

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Samsung Electronics America, Inc.
Samsung Electronics Co., Ltd.
Petitioners

v.

Massively Broadband LLC
Patent Owner

IPR2025-01564
Patent 11,063,625

PETITION FOR *INTER PARTES* REVIEW

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EXHIBIT LIST

Ex.	Description
1001	U.S. Patent No. 11,063,625 (“’625 Patent”)
1002	File History for U.S. Patent No. 11,063,625
1003	Declaration of Dr. Mark Mahon
1004	<i>Curriculum vitae</i> of Dr. Mark Mahon
1005	U.S. Patent Publication No. 2011/0250928 A1 (“Schlub”)
1006	U.S. Patent Publication No. 2013/0237272 A1 (“Prasad”)
1007	U.S. Patent No. 9,362,994 (“Seol”)
1008	WIPO International Publication No. WO 2014/194455 A1 (“Yin”)
1009	U.S. Patent Publication. No. 2011/0182174 A1 (“Pi”)
1010	U.S. Patent Publication No. 2009/0295648 A1 (“Dorsey”)
1011	U.S. Patent No. 8,593,358 (“the ’358 patent”)
1012	IEEE Standard 145-2013 - IEEE Standard for Definitions of Terms for Antennas
1013	Patent Owner’s Preliminary Infringement Contentions, Ex. 11
1014	Molisch, Andreas F., Wireless Communications 2nd Ed., Wiley, 2011
1015	Balanis, Constantine A., Antenna Theory: Analysis and Design, 2nd Ed., Wiley, 1997
1016	Lathi, B. P., Modern Digital and Analog Communication Systems, HRW, 1983
1017	Beard, Cory and Stallings, William, Wireless Communication Networks and Systems, Pearson, 2016

1018	U.S. Patent Publication No. 2004/0021605 A1
1019	Sanchez-Hernandez, David A., Editor, Multiband Integrated Antennas for 4G Terminals, Artech House, 2008
1020	U.S. Patent No. 5,794,145 (“Milam”)
1021	Marinez-Vazquez Marta, et al., “Integrated Planar Multiband Antennas for Personal Communication Handsets,” IEEE Transactions on Antennas and Propagation, Vol. 54, No. 2, February 2006
1022	B. D. Van Veen and K. M. Buckley, "Beamforming: a versatile approach to spatial filtering," in IEEE ASSP Magazine, vol. 5, no. 2, April 1988.
1023	M. A. Jensen and J. W. Wallace, "A review of antennas and propagation for MIMO wireless communications," in IEEE Transactions on Antennas and Propagation, vol. 52, no. 11, Nov. 2004.
1024	Yu, Zhong, et al., “Beamforming on Mobile Devices: A First Study,” Proceedings of the 17th International Conference on Mobile Computing and Networking, September 19-23, 2011, Las Vegas, NV.
1025	U.S. Patent No. 7,308,285 (“Nelson”)
1026	D. Mizell, "Using gravity to estimate accelerometer orientation," Seventh IEEE International Symposium on Wearable Computers, 2003. Proceedings., White Plains, NY, USA, 2003, pp. 252-253.
1027	K. Kunze, P. Lukowicz, K. Partridge and B. Begole, "Which Way Am I Facing: Inferring Horizontal Device Orientation from an Accelerometer Signal," 2009 International Symposium on Wearable Computers, Linz, Austria, 2009, pp. 149-150.
1028	Masters Thesis, Internal Control of a Beamforming Antenna Array for Use in Cellular Phones, Patrick Schmidt, 2010 (“Schmidt”)

1029	Johnson, D. H., & Dudgeon, D. E., Array Signal Processing: Concepts and Techniques, 1993.
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LIST OF CHALLENGED CLAIMS

Claim	Limitation
1[pre]	A method for avoiding radiation of a user or structure by a wireless device having at least one steerable antenna, comprising the steps of:
1[a]	detecting in a three dimensional space, using one or more cameras, microphones, audio sensors, ultrasound sensors or transducers, range finders, capacitive sensors, gyroscopes, light detectors, or motion detectors, an orientation of said wireless device relative to either or both said user and said structure;
1[b]	determining zones or spans of directions in the three dimensional space corresponding with one or more directions of either or both said user and said structure relative to said at least one steerable antenna; and
1[c][i]	adjusting one or more beam radiation patterns of said at least one steerable antenna to radiate in one or more directions which are not in said zones or spans of directions in the three dimensional space,
1[c][ii]	wherein said at least one steerable antenna is configured to steer or direct its energy in particular directions while providing nulls or dead zones in other directions, and
1[c][iii]	wherein said adjusting step adjusts the one or more beam radiation patterns for direction of energy to one or more of said particular directions while avoiding said zones or spans of directions in the three dimensional space, and
1[d]	wherein said at least one steerable antenna operates on one or multiple bands and radiates at one or more frequencies in the range of 10 GHz to 500 GHz.

Claim	Limitation
2	The method of claim 1, wherein said detecting step comprises one or more of: capturing one or more images with at least one camera; detecting ambient light or blockage thereof with at least one light sensor; detecting motion of said wireless device with at least one gyroscope; detecting one or more of audio or ultrasonic signals relating to the orientation of the user or structure with one or more of a microphone, ultrasonic sensor, or ultrasonic transducer; and detecting relative position of the user or structure with at least one capacitive sensor.
3	The method of claim 1 wherein a directional radiating pattern of said one or more beams is different from a receiving pattern used in said step of receiving said signals.
4	The method of claim 1 further comprising a step of receiving signals arriving from one or more directions that are within said zones or spans of directions of said user or structure.
5	The method of claim 1 wherein said at least one steerable antenna or said another antenna uses one or more of: beamforming, beamsteering, beam or antenna element selection, adaptive beamforming, multibeam combining, MIMO, phasing, beam switchable array, active combining, passive combining, and hybrid antenna structure.
6	The method of claim 1, wherein a directional radiating pattern of said one or more beams is different from a receiving pattern used in said step of receiving said signals.

Claim	Limitation
7	The method of claim 6 further comprising using time division duplexing for communication, using said one or more beams radiated by said at least one steerable antenna and signals received by at least one of said at least one steerable antenna.
8	The method of claim 6 wherein said step of receiving signals with said at least one steerable antenna receives said signals arriving from one or more directions that are within said zones or spans of directions of said user or structure.
9	The method of claim 1 wherein the at least one steerable antenna operates on multiple bands.
10	The method of claim 1, and wherein said steps of detecting, determining, and adjusting are performed multiple times as said one or more parameters change over time.
11[pre]	A wireless device for avoiding radiation of a user or structure, comprising:
11[a]	one or more sensors selected from the group consisting of cameras, microphones, audio sensors, ultrasound sensors or transducers, range finders, capacitive sensors, gyroscopes, light detectors, or motion detectors configured to detect in a three dimensional space an orientation of said wireless device relative to either or both said user and said structure;

Claim	Limitation
11[b]	one or more processors communicatively coupled to said one or more sensors;
11[c][i]	at least one steerable antenna communicatively coupled to said one or more processors
11[c][ii]	wherein said at least one steerable antenna is configured to adjust a beam radiation pattern so as to steer or direct its energy in particular directions while providing nulls or dead zones in other directions,
11[c][iii]	wherein said at least one steerable antenna radiates at one or more frequencies in the range of 10 GHz to 500 GHz; and
11[d][i]	a non-transitory computer readable medium comprising executable instructions that when executed by said one or more processors cause said one or more processors to perform the steps of:
11[d][ii]	receiving signals from said one or more sensors pertaining to said orientation in the three dimensional space;
11[d][iii]	using said signals, computing zones or spans of directions corresponding with one or more directions of either or both said user and said structure relative to said at least one steerable antenna in the three dimensional space; and
11[d][iv]	adjusting one or more beam radiation patterns of said at least one steerable antenna to radiate in one or more directions of said particular directions which are not in said zones or spans of directions in the three dimensional space,

Claim	Limitation
11[e]	wherein said at least one steerable antenna radiates said one or more beams based on signals from said one or more processors determined on execution of said executable instructions, and
11[f]	wherein said at least one steerable antenna operates on one or multiple bands; and
11[g]	a receiver for receiving over-the-air signals.
12	The wireless device of claim 11, wherein said at least one steerable antenna comprises a plurality of steerable antennas.
13	The wireless device of claim 11, wherein said one or more sensors includes one or more cameras, gyroscopes, light or motion detectors, capacitive sensors, microphones, and ultrasound sensors or transducers.
14	The wireless device of claim 11, wherein said one or more parameters are selected from the group consisting of light, motion, orientation, video, capacitance, ultrasound, and sound.
15	The wireless device of claim 11 wherein a directional radiating pattern of said one or more beams radiated from said at least one steerable antenna is different from a receiving pattern of said at least one steerable antenna.
16	The wireless device of claim 11 wherein said receiver receives said over-the-air signals in one or more directions that are within said zones or spans of directions of said user or structure.

Claim	Limitation
17	The wireless device of claim 11 wherein said at least one steerable antenna or said receiver uses one or more of: beamforming, beamsteering, beam or antenna element selection, adaptive beamforming, multibeam combining, MIMO, phasing, beam switchable array, active combining, passive combining, and hybrid antenna structure.
18	The wireless device of claim 11, wherein a directional radiating pattern of said one or more beams radiated from said at least one steerable antenna is different from a receiving pattern used by said at least one steerable antenna or said receiver used to receive said over-the-air signals.
19	The wireless device of claim 18 wherein said wireless device is configured for time division duplexing for communication, using said one or more beams radiated by said at least one steerable antenna and using over-the-air signals received by at least one of said at least one steerable antenna or said receiver.
20	The wireless device of claim 18 wherein said receiver receives signals in one or more directions that are within said zones or spans of directions of said user or structure.
21	The wireless device of claim 11 wherein the at least one steerable antenna operates on multiple bands.

Claim	Limitation
22	The wireless device of claim 11 wherein said executable instructions cause said steps of receiving, using, and adjusting to be performed multiple times as said one or more parameters change over time.
23[pre]	A steerable antenna system for avoiding radiation of a user or structure by a wireless device, comprising:
23[a]	one or more sensors configured to detect in a three dimensional space using one or more cameras, microphones, audio sensors or transducers, ultrasound sensors, range finders, capacitive sensors, gyroscopes, light detectors, or motion detectors, an orientation of said wireless device relative to either or both said user and said structure;
23[b]	a computation module communicatively coupled to said one or more sensors configured to determine zones or spans of directions;
23[c]	at least one steerable antenna that radiates at one or more frequencies in the range of 10 GHz to 500 GHz communicatively coupled to said computation module, said at least one steerable antenna being configured for adjustably radiating one or more beams in one or more directions which are not in said zones or spans of directions in the three dimensional space,
23[d]	wherein said zones or spans of directions correspond with one or more directions of said user or structure relative to said at least one steerable antenna in the three dimensional space,

Claim	Limitation
23[e]	wherein said at least one steerable antenna is configured to adjustably steer or direct its energy in particular directions while providing nulls or dead zones in other directions in the three dimensional space,
23[f]	wherein said at least one steerable antenna operates on one or multiple bands; and
23[g]	a receiver for receiving signals.
24	The steerable antenna system of claim 23, wherein said at least one steerable antenna comprises a plurality of steerable antennas.
25	The steerable antenna device of claim 23, wherein said one or more sensors includes one or more cameras, gyroscopes, light or motion detectors, capacitive sensors, microphones, and ultrasound transducers.
26	The steerable antenna device of claim 23, wherein said one or more parameters are selected from the group consisting of light, motion, orientation, video, capacitance, ultrasound, and sound.
27	The steerable antenna system of claim 23 wherein a directional radiating pattern of said one or more beams radiated from said at least one steerable antenna is different from a receiving pattern of said at least one steerable antenna.

Claim	Limitation
28	The steerable antenna system of claim 23 wherein said receiver using said at least one steerable antenna or said receiver receives signals in one or more directions that are within said zones or spans of directions of said user or structure.
29	The steerable antenna system of claim 23 wherein said at least one steerable antenna or said receiver uses one or more of: beamforming, beamsteering, beam or antenna element selection, adaptive beamforming, multibeam combining, MIMO, phasing, beam switchable array, active combining, passive combining, and hybrid antenna structure.
30	The steerable antenna system of claim 23, wherein a directional radiating pattern of said one or more beams radiated from said at least one steerable antenna is different from a receiving pattern used by said at least one steerable antenna or said receiver.
31	The steerable antenna system of claim 30 wherein the steerable antenna system is configured for time division duplexing for communication, using said one or more beams radiated by said at least one steerable antenna and signals received by at least one of said at least one steerable antenna or said receiver.
32	The steerable antenna system of claim 30 wherein said receiver receives signals in one or more directions that are within said zones or spans of directions of said user or structure.

Claim	Limitation
33	The steerable antenna system of claim 23 wherein the at least one steerable antenna operates on multiple bands.

I. INTRODUCTION

U.S. Patent No. 11,063,625 (“’625 patent”) is directed to steerable antenna technologies for wireless devices that allegedly improve safety and performance by avoiding radiation toward a user or structure. *See* EX1001, Abstract, 10:34-41. The ’625 patent purports to introduce beamsteering techniques that reduce radiation directed toward users or structures through sensor-based detection using, for example, cameras, gyroscopes, capacitive sensors, etc. *Id.*, Abstract; 10:34-41; 11:10-17. In general, the beam steering determinations are informed by detecting the device’s orientation relative to the user (or structure), determining spatial zones or spans in the direction of the user (or structure), and adjusting beam patterns to direct energy away from these areas. *Id.*, 5:21-46, Claim 1; EX1003, ¶3.

But, the claimed technologies of the ’625 patent were already well-known in the art before the earliest effective filing date. EX1003, ¶¶4-5, 45-66 (discussing EX1006-EX1029). As detailed below, Schlub disclosed the claimed steerable antenna features, together with a wide range of sensors that could be used to detect the orientation of users and structures in the vicinity of the radiating elements of the antenna. Similarly, Prasad disclosed using sensors to detect the orientation of a wireless device, determining zones or spans where the user is located, and adjusting a steerable antenna to avoid radiation toward the user via beamforming. Yin (EX1008) provided exemplary implementation details for how POSITAs could use

sensors and computing devices of the time to determine such zones and spans of directions, and how that information could be used to inform beam steering and null-forming. Finally, Seol (EX1007) disclosed the ability to utilize distinct transmission and reception beam patterns, together with the use of time division duplexing in the context of millimeter wave antenna applications.

For the reasons discussed herein, all Challenged Claims of the '625 patent are unpatentable under 35 U.S.C. §102 and §103. EX1003, ¶5.

II. STANDING

Petitioners certify that they are not barred or estopped from requesting review of the Challenged Claims.

III. MANDATORY DISCLOSURES

Pursuant to 37 C.F.R. § 42.8(a)(1), the following mandatory notices are provided as part of this Petition.

A. Real Party in Interest

The real parties-in-interest are Samsung Electronics America, Inc. and Samsung Electronics Co., Ltd (together, "Petitioners").

B. Related Matters

Patent Owner filed a patent infringement lawsuit against Petitioners asserting the '625 patent in related district court litigation captioned *Massively Broadband LLC v. Samsung Electronics Co., Ltd. et al*, 2:25-cv-00608-JRG (E.D. Tex.).

C. Lead and Back-Up Counsel (37 C.F.R. § 42.8(b)(3)) and Service Information (37 C.F.R. § 42.8(b)(3)-(4))

Petitioners provide the following counsel and service information. Pursuant to 37 C.F.R. § 42.10(b), a Power of Attorney accompanies this Petition. Petitioners agree to accept electronic service at the email addresses listed below.

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D. Payment of Fees (37 C.F.R. § 42.15(a))

The undersigned authorizes the Office to charge the fee required for this Petition for *Inter Partes* Review to Deposit Account No. 50-5708. Any additional fees that might be due are also authorized.

IV. GROUNDS

Petitioners request cancellation of claims 1-33 on the following grounds¹:

Ground	Basis	Reference(s)	Claims
1	§§ 102, 103	Schlub	1-2, 5, 9-14, 17, 21-26, 29, 33
2	§103	Schlub in view of Seol	3-4, 6-8, 15-16, 18-20, 27-28, 30-32.
3	§103	Prasad in view of Seol and further in view of Yin	1-33.

¹ Petitioners are not presently aware of any secondary considerations of non-obviousness applicable to the '625 patent. To the extent the Patent Owner presents any such evidence, Petitioners reserve the right to respond.

