

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

GEOTAB INC. and GEOTAB USA, INC.,
Petitioner,

v.

FRACTUS, S.A.,
Patent Owner.

PGR2025-00056
Patent 12,095,149 B2

Before KEVIN C. TROCK, STEVEN M. AMUNDSON, and
RUSSELL E. CASS, *Administrative Patent Judges*.

AMUNDSON, *Administrative Patent Judge*.

DECISION
Denying Institution of Post-Grant Review
35 U.S.C. § 324

I. INTRODUCTION

Geotab Inc. and Geotab USA, Inc. (collectively “Petitioner”) filed a Petition requesting a post-grant review of claims 1–20 in U.S. Patent No. 12,095,149 B2 (“the ’149 patent”) (Exhibit 1005) under 35 U.S.C. §§ 321–329. Paper 4 (“Pet.”).¹ Fractus, S.A. (“Patent Owner”) filed a Preliminary Response. Paper 11 (“Prelim. Resp.”). Further, after receiving Board authorization to address certain issues, Petitioner filed a Preliminary Reply, and Patent Owner filed a Preliminary Sur-reply. Paper 15 (“Prelim. Reply”); Paper 16 (“Prelim. Sur-reply”); *see* Ex. 3001.

Under 37 C.F.R. § 42.4(a), we have authority to determine whether to institute a post-grant review. We may not institute a post-grant review unless we determine that “the information presented in the petition filed under section 321, if such information is not rebutted, would demonstrate that it is more likely than not that at least 1 of the claims challenged in the petition is unpatentable.” 35 U.S.C. § 324(a) (2024).

After considering the Petition, the Preliminary Response, the Preliminary Reply, the Preliminary Sur-reply, and the evidence of record, and for the reasons explained below, we determine that Petitioner has failed to demonstrate that it is “more likely than not” that at least one of the claims challenged in the Petition is unpatentable. Hence, we deny the Petition and do not institute a post-grant review.

¹ Petitioner filed a confidential version of the Petition as Paper 3 and a public version of the Petition as Paper 4. We cite to the public version of the Petition.

II. BACKGROUND

A. Real Parties in Interest

Petitioner identifies the following real parties in interest: Geotab Inc. and Geotab USA, Inc. Pet. xvi. Patent Owner identifies itself as the sole real party in interest. Paper 8, 1. The parties do not raise any issue about real parties in interest.

B. Related Matters

Petitioner and Patent Owner identify the following civil actions as related matters involving the '149 patent or a related patent (or both):

- *Fractus, S.A. v. ADT LLC*, No. 2:22-cv-00412 (E.D. Tex. filed October 21, 2022) (the “ADT litigation”);
- *Fractus, S.A. v. Vivint, Inc.*, No. 2:22-cv-00413 (E.D. Tex. filed October 21, 2022) (the “Vivint litigation”);
- *Fractus, S.A. v. Geotab Inc.*, No. 2:24-cv-01008 (E.D. Tex. filed December 6, 2024) (the “Geotab litigation”); and
- *Fractus, S.A. v. Verizon Connect Inc. et al.*, No. 2:24-cv-01009 (E.D. Tex. filed December 6, 2024) (the “Verizon litigation”).

Pet. xviii; Paper 8, 1.

According to Petitioner, the ADT litigation and the Vivint litigation have been dismissed with prejudice. Pet. xviii.

Petitioner identifies the following Board proceedings involving a patent related to the '149 patent:

- *Vivint, Inc. v. Fractus, S.A.*, IPR2024-00087 (Patent 8,738,103 B2);
- *Vivint, Inc. v. Fractus, S.A.*, IPR2024-00088 (Patent 11,349,200 B2);

- *Geotab Inc. et al. v. Fractus, S.A.*, IPR2025-01026 (Patent 11,031,677 B2); and
- *Geotab Inc. et al. v. Fractus, S.A.*, IPR2025-01027 (Patent 11,349,200 B2).

Pet. xvii.

According to Petitioner, IPR2024-00087 and IPR2024-00088 were settled and terminated “before Fractus filed preliminary patent owner responses and before institution decisions.” Pet. xvii.

C. The '149 Patent (Exhibit 1005)

The '149 patent, titled “Multiple-Body-Configuration Multimedia and Smartphone Multifunction Wireless Devices,” issued on September 17, 2024, from U.S. application no. 18/339,523 (“the '523 application”) filed on June 22, 2023. Ex. 1005, codes (21), (22), (45), (54). The '149 patent identifies the '523 application as one of several applications in a series of continuation applications that started with U.S. application no. 11/614,429 (“the '429 application”) filed on December 21, 2006, and later issued as U.S. Patent No. 8,738,103 B2. *Id.* at 1:8–26, code (63). The '149 patent claims priority to U.S. provisional application no. 60/831,544 filed on July 18, 2006, and U.S. provisional application no. 60/856,410 filed on November 3, 2006. *Id.* at 1:8–30, code (60).

The '149 patent states that the invention relates to:

a multifunction wireless device (MFWD), and, more particularly, but not by way of limitation, to a multifunction wireless device and antenna designs thereof combining into a single unit mobile data and voice services with at least one of multimedia capabilities (multimedia terminal (MMT) and personal computer capabilities, (i.e., smartphone) or with both MMT and smartphone (SMRT) capabilities (MMT+SMRT)[)].

Ex. 1005, 1:37–44.

The '149 patent explains that a MFWD “will include the RF capabilities, antenna system and signal processing hardware to connect to a mobile network at a speed of preferably at least 350 Kbits/s.” Ex. 1005, 9:62–65. “For this purpose, a MFWD will preferably include at least 3G (such as for instance UMTS, UMTS-FDD, UMTS-TDD, W-CDMA, cdma2000, TD-SCDMA, Wideband CDMA) and/or 3.5G and/or 4G services (including for instance HSDPA, WiFi, WiMax, WiBro and other advanced services) in one or more of said frequency regions.”² *Id.* at 9:67–10:6. Further, a MFWD “incorporating 3.5G or 4G features (i.e. comprising 3G and other advanced services such as for instance HSDPA, WiBro, WiFi, WiMAX, UWB or other high-speed wireless standards, hereinafter 4G services) might require operation in additional frequency bands corresponding to said 4G standards.”³ *Id.* at 25:15–20. Those additional frequency bands include “bands within the frequency region 2-11 GHz and some of its sub-regions such as for instance 2-11 GHz, 3-10 GHz, 2.4-2.5 GHz and 5-6 GHz or some other bands.” *Id.* at 25:20–23; *see id.* at 10:37–39 (identifying “the 2-11 GHz frequency region” and “in particular the 2.3-2.4 GHz frequency region”).

In some embodiments, a MFWD includes “wireless connectivity to other wireless devices or networks through a wireless system such as for

² The acronym “UMTS” stands for “Universal Mobile Telecommunications System.” The acronym “FDD” stands for “Frequency Division Duplex.” The acronym “TDD” stands for “Time Division Duplex.” The acronym “CDMA” stands for “Code-Division Multiple Access.” The acronym “SCDMA” stands for “Synchronous Code-Division Multiple Access.” The acronym “HSDPA” stands for “High-Speed Downlink Packet Access.”

³ The acronym “UWB” stands for “Ultra wideband.”

instance WiFi (IEEE802.11 standards), Bluetooth, ZigBee, UWB in some additional frequency regions,” such as “an ISM band (for instance around 430 MHz or 868 MHz, or within 902-928 MHz or in the 2400-2480 MHz range, or in the 5.1-5.9 GHz frequency range or a combination of them) and/or within a ultra wide-band range (UWB) such as the 3-5 GHz or 3-11 GHz frequency range.”⁴ Ex. 1005, 10:24–34. But “the integration of an antenna system into” a MFWD “is further complicated by the presence in the MFWD” of “additional antennas, such as for example antennas for reception of broadcast radio and/or TV, antennas for geolocalization services, and/or antennas for wireless connectivity systems.” *Id.* at 9:46–51.

The ’149 patent discloses quantifying the complexity of an antenna contour with the complexity factor F_{21} and the complexity factor F_{32} to aid in designing a multiband antenna for a MFWD. *See, e.g.*, Ex. 1005, 16:64–18:26, 19:12–25, 20:5–17, 20:41–53, 42:26–35, code (57). According to the patent, these complexity factors “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.* at 16:66–17:4. Further, these complexity factors “guide the design of the antenna system by tailoring the degree of convolution of the antenna contour” and help “optimize both the miniaturization of the antenna as well as the multiband and RF performance characteristics.” *Id.* at 20:44–46, 42:30–34.

The complexity factor F_{21} “is predominantly characterized by capturing the complexity and degree of convolution of features of the

⁴ The acronym “ISM” stands for “Industrial, Scientific, and Medical.”

antenna contour that appear when the contour is viewed at coarser levels of scale.” Ex. 1005, 19:27–30. The complexity factor F_{21} “is geared more towards assessing an overall complexity of an antenna contour,” i.e., “whether the degree of convolution of an antenna contour distinguishes sufficiently from a simple rectangular shape when looked at from a zoomed-out view.” *Id.* at 19:40–44, 30:64–31:1. In some embodiments, the complexity factor F_{21} “is related to the number of paths that a structure of the antenna system provides to electric currents and/or the equivalent magnetic currents to excite radiation modes” and “tends to increase with the number of antenna portions within the structure of the antenna system and/or the number of antenna elements that form the antenna system.” *Id.* at 19:49–55.

The complexity 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.” Ex. 1005, 20:19–22. The complexity factor F_{32} “is geared more towards evaluating the full complexity of an antenna contour,” i.e., “whether the degree of convolution of an antenna contour tends to approach that of a highly-convoluted curve such as the Hilbert curve.” *Id.* at 20:29–33, 31:1–5. In some embodiments, the complexity factor F_{32} is “related to the degree of miniaturization achieved by the antenna system.” *Id.* at 20:35–37.

When explaining an antenna contour, the ’149 patent uses the terms “antenna box” and “antenna rectangle.” *See* Ex. 1005, 15:16–26. The patent defines “antenna box” as “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” where “each

possible pair of faces of the minimum-size parallelepiped shares an edge forming an inner angle of 90°.” *Id.* at 11:35–42. The patent defines “antenna rectangle” as “the orthogonal projection of the antenna box along the normal to the face with largest area of the antenna box.” *Id.* at 14:21–24.

The ’149 patent explains that the “antenna contour of the antenna system is a set of joined and/or disjointed segments” comprising “the perimeter of one or more antenna elements placed in the antenna rectangle” and “the perimeter of closed slots and/or closed apertures defined within the antenna elements, and/or the orthogonal projection onto the antenna rectangle of perimeters of antenna elements, or perimeters of or parts of antenna elements that are placed in the antenna box but not in the antenna rectangle.” Ex. 1005, 15:16–26. “The antenna contour needs to make efficient use of the area of the antenna rectangle in order to attain enough geometrical complexity to make the resulting structure of an antenna system suitable for” a MFWD. *Id.* at 16:23–26. Thus, “the antenna contour preferably comes into contact with each of the four (4) sides of the antenna rectangle in at least one point of each side of the antenna rectangle.” *Id.* at 16:27–30.

As Figure 3 shows, antenna element 300 has been shaped “to support different radiation modes” corresponding to different frequency bands and includes:

- aperture 302 with a closed perimeter;
- aperture 303 with a closed perimeter;
- opening 304 that “increases the number of segments that form the perimeter of the antenna element 300”;
- part 305 “bent 90° with respect to the rest of the antenna element 300” but “fully contained in the antenna box 301”; and
- part 306 also “bent 90° with respect to the rest of the antenna element 300” but “fully contained in the antenna box 301.”

Ex. 1005, 27:60–28:3, Fig. 3.

As Figure 3 also shows, “antenna contour 350 comprises three disjointed subsets of segments” as follows:

- “a first subset is formed by the segments of the perimeter 357 (which includes both external segments of the antenna element 300 and those segments added to said antenna element by the opening 304) and the group of segments 356 corresponding to the orthogonal projection of part 306 of the antenna element 300”;
- “a second subset is formed by the segments 352 associated to the perimeter of aperture 302”; and
- “a third subset is formed by the segments 353 associated to the perimeter of aperture 303.”

Ex. 1005, 28:8–17, Fig. 3. In this example, “part 305 of the antenna element 300 has an orthogonal projection that completely matches a segment of the perimeter 357, and therefore does not increase the number of segments of the antenna contour 350.” *Id.* at 28:18–21, Fig. 3.

The '149 patent discloses computing the complexity factor F_{21} and the complexity factor F_{32} for a particular antenna using three grids with “substantially square or rectangular cells” placed on the antenna rectangle: a first grid G_1 , a second grid G_2 , and a third grid G_3 . Ex. 1005, 17:5–8. The “three grids are adaptive to the antenna rectangle” such that “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 rectangle itself.” *Id.* at 17:8–12. “The use of adaptive grids is advantageous because it provides a sufficient number of cells within the antenna rectangle to fully capture the geometrical features of the antenna contour at differing levels of detail.” *Id.* at 17:12–15.

The grid G_1 and the grid G_3 are constructed from the grid G_2 , “which needs to be defined in the first place.” Ex. 1005, 17:26–27. The grid G_2 is “chosen so that the antenna rectangle is perfectly tessellated with an odd number of columns and an odd number of rows.” *Id.* at 17:28–32. Additionally, the number of columns and the number of rows are “selected to produce a cell as square as possible” such that a cell has “an aspect ratio close to one.” *Id.* at 17:57–61.

The '149 patent explains that “setting to nine (9) the number of columns that tessellate the antenna rectangle” for the grid G_2 provides “an advantageous compromise, for the preferred sizes of an MFWD, and the corresponding available volumes for the antenna system.” Ex. 1005, 17:49–53. Therefore, the cell width in the grid G_2 “is selected to be equal to a ninth ($1/9$) of the length of the longer side of the antenna rectangle.” *Id.* at 17:54–56.

The grid G_1 includes “an additional row and an additional column of cells” of the grid G_2 to “have enough cells of the grid G_1 as to completely

cover the antenna rectangle.” Ex. 1005, 18:21–23. A cell of the grid G_1 “is obtained by combining four (4) cells of the grid G_2 ” such that each cell of the grid G_1 “consists of a 2-by-2 arrangement of cells of grid G_2 .” *Id.* at 18:12–14. Thus, a cell of the grid G_2 “is half the size of a cell of grid G_1 (i.e., a $\frac{1}{2}$ scaling factor or an octave of scale).” *Id.* at 17:17–19. Also, a cell of the grid G_3 “is half the size of a cell of grid G_2 , or one fourth the size of a cell of grid G_1 (i.e., a $\frac{1}{4}$ scaling factor or two octaves of scale).” *Id.* at 17:19–21.

The ’149 patent provides the following equations for computing the complexity factor F_{21} and the complexity factor F_{32} :

$$F_{21} = -(\log(N_2) - \log(N_1)) / \log(1/2);$$

$$F_{32} = -(\log(N_3) - \log(N_2)) / \log(1/2);$$

where:

- (1) N_1 is the number of cells of “the grid G_1 that are at least partially inside the antenna rectangle and include at least a point of the antenna contour”;
- (2) N_2 is the number of cells of “the grid G_2 that are completely inside the antenna rectangle and include at least a point of the antenna contour”; and
- (3) N_3 is the number of cells of “the grid G_3 that are completely inside the antenna rectangle and include at least a point of the antenna contour.”

Ex. 1005, 19:12–25, 20:5–17.

Using Figures 12 and 13, the ’149 patent discloses a specific example of computing the complexity factor F_{21} and the complexity factor F_{32} . *See* Ex. 1005, 33:4–34:52, Figs. 12A–12B, 13A–13C.

The '149 patent's Figure 12A (reproduced below) depicts an illustrative antenna system for a MFWD:

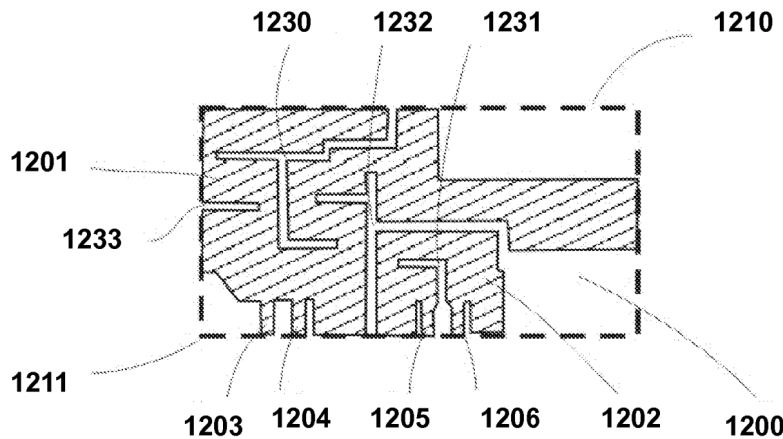


FIG. 12A

Figure 12A illustrates “the structure 1200 of an antenna system for a MFWD” surrounded by antenna rectangle 1210 shown as a dashed line. Ex. 1005, 33:4–7, Fig. 12A. “The structure 1200 has been shaped to attain the desired multiple frequency band operation as well as desired RF performance,” e.g., to operate “in four (4) separate frequency bands within three (3) separate regions of the electromagnetic spectrum.” *Id.* at 33:7–9, 33:28–30.

As Figure 12A shows, “peripheral parts of a substantially flat conducting plate have been removed, and slots 1230–1233 have been created within the structure 1200.” Ex. 1005, 33:10–12, Fig. 12A. “Slot 1232 divides the structure 1200 into two antenna elements 1201 and 1202.” *Id.* at 33:12–13, Fig. 12A. “Antenna element 1201 and antenna element 1202 are not in direct contact, although the two antenna elements 1201 and 1202 are in contact through the ground plane of the MFWD.” *Id.* at 33:14–16, Fig. 12A. Antenna element 1201 includes “a feeding point 1204 and a grounding point 1203.” *Id.* at 33:34–36, Fig. 12A. Antenna element 1202

includes “another feeding point 1205 and a grounding point 1206.” *Id.* at 33:36–37, Fig. 12A. Further, the bottom left corner 1211 of antenna rectangle 1210 “is chosen to be the feeding corner.” *Id.* at 33:41–42.

The '149 patent's Figure 13B (reproduced below) depicts the antenna contour in Figure 12A placed under a second grid:

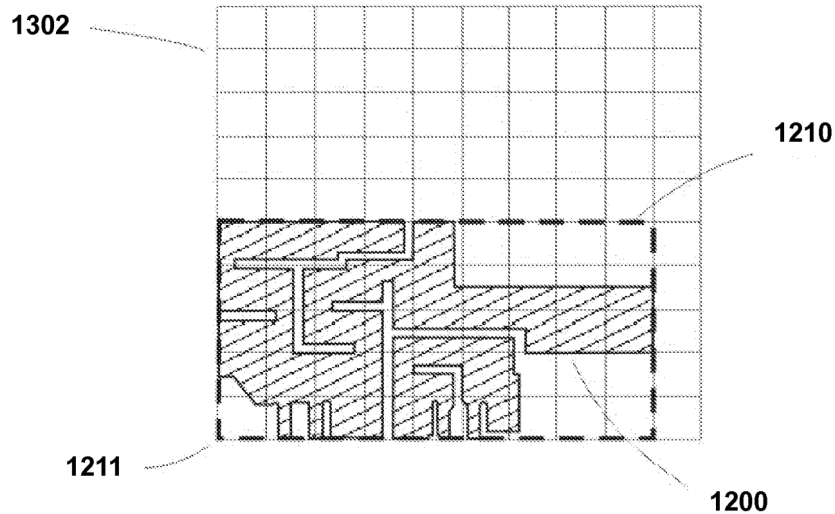


FIG. 13B

Figure 13B illustrates antenna structure 1200 surrounded by antenna rectangle 1210 placed under second grid 1302 having nine columns and five rows of cells. Ex. 1005, 34:12–18, Fig. 13B.

