

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

VIVINT, INC.,
Petitioner,

v.

FRACTUS S.A.,
Patent Owner,

Patent No. 11,349,200 to Puente Baliarda et al.

Issue Date: May 31, 2022

Title: Multiple-Body-Configuration Multimedia
and Smartphone Multifunction Wireless Device

Inter Partes Review No.: IPR2024-00088

Petition for *Inter Partes* Review of U.S. Patent No. 11,349,200
Under 35 U.S.C. §§311–319 and 37 C.F.R. §42.100 *et seq.*

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TABLE OF EXHIBITS

Exhibit No.	Exhibit Name
1001	U.S. Patent No. 11,349,200
1002	Prosecution History of U.S. Patent No. 11,349,200
1003	Declaration of Manos M. Tentzeris
1004	U.S. Patent Application Publication No. 2004/0125018 (“Ramasamy”)
1005	Final Fractus 4-3 Declaration by Dr. Stuart Long

I. INTRODUCTION

Pursuant to 35 U.S.C. §§311–19 and 37 C.F.R. §42.100 *et seq.*, Petitioner, Vivint, Inc. (“Petitioner”), requests *Inter Partes* review of Claims 11-4, 6-7, 9-13, 15, and 17-20 (the “Challenged Claims”) of U.S. Patent No. 11,349,200 (the “’200 Patent,” EX1001). The Challenged Claims should be found unpatentable and canceled.

II. MANDATORY NOTICES

A. Real Party-In-Interest

Petitioner identifies Vivint, Inc. (Petitioner) as a real party-in-interest (“RPI”). Petitioner is a wholly owned subsidiary of NRG Energy, Inc., but Petitioner does not believe NRG Energy is an RPI for this Petition. Further, Petitioner does not believe that NRG Energy has been involved in any action with respect to the Challenged Claims and is solely being brought to the attention Board based on its ownership status.

B. Related Matters

The ’200 Patent is the subject of the following matter, which may be affected by a decision in this proceeding: *Fractus, S.A. v. Vivint, Inc.*, 2:22-cv-00413 (E.D. Tex.), filed on October 21, 2022 (“Litigation”). The Litigation was consolidated for pre-trial issues with a separate “Lead Case,” *Fractus, S.A. v. ADT LLC*, 2:22-cv-412 (E.D. Tex.), involving similar but separate issues and asserted claims, with only

some overlapping asserted claims.

Petitioner is not aware of any post-grant proceeding before the Office involving the '200 Patent. *See* 37 C.F.R. §§42.8(b)(3), 42.8(b)(4), 42.10(a), and 42.10(b).

C. Lead Counsel, Back-Up Counsel, and Service Information

Pursuant to 37 C.F.R. §§42.8(b)(3) and 42.10(a), Petitioner designates Jared J. Braithwaite (Reg. No. 63,308) as lead counsel and R. Whitney Johnson (Reg. No. 62,997) as back-up counsel.

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

D. Service Information

Per 37 C.F.R. §42.8(b)(4), Petitioner provides the following service information for designated counsel:

Lead Counsel	Back-Up Counsel
Jared J. Braithwaite Reg. No. 63,308 FOLEY & LARDNER LLP 95 South State Street Suite 2500 Salt Lake City, UT 84111 801-401-8900 jbraithwaite@foley.com	R. Whitney Johnson Reg. No. 62,997 FOLEY & LARDNER LLP 95 South State Street Suite 2500 Salt Lake City, UT 84111 801-401-8900 whit.johnson@foley.com

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

III. PAYMENT OF FEES

The required fee is paid by credit card, with authorization to charge any fee deficiencies and credit overpayments to Deposit Acct. No. 19-0741 (Customer No. 22428).

IV. GROUNDS FOR STANDING

Pursuant to 37 C.F.R. §42.104(a), Petitioner certifies that the '200 Patent is available for *Inter Partes* review and that Petitioner is not barred or estopped from requesting *Inter Partes* review on the Grounds identified herein.

V. PRECISE RELIEF REQUESTED

A. Identification of Claims

Pursuant to 37 C.F.R. §§42.22(a)(1) and 42.104(b), the precise relief sought by Petitioner is that the Board review and cancel Claims 1-4, 6-7, 9-13, 15, and 17-20 of the '200 Patent as being unpatentable under 35 U.S.C. §§ 102 or 103, as set forth by this Petition and supported by the Declaration of Dr. Manos M. Tetzeris (Ex. 1003), under the following Grounds:

Ground #	Challenged Claims	Ground
1	1-4, 6-7, 9-13, 15, and 17-20	Ramaswamy renders the Challenged Claims unpatentable.

Petitioner establishes below that the Challenged Claims are unpatentable under the Grounds identified above, including by identifying where each claim element is found in the prior art, to demonstrate that Petitioner has at least a

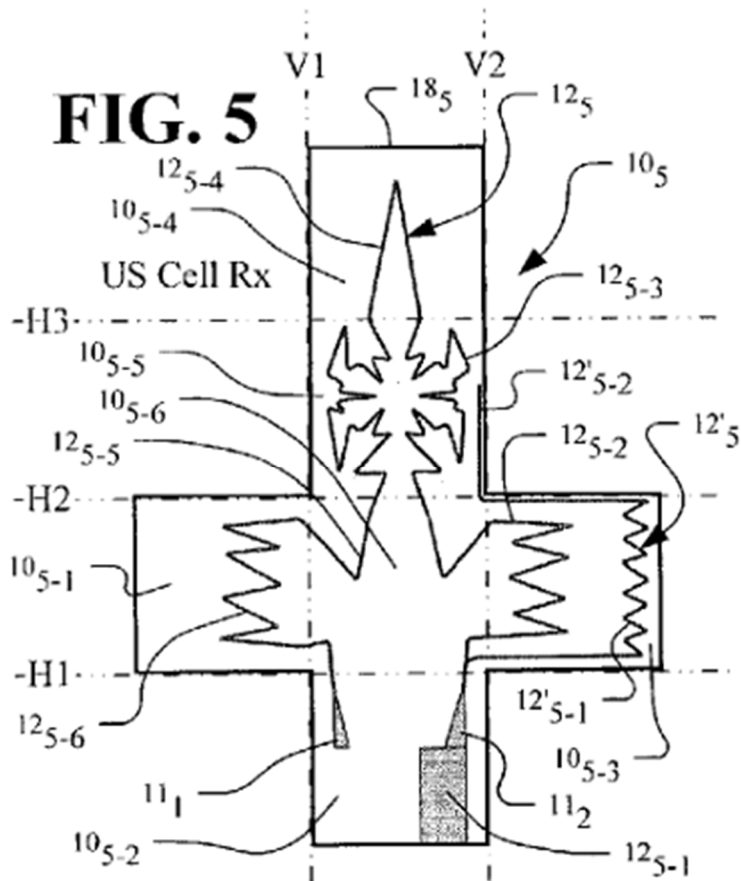
reasonable likelihood of prevailing on these Grounds.