V. LEVEL OF ORDINARY SKILL IN THE ART

A person of ordinary skill in the art at the time of the effective priority date of the '625 Patent ("POSITA") would have had at least a Bachelor's degree in electrical engineering, computer engineering, physics, or a related field, and at least two years of experience working with design and integration of RF circuits and antennas for wireless communication devices. EX1003, ¶¶29-32, 76. More education can substitute for practical experience and vice versa. *Id.* Petitioner's expert, Dr. Mark Mahon, exceeds this skill level (and exceeded this skill level as of the priority date of the '625 patent (August 14, 2013)), and thus has the qualifications and experience necessary to assess the '625 Patent from the perspective of a POSITA. *Id.*, ¶¶7-27, 76.

VI. THE '625 PATENT

A. Priority Date

The '625 patent issued on July 13, 2021 from an application filed on August 14, 2013, namely U.S. Application No. 13/966,853 ("853 Application"). The '853 Application is a continuation-in-part of U.S. Patent Application No. 13/713,804 (which was filed on December 13, 2012 and later issued as U.S. Patent No. 8,593,358 ("358 patent")), and claims priority to both U.S. Patent Application No. 12/541,764 (filed on August 14, 2009 and later issued as U.S. Pat. No. 8,350,763) and U.S. Provisional Application No. 61/088,829 (filed on August 14, 2008).

The claims of the '625 patent are not entitled to the priority dates of any of its parent applications because they claim subject matter that was not disclosed in any parent application and that was newly added in the application that issued as the '625 patent. EX1003, ¶¶68-69. In particular, the disclosures in column 10 line 34 through column 14 line 32 of the '625 patent specification comprise new matter that was first added in the application that led to the '625 patent and was not included in the specification of any parent application. *See id.*; EX1001, 10:34-14:32. This new matter in the '625 specification provides the only possible written description support under §112 for claims 1-33. EX1003, ¶69.

For example, every claim of the '625 patent recites sensors that detect the orientation of a wireless device relative to a user or structure and at least one steerable antenna configured to adjust its beam radiation pattern to steer or direct beams in directions where the user or structure are not situated. EX1001, Claims 1, 11, and 23. *Id.* None of these elements are disclosed in any parent application. EX1003, ¶70. For example, the words “steer” and “steerable” do not even appear in parent U.S. Patent Application No. 13/713,804 (the application that led to the '358 patent, to which the '625 patent attempts to claim priority). Nor does the specification of that parent application disclose (i) steerable or directional antennas in wireless devices, (ii) using sensors to detect a user or structure relative to the orientation of a wireless device and/or its antenna, or (iii) adjusting a beam radiation

pattern to steer or direct a beam of radiation in certain directions based on the spatial detection. *See* EX1011, *passim*. These limitations are disclosed only in the new matter first presented in the specification of the '625 patent. *E.g.*, EX1001, 10:34-62 (steerable antennas), 10:63-11:26, 12:4-17 (use of sensors to detect user/structure relative to device), 11:27-12:3 (use of detection to steer/adjust beam pattern); EX1003, ¶71.

Accordingly, the priority date of all '625 patent claims is the filing date of its corresponding application, August 14, 2013. EX1003, ¶71.

B. Prosecution History

During prosecution, the Examiner rejected the claims multiple times in light of the prior art. EX1003, ¶72. In response, the Applicant amended the claims several times, including by adding limitations reciting at least one steerable antenna, *see* EX1002, 491-499, controlling the direction of radiated energy to avoid certain zones, *see id.*, 383-392, and using sensors to detect a user or structure in three dimensional space, *see id.*, 318-325. After the Examiner issued a final rejection, the Applicant filed an appeal. In response, the Examiner withdrew the earlier rejection. *Id.*, 266 (2/15/2018 Notice of Appeal), 183-203 (6/14/2018 Office Action).

Subsequently, the Examiner rejected the pending claims based on U.S. Patent Application Publication No. 2009/02945648 (“Dorsey,” EX1010) alone or in combination with other references. *See id.* 186-202. The Applicant then amended

the claims to require “adjusting one or more beam radiation patterns.” *See id.*, 163-65 (9/14/2018 Amendment). After the Examiner again rejected the claims based on Dorsey, *see id.* 131-48 (10/30/2018 Office Action), the Applicant appealed to the Board, arguing that Dorsey does not disclose determining zones or spans in “three dimensional space,” and further does not disclose adjusting the beam of a single antenna. *Id.*, 102-11 (6/21/2019 Appeal Brief); EX1003, ¶73.

The Board rejected Applicant’s first argument and expressly found that Dorsey discloses the determining zones or spans in three dimensional space limitation because Dorsey discloses “detect[ing] when an object such as a user’s ear is close to” a part of the wireless device. EX1002, 41-42 (12/29/2020 Patent Board Decision, agreeing with the Examiner); EX1003, ¶74. However, the Board did agree with the Applicant that Dorsey does not disclose “adjusting the beam radiation pattern of the *one* steerable antenna” because Dorsey instead “*select[s] one of two or more* separately located, steerable antennas” to radiate from. EX1002, 42-44.² The claims were subsequently allowed. *Id.*, 8-9.

C. Disclosure

The ’625 patent is generally directed to using “steerable antenna” functionality to adjust wireless device radiation “beam patterns” so that they are

² All emphasis and annotations throughout this Petition have been added unless otherwise noted.

directed away from a “zone or span of directions” where users of those devices are located (or structures in the vicinity that are desirable to avoid), including in the 10 GHz band and above. EX1001, Abstract, 11:52-12:3; EX1003, ¶67. The steering adjustment decisions are informed, in part, by the “orientation of the wireless device” relative to the user or other structure as determined based on information obtained about the surrounding “three dimensional space” via various types of sensors. EX1001, 12:4-17, 13:54-14:3; EX1003, ¶67.

VII. CLAIM CONSTRUCTION

Petitioners have applied the plain and ordinary meaning understood by a POSITA at the time of the alleged invention, in the context of the '625 patent and its prosecution history. *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005); EX1003, ¶¶33, 77. Petitioners do not believe that the Board need construe any claim limitation to institute review.

VIII. GROUND 1: SCHLUB DISCLOSES AND RENDERS OBVIOUS CLAIMS 1-2, 5, 9-14, 17, 21-26, 29, AND 33

A. Schlub (EX1005)

U.S. Patent Publication No. 2011/0250928A1 (“Schlub”) was filed April 13, 2010, and published October 13, 2011. It is prior art under at least 35 U.S.C. §102(a)(1).

Schlub relates to “wireless communications circuitry” in “handheld electronic devices” that “may be adjusted based on the proximity of the electronic device[] to

external objects.” EX1005, [0001]-[0002]; EX1003, ¶¶78-80. Schlub uses sensor data, such as camera imagery, to “determine whether a user’s body or other external object is within a given distance of an antenna” and “how a device is being oriented.” EX1005, [0006]-[0007], [0022]. In response to detecting a user’s orientation relative to the wireless phone and its internal antenna, “processing circuitry” in the electronic device may make “adjustments” to “the direction in which the antenna array is operating” using beam steering techniques. *Id.*, [0009]. Schlub’s Figure 2 depicts the architecture of the proposed wireless device, and Figure 9 depicts the high-level process it is designed to achieve.

10

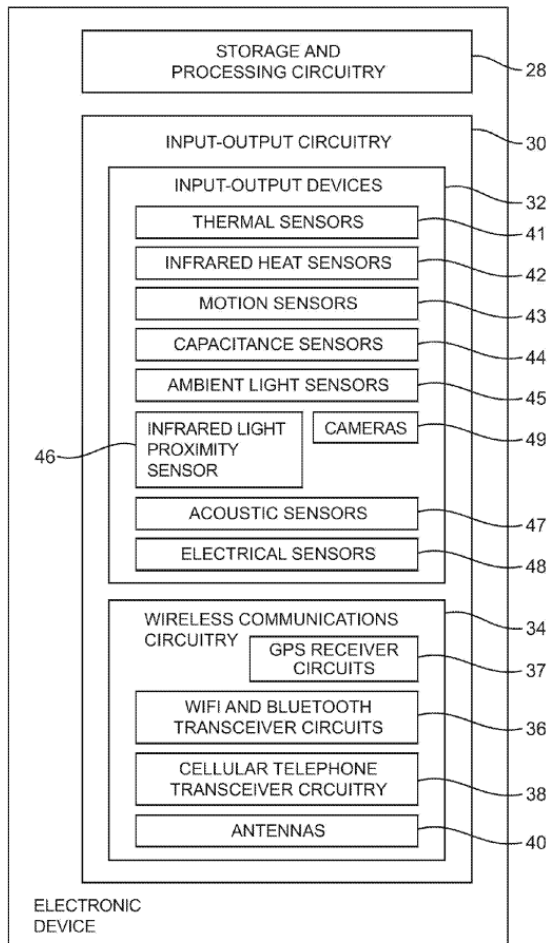


FIG. 2

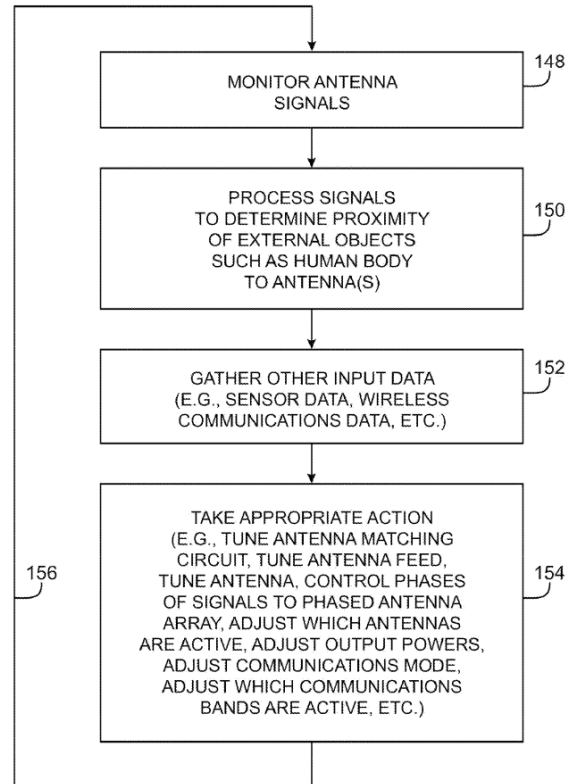


FIG. 9

Id. Figs. 2, 9; *see also* Fig. 8.

B. Claim 1

1. **1[pre]: A method for avoiding radiation of a user or structure by a wireless device having at least one steerable antenna, comprising the steps of:**

To the extent the preamble is limiting, Schlub discloses it. EX1003, ¶¶81-84. Schlub discloses a method for a “portable electronic device [that] has wireless communications circuitry,” whereby “signals that are emitted by the antenna array can be steered to avoid or minimize emissions into external objects (e.g., to comply

with regulatory limits by avoiding radio-frequency emissions into human tissue).”

EX1005, Abstract, [0032]. Just like the ’625 patent, the device and method of Schlub uses “one or more antennas” in a portable electronic device. *Id.*, [0005], EX1001, 3:66-4:5 (“one or more antennas . . . in a portable wireless device”). An exemplary method from Schlub’s disclosure is summarized in Figure 9, reproduced and annotated below:

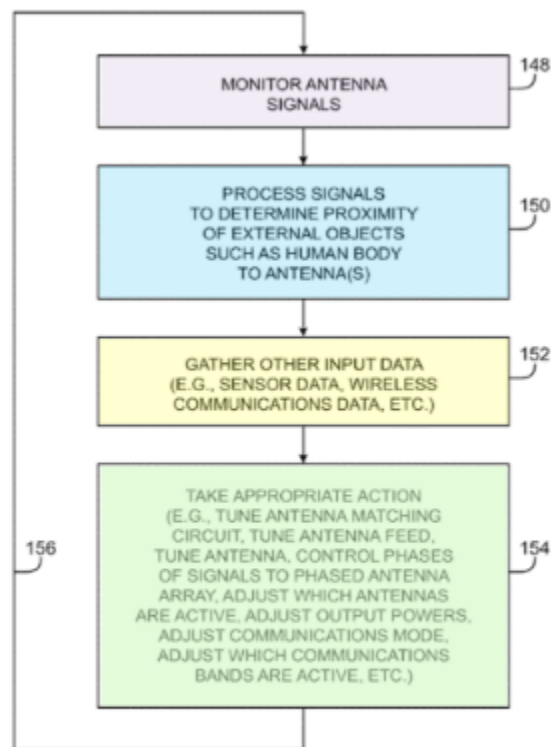


FIG. 9

Id., Fig. 9.

Schlub’s method can be applied “to determine whether a user’s body or other external object is within a given distance of an antenna by making antenna impedance measurements” in addition to using other “sensors such as...motion

sensors, capacitance sensors, ambient light sensors,...acoustic sensors, cameras...,” which together can “help accurately determine whether the external object is in the vicinity of the antenna.” EX1005, [0006]. Once it is “determine[d] [that] a user’s body or other external object is within a given distance of an antenna . . .” the method can use that information to adjust the radiation beams of a steerable antenna, such as “a phased antenna array,” to modify “the direction in which the antenna array is operating” to avoid radiation toward the user. *Id.*, [0006], [0009].

As detailed further below, Schlub discloses that its method can adjust the beam radiation direction when certain criteria are met, one of which is “how a device is being oriented” and one of which is “whether an external object appears to be in the vicinity of the device as measured by a light sensor, heat sensor, infrared light or heat sensor, acoustic sensor, or capacitive sensor, etc.” *Id.*, [0022].

2. **1[a]: detecting in a three dimensional space, using one or more cameras, microphones, audio sensors, ultrasound sensors or transducers, range finders, capacitive sensors, gyroscopes, light detectors, or motion detectors, an orientation of said wireless device relative to either or both said user and said structure;**

“detecting ... an orientation of said wireless device relative to either or both said user or said structure”: Schlub discloses that its system can use sensory detection “to determine whether *a user’s body or other external object* is within a given distance of an antenna” and to “*determine how device 10 is oriented* and whether device 10 is exhibiting movement characteristic of human use.” EX1005,

[0006], [0042]. Schlub further explains that sensor data is used “to determine the *location of external objects relative to the device*,” including “a *user’s body*.” *Id.*, [0033], [0060]; EX1003, ¶¶85-86.

Schlub further explains that motion sensors can be used to determine the *orientation relative to the user*, by determining whether a surface of the wireless device is “in a plane parallel to the plane of the earth’s surface ... or at a non-zero angle relative to the plane of the earth's surface.” EX1005, [0042]; EX1003, ¶87. For example, Schlub’s sensors can detect “if a user grips device 10 so that the user’s hand or other body part is *flush* with an antenna feed portion of antenna 40,” which describes the relative orientation of the device to the user’s hand or other body part. *Id.* [0064]; EX1003, ¶87.

“*in three dimensional space*”: Schlub’s detection is in three-dimensional space because it detects the plane of the phone where it is offset by some distance in another direction outside the plane (e.g., confirming a third dimension) and in certain cases by some “non-zero angle.” EX1005, [0042]; EX1003, ¶88. Moreover, Schlub discloses that its “[c]ameras 49 may gather information that is used in determining whether or not a user's body or other external objects are in the vicinity of device 10.” EX1005, [0048]. The information gathered by the cameras may include “images containing a user's face or other identifiable body part,” and “image data such as video data indicating motion towards the antennas of device 10 or other portion of

device” or “images and other images in which a camera sensor (i.e., a camera window and camera module lens) in device 10 has been obscured and therefore blocked by a human body part or other external object, etc.” *Id.* A POSITA would have understood these cameras to be taking images in 3D space. EX1003, ¶88.

“using one or more cameras, microphones, audio sensors, ultrasound sensors or transducers, range finders, capacitive sensors, gyroscopes, light detectors, or motion detectors”: Schlub discloses several of the recited sensor types that can be used together to detect orientation in three dimensional space. For instance, Schlub teaches that this detection can be done by (i) “making antenna impedance measurements,” and (ii) use of other “sensors such as ... motion sensors, capacitance sensors, ambient light sensors, ... acoustic sensors, cameras ...,” which together can inform orientation detection. EX1005, [0006]-[0007]; Fig. 2 (reproduced below, showing exemplary sensors). Schlub uses the sensor data to “determine whether the external object is in the vicinity of the antenna.” *Id.*, [0006]. In a further example, capacitance sensors are used “to generate proximity data (i.e., data on the proximity of external objects to device 10).” *Id.*, [0043]. A POSITA would have understood from Schlub’s disclosure that this proximity data is used in connection with the data from other sensors to “determine the location of external objects relative to the device” (i.e., in three-dimensional space). EX1003, ¶¶89-90.