The '149 patent's Figure 13A (reproduced below) depicts the antenna contour in Figure 12A placed under a first grid:

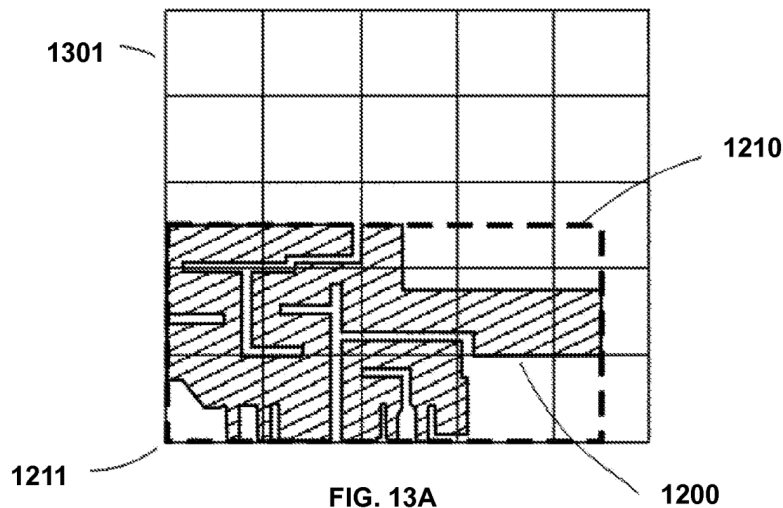


Figure 13A illustrates antenna structure 1200 surrounded by antenna rectangle 1210 placed under first grid 1301 having five columns and three rows of cells. Ex. 1005, 34:12–15, Fig. 13A.

The '149 patent's Figure 13C (reproduced below) depicts the antenna contour in Figure 12A placed under a third grid:

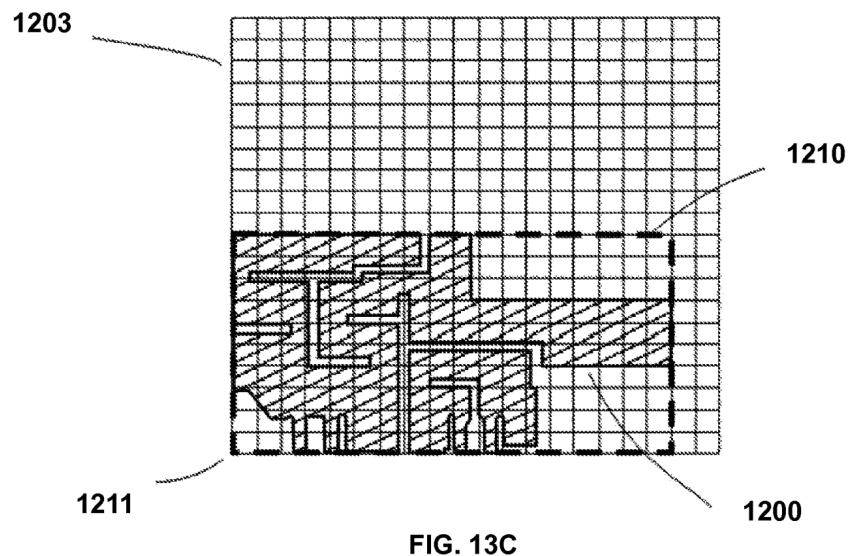


Figure 13C illustrates antenna structure 1200 surrounded by antenna rectangle 1210 placed under third grid 1303 (misabeled as 1203) having eighteen columns and ten rows of cells. Ex. 1005, 34:12–15, Fig. 13C.

Using the grids in Figures 13A–13C to compute the complexity factor F_{21} and the complexity factor F_{32} for the antenna contour in Figure 12A, the '149 patent explains that:

- (1) in Figure 13A “there are thirteen (13) cells of the first grid 1301 that, while being at least partially inside the antenna rectangle 1210 and including at least a point of the antenna contour of the structure 1200 (i.e., $N_1 = 13$)”;
- (2) in Figure 13B “there are thirty-eight (38) cells of the second grid 1302 completely inside the antenna rectangle 1210 and that include at least a point of the antenna contour of the structure 1200 (i.e., $N_2 = 38$)”; and
- (3) in Figure 13C “there are one hundred and fourteen (114) cells of the third grid 1303 completely inside the antenna rectangle 1210 and that include at least a point of the antenna contour of the structure 1200 (i.e., $N_3 = 114$).”

Ex. 1005, 34:22–33.

With $N_1 = 13$, $N_2 = 38$, and $N_3 = 114$, the equations for computing the complexity factor F_{21} and the complexity factor F_{32} yield the following values:

$$F_{21} = -(\log(38) - \log(13)) / \log(1/2) = 1.55$$

$$F_{32} = -(\log(114) - \log(38)) / \log(1/2) = 1.58$$

Ex. 1005, 34:34–52.

D. The Challenged Claims

The '149 patent includes twenty claims as follows:

- independent claim 1 for a “wireless device”;

- claims 2–6 that depend directly or indirectly from claim 1;
- independent claim 7 for a “wireless device”;
- claims 8–12 that depend directly from claim 7;
- independent claim 13 for a “wireless device”; and
- claims 14–20 that depend directly from claim 13.

Ex. 1005, 42:44–46:28. Petitioner challenges all twenty claims in the ’149 patent. Pet. 4, 32–100.

Claims 1 and 7 exemplify the challenged claims and read as follows (with formatting added for clarity and with bracketed numbers and letters added for reference purposes):⁵

1. [1.pre] A wireless device comprising:
 - [1.a] a ground plane;
 - [1.b] a first planar antenna proximate to a first side of a ground plane rectangle enclosing the ground plane,
 - [1.c] the first planar antenna being configured to support at least three frequency bands of the electromagnetic spectrum,
 - [1.d] the first planar antenna defining a first contour,
 - [1.e] wherein the first contour has 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 of at least 1.35; and
 - [1.f] a second antenna proximate to a second side of the ground plane rectangle, wherein the second antenna is configured to receive signals from at least two frequency bands of the at least three frequency bands;

⁵ We use the same reference numbers and letters that Petitioner uses to identify the claim language. *See* Pet. 152–55 (Claim List).

[1.g] wherein the first contour is defined as a perimeter of the first planar antenna and perimeters of any closed apertures defined within the first planar antenna;

[1.h] wherein the complexity factors F_{21} and F_{32} are given by:

$$F_{21} = - (\log(N_2) - \log(N_1)) / \log(1/2)$$

$$F_{32} = - (\log(N_3) - \log(N_2)) / \log(1/2)$$

[1.h.1] where N_1 is a number of cells of a grid G_1 that include at least a point of the first contour, N_2 is a number of cells of a grid G_2 that include at least a point of the first contour, and N_3 is a number of cells of a grid G_3 that include at least a point of the first contour,

[1.h.2] the grid G_2 divides a minimum-sized rectangle enclosing the first planar antenna into nine columns of equal width arranged along a long side of the minimum-sized rectangle and into an odd number of rows of equal height arranged along a short side of the minimum-sized rectangle, wherein the number of rows results in the cells of grid G_2 being as square as possible,

[1.h.3] the grid G_1 being aligned with a corner of the grid G_2 to cover the minimum-sized rectangle, the cells of the grid G_1 having widths and heights that respectively are double the widths and heights of the cells of the grid G_2 , and

[1.h.4] the grid G_3 being aligned with the grid G_2 , the cells of the grid G_3 having widths and heights that respectively are half the widths and heights of the cells of the grid G_2 , and

[1.i] wherein the level of complexity of the first contour is configured to provide operation of the wireless device in the at least three frequency bands.

7. [7.pre] A wireless device comprising:

[7.a] a ground plane;

[7.b] a first non-planar antenna proximate to a first side of a ground plane rectangle enclosing the ground plane,

[7.c] the first non-planar antenna being configured to support at least three frequency bands of the electromagnetic spectrum,

[7.d] a minimum-sized parallelepiped completely enclosing a volume of the first non-planar antenna, the minimum-sized parallelepiped having a face with a largest area;

[7.e] a second antenna proximate to a second side of the ground plane rectangle, and wherein the second antenna is configured to receive signals from at least two frequency bands of the at least three frequency bands;

[7.f] wherein the first non-planar antenna has a first contour defined as a perimeter of any portions of the first non-planar antenna arranged in the face, perimeters of any closed apertures of any portions of the first non-planar antenna arranged in the face, a perimeter of an orthogonal projection onto the face of any portions of the first non-planar antenna that are not arranged in the face, and perimeters of any closed apertures of the orthogonal projection;

[7.g] wherein the first contour has 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 of at least 1.35; and

[7.h] wherein the complexity factors F_{21} and F_{32} are given by:

$$F_{21} = -(\log(N_2) - \log(N_1)) / \log(1/2)$$

$$F_{32} = -(\log(N_3) - \log(N_2)) / \log(1/2)$$

[7.h.1] where N_1 is a number of cells of a grid G_1 that include at least a point of the first contour, N_2 is a number of cells of a grid G_2 that

include at least a point of the first contour, and N_3 is a number of cells of a grid G_3 that include at least a point of the first contour,

[7.h.2] the grid G_2 divides the face into nine columns of equal width arranged along a long side of the face and an odd number of rows of equal height arranged along a short side of the face, wherein the number of rows results in the cells of grid G_2 being as square as possible,

[7.h.3] the grid G_1 being aligned with a corner of the grid G_2 to cover the face, the cells of grid G_1 having widths and heights that respectively are double the widths and heights of the cells of the grid G_2 , and

[7.h.4] the grid G_3 being aligned with the grid G_2 , the cells of the grid G_3 having widths and heights that respectively are half the widths and heights of the cells of the grid G_2 , and

[7.i] wherein the level of complexity of the first contour is configured to provide operation of the wireless device in the at least three frequency bands.

Ex. 1005, 42:44–43:29, 43:45–44:34.

E. The Asserted References

For its challenges, Petitioner relies on the following references:

Name	Reference	Exhibit
Ciais-Quadband	Pascal Ciais et al., <i>Design of an Internal Quad-Band Antenna for Mobile Phones</i> , Vol. 14, No. 4 IEEE Microwave and Wireless Components Letters 148–50, (April 2004) ⁶	1009

⁶ The acronym “IEEE” stands for “Institute of Electrical and Electronics Engineers.”

Name	Reference	Exhibit
Ciais-Multiband	Pascal Ciais et al., <i>Compact Internal Multiband Antenna for Mobile Phone and WLAN Standards</i> , Vol. 40, No. 15 Electronics Letters 920–21 (July 2004)	1010
Jing	Xu Jing et al., <i>Compact Planar Monopole Antenna for Multi-Band Mobile Phones</i> , in 2005 Asia-Pacific Microwave Conference Proceedings Vol. 4 (IEEE) 2657–60 (December 2005)	1011
Nakano	Hisamatsu Nakano et al., <i>An Inverted FL Antenna for Dual-Frequency Operation</i> , Vol. 53, No. 8 IEEE Transactions on Antennas and Propagation 2417–21 (August 2005)	1012
Dou	US 2007/0200773 A1, published August 30, 2007 (based on an application filed February 24, 2006)	1013
Hilgers	US 2003/0025635 A1, published February 6, 2003 (based on an application filed July 30, 2002)	1040
Ying	US 6,166,694, issued December 26, 2000 (based on an application filed July 9, 1998)	1049

Pet. 4, 17–149.

At this stage of the proceeding, Patent Owner does not dispute that each reference qualifies as prior art. *See, e.g.*, Prelim. Resp. 1–4, 8–42; Prelim. Sur-reply 1–5.

F. The Asserted Challenges to Patentability

Petitioner asserts the following challenges to patentability:

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
7–9, 11–14, 16, 17, 19, 20	103	Dou, Ciais-Multiband
10, 18	103	Dou, Ciais-Multiband, Hilgers
1–20	103	Dou, Ciais-Quadband, Nakano

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1, 3–5, 13, 15, 17, 19, 20	103	Dou, Jing
6, 18	103	Dou, Jing, Ying

Pet. 4, 17–149.

G. Testimonial Evidence

To support its challenges, Petitioner relies on the declaration of Daniel van der Weide, Ph.D. (Exhibit 1007).⁷ Dr. van der Weide states, “I have been retained by Wolf, Greenfield & Sacks, P.C., counsel for Geotab Inc. and Geotab USA, Inc.,” to “assess claims 1–20” in the ’149 patent.

Ex. 1007 ¶ 1. Dr. van der Weide explains that he received (1) a “Bachelor of Science Degree in Electrical Engineering from the University of Iowa in 1987,” (2) a “Master of Science Degree in Electrical Engineering from Stanford University in 1990,” and (3) a “Ph.D. degree in Electrical Engineering from Stanford in 1993.” *Id.* ¶ 3.

Further, Petitioner relies on the declarations of James L. Mullins, Ph.D. (Exhibit 1014) and Gordon MacPherson (Exhibit 1027) to establish the public accessibility of Ciais-Quadband, Ciais-Multiband, Jing, and Nakano before the ’149 patent’s effective filing date.

To support its positions, Patent Owner relies on the declaration of Hossein Hashemi, Ph.D. (Exhibit 2010). Dr. Hashemi states, “I have been retained by Edell, Shapiro and Finnan, LLC” as “a technical expert in the field of electrical engineering” to “provide various opinions regarding” the

⁷ Petitioner filed a confidential version of Dr. van der Weide’s declaration and a public version of Dr. van der Weide’s declaration. We cite to the public version of Dr. van der Weide’s declaration.

'149 patent. Ex. 2010 ¶¶ 2–3. Dr. Hashemi explains that he received (1) a “Bachelor of Science degree in Electronics Engineering from Sharif University of Technology in 1997,” (2) a “Master’s degree in Electronics Engineering from Sharif University of Technology in 1999,” and (3) a “Master’s degree and Ph.D. in Electrical Engineering from the California Institute of Technology in 2001 and 2003, respectively.” *Id.* ¶ 7.

III. PATENTABILITY ANALYSIS

A. Eligibility for Post-Grant Review

The post-grant review provisions in § 6(d) of the Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112-29, 125 Stat. 284 (2011), apply only to patents subject to the AIA’s first-inventor-to-file provisions. *See* AIA § 6(f)(2)(A) (explaining that the amendments made in § 6(d) “shall apply only to patents described in” § 3(n)(1)). According to § 3(n)(1), the AIA’s first-inventor-to-file provisions apply to “any application for patent, and to any patent issuing thereon, that contains or contained at any time . . . a claim to a claimed invention that has an effective filing date . . . on or after” March 16, 2013. AIA § 3(n)(1). Additionally, a “petition for a post-grant review may only be filed not later than the date that is 9 months after the date of the grant of the patent or of the issuance of a reissue patent (as the case may be).” 35 U.S.C. § 321(c).

A petitioner bears the burden of demonstrating that the challenged patent is eligible for post-grant review. *See, e.g., US Endodontics, LLC v. Gold Standard Instruments, LLC*, PGR2015-00019, Paper 17 at 11–12 (PTAB Jan. 29, 2016).

The '149 patent issued on September 17, 2024. Ex. 1005, code (45). Petitioner filed the Petition on June 17, 2025, i.e., nine months after the date

of the grant of the '149 patent. Pet. 151. Patent Owner does not dispute that the '149 patent is eligible for post-grant review. *See, e.g.*, Prelim. Resp. 1–6, 22–42.

Because Petitioner has failed to show it is more likely than not that any of the challenged claims are unpatentable based on the merits of its challenges, we need not decide whether the '149 patent is eligible for post-grant review. *See infra* §§ III.E.3(c), III.F, III.G.3(c), III.H.2(c), III.I. For purposes of analysis, we assume without deciding that the '149 patent is eligible for post-grant review.

B. Legal Principles: Obviousness

A patent may not be obtained “if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains.” 35 U.S.C. § 103. An obviousness analysis involves underlying factual inquiries including (1) the scope and content of the prior art; (2) differences between the claimed invention and the prior art; (3) the level of ordinary skill in the art; and (4) where in evidence, objective indicia of nonobviousness, such as commercial success, long-felt but unsolved needs, and failure of others.⁸ *Graham v. John Deere Co. of Kan. City*, 383 U.S. 1, 17–18, 35–36 (1966); *Apple Inc. v. Samsung Elecs. Co.*, 839 F.3d 1034, 1047–48 (Fed. Cir. 2016) (en banc). When evaluating a combination of references, an obviousness analysis should address “whether there was an apparent reason to combine the known elements in the fashion

⁸ At this stage of the proceeding, the parties do not address objective indicia of nonobviousness. *See, e.g.*, Pet. 32–100; Prelim. Resp. 17–31.

claimed by the patent at issue.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 418 (2007).

We analyze the obviousness issues according to these principles.

C. Level of Ordinary Skill in the Art

Factors pertinent to determining the level of ordinary skill in the art include (1) the educational level of the inventor; (2) the type of problems encountered in the art; (3) prior-art solutions to those problems; (4) the rapidity with which innovations are made; (5) the sophistication of the technology; and (6) the educational level of workers active in the field. *Env’tl. Designs, Ltd. v. Union Oil Co.*, 713 F.2d 693, 696–97 (Fed. Cir. 1983). Not all factors may exist in every case, and one or more of these or other factors may predominate in a particular case. *Id.* These factors are not exhaustive, but merely a guide to determining the level of ordinary skill in the art. *Daiichi Sankyo Co. v. Apotex, Inc.*, 501 F.3d 1254, 1256 (Fed. Cir. 2007). Moreover, the prior art itself may reflect an appropriate skill level. *Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001).

Petitioner asserts that a person of ordinary skill as of the ’149 patent’s effective filing date would have had “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.” Pet. 10 (quoting Ex. 1018 ¶ 32). Petitioner also asserts that “[a]lternatively, the person of ordinary skill in the art would have a master’s degree in electrical engineering (or similar discipline) and at least two years of similar experience.” *Id.* (quoting Ex. 1018 ¶ 32). Dr. van der Weide’s testimony supports Petitioner’s assertions. *See* Ex. 1007 ¶ 39.

For purposes of the Preliminary Response only, Patent Owner employs Petitioner’s description of an ordinarily skilled artisan. Prelim. Resp. 22.

Based on the current record and for purposes of this decision, we accept Petitioner’s description of an ordinarily skilled artisan because it comports with the technology and claims of the ’149 patent as well as the asserted references. *See, e.g.*, Ex. 1005, 1:35–6:56, 42:44–46:28, code (57); *infra* §§ III.E.1–III.E.2, III.G.1–III.G.2, III.H.1.

D. Claim Construction

1. GENERAL PRINCIPLES

We construe claim terms “using the same claim construction standard” that district courts use to construe claim terms in civil actions for patent infringement. *See* 37 C.F.R. § 42.200(b) (2025). Under that standard, claim terms “are given their ordinary and customary meaning, which is the meaning the term would have to a person of ordinary skill in the art at the time of the invention.” *Power Integrations, Inc. v. Fairchild Semiconductor Int’l, Inc.*, 904 F.3d 965, 971 (Fed. Cir. 2018) (citing *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc)). The meaning of claim terms may be determined by “look[ing] principally to the intrinsic evidence of record, examining the claim language itself, the written description, and the prosecution history, if in evidence.” *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 469 F.3d 1005, 1014 (Fed. Cir. 2006) (citing *Phillips*, 415 F.3d at 1312–17).

2. PETITIONER’S POSITION

In a section of the Petition titled “Claim Interpretation,” Petitioner discusses the following claim terms:

- (a) “perimeter” in claims 1, 7, and 13;
- (b) “wireless device” in claims 1–20;
- (c) “antenna rectangle” in claims 11 and 16;
- (d) “first contour” in claims 1, 5, 7, 9, 13, and 17; and
- (e) “complexity factor F_{21} ” and “complexity factor F_{32} ” in claims 1, 5, 7, 9, 13, and 17.

