UNITED STATES PATENT AND TRADEMARK OFFICE

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**BEFORE THE PATENT TRIAL AND APPEAL BOARD**

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JOHNSON CONTROLS INC.,
Petitioner,

v.

FRACTUS S.A.,
Patent Owner.

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Case IPR2026-00338
U.S. Patent No. 8,738,103
Title: Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Device

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# PETITION FOR *INTER PARTES* REVIEW UNDER 35 U.S.C. §§ 311-319 AND 37 C.F.R. § 42.100 *et seq*.

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## TABLE OF AUTHORITIES

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**Table of Key Words & Abbreviations**

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|---|---|
| Baliarda | U.S. Published Patent Application No. 2004/0119644 |
| CDMA | Code-Division Multiple Access |
| DCS | Digital Communication System |
| Dominquez | U.S. Published Patent Application No. 2002/0175211 |
| GSM | Global System for Mobile |
| Hill | U.S. Patent No. 6,239,765 |
| HSDPA | High-Speed Downlink Packet Access |
| ISM | Industrial, Scientific, and Medical |
| Koyanagi | U.S. Published Patent Application No. 2007/0229383 |
| LCD | Liquid Crystal Display |
| Lehtola | U.S. Patent No. 6,476,769 |
| LTE | Long Term Evolution |
| MIMO | Multiple In Multiple Out |
| MFWD | Multifunction Wireless Device |
| OS | Operating System |
| Ozden | U.S. Patent No. 7,183,983 |
| PCB | Printed Circuit Board |
| PCS | Personal Communication Services |
| PDA | Personal Digital Assistant |
| PIFA | Planar Inverted F- Antenna |
| POSA | Person of Ordinary Skill in the Art |
| Ramer | U.S. Patent No. 7,548,915 |
| TFT | Thin Film Transistor |
| Tran | U.S. Patent No. 6,989,794 |
| UI | User Interface |
| UMTS | Universal Mobile Telecommunications System |
| UWB | Ultra-wideband |
| VSWR | Voltage Standing Wave Ratio |
| WCDMA | Wideband Code-Division Multiple Access |
| WiBro | Wireless Broadband |
| WiMax | Worldwide Interoperability for Microwave Access |
| WLAN | Wireless Local Area Network |
| Zeilinger | U.S. Published Patent Application No. 2003/0189522 |

# TABLE OF EXHIBITS

| Exhibit No. | Material |
|---|---|
| 1001 | U.S. Patent No. 8,738,103 ("the '103 patent") |
| 1002 | Excerpts from the File/Prosecution History of the '103 patent |
| 1003 | Ex Parte Reexamination (90/019,500) Certificate for the '103 patent |
| 1004 | Reexamination Control No. 90/019,500 – Order Granting Request for Ex Parte Reexamination (July 24, 2024) |
| 1005 | Reexamination Control No. 90/019,500 – USPTO Office Action (Nov. 07, 2024) |
| 1006 | Reexamination Control No. 90/019,500 – Patent Owner's Response to Non-Final Office Action (Jan 3, 2025) |
| 1007 | IPR2024-00087, *Vivint, Inc v. Fractus, S.A.*, Settlement Prior to Institution (Feb. 20, 2024) |
| 1008 | Expert Decl. of Stuart A. Long, *Fractus, S.A. v. ADT LLC*, No. 2:22-00412 (lead case) (E.D. Tex.); *Fractus S.A. v. Vivint, Inc.,* No. 2:22-00413 (E.D. Tex.) |
| 1009 | Claim Construction Order (Feb. 26, 2024), *Fractus, S.A. v. ADT LLC*, No. 2:22-00412 (E.D. Tex.) |
| 1010 | Fractus's Opening Claim Construction Brief (Nov. 16, 2023) , *Fractus, S.A. v. ADT LLC,* No. 2:22-00412 (E.D. Tex.); *Fractus, S.A. v. Vivint, Inc.,* No. 2:22-200413 (E.D. Tex.) |
| 1011 | Complaint for Patent Infringement, *Fractus, S.A. v. Geotab Inc.*, No. 2:24-1008 (E.D. Tex.) |
| 1012 | Expert Declaration of Dr. Emmanouil Tentzeris in Support of Petition for *Inter Partes* Review of Patent No. 8,738,103 |
| 1013 | Curriculum Vitae of Dr. Emmanouil Tentzeris |
| 1014 | Pascal Ciais, et al., *Design of an Internal Quad-Band Antenna for Mobile Phones.* IEE Microwave and Wireless Components Letters, Vol. 14, No. 4 (April 2004) ("Ciais-Quadband") |
| 1015 | U.S. Published Patent Application No. 2007/0238483 ("Boireau") |

| Exhibit No. | Material |
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| 1016 | Chinese Published Patent Application No. CN1728456A ("CN456") |
| 1017 | ETSI TS 145 005 V4.3.0 (2001-04), Digital cellular telecommunications system (Phase 2+); Radio transmission and reception (3GPP TS 45.005 version 4.3.0 Release 4) Global System for Mobile Communications |
| 1018 | Erik Dahlman, et al., 3G Evolution HSPA and LTE for Mobile Broadband, 2nd ed. 2007 |
| 1019 | ETSI TS 125 308 V6.2.0 (2004-09), Universal Mobile Telecommunications System (UMTS); UTRA High Speed Downlink Packet Access (HSDPA); Overall description; Stage 2 (3GPP TS 25.308 version 6.2.0 Release 6)) |
| 1020 | ETSI TS 121 101 v.6.0 (2004-12), Universal Mobile Telecommunications System (UMTS); Technical Specifications and Technical Reports for a UTRAN-based 3GPP system (3GPP TS 21.101 version 6.0.0 Release 6) |
| 1021 | ETSI TS 125 101 v6.5.0 (2004-09), Universal Mobile Telecommunications Systems (UMTS); User Equipment (UE) radio transmission and reception (FDD) (3GPP TS 25.101 version 6.5.0 Release 6) |
| 1022 | ETSI TS 125 102 v6.0.0 (2003-12); Universal Mobile Telecommunications System (UMTS); User Equipment (UE) radio transmission and reception (TDD) (3GPP TS 25.102 version 6.0.0 Release 6) |
| 1023 | 3GPP TS 36.101 V.8.4.0 (2008-12); 3rd Generation Partnership Project; Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception (Release 8) |
| 1024 | Ericsson (2009) LTE—an introduction [White paper]. |
| 1025 | Anne L. Fischer, "Camera Phones Emerge as a Health Care Tool" available at https://www.photonics.com/Articles/Camera-Phones-Emerge-as-a-Health-Care-Tool/a44077 (May 2006) ("Fischer"). |
| 1026 | Young Jun Cho, et al., *An Internal PIFA for 2.4/5 GHz WLAN applications*. APMC 2005 ("Cho") |

| **Exhibit No.** | **Material** |
|---|---|
| 1027 | Claim Construction Order (Mar. 17, 2026), *Fractus, S.A. v. Verizon Connect Inc., et al.*, No. 2:24-01009-JRG-RSP (E.D. Tex.) |
| 1028 | Michael Kanellos, "Micron crafts 5-megapixel sensor for cell phones". CNET (Sep.13, 2005) ("Kanellos") |
| 1029 | Erlend Bakke, "The smartphone camera evolution" Autopix (Oct. 14, 2004) *available at* https://www.autopix.no/blog/smartphone-cameras-have-come-a-long-way-since-the-early-days-of-mobile-phones ("Bakke") |

# I. INTRODUCTION

Johnson Controls Inc. ("JCI" or "Petitioner") petitions for *inter partes* review ("IPR") under 35 U.S.C. §§ 311-319 and 37 C.F.R. §§ 42 et seq., seeking cancellation of claims 1-11, 13-14, and 16-20 (the "Challenged Claims") of U.S. Patent No. 8,738,103 ("the '103 patent") (Ex. 1001), assigned to Patent Owner, Fractus S.A. ("Fractus" or "Patent Owner").

# II. MANDATORY NOTICES PURSUANT TO 37 C.F.R. § 42.8(A)(1)

## A. Real Party-In-Interest under 37 C.F.R. § 42.8(b)(1)

Pursuant to 37 C.F.R. § 42.8(b)(1), Petitioner certifies that Petitioner JCI is the real party-in-interest. Petitioner JCI has the sole authority to direct all activities relating to this Petition or any future proceedings related to this Petition.

## B. Related Matters under 37 C.F.R. § 42.8(b)(2)

Pursuant to 37 C.F.R. § 42.8(b)(2), Petitioner is aware of the following related matter(s), which could affect or be affected by this matter:

### 1. United States Patent and Trademark Office

The '103 patent issued from Application No. 11/614,429, which claims priority from Provisional Application No. 60/831,544 filed July 18, 2006, and Provisional Application No. 60/856,410 filed November 3, 2006.

The following applications are continuations of Application No. 11/614,429 filed December 21, 2006, that issued as the '103 patent:

- U.S. Application No. 14/246,491, which issued as U.S. Patent No. 9,099,773;
- U.S. Application No. 14/738,090, which issued as U.S. Patent No. 9,899,727;
- U.S. Application No. 15/856,626, which issued as U.S. Patent No. 10,644,380 ("the '380 patent");
- U.S. Application No. 16/832,820, which issued as U.S. Patent No. 11,031,677 ("the '677 patent");
- U.S. Application No. 17/246,192, which issued as U.S. Patent No. 11,349,200 ("the '200 patent");
- U.S. Application No. 17/704,942, which issued as U.S. Patent No. 11,735,810 ("the '810 patent");
- U.S. Application No. 18/339,523, which issued as U.S. Patent No. 12,095,149 ("the '149 patent");
- U.S. Application No. 90/019,275, which is the *ex parte* reexamination certificate for the '200 patent.
- U.S. Application No. 90/019,500, which is the *ex parte* reexamination certificate for the '103 patent pursuant to which independent claims 12 and 15 were cancelled (all other claims of the '103 patent were not reexamined). Ex.1003, 1:10.

### C. United States Patent Trial and Appeal Board

**D. ’103 patent**

Claims 12 and 15 of the ’103 patent were previously challenged by Vivint in IPR2024-0087. However, the PTAB terminated the IPR prior to institution. Ex.1007.

**E. Related Patents**

The ’677 patent, which issued as a continuation of the ’103 patent, is the subject of pending and instituted IPR2025-01026 and IPR2026-00191 for all claims.

The ’200 patent, which issued as a continuation of the ’103 patent, was the subject of IPR2024-000888 and IPR2025-01027. IPR2024-000888 was terminated prior to decision to institute. IPR2025-01027 was instituted for all claims and is currently pending.

The ’149 patent, which issued as a continuation of the ’103 patent, was the subject of IPR2025-00056. The PTAB denied institution.

**F. District Court Matters**

The ’103 patent, and/or the ’200 ’677, and ’149 patents (each of which issued from a continuation of the ’103 patent) were asserted in the following actions:

| Case Caption | Disposition |
|---|---|
| *Fractus S.A. v. Vivint, Inc.*, 2:22-cv-00413 (E.D. Tex.) (“Vivint Litigation”) (’103 patent) | Terminated—settled (Feb. 20, 2024) |
| *Fractus S.A. v. ADT LLC,* 2:22-cv-00412 (E.D. Tex.) (“ADT Litigation”)[1] (’200 patent) | Terminated—settled (Oct. 4, 2024) |

[1] The Vivint Litigation and ADT Litigation were consolidated in No. 2:22-cv-00412.

| Case Caption | Disposition |
|---|---|
| *Fractus, S.A. v. Geotab Inc.*, 2:24-cv-01008 (E.D. Tex) ("Geotab Litigation") ('677, '200, and '149 patents) | Pending |
| *Fractus, S.A. v. Verizon Connect Inc. et al.*, 2:24-cv-01009 (E.D. Tex.) ("Verizon Litigation") ('677 and '149 patents) | Terminated—settled (Mar. 24, 2026) |
| *Fractus, S.A. v. Resmed Inc. and Resmed Corp.*, 3:25-cv-02680-LL-JLB (S.D. Cal.) ('677 patent) | Pending |

### G. Lead and Backup Counsel under 37 C.F.R. § 42.8(b)(3)-(4)

Pursuant to 37 C.F.R. §§42.8(b)(3) and 42.10(a), Petitioner hereby designates the below individuals as its lead and backup counsel:

| Lead Counsel | Backup Counsel |
|---|---|
| Janine A. Carlan, Reg. No. 42,387<br>janine.carlan@afslaw.com<br>ARENTFOX SCHIFF LLP<br>1717 K Street, NW<br>Washington, DC 20006-5344<br>Tel.: 202.857.6000 | Ahmed M.T. Riaz (*pro hac vice* forthcoming)<br>ahmed.riaz@afslaw.com<br>ARENTFOX SCHIFF LLP<br>1301 Avenue of the Americas, 42nd Floor<br>New York, NY 10019<br>Tel: 212.484.3900 |

### H. Service Information under 37 C.F.R. § 42.8(b)(4)

Petitioner consents to service via email at the addresses listed below.

This Petition is being served by Federal Express Next Business Day Delivery on Litigation Counsel for Fractus S.A. and by electronic mail at:

Larry Shatzer
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The consolidated actions are referred to herein collectively as the "Vivint/ADT."

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### I. Power of Attorney under 37 C.F.R. § 42.10(b)

Pursuant to 37 C.F.R. §42.10(b), Petitioner has filed a power of attorney for the above-designated counsel.

## III. REQUIREMENTS FOR IPR UNDER 37 C.F.R. § 42.104

### A. Grounds for Standing under 37 C.F.R. § 42.104(a).

Petitioner hereby certifies that the ’103 patent is available for *inter partes* review, and that the Petitioner is not barred or estopped from requesting this IPR on the grounds identified in this Petition because: (1) Petitioner has not filed a civil action challenging the validity of any claim in the patent; (2) the estoppel provisions of 35 U.S.C. § 315(e)(1) do not prohibit this IPR; and (3) the patent is not described in §3(n)(1) of the America Invents Act and so is available for IPR under 37 C.F.R. § 42.102(a)(2). Petitioner has also not been served with a complaint alleging infringement of the ’103 patent, and is therefore also not barred under 35 U.S.C. § 315(b).

### B. Identification of Challenge and Precise Relief Requested, 37 C.F.R. § 42.104(b)

Petitioner requests cancellation of claims 1-4, 6-10, 13-14, and 16-20 of the ’103 patent on Ground **1** below. Petitioner further requests cancellation of claims 5 and 11 of the ’103 patent on Ground **2** below. Challenged Claims are unpatentable under pre-AIA 35 U.S.C. § 103 based on the combined teachings of:

| Ground | Claims | Obvious from the Combined Teachings of |
|---|---|---|
| **1** | 1-4, 6-10, 13-14, 16-20 | Boireau, CN456, Ciais-Quadband |
| **2** | 5, 11 | Boireau, CN456, Ciais-Quadband, Cho |

## IV. THE ’103 PATENT

### A. Overview

The ’103 patent issued on May 27, 2014, from U.S. Application No. 11/614,429 filed on December 21, 2006, and claims priority to provisional application no. 60/831,544, filed on July 18, 2006, and provisional application no. 60/856,410, filed on November 3, 2006. Therefore, July 18, 2006, is the earliest possible priority date for the ’103 patent. The ’103 patent is therefore also a pre-AIA patent.

The ’103 patent is titled “Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices.” It concerns antennas in multifunctional wireless devices or “MFWDs” such as mobile phones and purports to “provide antenna design parameters that tend to optimize the efficiency of” such antennas. Ex.1001, 4:66-5:3.

The claims recite design parameters called “complexity factors”—a term coined by the inventors—that purports to characterize the “complexity” of an antenna’s three-dimensional shape. *See, e.g.*, *id.*, 5:11-17. The ’103 patent asserts that antennas having “complexity factors” within certain ranges will ensure that the antenna is “optimized.” The ’103 patent does not allege that the inventors were the first to ever design an antenna having “complexity factor” values that fall within the claims.

