[s]” (*e.g.*, data, audio, and video between consumer electronics). Zhao, [0002], [0038], [0042], [0046], [0052], Fig. 7b (showing antenna 50’s return loss (denoted S22)).

The Figure 7a antenna positions “present[] the best isolation” with antenna 40 aligned along the top side of the PCB, and antenna 50 positioned toward the PCB’s lower-right corner. Zhao, [0044], [0049]. According to Zhao, this “presents the best isolation” because “the two antennas are separated by the greatest distance.” Zhao, [0046], [0049], [0055].

B. Analysis

1. Claim 14

a. Preamble

14.PRE	A wireless handheld or portable device comprising:
--------	--

Zhao meets [14.PRE] because it describes wireless ultra-wideband (“UWB”) communication systems comprising a UWB antenna “for mobile terminals” integrated on a PCB with dimensions consistent with conventional wireless handheld devices. Zhao, code (54), [0002] (describing “UWB-equipped mobile devices”), [0004] (describing UWB designs for mobile terminals comprising mobile handsets), [0007], [0031]-[0032] (describing “a quarter-wavelength slot UWB antenna integrated on a PCB of a mobile terminal”), [0038] (describing UWB slot antenna integrated on 80 mm x 40 mm PCB); EX1025, 87 (describing UWB antenna “for mobile UWB devices”) (*cited in* Zhao, [0004]). POSAs would have had reasons to use Zhao’s UWB antenna and PCB in a wireless handheld or portable device because Zhao describes such technology as “provid[ing] a clear

added-value benefit to the mobile phone industry by developing UWB-equipped mobile devices.” Zhao, [0002]; Pozar, ¶204.

b. Limitation [14.a]

14.a	a ground plane;
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Zhao describes integrating a UWB antenna “on a PCB of a mobile terminal.” *E.g.*, Zhao, [0031], [0032], [0038]. Zhao simultaneously describes integrating slot UWB antennas “on a ground plane” with 80mm×40mm×1mm dimensions, “which is the size of a typical PCB for a mobile terminal.” Zhao, [0038]. In short, Zhao integrated its antennas on a PCB comprising a dielectric material 21 (*e.g.*, FR4 in [0038]) and an “electrically conducting layer” 23). *E.g.*, Zhao, [0042]; Pozar, ¶205.

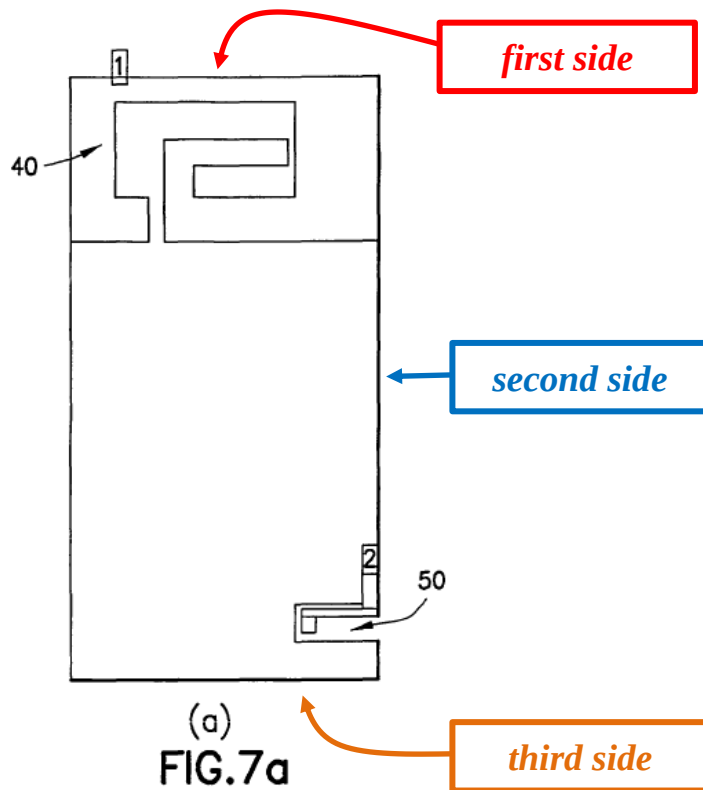
Figure 3 (annotated below) shows a planar view of the PCB surface comprising the “electrically conducting layer[] 23” (*e.g.*, *ground plane*). Zhao, Fig. 3, [0042]. Hash marks in annotated Figure 3 below show where the ground plane extends over the region where the slot antenna feed line 30 (with proximal end 31) is positioned on dielectric 21 on the opposing PCB side. Zhao, Fig. 3, [0042]. Figure 4 shows a profile view of PCB 20 comprising “electrically conducting layer[] 23,” having rectangular slot 27 (for the slot antenna). Zhao, Figs. 3-4 (annotated below), [0042]; Pozar, ¶206.

POSAs would have understood that Zhao’s electrically conducting layer is a *ground plane* because it is the only conductive layer that Zhao identifies on the PCB; it has the rectangular dimensions of the PCB as Zhao describes ([0038]); and it was conventional to dispose a ground plane on a surface of a PCB as shown in Figures 3-4. Pozar, ¶207.

c. Limitation [14.b]

14.b	the ground plane is inscribed in a first rectangular area comprising a first side, a second side and a third side, a length of the second side being greater than a length of the first side and a length of the third side;
------	--

Zhao meets [14.b] because—as discussed *supra* §IX.B.1.b ([14.a])—the electrically conducting layer (*ground plane*) has a rectangular area with length 80 mm (*e.g.*, on a *second side*) and width 40 mm (*e.g.*, on a *first* and *third side*). Zhao, [0038]. Herein the “sides” are defined by reference to the planar view of PCB 20 in Figure 7a. The 80 mm length is greater than the 40 mm width. A POSA would have understood that the ground plane “*is inscribed in a first rectangular area*” because the ground plane is bounded/enclosed by a rectangle having the PCB’s dimensions. Zhao, [0038]; EX1001, 10:38-42 (describing “the smallest rectangle in which the radiating element of the antenna can be inscribed”); EX1026, 220 (defining “inscribed”); Pozar, ¶208.