Pet. 13–16.

For “perimeter,” Petitioner proposes an explicit construction, i.e., “boundary of an object” excluding “any notion of ‘following the shape of the radiating element and extending it as necessary to complete the boundary.’” Pet. 13 (quoting Ex. 1020, 16–17).

For “wireless device,” Petitioner asserts that an ordinarily skilled artisan would have understood that “wireless device” refers to “the nature of the communication,” e.g., “that the device can communicate wirelessly.” Pet. 14 (quoting Ex. 1020, 11).

For “antenna rectangle,” Petitioner notes that the ’149 patent’s specification defines the term as “the orthogonal projection of the antenna box along the normal to the face with largest area of the antenna box.” Pet. 14 (quoting Ex. 1005, 14:21–24).

For “first contour,” “complexity factor F_{21} ,” and “complexity factor F_{32} ,” Petitioner notes that limitations in independent claims 1, 7, and 13 define the terms. Pet. 15–16.

3. PATENT OWNER’S POSITION

Patent Owner does not propose an explicit construction for any claim term, phrase, or limitation. *See* Prelim. Resp. 21–22. Patent Owner submits

that “the Board can resolve all issues without an explicit construction of any claim term.” *Id.*

4. DISCUSSION

“[O]nly those terms need be construed that are in controversy, and only to the extent necessary to resolve the controversy.” *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999); see *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017). Based on the current record, we determine that no claim term requires an explicit construction to decide whether Petitioner satisfies the “more likely than not” standard for instituting a post-grant review.

As Petitioner recognizes, the ’149 patent defines many of the claim terms Petitioner discusses in the “Claim Interpretation” section of the Petition. See Pet. 14–16. For instance, the patent defines “antenna rectangle” as “the orthogonal projection of the antenna box along the normal to the face with largest area of the antenna box.” Ex. 1005, 14:21–24. Further, the patent defines “complexity factor F_{21} ” and “complexity factor F_{32} ” consistent with the independent claims. See *id.* at 17:16–21, 17:49–61, 18:8–18, 19:12–25, 20:5–17, 42:62–43:25, 44:5–30, 45:8–46:3.

E. Alleged Obviousness over Dou and Ciais-Multiband: Claims 7–9, 11–14, 16, 17, 19, and 20

Petitioner contends that claims 7–9, 11–14, 16, 17, 19, and 20 are unpatentable under § 103 because the claims would have been obvious over Dou and Ciais-Multiband. See Pet. 4, 17–55; Prelim. Reply 1–4. Patent Owner disputes Petitioner’s contentions. See Prelim. Resp. 1–2, 22–27; Prelim. Sur-reply 1–3.

Below, we provide overviews of Dou and Ciais-Multiband. Then, we consider the obviousness issues. For the reasons explained below, Petitioner does not establish sufficiently for purposes of institution that claims 7–9, 11–14, 16, 17, 19, and 20 are unpatentable under § 103 based on Dou and Ciais-Multiband.

1. OVERVIEW OF DOU (EXHIBIT 1013)

Dou is a U.S. patent application publication titled “Internal Diversity Antenna Architecture,” filed on February 24, 2006, and published on August 30, 2007. Ex. 1013, codes (12), (22), (43), (54). Dou explains that:

- (1) “diversity antennas are based on the concept of a smart array and tend to improve the receiving sensitivity of a wireless device by reducing multi-path interference”; and
- (2) “[r]ecently, diversity antennas have been applied to wireless devices such as mobile telephones and handheld computers.”

Id. ¶ 1.

Dou also explains that various embodiments directed to “an internal diversity antenna architecture” may “potentially improve the performance of a wireless device by improving one or more of characteristics, such as a size, shape, form factor, power consumption, battery life, transceiver operations, signal quality, weight, and other characteristics of the wireless device.” Ex. 1013 ¶ 14; *see id.* ¶ 30.

Dou's Figures 2A and 2B (reproduced below) depict an embodiment of a wireless device having an internal diversity antenna architecture:

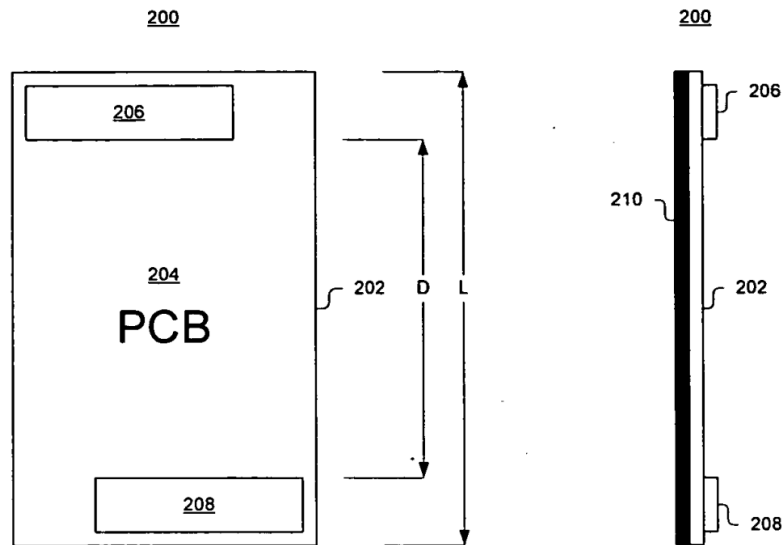


FIG. 2A

FIG. 2B

Figures 2A and 2B are front and side views, respectively, of wireless device 200 including housing 202, printed circuit board (PCB) 204, first internal antenna 206 disposed on PCB 204, second internal antenna 208 also disposed on PCB 204, and ground plane 210. Ex. 1013 ¶¶ 5–6, 15–17, Figs. 2A–2B. Wireless device 200 “may comprise, or be implemented as a handheld computer, mobile telephone, personal digital assistant (PDA), combination cellular telephone/PDA, data transmission device, one-way pager, two-way pager, and so forth.” *Id.* ¶ 15.

For wireless device 200, “the internal diversity antenna architecture may comprise” (1) first internal antenna 206 located “substantially near the top of the wireless device 200,” e.g., “substantially near the top of the housing 202 and/or the top of the PCB 204,” and (2) second internal antenna 208 located “substantially near the bottom of the wireless

device 200,” e.g., “substantially near the bottom of the housing 202 and/or the bottom of the PCB 204.” Ex. 1013 ¶ 17, Figs. 2A–2B.

First internal antenna 206 and second internal antenna 208 “may be used to implement various spatial diversity techniques to improve communication of wireless signals across one or more frequency bands of wireless shared media.” Ex. 1013 ¶ 22. For example, “the length (L) of the wireless device 200 may be greater than 0.3 wavelength ($>0.3\lambda$) of the lowest frequency.” *Id.* ¶ 24. Further, first internal antenna 206 and second internal antenna 208 “may be separated by a distance (D) that is no less than the quarter wavelength ($\geq \lambda/4$) of the lowest frequency.” *Id.*

First internal antenna 206 and second internal antenna 208 “may have varying polarities to implement one or more diversity techniques.” Ex. 1013 ¶ 18. For instance, first internal antenna 206 “may be vertically polarized,” and second internal antenna 208 “may be mainly horizontally polarized or vertically polarized with a cross-polarization component.” *Id.* Using antennas with “different polarized radiation patterns” reduces “mutual coupling” and permits “cooperative operation.” *Id.* ¶ 2.

First internal antenna 206 and second internal antenna 208 “may be designed for Evolution Data Optimized (EVDO) diversity at both the 800 MHz band (cellular) and the 1900 MHz (PCS).” Ex. 1013 ¶ 23.

First internal antenna 206 and second internal antenna 208 “may be tuned for operating at one or more frequency bands.” Ex. 1013 ¶ 22. For example, first internal antenna 206 and second internal antenna 208 “may allow the wireless device 200 to operate” in various frequency regions as follows:

the 824-894 Megahertz (MHz) frequency band for [Global System for Mobile communications] GSM operations, the 1850-1990 MHz frequency band for Personal Communications Services (PCS) operations, the 1575 MHz frequency band for Global Positioning System (GPS) operations, the 824-860 MHz frequency band for NAMPS operations, the 1710-2170 MHz frequency band for WCDMA/UMTS operations, ISM band in 2.4 GHz range for WiFi and Bluetooth, and other frequency bands.

Id.; *see id.* ¶ 45. Further, first internal antenna 206 and second internal antenna 208 “may be designed for Evolution Data Optimized (EVDO) diversity at both the 800 MHz band (cellular) and the 1900 MHz (PCS).” *Id.* ¶ 23.

First internal antenna 206 or second internal antenna 208 (or both) “may comprise a single antenna, or may be part of an array of antennas, such as a quad band antenna array.” Ex. 1013 ¶ 25. First internal antenna 206 or second internal antenna 208 (or both) “may be implemented using any type of suitable internal antenna” including the following types: “a planar inverted-F antenna, a planar inverted-L antenna, an inverted-F antenna with a helical structure, an inverted-L antenna with a helical structure, a monopole antenna, a meandered monopole antenna, a dipole antenna, a balanced antenna, a printed helical antenna, a chip antenna, and a ceramic antenna.” *Id.* ¶ 28; *see id.* ¶ 29 (discussing “a planar inverted-F antenna”).

Dou explains that while wireless device 200 shown in Figures 2A and 2B “comprises an exemplary embodiment of an internal diversity antenna architecture, it can be appreciated that the placement or location of the first internal antenna 206 and the second internal antenna 208 within the wireless device 200 may be performed in accordance with various performance and design constraints.” Ex. 1013 ¶ 30. For example, “the

efficiency of each antenna may depend upon a proper relationship between the size and shape of the antenna and the wavelength of the targeted frequency.” *Id.* “The specific frequency range that the antenna is designed to cover may dictate the optimal size of an antenna.” *Id.*

Dou’s Figures 3A and 3B (reproduced below) depict another embodiment of a wireless device having an internal diversity antenna architecture:

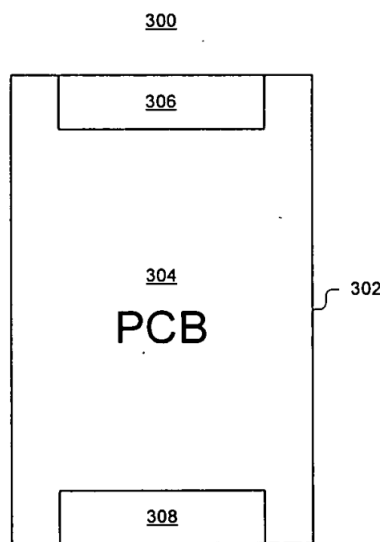


FIG. 3A

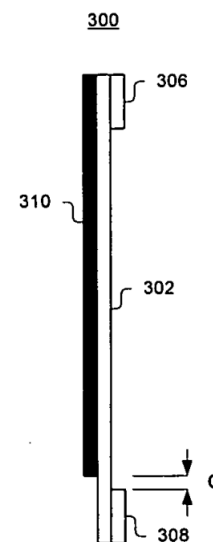


FIG. 3B

Figures 3A and 3B are front and side views, respectively, of wireless device 300 including housing 302, PCB 304, first internal antenna 306 disposed on PCB 304, second internal antenna 308 also disposed on PCB 304, and ground plane 310. Ex. 1013 ¶¶ 7–8, 31–34, Figs. 3A–3B. In “various embodiments,” wireless device 300 “may be similar in some structural and operational aspects as wireless device 200.” *Id.* ¶ 31.

As Figure 3B shows, however, “the ground plane 310 does not extend underneath the second internal antenna 308” in wireless device 300. Ex. 1013 ¶ 34, Fig. 3B. Also, second internal antenna 308 “may be

separated from the ground plane 310 by a clearance distance (C) that is no less than 5 mm (>5 mm).” *Id.* ¶ 34.

For wireless device 300, “the internal diversity antenna architecture may comprise” (1) first internal antenna 306 located “substantially at the top of the wireless device 300,” e.g., “substantially at the top of the housing 302 and/or the top of the PCB 304, and (2) second internal antenna 308 located “substantially at the bottom of the wireless device 300,” e.g., “substantially at the bottom of the housing 302 and/or the bottom of the PCB 304.” Ex. 1013 ¶ 32. In “some implementations, the first internal antenna 306 and the second internal antenna 308 may achieve maximum separation within the wireless device 300.” *Id.* ¶ 33.

First internal antenna 306 “may comprise, for example, a planar inverted F-antenna.” Ex. 1013 ¶ 34. Second internal antenna 308 “may comprise, for example, a monopole-antenna, an inverted-L antenna, a meandered monopole, a printed helical antenna, a dipole antenna, a balanced antenna, or other suitable antenna.” *Id.* “The embodiments are not limited in this context.” *Id.*

Regarding the wireless devices shown in Figures 2A–2B and 3A–3B, Dou explains that “the antenna architecture may comprise three or more antennas.” Ex. 1013 ¶ 40. For instance, “an additional antenna may comprise any suitable type of internal antenna disposed within the housing of a wireless device.” *Id.* Further, “an additional antenna may comprise any suitable type of external antenna such as a whip antenna, extendable antenna, antenna stubby, and so forth.” *Id.*

2. OVERVIEW OF CIAIS-MULTIBAND (EXHIBIT 1010)

Ciais-Multiband is a paper titled “Compact Internal Multiband Antenna for Mobile Phone and WLAN Standards” by Pascal Ciais et al., published in *Electronics Letters*, volume 40, number 15 (July 2004). Ex. 1010, 920;⁹ *see* Ex. 1014 ¶¶ 58–85.

Ciais-Multiband notes that “quad-band antennas for mobile phones and dual-band antennas for wireless local area network (WLAN) operations have been successfully designed.” Ex. 1010, 920 (citations omitted). According to Ciais-Multiband, however, “none of these antennas can simultaneously cover all the following communication standards”:

GSM (Global System for Mobile communications, 880–960 MHz), DCS (Digital Communication System, 1710–1880 MHz), PCS (Personal Communication Services, 1850–1990 MHz), UMTS (Universal Mobile Telecommunications System, 1920–2170 MHz), HIPERLAN/2 in Europe (High Performance Local Area Network—Type 2, 5150–5350/5470–5725 MHz) and IEEE 802.11a in the USA (Institute of Electrical and Electronics Engineers, 5150–5350/5725–5825 MHz).

Id.

Ciais-Multiband endeavors to address that deficiency by presenting a “novel internal planar inverted-F antenna (PIFA) suitable for handset terminals.” Ex. 1010, 920. The PIFA “combines shorted parasitic patches, capacitive loads and slots to achieve multiband operation.” *Id.* The PIFA “operates in the GSM, DCS, PCS, UMTS, HIPERLAN/2 and IEEE 802.11a

⁹ For Exhibit 1010 (Ciais-Multiband), we follow Petitioner’s practice and cite to the page numbers that appear in the publication.

bands within 2.5:1 voltage standing wave ratio (VSWR) and with good efficiency.” *Id.*

Specifically, the PIFA “consists of a main quarter-wavelength patch, with three additional parasitic elements.” Ex. 1010, 920. “This radiating structure has dimensions of $38.5 \times 28.5 \times 8.5$ mm and is placed on the corner of a ground plane having a size approximately equal to that of the printed circuit board (PCB) of a typical mobile phone, i.e. 40.5×105 mm.” *Id.*

Regarding the three additional parasitic elements, Ciais-Multiband explains that “[e]ach one is connected to the ground plane by metallic strips and located near the main patch in order to be efficiently electromagnetically coupled.” Ex. 1010, 920.

Ciais-Multiband’s Figure 1a (reproduced below) depicts a PIFA positioned above a ground plane whose size is representative of a PCB:

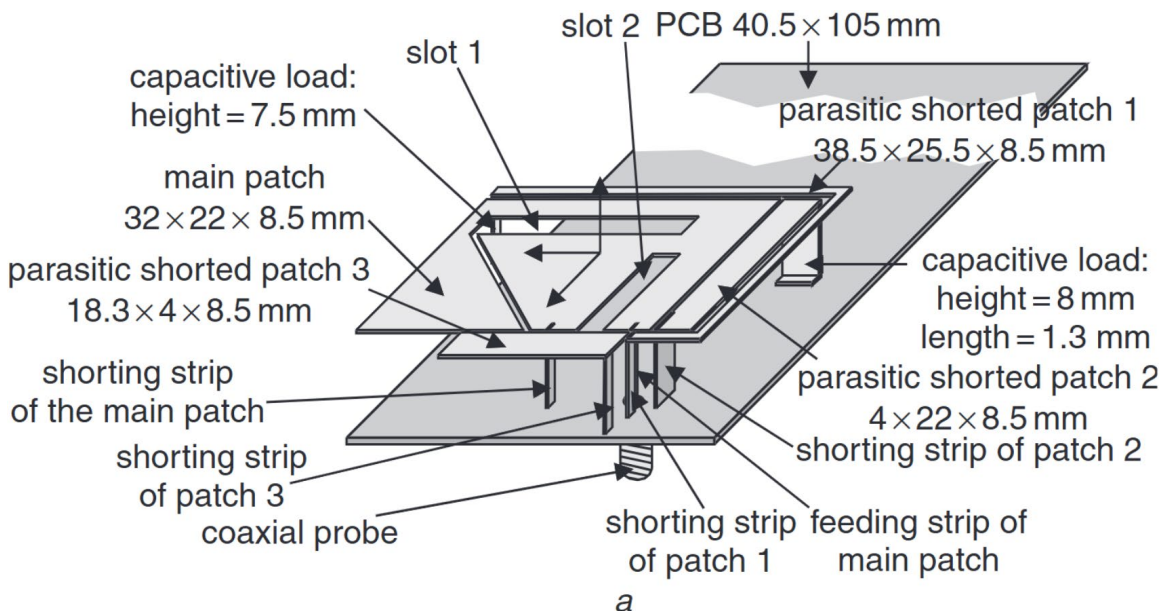


Figure 1a illustrates a PIFA including the following components:

- a main patch ($32 \text{ mm} \times 22 \text{ mm} \times 8.5 \text{ mm}$) with slot 1 and slot 2;

- a feeding strip for the main patch;
- a shorting strip between the main patch and the ground plane (40.5 mm $\times$ 105 mm);
- parasitic shorted patch 1 (38.5 mm $\times$ 25.5 mm $\times$ 8.5 mm) coplanar with the main patch;
- a shorting strip between parasitic shorted patch 1 and the ground plane;
- a capacitive load (height = 7.5 mm) between parasitic shorted patch 1 and the ground plane;
- parasitic shorted patch 2 (4 mm $\times$ 22 mm $\times$ 8.5 mm) coplanar with the main patch;
- a shorting strip between parasitic shorted patch 2 and the ground plane;
- a capacitive load (height = 8 mm and length = 1.3 mm) between parasitic shorted patch 2 and the ground plane;
- parasitic shorted patch 3 (18.3 mm $\times$ 4 mm $\times$ 8.5 mm) coplanar with the main patch; and
- a shorting strip between parasitic shorted patch 3 and the ground plane.