B. Prior Art

1. Ramasamy

U.S. Patent Application Publication No. 2004/0125018 to Ramasamy (Ex. 1004) (“Ramasamy”) published on July 1, 2004, and is prior art under at least 35 U.S.C. §§ 102(a) & (b). Ramasamy was not referenced during prosecution of the ’200 Patent.

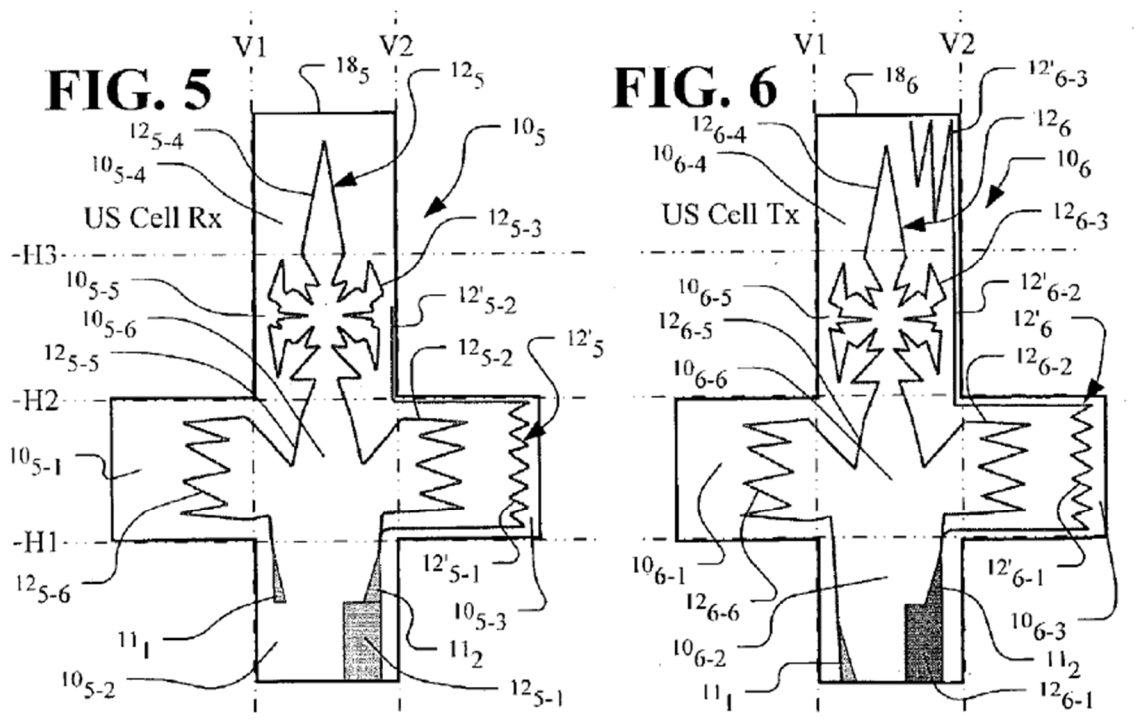
Ramasamy is directed to “[a] compressed antenna in a volume suitable for use in the front ends of small communication devices.” Ex. 1004 at Abstract. Figure 5 of Ramasamy “depicts a schematic top view ... of the unfolded compressed antenna.” Ex. 1004 at para. [0027].



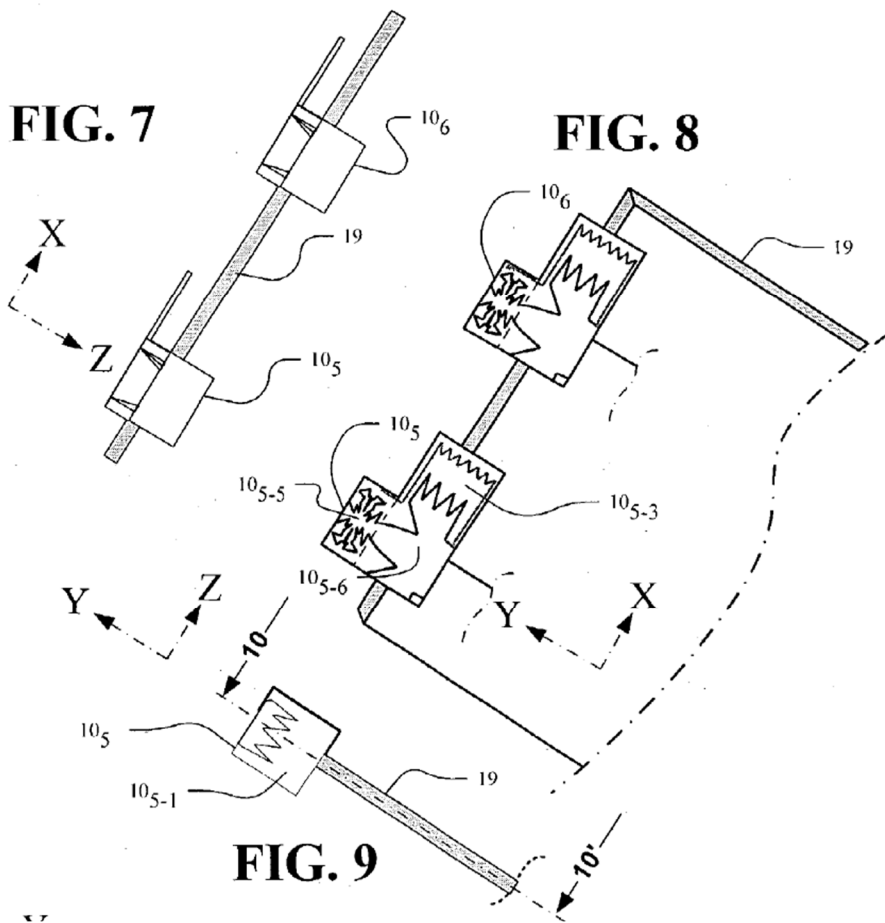
Ramasamy discloses a compressed or folded antenna structure similar to the '200 Patent. *See* Ex. 1004 at para. [0001].