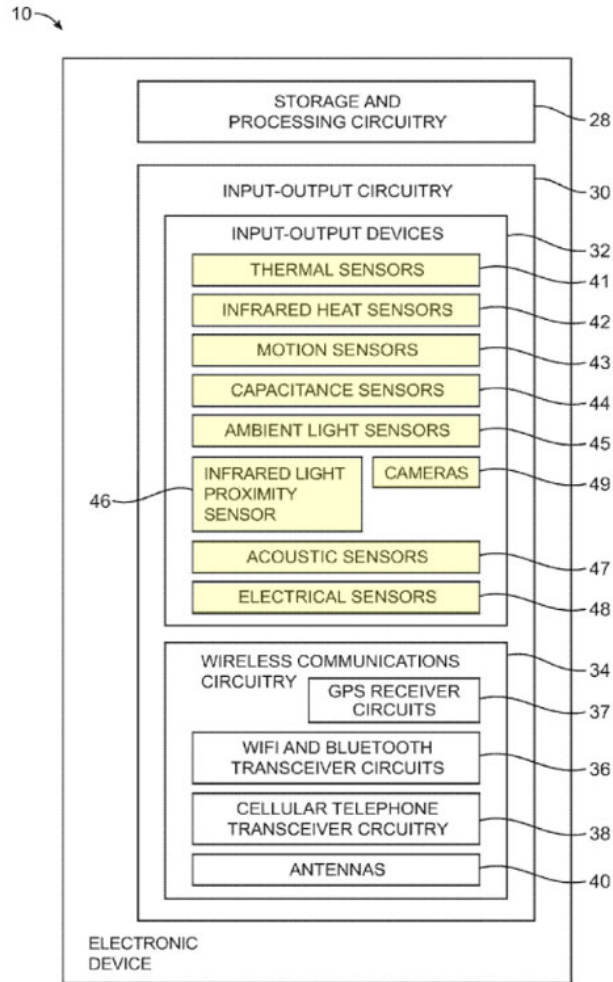


FIG. 2

Id., Fig. 2.

3. **1[b]: determining zones or spans of directions in the three dimensional space corresponding with one or more directions of either or both said user and said structure relative to said at least one steerable antenna; and**

Schlub “determine[s] a suitable course of action” in response to detected external objects. EX1005, [0087]. This includes adjusting “the direction of the signal beam associated with the antenna” so that “*if an external object is detected in one location*, the array can be adjusted so that antenna signals are oriented in a different

direction.” *Id.*, [0088]. A POSITA would have understood that, as any real world “external object” (such as a user or other structure) exists in three-dimensions, the location and boundaries of the object (e.g., from the left side of the person to the right side of the person) will constitute a zone or a span of directions in three-dimensional space that the “array can be adjusted” to avoid. *Id.*; EX1003, ¶¶91-92. The zones or spans of directions corresponding to an external object are shaded in blue in Figure 8, reproduced and annotated below; the beam radiation pattern can be adjusted accordingly to radiate in the “different direction,” e.g., the green area:

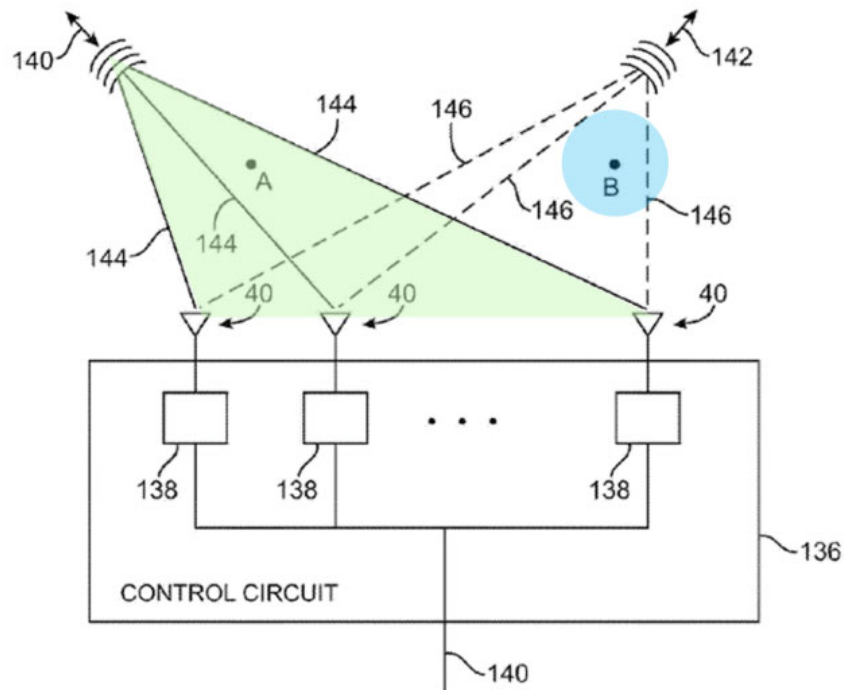


FIG. 8

Id., Fig. 8.

Notably, Schlub includes far more disclosure of 1[b] than (i) the Dorsey reference that the Board determined discloses 1[b] during prosecution, and (ii) what PO relies on in its infringement contentions. EX1002, 41-42 (finding Dorsey discloses 1[b] by “detect[ing] when an object such as a user’s ear is close to” a part of the wireless device); EX1013, 6-7 (PO contending “us[ing] one or more sensors to detect the location that the user of the Accused Instrumentalities is gripping the device and deactivate[] the corresponding antenna to avoid the user” satisfies 1[b]); EX1003, ¶¶93-94.

4. **1[c][i]: adjusting one or more beam radiation patterns of said at least one steerable antenna to radiate in one or more directions which are not in said zones or spans of directions in the three dimensional space,**

“adjusting one or more beam radiation patterns of said at least one steerable antenna”: Schlub teaches that its *steerable antenna* (see 1[pre]) comprises “multiple antenna elements,” and that “control circuitry” may be “used to control the signals that are routed to and from the antenna elements (e.g., by controlling signal phases).” EX1005, [0032]; EX1003, ¶¶95-96. In one example, Schlub discloses “a phased antenna array” that can be adjusted so that “the direction in which the antenna array is operating” will generate signal patterns that avoid radiation toward the user. EX1005, [0005]-[0006], [0009]; *see also* 1[b]. Schlub’s antenna is specifically designed so that “the direction of the signal beam associated

with the antenna” is “steered in response to the proximity information.” EX1005, [0088]; EX1003, ¶96.

“to radiate in one or more directions which are not in said zones or spans of directions in the three dimensional space”: Schlub expressly discloses that “[i]f . . . an external object such as a user's body is detected in the proximity of device 10, control circuitry 136 may be used to steer the direction in which the antenna array operates so as to bypass the external object.” EX1005, [0081]; EX1003, ¶97. In particular, “if an external object is detected in one location, the array can be adjusted so that antenna signals are *oriented in a different direction*.” EX1005, [0088]. The last step in Schlub’s Figure 9 (annotated below) reflects this process:

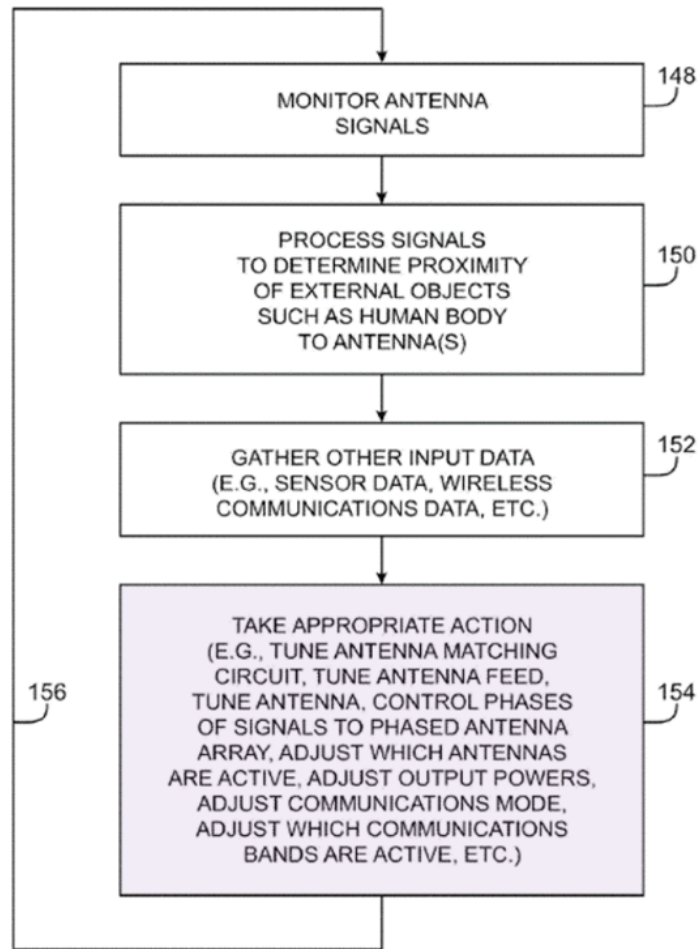


FIG. 9

EX1005, Fig. 9.

Figure 8 (reproduced and annotated below) further illustrates this process in operation. For example, if the sensors “detect[] that an external object is located at point A [shaded in blue below], control circuitry 136 may be used to adjust the antenna array so that the antenna sends and receives signals along path 142 in the direction of point B [shaded in green below].” EX1005, [0081]. The antenna is steered by “produc[ing] a first set of phases on the transmitted signals” to “form a

radio-frequency beam such as beam 142 that is oriented in the direction of point B,” while attenuating or nullifying the beam in the zones or spans of directions corresponding to the object. EX1005, [0080]; EX1003, ¶¶98-100.

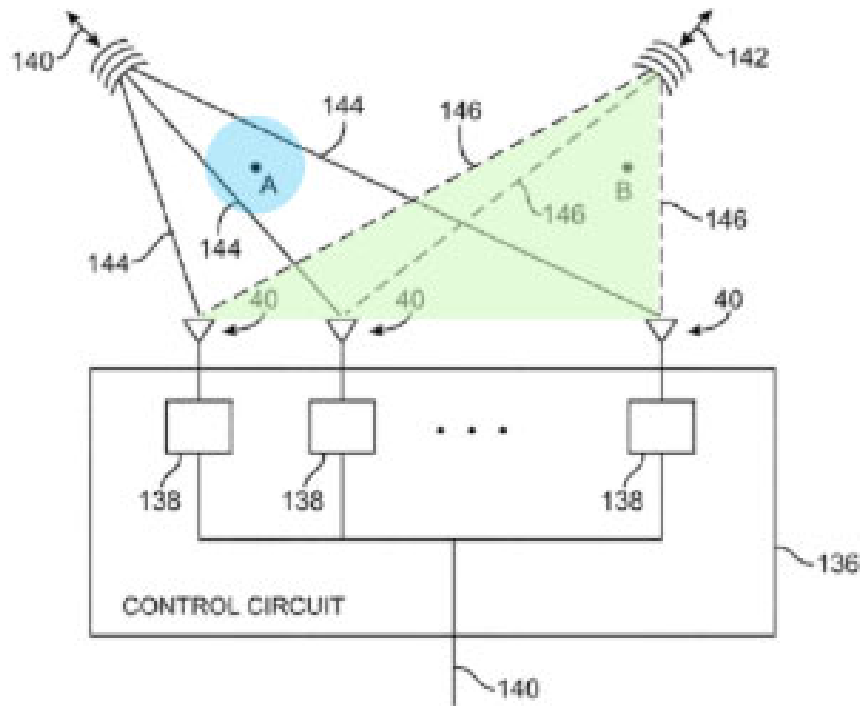


FIG. 8

EX1005, Fig. 8.

5. 1[c][ii]: wherein said at least one steerable antenna is configured to steer or direct its energy in particular directions while providing nulls or dead zones in other directions, and

Schlub teaches that its “phased antenna array” (*i.e.*, a *steerable antenna*) is configured with “multiple antenna elements,” and that “control circuitry” may be “used to control the signals that are routed to and from the antenna elements (e.g.,

by controlling signal phases).” EX1005, [0032]; EX1003, ¶101. Schlub further teaches that “[t]he control circuitry *can alter the direction in which the antenna operates.*” EX1005, [0032]. “If, for example, it is desired *to point the antenna in a first direction*, the control circuitry can use a first group of antenna element phase settings.” *Id.* “If it is desired to point the antenna in a second direction that is different than the first direction, the control circuitry can use a distinct second group of phase settings.” *Id.* Schlub discloses that “if an external object is detected in one location, the array can be adjusted so that antenna signals are *oriented in a different direction.*” *Id.*, [0088]; *see also* 1[c][i], *supra*; EX1003, ¶¶101-102.

A POSITA would have understood that a “null” does not mean an area of zero radiation. EX1003, ¶102. Antennas necessarily transmit some amount of radiation in all directions, and it is not possible to create a real-world antenna capable of emitting zero radiation in a given direction during transmission. Rather, a POSITA would have understood that “null” has a well-defined plain meaning in the RF art of “a sharp minimum in a radiation pattern.” EX1012, 24 (IEEE Standard 145-2013 - IEEE Standard for Definitions of Terms for Antennas) (defining “directional-null” as “[a] sharp minimum in a radiation pattern...for...the suppression of unwanted radiation in a specified direction”); EX1003, ¶102. Thus, nulls are minima in the radiation pattern. *Id.* Petitioner’s interpretation is consistent with PO’s interpretation in its infringement contentions in the related district court case. *See* EX1013, 9

(contending that “[b]y steering beams away from obstructed directions,” “phased-array antennas ... inherently place nulls or dead zones in those avoided directions”). Thus, by minimizing radiation in some directions while steering it in other directions, Prasad in my opinion discloses a steerable antenna that “steer[s] or direct[s] its energy in particular directions while providing nulls or dead zones in other directions” as claimed, and discloses 1[c][ii]. EX1003, ¶¶102-103.

6. **1[c][iii]: wherein said adjusting step adjusts the one or more beam radiation patterns for direction of energy to one or more of said particular directions while avoiding said zones or spans of directions in the three dimensional space, and**

See 1[c][i]-[ii]. Schlub discloses that “the direction of the signal beam associated with the antenna” (*i.e.*, the *beam radiation pattern*) is “steered in response to the proximity information.” EX1005, [0088]. More specifically, “if an external object is detected in one location, the array can be *adjusted* so that antenna signals are oriented *in a different direction*.” *Id.*; *see also* [0005]-[0006], [0009], [0032], [0080]-[0081], Figs. 8-9; EX1003, ¶¶104-05.

7. **1[d]: wherein said at least one steerable antenna operates on one or multiple bands and radiates at one or more frequencies in the range of 10 GHz to 500 GHz.**

“*wherein said at least one steerable antenna operates on one or multiple bands*”: Schlub teaches that “[s]ingle-band and multiband antennas may be used,” such as “a multiband antenna ... to handle cellular telephone communications in multiple cellular telephone bands” or a “phased antenna array” (*i.e.*, a *steerable*

antenna” operating as a “multiband antenna.” EX1005, [0029]; EX1003, ¶¶106, 108.

“radiates at one or more frequencies in the range of 10 GHz to 500 GHz”:

Schlub discloses that the “phased antenna array” can operate “at 60 GHz” and can support “other frequency bands of interest.” EX1005, [0034], [0080]; EX1003, ¶¶107-109.

C. Claim 2: The method of claim 1, wherein said detecting step comprises one or more of: capturing one or more images with at least one camera; detecting ambient light or blockage thereof with at least one light sensor; detecting motion of said wireless device with at least one gyroscope; detecting one or more of audio or ultrasonic signals relating to the orientation of the user or structure with one or more of a microphone, ultrasonic sensor, or ultrasonic transducer; and detecting relative position of the user or structure with at least one capacitive sensor.

Schlub discloses at least four of the five alternative detecting methods recited in claim 2. EX1003, ¶¶110-11. For example, Schlub explains that its wireless device may “include ... capacitance sensors, ambient light sensors, ... acoustic sensors, cameras, ...” The “[d]ata from each of these sensors” is used to “determine whether the external object is in the vicinity of the antenna. EX1005, [0007]. In particular, Schlub explains that its processing circuitry can use this data to “determine when it is necessary to adjust the wireless circuitry ... whenever appropriate criteria have been satisfied ... [such as] criteria specifying how close a user's body may be located

to a particular antenna ..., which antennas in an array are close to a user's body, how a device is being oriented, [etc.].” *Id.*

- D. Claim 5: The method of claim 1 wherein said at least one steerable antenna or said another antenna uses one or more of: beamforming, beamsteering, beam or antenna element selection, adaptive beamforming, multibeam combining, MIMO, phasing, beam switchable array, active combining, passive combining, and hybrid antenna structure.**

Schlub discloses multiple of the recited antenna steering techniques, including (i) implementing “beam steering arrangements ... by controlling the relative phases of the signals for the antennas” (*i.e.*, ***beamsteering*** and ***phasing***), (ii) “changing the settings in a beam forming phase antenna array so that emitted signals are directed towards a new location” (*i.e.*, ***beamforming***), (iii) “selectively connect[ing] and disconnect[ing]” other “[a]dditional resonating element structures” of “the antenna resonating element in antenna 40” (*i.e.*, ***antenna element selection***), and (iv) using “switching antennas,” particularly “in an antenna diversity scheme” (*i.e.*, ***beam switchable array***). EX1005, [0033], [0072], [0079]; EX1003, ¶¶112-113.