Ex. 1010, 920, Fig. 1a. For the main patch, parasitic shorted patch 1, parasitic shorted patch 2, and parasitic shorted patch 3, the dimension 8.5 mm represents the height above the ground plane. *See id.*

Ciais-Multiband's Figure 1b (reproduced below) is a top view of the PIFA in Figure 1a:

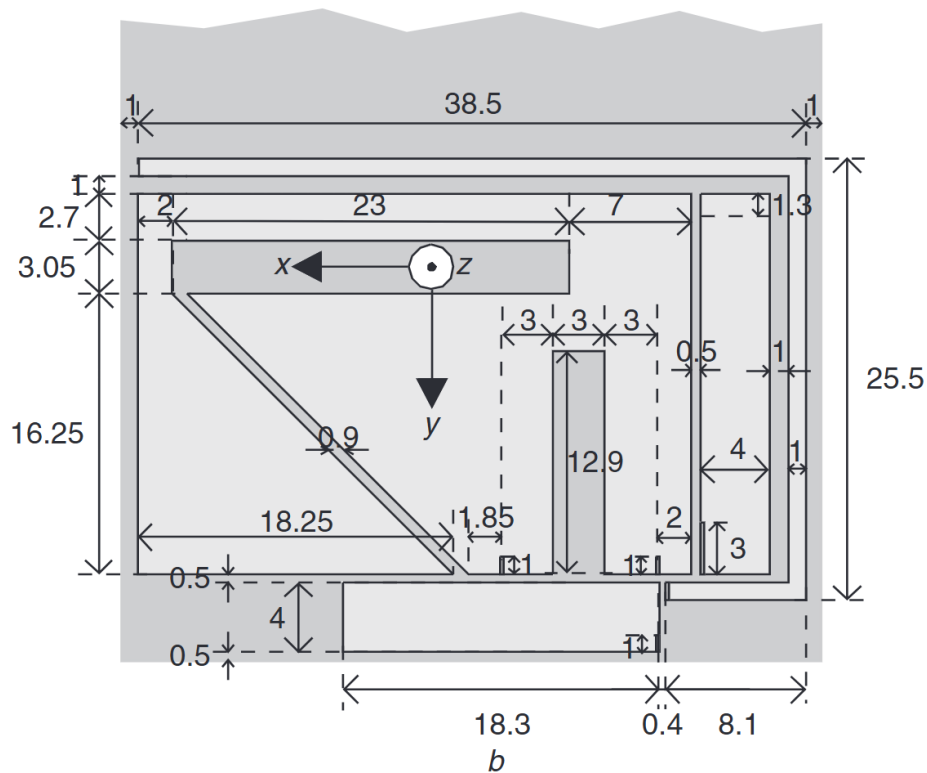


Figure 1b illustrates the dimensions of the main patch, parasitic shorted patch 1, parasitic shorted patch 2, parasitic shorted patch 3, and their respective parts as well as the dimensions between these components of the PIFA. Ex. 1010, 920, Fig. 1b. Figure 1b also illustrates offsets or clearances for the PIFA with respect to the ground plane, specifically, 0.5 mm between the bottom of the ground plane and the bottom of the PIFA, 1.0 mm between the left side of the ground plane and the left side of the PIFA, and 1.0 mm between the right side of the ground plane and the right side of the PIFA. *Id.*

For the PIFA, the “measured bandwidths with a VSWR better than 2.5:1 are 70 MHz (870–940 MHz) in the GSM band, 476 MHz (1608–2084

MHz) in the DCS/PCS/UMTS band and 1128 MHz (4863–5991 MHz) in the 5 GHz WLAN band.” Ex. 1010, 920–21, Fig. 2.

3. WHETHER AN ORDINARILY SKILLED ARTISAN WOULD
HAVE BEEN MOTIVATED TO COMBINE THE TEACHINGS OF
THE REFERENCES WITH A REASONABLE EXPECTATION OF SUCCESS

(a) Petitioner’s Contentions

Petitioner contends that Dou discloses a wireless handheld device with internally mounted antennas but “does not describe particular antennas” and “leaves the antenna selection” to an ordinarily skilled artisan. Pet. 19 (citing Ex. 1007 ¶ 84).

Petitioner contends that an ordinarily skilled artisan would have been motivated to use Ciais-Multiband’s antenna for Dou’s first internal antenna 206 and Dou’s second internal antenna 208, i.e., to replace Dou’s two antennas with duplicate copies of Ciais-Multiband’s antenna. Pet. 19–20. Petitioner explains that:

- (1) Ciais-Multiband’s antenna “was designed for use in ‘handset terminals’/‘handset devices’ (e.g., mobile phones), making it suitable for use as Dou’s ‘internal antenna’ 206 and 208 ‘disposed within . . . housing 202 of the wireless device 200’”;
- (2) Ciais-Multiband’s antenna “is a planar inverted-F antenna (PIFA)”;
- (3) Dou discloses using a PIFA for first internal antenna 206 and second internal antenna 208;
- (4) Ciais-Multiband’s antenna provides coverage “for well-known cellular services in extended GSM900 (880-960 MHz), standard GSM (890-960 MHz), DCS1800 (1710-1880 MHz), and PCS1900 (1850-1990 MHz),” thus making Ciais-Multiband’s antenna “suitable for mobile phone applications” like Dou’s wireless handheld device; and

- (5) Ciais-Multiband's antenna also provides coverage "at 4863-5991 MHz, supporting wireless networking (WLAN) at 5 GHz ISM bands (5150-5350 MHz and 5470-5725 MHz) used by IEEE Std. 802.11a and HiperLAN/2," thus "comporting with Dou's description of device antennas supporting wireless networking."

Id. at 20–22 (alteration by Petitioner) (quoting Ex. 1013 ¶ 18) (citing Ex. 1005, 37:41 (Table 1); Ex. 1007 ¶¶ 81–83, 85–87; Ex. 1009, 920–21; Ex. 1013 ¶¶ 22, 28; Ex. 1030, 8–9).

According to Petitioner, the proposed combination "has **two** antennas: antennas 206 and 208 (each a Ciais multiband antenna)." Pet. 23 (emphasis by Petitioner).

Petitioner asserts that using Ciais-Multiband's antenna for Dou's first internal antenna 206 and Dou's second internal antenna 208 "would have been nothing more than combining familiar elements according to known methods with predictable results, and been no more than the 'predictable use of prior art elements according to their established functions.'" Pet. 22 (quoting *KSR*, 550 U.S. at 417) (citing Ex. 1007 ¶ 88).

Further, Petitioner asserts that an ordinarily skilled artisan would have had a reasonable expectation of success in using Ciais-Multiband's antenna for Dou's first internal antenna 206 and Dou's second internal antenna 208 because:

- (1) Ciais-Multiband's antenna was designed for "internal use in cellular telephones";
- (2) "Dou expressly contemplates using a multiband PIFA antenna" like Ciais-Multiband's antenna "as its first and second internal antennas";

- (3) Dou describes antenna placement within a wireless device according to “various performance and design constraints” known to an ordinarily skilled artisan; and
- (4) Ciais-Multiband “describes placing the multiband antenna at the end of a PCB ‘on the corner of a ground plane’ where Dou places its antennas 206 and 208.”

Pet. 22–23 (citing Ex. 1007 ¶ 89; Ex. 1010, 920; Ex. 1013 ¶¶ 28–30, Figs. 2A–2B). According to Petitioner, implementing Ciais-Multiband’s antenna as Dou’s first internal antenna 206 and Dou’s second internal antenna 208 was “well within” the skills of an ordinarily skilled artisan, and “the resulting antenna operation was predictable.” *Id.* at 36 (citing Ex. 1007 ¶ 89; Ex. 1013 ¶¶ 12, 63).

Regarding Dou’s disclosure that first internal antenna 206 and second internal antenna 208 “may be separated by a distance (D) that is no less than the quarter wavelength ($\geq \lambda/4$) of the lowest frequency,” Petitioner asserts that Dou describes “spatial diversity” as “optional” and “one of several alternative ‘diversity techniques’ for creating diversity between its two antennas.” Prelim. Reply 2 (emphasis omitted) (citing Ex. 1013 ¶¶ 18, 22). According to Petitioner, Dou’s other diversity techniques include polarization diversity and pattern diversity. *Id.*

Petitioner also asserts that “[n]othing in Dou requires its ‘diversity antenna architecture’ to provide spatial diversity.” Prelim. Reply 2 (emphasis omitted). Petitioner explains that (1) “Dou’s dependent claim 8 recites at least a ‘quarter wavelength’ separation between a first and second ‘diversity antenna’” and (2) “Dou’s independent claims have no such requirement.” *Id.* at 3.

(b) Patent Owner's Contentions

Patent Owner disputes that an ordinarily skilled artisan would have been motivated to use Ciais-Multiband's antenna for Dou's first internal antenna 206 and Dou's second internal antenna 208. *See* Prelim. Resp. 1–2, 22–27; Prelim. Sur-reply 1–3. In particular, Patent Owner contends that the proposed combination would not have been obvious to an ordinarily skilled artisan because the proposed combination “directly contradicts the teachings of Dou.” Prelim. Resp. 22.

Patent Owner explains that:

- (1) an objective of “Dou's antenna design is to achieve spatial diversity between two antennas”;
- (2) “spatial diversity involves separating antennas by a sufficient distance to make their interference levels different” because “closely spaced antennas operating at the same frequency tend to experience similar interference levels”;
- (3) “Dou specifies a spacing between its two antennas of at least a quarter-wavelength at the lowest frequency of the antennas”;
- (4) “Dou's diversity antenna includes two antennas 206 and 208 located at opposite ends of a PCB 204 for the purpose of achieving spatial diversity”;
- (5) the lowest frequency of Ciais-Multiband's antenna is 870 MHz;
- (6) the wavelength (λ) corresponding to a frequency of 870 MHz is 344.8 mm, and a quarter wavelength ($\lambda/4$) is 86.2 mm;
- (7) the proposed combination employs Dou's ground plane 210 implemented “using the 40.5 mm $\times$ 105 mm dimensions” of Ciais-Multiband's ground plane;

- (8) using Ciais-Multiband's antenna for Dou's two antennas 206 and 208 on Ciais-Multiband's ground plane results in a spacing between the two antennas of 47.0 mm, i.e., "barely more than half of the quarter-wavelength lower bound (86.2 mm) of the spacing specified by Dou to achieve spatial diversity at the antennas' lowest frequency (870 MHz)";
- (9) a spacing between the two antennas of 47.0 mm "is contrary to the express teachings of Dou and would have eliminated effective spatial diversity, an important feature Dou's antenna architecture seeks to provide";
- (10) the proposed combination violates the "explicit design constraints" specified by Dou and understood by an ordinarily skilled artisan as "necessary to achieve the spatial diversity Dou's antenna design seeks"; and
- (11) an ordinarily skilled artisan would have recognized that the proposed combination "would destroy the very spatial diversity that Dou's antenna design sought to achieve."

Prelim. Resp. 1–2, 23–26 (emphasis omitted) (citing Ex. 1010, 920; Ex. 1013 ¶¶ 17, 22–24, codes (54), (57); Ex. 2010 ¶¶ 33–36, 50–56); *see* Prelim. Sur-reply 1–3.

As support, Patent Owner provides the following composite figure:

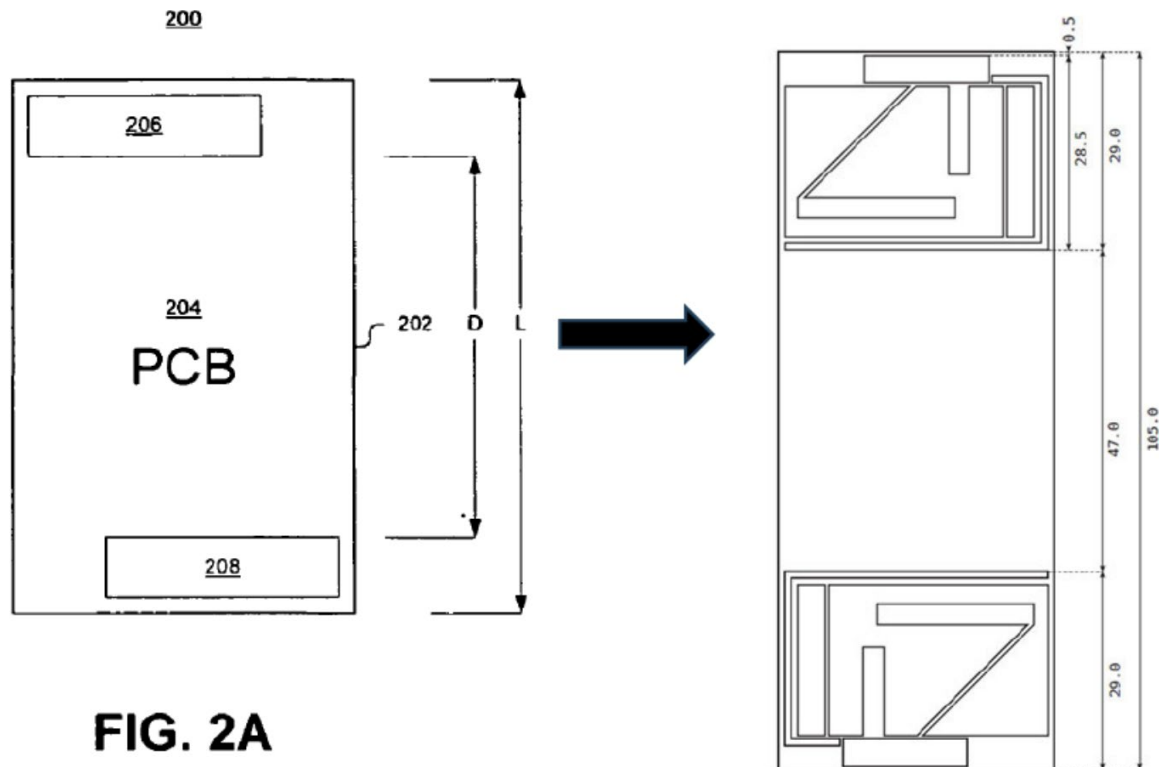


FIG. 2A

The above composite figure includes on the left Dou's Figure 2A and on the right a figure with (1) a first Ciais-Multiband antenna located near the top of a ground plane (or PCB) like Dou's first internal antenna 206 in Figure 2A and (2) a second Ciais-Multiband antenna located near the bottom of the ground plane (or PCB) like Dou's second internal antenna 208 in Figure 2A. *See Prelim. Resp. 25.*

In the above composite figure, the figure on the right includes the following dimensions:

- 0.5 mm for the vertical clearance between the top of the ground plane and the top of the upper multiband antenna and the same vertical clearance between the bottom of the ground plane and the bottom of the lower multiband antenna;
- 28.5 mm for the vertical length of a multiband antenna (and no dimension for the horizontal width);

- 29.0 mm for the distance between the top of the ground plane and the bottom of the upper multiband antenna and 29.0 mm for the distance between the bottom of the ground plane and the top of the lower multiband antenna;
- 47.0 mm for the distance between the bottom of the upper multiband antenna and the top of the lower multiband antenna; and
- 105.0 mm for the vertical length of the ground plane (and no dimension for the horizontal width).

See Prelim. Resp. 24–25. Patent Owner explains that “[s]ubtracting the 29 mm required for the antennas at each end of the PCB from the 105 mm overall length of the PCB results in a spacing between the two antennas of 47.0 mm.” *Id.* at 25.

Additionally, Patent Owner contends that the proposed combination does not provide any antenna diversity. *See* Prelim. Sur-reply 1–3. Regarding spatial diversity, Patent Owner asserts that with Ciais-Multiband’s antenna used for Dou’s two antennas 206 and 208, the two multiband antennas are insufficiently separated on Ciais-Multiband’s 40.5 mm × 105 mm ground plane for spatial diversity. *Id.* at 2–3.

Regarding pattern diversity, Patent Owner asserts that the two identical multiband antennas in the proposed combination would have “the same radiation patterns,” i.e., “identical substantially omnidirectional radiation patterns, in a parallel arrangement on the ground plane.” Prelim. Sur-reply 2–3.

Regarding polarization diversity, Patent Owner asserts that the two identical multiband antennas in the proposed combination would have “the same polarization” because they are (a) “arranged in parallel in the

combination” and (b) “not orthogonally polarized elements.” Prelim. Sur-reply 3.

Patent Owner also disputes that an ordinarily skilled artisan would have had a reasonable expectation of success in implementing the proposed combination. *See* Prelim. Resp. 2, 22–23, 26. Specifically, Patent Owner asserts that an ordinarily skilled artisan “understanding that at least a quarter-wavelength spacing between antennas is necessary to achieve spatial diversity” and “following Dou’s express specification of this spacing” would not have expected the proposed combination “to successfully provide the spatial diversity Dou’s antenna arrangement is intended to provide.” *Id.* at 22 (citing Ex. 2010 ¶ 56).

(c) Analysis

Based on the current record, Petitioner does not establish sufficiently for purposes of institution that an ordinarily skilled artisan would have been motivated to combine Ciais-Multiband’s teachings with Dou’s teachings in the way Petitioner proposes. *See* Pet. 19–25, 55; Prelim. Reply 1–4; Ex. 1007 ¶¶ 84–89, 92–94, 160; Ex. 2010 ¶¶ 33, 35–36, 38, 40, 50–56.

As Petitioner asserts, “[n]othing in Dou requires its ‘diversity antenna architecture’ to provide spatial diversity.” *See, e.g.,* Ex. 1013 ¶¶ 14, 17–18, 22–24, 30, 32–34; Prelim. Reply 2 (emphasis omitted). For example, Dou explains that first internal antenna 206 and second internal antenna 208:

- (1) “may be used to implement various spatial diversity techniques to improve communication of wireless signals across one or more frequency bands of wireless shared media”;
- (2) “may have varying polarities to implement one or more diversity techniques”; and

- (3) “may be designed for Evolution Data Optimized (EVDO) diversity at both the 800 MHz band (cellular) and the 1900 MHz (PCS).”

Ex. 1013 ¶¶ 18, 22–23; *see* Ex. 1007 ¶¶ 75–76.

Although “[n]othing in Dou requires its ‘diversity antenna architecture’ to provide spatial diversity,” Dou nevertheless requires a wireless device with some type of diversity antenna architecture. *See, e.g.*, Ex. 1013 ¶¶ 14, 17–18, 22–24, 30, 32–34, codes (54), (57), claims 1 and 16. As an example, Dou’s independent claim 1 covering a “wireless device” requires a “first diversity antenna” and a “second diversity antenna.” *Id.* at claim 1. As another example, Dou’s independent claim 16 covering a “wireless device” also requires a “first diversity antenna” and a “second diversity antenna.” *Id.* at claim 16. As yet another example, Dou’s Abstract describes a “wireless device” including a “first diversity antenna” and a “second diversity antenna.” *Id.* at code (57).

Petitioner does not explain how the proposed combination provides anything other than spatial diversity. *See* Pet. 19–22; Prelim. Reply 1–4; Ex. 1007 ¶¶ 84–88. Based on the current record, we agree with Patent Owner that with Ciais-Multiband’s antenna used for Dou’s two antennas 206 and 208, the two identical multiband antennas would have:

- (1) “the same radiation patterns,” i.e., “identical substantially omnidirectional radiation patterns, in a parallel arrangement on the ground plane”; and
- (2) “the same polarization” because they are (a) “arranged in parallel in the combination” and (b) “not orthogonally polarized elements.”

See Prelim. Sur-reply 2–3.

Regarding spatial diversity, Dou explains that first internal antenna 206 and second internal antenna 208 “may be separated by a distance (D) that is no less than the quarter wavelength ($\geq \lambda/4$) of the lowest frequency.” Ex. 1013 ¶ 24; *see* Ex. 2010 ¶¶ 35–36, 53. Consistent with Dou’s preference for at least a quarter-wavelength spacing between antennas at the lowest frequency, “a commonly accepted rule of thumb is that at least a quarter-wavelength spacing between antennas is necessary to provide effective spatial diversity.” Ex. 2010 ¶¶ 33, 35.