Ramasamy discloses a “compressed antenna in a volume suitable for use in the front ends of small communications devices. The compressed antenna operates for exchanging energy in one or more bands of radiation frequencies. The antenna includes one or more radiation elements formed of segments electrically connected so as to exchange energy in one or more of the bands of the radiation frequencies. The radiation element has segments three-dimensionally arrayed and compressed in a volume.” Ex. 1004 at Abstract.

Ramasamy also discloses using multiple antennas to provide services across multiple wireless services and/or frequency bands. *See* Ex. 1003 at ¶¶47-50, 69-75. For example, Ramasamy discloses two antennas (schematically depicted in Figures 5 and 6) both mounted on the same circuit board as shown in Figures 7-9. Ex. 1004 at [0059]-[0066].



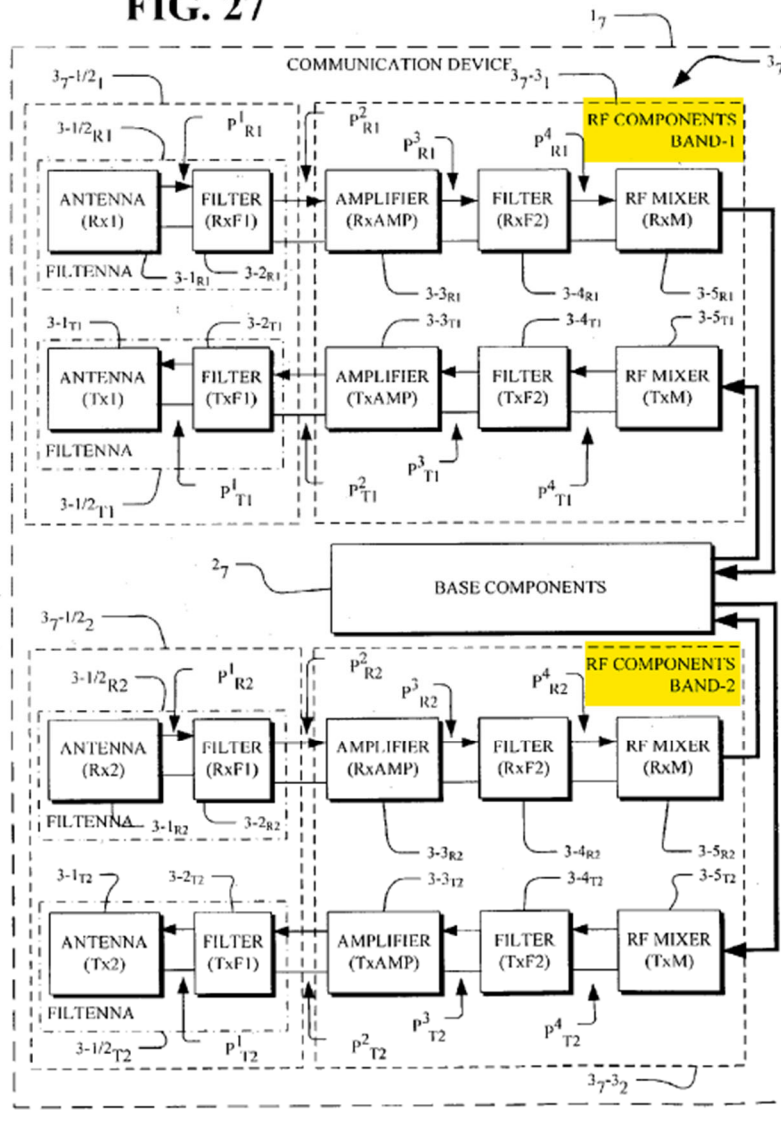
Ex. 1004 at Figs. 5-6.



Ex. 1004 at Figs. 7-9.

In Figure 27, Ramasamy also discloses multiple antennas that provide service across “two different bands, Band-1 and Band-2.” EX1004 at para. [0087].

FIG. 27



Ex. 1004 at Fig. 27 (highlighting added).

Ramasamy also discloses using the antennas to provide service across multiple frequency bands for example disclosing that “[t]he common frequency bands presently employed are US Cell, GSM 900, GSM 1800, GSM1900(PCS)” and gives the following frequency ranges for each of these four frequency bands.

Frequency Ranges	
US Cell	824–894 MHz
GSM 900	890–960 MHz
-continued	
Frequency Ranges	
GSM 1800	1710–1880 MHz
GSM 1900 (PCS)	1850–1990 MHz

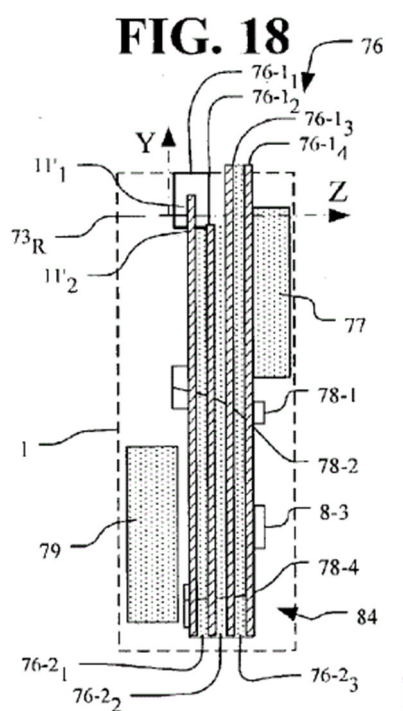
Ex. 1004 at [0004].