In addition to the “complexity factor,” the ’103 patent discloses that a “[MFWD] . . . advantageously comprises five functional blocks: display 11, processing module 12, memory module 13, communication module 14, and power management module 15.” *Id.*, 8:13-17. The specification further provides that: (1) the display can include “a touch screen with a size of at least half of the overall device,” *id.*, 9:13-14; (2) “[t]he processing module 12, that is the microprocessor or CPU,” *id.*, 8:21-22; (3) the memory module is one of the blocks; (4) “[t]he antenna system [is] within the communication module 14," *id.*, 8:47; and (5) "[t]he MFWD 100 has a single source of energy and it is the power management module 15." *Id.*, 8:26-28.

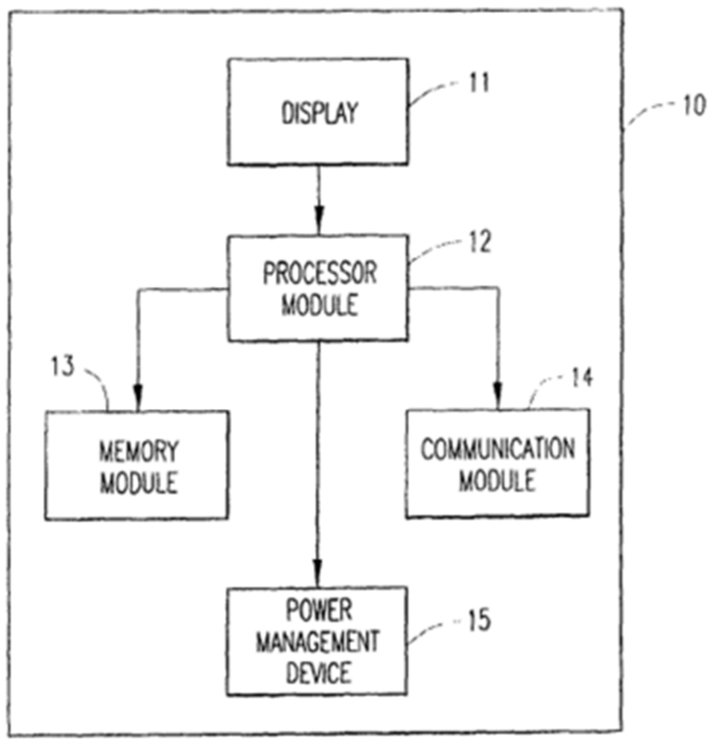


*FIG. 1A*

*Id.*, Fig. 1A.

The '103 patent asserts that the antenna system design "is intended to use efficiently as much of the volume" within a defined space "to obtain a superior RF performance . . . in at least one frequency band." *Id.*, 13:35-40. The patent refers to the resulting antenna structure's "geometrical complexity" (*id.*, 13:44-54) characterized in terms of the aforementioned "complexity factors," which the specification defines as a mathematical calculation based on antenna dimensions, as explained further below. The patent asserts:

> the level of complexity of an antenna contour can be advantageously parameterized by means of two complexity factors, hereinafter referred to as $F_{21}$ and $F_{32}$, which capture and characterize certain aspects of the geometrical details of the antenna contour (such as for instance its edge-richness, angle-richness and/or discontinuity-richness) when viewed at different levels of scale.

*Id.*, 16:28-35. "Complexity factor $F_{21}$ is predominantly characterized by capturing the complexity and degree of convolution of features of the antenna contour that appear when the contour is viewed at coarser levels of scale." *Id.*, 18:51-54. On the other hand, "[c]omplexity factor $F_{32}$ is predominantly characterized by capturing the complexity and degree of convolution of features of the antenna contour that appear when the contour is viewed at finer levels of scale." *Id.*, 19:39-42. In "some embodiments . . . $F_{21}$ is related to the number of paths that [an antenna system] structure . . . provides to electric currents . . . to excite radiation modes . . . . In general, the more frequency bands and/or radiation modes, that need to be supported by the antenna structure . . . the higher the value of $F_{21}$ that needs to be attained." *Id.*, 19:5-15.

The specification shows a single example of an antenna, e.g., an "antenna contour" reflecting a physical antenna layout (Figs. 12A, 17H), with a known frequency response (Fig. 19A) that the patent evaluates for "complexity factor." *Id.*, 37:33-39:32.

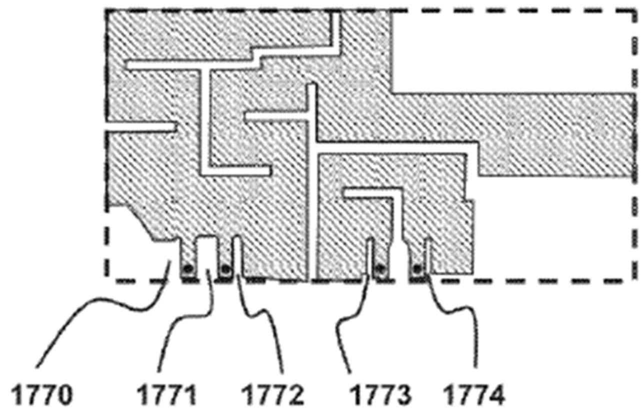


FIG. 17H

This antenna sends and receives electromagnetic signals at radio frequencies that are compatible with GSM and UMTS communication standards. *Id.* Fig. 19A, 37:33-38:11, 39:35-63. The operable frequency ranges are determined at a given VSWR, which measures how well the antenna works with the device electronics (e.g., transceiver) that send and receive electrical signals that the antenna converts to RF radiation. *Id.*, 1:57-59.

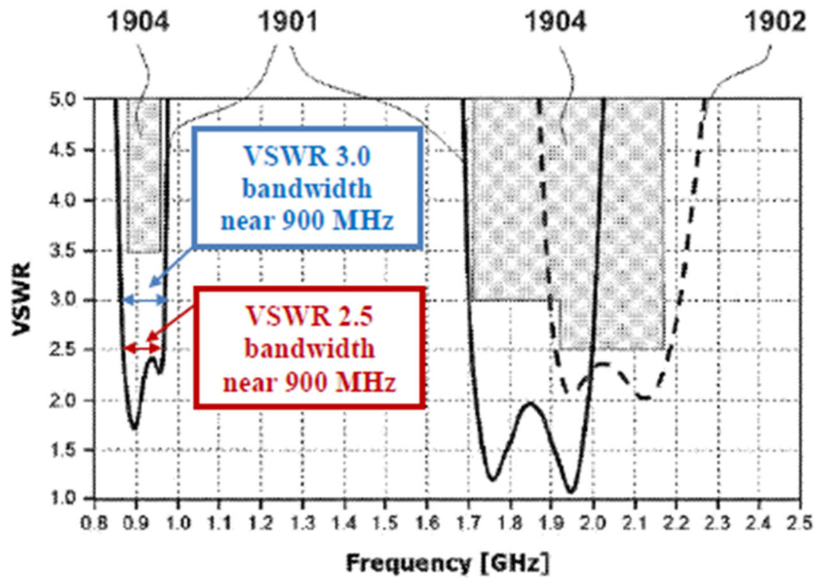


FIG. 19A

Fig. 19A above (annotated) shows that a lower VSWR is associated with lower antenna bandwidth, illustrating a well-known tradeoff between impedance match and antenna bandwidth. The specification describes "maximum" VSWR values for frequency ranges associated with GSM and UMTS communication standards (*id.*, 36:10-44, Table 1), and Figure 19A shades regions with VSWR above the specification's "maximum" levels at different frequency ranges for different communication standards. *Id.*, 39:43-46.

Notably, while the specification describes "complexity factors" for each step of "progressive modification" of an antenna contour from Figs. 17A-17H (*id.*, 37: 48-60, Table 2), the patent never shows the antenna performance—e.g., frequency response—associated with each "progressive modification" or the antenna's "complexity factors."

### B. Challenged Claims

The '103 patent has 20 claims of which claims 1, 6, 12, and 16 are independent claims. However, pursuant to an *ex parte* reexamination, claims 12 and 15 are cancelled. Ex.1003.

Petitioner hereby requests institution of *inter partes* review and cancellation of Challenged Claims 1-11, 13-14, and 16-20.

### C. History

### D. Prosecution History

The application from which the '103 Patent issued (11/614,429) was filed on December 21, 2006.

On August 16, 2010, the examiner issued a non-final office action that rejected original claims 1-3, 6-9, 11, 14, and 20 as being unpatentable over the combination of Ramer and Baliarda. Ex. 1002, 162. Pending claims 12 and 13 were rejected as obvious over Ramer, Baliarda, and Ozden. *Id.*, 174. Claims 16-19 were rejected as obvious over Ramer, Baliarda, and Dominquez". *Id.*, 178. Claims 10 and 15 were rejected as obvious over Ramer, Baliarda, and Koyanagi. *Id.*, 183. On February 11, 2011, Applicant responded and made no amendments nor cancelations to any of their claims. *Id.*, 147.

On March 7, 2011, the examiner issued a final rejection maintaining the original rejections based on the various combinations of Ramer, Puente-Baliarda, Ozden, Dominquez and Koyanagi. *Id.*, 117-45. Applicant requested continued examination on March 21, 2011. *Id.*, 115. Examiner issued a final rejection on May 27, 2011. *Id.*, 87-114.

On November 23, 2011, applicant filed a request for continued examination and amended pending independent claims 1, 16, 18, and 20. *Id.*, 70-85. Examiner issued a non-final rejection on March 19, 2013, asserting claims 1-3, 6-9, 11-14, and 20 were unpatentable over Tran in view of Ramer. *Id.*, 52. Claims 4-5 were rejected as being unpatentable over Tran in view of Ramer and Dominquez. *Id.*, 61. Claims 10 and 15 were rejected as being unpatentable over Tran in view of Ramer and Koyanagi. *Id.*, 62. Claim 16 was rejected as unpatentable over Tran in view of Dominquez. *Id.*, 64. Claim 17 was rejected as being unpatentable over Tran in view of Dominquez and Ramer. *Id.*, 66. Claims 18-19 were rejected as being unpatentable over U.S. Patent No. 6,476,769 to Lehtola in view of Ramer and Dominquez. *Id.*, 67.

On July 17, 2013, Applicant canceled pending claims 1-20 and added claims 21-40. *Id.*, 35-48. Examiner responded that the amendment was non-responsive and withdrew new claims 21-40 from consideration as being directed to a non-elected invention. *Id.*, 32-34. Applicant responded on November 13, 2013, by amending claims 1-5 and 16-20, canceling claims 6-15, and adding claims 21-30. *Id.*, 10-30.

A notice of allowance issued on January 8, 2014. Ex. 1002, 7-9. In the reason for allowance, the examiner stated that the prior art did not render obvious or anticipate the limitation: "wherein a perimeter of the second antenna element defines an antenna contour having a complexity level defined by the factor $F_{21}$ having a value of at least 1.20 and complexity factor $F_{32}$ having a value less than 1.75" and

> wherein a perimeter of the first antenna element defines a first antenna contour comprising at least thirty five segments, the first antenna element defining an antenna box, an orthogonal projection of the antenna box along a normal to a face with a largest area of the antenna box defining an antenna rectangle, wherein a length of the first antenna contour is greater than four times a diagonal of the antenna rectangle; and a second antenna element configured to operate in at least one frequency band used by a 4G communication standard, wherein a perimeter of the second antenna element defines a second antenna contour comprising at least twenty segments.

*Id.*, 8.

### E. IPR2024-0087

In October 2023, Vivint, Inc. ("Vivint") filed an IPR petition asserting that Claims 12 and 15 of the '103 patent should be found unpatentable and canceled. Vivint asserted two grounds: (1) Obviousness in view of Hill and Boireau; and (2) Obviousness in view of Zeilinger and Boireau. IPR2024-0087 was terminated prior to Patent Owner's submission of a preliminary response and before decision to institute. Ex.1007.

### F. *Ex Parte* Reexamination No. 90/019,500

On July 24, 2024, the USPTO issued an Order Granting Request for *Ex Parte* Reexamination of the '103 patent claims 12 and 15 because Boireau and Zeilinger—"the same prior art grounds that were previously presented to the Office in the prior terminated IPR[2024-0087] petition" (Ex.1004, 13)—"do raise a substantial new question of patentability." *Id.*, 8.

On November 7, 2024, the Examiner rejected claims 12 and 15 as obvious over Boireau and Zeilinger because

> [i]t would have been obvious to achieve the claimed invention by modifying the wireless device of Boireau to include two internal antenna elements and a ground plane layer, such as disclosed by Zeilinger, because Boireau expressly teaches incorporating an antenna system comprising one or more PIFAs into the wireless device at paragraph [0025], and Zeilinger teaches that the claimed configurations of the first and second antenna elements were conventional configurations of PIFA-style antenna suitable for use in handheld wireless communication devices.

Ex.1005, 11-12.

In January 2025, Patent Owner did not rebut the rejection of claims 12 and 15 as obvious. Instead, the Patent Owner "cancel[ed] claims 12 and 15 without prejudice or disclaimer." Ex.1006, 4. "As a Result of Reexamination, it has been determined that: claims 12 and 15 are cancelled. Claims 1-11, 13, 14 and 16-20 were not reexamined." Ex.1003, 1:7-12.

## V. LEVEL OF ORDINARY SKILL IN THE ART

Patent Owner submitted the Expert Declaration of Dr. Stuart A. Long (Ex.1008) in support of its claim construction position for the '103 patent in the ADT and Vivint Litigations. Petitioner adopts Dr. Long's definition for a POSA:

> [A] person with at least a bachelor's degree in electrical engineering, computer science, or a similar degree and at least four years of experience in applied electromagnetics with an emphasis on antennas. Alternatively, the [POSA] would have a master's degree in electrical engineering (or similar discipline) and at least two years of similar experience.

Ex.1008, ¶ 32.[2]

## VI. CLAIM CONSTRUCTION

A claim is construed in an IPR proceeding using the standard set forth in *Phillips v. AWH Corp.*, 415 F.3d 1303, 1316-1317 (Fed. Cir. 2005) (*en banc*). 37 C.F.R. §42.100(b).

Except for terms discussed below, Petitioner submits that the Board need not specially construe any terms of the Challenged Claims to institute IPR because they

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[2] While not disputed for purposes of the asserted Grounds, Petitioner reserves the right to dispute Patent Owner's asserted description of the level of ordinary skill in the art.

are shown to be obvious regardless of construction. *Toyota Motor Corp. v. Cellport Sys., Inc.*, IPR2015-00633, Paper 11, 16 (PTAB Aug. 14, 2015). Petitioner reserves all rights to raise claim construction and related challenges under 35 U.S.C. §112 in other proceedings.

### A. "perimeter"

In the ADT Litigation, the Court construed the term "perimeter" as used in the '103 patent and other patents sharing substantively the same specification: "the Court holds the ordinary and customary meaning of 'perimeter' applies, which is 'boundary of an object.'" Ex.1009, 16-17. The Court's construction of "perimeter" comports with the plain and ordinary meaning and the Board should apply it.