- E. Claim 9: The method of claim 1 wherein the at least one steerable antenna operates on multiple bands.**

See 1[d]; EX1003, ¶114.

- F. Claim 10: The method of claim 1, and wherein said steps of detecting, determining, and adjusting are performed multiple times as said one or more parameters change over time.**

Schlub discloses that the detecting, determining, and adjusting steps (*see* Limitations 1[a]-1[c][iii]), “these operations may be repeated (e.g., continuously)

during operation . . . ” (i.e., ***performed multiple times***). EX1005, [0091]; *see also*

id., Fig. 9:

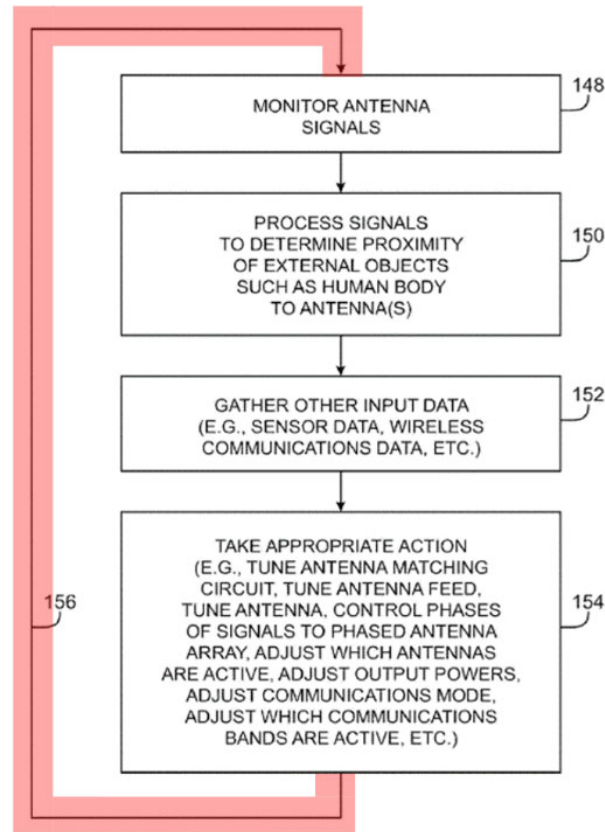


FIG. 9

EX1005, Fig. 9. Schlub also explains that this process can be achieved in real time.

EX1005, [0056] (“...transmitted antenna signal power may be adjusted in ***real time*** ...”); *see also id.*, [0060]. A POSITA would have understood that the ability to conduct the process continuously with real time adjustments discloses that the recited detecting, determining, and adjusting steps occur repeatedly with high frequency across changing parameters. EX1003, ¶¶115-16.

G. Claim 11

- 1. 11[pre]: A wireless device for avoiding radiation of a user or structure, comprising:**

See 1[pre]; EX1003, ¶117.

- 2. 11[a]: one or more sensors selected from the group consisting of cameras, microphones, audio sensors, ultrasound sensors or transducers, range finders, capacitive sensors, gyroscopes, light detectors, or motion detectors configured to detect in a three dimensional space an orientation of said wireless device relative to either or both said user and said structure;**

See 1[a]; EX1003, ¶117.

- 3. 11[b]: one or more processors communicatively coupled to said one or more sensors;**

Schlub discloses “[s]torage and processing circuitry” (*i.e.*, a ***processor***) that is in communication with (*i.e.*, ***communicatively coupled to***) “an antenna-based proximity sensor and ... other sensors and sources of data within the electronic device to determine when external objects are within a given distance of the antennas in the device.” EX1005, [0009]; EX1003, ¶¶119-20. This circuitry may include “one or more ***microprocessors***, microcontrollers, digital signal ***processors***, application specific integrated circuits, etc.” configured to “control the operation of device 10.” EX1005, [0036]; *see also id.*, Fig. 2 (“storage and processing circuitry 28” (pink) coupled with sensors 41-48 (yellow)):

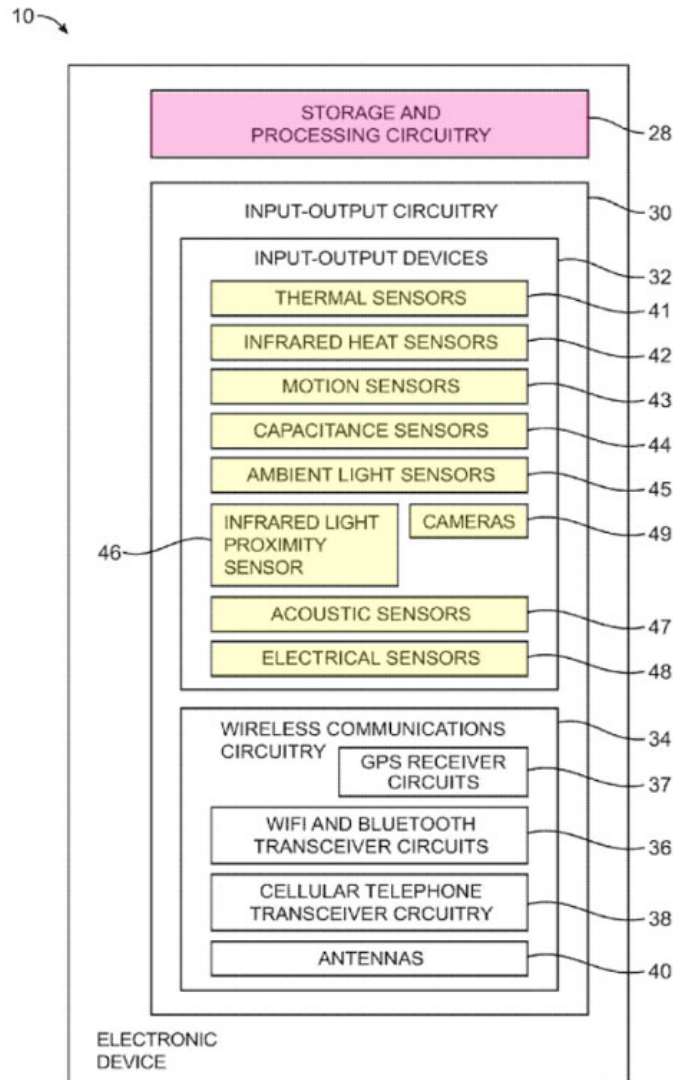
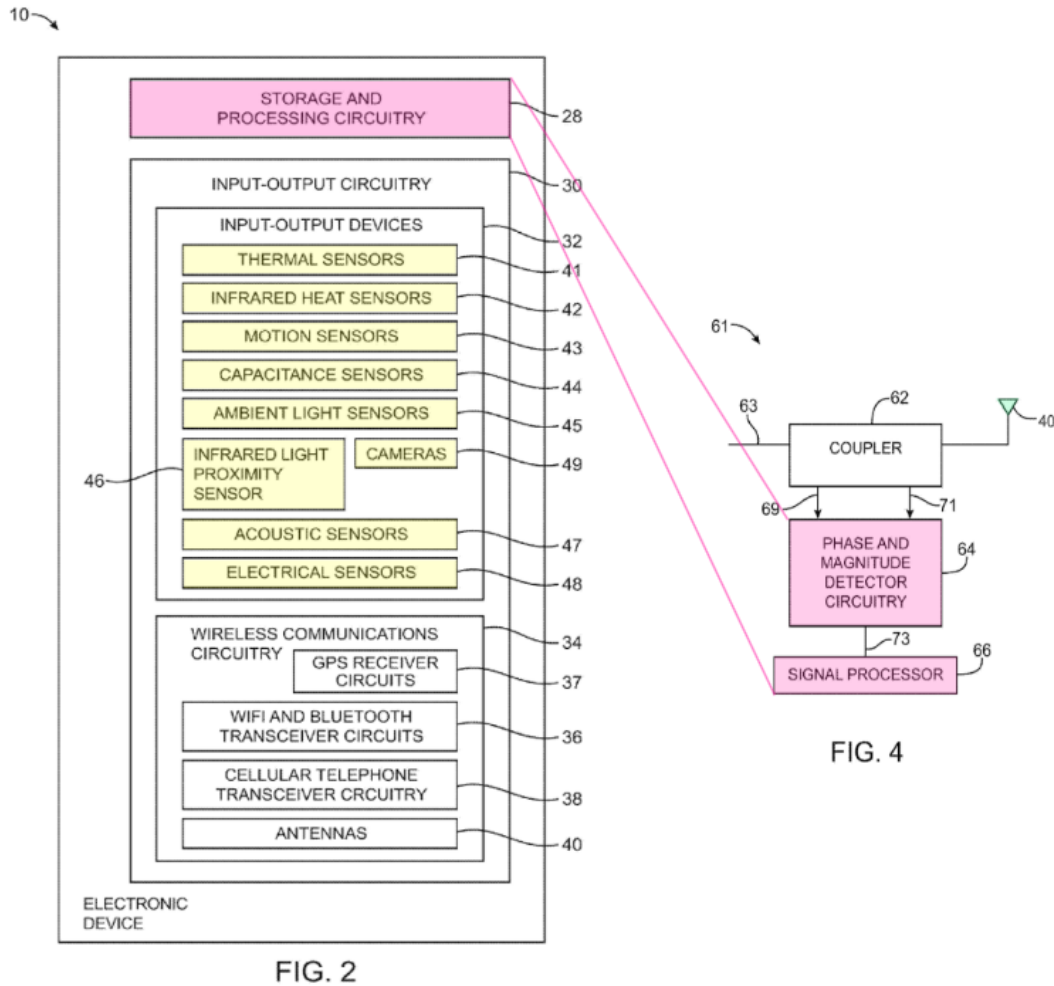


FIG. 2

Id., Figs. 2, 4.

4. 11[c][i]: at least one steerable antenna communicatively coupled to said one or more processors

Schlub discloses a *steerable antenna* 40 coupled with “phase and magnitude detector circuitry 64” and “signal processor 66,” both of which can be “implemented using ... *suitable control circuitry* (e.g., *storage and processing circuitry 28* of FIG. 1).” EX1005, [0059], Figs. 2, 4 (annotated below); EX1003, ¶¶121-22.



Id., Figs. 2, 4.

5. 11[c][ii]: wherein said at least one steerable antenna is configured to adjust a beam radiation pattern so as to steer or direct its energy in particular directions while providing nulls or dead zones in other directions,

See 1[c][i]-[iii]; EX1003, ¶123.

6. 11[c][iii]: wherein said at least one steerable antenna radiates at one or more frequencies in the range of 10 GHz to 500 GHz; and

See 1[d]; EX1003, ¶124.

7. **11[d][i]: a non-transitory computer readable medium comprising executable instructions that when executed by said one or more processors cause said one or more processors to perform the steps of:**

Schlub's "storage and processing circuitry 28 may include storage such as hard disk drive storage, nonvolatile memory (e.g., flash memory or other electrically-programmable-read-only memory configured to form a solid state drive)" (*i.e.*, *non-transitory computer readable media*). EX1005, [0036]. The "storage and processing circuitry 28" may be used to "run software on device 10" (*i.e.*, *execute instructions*) to perform the various operations disclosed, including each of the operations recited below as discussed in connection with 11[d][ii]-[iv]. *Id.*, [0037], [0091]; EX1003, ¶¶125-26.

8. **11[d][ii]: receiving signals from said one or more sensors pertaining to said orientation in the three dimensional space;**

Schlub's "storage and processing circuitry 28" "*process[es] the signals from ... the sensors* of FIG. 2" in order to "determine whether antenna adjustments and other adjustments to the operation of the wireless circuitry of device 10 should be made." EX1005, [0086]; *see also id.*, [0036], [0048]; 11[b]. Processing such signals confirms they are received as claimed. EX1003, ¶127. The sensors determine *the orientation of the device in three dimensional space*. *See* 1[a]; EX1003, ¶127.

9. **11[d][iii]: using said signals, computing zones or spans of directions corresponding with one or more directions of either or both said user and said structure relative to said at**

**least one steerable antenna in the three dimensional space;
and**

Schlub's "storage and processing circuitry 28" "process[es] *the signals from ... the sensors*" to "determine whether antenna adjustments and other adjustments to the operation of the wireless circuitry of device 10 should be made." EX1005, [0086]; *see also* [0036], [0048]. Schlub further discloses that this "determination" involves *computing zones or spans of directions corresponding with the user or a structure*. *See* 1[b]; EX1003, ¶128.

10. **11[d][iv]: adjusting one or more beam radiation patterns of said at least one steerable antenna to radiate in one or more directions of said particular directions which are not in said zones or spans of directions in the three dimensional space,**

Schlub's "storage and processing circuitry 28" "determine[s] whether antenna *adjustments* ... should be made." EX1005, [0086]; *see also id.*, [0036], [0048]; *see also* 1[c][i], EX1003, ¶129.

11. **11[e]: wherein said at least one steerable antenna radiates said one or more beams based on signals from said one or more processors determined on execution of said executable instructions, and**

Schlub discloses that the "storage and processing circuitry" "adjust[s] a phased antenna array (e.g., to steer an antenna away from the user's body." EX1005, [0023]. The "storage and processing circuitry" may include "control circuitry" to "adjust ... transmitted radio-frequency antenna signals" to "form a radio-frequency

beam ... that is oriented in” a particular “direction.” *Id.*, [0077], [0080]; *see also* 1[c][ii], 11[d][i]-[ii]; EX1003, ¶130.

12. 11[f]: wherein said at least one steerable antenna operates on one or multiple bands; and

See 1[d]; EX1003, ¶131.

13. 11[g]: a receiver for receiving over-the-air signals.

Schlub discloses that received wireless signals are “passed to *receiver circuitry* in transceiver circuitry 54.” EX1005, [0055]. Schlub continues that “[d]uring signal reception operations, path 140 may be used to route radio-frequency antenna signals that have been received by antennas 40 from external wireless equipment to receiver circuitry in device 10.” *Id.*, [0078]. Radio frequency signals are “over-the-air signals” as claimed. EX1003, ¶¶132-33.

H. Claim 12: The wireless device of claim 11, wherein said at least one steerable antenna comprises a plurality of steerable antennas.

Schlub discloses that “[d]evice 10 may include a phased antenna array” and that “include[s] *multiple antenna elements*.” EX1005, [0032]. Each antenna element is *steerable* using “[c]ontrol circuitry ... to control the signals that are routed to and from the antenna elements (e.g., by controlling signal phases).” *Id.* “The control circuitry can alter the direction in which the antenna operates.” *Id.*; EX1003, ¶¶134-35.

I. Claim 13: The wireless device of claim 11, wherein said one or more sensors includes one or more cameras, gyroscopes, light or motion

detectors, capacitive sensors, microphones, and ultrasound sensors or transducers.

See 1[a]; EX1003, ¶136.

- J. Claim 14: The wireless device of claim 11, wherein said one or more parameters are selected from the group consisting of light, motion, orientation, video, capacitance, ultrasound, and sound.**

See Claim 2 (referring to sensors capable of transducing claimed parameters);
EX1003, ¶137.

- K. Claim 17: The wireless device of claim 11 wherein said at least one steerable antenna or said receiver uses one or more of: beamforming, beamsteering, beam or antenna element selection, adaptive beamforming, multibeam combining, MIMO, phasing, beam switchable array, active combining, passive combining, and hybrid antenna structure.**

See Claim 5; EX1003, ¶138.

- L. Claim 21: The wireless device of claim 11 wherein the at least one steerable antenna operates on multiple bands.**

See 1[d]; EX1003, ¶137.

- M. Claim 22: The wireless device of claim 11 wherein said executable instructions cause said steps of receiving, using, and adjusting to be performed multiple times as said one or more parameters change over time.**

See Claim 10; EX1003, ¶140.

- N. Claim 23**

- 1. 23[pre]: A steerable antenna system for avoiding radiation of a user or structure by a wireless device, comprising:**

See 1[pre], 11[pre]; EX1003, ¶141.

2. **23[a]: one or more sensors configured to detect in a three dimensional space using one or more cameras, microphones, audio sensors or transducers, ultrasound sensors, range finders, capacitive sensors, gyroscopes, light detectors, or motion detectors, an orientation of said wireless device relative to either or both said user and said structure;**

See 1[a], 11[a]; EX1003, ¶142.