Ramasamy further discloses that

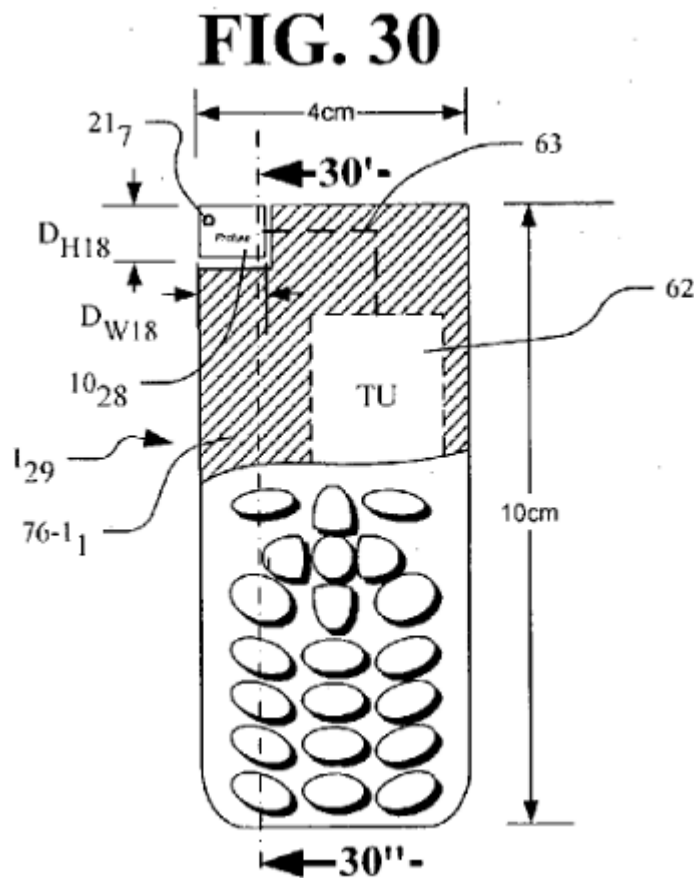
[T]he compressed antenna 10₂₈ operates in allocated frequency spectrums around the world including those of North America, South America, Europe, Asia and Australia. The cellular frequencies are used when the communication device 129 is a mobile phone, PDA, portable computer, telemetering equipment or any other wireless device. The antenna 10₂₈ operates to transmit and/or receive as a tri-band device in frequency bands GSM900, GSM1800 and GSM1900. In other embodiments, compressed antennas operate to transmit and/or receive in allocated frequency bands, for example anywhere from 800 MHz to 2500 MHz.

Ex. 1004 at [0106].

Ramasamy further provides schematics for where the antennas are in relation to the ground plane as shown in figures 18 and 30 for example.



Ex. 1004 at FIG. 18.



Ex. 1004 at Fig. 30.

VI. THE '200 PATENT

A. Specification

The '200 Patent is directed to “[a] multifunction wireless device” which “includes an antenna system.” Ex. 1001, Abstract. The '200 Patent teaches that such multifunction wireless devices (“MFWDs”) have various design constraints that “translate to specific demands for antennas thereof.” Ex. 1001, 1:48-50. For example, the '200 Patent notes various size, shape, and functionality constraints of the antennas facing designers. *See* Ex. 1001, 1:48-2:28. The '200 Patent further notes

that “a simultaneous improvement of all features described above is a major challenge for persons skilled in the art” and that “[a] typical exemplary design problem is the generally uniform line of thinking that due to the limits of diffraction, a substantial increase in gain and directivity can only be achieved through an increase in the antenna size.” Ex. 1001, 2:29-34. The ’200 patent further notes that “[i]n every MFWD, the choice of the antenna, its placement in the device and its interaction with the surrounding elements of the device will have an impact on the overall wireless connection performance making its selection non-trivial and subject to constraints due to particular target use, user and market segments for every device.” Ex. 1001, 2:62-67.

The ’200 Patent teaches that:

All these different design problems of antennas may only be solved in the design of the geometry of the antenna. All parameters such as size, flatness, multi-band operation, broadband operation, gain, efficiency, impedance, radiation patterns, specific absorption rate, robustness and polarization are highly dependent on the geometry of the antenna. Nevertheless, it is practically impossible to identify at least one or two geometric features which affect only one or two of the above-mentioned antenna characteristics. Thus, there is no individual geometry feature which can be identified in order to optimize one or two antenna characteristics, without also influencing all other antenna characteristics.

Any change to the antenna geometry may harm more than it helps without knowing in advance how and why it happens or how it can be avoided.

Ex. 1001 at 4:52-64.

The '200 Patent further notes the various “problems to be solved”:

One problem is solved by providing the MFWD with an RF system and an antenna system with the capability of fully functioning in one, two, three or more communication standards (such as e.g. GSM 850, GSM 900, GSM 1800, GSM 1900, UMTS, CDMA, W-CDMA, etc.), and in particular mobile or cellular communication standards, each standard allocated in one or more frequency bands, each of said frequency bands being fully contained within one of the following regions of the electromagnetic spectrum:

the 810 MHz-960 MHz region,

the 1710 MHz-1990 MHz region,

and the 1900 MHz-2170 MHz region

such that the MFWD is able to operate in three, four, five, six or more of said bands contained in at least said three regions.

One problem to be solved by the present invention is therefore to provide an enhanced wireless connectivity. Another effect of the invention is to provide antenna design parameters that tend to optimize the efficiency of an antenna for a MFWD device while observing the constraints of small device size and enhanced performance characteristics.

Ex. 1001 at 5:5-26.

In an alleged attempt to solve these problems, the '200 Patent teaches applying various geometrical constraints upon antennas to obtain the desired performance. For example, the '200 Patent teaches that “in accordance with embodiments of the invention, the level of complexity of an antenna contour can be advantageously parameterized by means of two complexity factors, hereinafter referred to as F_{21} and F_{32} , which capture and characterize certain aspects of the geometrical details of the antenna contour (such as for instance its edge-richness, angle-richness and/or discontinuity-richness) when viewed at different angles of scale.” Ex., 1001 at 16:64-17:4. The specification then provides the following description as to how the “complexity factor” determination is carried out:

For the computation of F_{21} and F_{32} of a particular antenna, a first, a second, and a third grid (hereinafter called grid G_1 , grid G_2 and grid G_3 respectively) of substantially square or rectangular cells are placed on the antenna rectangle. The three grids are adaptive to the antenna rectangle. That is, the size and aspect ratio of the cells of each one of said three grids is determined by the size and aspect ratio of the antenna rectangle itself. The use of adaptive grids is advantageous because it provides a sufficient number of cells within the antenna rectangle to fully capture the geometrical features of the antenna contour at differing levels of detail.

Moreover, the three grids are selected to span

a range of levels of scale corresponding to two octaves: A cell of grid size G_2 is half the size of a cell of grid G_1 (i.e., a $\frac{1}{2}$ scaling factor or an octave of scale); a cell of grid size G_3 is half the size of a cell of grid G_2 , or one fourth the size of a cell of grid G_1 (i.e., a $\frac{1}{4}$ scaling factor or two octaves of scale). A range of scales of two octaves provides a sufficient variation in the size of the cells across the three grids as to capture gradually from the coarser features of the antenna contour to the finer ones.

Grids G_1 and G_3 are constructed from grid G_2 , which needs to be defined in the first place. As far as the second grid (or grid G_2) is concerned, the size of a cell and its aspect ratio (i.e., the ratio between the width and the height of the cells) are first chosen so that the antenna rectangle is perfectly tessellated with an odd number of columns and an odd number of rows.

Ex. 1001 at 17:5-33.