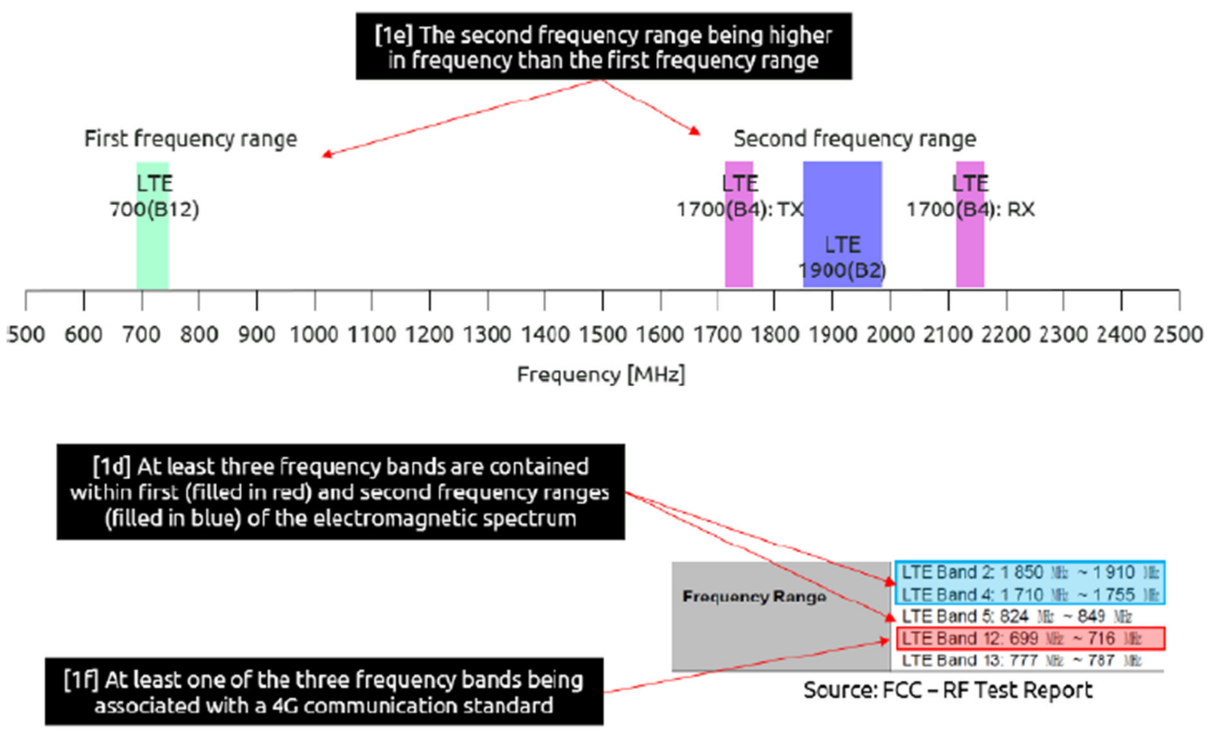
### B. "wireless device"

In the ADT Litigation, the Court construed the term "wireless device" as used in the '103 patent and other patents sharing substantively the same specification: "The ordinary meaning of 'wireless device' in this context refers to the nature of the communication," e.g., that the device can communicate wirelessly. Ex.1009, 11.

### C. "4G communication standard"

In the ADT/Vivint Litigation, Fractus argued that antenna functions: for "4G communication standard" means antenna "compatibility with HSDPA, WiFi, WiMax, WiBro, UWB, or other highspeed wireless standards" and included "second-generation (2G) mobile, IMT-2000, [and] [WLAN]" (Ex.1010, 23-24) while "communication standard" means "technical specifications relating to mobile or radio communication systems, including but not limited to GSM, UMTS, CDMA, W-CDMA, and LTE." *Id.*, 24 n.9. Fractus also argued that "receive signals from a 4G communication standard" means "the antenna could interact with a signal sent by a Fourth-generation cellular technology to obtain or receive electromagnetic energy." *Id.*, 22 n.8 (cleaned up).

In the *Geotab* Litigation, Fractus maps [1.d] "frequency bands being associated with a 4G communication standard" to LTE bands:




Ex.1011, 20-21.

In Verizon Litigation, Fractus again agreed that "4G communication standard[s] include [but not limited to] frequency bands associated with/used by LTE, such as LTE Bands 12, 13, and 14." Ex. 1027, 16-17. The Magistrate Judge ultimately construed this term to mean "4G communications standards that had been adopted or proposed as of the effective filing date of the '677 Patent and the '200 Patent, including but not limited to Long Term Evolution ('LTE')." Ex.1027, 18.

Thus, "4G communication standards" is met by HSDPA, WiFi, WiMax, WiBro, UWB or other highspeed wireless standards and LTE, which was "an evolution of 3G into an evolved radio access." Ex.1011, 3, 21-25. Indeed, the '103 patent itself equates "4G services" with "for instance HSDPA, WiFi, WiMax, WiBro, and other advanced services." Ex.1001, 9:45-47. Further, LTE is a "fourth generation cellular technology" so that an antenna that can send/receive signals using LTE meets the construction of "'receiv[ing] signals' from a 4G communication 'standard.'" Ex.1010, 18 n.8.

**D. "antenna box"**

The '103 patent states that Fig.1B's element 103 shows an "antenna box" (red outline in the image below) and further discloses that

> [a]n antenna box . . . ***is herein defined*** as being the minimum-sized parallelepiped of square or rectangular faces that completely encloses the antenna volume of space and wherein each one of the faces of the minimum-

> sized parallelepiped is tangent to at least one point of the volume. Moreover, each possible pair of faces of the minimum-size parallelepiped shares an edge forming an inner angle of 90°.

Ex.1001, Fig. 1B (annotated), 11:3-12 (emphasis added).

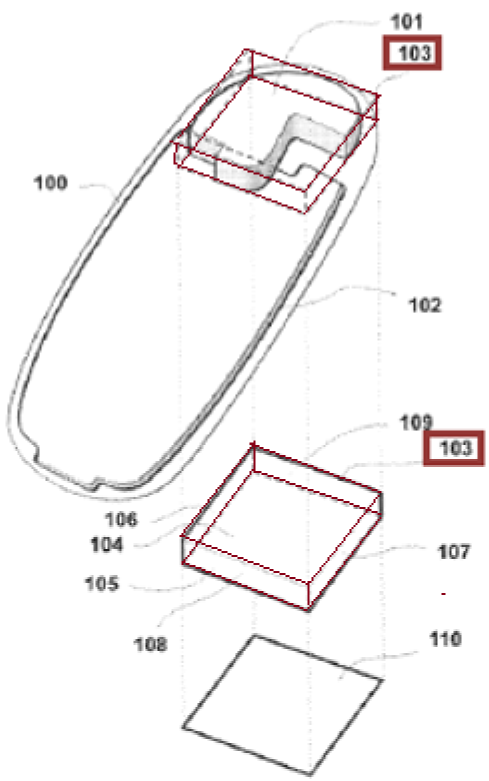



FIG. 1B

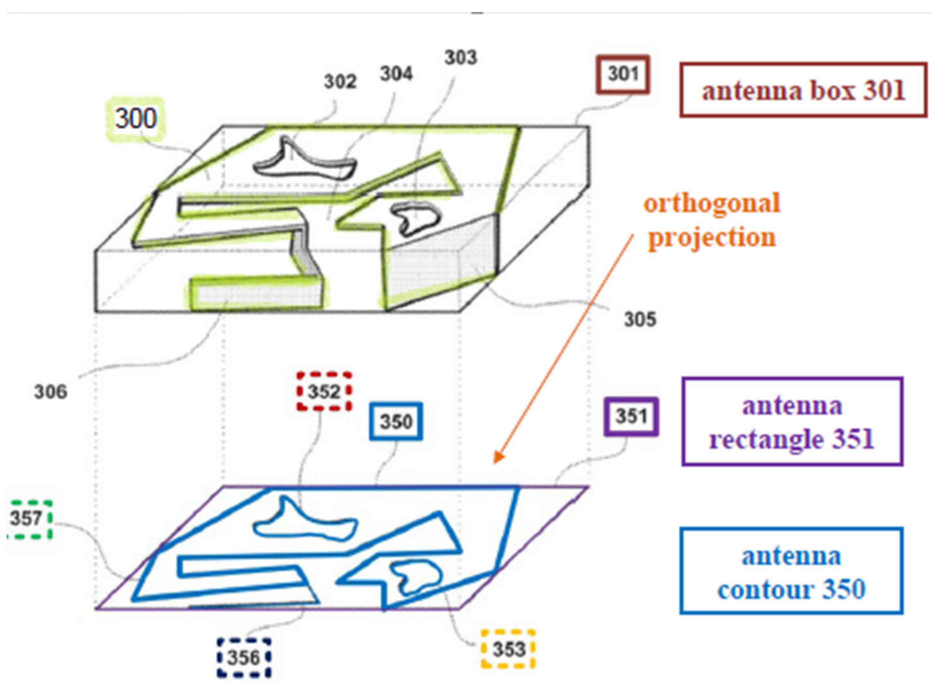
Thus, the inventor acted as his own lexicographer and provides the definition that the Board should apply. *Phillips,* 415 F.3d at 1316 ("specification may reveal a special definition given to a claim term" wherein "the inventor's lexicography governs").

**E. “antenna rectangle”**

The ’103 patent discloses that “an antenna rectangle is defined as being the orthogonal projection of the antenna box along the normal to the face with largest area of the antenna box.” Ex.1001, 13:55-58.

**F. “antenna contour”**

The ’103 patent discloses that “[t]he bottom of Fig. 3 shows an antenna rectangle 351 associated with the antenna box 301. The antenna rectangle 351 contains the antenna contour 350 associated with the antenna element 300”:



EX1001, Fig. 3 (annotated)

Ex.1001, 27:5-8, Fig. 3.

The ’103 patent further discloses that

> [t]he antenna contour of the antenna system is a set of

> joined and/or disjoined segments comprising: the perimeter of one or more antenna elements placed in the antenna rectangle, the perimeter of closed slots and/or closed apertures defined within the antenna elements, and/or the orthogonal projection onto the antenna rectangle of perimeters of antenna elements, or perimeters of or parts of antenna elements that are placed in the antenna box but not in the antenna rectangle" [and further that] [n]ot all the segments that form the antenna contour need to be connected (i.e., to be joined). In some cases, the antenna contour comprises, two, three, four, or more disjointed subsets of segments.

Ex.1001, 14:49-65. The Board is requested to adopt this definition for "antenna contour" as used in the '103 patent.

### G. "complexity factor," "$F_{21}$" "$F_{32}$"[3]

The '103 patent states that "two complexity factors, hereinafter referred to as $F_{21}$ and $F_{32}$ . . . capture and characterize certain aspects of the geometrical details of the antenna contour (such as for instance its edge-richness, angle-richness and/or discontinuity-richness) when viewed at different levels of scale." Ex.1001, 16:30-35.

The "complexity factor $F_{21}$" and "$F_{32}$" have no ordinary meaning in the art, and the patent could have more than one way of calculating complexity factor, which

[3] In the Verizon Litigation, the Court found that "'complexity factor' is indefinite." Ex.1027, 32. Petitioner reserves the right to similarly assert that "complexity factor" is indefinite in any future proceedings.

could lead to inconsistent results. Ex.1027, 32; Ex.1012, ¶¶54-55. However, for purposes of this petition only, Petitioner is using the definition as the numerical result of a calculation based on operations involving overlaying a series of three specifically-formulated grids ($G_1$, $G_2$, and $G_3$, respectively) on the "antenna rectangle," as explained below. Ex.1001, 16:36-46; *Phillips,* 415 F.3d at 1316.

The Court in the ADT Litigation provides the following explanation of how to arrive at the "complexity factor," which Petitioner adopts for purposes of this Petition:

> The first step in computing the complexity factors is finding the antenna contour. To do this, one starts by determining an 'antenna box' and an 'antenna rectangle.'. . . Next, the complexity-factor calculation requires finding an 'antenna contour.' . . . After determining an antenna contour, that contour is overlaid on 'a first, a second, and a third grid (hereinafter called frig $G_1$, grid $G_2$, and grid G3 respectively) of substantially square or rectangular cells . . . . The Three grids are adaptive to the antenna rectangle. That is, the size and aspect ratio of the cells of each one of said three grids is determined by the size and aspect ratio of the antenna itself.
>
> . . .
>
> The starting point for constructing the three grids is grid 2, for which 'the size of a cell and its aspect ratio . . . are first chosen so that the antenna rectangle is perfectly tessellated with an odd number of columns and an odd number of rows.' '103 Patent at 16:58–62; *see also id.*, 17:20–23 ("the number of columns and rows of cells of the second grid that tessellate the antenna rectangle are selected to

> produce a cell as square as possible"). Other parts of the specification suggest a grid G2 with nine columns is preferred. *See id*., 17:12-18 . . . .
>
> After constructing $G_2$, constructing $G_1$ and $G_3$ is straightforward. 'A cell of grid size $G_2$ is half the size of a cell of grid $G_1$ [and] a cell of grid size $G_3$ is half the size of a cell of grid G2, or one fourth the size of a cell of grid $G_1$.' *Id.*, 16:48-52.
>
> From there, $F_{21}$ and $F_{32}$ are computed by counting the number of cells $N_1$, $N_2$, and $N_3$, of the grids $G_1$, $G_2$, and $G_3$, respectively, that are at least partially inside the antenna rectangle and include at least a point of the antenna contour. After counting $N_1$, $N_2$, and $N_3$, [the following formula is applied]
>
> $F_{21} = -(\log(N_2) - \log(N_1)) / \log(1/2)$, and
>
> $F_{32} = -(\log(N_3) - \log(N_2)) / \log(1/2)$.
>
> *Id.*, 18:36–50 (explaining the calculation of $F_{21}$); *id.*, 19:26–38 (explaining the calculation of $F_{32}$).

Ex.1009, 4-7.

Thus, using the '103 patent Figure 14's antenna contour 1410, the patent describes:

- a first grid (Fig. 14A (annotated), 1401) with $N_1$= "fifteen (15) cells," shown as shaded group 1412, and

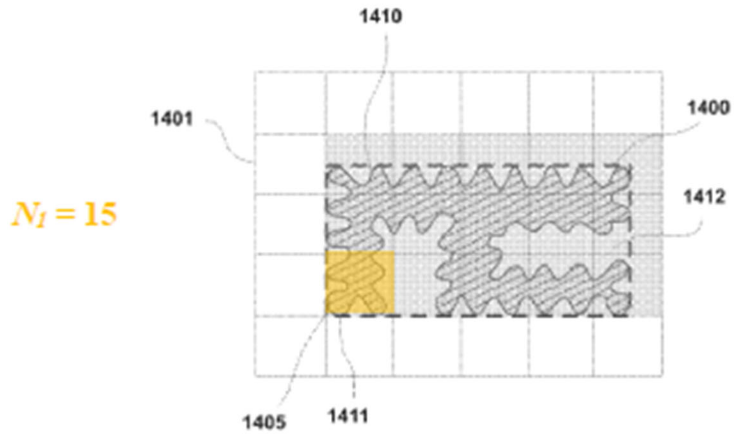



FIG. 14A

- a second grid (Fig.14B (annotated), 1402) with $N_2$= "forty-two (42) cells," shown as shaded group 1413. Within antenna rectangle 1400, unshaded cells do not meet the requirement to "include at least a point of the antenna contour[.]"

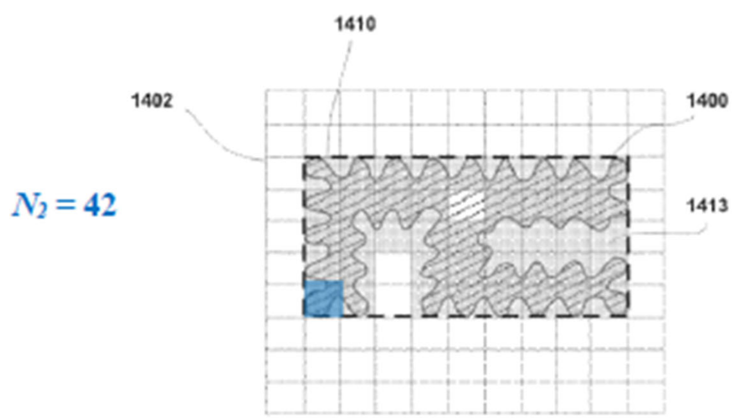



FIG. 14B

- a third grid (Fig. 14C (annotated), 1403) with $N_3$= "one hundred and forty-two (142) cells," shown as shaded group 1414, where unshaded cells in Figure 14C do not meet the $G_3$ cell counting criteria.

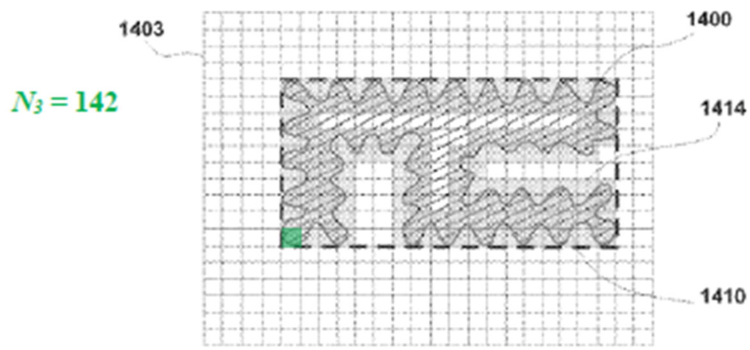



FIG. 14C

Ex.1001, Figs. 14A-14C (annotated), 33:59-34:2.