3. **23[b]: a computation module communicatively coupled to said one or more sensors configured to determine zones or spans of directions;**

Schlub discloses “storage and processing circuitry 28” (*computation module*) communicatively coupled to the sensors. *See* 1[b], 11[b]; EX1003, ¶143. The “storage and processing circuitry” *determines zones or spans of directions* based on sensor signals. *See* 11[d][iii]; EX1003, ¶143.

4. **23[c]: at least one steerable antenna that radiates at one or more frequencies in the range of 10 GHz to 500 GHz communicatively coupled to said computation module, said at least one steerable antenna being configured for adjustably radiating one or more beams in one or more directions which are not in said zones or spans of directions in the three dimensional space,**

Schlub discloses a steerable antenna that radiates at frequencies in the 10 GHz to 500 GHz range. *See* 1[d]; EX1003, ¶144. The antenna is communicatively coupled to the “storage and processing circuitry.” *See* 11[c]; EX1003, ¶144. The steerable antenna is configured to adjustably radiate beams as recited in the claim. *See* 1[c][i]-[iii]; EX1003, ¶144.

5. **23[d]: wherein said zones or spans of directions correspond with one or more directions of said user or structure relative**

to said at least one steerable antenna in the three dimensional space,

See 1[b]; EX1003, ¶145.

- 6. 23[e]: wherein said at least one steerable antenna is configured to adjustably steer or direct its energy in particular directions while providing nulls or dead zones in other directions in the three dimensional space,**

See 1[c][i]-[ii], 11[c][ii]; EX1003, ¶146.

- 7. 23[f]: wherein said at least one steerable antenna operates on one or multiple bands; and**

See 1[d]; EX1003, ¶147.

- 8. 23[g]: a receiver for receiving signals.**

See 11[e], 11[g]; EX1003, ¶148.

- O. Claim 24: The steerable antenna system of claim 23, wherein said at least one steerable antenna comprises a plurality of steerable antennas.**

See Claim 12; EX1003, ¶149.

- P. Claim 25: The steerable antenna device of claim 23, wherein said one or more sensors includes one or more cameras, gyroscopes, light or motion detectors, capacitive sensors, microphones, and ultrasound transducers.**

See Claim 2; EX1003, ¶150.

- Q. Claim 26: The steerable antenna device of claim 23, wherein said one or more parameters are selected from the group consisting of light, motion, orientation, video, capacitance, ultrasound, and sound.**

See Claim 2 (referring to sensors capable of transducing claimed parameters);

EX1003, ¶151.

- R. Claim 29: The steerable antenna system of claim 23 wherein said at least one steerable antenna or said receiver uses one or more of: beamforming, beamsteering, beam or antenna element selection, adaptive beamforming, multibeam combining, MIMO, phasing, beam switchable array, active combining, passive combining, and hybrid antenna structure.**

See Claim 5; EX1003, ¶152.

- S. Claim 33: The steerable antenna system of claim 23 wherein the at least one steerable antenna operates on multiple bands.**

See 1[d]; EX1003, ¶150.

IX. GROUND 2: SCHLUB IN VIEW OF SEOL RENDERS OBVIOUS CLAIMS 3-4, 6-8, 15-16, 18-20, 27-28, AND 30-32

Schlub discloses a wireless device operating in the 10-500 GHz range that uses sensors (*e.g.*, a camera) to detect the user's orientation in the three-dimensional environment relative to the device, and a steerable antenna that adjusts its radiation patterns based on the detection. EX1003, ¶154. Seol discloses transmitting and receiving using different beam patterns with a steerable antenna and using time division duplexing for bidirectional communications. *Id.* It would have been obvious to a POSITA to apply Seol's teachings to Schlub's wireless device and steerable antenna, including as set forth below. *Id.*

A. Seol (EX1007)

U.S. Pat. No. 9,362,994 ("Seol") was filed May 10, 2013 and issued June 7, 2016. It is prior art under at least 35 U.S.C. §102(a)(2).

Seol describes a “wireless mobile communication system” that uses improved “beamforming” for “signal transmission and reception between a Mobile Station (MS) and a Base Station (BS). EX1007, 1:18-21, 2:31-35; EX1003, ¶¶155-156. Seol’s system operates in the “millimeter-wave frequency band” (*i.e.*, in the 30-300 GHz range). EX1007, 1:37-38, 2:27-30, 6:48-62. Seol’s beamforming employs distinct transmission and reception beam patterns. EX1003, ¶156. For example, the mobile station maintains separate beamforming capabilities for uplink (transmission) and downlink (reception), as detailed in Table 1, which lists distinct “Tx Hybrid BF capability” fields including “Number of *Tx analog beamforming-patterns* (or beams) per array/subarray,” and distinct “Rx Hybrid BF capability” fields with “Number of *Rx analog beamforming-patterns* (or beams) per array/subarray.” EX1007, 18:62-19:35. Seol further discloses using “Time Division Duplex (TDD)” to synchronize uplink and downlink communications. *Id.*, 9:39-47.

B. Motivation to Combine

A POSITA would have been motivated to configure Schlub’s wireless device and steerable antenna to use different radiation patterns for transmission and reception, as taught by Seol, and would have reasonably expected the combination to succeed. EX1003, ¶157.

Seol provides an express motivation for the combination. *Id.*, ¶158. Seol discloses that propagation loss in a mmWave system can be minimized, while

maximizing performance, by determining and selecting the best directional beam (*i.e.*, the best radiation pattern) in each of the uplink direction (*i.e.*, from wireless device to base station) and downlink direction (*i.e.*, from base station to wireless device). EX1007, 19:49-58 (“[E]xemplary embodiments of the present invention can ***mitigate a large propagation loss in a millimeter-wave band and maximize efficiency and diversity*** by additional use of MIMO/BF by performing an efficiency hybrid beam forming scheme in which ***one or more best beams are selected from a set of one or more analog beams having directivity on uplink/downlink*** and digital MIMO/BF is performed in the selected beams during transmission and reception between an MS and a BS.”); EX1003, ¶158.

Further, a POSITA would have understood that objects in the environment of a mobile device (*e.g.*, a user or structure) may move over time, such that the optimal transmit path (during uplink) may be different from the optimal receive path (during downlink). EX1003, ¶159. Accordingly, a POSITA would have been motivated to enable the mobile device to use different transmit and receive beam patterns such that the optimal pattern can be selected for a particular communication. *Id.* A POSITA would further have been motivated to enable the mobile device to use different transmit and receive patterns so that the mobile device is capable of communicating with older devices, which may use an omnidirectional antenna that cannot be steered. *Id.*

A POSITA would have further been motivated to configure Schlub’s wireless device and steerable antenna to use TDD, as taught by Seol, and would have reasonably expected the combination to succeed. EX1003, ¶160.

Seol discloses that TDD can be used to synchronize the base station and mobile device in order to identify the best beam pattern in the uplink or downlink direction. EX1007, 9:39-11:5; EX1003, ¶161. U.S. Pat. Pub. 2011/0182174 (“Pi”), published in 2011, similarly teaches that the use of TDD enables bidirectional communication, which is necessary for the base station and mobile device to synchronize their beam patterns. EX1009, [0041], [0042]. In addition, a POSITA would have known that bidirectional communications can be accomplished using one of two well-known methods: TDD or FDD (Frequency Division Duplexing). EX1003, ¶161. Accordingly, the use of TDD would have constituted the application of a known technique to a well-known device type (*i.e.*, a wireless communication device) with predictable results. *Id.*

In addition, Schlub, Seol, and the ’625 patent are all analogous art because they are directed to the same technological subject matter, namely wireless communication systems that can steer or direct beams of radiation in specific directions. EX1001, 4:36-38; EX1005, Abstract (disclosing a “portable electronic device” with “wireless communications circuitry” that “steer[s] a phased antenna array”); EX1007, 1:18-19; EX1003, ¶162.

Finally, a POSITA would have reasonably expected the combination to succeed. EX1003, ¶163. As both Schlub and Seol confirm, antenna steering techniques such as beamforming and beam steering were well known and in use prior to the '625 patent. EX1005, [0005], [0033], [0042], [0079]-[0080]; EX1007, 1:43-1:59; EX1003, ¶163. Time Division Duplexing was also a well-known way of dividing a channel to allow for bidirectional communications, *i.e.*, by allocating a different time slot for each of a pair of communicating devices. EX1007, [0041]-[0042]; EX1003, ¶163. A POSITA would thus have been capable of configuring Schlub's antennas to use TDD for bidirectional communication between a wireless device and a base station. EX1003, ¶163. Further, since Schlub is already configured to adjust the radiation beam pattern of its antenna, a POSITA would have been capable of configuring Schlub's system to adjust the beam pattern *both* for transmission and for reception to use different beam patterns. *Id.* All these changes to Schlub would have required only routine engineering with predictable results. *Id.*

C. Claim 3: The method of claim 1 wherein a directional radiating pattern of said one or more beams is different from a receiving pattern used in said step of receiving said signals.

Claim 3 is obvious over Schlub in view of Seol. EX1003, ¶¶164-66.

Seol discloses using different beam patterns for transmission and reception as claimed. EX1003, ¶164. Specifically, Seol describes a wireless device that employs distinct transmission and reception beam patterns in the mmWave frequency band.

For transmission, the mobile station supports use of beamforming. EX1007, Table 1 (“Capability to support Tx analog beamforming”). For reception, the MS “may be configured to receive signals omni-directionally without supporting RX beam forming” or it may “receive signals while supporting RX beam forming.” *Id.*, 9:8-14. A POSITA would have understood that when the MS is receiving omnidirectionally and transmitting via beamforming as disclosed in Seol, the transmission beam pattern is different from the reception beam pattern. EX1003, ¶164.

Moreover, Seol expressly discloses that the wireless device maintains separate beamforming capabilities for uplink and downlink, as detailed in Table 1, which lists distinct “Tx Hybrid BF capability” fields including “Number of *Tx analog beamforming-patterns* (or beams) per array/subarray,” and distinct “Rx Hybrid BF capability” fields with “Number of *Rx analog beamforming-patterns* (or beams) per array/subarray.” EX1007, Table 1; EX1003, ¶165.

A POSITA would have been motivated to combine these teachings of Seol into the system of Schlub with a reasonable expectation of success as set forth in Section IX.B. EX1003, ¶166.

D. Claim 4: The method of claim 1 further comprising a step of receiving signals arriving from one or more directions that are within said zones or spans of directions of said user or structure.

Claim 4 is obvious over Schlub in view of Seol. EX1003, ¶¶167-68.

Seol discloses that the MS “may be configured to receive signals omni-directionally without supporting RX beam forming” or it may “receive signals while supporting RX beam forming.” EX1007, 9:8-14. If the MS is configured to receive signals omni-directionally, then it would receive signals arriving from *all* directions, including *directions that are within the zones or spans of directions of the user*. EX1003, ¶¶167-68.

A POSITA would have been motivated to combine these teachings of Seol into the system of Schlub with a reasonable expectation of success as set forth in Section IX.B.

E. Claim 6: The method of claim 1, wherein a directional radiating pattern of said one or more beams is different from a receiving pattern used in said step of receiving said signals.

See Claim 3; EX1003, ¶169.

F. Claim 7: The method of claim 6 further comprising using time division duplexing for communication, using said one or more beams radiated by said at least one steerable antenna and signals received by at least one of said at least one steerable antenna.

Claim 7 is obvious in view of Seol. EX1003, ¶¶170-71.

In particular, Seol discloses using a “Time Division Duplex (TDD) frame” to divide “synchronization/broadcasting” between a base station and mobile station for beamforming. EX1007, 9:41-47.

A POSITA would have been motivated to combine this teaching of Seol into the system of Schlub with a reasonable expectation of success as set forth in Section IX.B. EX1003, ¶171.

- G. Claim 8: The method of claim 6 wherein said step of receiving signals with said at least one steerable antenna receives said signals arriving from one or more directions that are within said zones or spans of directions of said user or structure.**

See Claim 4; EX1003, ¶172.

- H. Claim 15: The wireless device of claim 11 wherein a directional radiating pattern of said one or more beams radiated from said at least one steerable antenna is different from a receiving pattern of said at least one steerable antenna.**

See Claim 3; EX1003, ¶173.

- I. Claim 16: The wireless device of claim 11 wherein said receiver receives said over-the-air signals in one or more directions that are within said zones or spans of directions of said user or structure.**

See Claim 4; EX1003, ¶174.

- J. Claim 18: The wireless device of claim 11, wherein a directional radiating pattern of said one or more beams radiated from said at least one steerable antenna is different from a receiving pattern used by said at least one steerable antenna or said receiver used to receive said over-the-air signals.**

See Claim 3; EX1003, ¶175.

- K. Claim 19: The wireless device of claim 18 wherein said wireless device is configured for time division duplexing for communication, using said one or more beams radiated by said at least one steerable antenna and using over-the-air signals received by at least one of said at least one steerable antenna or said receiver.**

See Claim 7; EX1003, ¶176.

- L. Claim 20: The wireless device of claim 18 wherein said receiver receives signals in one or more directions that are within said zones or spans of directions of said user or structure.**

See Claim 4; EX1003, ¶177.

- M. Claim 27: The steerable antenna system of claim 23 wherein a directional radiating pattern of said one or more beams radiated from said at least one steerable antenna is different from a receiving pattern of said at least one steerable antenna.**

See Claim 3; EX1003, ¶178.

- N. Claim 28: The steerable antenna system of claim 23 wherein said receiver using said at least one steerable antenna or said receiver receives signals in one or more directions that are within said zones or spans of directions of said user or structure.**

See Claim 4; EX1003, ¶179.

- O. Claim 30: The steerable antenna system of claim 23, wherein a directional radiating pattern of said one or more beams radiated from said at least one steerable antenna is different from a receiving pattern used by said at least one steerable antenna or said receiver.**

See Claim 3; EX1003, ¶180.

- P. Claim 31: The steerable antenna system of claim 30 wherein the steerable antenna system is configured for time division duplexing for communication, using said one or more beams radiated by said at least one steerable antenna and signals received by at least one of said at least one steerable antenna or said receiver.**

See Claim 7; EX1003, ¶181.

- Q. Claim 32: The steerable antenna system of claim 30 wherein said receiver receives signals in one or more directions that are within said zones or spans of directions of said user or structure.**

See Claim 4; EX1003, ¶182.

X. GROUND 3: PRASAD IN VIEW OF SEOL AND FURTHER IN VIEW OF YIN RENDERS OBVIOUS CLAIMS 1-33

Prasad discloses a wireless device that uses sensors (*e.g.*, cameras, gyroscopes, accelerometers, etc.) to detect a wireless device's orientation relative to a user in three-dimensional space, determines zones where the user is located relative to the wireless device, and adjusts a steerable antenna so that its radiation pattern points away from the zones or spans of directions where the user is located, and instead radiates in other directions. Seol discloses using steerable antennas at frequencies within the claimed 10 GHz to 500 GHz range, transmitting and receiving using different beam patterns, and using time division duplexing ("TDD") for bidirectional communications. It would have been obvious to a POSITA to apply Seol's teachings to Prasad's wireless device and steerable antenna as set forth below. EX1003, ¶183.

To the extent PO contends that Prasad does not disclose determining and using "zones" or "spans of directions" (*e.g.*, 1[b] and 1[c][ii]), these limitations would have been obvious in view of Yin³ as explained below. EX1003, ¶184.

³ WIPO Pat. Pub. 2014/194455 ("Yin") was filed on June 3, 2013 and published December 11, 2014. It is prior art under at least 35 U.S.C. §102(a)(2).

A. Prasad (EX1006)

U.S. Patent Pub. No. 2013/0237272A1 (“Prasad”) was filed September 16, 2011 and published September 12, 2013. It is prior art under at least 35 U.S.C. §102(a)(2).

Prasad discloses a “smart directional radiation protection system” for “portable wireless mobile devices” designed to “reduc[e] the intensity of radiation” on a “user[-]facing direction.” EX1006, Abstract; EX1003, ¶¶185-186. Prasad’s system “focus[es] on multimode dynamic radiation pattern for actively varying, controlling and reducing the intensity of radiation on direction facing the user.” EX1006, [0007]. Prasad accomplishes this using a “tunable ... antenna system” with a “directional transmit power controller” that “actively controls the radiation on [the] required direction facing the user.” *Id.*, [0020]. The system uses sensors (*e.g.*, “location sensor like proximity or contact sensor” or “orientation sensors like gyro sensor[or] accelerometer”) to “align the direction of controlling and reducing of radiation facing the user.” *Id.*, [0008], [0010]. When sensors detect that the device is near the user’s head or body, a microprocessor analyzes the sensed information and a controller then adjusts the antenna system to redirect radiation away from the user-facing direction using “beamforming” or “beam steering.” *Id.*, [0016], [0020]-[0025]. The antenna system uses “one or a combination of” tunable antennas. *Id.*, Claim 24(d).