In order to determine this “complexity factor” for an antenna contour, the ’200 patent teaches the following to create the second grid (“ G_2 ”):

If the antenna rectangle is tessellated with an excessive number of columns, then the size of the resulting cells is much smaller than the range of typical sizes of the features necessary to shape the antenna contour. However, if the antenna rectangle is tessellated with an insufficient number of columns, then the size of the resulting cells is much larger than the range of typical sizes of the features necessary to shape the antenna contour. It has been found that setting to nine

(9) the number of columns that tessellate the antenna rectangle provides an advantageous compromise, for the preferred sizes of an MFWD, and the corresponding available volumes for the antenna system, according to the present invention. Therefore, a cell width (W_2) is selected to be equal to a ninth ($1/9$) of the length of the longer side of the antenna rectangle (W).

Moreover, it is also advantageous to use cells that have an aspect ratio close to one. In other words, the number of columns and rows of cells of the second grid that tessellate the antenna rectangle are selected to produce a cell as square as possible. A grid formed by cells having an aspect ratio close to one is preferred in order to perceive features of the antenna contour using approximately a same level of scale along two orthogonal directions defined by the longer side and the shorter side of the antenna rectangle. Therefore, preferably, the cell height (H_2) is obtained by dividing the length of the shorter side of the antenna rectangle (H) by the odd integer number larger than one (1) and smaller than, or equal to, nine (9), that results in an aspect ratio W_2/H_2 closest to one.

Ex. 1001 at 17:41-18:3.

Next, the '200 patent teaches that the first grid ("G₁") is created from G₂.

This is explained in the disclosure below:

In the particular case that two different combinations of a number of columns and rows of cells of the second grid produce a cell as square as possible, a second grid is selected such that the aspect ratio is larger

than 1.

Thus, the antenna rectangle is tessellated perfectly with 9 by $(2n+1)$ cells of grid G_2 , wherein n is an integer larger than zero (0) and smaller than five (5).

A first grid (or grid G_1) is obtained by combining four (4) cells of the grid G_2 . Each cell of the grid G_1 consists of a 2-by-2 arrangement of cells of grid G_2 . Therefore, a cell of the grid G_1 has a cell width equal to twice (2) the width of a cell of the second grid (W_2) (i.e., $W_1=2\times W_2$); and a cell height (H_1) equal to twice (2) the height of a cell of the second grid (H_2) (i.e., $H_1=2\times H_2$).

Since grid G_2 tessellates perfectly the antenna rectangle with an odd number of columns and an odd number of rows, an additional row and an additional column of cells of said grid G_2 are necessary to have enough cells of the grid G_1 as to completely cover the antenna rectangle.

EX1001 at 18:8-23.

Similarly, the '200 patent teaches that the third grid (" G_3 ") is also created from G_2 . This is explained in the disclosure below:

A third grid (or grid G_3) is readily obtained by subdividing each cell of grid G_2 into four cells, with each of the cells having a cell width (W_3) equal to one half ($\frac{1}{2}$) of the width of a cell of the second grid (W_2) (i.e., $W_3=\frac{1}{2}\times W_2$); and a cell height (H_3) equal to one half ($\frac{1}{2}$) of the height of a cell of the second grid (H_2) (i.e., $H_3=\frac{1}{2}\times H_2$).

Therefore, since each cell of the grid G_2 is replaced with 2-by-2 cells of the grid G_3 , then 18 by $(4n+2)$ cells of grid G_3 are thus required

to tessellate completely the antenna rectangle.

EX1001 at 19:62-20:5.

The '200 patent then teaches computing the “complexity factor” F_{21} and the “complexity factor” F_{32} using these grids. The first step is to determine three different “N” values – one for each grid. In this regard, the '200 patent teaches the following:

The complexity factor F_{21} is computed by counting the number of cells N_1 of the grid G_1 that are at least partially inside the antenna rectangle and include at least a point of the antenna contour (in the present invention the boundary of the cell is also part of the cell), and the number of cells N_2 of the grid G_2 that are completely inside the antenna rectangle and include at least a point of the antenna contour, and then applying the following formula:

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

Ex. 1001 at 19:13-25.

The '200 Patent further discloses how to calculate the F_{32} number:

The complexity factor F_{32} is computed by counting the number of cells N_2 of grid G_2 that are completely inside the antenna rectangle and include at least a point of the antenna contour, and the number of cells

N_3 of the grid G_3 that are completely inside the antenna rectangle and include at least a point of the antenna contour, and applying then the following formula:

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

Ex. 1001 at 20:5-17.

The '200 patent further teaches that:

The complexity factors F_{21} and F_{32} span a two-dimensional space on which the antenna contour of the antenna system of the MFWD 100 is mapped as a single point with coordinates (F_{21} , F_{32}). Such a mapping can be advantageously used to guide the design of the antenna system by tailoring the degree of convolution of the antenna contour until some preferred values of the factors F_{21} and F_{32} are attained, so that the resulting antenna system: (a) provides the required number of frequency bands in which the MFWD operates; (b) meets MFWD size and/or integration constraints; and/or (c) enhances the RF performance of the antenna system and/or that of the MFWD in at least one of the frequency bands of operation.

Ex. 1001 at 20:40-52.

The '200 patent teaches a multitude of different “minimum and maximum values” for the complexity factors that “can be selected from” the long provided

lists of “1.10, 1.15, 1.20, 1.25, 1.30, 1.35, 1.40, 1.45, 1.50, 1.55, 1.60, 1.65, 1.70, 1.75, 1.80, 1.85, and 1.90” for F_{32} and “1.05, 1.10, 1.15, 1.20, 1.25, 1.30, 1.35, 1.40, 1.45, 1.50, 1.55, 1.60, 1.65, 1.70, 1.75, and 1.80” for F_{12} . Ex. 1001 at 21:11-21.

The '200 patent teaches that the claimed MFWD provide service for various wireless standards including what it labels as “4G”, which it defines as “comprising 3G and other advanced services such as for instance HSDPA, WiBro, WiFi, WiMAX, UWB or other high-speed wireless standards” and it defines as including “bands within the frequency region 2-11 GHz and some of its sub-regions such as for instance 2-11 GHz, 3-10 GHz, 2.4-2.5 GHz and 5-6 GHz or some other bands.” Ex. 1001 at 25:15-23.¹

B. Prosecution History

The application from which the '200 Patent issued (No. 17/246,192) was filed on April 30, 2021. As part of the application, the applicant filed 23 different Information Disclosure Statements (“IDS”) that identified hundreds of potential prior art references. *See* Ex. 1002 at 581-85.