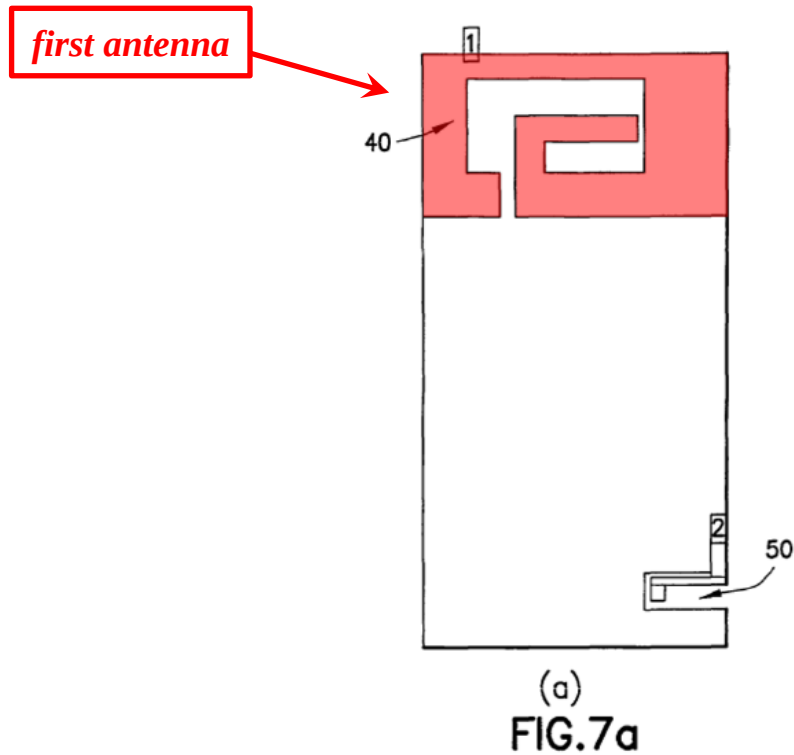


d. Limitations [14.c]-[14.d]

14.c	a first antenna configured to transmit and receive electromagnetic waves corresponding to at least two frequency bands;
14.d	the at least two frequency bands being used for mobile communication services;

Zhao meets [14.c]-[14.d] because it describes a mobile terminal using a dual-band PIFA [planar inverted-F antenna] antenna 40 (i.e., a *first antenna*) that operates in the GSM900 and GSM1800 frequency bands. Zhao, Fig. 7a (annotated below); [0044] (antenna 40 is “a conventional dual band PIFA GSM antenna (working at frequencies of 0.9 GHz and 1.8 GHz)”); [0046] (“The location[] of the dual-band PIFA antenna 40... [is] shown in FIG. 7a[.]”). POSAs would have understood that the PIFA GSM antenna works (is “*configured to transmit and*

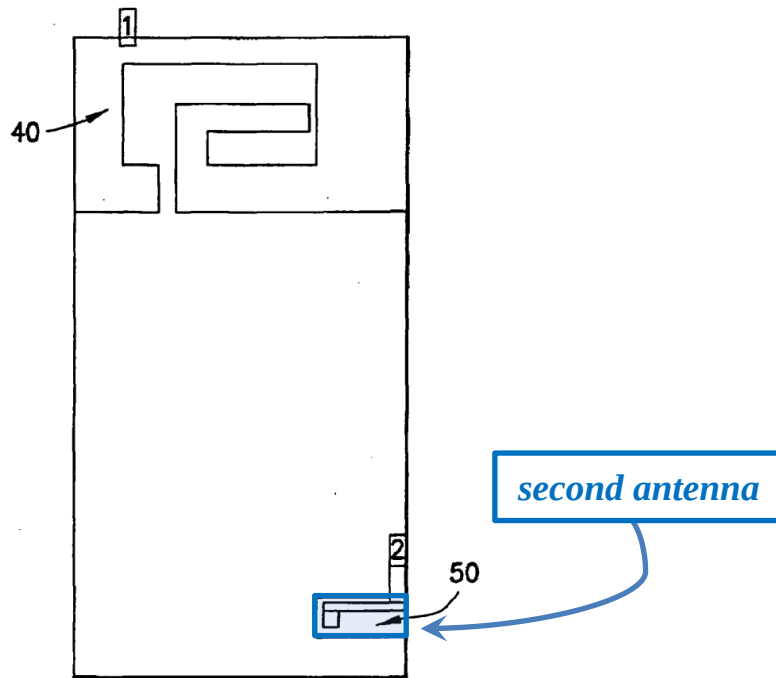
receive”) in the GSM900 and GSM1800 *frequency bands*. Zhao, Fig. 7b, [0044]; EX1009, 9; *supra* §VIII.B.1.e ([1.d]); *see also* EX1001, 2:4-10 (describing exemplary bands for mobile communication services), 9:26-43 (similar); Pozar, ¶209.



e. Limitation [14.e]

14.e	a second antenna configured to operate in at least one frequency band;
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Zhao meets [14.e] because its mobile terminal includes a “quarter-wavelength slot UWB antenna 50” (i.e., a *second antenna*). Zhao, [0046] (“The location[] of... the quarter-wavelength slot UWB antenna 50 [is] shown in FIG. 7a[.]”), Fig. 7a (annotated detail below). Pozar, ¶210.



(a)
FIG.7a

Antenna 50 “operate[s] in the frequency range of 3.1 GHz to 4.9 GHz,” which covers ultra-wideband (UWB) frequencies for “higher-data-rate communication links” like video and audio data transmissions. Zhao, Fig. 5, [0002], [0038], [0043]; *see also id.*, Fig. 7b (showing antenna 50 return loss S22).

Claim 17 depends from claim 14 and recites that the “*at least one frequency band*” includes “UWB” frequency bands. EX1001, 26:41-46. Thus, Zhao’s antenna 50 is “*a second antenna configured to operate in at least one frequency band*” as claimed. Pozar, ¶212.

f. Limitation [14.f]