Effective spatial diversity requires sufficient spacing between antennas because that technique “uses multiple antennas to improve signal reliability and performance by mitigating the effects of multipath fading and other interference.” Ex. 2010 ¶ 33. “Multipath fading occurs when a wireless signal propagates along multiple different paths of differing lengths because of interactions with obstacles, resulting in portions of the signal energy arriving at a receiver with different phases slightly offset in time.” *Id.* Locations insufficiently separated in terms of wavelength “tend to experience similar fading and interference characteristics.” *Id.* Thus, closely spaced antennas “cannot provide effective spatial diversity.” *Id.* By providing sufficient spacing between antennas, however, “the likelihood increases that at least one of the antennas will be positioned at a location where the multipath or other interference is relatively low, thereby improving overall signal quality and reliability.” *Id.*

As Patent Owner contends, the proposed combination employs Dou’s ground plane 210 implemented “using the 40.5 mm × 105 mm dimensions” of Ciais-Multiband’s ground plane. *See* Pet. 19–25, 55; Prelim. Resp. 24; Prelim. Sur-reply 2; Ex. 1007 ¶¶ 84–88, 92–94, 160; Ex. 2010 ¶ 54. The

lowest frequency of Ciais-Multiband's antenna is 870 MHz. Ex. 1010, 920–21; *see* Ex. 1007 ¶¶ 79, 82–83; Ex. 2010 ¶¶ 40, 53. The wavelength (λ) corresponding to a frequency of 870 MHz is 344.8 mm, and a quarter wavelength ($\lambda/4$) is 86.2 mm. Ex. 2010 ¶¶ 38, 53.

In the proposed combination, a distance of 47.0 mm separates the two multiband antennas. Ex. 2010 ¶¶ 54–55. A distance of 47.0 mm corresponds to about 55% of a quarter wavelength ($\lambda/4$) at a frequency of 870 MHz, i.e., about 55% of 86.2 mm. *See id.* ¶ 55. Dr. Hashemi testifies that a distance of 47.0 mm separating the two multiband antennas in the proposed combination “would eliminate effective spatial diversity, the core feature Dou’s antenna architecture seeks to provide.” *Id.*

Petitioner does not explain why an ordinarily skilled artisan who used Ciais-Multiband’s antenna for Dou’s two antennas 206 and 208 would have departed from the commonly accepted rule of thumb and Dou’s preference for at least a quarter-wavelength spacing between antennas at the lowest frequency to the extent needed to implement the proposed combination, i.e., with only about 55% of the preferred spacing between antennas. *See* Pet. 19–22; Prelim. Reply 1–4; Ex. 1007 ¶¶ 84–88. Hence, based on the current record, Petitioner does not establish sufficiently for purposes of institution that an ordinarily skilled artisan would have been motivated to combine Ciais-Multiband’s teachings with Dou’s teachings in the way Petitioner proposes.

In the Preliminary Reply, Petitioner contends that the proposed combination “implements Dou’s wireless device” with Ciais-Multiband’s antenna, not with Ciais-Multiband’s ground plane. Prelim. Reply 3 (citing Pet. 19–20, 22). In the Preliminary Sur-reply, Patent Owner responds by

asserting that Petitioner “mischaracterizes the Petition.” Prelim. Sur-reply 1. According to Patent Owner, the Petition “states that it is implementing Dou’s PCB 204 using the Ciais Multiband 40.5×105 mm PCB ground plane.” *Id.* at 2. As support, Patent Owner quotes the Petition’s statement about limitation 7.b. *Id.* (quoting Pet. 24–25).

Based on the current record, we agree with Patent Owner that the proposed combination employs Dou’s ground plane 210 implemented “using the $40.5 \text{ mm} \times 105 \text{ mm}$ dimensions” of Ciais-Multiband’s ground plane. *See* Pet. 19–25, 55; Prelim. Resp. 24; Prelim. Sur-reply 2; Ex. 1007 ¶¶ 84–88, 92–94, 160; Ex. 2010 ¶ 54.

In particular, for limitation 7.a reciting “a ground plane,” the Petition states that the proposed combination “uses Dou’s ground plane 210 to implement Ciais’s ground plane teaching.” Pet. 23; *see* Ex. 1005, 43:46; Ex. 1007 ¶ 92. Ciais-Multiband teaches that the antenna “is placed on the corner of a ground plane having a size approximately equal to that of the printed circuit board (PCB) of a typical mobile phone, i.e. $40.5 \times 105 \text{ mm}$.” Ex. 1010, 920; *see* Pet. 24–25, 53–54; Ex. 1007 ¶¶ 93–94, 158. Hence, Ciais-Multiband’s “ground plane teaching” concerns both antenna placement with respect to a ground plane, i.e., “on the corner of a ground plane,” and the ground plane size, i.e., “ $40.5 \times 105 \text{ mm}$.” *See* Ex. 1010, 920; Pet. 53–54; Ex. 1007 ¶ 158.

Further, for limitation 7.b reciting “a first non-planar antenna proximate to a first side of a ground plane rectangle enclosing the ground plane,” the Petition states that “PCB 204 implements Ciais’s teaching of a rectangular ($40.5 \text{ mm} \times 105 \text{ mm}$) PCB, also backed by a ground plane, that Ciais explains is representative of PCBs for typical mobile phones.”

Pet. 24–25; *see* Ex. 1005, 43:47–48; Ex. 1007 ¶ 94. The Petition similarly states that “Dou’s PCB 204 is implemented with a width of 40.5 mm as taught in Ciais-Multiband.” Pet. 55; *see* Ex. 1007 ¶ 160.

Because Petitioner does not establish sufficiently for purposes of institution that an ordinarily skilled artisan would have been motivated to combine Ciais-Multiband’s teachings with Dou’s teachings in the way Petitioner proposes, Petitioner fails to demonstrate that it is “more likely than not” that at least one of claims 7–9, 11–14, 16, 17, 19, and 20 is unpatentable under § 103 based on Dou and Ciais-Multiband.

*F. Alleged Obviousness over Dou,
Ciais-Multiband, and Hilgers: Claims 10 and 18*

Petitioner contends that claims 10 and 18 are unpatentable under § 103 because the claims would have been obvious over Dou, Ciais-Multiband, and Hilgers. *See* Pet. 4, 56–59. Patent Owner disputes Petitioner’s contentions. *See* Prelim. Resp. 2, 27–28. For the reasons explained below, Petitioner does not establish sufficiently for purposes of institution that claims 10 and 18 are unpatentable under § 103 based on Dou, Ciais-Multiband, and Hilgers.

Claim 10 depends directly from claim 7 and specifies that “a third antenna is configured to operate in at least two frequency bands being different from the at least three frequency bands and the third antenna is arranged within the wireless device.” Ex. 1005, 44:40–43. Claim 18 depends directly from claim 13 and includes limitations similar to claim 10. *Id.* at 46:19–22.

Petitioner cites Hilgers as disclosing the “third antenna” required by claims 10 and 18. *See* Pet. 56–59. Specifically, Petitioner asserts that

“Hilgers discloses a dual-band antenna for receiving GPS signals (at 1575.42 MHz) and transmitting/receiving Bluetooth at 2400-2483.5 MHz in the 2.4 GHz ISM band.” *Id.* at 56 (citing Ex. 1040 ¶¶ 1, 3, 23–24, 35).

According to Petitioner, the proposed combination of Hilgers with Dou and Ciais-Multiband “has **three** antennas: antennas 206 and 208 (each a Ciais multiband antenna), and Hilgers’s dual-band GPS/Bluetooth antenna.” Pet. 58 (emphasis by Petitioner) (citing Ex. 1007 ¶ 167).

Patent Owner contends that the proposed combination of Hilgers with Dou and Ciais-Multiband:

- (1) “merely introduces an additional antenna disclosed by Hilgers to address certain frequency bands missing from” Dou and Ciais-Multiband;
- (2) “still proposes to replace Dou’s two antennas 206 and 208 with duplicate copies of the Ciais-Multiband antenna”;
- (3) “does nothing to address the non-obviousness of replacing Dou’s antennas with two copies of Ciais-Multiband’s antenna”; and
- (4) “still destroys the spatial diversity Dou sought to achieve between antennas 206 and 208, because the spacing between the swapped-in Ciais-Multiband antennas is barely half that specified by Dou.”

Prelim. Resp. 2, 27–28.

For the challenge based on Dou, Ciais-Multiband, and Hilgers, Petitioner does not propose using a ground plane other than Ciais-Multiband’s ground plane that Petitioner relies on for the challenge based on Dou and Ciais-Multiband. *See* Pet. 56–59; Ex. 1007 ¶¶ 161–169. Nor does Petitioner propose separating the duplicate copies of Ciais-Multiband’s antenna by a larger distance in the challenge based on Dou, Ciais-Multiband,

and Hilgers than in the challenge based on Dou and Ciais-Multiband. *See* Pet. 56–59; Ex. 1007 ¶¶ 161–169. Hence, the challenge based on Dou, Ciais-Multiband, and Hilgers fails for the same reasons as the challenge based on Dou and Ciais-Multiband. *See* Ex. 2010 ¶¶ 50–59; *supra* § III.E.3(c).

Accordingly, Petitioner fails to demonstrate that it is “more likely than not” that at least one of claims 10 and 18 is unpatentable under § 103 based on Dou, Ciais-Multiband, and Hilgers.

*G. Alleged Obviousness over Dou,
Ciais-Quadband, and Nakano: Claims 1–20*

Petitioner contends that claims 1–20 are unpatentable under § 103 because the claims would have been obvious over Dou, Ciais-Quadband, and Nakano. *See* Pet. 4, 59–120. Patent Owner disputes Petitioner’s contentions. *See* Prelim. Resp. 1–3, 28–35.

Above, we provided an overview of Dou. *See supra* § III.E.1. Below, we provide overviews of Ciais-Quadband and Nakano. Then, we consider the obviousness issues. For the reasons explained below, Petitioner does not establish sufficiently for purposes of institution that claims 1–20 are unpatentable under § 103 based on Dou, Ciais-Quadband, and Nakano.

1. OVERVIEW OF CIAIS-QUADBAND (EXHIBIT 1009)

Ciais-Quadband is a paper titled “Design of an Internal Quad-Band Antenna for Mobile Phones” by Pascal Ciais et al., published in IEEE Microwave and Wireless Components Letters, volume 14, number 4 (April

2004). Ex. 1009, 148;¹⁰ *see* Ex. 1014 ¶¶ 33–57; Ex. 1027 ¶¶ 8–9, 13 & Attach. A.

Ciais-Quadband “presents the design of a compact Planar Inverted-F Antenna (PIFA) suitable for cellular telephone applications.” Ex. 1009, 148; *see id.* at 150. The PIFA “combines the use of a slot, shorted parasitic patches and capacitive loads to achieve multiband operation.” *Id.* at 148.

Specifically, the 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 Printed Circuit Board (PCB) of a typical mobile phone,” i.e., “40.5 mm × 105 mm.” Ex. 1009, 148. The “chosen length is not the best choice for an optimum GSM bandwidth (around 130 mm) or an optimum DCS bandwidth (around 70 mm) but it will equally helps [sic] in these both bands for an efficient antenna-chassis combination.” *Id.*

Regarding the three additional parasitic elements, Ciais-Quadband explains that they were “added to the main patch to achieve our desired multiband goal.” Ex. 1009, 149. Each of the three additional parasitic elements is connected to the ground plane by a metallic strip and “located near the main patch in order to be correctly electromagnetically excited.” *Id.*

¹⁰ For Exhibit 1009 (Ciais-Quadband), we follow Petitioner’s practice and cite to the page numbers that appear in the publication.

Ciais-Quadband's Figure 1a (reproduced below) depicts a PIFA positioned above a ground plane whose size is representative of a PCB:

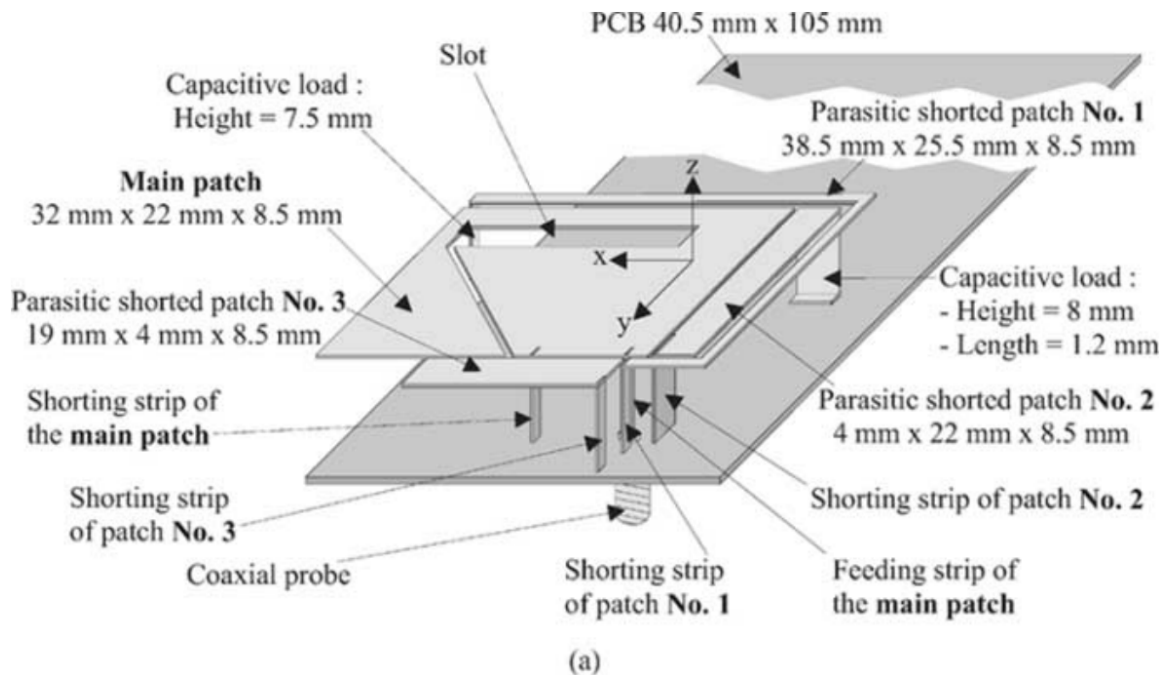


Figure 1a illustrates a PIFA including the following components:

- a main patch (32 mm × 22 mm × 8.5 mm) with a slot;
- a feeding strip for the main patch;
- a shorting strip between the main patch and the ground plane (40.5 mm × 105 mm);
- parasitic shorted patch no. 1 (38.5 mm × 25.5 mm × 8.5 mm) coplanar with the main patch;
- a shorting strip between parasitic shorted patch no. 1 and the ground plane;
- a capacitive load (height = 7.5 mm) between parasitic shorted patch no. 1 and the ground plane;
- parasitic shorted patch no. 2 (4 mm × 22 mm × 8.5 mm) coplanar with the main patch;
- a shorting strip between parasitic shorted patch no. 2 and the ground plane;

- a capacitive load (height = 8 mm and length = 1.2 mm) between parasitic shorted patch no. 2 and the ground plane;
- parasitic shorted patch no. 3 (19 mm × 4 mm × 8.5 mm) coplanar with the main patch; and
- a shorting strip between parasitic shorted patch no. 3 and the ground plane.

Ex. 1009, 148–49, Fig. 1a. For the main patch, parasitic shorted patch no. 1, parasitic shorted patch no. 2, and parasitic shorted patch no. 3, the dimension 8.5 mm represents the height above the ground plane. *See id.* at 148, Fig. 1a.

“Capacitive loads were added to the parasitic patches no. 1 and no. 2 by vertically folding their strip ends.” Ex. 1009, 149. Thus, “the electrical lengths of these resonators are artificially increased without enlarging the whole antenna size.” *Id.*

Ciais-Quadband's Figure 1b (reproduced below) is a top view of the PIFA in Figure 1a:

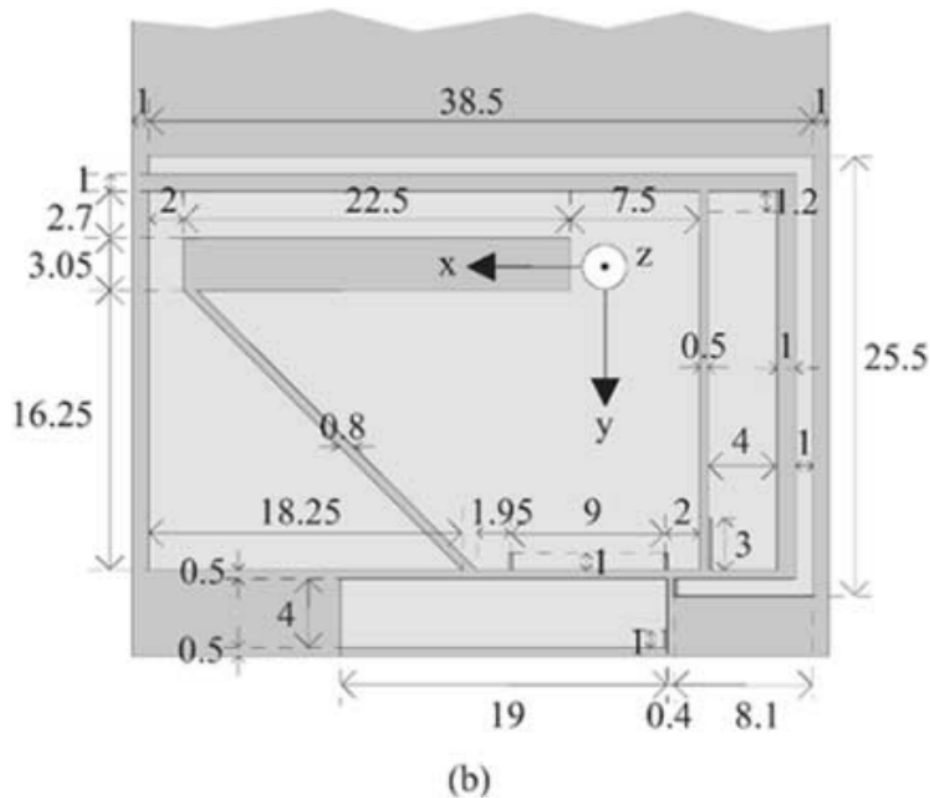


Figure 1b illustrates the dimensions of the main patch, parasitic shorted patch no. 1, parasitic shorted patch no. 2, parasitic shorted patch no. 3, and their respective parts as well as the dimensions between these components of the PIFA. Ex. 1009, 148, Fig. 1b. Figure 1b also illustrates offsets or clearances for the PIFA with respect to the ground plane, specifically, 0.5 mm between the bottom of the ground plane and the bottom of the PIFA, 1.0 mm between the left side of the ground plane and the left side of the PIFA, and 1.0 mm between the right side of the ground plane and the right side of the PIFA. *Id.*

The PIFA “covers the GSM standard (Global System for Mobile communications, 880–960 MHz)” and “also the DCS (Digital Communication System, 1710–1880 MHz), PCS (Personal Communication

Services, 1850–1990 MHz) and UMTS (Universal Mobile Telecommunications System, 1920–2170 MHz) standards.” Ex. 1009, 148; *see id.* at 150.

2. OVERVIEW OF NAKANO (EXHIBIT 1012)

Nakano is a paper titled “An Inverted FL Antenna for Dual-Frequency Operation,” by Hisamatsu Nakano et al., published in IEEE Transactions on Antennas and Propagation, volume 53, number 8 (August 2005). Ex. 1012, 2417;¹¹ *see* Ex. 1014 ¶¶ 117–143; Ex. 1027 ¶¶ 8, 10, 14 & Attach. B.

Nakano notes that an “increasing demand for wireless communications” has accelerated the development of new antennas, including dual-frequency antennas. Ex. 1012, 2417. Nakano “presents an antenna that responds to the above-mentioned trend,” specifically, an inverted FL antenna for dual-frequency operation at 2.45 GHz and 5.2 GHz (wireless LAN system frequencies). *Id.* at 2417, 2420. The inverted FL antenna “is intended for installation in mobile equipment,” e.g., “mobile phone handsets.” *Id.* at 2417–18 (emphasis omitted).