¹ As explained by Dr. Tentzeris, this definition by the '200 Patent is at odds with the traditional applications of the “4G” moniker which does not include, for example, WiFi. Ex. 1003 at ¶84.

On August 2, 2021, Applicant provided an amendment canceling all twenty pending claims and providing a new twenty claims for consideration. *See id. at* 561-67. On March 17, 2022 the Examiner issued a Notice of Allowance without any rejections. Ex. 1002 at 24-26. The Applicant made a minor amendment on March 25, 2022 following the Notice of Allowance, which the Examiner entered on April 8, 2022. Ex. 1002 at 8, 16. The patent lists on its face May 31, 2022 as the “Date of Patent.” Ex. 1001.

VII. LEVEL OF ORDINARY SKILL IN THE ART

According to the Patent Owner in the Litigation, a person of ordinary skill in the art (“POSITA”) as of the earliest claimed priority date of July 18, 2006² would have had “at least a bachelor’s degree in electrical engineering, computer science, or a similar degree and at least four years of experience in applied electromagnetics with an emphasis on antennas” or “[a]lternatively, the person of ordinary skill in the art would have a master’s degree in electrical engineering (or similar discipline) and at least two years of similar experience.” Ex. 1005 at ¶32.³

² While not disputed for purposes of the asserted Grounds, Petitioner reserves the right to dispute the priority claim of the Challenged Claims in other proceedings.

³ While not disputed for purposes of the asserted Grounds, Petitioner reserves the right to dispute the Patent Owner’s asserted description of the level of ordinary skill in the art.

VIII. CLAIM CONSTRUCTION

A claim is construed in an IPR proceeding using the standard set forth in *Phillips v. AWH Corp.*, 415 F.3d 1303, 1316-1317 (Fed. Cir. 2005) (en banc). 37 C.F.R. §42.100(b). Except as discussed specifically below, Petitioner submits that the Board need not specially construe any terms of the Challenged Claims to institute IPR because they are shown to be anticipated and/or obvious regardless of construction. *Toyota Motor Corp. v. Cellport Sys., Inc.*, IPR2015-00633, Paper 11, 16 (PTAB Aug. 14, 2015). Petitioner reserves all rights to raise claim construction and related challenges under 35 U.S.C. §112 in other proceedings.

IX. GROUNDS OF UNPATENTABILITY

As established below, all features of the Challenged Claims were well known in the prior art.

A. Ground 1:

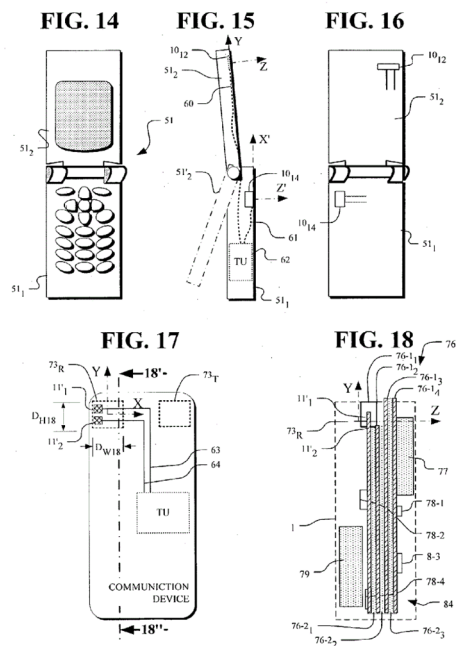
Claims 1-4, 6-7, 9-13, 15, and 17-20 of the '200 Patent are anticipated by Ramasamy or are obvious in view of Ramasamy.

1. Claim 1

i. 1(pre) “a wireless device comprising”

To the extent the preamble is limiting, Ramasamy discloses this claim limitation. For example, the following passages and figures (and their corresponding disclosures) disclose a wireless device (i.e., a wireless “flip-top”

cellular phone):



Ramasamy, FIGS. 14-18

Ramasamy explains that:

FIG. 14 depicts a top view of a flip-top phone communication device using antennas in accordance with the present invention.

FIG. 15 depicts an end view of the communication device of FIG. 14 cut away to reveal the antennas.

FIG. 16 depicts a top view of the communication device of FIG. 14 cut away to reveal the antennas.

FIG. 17 depicts a top view of another communication device cut away to reveal the antennas inside.

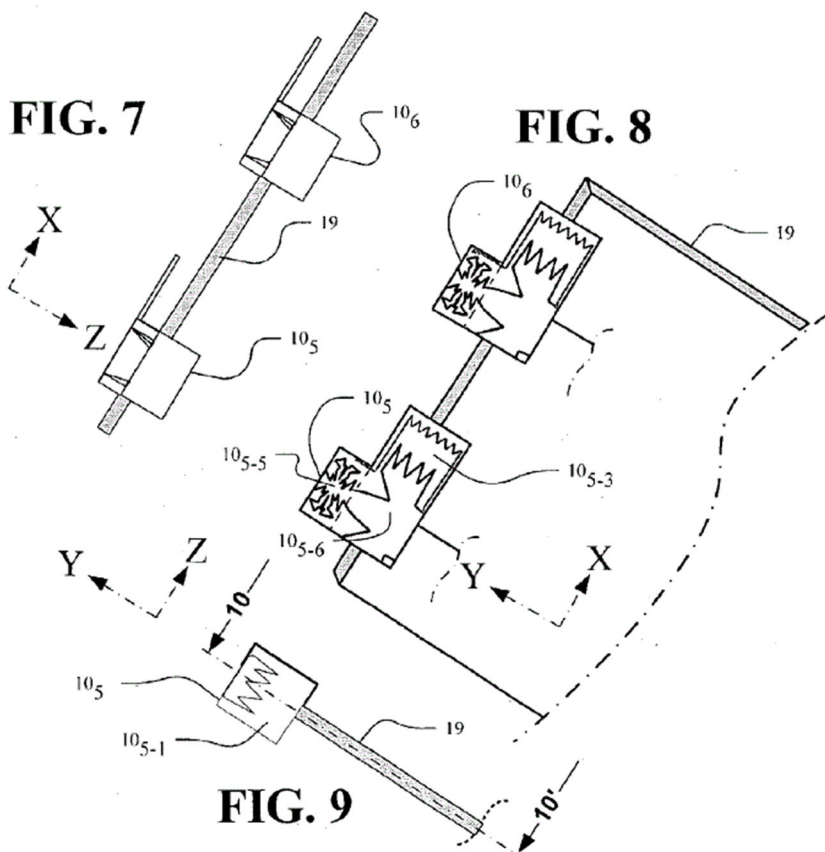
FIG. 18 depicts an end sectional view of the communication device of FIG. 17 that reveals an antenna.