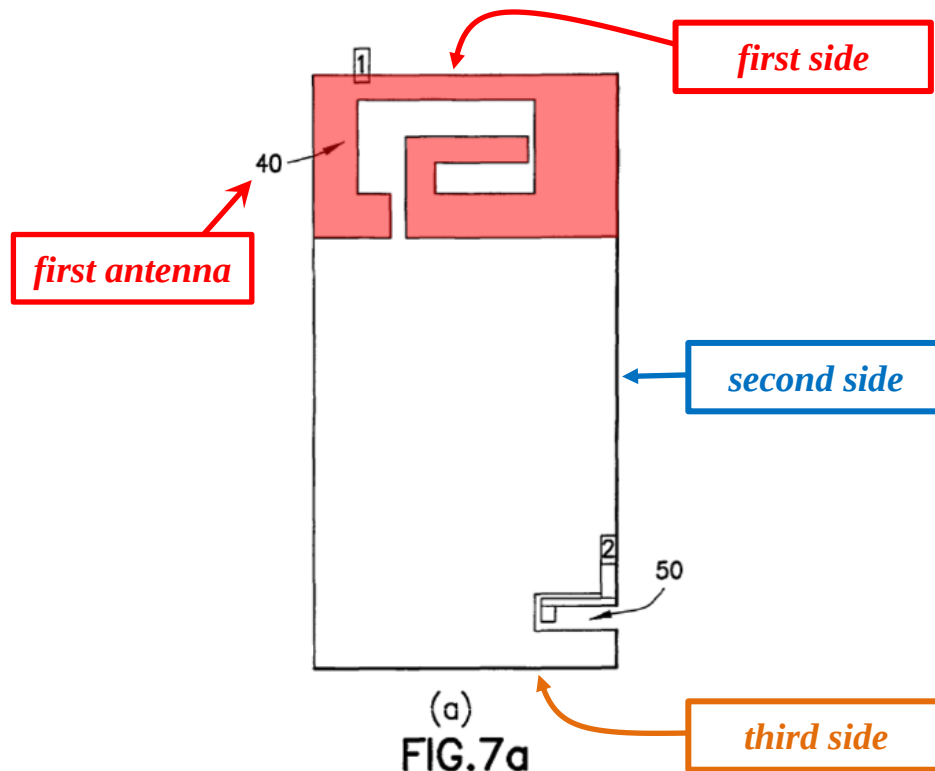
14.f	the at least one frequency band being different from the at least two frequency bands;
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Zhao meets [14.f] because the UWB band (3.1 GHz to 4.9 GHz), *supra* §IX.B.1.e ([14.e]), is different from the GSM900 (890-960 MHz) and GSM1800 (1710-1880 MHz) bands, *supra* §IX.B.1.d ([14.c]-[14.d]). Pozar, ¶213.

g. Limitations [14.g]-[14.h]

14.g	the first antenna extends in a direction substantially parallel to the first side;
14.h	the first antenna is proximate to the first side;

Zhao meets [14.g] and [14.h] because *first antenna 40* has a long axis that is disposed substantially parallel—and proximate—to the top edge (“*first side*”) of the mobile terminal PCB and its ground plane as depicted in the planar view in Figure 7a. Zhao, Fig. 7a (annotated detail below), [0044], [0046] (“The location[] of the dual-band PIFA antenna 40... [is] shown in FIG. 7a[.]”); *supra* §IX.B.1.c ([14.b]); Pozar, ¶214.



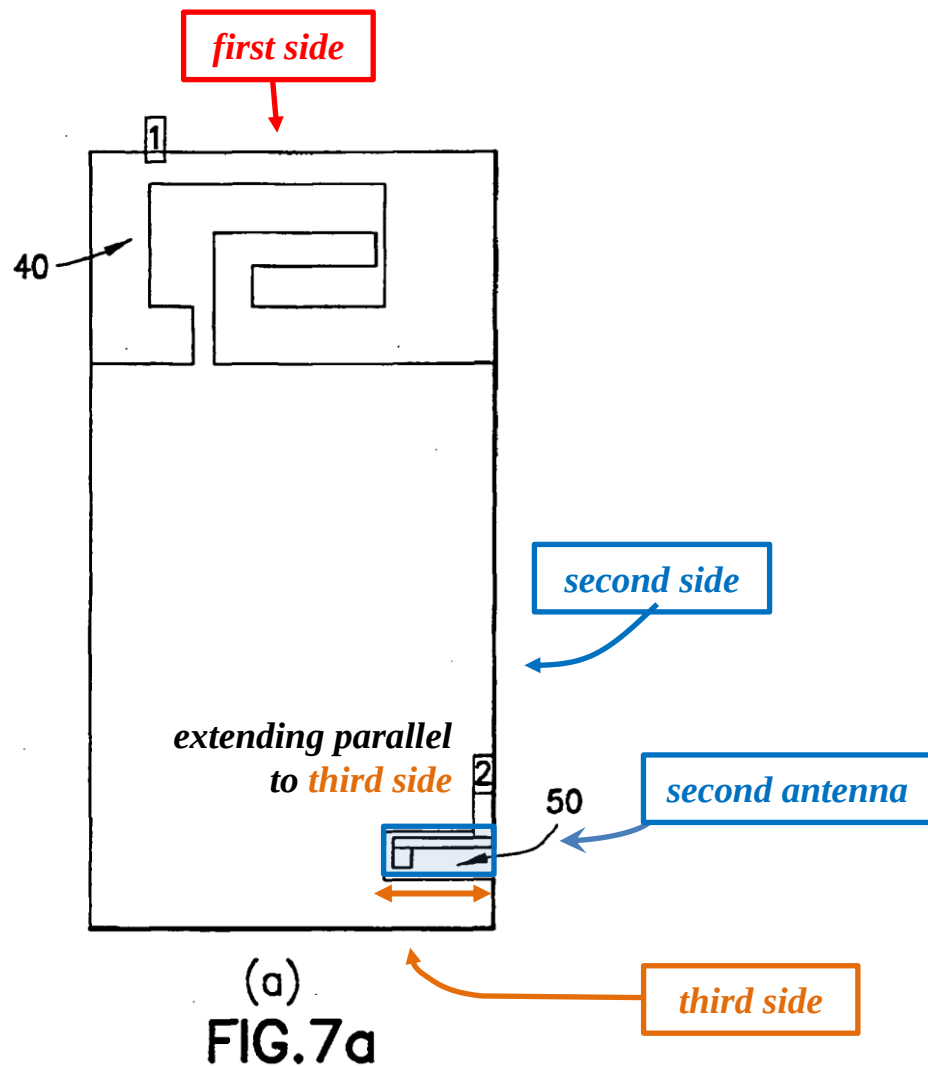
h. Limitation [14.i]-[14.j]

14.i	the second antenna extends in a direction substantially parallel to the third side;
14.j	the second antenna is proximate to the third side;

Zhao meets [14.i] and [14.j] because antenna 50 (*second antenna*) is located proximate to the lower-right corner of the mobile terminal's PCB and its *ground plane*—and thus proximate to the PCB/ground plane's lower edge (*third side*) as shown in the planar view of Figure 7a (annotated below) depicting PCB 20 and dielectric 21. Zhao, Figs. 3-4, 7a, [0042] (describing quarter-wavelength UWB slot antenna), [0046] (“The location[] of...the quarter-wavelength slot UWB antenna 50 [is] shown in FIG. 7a...”); *supra* §IX.B.1.e ([14.e]). In Figure 7a's

planar view depicting the PCB surface with dielectric 21, the PCB's lower side is the *third side* of the *ground plane*'s rectangular area. *Supra* §IX.B.1.c ([14.b]); Pozar, ¶215.