B. Motivation to Combine

A POSITA would have been motivated to operate Prasad's wireless communication device and steerable antenna in millimeter-wave (mmWave) frequency bands disclosed in Seol, and would have reasonably expected the combination to succeed. EX1003, ¶187.

First, Seol provides an express motivation to operate wireless devices in the mmWave frequency band. *Id.*, ¶188. Seol discloses that “demands for [wireless] traffic have accelerated due to increased demands for smartphones and tablet Personal Computers.” EX1007, 1:31-36. Seol teaches that “recent interest has focused on a millimeter-wave wireless communication system” to solve this problem. *Id.* Other references corroborate the advantages of mmWave communications. For example, Pi (EX1009) discloses that “the larger amount of spectrum available in the mmWave bands” allows for a “data rate ... much higher than that provided in cellular bands.” EX1009, [0051]. Thus, mmWave frequency bands “achieve data communications with very high throughput and low latency, thus greatly improving user experience and enabling new mobile communication applications.” *Id.*

Second, Seol's teachings would motivate a POSITA to implement mmWave communications in a steerable antenna system, such as Prasad's. EX1003, ¶189. Seol teaches that for wireless communication in mmWave frequencies, “propagation

loss ... is increased ... and resulting shortened propagation distance reduces service coverage.” EX1007, 1:38-43. Thus, implementing effective mmWave communication systems requires “mitigating the path loss of waves using **beamforming** and thus increasing the propagation distance of the waves.” *Id.*, 1:43-47. Accordingly, mmWave communication systems uniquely benefit from the beamforming capabilities of steerable antenna systems such as Prasad’s. EX1006, [0024] (Prasad disclosing that its steerable antenna is capable of “beamforming and beam steering”); EX1003, ¶189. Pi similarly discloses that beamforming can be used to overcome these known disadvantages of mmWave systems to “achieve good quality of communication,” providing additional motivation. EX1009, [0042].

Third, Prasad discloses that the “[o]bjective of the invention is to protect the user from mobile cell phone radiation and its adverse health effects simultaneously maintaining the quality of communication.” EX1006, [0006]. Prasad’s smart directional radiation protection system, which incorporates a steerable antenna and utilizes techniques such as beamforming and beam steering, achieves this goal. EX1006, Abstract. Thus, a POSITA would have understood that using Prasad’s steerable antenna in mmWave frequencies offers the added benefit of protecting users from potentially harmful radiation in that frequency band. EX1003, ¶190.

A POSITA would have further been motivated to configure Prasad's steerable antenna to use different radiation patterns for transmission and reception, as taught by Seol, and would have reasonably expected the combination to succeed. *Id.*, ¶191.

Seol provides an express motivation for the combination. EX1003, ¶192. Specifically, Seol discloses that propagation loss in a mmWave system can be minimized, while maximizing performance, by determining and selecting the best radiation pattern in each of the uplink and downlink directions. EX1007, 19:49-58; *see also* Section IX.A-B. A POSITA would have also understood that enable different send and receive beam patterns promotes interoperability with older devices, and allows the mobile device to adapt to movement. EX1003, ¶192; Section IX.B.

A POSITA would have further been motivated to configure Prasad's steerable antenna to use Time Division Duplexing (TDD), as taught by Seol, and would have reasonably expected the combination to succeed. EX1003, ¶193.

Seol discloses that TDD can be used for bidirectional communications to synchronize the beam patterns of the base station and mobile device. EX1007, 9:39-11:5; *see also* EX1009, [0041], [0042]; Section IX.A. A POSITA would have also understood that using TDD for bidirectional communications in a mobile device simply applies a known technique to achieve predictable results. EX1003, ¶194; Section IX.B.

In addition, Prasad, Seol, and the '625 patent are all analogous art because they are directed to the same technological subject matter, namely wireless communication systems that can steer or direct beams of radiation in specific directions. EX1001, 4:36-38; EX1006, [0007]; EX1007, 1:18-19.

Finally, a POSITA would have reasonably expected the combination to succeed. EX1003, ¶196. As Seol acknowledges, mmWave communications were well known and in use prior to the '625 patent. EX1007, 1:31-38; *see also* EX1007, [0009]. In addition, as both Prasad and Seol acknowledge, antenna steering techniques (including beamforming and beam steering) were also well known and in use prior to the '625 patent. EX1006, [0007]; EX1007, 1:43-1:59; *see also* EX1007, [0033], [0042]; EX1003, ¶196. Time Division Duplexing was also a well-known way of dividing a channel to allow for bidirectional communications, *i.e.*, by allocating a different time slot for each of a pair of communicating devices. EX1007, [0041]-[0042]; EX1003, ¶196. A POSITA would thus have been capable of configuring Prasad's antennas to operate at mmWave frequencies, including within the 10 GHz to 500 GHz range, and to use TDD for bidirectional communication between the mobile device and a base station. EX1003, ¶196. Indeed, Prasad's implementation is not limited to or dependent on certain operating frequencies, and a POSITA would have understood that Prasad's steerable antenna may be configured to operate at frequencies including in the 10-500 GHz band. *Id.*, ¶¶196-197. Further,

since Prasad is already configured to adjust the radiation beam pattern of its antenna, a POSITA would have been capable of configuring Prasad's system to adjust the beam pattern **both** for transmission and for reception to use different beam patterns. *Id.* All these changes to Prasad would have required only routine engineering with predictable results. *Id.*

C. Claim 1

1. 1[pre]

To the extent the preamble is limiting, Prasad discloses it. EX1003, ¶197.

Prasad discloses a “directional **radiation protection system** for **wireless mobile device** to reduce SAR [Specific Absorption Rate].” EX1006, Title; *see also id.*, [0015]-[0016] (disclosing methods to “reduc[e] SAR”), [0017] (system is “mainly concerned about varying and **reducing the intensity of radiation 180 facing the user**”). “SAR” refers to how much radiation a user absorbs when exposed to electromagnetic fields emitted by the wireless device. EX1003, ¶¶198-99.

Prasad reduces radiation directed to a user through “dynamic radiation pattern[s], beamforming, beam steering etc.” EX1006, [0024]. These techniques are implemented using an antenna that “varies and controls the directional transmission & intensity of radiation” (*i.e.*, a **steerable antenna**). *Id.*, [0027].

2. 1[a]

Prasad discloses 1[a]. EX1003, ¶¶200-204.

“detecting ... an orientation of said wireless device relative to either or both said user or said structure”: Prasad discloses a “sensor system 130 to determine... device *orientation* and proximity of wireless device *to user*.” EX1006, [Abstract]; *see also* [0010] (using sensors to “sense the change in *orientation of the device*”), cl. 22(d) (using sensors to “sense the change in *orientation* and direction *of the mobile device*”); EX1003, ¶¶200-201.

“in three dimensional space”: Prasad’s sensor system includes three-*dimensional sensors*, such as “2D & 3D cameras” for “for scanning and detecting the environment in all possible directions [*i.e.*, in *all three dimensions*].” EX1006, cl. 22(c) (using “360 degree or *omnidirectional sensors*”). For example, Prasad uses “optical or visual & infrared cameras or sensors for sensing the user presence with direction, range, dimension” (*i.e.*, *in three dimensions*”). *Id.*, cl. 30. Prasad also discloses using sensors with “multi dimension and axis sensing capability,” which would be capable of detecting in *three dimensions*. *Id.*, cl. 22. A POSITA would have understood that these disclosures all describe techniques for detecting users or structures in three dimensional space. EX1003, ¶202.

“using one or more cameras, microphones, audio sensors, ultrasound sensors or transducers, range finders, capacitive sensors, gyroscopes, light detectors, or motion detectors”: Prasad discloses each of the recited sensor types, including “2D & 3D cameras,” “MIC ... to sense the change in sound,” “ultrasonic

sensors,” “distance or range sensor,” “capacitive sens[ors],” “[g]yro sensor,” “light sensors,” and “accelerometer.” EX1006, cl. 22; *see also id.*, [0008-10], [0020-22]; EX1003, ¶203.

3. 1[b]

Prasad, alone or in combination with Yin, discloses and renders obvious 1[b]. EX1003, ¶¶205-220. For example, in Figure 2, Prasad illustrates the radiation emitted by the antenna of the wireless device in different directions (represented by concentric circles). EX1006, [0018], Fig. 2. As shown in Figure 2, Prasad’s system detects the “direction facing head” (*i.e.*, the ***zones/spans corresponding with the direction*** of the ***user relative to the antenna***). *Id.*, [0018].

Prasad ***determines*** the zones and spans corresponding with the direction of the user based on the sensor detections described above. *See* 1[a]; EX1006, [0027]; EX1003, ¶207. The zones/spans corresponding to the user are illustrated with the “dotted lines” (annotated in yellow below), which represent “controlled and reduced radiation 180” in the direction of the user. EX1006, [0027]; EX1003, ¶207.

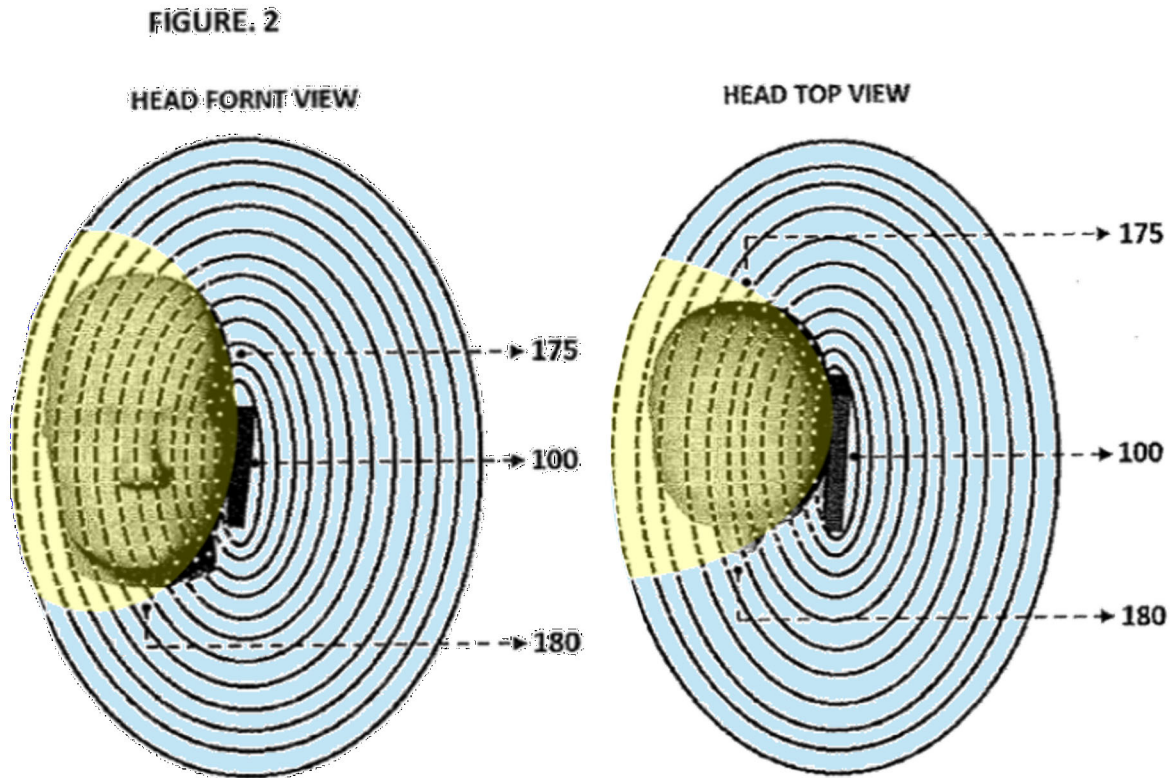
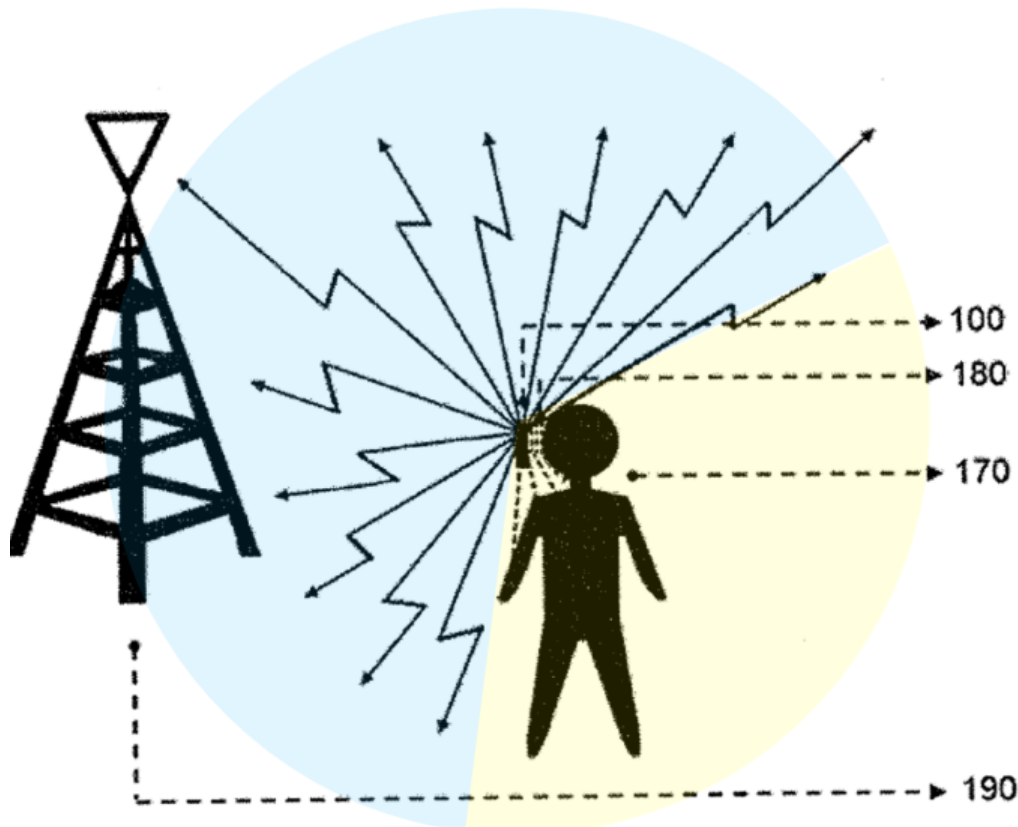


Figure 2 shows the emitted radiation from both a top view (*e.g.*, an x-y plane) and a front view (*e.g.*, an x-z plane), confirming detection in all three dimensions (*i.e.*, ***three dimensional space***). EX1006, [0018], Fig. 2; EX1003, ¶208.

Figure 1 provides an alternative illustration that also shows the zones or spans corresponding with the direction of the user in three dimensional space (illustrated with dotted lines and annotated in yellow below). EX1006, [0017], Fig. 1. The dotted lines specifically represent the “controlling of radiation intensity 180” in that direction. *Id.*, [0017]; EX1003, ¶209.

FIGURE. 1



EX1006, Fig. 1.

To the extent PO contends Prasad alone does not disclose “zones” or “spans of directions,” Yin renders it obvious. EX1003, ¶¶210-220.