Ex. 1004 paragraphs [0036]-[0040].

One of ordinary skill would find this limitation disclosed in the teachings of Ramasamy and its incorporated disclosures taken as a whole. Ex. 1003 at ¶¶53-56.

- ii. 1(a) “an antenna system comprising a ground plane and at least two antennas within the wireless device, the antenna system comprising:”

Ramasamy discloses this claim limitation. For example, the following figures and their corresponding written description disclose an antenna system having a ground plane and two antennas within the wireless device:



Ramasamy, FIGS. 7-9

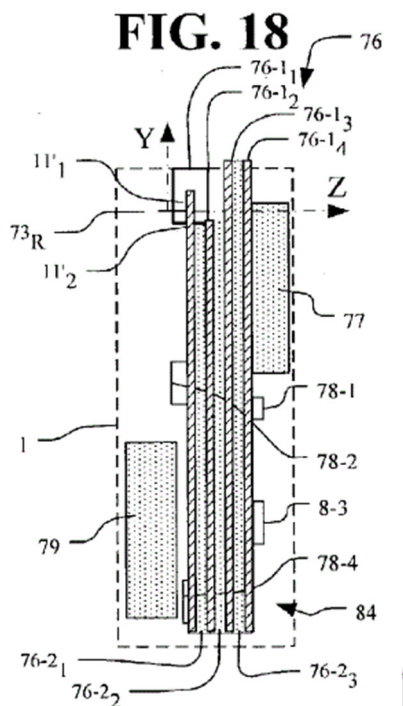
Ramasamy teaches that “FIG. 7 depicts an end view of the antennas 10₅ and 10₆ of FIG. 5 and FIG. 6 folded and mounted on the end of a circuit board 19.”

Ex. 1004 at para. [0064]. Ramasamy further teaches that “FIG. 8 depicts an isometric view of the antennas 10 and 10₆ of FIG. 5 and FIG. 6 folded and mounted on the end of a circuit board 19. The regions 10₅₋₃ is not folded and lies in the same plane as region 10₅₋₆ folded normal to the plane of regions 10₅₋₃ and 10₅₋₆.” Ex. 1004 at para. [0065]. Ramasamy also teaches that “FIG. 9 depicts a front view of the antenna 10₅ of FIG. 5 folded and mounted on the end of a circuit board 19 with region 10₅₋₁ exposed.” Ex. 1004 at para. [0066].

In addition, with reference to Figure 17, Ramasamy explains that “communication device 1 is typically a cell phone, pager or other similar communication device that can be used in close proximity to people with antennas of the present invention,” and adds that “communication device 1 is typically a mobile telephone of small volume, for example, of approximately 4 inches by 2 inches by 1 inch, or smaller, and the antennas, such as described in the present invention, readily fit within such small volume.” Ex. 1004 at para. [0076] (emphasis added). The reference, therefore, explicitly teaches that the antennas are within the wireless device, as claimed by the ’200 patent.

Ramasamy also teaches that the antenna system comprises a ground plane in addition to at least two antennas. In particular, with reference to Figure 18, Ramasamy explains that “a circuit board 76 includes, by way of example, an outer conducting layer 76-1₁, internal conducting layers 76-1₂ and 76-1₃, internal

insulating layers 76-2₁, 76-2₂ and 76-2₃, and another outer conducting layer 76-1₄.” Ex. 1004 at para [0078]. Ramasamy further teaches that “the layer 76-1₁ is a ground plane and the layer 76-1₂ is a power supply plane,” that “printed circuit board 76 supports the electronic components associated with the communication device 1 including a display 77 and miscellaneous components 78-1, 78-2, 78-3 and 78-4,” and “[t]he antennas 73_R and 73_T are mounted or otherwise coupled to the printed circuit board 76 by solder or other convenient connection means.” *Ramasamy*, paragraph [0078].” Ex. 1004 at para. [0078]. As shown clearly in Figure 18 and described in the corresponding written description, the ground plane of the antenna system of Ramasamy is runs along the printed circuit board of the wireless device. Ex. 1003 at ¶ 60.



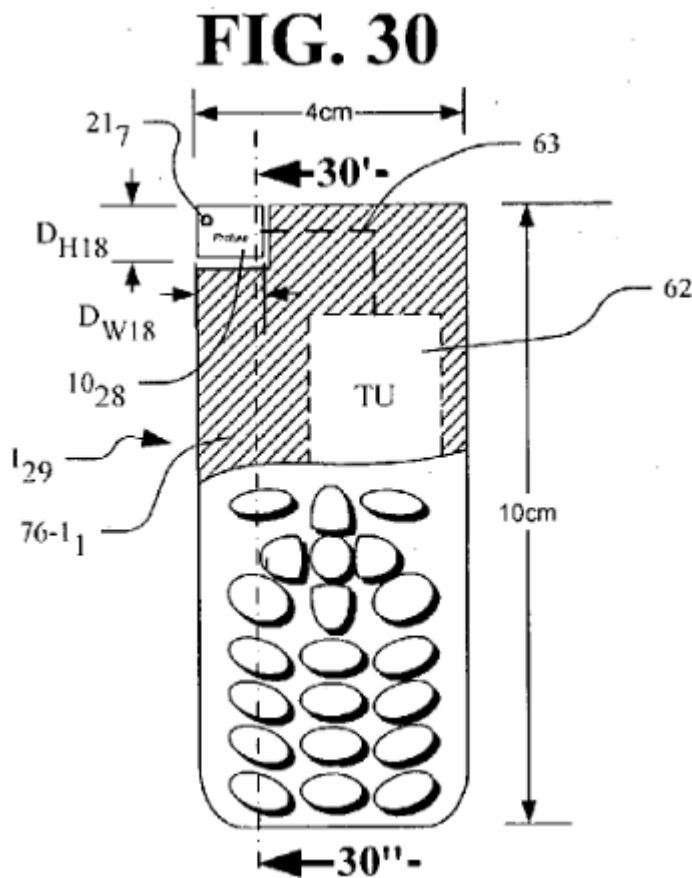
Ramasamy, FIG. 18

Further, as explained by Dr. Tetzeris, the ground plane of Ramasamy would have been apparent to a POSITA as a ground plane is a basic feature in antenna design. Ex. 1003 at ¶60.

One of ordinary skill would find this limitation disclosed in the teachings of Ramasamy and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1003 at ¶¶57-61.