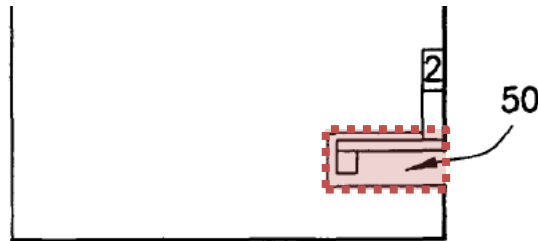
Antenna 50 has a long axis because its largest size is “12.75 mm×4 mm” (*id.*, [0052]), and planar view Figure 7a (showing a planar view of PCB 20 with dielectric 21) shows antenna 50 *extending a maximum of 12.75 mm parallel to the third side*. Zhao, Fig. 7a; see also *id.*, Fig. 3, [0042]; Pozar, ¶216.



i. Limitation [14.k]

14.k	the second antenna is inscribed in a second rectangular area;
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Zhao meets [14.k] because Zhao’s slot antenna 50 (“*second antenna*”) is bounded by (*inscribed in*) a *rectangular area* of at most “12.75mm×4 mm,” shown as “rectangular slot 27” in planar view Figure 4. Zhao, Fig. 4, [0042], [0052]; *see also id.*, Fig. 7a (annotated detail below), [0046] (“The location[] of... antenna 50 [is] shown in FIG. 7a...”); *supra* §IX.B.1.g ([14.h]); Pozar, ¶217.



j. Limitation [14.l]

14.l	a sum of a length and a width of the second rectangular area is smaller than a quarter of an operating wavelength of the second antenna;
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Zhao meets [14.l] because *second antenna 50* (a “quarter-wavelength” slot antenna) measures **at most** “12.75mm×4mm” (Zhao, [0052]), thereby making “a sum of a length and a width of the *second rectangular area*” **at most 16.75 mm**. *Supra* §IX.B.1.i ([14.k]); Pozar, ¶218.

Zhao’s antenna 50 operates from “3.1 GHz to 4.9 GHz.” Zhao, [0038]; *supra* §IX.B.1.f ([14.f]). Frequency and wavelength are inversely related to each other via the equation $\lambda = \frac{v}{f}$, where ‘ λ ’ is wavelength, ‘ v ’ is velocity (i.e., speed of light), and ‘ f ’ is frequency. EX1027, 15-16; Pozar, ¶219. Based on this equation, antenna 50’s free-space “operating wavelength” for 3.1-4.9 GHz, using the speed of light $3.0 \times 10^8 \text{ (m/s)} \times 10^3 \text{ (mm/m)} = 3.0 \times 10^{11} \text{ (mm/s)}$, is between 61 and 97 mm. Pozar, ¶219; EX1001, 4:18-26 (antenna segments sized relative to “free-space” operating wavelength), 5:11-16 (“rectangle... longest side... does not exceed [1/20] the longest free-space operating wavelength of the antenna”), 23:3-12 (sizing slots by reference to “free-space operating wavelength”).

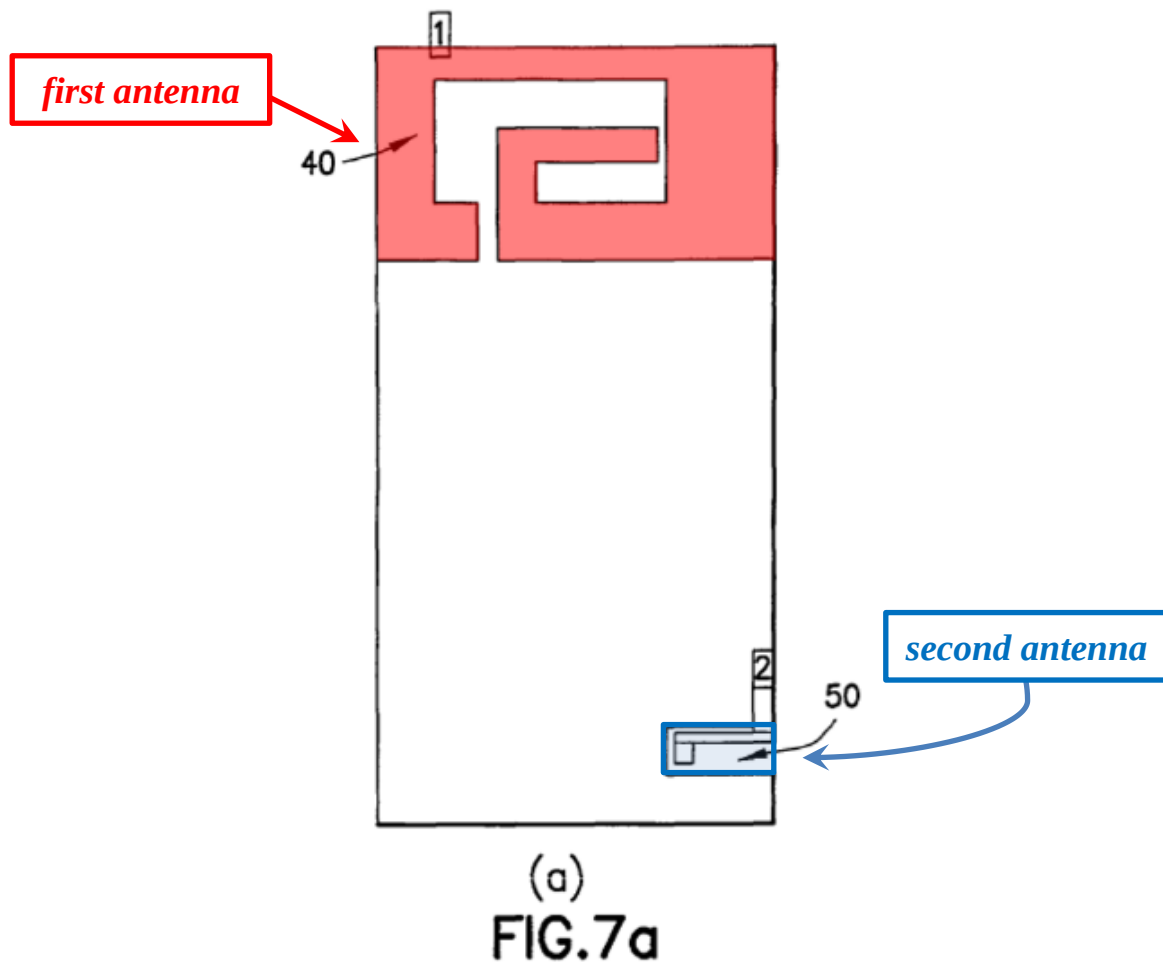
f (Hz)	wavelength (mm)	$\frac{1}{4}$ wavelength (mm)
3.1×10^9	$\left(\frac{3.0 \times 10^{11}}{3.1 \times 10^9} \right) = 0.97 \times 10^2 = 97$	$97/4 = 24.25$
4.9×10^9	$\left(\frac{3.0 \times 10^{11}}{4.9 \times 10^9} \right) = 0.61 \times 10^2 = 61$	$61/4 = 15.25$