The inverted FL antenna “is made of a thin conducting film” with “a flat structure” where “both the radiation element (inverted F and L strip lines) in the positive y space and the ground plate (GP) in the negative y space lie in the same plane (x - y plane)” such that the antenna and ground plate are coplanar. Ex. 1012, 2417; *see id.* at 2420.

¹¹ For Exhibit 1012 (Nakano), we follow Petitioner’s practice and cite to the page numbers that appear in the publication.

Nakano's Figures 1a and 1b (reproduced below) depict antenna structures:

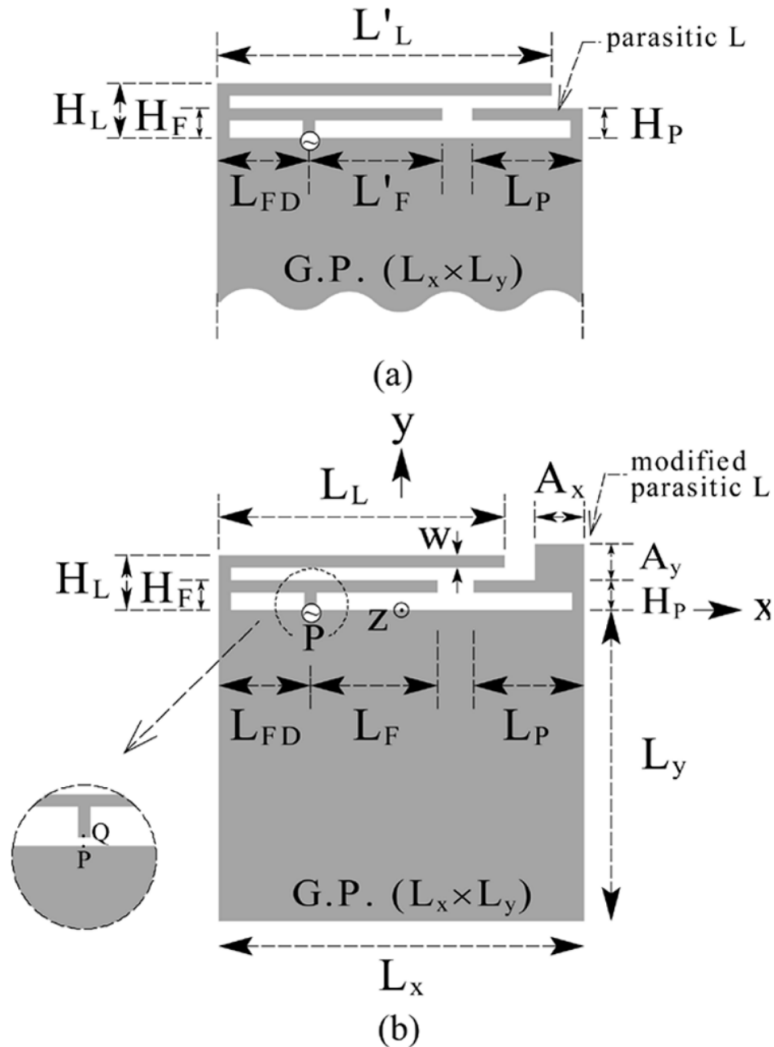


Figure 1a illustrates an antenna comprising inverted F and L elements with a parasitic L element above a coplanar ground plate. Ex. 1012, 2417.

Figure 1b illustrates an antenna ("referred to as the inverted FL antenna") comprising inverted F and L elements with a modified parasitic L element above a coplanar ground plate. *Id.* at 2417–18. In Figures 1a and 1b, the ground plate has the same size, i.e., " $L_x \times L_y = 30 \text{ mm} \times 25.5 \text{ mm}.$ " *Id.*

For the inverted FL antenna in Figure 1b, Nakano identifies "nine structural parameters" as follows: "the heights (H_L , H_F , H_P), the strip line

lengths (L_L , L_F , L_P), the protrusion size (A_x , A_y), and the feed point location (L_{FD}).” Ex. 1012, 2418. Nakano provides the following dimensions for those structural parameters:

$A_x = 4.0$ mm;
 $A_y = 3.0$ mm;
 $H_L = 4.5$ mm;
 $H_F = 2.5$ mm;
 $H_P = 2.5$ mm;
 $L_L = 24.5$ mm;
 $L_F = 10.5$ mm;
 $L_P = 9.0$ mm; and
 $L_{FD} = 7.5$ mm.

Id. at 2418–20.

The inverted FL antenna in Figure 1b “is excited at terminals P and Q, where the distance between P and Q is fixed to be 0.5 mm.” Ex. 1012, 2418.

3. WHETHER AN ORDINARILY SKILLED ARTISAN WOULD
HAVE BEEN MOTIVATED TO COMBINE THE TEACHINGS OF
THE REFERENCES WITH A REASONABLE EXPECTATION OF SUCCESS

(a) Petitioner’s Contentions

Petitioner contends that Dou discloses a wireless handheld device with “three or more” internally mounted antennas, including antennas for WiFi and Bluetooth, but “leaves the antenna selection” to an ordinarily skilled artisan. Pet. 60 (citing Ex. 1007 ¶ 172; Ex. 1013 ¶ 22). According to Petitioner, “Dou teaches that the antennas may be of ‘any suitable type’” and “may be arranged in ‘any suitable topology . . . for a given implementation.’” *Id.* (alteration by Petitioner) (quoting Ex. 1013 ¶¶ 39–40).

Petitioner contends that an ordinarily skilled artisan would have been motivated to use Nakano's inverted FL (InvFL) antenna with Dou's wireless device and "place one of Nakano's InvFL antenna at the 'top' and 'bottom' of Dou's PCB 204" to "provide spatial diversity in a 'diversity antenna architecture' that Dou explains improves 'receiving sensitivity' and device performance." Pet. 60–61 (citing Ex. 1007 ¶ 175; Ex. 1013 ¶¶ 1, 14–17, 22, 30, code (57)). Petitioner explains that:

- (1) Nakano's InvFL antenna was designed for internal use in "mobile phone handsets" like Dou's wireless device;
- (2) Nakano's InvFL antenna implements "WLAN functionality that Dou describes its wireless device having," i.e., operation at (a) 2.45 GHz used by IEEE Std. 802.11b and Bluetooth and (b) 5.2 GHz used by IEEE Std. 802.11a;
- (3) Nakano's dual-frequency antenna "met an 'increasing demand for wireless communications'"; and
- (4) market demand gave skilled artisans additional reasons to include Nakano's dual-frequency antenna in Dou's wireless device.

Id. (citing Ex. 1007 ¶ 174; Ex. 1012, 2417, 2419, Fig. 4; Ex. 1013 ¶ 22; Ex. 1042, 3; Ex. 1043, 49–50; Ex. 1044, 27).

According to Petitioner, an ordinarily skilled artisan "would have modified Dou's wireless device to use Nakano's teaching" by (1) "placing an InvFL antenna co-planar with ground plane 210," (2) extending each Nakano antenna from "the ground plane both 'above' and 'below' PCB 204," and (3) positioning each Nakano antenna "along an edge of the PCB" to "simplify offsetting the feed lines to terminal Q from Dou antennas 206 and 208, respectively." Pet. 61–63 (citing Ex. 1007 ¶¶ 175–177; Ex. 1012, 2417–18; Ex. 1013 ¶¶ 16–17, Figs. 2A–2B).

Petitioner contends that an ordinarily skilled artisan would have been motivated to use Ciais-Quadband's antenna for Dou's first internal antenna 206 and Dou's second internal antenna 208, i.e., to replace Dou's two antennas with duplicate copies of Ciais-Quadband's antenna. Pet. 64. Petitioner explains that:

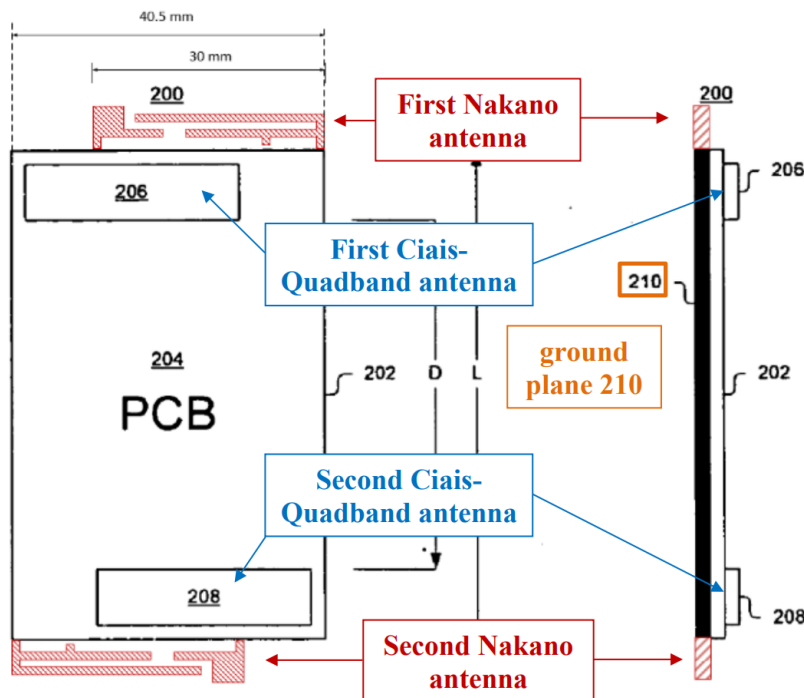
- (1) Ciais-Quadband's antenna "was designed for internal use in mobile phones," thus "making it suitable for use as Dou's 'internal antenna' 206 and 208";
- (2) Ciais-Quadband's antenna "is a planar inverted-F antenna (PIFA)";
- (3) Dou discloses using a PIFA for first internal antenna 206 and second internal antenna 208;
- (4) Ciais-Quadband's antenna operates in frequency regions used by "well-known communication standards (GSM, DCS, PCS, UMTS)" suitable for mobile phones like Dou's wireless device, i.e., "870-960 MHz and 1710-2170 MHz"; and
- (5) Ciais-Quadband "teaches placing the quadband antenna 'on the corner of a ground plane' with dimensions (40.5×105 mm) that are 'representative' of a 'typical mobile phone' PCB."

Id. at 64–65 (citing Ex. 1007 ¶¶ 179–180; Ex. 1009, 148, 150; Ex. 1013 ¶¶ 18, 22, 28).

According to Petitioner, an ordinarily skilled artisan "would have used Ciais's teaching to modify Dou by covering the back surface of PCB 204 with ground plane 210, and placing a Ciais quadband antenna over 'the corner of' ground plane 210 to provide Dou antennas 206 and 208." Pet. 65 (citing Ex. 1007 ¶ 182).

Petitioner explains that the proposed combination has four antennas as follows: Dou's antennas 206 and 208 "implemented as Ciais-Quadband

antennas with spatial diversity supporting frequencies for cellular communications” and two additional antennas “implemented as Nakano antennas with spatial diversity supporting frequencies for WLAN/Bluetooth.” Pet. 66–67 (citing Ex. 1007 ¶ 184; Ex. 1013 ¶ 40). To show the proposed combination, Petitioner provides the following figure based on Dou’s Figures 2A and 2B:



The above figure includes front and side views from Dou’s Figures 2A and 2B, respectively, of Dou’s wireless device 200 with (1) a first Nakano InvFL antenna arranged above Dou’s ground plane 210 and shown in red and (2) a second Nakano InvFL antenna arranged below Dou’s ground plane 210 and shown in red. See Pet. 66. The above figure also includes:

- the red annotation “First Nakano antenna” and red arrows identifying the Nakano InvFL antenna arranged above Dou’s ground plane 210;

- the red annotation “Second Nakano antenna” and red arrows identifying the Nakano InvFL antenna arranged below Dou’s ground plane 210;
- the blue annotation “First Ciais-Quadband antenna” and blue arrows identifying the location of Dou’s first internal antenna 206;
- the blue annotation “Second Ciais-Quadband antenna” and blue arrows identifying the location of Dou’s second internal antenna 208;
- the orange annotation “ground plane 210” next to an orange rectangle around reference numeral 210;
- the dimension 30 mm showing the width of the Nakano InvFL antenna arranged above the ground plane in the proposed combination; and
- the dimension 40.5 mm showing the width of the ground plane in the proposed combination.

See id.

Further, Petitioner asserts that an ordinarily skilled artisan “would have had a reasonable expectation of success in combining Ciais’s and Nakano’s teachings with Dou.” Pet. 67 (citing Ex. 1007 ¶ 185); *see id.* at 67–69. According to Petitioner, “Dou confirms that combining multiple antennas within a single mobile wireless device was conventional” and within the skills of an ordinarily skilled artisan. *Id.* at 67 (citing Ex. 1007 ¶ 185; Ex. 1013 ¶¶ 22, 40).

(b) Patent Owner’s Contentions

Patent Owner disputes that an ordinarily skilled artisan would have been motivated to use Ciais-Quadband’s antenna for Dou’s first internal antenna 206 and Dou’s second internal antenna 208 in the proposed combination. *See* Prelim. Resp. 1–3, 28–35. In particular, Patent Owner

contends that the proposed combination would not have been obvious to an ordinarily skilled artisan because the proposed combination “directly contradicts the teachings of Dou.” Prelim. Resp. 28.

Patent Owner explains that:

- (1) an objective of “Dou’s antenna design is to achieve spatial diversity between two antennas”;
- (2) “spatial diversity involves separating antennas by a sufficient distance to make their interference levels different”;
- (3) “Dou specifies that the first and second antennas 206 and 208 be ‘separated by a distance (D) that is no less than the quarter wavelength ($\geq \lambda/4$) of the lowest frequency’”;
- (4) “Dou’s diversity antenna includes two antennas 206 and 208 located at opposite ends of a PCB 204 for the purpose of achieving spatial diversity”; [29]
- (5) the lowest frequency of Ciais-Quadband’s antenna is 870 MHz;
- (6) the wavelength (λ) corresponding to a frequency of 870 MHz is 344.8 mm, and a quarter wavelength ($\lambda/4$) is 86.2 mm;
- (7) the proposed combination employs Dou’s ground plane 210 implemented “using the 40.5 mm $\times$ 105 mm dimensions” of Ciais-Quadband’s ground plane;
- (8) using Ciais-Quadband’s antenna for Dou’s two antennas 206 and 208 on Ciais-Quadband’s ground plane results in a spacing between the two antennas of 47.0 mm, i.e., “barely more than half of the quarter-wavelength lower bound (86.2 mm) of the spacing specified by Dou to achieve spatial diversity at the antennas’ lowest frequency (870 MHz)”;
- (9) a spacing between the two antennas of 47.0 mm “is contrary to the express teachings of Dou and would

eliminate effective spatial diversity, an important feature Dou's antenna architecture seeks to provide";

- (10) the proposed combination violates the "explicit design constraints" specified by Dou and understood by an ordinarily skilled artisan as "necessary to achieve the spatial diversity Dou's antenna design seeks"; and
- (11) an ordinarily skilled artisan would have recognized that the proposed combination "destroys the spatial diversity Dou sought to achieve between antennas 206 and 208, because the spacing between the swapped-in Ciais-Quadband antennas is barely half that specified by Dou."

Prelim. Resp. 1, 29–34 (emphasis omitted) (citing Ex. 1009, 148–49; Ex. 1013 ¶¶ 17, 22–24, codes (54), (57); Ex. 2010 ¶¶ 33, 61–67).

As support, Patent Owner provides the following composite figure:

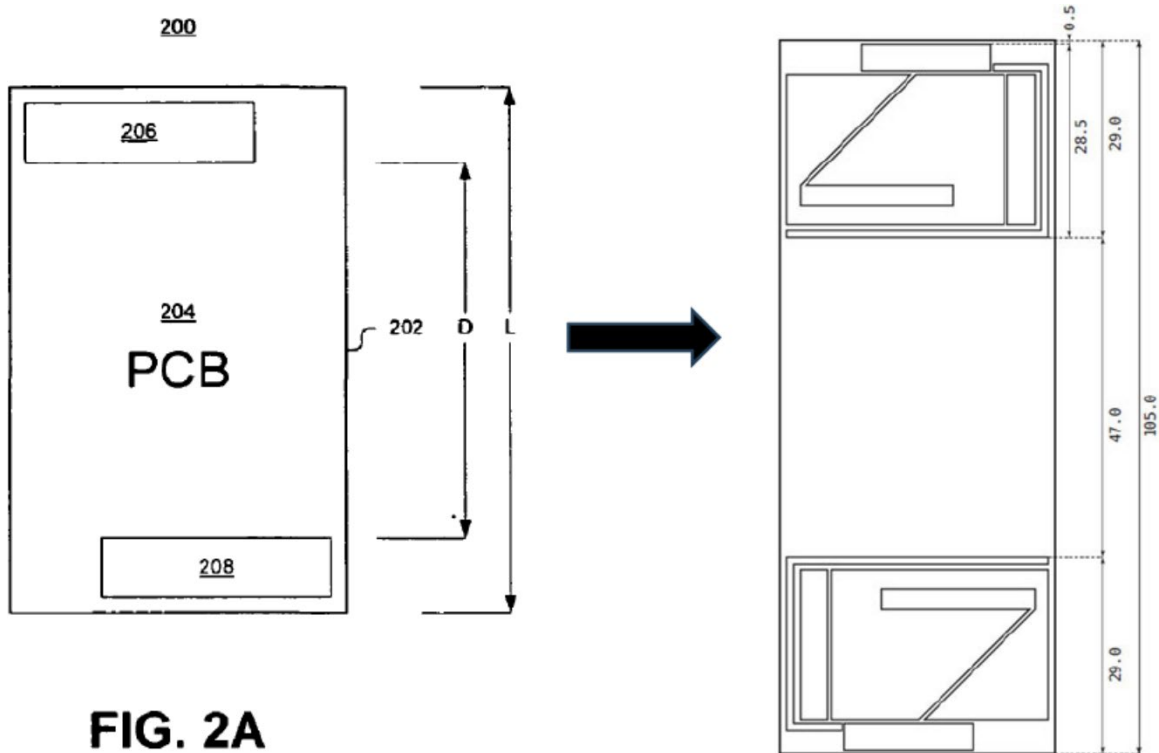


FIG. 2A

The above composite figure includes on the left Dou's Figure 2A and on the right a figure with (1) a first Ciais-Quadband antenna located near the top of a ground plane (or PCB) like Dou's first internal antenna 206 in Figure 2A

and (2) a second Ciais-Quadband antenna located near the bottom of the ground plane (or PCB) like Dou's second internal antenna 208 in Figure 2A. *See Prelim. Resp. 32.*

In the above composite figure, the figure on the right includes the following dimensions:

- 0.5 mm for the vertical clearance between the top of the ground plane and the top of the upper quadband antenna and the same vertical clearance between the bottom of the ground plane and the bottom of the lower quadband antenna;
- 28.5 mm for the vertical length of a quadband antenna (and no dimension for the horizontal width);
- 29.0 mm for the distance between the top of the ground plane and the bottom of the upper quadband antenna and 29.0 mm for the distance between the bottom of the ground plane and the top of the lower quadband antenna;
- 47.0 mm for the distance between the bottom of the upper quadband antenna and the top of the lower quadband antenna; and
- 105.0 mm for the vertical length of the ground plane (and no dimension for the horizontal width).

See Prelim. Resp. 31–32. Patent Owner explains that “[s]ubtracting the 29 mm required for the antennas at each end of the PCB from the 105 mm overall length of the PCB results in a spacing between the two antennas of 47.0 mm.” *Id.* at 32.