The complexity factor $F_{21}$ for antenna contour 1410 is therefore:

$$F_{21} = -\left(\frac{\log(N_2) - \log(N_1)}{\log(1/2)}\right) = -\left(\frac{\log(42) - \log(15)}{(-1)\log(2)}\right)$$
$$= \left(\frac{\log(42/15)}{\log(2)}\right) = \left(\frac{0.447}{0.301}\right) = 1.49.$$

*Id.*, 34:9-15. And the complexity factor $F_{32}$ for antenna contour 1410 is therefore:

$$F_{32} = -\left(\frac{\log(N_3) - \log(N_2)}{\log(1/2)}\right) = -\left(\frac{\log(142) - \log(42)}{(-1)\log(2)}\right)$$
$$= \left(\frac{\log(142/42)}{\log(2)}\right) = \left(\frac{0.529}{0.301}\right) = 1.76.$$

*Id.*, 34:16-21.

In the ADT Litigation, Fractus argued that the ’103 patent specification "explain[s] precisely how to calculate the complexity factors $F_{21}$ and $F_{32}$ [.]" Ex.1010, 28. JCI's expert, Dr. Tentzeris, applies the above approach in his analysis of the complexity factors for the Ciais-Quadband PIFA in his declaration supporting the present petition. Ex.1012, ¶¶54-77, 163-85. Notably, Dr. Daniel Van Der Weide, who was the expert for the petitioners in IPR2025-01026 similarly applied the above approach to calculate the complexity factors for Ciais-Quadband. IPR2025-01026 (Ex. 1007, ¶¶77-100, 188-213). Thus, the above, including the ADT Litigation Court's explanation, sets forth the '103 patent's construction for "complexity factors", "$F_{21}$" and "$F_{32}$" and should be adopted by the Board.

## VII. PRIOR ART

JCI identifies the prior art that renders unpatentable, alone or in combination, each of the Challenged Claims of the '103 patent. To the extent any elements of the Challenged Claims are deemed missing from the references, such elements would have been known or obvious to a POSA at the time of the invention. *See KSR, Int'l Co. v. Teleflex, Inc.*, 550 U.S. 398 (2007).

JCI reserves the right to rely on inherency, public use, offer for sale, and/or sale of the products described in the prior art once JCI has had an opportunity to take discovery on these subjects.

Without limiting the contents of the prior art references, JCI sets forth a summary of each prior art reference below. Where elements are disclosed at multiple locations within a single prior art reference, JCI has not necessarily identified every location. Likewise, where a reference is listed for one or more claim elements, JCI has not necessarily identified every element, or claim, to which that reference applies. JCI may rely on uncited portions of the identified prior art, references identified in the prior art disclosed herein, other documents, and expert testimony. Citations to a particular Example, Table, or Figure from a reference include the caption and description and any text relating to the same. Similarly, citations to text referring to an Example, Table, or Figure also include the Example, Table, or Figure and caption.

Under 35 U.S.C. § 102(a)(1) & (2):

| Citation | Date Published or Issued |
|---|---|
| Pascal Ciais, et al., *Design of an Internal Quad-Band Antenna for Mobile Phones.* IEE Microwave and Wireless Components Letters, Vol. 14, No. 4 (April 2004) ("Ciais-Quadband") | April 2004 |
| U.S. Published Patent Application No. 2007/0238483 ("Boireau") | Filed: April 5, 2006<br>Published: Oct. 11, 2007 |
| Chinese Published Patent Application No. CN1728456A ("CN456") | Filed: July 1, 2005<br>Published: February 1, 2006 |
| Young Cho, et al., *An Internal PIFA for 2.4/5 GHz WLAN applications,* 2005 APMC Proceedings, Suzhou, China, 2005 ("Cho") | Published 2005 |

### A. Summaries of Prior Art

**1. Ciais-Quadband (Ex.1014)**

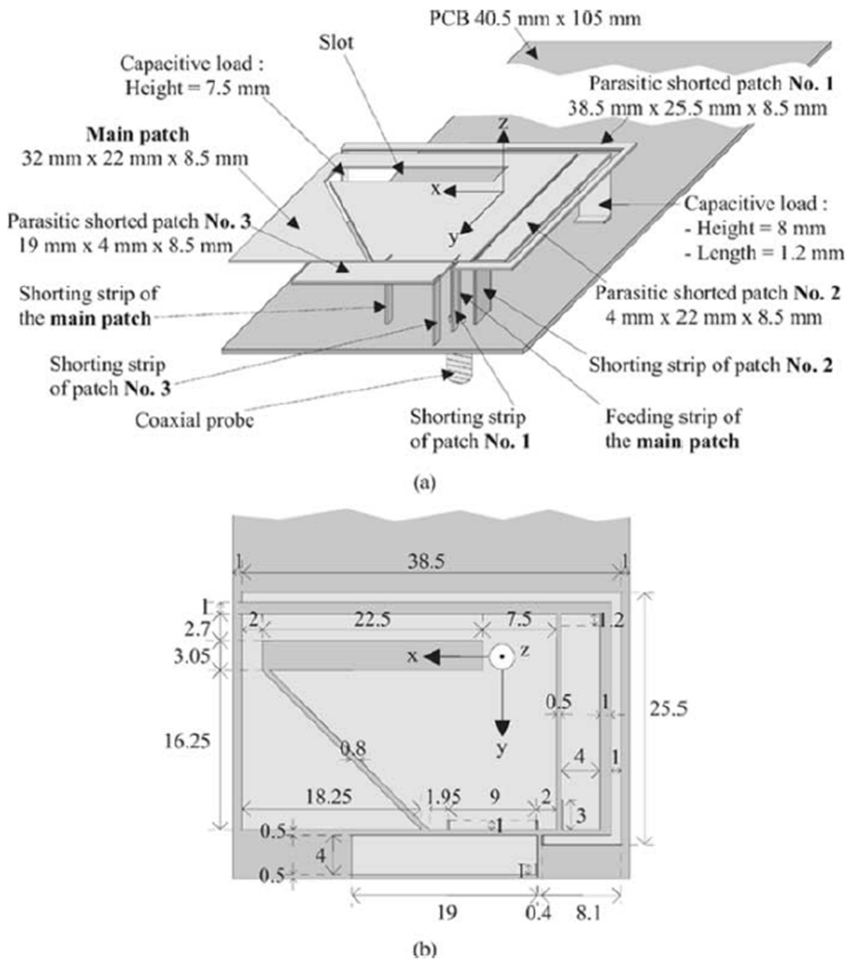
Ciais-Quadband is an article published in April 2004, more than one year before the earliest priority date of the ’103 patent and therefore qualifies as prior art to the ’103 patent.

Ciais-Quadband presents the design of a “miniature multiband internal” PIFA for “modern mobile handsets” capable of quad-band operation that “covers”—i.e., can send and receive signals—at 870-960 MHz with a VSWR “better than” (i.e., less than) 2.5:1 and at 1710-2170 MHz with a VSWR under 2.0:1. Ex.1014, Fig. 3, 148-150. These VSWR levels are below the maximum levels that the ’103 patent calls a functional requirement for antennas at these frequencies. Ex.1001, 36:10-43, Table 1 (specifying maximum VSWR 3.5:1 for 800-960 MHz, VSWR 3.0:1 for 1710-1990 MHz, and VSWR 2.5:1 for 1920-2170 MHz).

The Ciais-Quadband PIFA “consists of a main patch with three additional parasitic elements placed on the corner of a ground plane whose size is representative of the [PCB] of a typical mobile phone: 40.5 mm x 105 mm (Fig. 1).” Ex.1014, 1. The three parasitic patches are “each connected to the ground plane by metallic strips and located near the main patch in order to be correctly electromagnetically excited.” *Id*., 2.

A slot has been introduced into the main patch to achieve a frequency decrease in its fundamental resonance. Ex. 1014, 1. An end-positioned capacitive load is used to decrease the higher order modes of the main patch in frequency, thereby bringing the third harmonic resonance down into 1710-2170 MHz range needed for DCS/PCS/UMTS operation. *Id.*, 2. This capacitive loading is achieved by folding the patch over on itself, with the value of capacitance controlled by increasing or decreasing the metal facing surfaces. Three quarter-wavelength shorted parasitic patches are added to create new resonances and enlarge both the lower and upper impedance bandwidths. *Id.*, 1. Specifically, parasitic patch no. 1 is added to enlarge the GSM bandwidth. *Id.*, 2. Parasitic patches no. 2 and no. 3 are added to increase the upper bandwidth: parasitic no. 2 works below the third resonance of the main patch, while parasitic patch no. 3 works above it, thus broadening coverage across DCS, PCS, and UMTS. Capacitive loads are added to parasitic patches no. 1 and no. 2 by vertically folding their strip ends, thereby artificially increasing their electrical lengths without enlarging the overall antenna size. *Id.*, 2.

Ciais-Quadband provides the below image depicting the PIFA, including measurements:




Ex.1014, Fig. 1.

### 2. Boireau (Ex.1015)

Boireau was published on October 11, 2007, and filed April 5, 2006—before the earliest priority date of the ’103 patent, and therefore qualifies as prior art under 35 U.S.C. § 102.

Boireau discloses antenna sharing techniques for a mobile computing device, such as a smartphone, employing multiple transceivers for voice and data communications. Ex.1015, [0016]. Boireau recognizes that each transceiver in such a device may need one or more antennas, and that providing a dedicated antenna for each transceiver can increase device power requirements, create inter-antenna interference, increase complexity and cost, and adversely affect device size and shape. *Id.* [0001]. To address these problems, Boireau teaches a shared antenna architecture in which multiple transceivers are coupled to a single antenna or antenna array through a switch, with an antenna management module ("AMM") controlling the switch to electrically connect one transceiver to the antenna at a given time. *Id.*, [0016]. The AMM alternates connections between the transceivers and the antenna "fast enough to enable substantially simultaneous operation," enhancing user experience while reducing device size, power consumption, and complexity. *Id.*, [0073].

Boireau discloses a mobile computing device implemented as a handheld smartphone with a housing enclosing a processor, memory, one or more transceivers, PCB, and one or more antennas. *Id.*, [0019], [0020], [0026]. The device includes a display, which may be a touch-sensitive display screen (i.e., a touch screen), as well as various input/output elements including an alphanumeric keyboard, microphone, camera, audio port, and expansion slot for multimedia and/or memory cards. *Id.*, [0023]. The device further includes a radio sub-system, a processing sub-system with a processor and memory, and a power management sub-system, all interconnected to support voice and data communications and the execution of application software and OS. *Id.*, [0028]-[0030].

Regarding wireless communications capabilities, Boireau discloses that the device may include at least three types of transceivers: a cellular radiotelephone system transceiver for voice communications (e.g., GSM, UMTS, CDMA, W-CDMA), a wireless networking transceiver for longer-range data communications (e.g., IEEE 802.11x/WiFi), and a personal area network transceiver for shorter-range data communications (e.g., Bluetooth). *Id.*, [0026], [0031], [0033], [0034]. These transceivers may have overlapping transmit and/or receive bands and are coupled to a shared antenna system through a switch and filter arrangement, controlled by the AMM. *Id.*, [0026], [0038]. The antenna system itself may include internal antennas, external antennas, or a combination of both, and may be implemented as part of a broader antenna array suitable for spatial diversity techniques and MIMO systems. *Id.*, [0025]. Boireau further discloses coexistence interfaces between the transceivers, which communicate information in accordance with a multiple transceiver coexistence protocol to coordinate timing and prevent interference when multiple transceivers share the same antenna. *Id.*, [0073].

#### 3. CN456 (Ex.1016)[4]

[4] The discussion that follows is based on a certified English translation of CN456,

CN456 was published on February 1, 2006, with a filing date of July 1, 2005, before the earliest priority date of the ’103 patent, and therefore qualifies as prior art under 35 U.S.C. § 102.

CN456 is titled “Four-Plane Inverted-F Antenna System for a Multiple-Input Multiple-Output (MIMO) Wireless Communication Terminal.” CN456 generally teaches a multi-antenna system comprising four ground-plane-shortened PIFA mounted on a PCB and specifically designed for use in compact wireless communication terminals. *Id.*, [57], Claim 1. Each PIFA includes a conductive ground plane formed as a metallic patch or metallic layer on the front surface of the PCB arranged parallel to a metallic layer on the rear surface of the PCB, a conductive radiating plane arranged parallel to the ground plane, a conductive short-circuit plane arranged perpendicular to the ground plane and electrically connecting the ground plane to the radiating plane, and a conductive feeding post arranged perpendicular to the ground plane and electrically connecting a radio-frequency feeder to the radiating plane. *Id.*, Claim 1. The four PIFAs are arranged in four quadrants on the PCB with adjacent units oriented mutually perpendicularly to achieve low mutual coupling and high radiation efficiency. *Id.*, Claim 1, 9.

CN456 further discloses that the antenna system is designed to achieve the

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the accuracy of which has been attested to by a qualified translator. Ex.1016, 17.

low-correlation data links essential to MIMO wireless communication, including spatial diversity, polarization diversity, and radiation-pattern diversity. *Id.*, 6. CN456 explains that the radiation patterns of the respective antenna units are complementary to one another over a spherical surface, forming an approximately omnidirectional radiation pattern, and that the main polarization directions of certain antenna units are mutually perpendicular to achieve polarization diversity. *Id.*, 6, 8. CN456 also discloses the use of optional features such as a cross-shaped expanded metallic ground plane with vias, and slots etched in the rear metallic layer to further reduce coupling between antenna units caused by ground currents. *Id.*, Claims 3 and 4.

CN456 also discloses that the MIMO antenna system is designed for use with space-time coding techniques and that the system can be applied in cellular systems, WLAN, and other wireless communication systems employing standards such as UMTS and IEEE 802.11n (Wi-Fi). *Id.*, 4, 9.

CN456 addresses the same fundamental design challenge as the ’103 patent: achieving effective antenna performance in compact wireless terminal devices where limited physical space constrains the spacing between antenna units, and where multiple antenna units must operate with low mutual coupling and high radiation efficiency to support advanced wireless communication standards. *Id.*, 6.

### 4. Cho (Ex.1026)

Cho is an article published in 2005, before the earliest priority date of the '103 patent, and therefore qualifies as prior art.

Cho disclosed that "note book computers are increasingly being equipped with [WLAN] for the IEEE 802.11b (2.4-2.48 GHz), 802.11a (5.15-5.35 GHz, 5.725-5.825 GHz) in the US" and that "[i]nternal PIFAs are very suitable in WLAN applications since they are compact, low profile and easy to manufacture." Ex.1026, 1. Cho thus "investigates the miniature internal PIFA for the dual band [2.4-2.48 GHz and 5.15-5.35 GHz]

Cho disclosed "Fig. 1 and 2 [to] show[] the structure of the proposed dual-band . . . [PIFA] type." *Id.*, 1.

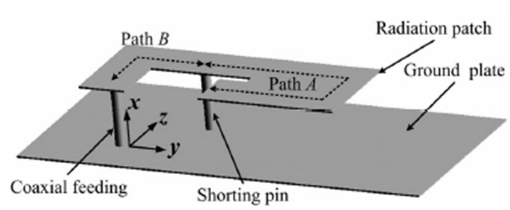



Fig. 1. Geometries of the proposed antenna in 3-D

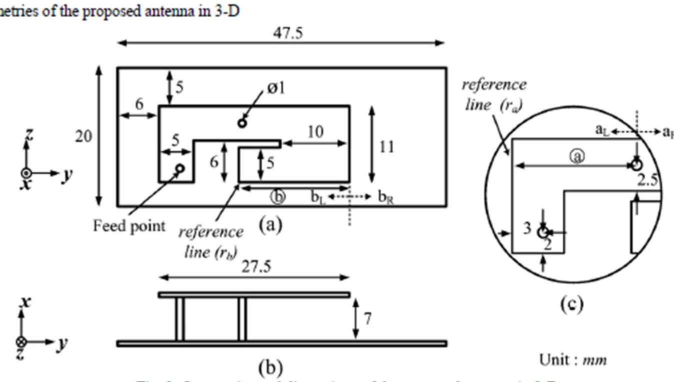
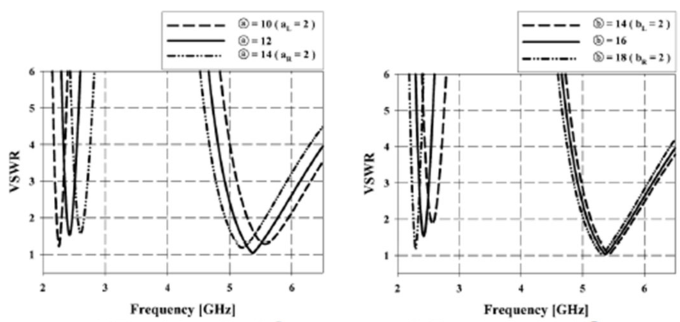



Fig. 2. Geometries and dimensions of the proposed antenna in 2-D
(a) Top view (b) Front view (c) Feeding and shorting locations

*Id.*, Figs. 1 and 2.