Yin describes a mobile communication system that addresses health and performance concerns related to electromagnetic radiation exposure. EX1008, 1:9-14; EX1003, ¶¶212-213. To accomplish this goal, Yin “capture[s] a digital photograph” of the three-dimensional area around the wireless device and “identif[ies] a presence of one or more people in the area.” EX1008, 1:19-26, 7:6-12, 8:5-23. Figure 3 (reproduced and annotated below) illustrates this process:

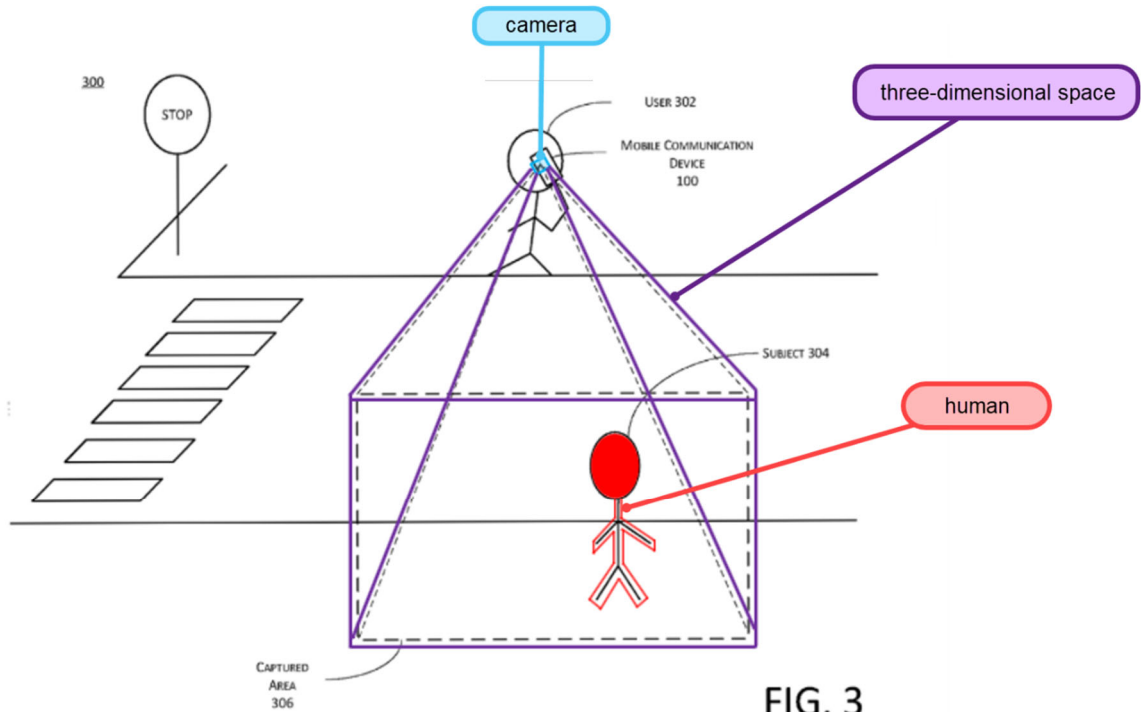
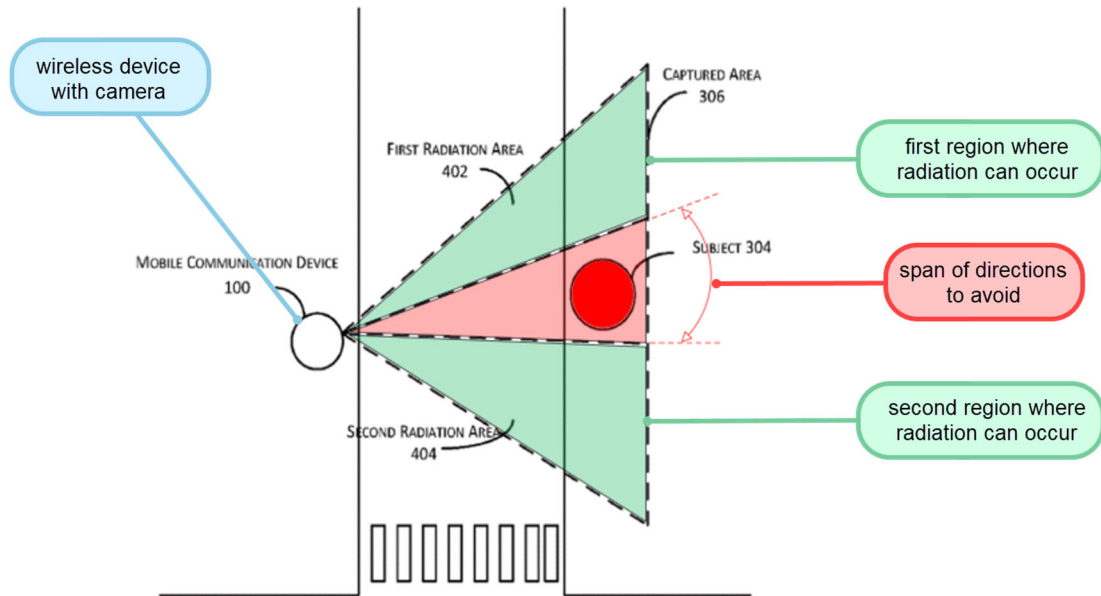


FIG. 3

Yin determines “regions in the area”/“regions in the surroundings” (*i.e.*, ***zones or spans of directions***) where people are located. *Id.*, 1:19-26, 7:12-13; EX1003, ¶¶212-13. The determined zones dictate where radiation should be directed and where it should be avoided. *Id.*, 7:12-13, 8:24-9:6. This process is illustrated in Figure 4 (reproduced and annotated below), where radiation is directed to a “first radiation region 402” and a “second radiation region 404” where radiation is to be directed, while avoiding the zone between those two regions is where a person was detected. Specifically, “[o]nce the one or more subject(s) 304 are detected, processor 206 may determine regions to which the EM radiation may be preferably directed, *i.e.*, away from subject(s) 304.” *Id.* 10:3-8; EX1003, ¶¶212-13.



EX1008, Fig. 4; EX1003, ¶213.

A POSITA would have been motivated to apply Yin's teachings regarding the determination and usage of zones or spans of directions to Prasad's wireless device and would have reasonably expected the combination to succeed. EX1003, ¶214.

As discussed above, Prasad already discloses detecting the presence and location of a user in order to steer away potentially harmful radiation. To the extent not already disclosed by Prasad, a POSITA would have been motivated to apply Yin's method of determining zones or spans because doing so simplifies and improves control of the antenna, *e.g.*, by identifying objects and steering based on discrete zones, rather than more complex contours and boundaries defining the outlines of particular objects. EX1003, ¶¶215-217. Prasad and Yin both disclose similar camera solutions coupled to processing circuitry, and a POSITA would have

understood that both systems can thus be configured to determine zones based on object detections using routine software and programming, and thus reasonably expected the combination to succeed. *Id.* Indeed, Yin expressly recognizes that “it is common within the art to describe devices and/or processes in the fashion set forth herein, and thereafter use engineering practices to integrate such described devices and/or processes into data processing systems.” EX1008, 13:7-11.

In addition, like Prasad, Seol, and the ’625 patent, Yin is analogous art because it is directed to the same technological subject matter, namely wireless communication systems that can steer or direct beams of radiation in specific directions. EX1008, 1:19-26 (invention is a “mobile communication device” with a “multi-element antenna array” that “avoid[s] EM radiation being directed toward ... one or more regions”). EX1003, ¶218-19.

In addition, Prasad and Yin both provide more disclosure of 1[b] than Dorsey (cited during prosecution) or the elements PO accuses of infringement in the related district court action. EX1002, 22-23; EX1013, 7; 1[b].

4. 1[c][i]

Prasad, alone or in combination with Yin, discloses and renders obvious 1[c][i]. EX1003, ¶221-228.

“adjusting one or more beam radiation patterns of said at least one steerable antenna”: Prasad’s *steerable antenna* (see 1[pre]; EX1006, [0027]) comprises an

“[a]ntenna system” with “**one or more** radiating element[s]” used “to achieve **dynamic radiation pattern.**” EX1006, cl. 24(f). As such, Prasad discloses “**at least one** steerable antenna” that itself has its beam radiation pattern adjusted to achieve a dynamic radiation pattern. EX1003, ¶¶221-222. A POSITA would have understood that the dynamic radiation pattern of Prasad refers to a pattern of a single antenna⁴ that can be adjusted at different points in time. *Id.* In that respect, Prasad discloses the key limitation the Board found the Dorsey prior art did not disclose during prosecution—use of beamforming by a single antenna. EX1002, 42-44.

Other disclosures in Prasad confirm this understanding. EX1003, ¶223. For example, Prasad discloses sending a “control signal” based on the sensor detection to the “antenna system” that “varies and controls [*i.e.*, **adjusts**] the directional transmission & intensity of radiation on the user facing direction.” EX1006, [0027]; *see also id.*, [0026] (distinguishing Prasad’s “active dynamic radiation pattern solution” from the “fixed radiation pattern approach”). Prasad further discloses that the antenna system is “tunable” such that the “structure” of the antenna material “can be **adjusted** in real time, making it possible to reconfigure the structure during

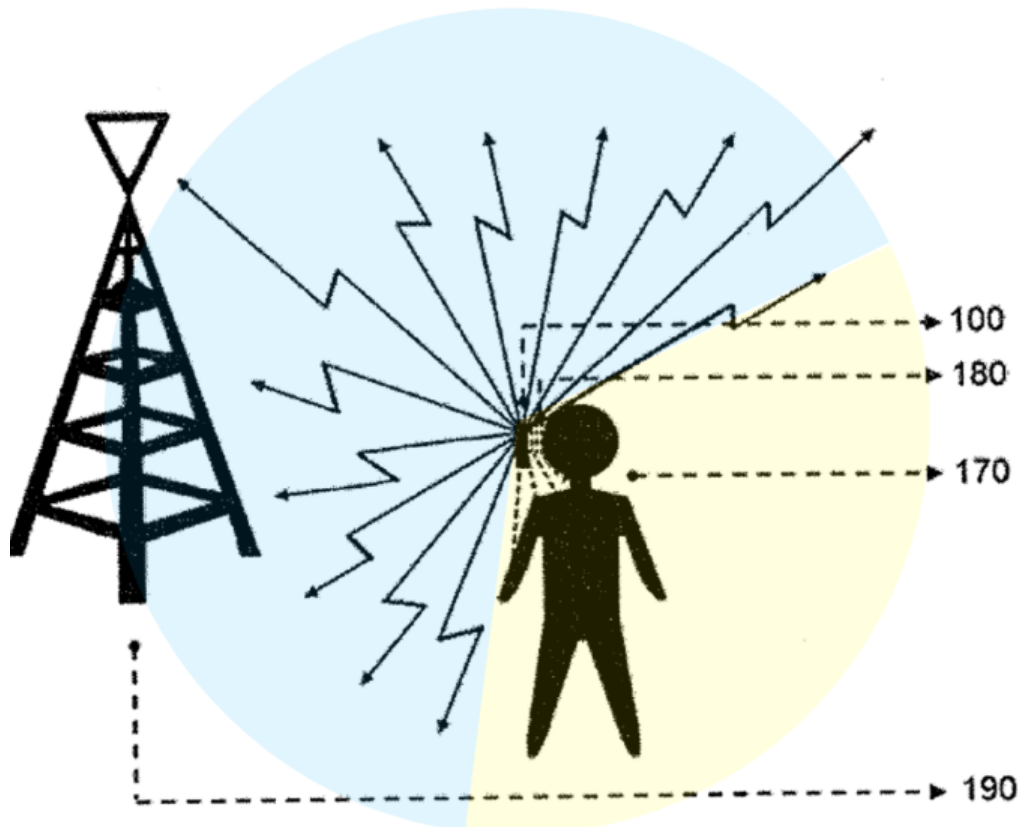
⁴ The ’625 patent specification teaches that a single steerable antenna may itself include multiple “elements” or “antennas.” EX1001, 14:32-43 (“[T]he disclosed invention with **single antenna** which **may have one or more elements or antennas**...may be used in conjunction with other antennas in various switching, phasing, or active or passive combining techniques to form a larger or distributed antenna structure that also works over multiple frequencies.”); 13:35-37 (“**Multiple embedded antenna elements** 75 are usable to provide **a steerable antenna beam.**”).

operation.” *Id.*, [0024]; *see also id.*, [0026] (system can “change and adapt to various radiation patterns which in turn alters the intensity of radiation in required direction and time”). By tuning the structure of the antenna during operation, the system is able to “actively control[] the radiation intensity in required direction and time.” *Id.*; *see also id.*, [0020] (describing the use of a “control signal” to “actively control[] the radiation on required direction facing the user utilising tunable ... antenna system 110”); EX1003, ¶223.

In addition, Prasad consistently discloses that the radiation pattern is determined by a singular “antenna system 110” or “tunable metamaterial or tunable EBG antenna system,” as opposed to multiple selectable antenna structures. *Id.*, [0019]-[0022], [0024], [0027], Fig. 3; EX1003, ¶224.

“to radiate in one or more directions which are not in said zones or spans of directions in the three dimensional space”: Prasad expressly discloses adjusting the radiation pattern of its antenna system to radiate in the directions where the user was ***not*** detected. EX1003, ¶225. For example, Figure 1, reproduced and annotated below, illustrates how the antenna is adjusted to ***radiate in the directions highlighted in blue***, which are ***not the zones or spans of directions where the user is located*** (*i.e.*, the yellow-highlighted zone):

FIGURE. 1



EX1006, Fig. 1; *see also* Fig. 2 (illustrating the same).

Prasad explains that “[t]he radiation protection system is mainly concerned about varying and *reducing the intensity of radiation 180 facing the user 170 while maintaining the radiation on other directions.*” EX1006, [0017]; *see also id.*, [0007] (disclosing “multi mode dynamic radiation patterns for actively varying, controlling and *reducing the intensity of radiation on direction facing the user and accordingly maintaining the radiation on other directions*”). Thus, Prasad’s system “control[s] [the] radiation intensity from wireless device to reduce SAR,” as illustrated by the “dotted lines [180] in the diagram on user facing direction.” *Id.*,

[0017]; EX1003, ¶223. . The antenna continues to radiate in the “other directions,” represented by the solid arrows in Figure 1. EX1006, [0026] (“The present invention provides a fine tuning and controllable radiation on the user facing direction while maintaining the radiation on other direction.”); EX1003, ¶226.

To the extent PO argues that Prasad does not disclose determining zones or spans of direction to avoid (*i.e.*, zones or spans of directions corresponding to a user or other structure), Yin renders this obvious. *See* 1[b]; EX1003, ¶¶227-28.

5. 1[c][ii]

Prasad, alone or in combination with Yin, discloses and renders obvious 1[c][i]. EX1003, ¶229-233.

As discussed in 1[c][i], Prasad’s *steerable antenna is configured to direct energy in particular directions* (*i.e.*, directions where a user is not detected) *while providing nulls or dead zones in other directions* (*i.e.*, directions where a user is detected). EX1003, ¶¶229-230. Specifically, Prasad discloses that its system controls the antenna to “reduc[e] the intensity of radiation 180 facing the user 170 while maintaining the radiation on other directions.” EX1006, [0017]; *see also id.*, [0007], [0018], [0026], Fig. 1, Fig. 2.

As noted above in 1[c][ii] of Ground 1, a POSITA would have understood “nulls” are minima in the radiation pattern, and Prasad’s directional transmission pattern would form minima in the direction of where the external object is located.

See Ground 1, 1[c][ii]; EX1003, ¶231. Yin further confirms that a POSITA would have understood that “nulls” are achieved by reducing or weakening the intensity of radiation in certain directions, as disclosed by Prasad. For example, Yin describes a “**null-forming** technique” that “avoid[s]” certain “directions.” EX1008, 6:6-9; EX1003, ¶232. Yin performs null-forming through “destructive interference,” wherein “signal strength may be *weakened*, in one or more undesirable directions.” EX1008., 6:9-19; EX1003, ¶¶232-233.

6. 1[c][iii]

Prasad, alone or in combination with Yin, discloses and renders obvious 1[c][iii]. EX1003, ¶¶234-237. As discussed in 1[c][i], Prasad discloses adjusting the beam radiation pattern to direct energy to one or more directions that do not correspond to zones or spans where the user is located. EX1006, [0007] (disclosing “dynamic radiation pattern for actively varying, controlling and reducing the intensity of radiation on direction facing the user and accordingly maintaining the radiation on other directions.”). The adjusting step also includes the step of adjusting the beam radiation pattern to avoid the zones or spans of directions where the user is located. *Id.*, [0026] (“[i]nstead of fixed radiation pattern approach the present invention provides an **active dynamic radiation pattern solution that can change and adapt to various radiation pattern** which in turn **alters the intensity of radiation**

in required direction and time according to scenarios to protect user from radiation.”).

As Prasad explains, “[t]he lattice structure of the tuneable metamaterial and EBG is *adjusted in real time*, making it possible to *reconfigure the structure during operation.*” *Id.* An advantage of this is that “[i]nstead of fixed radiation pattern approach the present invention provides an *active dynamic radiation pattern solution that can change and adapt to various radiation pattern* which in turn *alters the intensity of radiation in required direction and time according to scenarios to protect user from radiation.*” *Id.*, [0026]. This steerable antenna is configured to steer radiation energy away from the user and into the areas where the user is not located, thereby created dead zones in the other directions, as illustrated in Figure 1.

To the extent a POSITA looked to Yin to determine the zones to avoid and zones to direct radiation toward, it would have been obvious for a POSITA to use Prasad’s ability to adjust beam radiation patterns of its steerable antenna to radiate in directions that are not in said zones or spans of directions in the three dimensional space (as explained above) based on the determination of zones or spans of directions disclosed in Yin (*see* Section X.C.3, *supra*); EX1003, ¶¶236-237.