At 3.1 GHz a quarter of the 97 mm operating wavelength is 24.25 mm. Since 16.75 mm is **smaller** than “a quarter of an operating wavelength” of *second antenna 50* at 3.1 GHz—e.g., 24.25 mm—Zhao’s UWB antenna meets [14.l]. Pozar, ¶220.

k. Limitation [14.m]

14.m	a geometry of the first antenna being different than a geometry of the second antenna;
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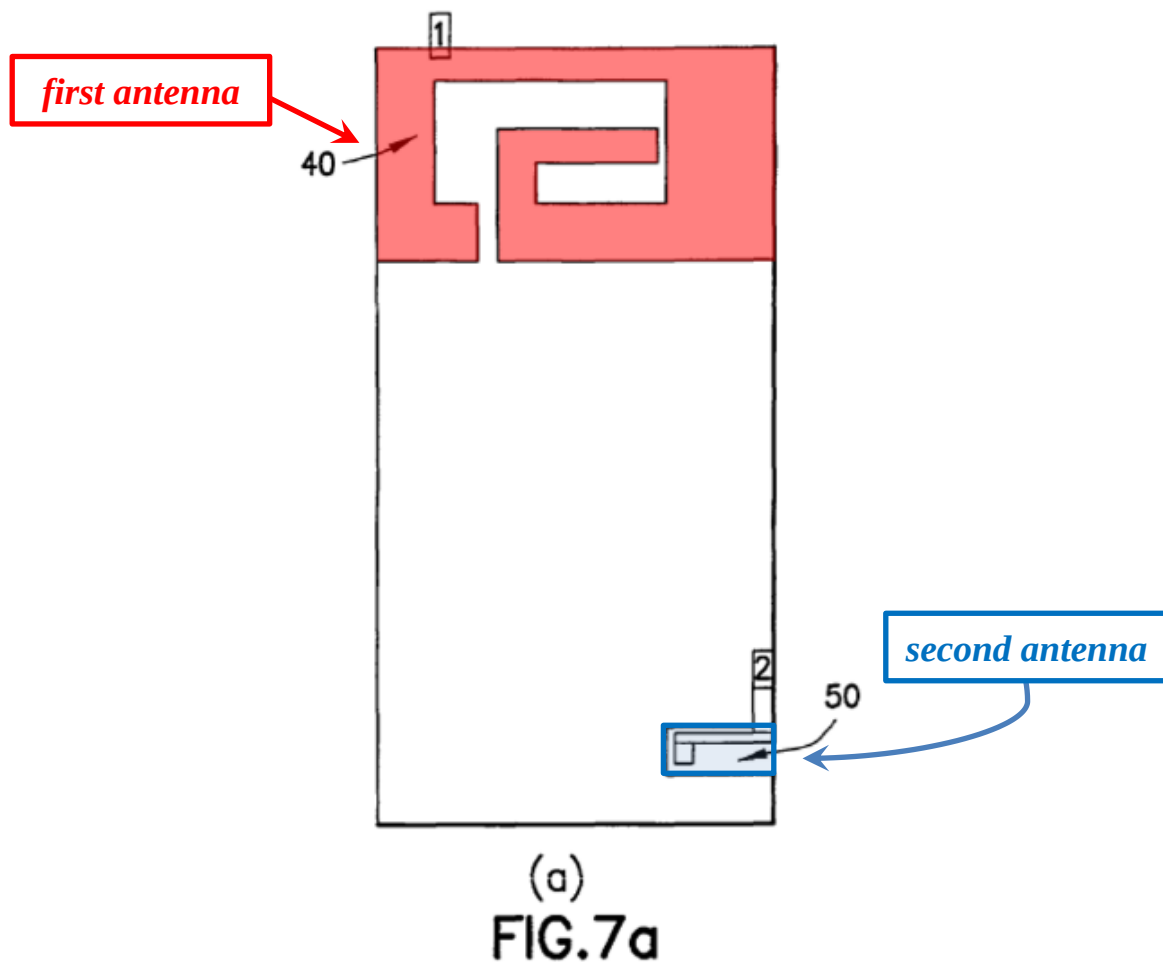
Zhao meets [14.m] because the quarter-wave “L-shaped stub” slot antenna 50 (second antenna) has a different geometry than the PIFA antenna 40 (first antenna). Zhao, [0046], [0042], Fig. 7(a) (annotated detail below); Pozar, ¶221.



I. Limitation [14.n]

14.n	at least one of the first antenna and the second antenna is proximate to a corner of the first rectangular area; and
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Zhao meets [14.n] in at least two ways because **antenna 40** (*first antenna*) and **antenna 50** (*second antenna*) are each disposed proximate to a corner of the “rectangular area” that circumscribes the ground plane (and PCB). Zhao, Fig. 7a (annotated detail below); [0046], *supra* §§IX.B.1.b ([14.a]), IX.B.1.c ([14.b]); Pozar, ¶222.