Cho disclosed the "measured and simulated VSWR results in terms of frequency are compared in Fig. 4" and "[the] [VSWR ≤ 2] at the lower frequency band is about 110 MHz from 2.38 GHz to 2.49 GHz, which meets the bandwidth requirement for IEEE 802.11b applications. As for the upper band, the impedance bandwidth is about 900 MHz from 5.1 GHz to 6.0 GHz, which also covers the required bandwidth for IEEE 802.11a and HIPERLAN/2." *Id.*, 2.




(a) The variations of length ⓐ (b) The variations of length ⓑ
Fig. 3. Simulated VSWR according to the lengths of ⓐ and ⓑ (Unit: mm)

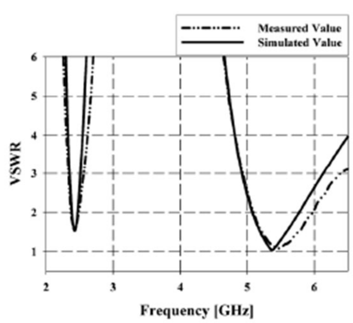



Fig. 4. Measured and simulated results of VSWR

*Id.*, Figs. 3 and 4.

"Fig. 5 and 6 show the measured and simulated radiation patterns at 2.44 GHz and 5.5 GHz, respectively. The radiation patterns are approximately omnidirectional" *Id.*, 2.

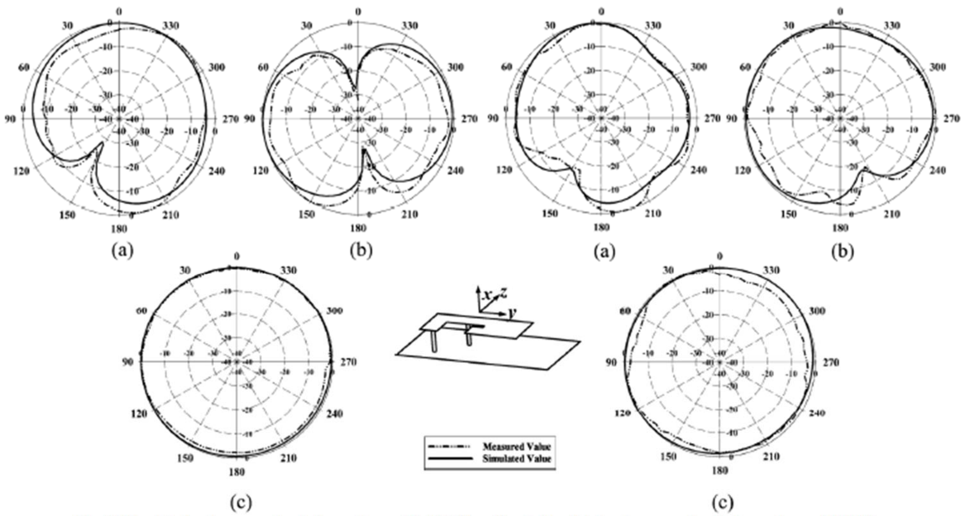



Fig. 5. Simulated and measured radiation patterns at 2.44 GHz. Fig. 6. Simulated and measured radiation patterns at 5.8 GHz
(a) *x-y* plane (b) *x-z* plane (c) *y-z* plane

*Id.*, Fig. 5.

## VIII. GROUNDS FOR UNPATENTABILITY

### A. Motivation to Combine with a Reasonable Expectation of Success

As of 2006, a POSA would have been motivated to combine the teachings of Ciais-Quadband, Cho, CN456, and Boireau with a reasonable expectation of success. There was strong motivation in the handheld device industry to develop small, handheld MFWD serving a multitude of functions, including sending and receiving phone calls, providing geolocation services, sending and receiving text messages, and connecting to the internet. Ex.1012, ¶¶122-131. As the prior art recognized, "[a] mobile computing device such as a smart phone may have voice and data communications capabilities as well as processing capabilities" and "may use multiple communications transceivers." Ex.1015, [0001].

To achieve these functions, POSAs understood that mobile devices would have to operate in at least the cellular regions of 810–960 MHz, 1710–1990 MHz, and 1900–2170 MHz, while also supporting high-speed services such as Wi-Fi, WiBro/WiMAX, or Bluetooth in the 2.3–2.5 GHz and possibly 5 GHz ranges. Ex.1012, ¶¶122-131. As Ciais-Quadband explained, the relevant standards included "GSM (…, 880–960 MHz)" as well as "DCS (…, 1710–1880 MHz), PCS (…, 1850–1990 MHz) and UMTS (…, 1920–2170 MHz)." Ex.1014, 1. Cho similarly recognized the industry demand for dual-band WLAN coverage, noting that note book computers are increasingly being equipped with [WLAN] for the IEEE 802.11b (2.4 - 2.48 GHz), 802.11a (5.15 - 5.35 GHz, 5.725 - 5.825 GHz) in the US" and that "the dual band 802.11a/b and HIPERLAN/2 antennas are required toward a small size and high gain while retaining the high efficiency." Ex.1026, 1.

POSAs further understood it was desirable for mobile handheld devices to be compact even while providing these multiple uses. "With the rapid progress in new communication standards, miniature multiband internal antennas are needed for modern mobile handsets" and "[s]everal techniques applied simultaneously are thus necessary to reduce the size of these antennas while maintaining good multiband/wideband performance." Ex.1014, 1.

A POSA would have understood that combining the teachings from Ciais-Quadband, Cho, CN456, and Boireau would achieve these goals. These three references address complementary aspects of the technical challenges facing designers of compact, multiband MFWDs.

Ciais-Quadband supplies a demonstrably compact PIFA that achieves multiband cellular requirements with measured performance and design rules a POSA can adopt. Ex.1014, 1. Ciais-Quadband disclosed that "[t]he quarter-wavelength antenna combines the use of a slot, shorted parasitic patches and capacitive loads to achieve multi-band operation," resulting in an antenna that "can operate from 880 to 960 MHz and 1710 to 2170 MHz covering GSM, DCS, PCS, and UMTS standards with a VSWR better than 2.5." *Id.* That antenna was designed on a ground plane "whose size is representative of the [PCB] of a typical mobile phone." *Id.*

Ciais-Quadband further demonstrated that "[t]he computed efficiency was respectively above 69% and 74% in the GSM and DCS/PCS/UMTS bands which is suitable for mobile phone communication terminals." *Id.*, 3. Ciais-Quadband provided empirical design rules for miniaturization, explaining that the parasitic patches "are chosen quarter-wavelength type, each connected to the ground plane by metallic strips and located near the main patch in order to be correctly electromagnetically excited" and that "[c]apacitive loads can be added to these parasitic patches by vertically folding their strip ends," thereby artificially increasing the electrical lengths of these resonators "without enlarging the whole antenna size." *Id.*, 2. Ciais-Quadband itself identified the natural next step for PIFA-based mobile antenna design, stating that "[f]urther work will be concentrated on the coverage of new 2.4 GHz and 5.2 GHz standards." *Id.*, 3. This express recognition would have directed a POSA to seek a complementary PIFA solution for these higher-frequency WLAN bands—precisely what Cho provides.

Cho supplies an internal PIFA design proven to cover the 2.4 GHz and 5 GHz WLAN bands. Cho presented a "[PIFA] for 2.4/5 GHz Bluetooth and WLAN applications." Ex.1026, 1. Cho's PIFA was compact, with a total volume of only $47.5 \times 20 \times 7$ mm$^3$, and used a straightforward design consisting of "a radiation element with a hook shape and a rectangular ground plate with a small size" that "is directly fed by a 50Ω coaxial cable." *Id*. Cho recognized that "[i]nternal PIFAs are very suitable in WLAN applications since they are compact, low profile and easy to manufacture." *Id*. Cho's measured results demonstrated "an approximately omni-directional radiation pattern" and gains of 2.39 dBi at 2.44 GHz and 3.70 dBi at 5.8 GHz. *Id.*, 1-2.

CN456 then shows how, in the same compact mobile device context, multiple

PIFAs such as the one disclosed in Ciais-Quadband and Cho can be arranged on the PCB to minimize mutual coupling, maintain high radiation efficiency, and provide complementary patterns and polarization diversity, enabling high-throughput MIMO WLAN/WiBro operation without unduly disturbing the primary cellular radiator. Ex.1016, 6.

CN456 recognized that "[a] [PIFA] is a typical type of built-in antenna" possessing "the advantages of small physical size and high radiation efficiency." *Id.*, 4. CN456 addressed the challenge of arranging multiple PIFAs in a compact terminal, explaining that the object of the invention is to "rationally arrange the spatial positions, spacings, and mutual spatial relationships of PIFA antenna units" to achieve several key characteristics:

> (1) Low-correlation data links are obtained with a minimum spacing between antenna units, so that the MIMO antenna structure is as compact as possible, particularly within small-sized wireless terminals.
>
> (2) After the antenna units are installed in a terminal, the antenna units exhibit wide radiation patterns.
>
> (3) The radiation patterns of the respective antenna units are complementary to each other.
>
> (4) The main polarization directions of certain antenna units are mutually perpendicular, thereby achieving polarization diversity.
>
> (5) Mutual coupling among the multiple antenna units is relatively low, thereby realizing low-correlation data links

and high radiation efficiency.

*Id*., 6.

CN456 demonstrated practical implementation of these principles, noting that "[t]he transmission coefficient S-parameters between the ports of the respective antenna units are less than −8.5 dB" and that "[t]he average in-band radiation efficiency of the antenna units is greater than 0.8." *Id*., 8. Thus, a POSA would have recognized that Cho's WLAN PIFA could complement Ciais-Quadband's PIFA within the same device, and that the use of the same antenna type—a PIFA—for both the cellular and WLAN elements would simplify integration and make the combined system more predictable.

Boireau supplies the radio and antenna system integration layer, including a switch and AMM that control which transceiver uses a given antenna at what time, thereby avoiding in-band and adjacent-band interference between, for example, Bluetooth and Wi-Fi in shared ISM spectrum. Ex.1015, [0016], [0079].

Boireau described a shared antenna architecture in which "a mobile computing device may include an antenna, a switch, and multiple transceivers" and "[a]n [AMM] may control the switch to electrically connect one of the transceivers to the antenna in order for a given transceiver to transmit or receive information over the antenna." *Id.*, [0016].

Boireau also provides encompassing device architecture with a processing subsystem, power-management subsystem, touch-screen UI, and camera. *Id.*, [0019], [0021]. Boireau recognized that mobile computing devices "may comprise a housing" suitable for "being held with an average human hand, such as a handheld computer, cellular telephone, PDA, combination PDA/cellular telephone, smart phone, and so forth," and may include components such as "an alphanumeric keyboard," "a touch-sensitive color . . . display screen," and "a rechargeable battery." *Id.*, [0020]-[0022].

Combined, the teachings of Ciais-Quadband, Cho, CN456, and Boireau result in an internal cellular antenna system covering GSM/DCS/PCS/UMTS, and 2.3–2.4/5 GHz services, together with a control system to manage coexistence and power—precisely the system-level solution that meets the July 2006 motivation for compact, multiband, high-capacity handhelds with reduced reception and transmission issues. Ex.1012, ¶¶122-131.

The prior art—including Ciais-Quadband's demonstration that PIFA structures with parasitic patches could achieve "[a] compact multiband PIFA antenna" covering "both GSM and DCS/PCS/UMTS bands" with "good efficiency over the covered frequency bands"; CN456's teaching that multiple PIFA antennas could be arranged with perpendicular polarization directions to achieve "low mutual coupling, high radiation efficiency, and large system capacity"; Cho's confirmation that internal PIFAs were "very suitable in WLAN applications" covering the 2.4 and 5 GHz bands with "approximately omni-directional radiation pattern[s]"; and Boireau's disclosure of antenna switching architectures enabling shared antenna use among multiple transceivers to reduce "device power requirements, interference between antennas, device size, device shape, device complexity, device component count"—collectively provided ample motivation and technical guidance for such a design. Ex.1012, ¶¶122-131.

Each of the solutions offered by Ciais-Quadband, CN456, Cho, and Boireau reinforce each other's risk mitigation. Ciais-Quadband's overlapping modes and widened upper-band impedance bandwidth reduce the tuning sensitivity of the cellular radiator in the presence of nearby structures. Ex.1014, 2. The structure achieves "an upper bandwidth of 470 MHz (1705–2175 MHz) with a VSWR less than 2 covering the DCS, PCS and UMTS standards," made possible by adding parasitic patches that work "below the 3rd resonance of the main patch" and "above" to provide broad coverage. *Id.*

Cho's WLAN PIFA contributes to risk mitigation through its broadband characteristics. Cho achieved an impedance bandwidth of 900 MHz in the 5 GHz band (5.1–6.0 GHz). Cho demonstrated that the resonant frequencies of the PIFA could be independently tuned by "adjusting a location of a shorting pin and a length of a radiation element," with each path having "dominant roles of the each associated frequency, 2.4 GHz and 5 GHz band, respectively." Ex.1026, 1. This independent tunability would have given a POSA confidence that Cho's WLAN PIFA could be reoptimized as needed to account for the electromagnetic environment of a particular handset design without sacrificing coverage of either band.

CN456's layout rules actively lower coupling and correlation, making it less likely that added high-frequency radiators will detune the cellular element or each other. Ex.1016, 6. CN456 explained that its design ensures that "[m]utual coupling among the multiple antenna units is relatively low, thereby realizing low-correlation data links and high radiation efficiency," and that slots formed in the metallic layer "reduce coupling between the antenna units caused by ground currents flowing between the units." *Id.*, Claim 4. For handheld devices in particular, CN456 addressed how proper antenna arrangement avoids "ground currents excited on the conductive ground planes interacting strongly with the surrounding environment, such as a user's hand," which would otherwise cause "instability in matching characteristics and degradation in radiation efficiency [that] will significantly increase terminal power consumption and reduce standby time." *Id.*, 6.

Boireau's switch-timing and RF control extend battery life through coordinated radio use and sleep states. Ex.1015, [0079]. Boireau recognized that "[e]ach antenna may potentially increase device power requirements, create interference between antennas, increase complexity and cost, and affect a size and shape for a mobile computing device." *Id.*, [0001]. To address these concerns, the AMM coordinates transceiver operations so that "wired co-existence algorithms using 2, 3, or 4 wires may allow the Bluetooth and 802.11x transceivers to inform each other when its radio is active and 'suggest' that the other radio back-off its transmission during critical times." *Id.*, [0079].

This division of labor—radiator design for the cellular bands, compact multi-radiator design for capacity, and system-level coexistence and power management—gave a POSA a credible, stepwise method to achieve the claimed inventions. Ex.1012, ¶¶122-131.

Finally, a POSA would have had a reasonable expectation of success in combining these teachings. The suitability of PIFA antennas for handheld devices was well-established, with Boireau listing among the available internal antenna types including PIFA. Ex.1015, [0025]. Similarly, Cho confirmed that "[i]nternal PIFAs are very suitable in WLAN applications since they are compact, low profile and easy to manufacture." Ex.1026, 1. A POSA would have viewed PIFA elements as an appropriate and predictable choice for implementing internal multiband antenna systems in a handset operating across the 800–2170 MHz range and the 2.4/5 GHz WLAN range. Ex.1012, ¶122.

The use of multiple antennas for diversity was similarly well-understood. CN456 taught that "MIMO diversity techniques, in terms of antenna implementation methods, include spatial diversity, polarization diversity, and radiation-pattern diversity," and that "a MIMO antenna system may employ antenna units having different polarization directions, thereby obtaining stable received power through polarization diversity." Ex.1016, 4-5. Boireau confirmed that "[m]ultiple antennas may be desirable when implementing spatial diversity techniques (e.g., beamforming) and/or high-throughput [MIMO] systems (e.g., 802.11n and 802.16e systems)." Ex.1015, [0048].