7. 1[d]

Prasad in view of Seol discloses and renders obvious 1[d]. Prasad discloses that its “system can be designed to adopt *different multi band antennas*” such as a

“dual band” antenna system that *operates on multiple bands*. EX1006, [0024]; EX1003, ¶¶238-41.

It would have been obvious to a POSITA to operate Prasad’s steerable antenna system to radiate at frequencies in the range of 10 GHz to 500 GHz in view of Seol. EX1003, ¶239. Seol discloses transmitting and receiving signals by “beamforming in a millimeter-wave communication system.” EX1007, 2:27-30; *see also id.*, 5:29-37. A POSITA would have known that mmWave systems operate at frequencies between 30 and 300 GHz, *i.e.*, ***in the range of 10 to 500 GHz***. EX1003, ¶¶239-40; *see also* EX1007, 5:38-42 (example using 60 GHz); EX1015, [0006] (explaining that mmWave systems operate at “a radio frequency of 30 GigaHertz (GHz)-300 GHz”). Seol also discloses that beamforming is implemented using an “antenna array” that “focus[es] signal waves in a specific direction” (*i.e.*, a ***steerable antenna***). EX1007, 5:12-28.

A POSITA would have been motivated to apply Seol’s teachings regarding mmWave band steerable antennas to Prasad’s steerable antenna system, and would have reasonably expected the combination to succeed, for the reasons set forth in Section X.B.

Accordingly, Prasad in view of Seol, and/or Prasad in view of Seol and Yin, discloses and renders obvious the entirety of claim 1. EX1003, ¶241.

D. Claim 2

Claim 2 is obvious over Prasad in view of Seol, and also over Prasad in view of Seol and Yin. Prasad teaches each of the additional alternative steps recited in Claim 2. EX1003, ¶¶242-247.

As to “**capturing one or more images with at least one camera,**” Prasad teaches “[o]ne or more *sensors or cameras* . . . optimally located in the mobile device according to the design for scanning & sensing the environment, . . . scanning & sensing in *multi direction & dimension, computing distance range of user & other environment with respect to device.*” EX1006, Claim 22; *see also id.*, Claim 32 (“utilise active and passive infrared sensors or cameras for sensing the user”).

As to “**detecting ambient light or blockage thereof with at least one light sensor,**” Prasad teaches a “proximity sensor” that can be implemented as an “*ambient light* sensor to sense the change in . . . ambient light level on the environment of the mobile device.” *Id.*, Cl. 22.

As to “**detecting motion of said wireless device with at least one gyroscope,**” Prasad teaches “the sensor system 130 utilises *Gyro sensor*, accelerometer or similar sensor *to actively sense the change in orientation of the wireless mobile device 100 and accordingly control the direction and intensity of radiation on user facing direction.*” *Id.*, [0022]; *see also id.*, Claim 22, [0010].

Although the foregoing is sufficient to satisfy the claim, Prasad also discloses the other types of recited sensors. *Id.*, [0022] (acoustic sensors, capacitive sensors), Claim 22 (microphone).

E. Claim 3

Claim 3 is obvious over Prasad in view of Seol, and also over Prasad in view of Seol and Yin. EX1003, ¶¶248-250.

Seol discloses using different beam patterns for transmission and reception as claimed. *See* Ground 2, Claim 3; EX1007, 9:8-14, Table 1.

A POSITA would have been motivated to apply Seol's teachings regarding transmit and receive beam patterns to Prasad's steerable antenna system, and would have reasonably expected the combination to succeed, for the reasons set forth in Section X.B.

F. Claim 4

Claim 4 is obvious over Prasad in view of Seol, and also over Prasad in view of Seol and Yin. EX1003, ¶¶251-253.

Seol discloses that the MS may receive signals "omni-directionally," *i.e.*, in all directions including those *within the zones or spans of directions of the user*. *See* Ground 1, Claim 4; EX1007, 9:8-14.

A POSITA would have been motivated to apply Seol's teachings regarding transmit and receive beam patterns to Prasad's steerable antenna system, and would

have reasonably expected the combination to succeed, for the reasons set forth in Section X.B.

G. Claim 5

Claim 5 is obvious over Prasad in view of Seol, and also over Prasad in view of Seol and Yin. EX1003, ¶¶251-253. Prasad discloses a “smart RF antenna system” using “*adaptive beamforming, beam steering, switching*, antenna diversity, spatial processing & filtering, spatial diversity, diversity gain, pattern diversity, polarization diversity, reconfigure antenna system & controlling excitation phase to match polarization, multidirectional antenna amplification.” EX1006, Claim 24; EX1003, ¶¶254-255. Prasad further discloses that “the antenna design uses either one or combination of following but not limited to tunable Metamaterials, tunable Electromagnetic Band Gap (EBG) . . . to achieve dynamic radiation pattern, *beamforming, beam steering* etc.” EX1006, [0024].

H. Claim 6

See Claim 3; EX1003, ¶256.

I. Claim 7

Claim 7 is obvious over Prasad in view of Seol, and also over Prasad in view of Seol and Yin. EX1003, ¶¶257-259.

Seol discloses using a “Time Division Duplex (TDD) frame” to divide “synchronization/broadcasting” between a base station and mobile station for beamforming. EX1007, 9:41-47.

A POSITA would have been motivated to apply Seol's teachings regarding Time Division Duplexing to Prasad's steerable antenna system, and would have reasonably expected the combination to succeed, for the reasons set forth in Section X.B.

J. Claim 8

See Claim 4; EX1003, ¶260.

K. Claim 9

See 1[d]; EX1003, ¶261.

L. Claim 10

Claim 10 is obvious over Prasad in view of Seol, and also over Prasad in view of Seol and Yin. EX1003, ¶¶262-264.

Prasad uses the term "active" to convey that its system can adapt as the device moves or the environment changes over time. EX1003, ¶¶262-264. Prasad teaches that "[t]he system *actively sense multiple environments surrounding the device and checks for appropriate space & environment based on* its property, *dimension, direction, range, location, position, device orientation*, diffraction, usage scenarios, operating modes and signal quality parameters *for selecting the best feasible directions to actively shape and optimise the radiation pattern.*" EX1006, Claim 21(e). Prasad further teaches that its solution "primarily focus[es] on multi mode dynamic radiation pattern for *actively* varying, controlling and reducing the intensity of radiation on direction facing the user and accordingly maintaining the radiation

on other directions taking signal quality parameters into account to maintain quality of communication.” *Id.*, [0007]. Prasad further discloses that “[t]he lattice structure of the tunable metamaterial and EBG is adjusted in real time, making it possible to reconfigure the structure during operation.” *Id.*, [0024].

A POSITA would have understood Prasad’s disclosure that the adjustment to the antenna can be “reconfigure[d] . . . during operation” to disclose that that both the beamforming adjustments themselves, and the inputs required for that adjustment (i.e. the “detecting” and “determining” steps) occur multiple times as said one or more parameters change over time. EX1003, ¶263.

M. Claim 11

1. 11[pre]

See 1[pre]; EX1003, ¶265.

2. 11[a]

See 1[a]; EX1003, ¶266.

3. 11[b]

Prasad discloses a “processing unit” that “compute[s] the information from the sensors” and “controls the sensor system.” EX1006, Claim 23; EX1003, ¶¶267-268. For example, the processing unit may be a “*microprocessor*” that “*interact[s] with [the] sensor system.*” *Id.*, [0019].

4. 11[c][i]

Prasad discloses a *steerable antenna*. See 1[pre]. The steerable antenna is in communication with (*i.e.*, *communicatively coupled with*) Prasad's *processor*. EX1003, ¶272. Among other things, Prasad's "processing unit" may "actively shape & optimise the antenna radiation pattern," "compute[] and control[] the antenna system of the communicating devices," and "reconfigure the antenna system in real time. EX1006, Cl. 23; *see also id.*, [0022] (embodiment using microprocessor to "manipulate" a "control signal" to "control[] the radiation pattern" of the antenna).

5. 11[c][ii]

See 1[c][i]-[iii]; EX1003, ¶271.

6. 11[c][iii]

See 1[d]; EX1003, ¶272.

7. 11[d][i]

As discussed above, Prasad discloses a "processing unit" such as a "microprocessor." See 11[b]. A POSITA would have understood that a microprocessor executes instructions (*i.e.*, *executable instructions*) stored in memory (*i.e.*, a *non-transitory computer readable medium*) to perform specific functions. EX1003, ¶¶273-274. Indeed, Prasad expressly discloses that the processing units "utilise[s]" information, such as "[c]orrelation tables or lookup tables" that "are saved in memory of mobile device." EX1006, cl. 23.

8. 11[d][ii]

Prasad discloses that the processing unit/microprocessor *receives and processes information from the sensors*. See 11[a]-[b]; EX1003, ¶275. Prasad further discloses sensors that *detect the orientation of the device in three dimensional space*. See 1[a]; EX1003, ¶¶275-276.

9. 11[d][iii]

Prasad discloses that the processing unit uses the “sensor system parameters” (*i.e., said signals*) for “user recognition ... and environment sensing with dimension and range.” EX1006, cl. 23; EX1003, ¶¶277-278. Prasad, alone or in view of Yin, further discloses that user recognition involves *computing zones or spans of directions corresponding with the user*. See 1[b]; EX1003, ¶¶277-278.

10. 11[d][iv]

Prasad discloses that the processing unit “comput[es] the control signal” used to *adjust the “antenna radiation pattern” to reduce “radiation exposure on user facing direction while maintaining radiations on other directions.”* EX1006, cl. 21; *see also id.*, [0022] (“microprocessor 150 manipulate[s] the ... control signal” to “control[] the radiation pattern”); *see also* 1[c][i]; EX1003, ¶¶279-280.

11. 11[e]

Prasad’s processing unit uses a “*control signal*,” determined “based on signal[s] from ... [the] sensors” to control the *antenna radiation pattern*. EX1006, [0021]; *see also* 11[d][i]-[ii] (discussing how processing unit processes signals from

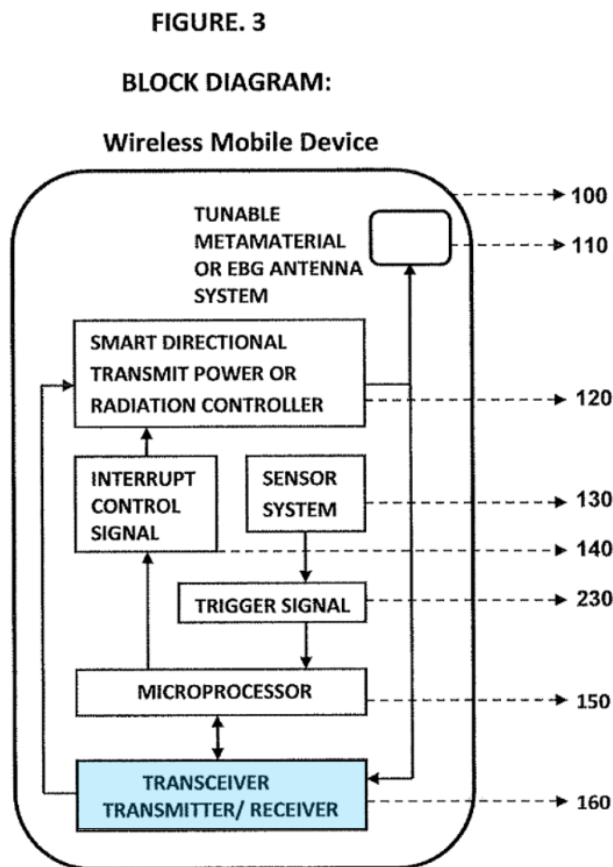
the sensors); 1[c][ii] (discussing radiation pattern of steerable antenna); EX1003, ¶¶281-282.

12. 11[f]

See 1[d]; EX1003, ¶¶279-280.

13. 11[g]

Prasad discloses a wireless device that includes a “*receiver*” portion in its transceiver:



EX1006, Fig. 3. Prasad further discloses incorporating its antenna system in “wireless mobile devices ... utilising [an] RF system.” *Id.* [0007], Abstract. A POSITA would have understood that an “RF system,” including Prasad’s

“receiver,” is designed to receive “over-the-air” signals (*e.g.*, cellular signals). EX1003, ¶¶284-285. Indeed, a receiver capable of receiving over-the-air signals is integral to wireless device operation (*e.g.*, a cellular phone). *Id.*

Accordingly, Prasad in view of Seol, and/or Prasad in view of Seol and Yin, discloses and renders obvious the entirety of claim 11. EX1003, ¶285.

N. Claim 12

Claim 12 is obvious over Prasad in view of Seol, and also over Prasad in view of Seol and Yin. EX1003, ¶¶286-287. Prasad discloses that “the antenna design” of the steerable antenna may use “antenna arrays or diversity with RF system to achieve dynamic radiation pattern, beamforming, beam steering.” EX1006, [0024]; *see also id.*, cl. 24 (reciting an “[a]ntenna system” that uses “MIMO and antenna arrays.” A POSITA would have understood that an “antenna array” is made up of an organized arrangement of *a plurality of steerable antenna* elements, each of which operates an individual antenna. EX1003, ¶286; *see also* EX1007, 5:14-16 (explaining that an “antenna array” comprises a set of “individual antennas ... called antenna elements”).

O. Claim 13

See 1[a]; EX1003, ¶288.

P. Claim 14

See Claim 2 (referring to sensors capable of transducing claimed parameters); EX1003, ¶289.

Q. Claim 15

See Claim 3; EX1003, ¶290.

R. Claim 16

See Claim 4; EX1003, ¶291.

S. Claim 17

See Claim 5; EX1003, ¶292.

T. Claim 18

See Claim 3; EX1003, ¶293.

U. Claim 19

See Claim 7; EX1003, ¶294.

V. Claim 20

See Claim 4; EX1003, ¶295.

W. Claim 21

See 1[d]; EX1003, ¶296.

X. Claim 22

See Claim 10; EX1003, ¶297.

Y. Claim 23

1. 23[pre]

See 1[pre], 11[pre]; EX1003, ¶298.

2. 23[a]

See 1[a], 11[a]; EX1003, ¶299.

3. 23[b]

Prasad discloses a processing unit (“**computation module**”) communicatively coupled to the sensors. *See* 11[b]. The processing module **determines zones or spans of directions** based on sensor signals. *See* 11[d][iii]; EX1003, ¶¶300-301.

4. 23[c]

Prasad in view of Seol renders obvious a steerable antenna that radiates at frequencies in the 10 GHz to 500 GHz range. *See* 1[d]. The antenna is communicatively coupled to the processing unit. *See* 11[c]. The steerable antenna is configured to adjustably radiate beams as recited in the claim. *See* 1[c][i]-[iii]. ; EX1003, ¶¶302-303.

5. 23[d]

See 1[b]; EX1003, ¶304.

6. 23[e]

See 1[c][i]-[ii], 11[c][ii]; EX1003, ¶305.

7. 23[f]

See 1[d]; EX1003, ¶306.

8. 23[g]

See 11[e], 11[g]; EX1003, ¶307.

Z. Claim 24

See Claim 12; EX1003, ¶308.

AA. Claim 25

See Claim 2; EX1003, ¶309.

BB. Claim 26

See Claim 2; EX1003, ¶310.

CC. Claim 27

See Claim 3; EX1003, ¶311.

DD. Claim 28

See Claim 4; EX1003, ¶312.

EE. Claim 29

See Claim 5; EX1003, ¶313.

FF. Claim 30

See Claim 3; EX1003, ¶314.

GG. Claim 31

See Claim 7; EX1003, ¶315.

HH. Claim 32

See Claim 4; EX1003, ¶316.

II. Claim 33

See 1[d]; EX1003, ¶317.

XI. CONCLUSION

Petitioner requests institution of an IPR and cancellation of the Challenged Claims.

Date: September 26, 2025

Respectfully submitted,

By: /s/ James M. Glass

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**CERTIFICATE OF COMPLIANCE WITH
TYPE-VOLUME LIMITATION, TYPEFACE REQUIREMENTS,
AND TYPE STYLE REQUIREMENTS**

1. This Petition complies with the type-volume limitation of 14,000 words, comprising 13,972 words, as counted using the Microsoft Word software that was used to prepare this paper, excluding the parts exempted by 37 C.F.R. § 42.24(a).

2. This Petition complies with the general format requirements of 37 C.F.R. § 42.6(a) and has been prepared using Microsoft® Word 2016 in 14-point Times New Roman.

Date: September 26, 2025

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CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. §§ 42.6(e), 42.105(a), the undersigned hereby certifies service on the PO of a copy of this Petition and its respective exhibits at the official correspondence address for the attorneys of record for the '625 patent as shown in USPTO PAIR via FedEx:

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