As can be observed in Zhao’s Figure 7a, *first antenna* 40 is located above and spans the length of the upper-side of the PCB, while *second antenna* 50 is in the lower-right corner. Zhao, [0044], [0046]. The PCB comprises a ground plane (electrically conductive layer 23) that is coterminous with the PCB excepting the aperture formed by slot 27, as shown in Figs. 3-4. *Supra* §IX.B.1.b ([14.a]); Zhao, Figs. 3-4, [0038], [0042]; Pozar, ¶223.

Thus, *antenna* 40 is “*proximate to*” both upper corners and *antenna* 50 is “*proximate to*” the lower-right corner of the *ground plane’s* rectangular area. POSAs would have recognized that Zhao’s antennas are both “*proximate*” to their respective upper and lower corners because Zhao teaches separating the antennas as far as possible across the PCB for better performance. Zhao, [0055] (“[T]he best isolation performance... is obtained when the PIFA antenna 40 and the quarter-wavelength slot UWB antenna 50 have the greatest separation distance.”); Pozar, ¶224.

Regardless, POSAs would have found it obvious to position each antenna in this manner because Zhao describes maximizing the distance between antennas. Pozar, ¶225.

m. Limitation [14.o]

14.o	the first antenna and the second antenna are located internally within the wireless handheld or portable device.
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Zhao meets [14.o] because **antenna 40** (*first antenna*) is a PIFA [planar inverted F antenna] antenna “located 8 mm above the PCB” of the mobile terminal and **antenna 50** (*second antenna*) is slot antenna disposed in rectangular slot 27 in conductive layer 23 (*e.g.*, the ground plane) on the mobile terminal PCB. Zhao, [0042], [0044], [0046]. POSAs would have disposed the PCB, and the two antennas, “*internally within*” the wireless mobile terminal (“*wireless handheld or portable device*”) because a mobile device PCB and its electronics were conventionally located internal to the mobile device. *Supra* §VI.B (discussing PCBs housed in mobile devices, *e.g.*, EX1032-EX1034); Pozar, ¶226.

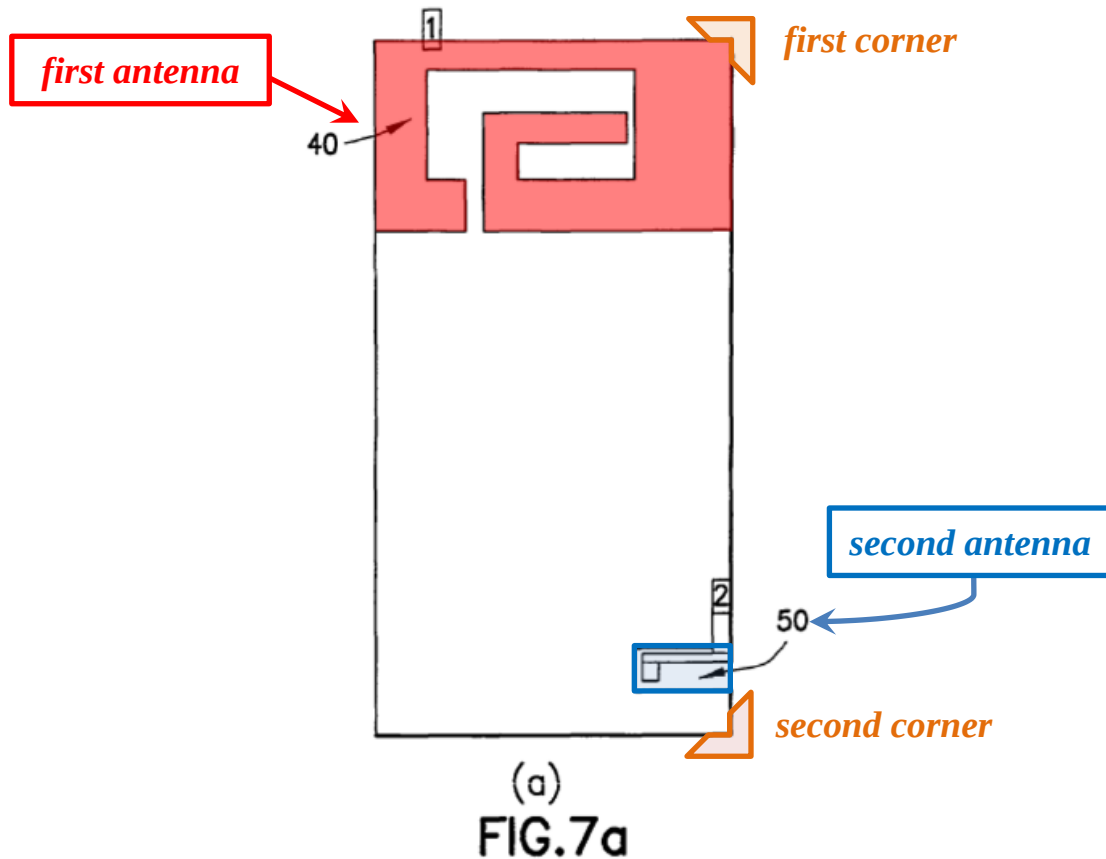
POSAs would have had additional reason to place both antennas (and PCB) internally because a mobile device conventionally comprised a housing to protect the PCB, its electronics, and the antennas from external exposure and physical damage. *E.g.*, Gaucher⁸⁴⁸, [0003]-[0004]; Asano, [0006]. Moreover, POSAs would have understood that Zhao’s planar (PIFA) and slot antenna form factors were well-suited to placement within a mobile device housing because their profiles conformed to the PCB profile, *e.g.*, planar and rectangular, which would readily have been located internal to the mobile device. Pozar, ¶227.

2. Claim 15

15	[Claim 14's device], wherein the first antenna is proximate to a first corner of the first rectangular area and the second antenna is proximate to a second corner of the first rectangular area.
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As discussed *supra* §§IX.B.1.b ([14.a]), IX.B.1.l ([14.n]), Zhao's PCB forms a *ground plane* defining "*the first rectangular area.*" Zhao, [0038], [0046], Fig. 7a (annotated detail below).

Zhao's Figure 7a (annotated detail below) teaches that the *first antenna 40* is located above and spans across the upper corners of the PCB and the *second antenna 50* is in the bottom-right corner of the PCB, making either of the upper corners "*a first corner*" and the bottom-right corner "*a second corner,*" as claimed. Pozar, ¶229.