Each reference provided measured or simulated results demonstrating the practicality of its teachings. Ciais-Quadband reported "[g]ood agreement . . . between simulated and measured results" and provided measured radiation gain patterns. Ex.1014, 1, 3. CN456 provided "[m]easured S-parameter values of the reflection coefficients and coupling coefficients of the respective antenna units" and "radiation efficiency curves." Ex.1016, 8. Boireau provided detailed specifications for cellular coexistence, filter requirements, and interface signals. Ex.1015, [0061].

Accordingly, a POSA would have been motivated to combine the teachings of Ciais-Quadband, CN456, Cho, and Boireau with a reasonable expectation of success of achieving a compact, multiband, handheld MFWD with multiple PIFA antennas supporting cellular and high-frequency operation, polarization diversity, and coordinated antenna management.

### B. Ground 1

#### 1. Claim 1

Claim 1 recites a handheld MFWD having at least one of multimedia functionality and smartphone functionality, comprising: a touch screen; a geolocalization system; and an antenna system comprising a ground plane layer and three antenna elements, configured to transmit and receive signals from at least four frequency bands, including a first antenna element with a conductive plate supporting radiation modes for at least three frequency bands and a second antenna element configured to receive signals from a 4G communication standard, wherein the second antenna element has complexity factors $F_{21} \geq 1.20$ and $F_{32} < 1.75$.

##### i. A handheld MFWD having at least one multimedia functionality and smartphone functionality

Boireau disclosed a "combination handheld computer and mobile telephone, sometimes referred to as a smart phone" with voice and data capabilities, a processor, memory, multiple radios, a camera, a microphone, and an audio headset. Ex.1012, ¶¶80-86; Ex.1015, [0001], [0019]-[0024], claim 10. The '103 patent defines multimedia functionality to include digital music reproduction, digital camera capabilities, and microphone systems—all features disclosed in Boireau. Ex.1001, 5:57-65; Ex.1015, [0001], [0019]-[0024], claim 10. Boireau also explicitly identified its device as a "smartphone." Ex.1015, [0018]-[0020]

Further, a POSA would have recognized that the Ciais-Quadband PIFA, which "is suitable for cellular telephone applications," "achieve[s] multiband operation," "can operate from 880 to 960 MHz and 1710 to 2170 MHz covering GSM, DCS, PCS, and UMTS standards with a VSWR better than 2.5" which is intended to be used in "modern mobile handsets" would also be compatible with and facilitate the capabilities of the Boireau MFWD. Ex.1012, ¶136; Ex.1014, 1.

Moreover, a POSA would have recognized that CN456 teaches how to arrange multiple antennas including the Ciais-Quadband PIFA within Boireau's MFWD to "exhibit polarization diversity performance." Ex.1012, ¶137; Ex.1016, 9.

**ii. Touch screen**

Boireau disclosed that the mobile computing device "may comprise various input/output (I/O) devices, such as . . . a touch-sensitive display screen," implemented using resistive, capacitive, surface acoustic wave, or infrared techniques. Ex.1012, ¶139; Ex.1015, [0021], [0023].

**iii. A geolocalization system**

Boireau disclosed that the radio sub-system "may include various other transceivers and accompanying antennas, such as . . . a GPS transceiver." Ex.1012, ¶141; Ex.1015, [0061]. The '103 patent defines a geolocalization system to include GPS. Ex.1001, 9:15-16. A POSA would understand that "GPS" stands for global positioning system. Ex.1012, ¶141. Thus, Boireau disclosed a handheld MFWD comprising a geolocalization system.

**iv. An antenna system comprising a ground plane layer and three antenna elements within the handheld MFWD**

Ciais-Quadband disclosed a single internal PIFA suitable for cellular telephone applications that operates from 880 to 960 MHz and 1710 to 2170 MHz, positioned on a ground plane whose size is representative of a typical mobile phone PCB (40.5 mm × 105 mm). Ex.1012, ¶143; Ex.1014, 1, Fig. 1. CN456 similarly disclosed an antenna system comprising a ground plane layer ("a conductive ground plane, wherein the ground plane is a . . . metallic layer attached to a front surface of the [PCB] arranged parallel to the metallic layer on the rear surface of the [PCB]") with four PIFA units arranged in four quadrants. Ex.1012, ¶144; Ex.1016, claim 1, 6.

Further, CN456 specifically contemplates "four [PIFA] system for [MIMO]. *Id.* Boireau disclosed that the device may include "one or more internal antennas" and "may use multiple antennas in the form of an array." Ex.1012, ¶145; Ex.1015, [0048].

A POSA would have been motivated to use multiple Ciais-Quadband PIFAs arranged according to CN456's teachings in the MFWD of Boireau to arrive at an antenna system comprising a ground plane layer and three antenna elements. Ex.1012, ¶146.

**v. Configured to transmit and receive signals from at least four frequency bands, each of the at least four frequency bands being used by at least one communication standard**

Boireau disclosed cellular transceivers supporting GSM, CDMA, WCDMA, UMTS, and other standards, as well as WiFi (802.11) and Bluetooth transceivers, covering multiple bands across 900/1800/1900/2100 MHz and 2.4 GHz. Ex.1012, ¶147; Ex.1015, [0032], [0033].

The Ciais-Quadband PIFA is capable of sending and receiving electromagnetic radiation at 870–960 MHz and 1710–2170 MHz, supporting at least twenty-five frequency bands across those ranges. Ex.1012, ¶¶148-151; Ex.1014, 148-50, Fig. 3.

Therefore, a POSA would have been motivated to use multiple Ciais-Quadband PIFAs in Boireau's MFWD, arriving at a MFWD configured to transmit and receive signals from at least four frequency bands. Ex.1012 ¶¶147-152.

**vi. A first antenna element having a conductive plate configured to simultaneously support radiation modes for at least first, second, and third of the at least four frequency bands**

The Ciais-Quadband PIFA is capable of sending and receiving electromagnetic radiation at 870-960 MHz and 1710-2170 MHz. Ex.1014, Fig. 3, 148-50. A POSA would know PIFA must have a conductive radiating element—i.e., a "conductive plate"—that acts as a surface or resonator in order to work. For example, the main patch of the Ciais-Quadband PIFA may be considered the "conductive plate." Ex.1012, ¶154.

Ciais-Quadband PIFA's main patch has two radiation modes, and each parasitic patch provides an additional radiation mode covering GSM, DCS, PCS, and UMTS. Ex.1012, ¶155. Thus, the Ciais-Quadband PIFA would be able to simultaneously support radiation modes for at least first, second, and third frequency bands. *Id.*, ¶¶156-157.

**vii. A second antenna element configured to receive signals from a 4G communication standard**

The Ciais-Quadband PIFA supports seven UMTS frequency bands. Ex.1012, ¶160. The '103 patent expressly asserts HSDPA as a "4G feature" and "4G service," equating it with a "4G standard." Ex.1012, ¶160; Ex.1001, 24:22-35. Because the UMTS bands support HSDPA, each is a "4G communication standard." Ex.1012,

¶¶159-162.

A POSA would have been motivated to use multiple Ciais-Quadband PIFAs arranged per CN456's teachings, and such a second PIFA would serve as the "second antenna element" configured to receive signals from a 4G communication standard. *Id*.

**viii. Wherein a perimeter of the second antenna element defines an antenna contour having a level of complexity defined by complexity factor $F_{21}$ having a value of at least 1.20 and complexity factor $F_{32}$ having a value less than 1.75.**

As Dr. Tentzeris demonstrates through detailed calculations, the Ciais-Quadband PIFA antenna contour has a complexity factor $F_{21}$ of 1.31 and a complexity factor $F_{32}$ of 1.57. Ex.1012, ¶¶163-185. These values satisfy claim 1's requirements that $F_{21}$ be at least 1.20 and $F_{32}$ be less than 1.75.

**ix. Conclusion**

Accordingly, a POSA would have been motivated with a reasonable expectation of success to use multiple antennas, including multiple Ciais-Quadband PIFAs arranged according to the teachings in CN456 in Boireau's MFWD to arrive at the invention of claim 1. Ex.1012 ¶186.

**2. Claim 2**

Claim 2 depends from claim 1. Therefore, the analysis set forth above with respect to claim 1 is incorporated as if fully set forth herein. Claim 2 further requires:

**i. The first frequency band is contained within 810-960 MHz frequency range**

The Ciais-Quadband PIFA operates at 870–960 MHz, which falls within 810–960 MHz. At least four frequency bands (standard GSM900, extended GSM900, ISM, and LTE Band 8) are contained within this range. Ex.1012, ¶188; Ex.1014, 148-150. Any one of these frequency bands can be the claimed "first frequency band [that] is contained within 810-960 MHz."

**ii. The second frequency band is contained within 1710-1990 MHz frequency range**

The Ciais-Quadband PIFA operates in 1710–2170 MHz, which encompasses 1710–1990 MHz. At least twenty frequency bands are contained within this range, including DCS1800 and PCS1900. Ex.1012, ¶¶189-190. Any one of these frequency bands can be the claimed "the second frequency band [that] is contained within 1710-1990 MHz." *Id.*

**iii. The third frequency band is contained within 1900-2170 MHz frequency range**

The Ciais-Quadband PIFA's operational range of 1710–2170 MHz also encompasses 1900–2170 MHz, which includes at least seventeen frequency bands such as UMTS Band I and multiple LTE bands. Ex.1012, ¶¶191-192; Ex.1014, 1. Any one of these can be claimed "the third frequency band [that] is contained within 1900-2170 MHz."

**iv. Conclusion**

Accordingly, a POSA would have been motivated with a reasonable expectation of success to arrive at the invention of claim 2. Ex.1012, ¶193.

**3. Claim 3**

Claim 3 depends from claim 1. Therefore, the analysis set forth above with respect to claim 1 is incorporated as if fully set forth herein. Claim 3 further requires:

**i. The first antenna element is proximate to a short side of ground plane rectangle defined by the ground plane layer, and the second antenna element is proximate to a short side of the ground plane rectangle**

As discussed above, a POSA would have been motivated with a reasonable expectation of success to follow the arrangement of multiple PIFAs in a MFWD according to the teachings in CN456.

CN456 discloses a PCB with a metallic layer serving as the ground plane, defining a ground plane rectangle. Ex.1016, claims 1, 6. A POSA would understand that the PCB with a metallic layer is the ground plane layer. Ex.1012, ¶196.

Further, Figure 1 from CN456 defines the rectangle of the PCB—i.e., the "ground plane rectangle (blue outline below)—because it "is a rectangle whose edges are tangent to at least one point of the ground plane." Ex.1012, ¶197. Ex.1001, 14:9-11. CN456 further discloses "four ground-plane-shorted [PIFA] units are respectively denoted as (2d), (2a), (2b), and (2c)" that are placed on the ground plane. Ex.1012, ¶197; Ex.1016, 7.

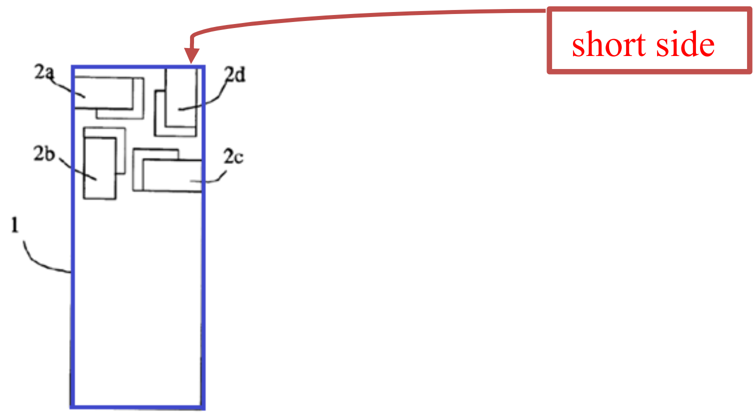



FIG. 1

*Id.*, Fig. 1 (annotated).

Disposing a first Ciais-Quadband PIFA (the "first antenna element") and a second Ciais-Quadband PIFA (the "second antenna element") at position 2a and 2d, respectively results in both first and second antenna elements that are "proximate to a short side of a ground plane rectangle defined by the ground plane layer." Ex.1012, ¶198.

**ii. Conclusion**

Accordingly, a POSA would have been motivated with a reasonable expectation of success to arrive at the invention of claim 3. Ex.1012, ¶199.

**4. Claim 4**

Claim 4 depends from claim 1. Therefore, the analysis set forth above with respect to claim 1 is incorporated as if fully set forth herein. Claim 4 further requires:

**i. The first antenna element is proximate to a short side and the second antenna element is proximate to a long side of the ground plane rectangle**

As discussed above with respect to claim 3, disposing a first Ciais-Quadband PIFA ("first antenna element") at position 2a or 2d as taught by CN456 results in a first antenna element proximate to a short side. Ex.1012, ¶202. Further, disposing a second Ciais-Quadband PIFA ("second antenna element") at position 2a, 2b, 2c, or 2d results in a second antenna element that is "proximate to a long side of the ground plane rectangle defined by the ground plane layer." Ex.1012, ¶203.

**ii. Conclusion**

Accordingly, a POSA would have been motivated with a reasonable expectation of success to arrive at the invention of claim 4. Ex.1012, ¶204.

**5. Claim 6**

Claim 6 is an independent claim reciting a handheld MFWD comprising: a touch screen; a microprocessor and an OS adapted to permit running of word-processing, spreadsheet, and slide software; an image recording system with at least a two-megapixel sensor; an antenna system configured to operate in at least five frequency bands, comprising a ground plane layer, a first antenna element supporting three radiation modes, and a second antenna element configured to operate in at least one 4G frequency band, with both the first and second antenna elements having complexity factors $F_{21} \geq 1.20$ and $F_{32} < 1.75$.

**i. A handheld MFWD having at least one of multimedia functionality and smartphone functionality, the handheld MFWD comprising a touch screen**

These limitations are met for the same reasons as in claim 1. Ex.1012, ¶¶206-207.

**ii. A microprocessor and an OS adapted to permit running of word-processing, spreadsheet, and slide software application**

Boireau disclosed a processor implemented as a CISC or RISC microprocessor, and OS including Palm OS, Microsoft Windows CE, Microsoft Pocket PC, Microsoft Mobile, and Symbian OS—all capable of running word-processing, spreadsheet, and slide software. Ex.1012, ¶¶208-210; Ex.1015, [0026], [0049], [0065], [0066].

**iii. An image recording system comprising an at least two megapixel image sensor**

Boireau disclosed that the device may comprise "a camera." As of 2006, a POSA would have known that cell phones with a camera necessarily require an image recording system. Ex.1012, ¶¶211-212; Ex.1015, [0021]. Boireau also disclosed "display 138 may comprise one or more [TFT] LCD including embedded transistors. In such implementation, the display 138 may comprise a transistor for each pixel to implement an active matrix." Ex.1015, [0024]. Further, a POSA would have known that TFT LCD are typically integrated with or used in screen displays that have three or more megapixel sensors; and that "cell phones have 2- to 5-megapixel sensors, and that 8 megapixels are on the horizon." Ex.1012, ¶¶211-212; Ex.1025, 2. Thus, it would have been obvious to have an image recording system comprising at least a two megapixel image sensor in the MFWD of Boireau. Ex.1012, ¶212.

**iv. An antenna system within the handheld MFWD**

Boireau disclosed that the handheld MFWD disclosed therein "may comprise an antenna system including one or more antennas" and that "[t]he antennas system may also include one or more internal antennas, such as [PIFA]." Ex.1012, ¶213; Ex.1015, [0024], [0025]. Further, CN456 disclosed that to take advantage of the antenna arrangement disclosed therein, PIFA should be arranged within the wireless terminal device. Ex.1012, ¶214; Ex.1016, 6. Finally, Ciais-Quadband disclosed specifications for a PIFA that could be arranged inside of the handheld device of Boireau according to the teachings in CN456. Ex.1012, ¶215.

**v. Configured to operate in at least five frequency bands**

Ciais-Quadband's PIFA is "configured to transmit and receive signals" from at least twenty-five frequency bands because it is capable of sending and receiving electromagnetic radiation at 870-960 MHz and 1710-2170 MHz. Ex.1012, ¶217; Ex.1014, Fig. 3, 148-50.