Patent Owner also disputes that an ordinarily skilled artisan would have had a reasonable expectation of success in implementing the proposed combination. *See Prelim. Resp. 28, 33.* Specifically, Patent Owner asserts that an ordinarily skilled artisan “understanding that at least a quarter-wavelength spacing between antennas is necessary to achieve spatial

diversity” and “following Dou’s express specification of this spacing” would not have expected the proposed combination “to successfully provide the spatial diversity Dou’s antenna arrangement is intended to provide.” *Id.* at 33 (citing Ex. 2010 ¶ 66).

(c) Analysis

Based on the current record, Petitioner does not establish sufficiently for purposes of institution that an ordinarily skilled artisan would have been motivated to combine the teachings of Dou, Ciais-Quadband, and Nakano in the way Petitioner proposes. *See* Pet. 60–69; Ex. 1007 ¶¶ 172–187; Ex. 2010 ¶¶ 38, 44, 60–67.

For the proposed combination, Petitioner explains that “Dou’s modified ground plane 210 is $40.5 \times 105 \text{ mm}^2$ as taught by Ciais-Quadband.” Pet. 84; *see* Ex. 1007 ¶ 223. Hence, as Patent Owner contends, the proposed combination employs Dou’s ground plane 210 implemented “using the $40.5 \text{ mm} \times 105 \text{ mm}$ dimensions” of Ciais-Quadband’s ground plane. *See* Pet. 64–66; Prelim. Resp. 31; Ex. 1007 ¶¶ 179–184; Ex. 2010 ¶ 64. The lowest frequency of Ciais-Quadband’s antenna is 870 MHz. Ex. 1009, 149–50; *see* Ex. 1007 ¶¶ 170, 180; Ex. 2010 ¶¶ 44, 63. The wavelength (λ) corresponding to a frequency of 870 MHz is 344.8 mm, and a quarter wavelength ($\lambda/4$) is 86.2 mm. Ex. 2010 ¶¶ 38, 63.

In the proposed combination, a distance of 47.0 mm separates the two quadband antennas. Ex. 2010 ¶¶ 64–65. A distance of 47.0 mm corresponds to about 55% of a quarter wavelength ($\lambda/4$) at a frequency of 870 MHz, i.e., about 55% of 86.2 mm. *See id.* ¶ 65. Dr. Hashemi testifies that a distance of 47.0 mm separating the two quadband antennas in the proposed combination “would eliminate effective spatial diversity, an

important feature Dou’s antenna architecture seeks to provide.” *Id.*; *see id.* ¶ 67.

Petitioner does not explain why an ordinarily skilled artisan who used Ciais-Quadband’s antenna for Dou’s two antennas 206 and 208 would have departed from the commonly accepted rule of thumb and Dou’s preference for at least a quarter-wavelength spacing between antennas at the lowest frequency to the extent needed to implement the proposed combination, i.e., with only about 55% of the preferred spacing between antennas. *See* Pet. 60–69; Ex. 1007 ¶¶ 172–187. Hence, based on the current record, Petitioner does not establish sufficiently for purposes of institution that an ordinarily skilled artisan would have been motivated to combine Ciais-Quadband’s teachings with Dou’s teachings in the way Petitioner proposes. Further, the addition of two Nakano InvFL antennas extending from the ground plane both above and below the PCB does not remedy the insufficient spacing between “the swapped-in Ciais-Quadband antennas.” Ex. 2010 ¶ 67.

Because Petitioner does not establish sufficiently for purposes of institution that an ordinarily skilled artisan would have been motivated to combine the teachings of Dou, Ciais-Quadband, and Nakano in the way Petitioner proposes, Petitioner fails to demonstrate that it is “more likely than not” that at least one of claims 1–20 is unpatentable under § 103 based on Dou, Ciais-Quadband, and Nakano.

*H. Alleged Obviousness over Dou and Jing:
Claims 1, 3–5, 13, 15, 17, 19, and 20*

Petitioner contends that claims 1, 3–5, 13, 15, 17, 19, and 20 are unpatentable under § 103 because the claims would have been obvious over Dou and Jing. *See* Pet. 4, 120–46; Prelim. Reply 4. Patent Owner disputes

Petitioner's contentions. *See* Prelim. Resp. 3–4, 35–41; Prelim. Sur-reply 4–5.

Above, we provided an overview of Dou. *See supra* § III.E.1. Below, we provide an overview of Jing. Then, we consider the obviousness issues. For the reasons explained below, Petitioner does not establish sufficiently for purposes of institution that claims 1, 3–5, 13, 15, 17, 19, and 20 are unpatentable under § 103 based on Dou and Jing.

1. OVERVIEW OF JING (EXHIBIT 1011)

Jing is a paper titled “Compact Planar Monopole Antenna for Multi-Band Mobile Phones” by Xu Jing et al., published in the 2005 Asia-Pacific Microwave Conference Proceedings, volume 4 (December 2005).

Ex. 1011, 2657;¹² *see* Ex. 1014 ¶¶ 86–116; Ex. 1027 ¶¶ 8, 11, 15 & Attach. C.

Jing explains that the “rapid development of modern wireless communication systems has caused wide interests in designing wide-band and multi-band antennas,” e.g., for mobile handsets. Ex. 1011, 2657. Jing identifies a drawback with some monopole antennas, specifically, “their structures are all 3-dimensional instead of 2-dimensional, increasing the manufacture difficulty and cost.” *Id.*

Jing endeavors to address that deficiency by disclosing a monopole antenna with a 2-dimensional structure. Ex. 1011, 2657–58. Specifically, “the antenna consists of three branches” printed on “a dielectric board.” *Id.* at 2657. Despite occupying a relatively small area, “the antenna meets the demand of the following communication standards: GSM (Global System

¹² For Exhibit 1011 (Jing), we follow Petitioner's practice and cite to the page numbers that appear in the publication.

for Mobile communications, 890-960 MHz), DCS (Digital Communication System, 1710-1880 MHz), PCS (Personal Communication Services, 1850-1990 MHz), UMTS (Universal Mobile Telecommunications System, 1920-2170 MHz), and WLAN (Wireless Local Area Network, 2400-2484 MHz).”
Id.

Jing’s Figure 1a (reproduced below) provides a general view of a planar monopole antenna:

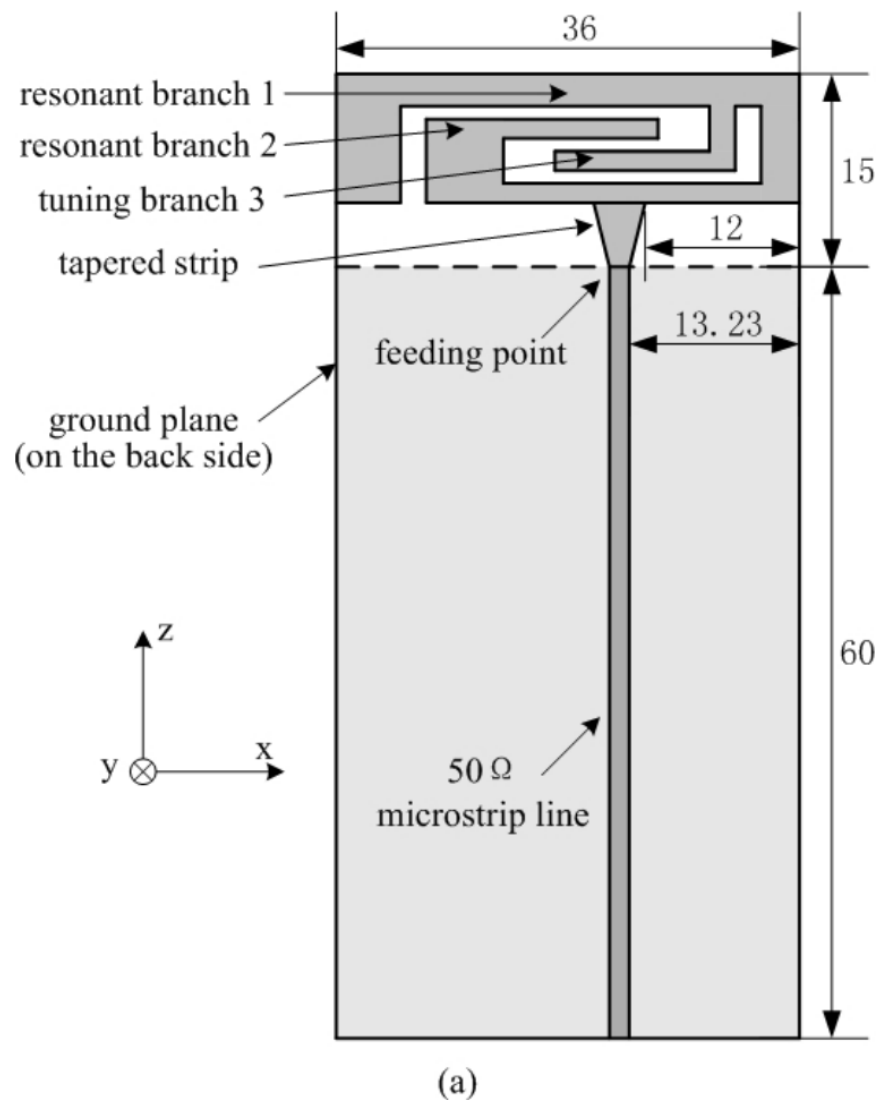


Figure 1a illustrates a planar monopole antenna comprising a rectangular patch (main radiating element) with “resonant branch 1 (the longer branch),

resonant branch 2 (the shorter branch) and tuning branch 3 (the additional inner branch)” and a tapered strip. Ex. 1011, 2657–58, Fig. 1a. The tapered strip connects the patch to a 50 Ω microstrip line at a feeding point. *Id.* at 2657. “The width of the strip changes linearly from 1.54 mm at the feeding point to 4 mm at the edge of the patch, improving the impedance matching at the feeding point.” *Id.* at 2658.

The patch and tapered strip occupy an area 36 mm wide and 15 mm long. Ex. 1011, 2657–58, 2660. The patch and tapered strip are printed on a substrate 36 mm wide and 75 mm long. *Id.* at 2658. The substrate “is considered to be the typical system circuit board of a mobile phone.” *Id.*

On “the back surface of the substrate,” a ground plane “is printed and treated as the system ground plane.” Ex. 1011, 2657–58. The ground plane occupies an area 36 mm wide and 60 mm long. *Id.*

Jing’s Figure 1b (reproduced below) provides detailed dimensions in millimeters for the rectangular patch (main radiating element) in the planar monopole antenna shown in Figure 1a:

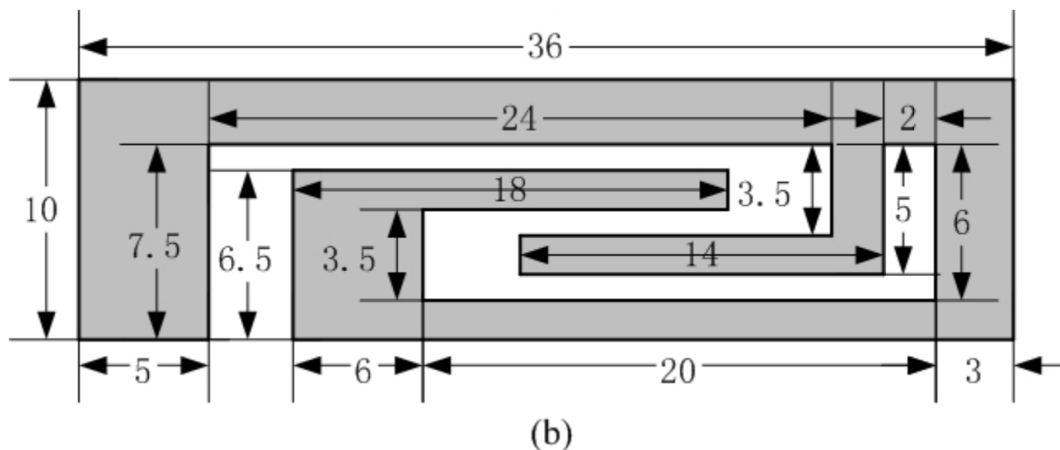


Figure 1b illustrates the rectangular patch (main radiating element) occupying an area 36 mm wide and 10 mm long. Ex. 1011, 2657, Fig. 1b.

Jing's Figure 3 (reproduced below) plots the Return Loss (dB) versus Frequency (MHz) for the planar monopole antenna shown in Figures 1a and 1b:

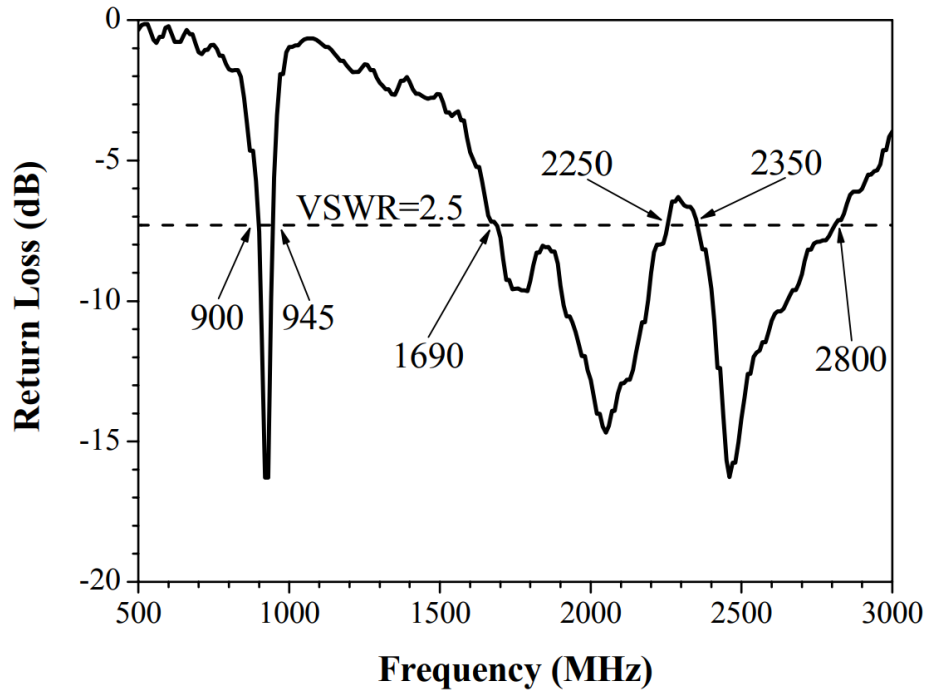


Figure 3 illustrates Frequency from 500 MHz to 3000 MHz along the x axis, Return Loss from -20 dB to 0 dB along the y axis, and measured data for the planar monopole antenna shown in Figures 1a and 1b. Ex. 1011, 2658, Fig. 3. According to the measured data in Figure 3, the antenna has a voltage standing wave ratio (VSWR) of 2.5 or better from 900 MHz to 945 MHz, from 1690 MHz to 2250 MHz, and from 2350 MHz to 2800 MHz. *Id.*

2. WHETHER AN ORDINARILY SKILLED ARTISAN WOULD
HAVE BEEN MOTIVATED TO COMBINE THE TEACHINGS OF
THE REFERENCES WITH A REASONABLE EXPECTATION OF SUCCESS

(a) Petitioner's Contentions

Petitioner contends that Dou discloses a wireless handheld device with internally mounted antennas but “does not describe particular antennas”

and “leaves antenna selection” to an ordinarily skilled artisan. Pet. 123 (citing Ex. 1007 ¶ 303).

Petitioner contends that an ordinarily skilled artisan would have been motivated to use Jing’s antenna for Dou’s first internal antenna 306 and Dou’s second internal antenna 308, i.e., to replace Dou’s two antennas with duplicate copies of Jing’s antenna. Pet. 123–25. Petitioner explains that:

- (1) “Jing’s antenna was designed for internal use in mobile handsets,” thus “making it suitable for use as Dou’s ‘internal antenna[s]’ 306 and 308 ‘integrated with the wireless device’”;
- (2) Jing’s antenna is a planar monopole antenna;
- (3) Dou discloses using a planar monopole antenna “for the first/second antennas”; and
- (4) “Jing’s antenna provided operation at frequencies used by well-known communication standards (DCS, PCS, UMTS, Zigbee, WiFi/Bluetooth) making it ‘suitable for mobile phone applications’ like Dou’s device.”

Id. at 123–24 (citing Ex. 1007 ¶¶ 304–305; Ex. 1011, 2657–58; Ex. 1013 ¶¶ 22, 33–34, Figs. 3A–3B).

Petitioner asserts that an ordinarily skilled artisan would have “recognized that whether the ground plane extends under Dou’s antennas depends on the specifications required by the implemented antennas.” Pet. 124–25 (citing Ex. 1007 ¶ 306). Petitioner notes that “Dou places antenna 308 at ‘no less than 5 mm’ offset from ground plane 310 just like Jing places its antenna with a 5 mm taper offsetting it from its ground plane.” *Id.* at 125 (quoting Ex. 1013 ¶ 34) (citing Ex. 1007 ¶ 307; Ex. 1011, 2657–58; Ex. 1013, Fig. 3B). Petitioner asserts that an ordinarily skilled artisan would have “implemented Dou’s antenna 306 and 308 using a Jing

antenna for each and Jing's 36×60 mm ground plane as a modified ground plane 310, to achieve Dou's diversity architecture." *Id.* (citing Ex. 1007 ¶ 306; Ex. 1013 ¶ 34).

For the proposed combination, Petitioner explains that an ordinarily skilled artisan would have "limited the extent of Dou's ground plane 310 to not extend behind Jing's antenna at 306, just like Dou does not extend it behind antenna 308." Pet. 125 (citing Ex. 1007 ¶ 306).

Petitioner provides the following composite figure to further explain the proposed combination:

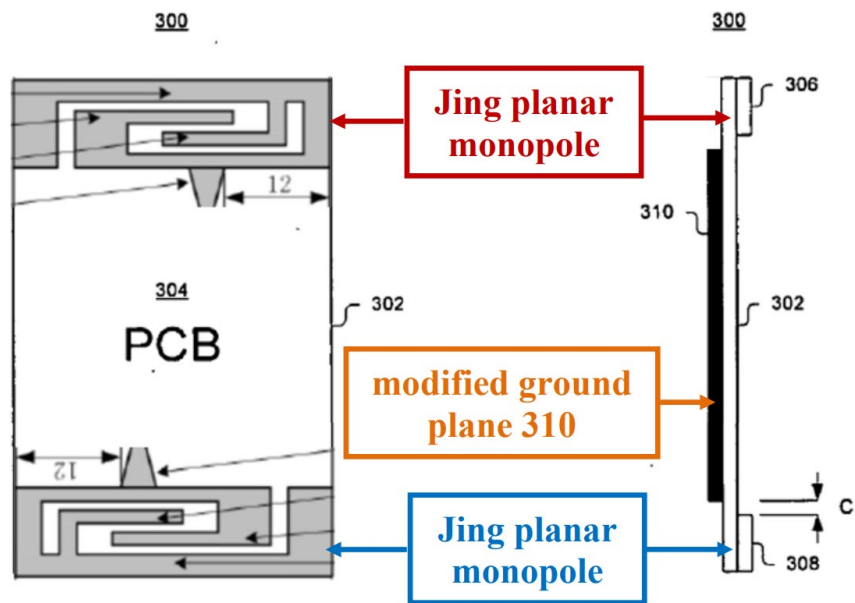


FIG. 3A

FIG. 3B

Above on the left, the composite figure includes Dou's Figure 3A with Jing's antenna replacing Dou's first internal antenna 306 and Jing's antenna replacing Dou's second internal antenna 308. *See* Pet. 125. Above on the right, the composite figure includes Dou's Figure 3B with ground plane 310 modified to extend from only slightly below first internal antenna 306 to slightly above second internal antenna 308, i.e., with a clearance distance

(C) separating second internal antenna 308 and ground plane 310. *See id.*

The composite figure also includes:

- (1) the red annotation “Jing planar monopole” and red arrows identifying the first (upper) antenna in Figures 3A and 3B;
- (2) the blue annotation “Jing planar monopole” and blue arrows identifying the second (lower) antenna in Figures 3A and 3B; and
- (3) the orange annotation “modified ground plane 310” and an orange arrow identifying modified ground plane 310 in Figure 3B.