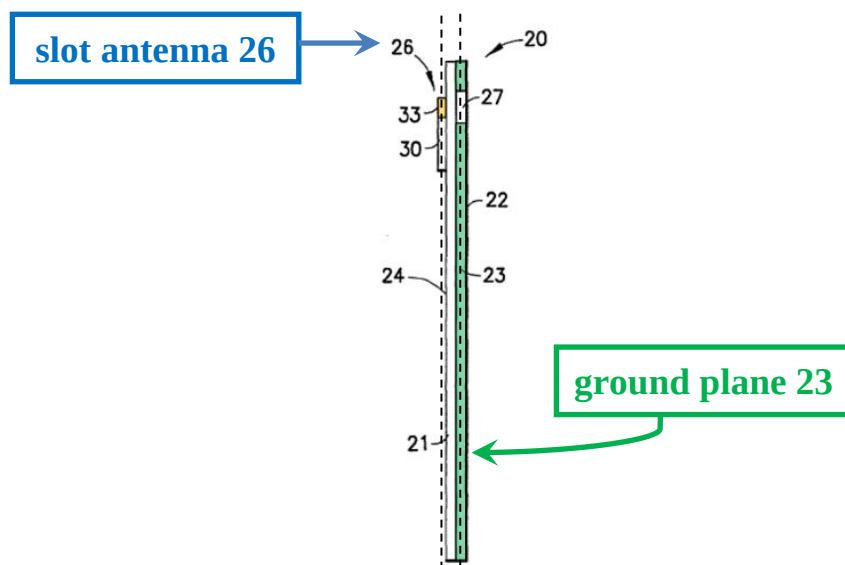
As also discussed *supra* §§IX.B.1.b ([14.a]), IX.B.1.l ([14.n]), Zhao teaches that both antennas are “proximate” to their respective upper and lower corners because when placing the antennas on the PCB as Zhao describes “the greatest separation distance” between the antennas provides “the best isolation performance.” Zhao, [0049], [0055]; Pozar, ¶230.

3. Claim 16

16	[Claim 14’s device], wherein the second antenna is contained in a plane substantially parallel to a plane containing the ground plane.
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Zhao meets claim 16 because “quarter-wavelength slot antenna 26” (e.g., antenna 50 in Fig. 7a) comprises L-shaped stud 33 “printed on second side[] 24 of

the PCB[] 20” opposite the “first side[] 22” comprising electrically conductive layer 23 (e.g., *ground plane*). Zhao, Fig. 4 (annotated detail below), [0042], [0046]; *supra* §§IX.B.1.b ([14.a]), IX.B.1.i ([14.k]). As shown in Figure 4 (annotated detail below), slot antenna 26 is contained with a plane that is “*substantially parallel*” to the plane containing layer 23 similar to the slot antennas described in the ’458 patent. *See, e.g.*, Zhao, [0014], [0042] (describing printing slot antenna on PCB); EX1001, 10:53-54 (same); Pozar, ¶¶231-232.



4. Claim 17

17	[Claim 14’s device], wherein the at least one frequency band is used for a wireless connectivity service selected from the group comprising: Bluetooth™, IEEE802.11a, IEEE802.11b, IEEE802.11g, WLAN, WiFi, UWB, ZigBee, GPS, Galileo, SDARs, XDARS, WiMAX, DAB, FM, DVB-H, and DMB.
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Zhao meets claim 17 because “quarter-wavelength slot UWB antenna 50” / slot antenna 26 (e.g., *second antenna*) is a UWB antenna that “operat[es] in the

frequency range of 3.1 GHz to 4.9 GHz[.]” Zhao, [0002], [0007], [0038], [0042], [0046]; *supra* §IX.B.1.e ([14.e]).

5. Claim 18

18	[Claim 14’s device], wherein the first antenna is an antenna selected from the group comprising: a monopole antenna, an inverted-F antenna, a patch antenna, and a planar inverted-F antenna.
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Zhao meets claim 18 because antenna 40 (*first antenna*) is a “dual-band *planar inverted F-antenna*.” Zhao, Fig. 7a, [0015], [0021], [0023], [0035], [0044], [0046]-[0047], claim 6.

X. *SOTERA*

Petitioners stipulate that if IPR is instituted on this Petition they will not pursue, in the Texas Litigation, any ground raised or that reasonably could have been raised in IPR. *Sotera Wireless v. Masimo*, IPR2020-01019, Paper 12, 18-19 (Dec. 1, 2020) (precedential as to §II.A).

XI. DISCRETIONARY DENIAL IS UNWARRANTED

There is no basis for discretionary denial. Petitioners rely on the Director’s March 26, 2025 Memorandum concerning Interim Processes for PTAB Workload Management⁵ and the Board’s guidance concerning “the new interim processes

⁵ Available at <https://www.uspto.gov/sites/default/files/documents>

/InterimProcesses-PTABWorkloadMgmt-20250326.pdf (visited April 30, 2025).

relating to institution in AIA proceedings”⁶ wherein “the Director... will determine whether discretionary denial of institution is appropriate” in separate briefing filed after a Notice of Filing Date Accorded.

Petitioners reserve the right to respond to any Patent Owner discretionary denial arguments in opposition briefing under the March 26, 2025 Interim Process.

⁶ FAQ, available at <https://www.uspto.gov/patents/ptab/faqs/interim-processes-workload-management> (visited April 30, 2025); USPTO Boardside Chat (Apr. 17, 2025), available at <https://www.uspto.gov/about-us/events/learn-about-new-interim-processes-relating-institution-aia-proceedings> (visited April 30, 2025).

XII. CONCLUSION

The Board should institute review and cancel claims 1-10 and 12-19.

Respectfully submitted,
Geotab Inc. and Geotab USA, Inc.

Dated: April 30, 2025

By: /Adam R. Wichman/
Adam R. Wichman, Reg. No. 43,988
WOLF, GREENFIELD & SACKS, P.C.

APPENDIX A: U.S. PATENT NO. 8,810,458 CLAIM LIST

REF	Limitation
[1.PRE]	A wireless handheld or portable device comprising:
[1.a]	a ground plane;
[1.b]	the ground plane is inscribed in a rectangular area comprising a first side and a second side, a length of the second side being greater than a length of the first side;
[1.c]	a first antenna configured to transmit and receive electromagnetic waves corresponding to at least three frequency bands;
[1.d]	the at least three frequency bands being used for mobile communication services;
[1.e]	a second antenna configured to receive electromagnetic waves corresponding to at least one frequency band;
[1.f]	the at least one frequency band being used for wireless connectivity services;
[1.g]	the first antenna extends in a direction substantially parallel to the first side;
[1.h]	the second antenna extends in a direction substantially parallel to the second side;
[1.i]	the first antenna is arranged substantially close to the first side; and
[1.j]	the first antenna and the second antenna are located internally within the wireless handheld or portable device.
2	The wireless handheld or portable device according to claim 1, wherein the second antenna is arranged substantially close to the second side.
3	The wireless handheld or portable device according to claim 2, wherein the second antenna is arranged substantially close to a corner of the rectangular area.
4	The wireless handheld or portable device according to claim 1, wherein the first antenna is arranged substantially close to a corner of the rectangular area.