**vi. The antenna system comprising: a ground plane layer**

This limitation is met for the same reasons as in claim 1. Ex.1012, ¶¶143-146, 219.

**vii. The first antenna element having a conductive plate configured to support first, second, and third radiation modes respectively providing first, second, and third paths for current respectively associated with first, second and third frequency bands**

The Ciais-Quadband PIFA's main patch may be the conductive plate. Ex.1012, ¶220.

The Ciais-Quadband PIFA covers GSM at 880–960 MHz, DCS at 1710–1880 MHz, PCS in 1850–1990 MHz, UMTS at 1920–2170 MHz and LTE bands. Ex.1012, ¶221. For example, DCS1800, UMTS Band II, and LTE Band I may be the claimed first, second and third frequency bands, respectively. *Id.* The second parasitic patch's 1760 MHz creates a first radiation mode; the main patch's center frequency of 1920 MHz creates the second radiation mode, and the third parasitic patch's 2120 MHz creates the third radiation mode. *Id.*, ¶222. Each of these modes provides the claimed first, second, and third path for current respectively associated with the first, second and third frequency band. *Id*. ¶223.

**viii. The first, second, and the third radiation modes overlapping at least partially with each other**

The radiation mode for the main patch (~1930 MHz), parasitic patch 2 (~1760

MHz), and parasitic patch 3 (~2120 Mhz) overlap to yield a measured 460 MHz continuous bandwidth from 1710 to 2170 MHz. Ex.1012, ¶226. Ciais-quadband explicitly discloses "parasitic no. 2 works below the 3rd resonance of the main patch while parasitic no. 3 works above," and their simultaneous addition produces the wide upper bandwidth. *Id.* Ciais-Quadband Figure 2 (annotated below) shows the overlapping radiation modes:

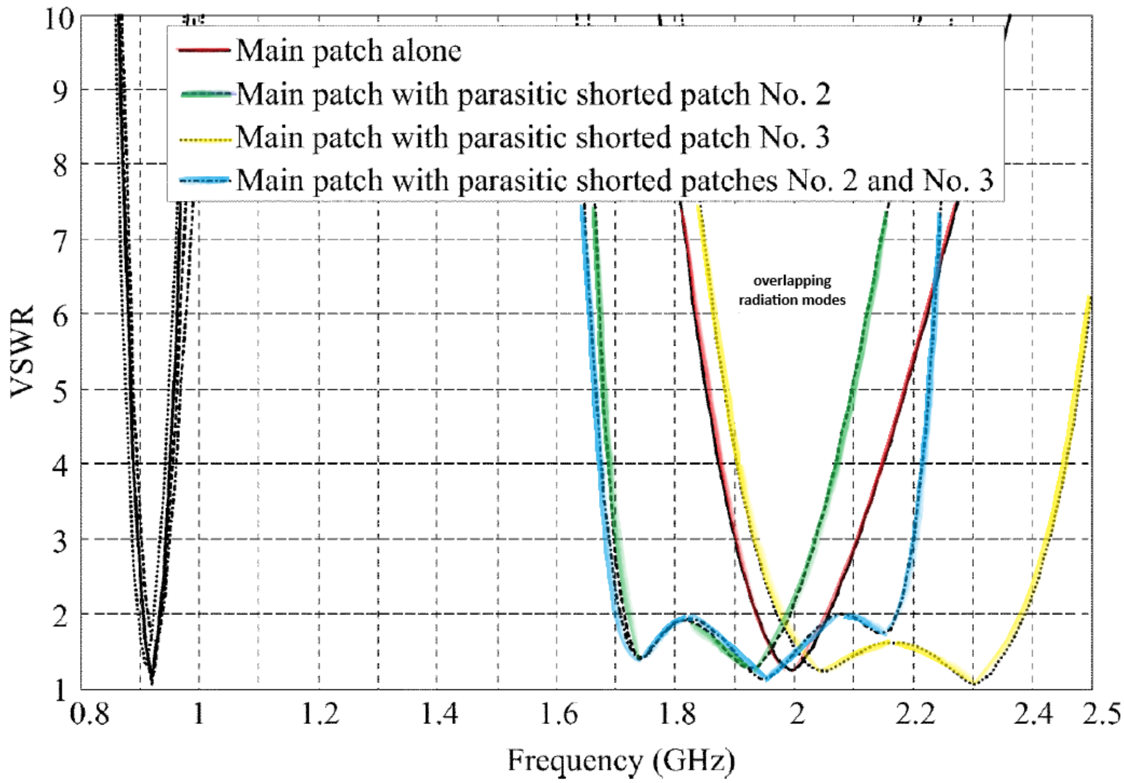



Fig. 2. Simulated VSWR of the main patch with and without parasitic shorted

*Id.*, Fig. 2.

Therefore, a POSA would have been motivated to use multiple antennas including Ciais-Quadband PIFA arranged according to the teachings in CN456 in the MFWD of Boireau to arrive at an antenna system wherein the first, second, and third radiation modes overlap at least partially with each other. Ex.1012, ¶227.

#### ix. The first frequency band being contained within a first frequency region of an electromagnetic spectrum, the second and third frequency bands being contained within a second frequency region of the electromagnetic spectrum that is higher in frequency than the first frequency region

As discussed above, the Ciais-Quadband PIFA's "first frequency band" may be DCS1800, which is included in the 1710–1880 MHz region ("first frequency region"). Ex.1012, ¶228. Also, as discussed above, the Ciais-Quadband PIFA's "second frequency band" may be UMTS Band II, which is included in the 1880-1990 MHz frequency regions, and the "third frequency band" may be LTE Band 1, which is in the 1920-2170 MHz frequency region ("third frequency region"). *Id.*, ¶230. The 1880-1990 MHz (i.e., "second frequency region") and 1920-2170 MHz (i.e., "third frequency region") are higher in frequency than 1710-1880 MHz (i.e., "first frequency region"). *Id.*

#### x. A second antenna element configured to operate in at least one frequency band, the at least one frequency band being used by a 4G communication standard

As discussed in claim 1 and above, the Ciais-Quadband PIFA supports LTE, and UMTS frequency bands that are 4G communications standards because they support HSDPA. Ex.1012, ¶¶232-235.

**xi. A perimeter of the first antenna element defines a first antenna contour having a level of complexity defined by first complexity factor $F_{21}$ having a value of at least 1.20 and first complexity factor $F_{32}$ having a value less than 1.75; and a perimeter of the second antenna element defines a second antenna contour having a level of complexity defined by second complexity factor $F_{21}$ having a value of at least 1.20 and second complexity factor $F_{32}$ having a value less than 1.75**

As discussed in claim 1, Ciais-Quadband PIFA, which would serve as both the first and second antenna elements, has a complexity factor $F_{21}$ of 1.31, which is at least 1.20; and second complexity factor $F_{32}$ of 1.57, which is less than 1.75. Ex.1012, ¶¶163-185, 236-237.

**xii. Conclusion**

Accordingly, a POSA would have been motivated to use multiple antennas, including multiple Ciais-Quadband PIFAs arranged according to the teachings in CN456 in the MFWD of Boireau to arrive at the invention of claim 6. Ex.1012, ¶238.

**6. Claim 7**

Claim 7 depends from claim 6. Therefore, the analysis set forth above with respect to claim 6 is incorporated as if fully set forth herein. Claim 7 further requires:

**i. The first antenna element is configured to transmit and receive signals from a 4G communication standard**

This limitation is met for the same reasons as in claims 1 and 6 because the Ciais-Quadband would serve as a first antenna element. Ex.1012, ¶240.

**ii. Conclusion**

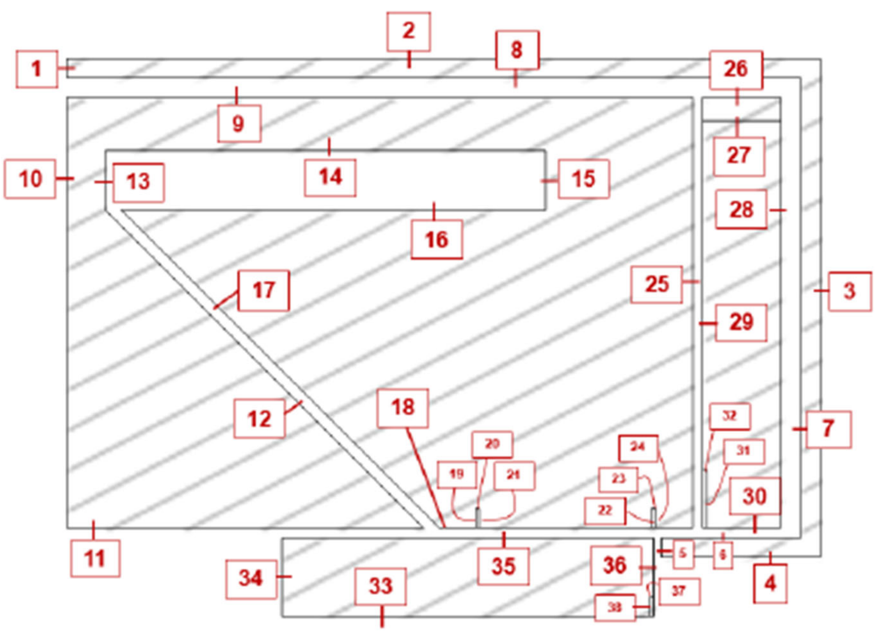
Accordingly, a POSA would have been motivated to arrive at the invention of claim 7. *Id.*, ¶241.

**7. Claim 8**

Claim 8 depends from claim 6. Therefore, the analysis set forth above with respect to claim 6 is incorporated as if fully set forth herein. Claim 8 further requires:

**i. The first antenna contour comprises at least thirty-five segments**

As Dr. Tentzeris demonstrates, the Ciais-Quadband PIFA antenna contour comprises more than thirty-five segments:




Ex.1012, ¶¶243-244.

**ii. Conclusion**

Accordingly, a POSA would have been motivated to arrive at the invention of claim 8. Ex.1012, ¶245.

#### 8. Claim 9

Claim 9 depends from claim 8. Therefore, the analysis set forth above with respect to claim 8 is incorporated as if fully set forth herein. Claim 9 further requires:

##### i. The second antenna contour comprises at least twenty segments

Because a POSA would have been motivated to use multiple Ciais-Quadband PIFAs, the second antenna contour would also be a Ciais-Quadband PIFA, which has at least thirty-two segments—more than the required twenty. *Id*., ¶247.

##### ii. Conclusion

Accordingly, a POSA would have been motivated to arrive at the invention of claim 9. *Id*., ¶248.

#### 9. Claim 10

Claim 10 depends from claim 6. Therefore, the analysis set forth above with respect to claim 6 is incorporated as if fully set forth herein. Claim 10 further requires:

##### i. the first antenna contour comprises at least two disjointed subsets of segments comprising at least ten segments

As Dr. Tentzeris demonstrates, the Ciais-Quadband PIFA comprises at least four disjointed subsets of segments corresponding to the main patch, parasitic shorted patch No. 1, parasitic shorted patch No. 2, and parasitic shorted patch No. 3. The main patch alone comprises at least 19 segments, and parasitic shorted patch No. 1 comprises at least 10 segments. *Id.*, ¶¶250-252 (providing annotated images identifying each disjointed subset).

**ii. Conclusion**

Accordingly, a POSA would have been motivated to arrive at the invention of claim 10. *Id.*, ¶253.

**10. Claim 12**[5]

Claim 12 is an independent claim reciting a handheld MFWD comprising: a touch screen; a processing module; a communication module; a power management module; and an antenna system with a ground plane layer, a first antenna element supporting three frequency band radiation modes (with a first antenna contour of at least thirty-five segments, an antenna box, antenna rectangle, and contour length greater than four times the antenna rectangle diagonal), and a second antenna element for a 4G standard with a second antenna contour of at least twenty segments.

**i. A handheld MFWD having at least one of multimedia functionality and smartphone functionality, the handheld MFWD comprising: a touch screen**

[5] While not challenged here, we present claim 12 in order to challenge the claims that depend from claim 12.

These limitations are met for the same reasons as in claim 1. Ex.1012, ¶¶255-256.

**ii. Processing module**

Boireau disclosed a processor implemented as a CISC, RISC, or VLIW microprocessor. Ex.1012, ¶¶257-259; Ex.1015, [0049].

**iii. A communication module**

Boireau disclosed a MFWD configured to transmit and receive data communications that includes integrated hardware components that function in tandem with the antenna to transmit and receive data including "radio sub-system" that performs voice and data communications using multiple transceivers, including cellular, WiFi, and Bluetooth. Ex.1012, ¶261; Ex.1015, [0026], [0028], [0031], [0032] A POSA would understand this constitutes the "communication module." Ex.1012, ¶¶260-262.

**iv. A power management module**

Boireau disclosed a "power management sub-system" that manages power for the entire mobile computing device. Ex.1012, ¶¶263-264; Ex.1015, [0029].

**v. an antenna system within the handheld MFWD and comprising a ground plane layer; a first antenna element configured to simultaneously support radiation modes for first, second, and third frequency bands**

This limitation is met for the same reasons as in claim 1. Ex.1012, ¶¶265-266.

**vi. the first frequency band being contained within a first frequency region of an electromagnetic spectrum; the second frequency band being contained within a second frequency region of the electromagnetic spectrum that is higher in frequency than the first frequency region; the third frequency band of operation being used by a 4G communication standard**

Ciais-Quadband PIFA is capable of sending and receiving electromagnetic radiation at 870-960 MHz, which is included in the '103 patent's "810 MHz–960 MHz region" ("first frequency region"), which covers at least standard GSM900, extended GSM900, ISM, and LTE Band 8. Ex.1012, ¶267.

Ciais-Quadband PIFA is also capable of sending and receiving electromagnetic radiation at 1710-2170 MHz, which covers at least DCS1800, UMTS Band III, LTE Band 3, and LTE Band 9, which are within 1710-1990 MHz electromagnetic region ("second frequency region". Ex.1012, ¶¶ 268-269.

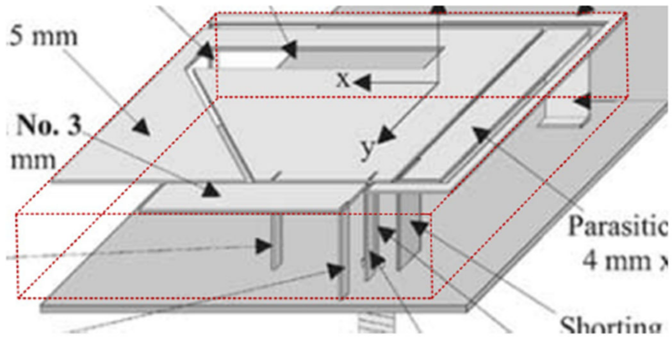
Further, as discussed in claim 1, Ciais-Quadband PIFA has a third frequency band of operation being used by a 4G communications standard. Ex.1012, ¶270.

**vii. a perimeter of the first antenna element defines a first antenna contour comprising at least thirty-five segments**

This limitation is met for the same reasons as in claim 8. Ex.1012, ¶¶243-245, 271.

**viii. the first antenna element defining an antenna box**

The Ciais-Quadband PIFA defines an antenna box (annotated with the dotted red outline in image below) of the PIFA disclosed in Ciais-Quadband Fig. 1(a):




Ex.1012, ¶272-273.

**ix. an orthogonal projection of the antenna box along a normal to a face with a largest area of the antenna box defining an antenna rectangle**

The Ciais-Quadband PIFA defines an antenna box (the minimum parallelepiped enclosing the antenna volume) and an antenna rectangle (the orthogonal projection of the antenna box along the normal to its largest face), with dimensions of 38.5 mm × 28.5 mm. Ex.1012, ¶¶274-275.

**x. a length of the first antenna contour is greater than four times a diagonal of the antenna rectangle**

As Dr. Tentzeris demonstrates, the diagonal of the Ciais-Quadband antenna rectangle is approximately 47.9 mm, making four times the diagonal approximately 191.6 mm. Ex.1012, ¶¶276-278. The total length of the Ciais-Quadband PIFA contour is approximately 433.5 mm, which is greater than 191.6 mm. *Id.*, ¶¶ 279-291 (providing detailed calculations of each antenna contour segment's length).