See id.

Petitioner asserts that using Jing’s antenna for Dou’s first internal antenna 306 and Dou’s second internal antenna 308 “would have combined familiar elements according to known methods with predictable results” and “been no more than the ‘predictable use of prior art elements according to their established functions.’” Pet. 126 (quoting *KSR*, 550 U.S. at 417) (citing Ex. 1007 ¶ 307).

Further, Petitioner asserts that an ordinarily skilled artisan would have had a reasonable expectation of success in using Jing’s antenna for Dou’s first internal antenna 306 and Dou’s second internal antenna 308 because:

- (1) “Jing designed its antenna for internal use in mobile handsets”;
- (2) “Dou expressly contemplates using multiband PIFA antennas—like Jing’s—as its first/second internal antenna”;
- (3) Dou describes antenna placement within a wireless device according to “various performance and design constraints” known to an ordinarily skilled artisan; and

- (4) “Jing describes placing its antenna at the end of a PCB, just like Dou.”

Pet. 126 (citing Ex. 1007 ¶ 308; Ex. 1011, 2657; Ex. 1013 ¶¶ 28–32, 34, Figs. 3A–3B). According to Petitioner, implementing Jing’s antenna as Dou’s first internal antenna 306 and Dou’s second internal antenna 308 was well within the skills of an ordinarily skilled artisan, and “the resulting antenna operation was predictable.” *Id.* (citing Ex. 1007 ¶ 308; Ex. 1013 ¶¶ 12, 63).

Petitioner also asserts that “Dou does not require spatial diversity.” Prelim. Reply 4.

(b) Patent Owner’s Contentions

Patent Owner disputes that an ordinarily skilled artisan would have been motivated to use Jing’s antenna for Dou’s first internal antenna 306 and Dou’s second internal antenna 308. *See* Prelim. Resp. 3–4, 35–41; Prelim. Sur-reply 4–5. In particular, Patent Owner contends that the proposed combination would not have been obvious to an ordinarily skilled artisan because the proposed combination “directly contradicts the teachings of Dou.” Prelim. Resp. 35–36.

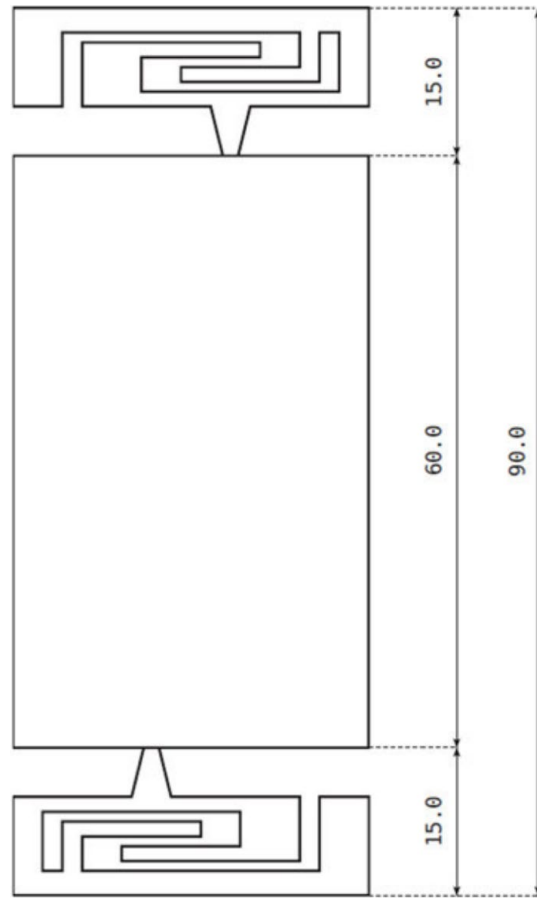
Patent Owner explains that:

- (1) an objective of “Dou’s antenna design is to achieve spatial diversity between two antennas”;
- (2) “Dou specifies that the first and second antennas be ‘separated by a distance (D) that is no less than the quarter wavelength ($\geq \lambda/4$) of the lowest frequency’”;
- (3) “Dou’s diversity system includes two antennas 306 and 308 located at opposite ends of a PCB 304 to achieve spatial diversity”;
- (4) the lowest frequency of Jing’s antenna is 900 MHz;

- (5) the wavelength (λ) corresponding to a frequency of 900 MHz is 333.3 mm, and a quarter wavelength ($\lambda/4$) is 83.3 mm;
- (6) the proposed combination implements “Dou’s antenna 306 and 308 using a Jing antenna for each and Jing’s 36×60 mm ground plane as a modified ground plane 310, to achieve Dou’s diversity architecture”;
- (7) using Jing’s ground plane in the proposed combination results in a spacing between the two antennas of 60 mm;
- (8) a spacing between the two antennas of 60 mm “is contrary to the express teachings of Dou (as well as the general understanding in the art at the time of invention)” and “would have eliminated effective spatial diversity, a feature Dou’s antenna architecture seeks to provide”; and
- (9) the proposed combination violates the “explicit design constraints” specified by Dou and understood by an ordinarily skilled artisan as “necessary to achieve the spatial diversity Dou’s antenna design seeks.”

Prelim. Resp. 36–40 (quoting Pet. 125) (citing Ex. 1011, 2658; Ex. 1013 ¶¶ 17, 22–24, 31, 35; Ex. 2010 ¶¶ 70–76); *see* Prelim. Sur-reply 4–5.

As support, Patent Owner provides the following figure representing the proposed combination:



The above figure depicts Jing's ground plane connected to a first (upper) Jing antenna and a second (lower) Jing antenna. *See* Prelim. Resp. 39. The above figure also includes the following length dimensions:

- 15.0 mm for the first (upper) Jing antenna;
- 60.0 mm for the ground plane;
- 15.0 mm for the second (lower) Jing antenna; and
- 90.0 mm for the overall distance between the bottom of the second (lower) Jing antenna and the top of the first (upper) Jing antenna.

See id.

Additionally, Patent Owner contends that the proposed combination does not provide any antenna diversity. *See* Prelim. Sur-reply 4–5.

Regarding spatial diversity, Patent Owner asserts that (a) “the Petition is explicit” about using Jing’s 36 mm × 60 mm ground plane in the proposed combination and (b) “the 60 mm spacing between the two antennas in the Petition’s modified antenna is well short of the lower bound (83.3 mm) of the spacing specified by Dou to achieve spatial diversity at the antennas’ lowest frequency (900 MHz).” *Id.* (citing Pet. 125; Ex. 2010 ¶¶ 73–74).

Regarding pattern diversity, Patent Owner asserts that the two identical Jing antennas in the proposed combination would have “the same substantially omnidirectional radiation patterns.” Prelim. Sur-reply 5 (citing Pet. 125; Ex. 1011, 2659).

Regarding polarization diversity, Patent Owner asserts that the two identical Jing antennas in the proposed combination would not provide polarization diversity because:

- (a) “polarization diversity uses orthogonally polarized elements”;
- (b) “the Jing antennas are placed on the same ground plane” in “a parallel arrangement”; and
- (c) the “parallel arrangement of the Jing antennas in the combination ensures that the antennas are not orthogonally polarized elements.”

Prelim. Sur-reply 5 (citing Pet. 125; Ex. 1007 ¶ 76).

Patent Owner also disputes that an ordinarily skilled artisan would have had a reasonable expectation of success in implementing the proposed combination. *See* Prelim. Resp. 3–4, 36, 41. Specifically, Patent Owner asserts that an ordinarily skilled artisan “understanding that at least a

quarter-wavelength spacing between antennas is implemented to achieve spatial diversity” and “following Dou’s express teaching of this spacing” would not have expected the proposed combination “to successfully provide the spatial diversity Dou’s antenna arrangement intended to provide.” *Id.* at 41 (citing Ex. 2010 ¶ 77).

(c) Analysis

Based on the current record, Petitioner does not establish sufficiently for purposes of institution that an ordinarily skilled artisan would have been motivated to combine Jing’s teachings with Dou’s teachings in the way Petitioner proposes. *See* Pet. 123–26; Prelim. Reply 4–5; Ex. 1007 ¶¶ 303–309; Ex. 2010 ¶¶ 38, 47, 69–77.

As Petitioner asserts, “Dou does not require spatial diversity.” *See, e.g.*, Ex. 1013 ¶¶ 14, 17–18, 22–24, 30, 32–34; Prelim. Reply 4. As explained above for the challenge based on Dou and Ciais-Multiband, however, Dou requires a wireless device with some type of diversity antenna architecture. *See, e.g.*, Ex. 1013 ¶¶ 14, 17–18, 22–24, 30, 32–34, codes (54), (57), claims 1 and 16; *supra* § III.E.3(c).

Petitioner does not explain how the proposed combination provides anything other than spatial diversity. *See* Pet. 123–26; Prelim. Reply 4–5; Ex. 1007 ¶¶ 303–309. Based on the current record, we agree with Patent Owner that in the proposed combination employing Jing’s ground plane and using Jing’s antenna for Dou’s two antennas 306 and 308, the two identical Jing antennas:

- (1) would have “the same substantially omnidirectional radiation patterns”; and
- (2) would not provide polarization diversity because
 - (a) “polarization diversity uses orthogonally polarized

elements,” (b) “the Jing antennas are placed on the same ground plane” in “a parallel arrangement,” and (c) the “parallel arrangement of the Jing antennas in the combination ensures that the antennas are not orthogonally polarized elements.”

See Prelim. Sur-reply 5.

Regarding spatial diversity, the proposed combination implements “Dou’s antenna 306 and 308 using a Jing antenna for each and Jing’s 36×60 mm ground plane as a modified ground plane 310, to achieve Dou’s diversity architecture.” Pet. 125; *see* Ex. 1007 ¶ 306. The lowest frequency of Jing’s antenna is 900 MHz. Ex. 1011, 2657–58; *see* Ex. 1007 ¶ 302; Ex. 2010 ¶¶ 47, 72. The wavelength (λ) corresponding to a frequency of 900 MHz is 333.3 mm, and a quarter wavelength ($\lambda/4$) is 83.3 mm. Ex. 2010 ¶¶ 38, 72.

In the proposed combination, a distance of 60 mm separates the two Jing antennas. Ex. 2010 ¶¶ 73–74. A distance of 60 mm corresponds to about 72% of a quarter wavelength ($\lambda/4$) at a frequency of 900 MHz, i.e., about 72% of 83.3 mm. *See id.* ¶¶ 38, 74. Dr. Hashemi testifies that a distance of 60 mm separating the two Jing antennas in the proposed combination “would eliminate effective spatial diversity, a feature Dou’s antenna architecture seeks to provide.” *Id.* ¶ 76.

Petitioner does not explain why an ordinarily skilled artisan who employed Jing’s ground plane and used Jing’s antenna for Dou’s two antennas 306 and 308 would have departed from the commonly accepted rule of thumb and Dou’s preference for at least a quarter-wavelength spacing between antennas at the lowest frequency to the extent needed to implement the proposed combination, i.e., with only about 72% of the preferred spacing

between antennas. *See* Pet. 123–26; Prelim. Reply 4–5; Ex. 1007

¶¶ 303–309. Hence, based on the current record, Petitioner does not establish sufficiently for purposes of institution that an ordinarily skilled artisan would have been motivated to combine Jing’s teachings with Dou’s teachings in the way Petitioner proposes.

Because Petitioner does not establish sufficiently for purposes of institution that an ordinarily skilled artisan would have been motivated to combine Jing’s teachings with Dou’s teachings in the way Petitioner proposes, Petitioner fails to demonstrate that it is “more likely than not” that at least one of claims 1, 3–5, 13, 15, 17, 19, and 20 is unpatentable under § 103 based on Dou and Jing.

I. Alleged Obviousness over Dou, Jing, and Ying: Claims 6 and 18

Petitioner contends that claims 6 and 18 are unpatentable under § 103 because the claims would have been obvious over Dou, Jing, and Ying. *See* Pet. 4, 146–49. Patent Owner disputes Petitioner’s contentions. *See* Prelim. Resp. 4, 41–42. For the reasons explained below, Petitioner does not establish sufficiently for purposes of institution that claims 6 and 18 are unpatentable under § 103 based on Dou, Jing, and Ying.

Claim 6 depends indirectly from claim 1 and further requires “a third antenna configured to operate in at least two frequency bands that are different from the at least three frequency bands.” Ex. 1005, 43:41–44. Claim 18 depends directly from claim 13 and includes limitations similar to claim 6. *Id.* at 46:19–22.

Petitioner cites Ying as disclosing the “third antenna” required by claims 6 and 18. *See* Pet. 146–49. Specifically, Petitioner asserts that “Ying discloses ‘a miniature, built-in dual band antenna which is suitable for use in

[] compact mobile terminals” that covers several “low and high bands,” including “GSM+GPS.” *Id.* at 146 (alteration by Petitioner) (citing Ex. 1049, 3:39–40, 3:43–46, 5:14–28, code (57)).

According to Petitioner, the proposed combination of Ying with Dou and Jing “has **three** antennas: antennas 306 and 308 (each a Jing antenna), and Ying’s dual-band GPS/GSM900 antenna.” Pet. 148 (emphasis by Petitioner) (citing Ex. 1007 ¶ 358).

Patent Owner contends that the proposed combination of Ying with Dou and Jing:

- (1) “merely introduces an additional antenna disclosed by Ying to address certain frequency bands missing from” Dou and Jing;
- (2) “still proposes to replace Dou’s two antennas 306 and 308 with duplicate copies of the single Jing antenna”;
- (3) “does nothing to address the non-obviousness of replacing Dou’s antennas with two copies of Jing’s antenna”; and
- (4) “still destroys the spatial diversity Dou sought to achieve between antennas 306 and 308, because the spacing between the swapped-in Jing antennas is only a fraction of that specified by Dou.”

Prelim. Resp. 4, 42.

For the challenge based on Dou, Jing, and Ying, Petitioner does not propose using a ground plane other than Jing’s ground plane that Petitioner relies on for the challenge based on Dou and Jing. *See* Pet. 146–49; Ex. 1007 ¶¶ 353–360. Nor does Petitioner propose separating the duplicate copies of Jing’s antenna by a larger distance in the challenge based on Dou, Jing, and Ying than in the challenge based on Dou and Jing. *See* Pet. 146–49; Ex. 1007 ¶¶ 353–360. Hence, the challenge based on Dou, Jing,

and Ying fails for the same reasons as the challenge based on Dou and Jing. *See* Ex. 2010 ¶¶ 69–79; *supra* § III.H.2(c).

Accordingly, Petitioner fails to demonstrate that it is “more likely than not” that at least one of claims 6 and 18 is unpatentable under § 103 based on Dou, Jing, and Ying.

IV. PETITIONER’S MOTION TO SEAL

A. Introduction

Petitioner filed a confidential version of the Petition as Paper 3 and a public version of the Petition as Paper 4. Petitioner filed confidential and public versions of Dr. van der Weide’s declaration (Exhibit 1007). Additionally, Petitioner filed confidential versions of Exhibits 1045 and 1046. Concurrently with filing these confidential materials, Petitioner filed a Motion to Seal these confidential materials. Paper 5 (“Mot.”).

Patent Owner has not submitted a paper responding to Petitioner’s Motion to Seal.

B. Petitioner’s Position

Petitioner contends that the confidential version of the Petition, the confidential version of Dr. van der Weide’s declaration, and Exhibits 1045 and 1046 contain information from Patent Owner’s infringement contentions that Patent Owner “designated as confidential under a protective order” in the Geotab litigation. Mot. 2. According to Petitioner, “[t]his information is not publicly available.” *Id.*

C. Analysis

A strong public policy favors making all information filed in a post-grant review open to the public, e.g., because the proceeding determines the patentability of claims in an issued patent and, therefore, affects the rights of

the public. *See Garmin Int’l, Inc. v. Cuozzo Speed Techs. LLC*, IPR2012-00001, Paper 34 at 1 (PTAB Mar. 14, 2013). Hence, in a post-grant review, the default rule is that all papers and exhibits are open and “available to the public.” 35 U.S.C. § 326(a)(1); *see* 37 C.F.R. § 42.14. A party may, however, file papers or exhibits under seal along with a motion to seal, and then the papers or exhibits will be “treated as sealed pending the outcome of the ruling on the motion.” 35 U.S.C. § 326(a)(1); *see* 37 C.F.R. § 42.14.

The Board’s rules “identify confidential information in a manner consistent with Federal Rule of Civil Procedure 26(c)(1)(G), which provides for protective orders for trade secret or other confidential research, development, or commercial information.” PTAB Consolidated Trial Practice Guide at 19 (Nov. 2019) (“CTPG”)¹³ (citing 37 C.F.R. § 42.54); *see* 37 C.F.R. § 42.2 (defining “Confidential information”). The Board seeks to “strike a balance between the public’s interest in maintaining a complete and understandable file history and the parties’ interest in protecting truly sensitive information.” CTPG at 19.

The movant bears the burden to establish entitlement to the requested relief. *See* 37 C.F.R. § 42.20(c). In deciding a motion to seal, the Board applies a “good cause” standard. *See* 37 C.F.R. § 42.54(a).

“The ‘good cause’ standard for granting a motion to seal reflects the strong public policy for making all information . . . open to the public.” *Argentum Pharms. LLC v. Alcon Rsch., Ltd.*, IPR2017-01053, Paper 27 at 3 (PTAB Jan. 19, 2018) (informative). When assessing whether that standard has been met, we may consider whether the information at issue is truly

¹³ Available at <https://www.uspto.gov/TrialPracticeGuideConsolidated>.

confidential, whether harm would result from public disclosure, and whether the interest in maintaining confidentiality as to the information outweighs the strong public interest in an open record. *Id.* at 3–4.

We have reviewed the information at issue and determine that Petitioner has not satisfied the “good cause” standard for granting a motion to seal. The information at issue appears to relate to Patent Owner’s contentions concerning how asserted patent claims cover allegedly infringing products that are publicly available. *See* Pet. x, xii (Exhibit List) (describing Exhibits 1045 and 1046 as charts to Exhibit 1016 titled “Plaintiff’s Disclosure of Asserted Claims and Infringement Contentions Against Geotab Pursuant to Local Patent Rules 3-1 and 3-2”). Petitioner’s contention that the information at issue (1) concerns Patent Owner’s infringement contentions that Patent Owner “designated as confidential under a protective order” in the Geotab litigation and (2) “is not publicly available” fails to show that the information at issue is truly confidential, that harm would result from public disclosure, or that the interest in maintaining confidentiality as to the information outweighs the strong public interest in an open record. *See* Mot. 2; *Argentum*, IPR2017-01053, Paper 27 at 3–4. Further, Patent Owner has not asserted that the information at issue constitutes “trade secret or other confidential research, development, or commercial information.” *See* 37 C.F.R. § 42.2.

For these reasons, we deny Petitioner’s Motion to Seal without prejudice.

V. CONCLUSION

After considering the Petition, the Preliminary Response, the Preliminary Reply, the Preliminary Sur-reply, and the evidence of record,

and for the reasons discussed above, we determine that Petitioner has failed to demonstrate that it is “more likely than not” that at least one of the claims challenged in the Petition is unpatentable. Hence, we deny the Petition and do not institute a post-grant review.

VI. ORDER

Accordingly, it is

ORDERED that the Petition is denied and no trial is instituted; and

FURTHER ORDERED that Petitioner’s Motion to Seal (Paper 5) is denied without prejudice.

PGR2025-00056
Patent 12,095,149 B2

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