REF	Limitation
5	The wireless handheld or portable device according to claim 1, wherein the first antenna is an antenna selected from the group comprising: a monopole antenna, an inverted-F antenna, a patch antenna, and a planar inverted-F antenna.
6	The wireless handheld or portable device according to claim 5, wherein the second antenna is an antenna selected from the group comprising: a monopole antenna, an inverted-F antenna, a patch antenna, and a planar inverted-F antenna.
7	The wireless handheld or portable device according to claim 1, wherein the at least one frequency band used for wireless connectivity services corresponds to at least one wireless connectivity service selected from the group comprising: Bluetooth™, IEEE802.11a, IEEE802.11b, IEEE802.11g, WLAN, WiFi, UWB, ZigBee, GPS, Galileo, SDARs, XDARS, WiMAX, DAB, FM, DVB-H, and DMB.
[8.PRE]	A portable device comprising:
[8.a]	a ground plane;
[8.b]	a first antenna configured to transmit and receive electromagnetic waves corresponding to at least three frequency bands;
[8.c]	the at least three frequency bands being used for mobile communication services;
[8.d]	a second antenna configured to operate in at least one frequency band;
[8.e]	the first antenna extends in a direction substantially parallel to a first side of the portable device;
[8.f]	a length of a second side of the portable device is greater than a length of the first side of the portable device;
[8.g]	the first antenna is arranged substantially close to the first side of the portable device;
[8.h]	the second antenna is arranged substantially close to a first corner of the portable device;
[8.i]	the first corner of the portable device corresponding to a first end of the first side with an end of the second side of the portable device; and

REF	Limitation
[8.j]	the first antenna and the second antenna are located internally within the portable device.
9	The portable device according to claim 8, wherein a portion of an orthogonal projection of the first antenna on a plane containing the ground plane does not overlap with the ground plane.
10	The portable device according to claim 8, wherein the second antenna is substantially close to the first side of the portable device and extends in a direction substantially parallel to the first side of the portable device.
11	The portable device according to claim 8, wherein the at least one frequency band is used for a mobile communication service, and said at least one frequency band being different from the at least three frequency bands.
12	The portable device according to claim 8, wherein the first antenna is an antenna selected from the group comprising: a monopole antenna, an inverted-F antenna, a patch antenna, and a planar inverted-F antenna.
13	The portable device according to claim 12, wherein the second antenna is an antenna selected from the group comprising: a monopole antenna, an inverted-F antenna, a patch antenna, and a planar inverted-F antenna.
[14.PRE]	A wireless handheld or portable device comprising:
[14.a]	a ground plane;
[14.b]	the ground plane is inscribed in a first rectangular area comprising a first side, a second side and a third side, a length of the second side being greater than a length of the first side and a length of the third side;
[14.c]	a first antenna configured to transmit and receive electromagnetic waves corresponding to at least two frequency bands;
[14.d]	the at least two frequency bands being used for mobile communication services;
[14.e]	a second antenna configured to operate in at least one frequency band;

REF	Limitation
[14.f]	the at least one frequency band being different from the at least two frequency bands;
[14.g]	the first antenna extends in a direction substantially parallel to the first side;
[14.h]	the first antenna is proximate to the first side;
[14.i]	the second antenna extends in a direction substantially parallel to the third side;
[14.j]	the second antenna is proximate to the third side;
[14.k]	the second antenna is inscribed in a second rectangular area;
[14.l]	a sum of a length and a width of the second rectangular area is smaller than a quarter of an operating wavelength of the second antenna;
[14.m]	a geometry of the first antenna being different than a geometry of the second antenna;
[14.n]	at least one of the first antenna and the second antenna is proximate to a corner of the first rectangular area; and
[14.o]	the first antenna and the second antenna are located internally within the wireless handheld or portable device.
15	The wireless handheld or portable device according to claim 14, wherein the first antenna is proximate to a first corner of the first rectangular area and the second antenna is proximate to a second corner of the first rectangular area.
16	The wireless handheld or portable device according to claim 14, wherein the second antenna is contained in a plane substantially parallel to a plane containing the ground plane.
17	The wireless handheld or portable device according to claim 14, wherein the at least one frequency band is used for a wireless connectivity service selected from the group comprising: Bluetooth™, IEEE802.11a, IEEE802.11b, IEEE802.11g, WLAN, WiFi, UWB, ZigBee, GPS, Galileo, SDARs, XDARS, WiMAX, DAB, FM, DVB-H, and DMB.

REF	Limitation
18	The wireless handheld or portable device according to claim 14, wherein the first antenna is an antenna selected from the group comprising: a monopole antenna, an inverted-F antenna, a patch antenna, and a planar inverted-F antenna.
19	The wireless handheld or portable device according to claim 18, wherein the second antenna is an antenna selected from the group comprising: a monopole antenna, an inverted-F antenna, a patch antenna, and a planar inverted-F antenna.
20	The wireless handheld or portable device according to claim 14, wherein the second antenna is fitted over a curved surface.

CERTIFICATE OF WORD COUNT

Pursuant to 37 C.F.R. § 42.24, the undersigned certifies that the foregoing Petition for *Inter Partes* Review contains 13,806 words excluding a table of contents, a table of authorities, Mandatory Notices under § 42.8, a certificate of service or word count, or appendix of exhibits or claim listing. Petitioner has relied on the word count feature of the word processing system used to create this paper in making this certification.

Date: April 30, 2025

/Dara Del Rosario/
Dara Del Rosario
Paralegal
WOLF, GREENFIELD & SACKS, P.C.

CERTIFICATE OF SERVICE UNDER 37 C.F.R. § 42.6 (E)(4)

I certify that on April 30, 2025, a copy of the foregoing document, including any exhibits or appendices filed therewith, is being served via *Overnight FedEx* at the following correspondence address of record for the patent:

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Date: April 30, 2025

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