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

These limitations are met for the same reasons as in claims 1 and 8. *Id.,* ¶¶292-293.

**xii. Conclusion**

Accordingly, a POSA would have been motivated to use multiple antennas, including multiple Ciais-Quadband PIFAs arranged according to the teachings in CN456 in the MFWD of Boireau to arrive at the invention of claim 12. *Id.*, ¶294.

**11. Claim 13**

Claim 13 depends from claim 12. Therefore, the analysis set forth above with respect to claim 12 is incorporated as if fully set forth herein. Claim 13 further requires:

**i. the communication module is configured to simultaneously transmit signals from CDMA communication standard, a WiFi communication standard, and a 4 G communication standard**

Boireau disclosed multiple transceivers including a cellular transceiver supporting CDMA, a WiFi transceiver supporting IEEE 802.11, and data communication systems including HSDPA (a 4G standard). Ex.1012, ¶¶296-298; Ex.1015, [0026],[0031]. Boireau further disclosed that its AMM may cause transceivers to "switch between antenna 318 fast enough to enable substantially simultaneous operation." Ex.1012, ¶299; Ex.1015 [0073]. Further, CN456 taught the use of multiple PIFAs to enable more efficient and reliable simultaneous signal transmission. Ex.1012, ¶300.

A POSA would have been motivated to use multiple Ciais-Quadband PIFAs in Boireau's MFWD to enable the communication module to simultaneously transmit signals from CDMA, WiFi, and 4G standards. Ex.1012, ¶¶ 296–300.

**ii. Conclusion**

Accordingly, a POSA would have been motivated with a reasonable expectation of success to arrive at the invention of claim 13. *Id.*, ¶301.

**12. Claim 14**

Claim 14 depends from claim 12. Therefore, the analysis set forth above with respect to claim 12 is incorporated as if fully set forth herein. Claim 14 further requires:

**i. Each of the first frequency band and the second frequency band is used by at least one communication standard selected from: GSM, UMTS, CDMA, and W-CDMA**

The Ciais-Quadband PIFA operates at 870–960 MHz, which includes at least GSM communication standards; and 1710–2170 MHz, which includes at least UMTS communication standards. Ex.1012, ¶¶303-306; Ex.1014, 148-50, Fig. 3.

Thus, the first frequency band uses at least GSM and the second frequency band uses at least UMTS. Ex.1012, ¶306.

#### ii. Conclusion

Accordingly, a POSA would have been motivated with a reasonable expectation of success to arrive at the invention of claim 14. *Id.*, ¶307.

### 13. Claim 16

Claim 16 is an independent claim reciting a handheld MFWD comprising: a touch screen; a microprocessor; at least one memory module; and a communication module configured to operate in first, second, and third frequency bands (with the second frequency region higher than the first, and the third band used by a 4G standard), comprising an antenna system with first and second antenna elements and a ground plane layer, with the first antenna element proximate to a first short side and the second antenna element proximate to a second short side of the ground plane rectangle, and the second antenna element having complexity factors $F_{21} \geq 1.20$ and $F_{32} < 1.75$.

#### i. A handheld MFWD having at least one multimedia functionality and smartphone functionality, the handheld MFWD comprising: a touch screen, a microprocessor

These limitations are met for the same reason as in claims 1, 6 and 12. Ex.1012, ¶¶310-312.

**ii. At least one memory module**

Boireau disclosed that the device includes a housing encapsulating "a processor, a memory," as well as a memory expansion slot and memory storing the AMM, implemented using volatile and non-volatile memory including ROM, RAM, DRAM, SDRAM, flash memory, and others. Ex.1012, ¶¶313-314; Ex.1015, [0021], [0038], [0042].

**iii. A communication module configured to operate in a first frequency band used by at least one communication standard within a first frequency region of an electromagnetic spectrum, in a second frequency band used by at least one communication standard contained within a second frequency region of the electromagnetic spectrum that is higher in frequency than the first frequency region, in a third frequency band used by a 4G communication standard**

As Dr. Tentzeris explains the combination of Boireau and Ciais-Quadband meet this limitation because Boireau disclosed that a "radio sub-system" may be configured to operate with multiple bands at a lower first frequency region of 810-960MHz, a higher second frequency region of 1710-2170 MHz, and at LTE and UMTS bands. Ex.1012, ¶¶316-330.

**iv. The communication module comprising an antenna system within the handheld MFWD having at least a first and second antenna elements and a ground plane layer**

These limitations are met for the same reasons as in claim 1. *Id.*, ¶¶331-333.

**v. The first antenna element being configured to transmit and receive signals from a 4G communication standard, the second element being configured to receive signals from a 4G communication standard**

These limitations are met for the same reasons as in claim 1. *Id.*, ¶¶334-336.

**vi. Wherein the ground plane layer defines a ground plane rectangle; the first antenna element is proximate to a first short side of the ground plane rectangle; the second antenna element is proximate to a second short side of the ground plane rectangle**

These limitations are met for the same reasons as in claim 3. Further, arranging a first Ciais-Quadband PIFAs at positions 2a or 2d and a second Ciais-Quadband PIFA at positions 2b or 2c per CN456's teachings satisfies these limitations. Ex.1012, ¶¶338-340, Fig. 1 (annotated below).

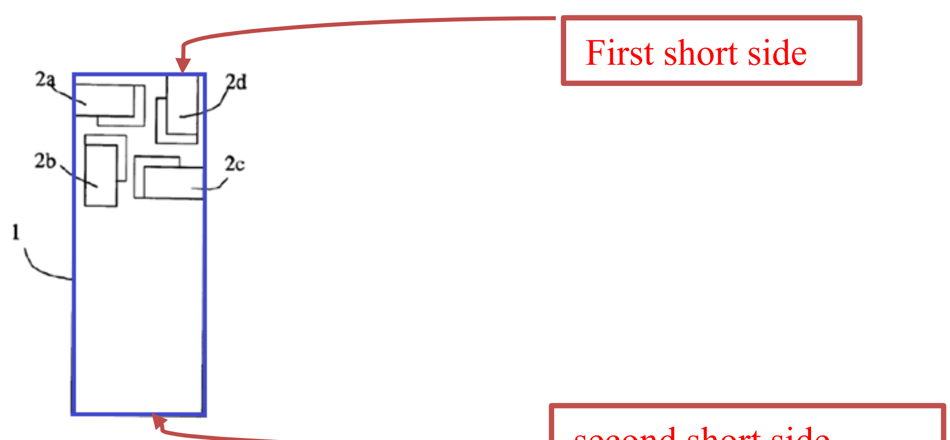



FIG. 1

**vii. A perimeter of the second antenna element defines an antenna contour having a level of complexity factor $F_{21}$ having a value of at least 1.20 and complexity factor $F_{32}$ having a value less than 1.75.**

This limitation is met for the same reasons as in claim 1. Ex.1012, ¶¶163-

185, 341.

**viii. Conclusion**

Accordingly, a POSA would have been motivated to use multiple antennas, including multiple Ciais-Quadband PIFAs arranged according to the teachings in CN456 in the MFWD of Boireau to arrive at the invention of claim 16. *Id.*, ¶342.

**14. Claim 17**

Claim 17 depends from claim 16. Therefore, the analysis set forth above with respect to claim 16 is incorporated as if fully set forth herein. Claim 17 further requires:

**i. An antenna box is defined by the first antenna element, an antenna rectangle is defined by an orthogonal projection of the antenna box along the normal to a face with a largest area of the antenna box, and wherein a longer side of said antenna rectangle is substantially parallel to the first short side of the ground plane rectangle**

The Ciais-Quadband PIFA defines an antenna box and antenna rectangle as discussed in claim 12. Ex.1012, ¶¶344-345. Arranging Ciais-Quadband PIFA at positions 2a from CN456's Figure 1 (annotated below) results in the longer side of the antenna rectangle being substantially parallel to the first short side of the ground plane rectangle. Ex.1012, ¶¶346; Ex.1016, Fig. 1 (annotated below).

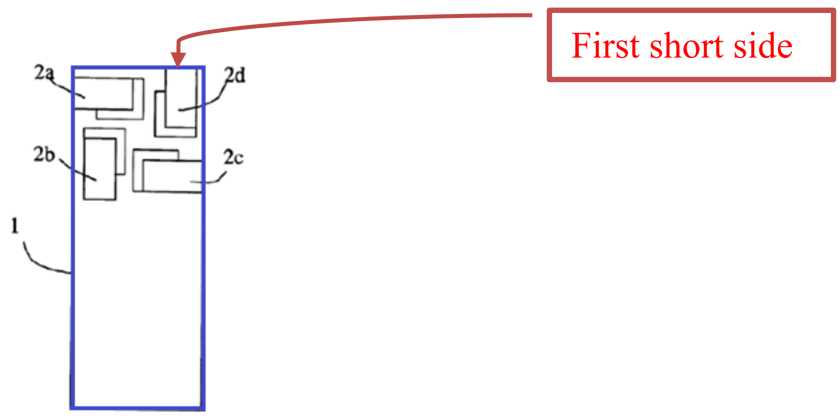



FIG. 1

**ii. Conclusion**

Accordingly, a POSA would have been motivated with a reasonable expectation of success to arrive at the invention of claim 17. Ex.1012, ¶349.

**15. Claim 18**

Claim 18 depends from claim 16. Therefore, the analysis set forth above with respect to claim 16 is incorporated as if fully set forth herein. Claim 18 further requires:

**i. The first frequency region is delimited by 810-960 MHz frequency range, and the second frequency region delimited by 1710-1990 MHz frequency range**

Ciais-Quadband PIFA operates from 880 to 960 MHz, which covers GSM and is within the '103 patent's 810–960 MHz region. Ex.1012, ¶351; Ex.1014, 1. Boireau disclosed support for GSM communication standards as well. Ex.1012, ¶352; Ex.1015, [0031]. Ciais-Quadband PIFA also operates at 1710–2170 MHz, which includes the 1710–1990 MHz region, and that region includes UMTS communication standards, which Boireau also supports. *Id.,* Ex.1012, ¶¶ 354-357.

**ii. Conclusion.**

Accordingly, a POSA would have been motivated with a reasonable expectation of success to arrive at the invention of claim 18. Ex.1012, ¶358.

**16. Claim 19**

Claim 19 depends from claim 16. Therefore, the analysis set forth above with respect to claim 16 is incorporated as if fully set forth herein. Claim 19 further requires:

**i. The complexity factor $F_{21}$ has a value less than 1.45**

As demonstrated in the complexity factor analysis for claim 1, the Ciais-Quadband PIFA has an $F_{21}$ value of 1.31, which is less than 1.45. Ex.1012, ¶¶164-185, 360.

**ii. Conclusion**

Accordingly, a POSA would have been motivated with a reasonable expectation of success to arrive at the invention of claim 19, wherein the complexity factor $F_{21}$ has a value less than 1.45. *Id.*, ¶361.

**17. Claim 20**

Claim 20 depends from claim 16. Therefore, the analysis set forth above with respect to claim 16 is incorporated as if fully set forth herein. Claim 20 further requires:

**i. The handheld MFWD is configured to use the first antenna element and the second antenna element as a diversity system**

CN456 directly addressed diversity systems, teaching how to arrange multiple PIFAs to achieve low-correlation data links, wide radiation patterns, complementary radiation patterns forming an approximately omnidirectional pattern, polarization diversity through mutually perpendicular main polarization directions, and low mutual coupling for high radiation efficiency. Ex.1012, ¶¶363–364. The '103 patent defines a diversity system as one where "more than one antenna (system) may be provided in order to obtain a diversity system and/or a [MIMO] system." Arranging Ciais-Quadband PIFAs according to CN456's teachings in Boireau's MFWD results in the claimed diversity system. *Id*., ¶¶363–364; Ex.1016, 6.

**ii. Conclusion**

Accordingly, a POSA would have been motivated with a reasonable expectation of success to arrive at the invention of claim 20. Ex.1012, ¶365.

## C. Ground 2

### 1. Claim 5

Claim 5 depends from claim 1. Therefore, the analysis set forth above with respect to claim 1 is incorporated as if fully set forth herein. Claim 5 further requires:

**i. The third antenna element is configured to operate in a fifth frequency band within 2400-2480 MHz frequency range**

Cho would have supplied claim 5's third antenna element. Cho disclosed an internal PIFA covering 2.4 GHz (2.38-2.49 GHz). Ex.1012, ¶367; Ex.1026, 2. A POSA would recognize that 2.38-2.49 GHz is 2380-2490 MHz, which overlaps with the claimed frequency range. *Id*.

**ii. Conclusion**

Accordingly, a POSA would have been motivated with a reasonable expectation of success to use multiple antennas including Ciais-Quadband's and Cho's PIFAs arranged according to the teachings in CN456 in a MFWD of Boireau to arrive at the invention of claim 5. *Id*., ¶368.

**2. Claim 11**

Claim 11 depends from claim 6 and further requires:

**i. A third antenna configured to operate in a frequency band within 2400-2480 MHz frequency range**

This limitation is met for the same reasons as in claim 5. *Id*., ¶370.

**ii. Conclusion**

Accordingly, a POSA would have been motivated with a reasonable expectation of success to use multiple antennas including Ciais-Quadband's and Cho's PIFAs arranged according to the teachings in CN456 in a MFWD of Boireau to arrive at the invention of claim 11. *Id*., ¶371.

## IX. THERE ARE NO SECONDARY CONSIDERATIONS OF NON-OBVIOUSNESS

Petitioners are not aware of any secondary considerations of non-obviousness. Petitioner reserves the right to address any evidence of secondary considerations that may be presented by the Patent Owner.

## X. THE BOARD SHOULD NOT DECLINE TO INSTITUTE BASED ON ITS DISCRETIONARY AUTHORITY § 314(A) OR §315(D)

The Board should not decline to institute this IPR under 35 U.S.C. §§ 314(a) and 315(d). As established above and pursuant to the expert declaration of Dr. Tentzeris (Ex.1012) Petitioner has set forth strong Grounds—overwhelmingly establishing that the Challenged Claims are not patentable.

The Board has authority to determine whether to institute an IPR. *Apple Inv. V. Telefonaktiebolaget LM Ericsson*, IPR2022-00337, Paper 7, 2 (PTAB Sep. 7, 2022). Based on the compelling merits, denial of the Petition under 35 U.S.C. §314(a) is inappropriate.

Moreover, there are no other proceedings or matters involving the '103 patent before the PTAB. Thus, the Board should not decline to institute this petition based on §315(d).

## XI. PAYMENT OF FEES UNDER (37 C.F.R. §§ 42.15(A) AND 42.103

The requisite filing fee is submitted herewith. Claims 1-11, 13-14, and 16-20 are requested for review as part of this Petition. If any additional fees are due during this proceeding, the Office is authorized to charge such fees to Deposit Account No. D506990. Any overpayment or refund of fees may also be deposited in this Deposit Account.

## XII. CONCLUSION

For the foregoing reasons, Petitioner has established a reasonable likelihood that Challenged Claims are unpatentable. Petitioner therefore respectfully requests that *inter partes* review of the '103 patent be granted.

Dated: April 20, 2026

Respectfully submitted,

*/s/ Janine A. Carlan*

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**CERTIFICATE OF COMPLIANCE**

Pursuant to 37 C.F.R. § 42.24(a) and (d), the undersigned hereby certify that the foregoing Petition for *Inter Partes* Review of U.S. Patent No. 8,738,103 complies with the type-volume limitation of 37 C.F.R. § 42.24(a)(1)(i) and (b)(1)(i) permitting a petition of up to 14,000 words because, exclusive of the exempted portions, it contains 13,964 words as counted by the word processing program used to prepare the paper.

Dated: April 20, 2026

*/s/ Janine A. Carlan*
Janine A. Carlan, Reg. No. 42,387

## CERTIFICATE OF SERVICE

Pursuant to 37 CFR §§ 42.6(e)(4)(i) *et seq.* and 42.105(b), the undersigned certifies that on April 20, 2026, a complete and entire copy of this Petition for *Inter Partes* Review of U.S. Patent No. 8,738,103, all supporting exhibits and Power of Attorney, were provided to the Patent Owner at the correspondence address of record as follows:

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