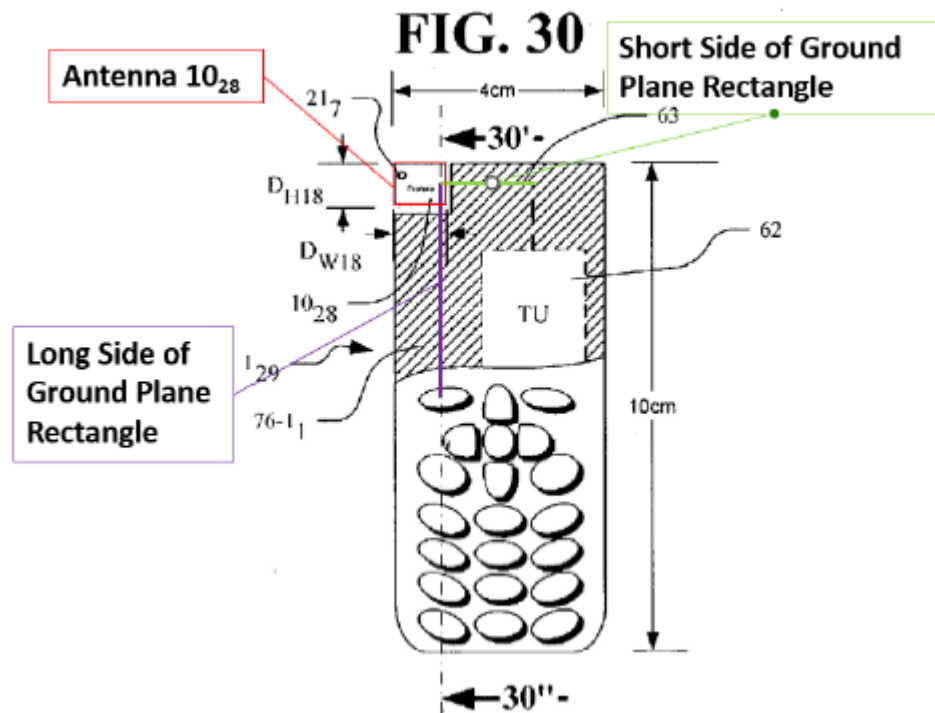
iii. 1(b) “a first antenna proximate to a first short side of a ground plane rectangle enclosing the ground plane,”

Ramasamy discloses this claim limitation. As shown immediately above, layer 76-1₁ in Ramasamy is a ground plane and the layer 76-1₂ is a power supply plane. Figure 30, reproduced below, shows a front view of the wireless device, including a front view of the ground plane. Ex. 1004 at paras. [0053] & [0105].



The '200 patent teaches that “a ground plane rectangle is defined as being the minimum-sized rectangle that encompasses the ground plane of the antenna system included in the PCB of the MFWD 100 that comprises the feeding means responsible for the operation of the antenna system in its lowest frequency plane.” EX1001 at 14:37-42. It goes on to state, “the ground plane rectangle is a rectangle whose edges are tangent to at least one point of the ground plane.” EX1001 at 14:42-44. Accordingly, any rectangle with each side touching at least one point of the ground plane would meet the definition of a ground plane rectangle in the '200 patent. Ex. 1003 at ¶64.

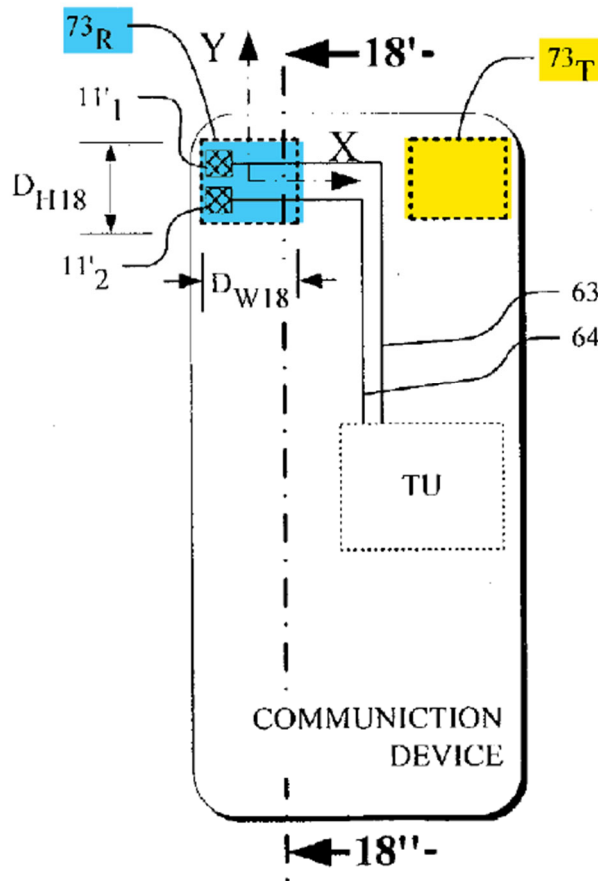
Ramasamy clearly discloses a first antenna proximate to a first short side of a ground plane rectangle enclosing the ground plane. For example, as shown in the annotated version of Figure 30 of Ramasamy below, antenna 10₂₈ (in red) is positioned at the corner of the ground plane 76-1₁, meaning that the antenna in this embodiment is proximate to both the short side (in green) and the long side (in purple) of the ground plane rectangle as the ground plane rectangle has edges that are tangent to the top side and the left side of the ground. Ex. 1003 at ¶65.



Ex. 1004 at Fig. 30 (annotated).

Similarly, Figure 17 of Ramasamy shows two antennas – labeled 73R and 73T – both positioned along the corners of the ground plane rectangle.

FIG. 17



Ex. 1004 at Fig. 17 (highlighting added).

Therefore, Ramasamy discloses a first antenna proximate to a first short side of a ground plane rectangle enclosing the ground plane. Ex. 1003 at ¶¶62-67.

- iv. **1(c) “the first antenna being configured to support at least three frequency bands contained within first and second frequency ranges of the electromagnetic spectrum”**

The first antenna of Ramasamy is also configured to support at least three frequency bands contained within first and second frequency ranges of the

electromagnetic spectrum.

As explained by Dr. Tentzeris, a POSITA would recognize that Ramasamy's antennas systems are designed for use with at least three frequency bands. Ex. 1003 ¶ 69.

For example, Ramasamy discloses that “[t]he common frequency bands presently employed are US Cell, GSM 900, GSM 1800, GSM1900(PCS)” and gives the following frequency ranges for each of these four frequency bands.

Frequency Ranges	
US Cell	824–894 MHz
GSM 900	890–960 MHz
-continued	
Frequency Ranges	
GSM 1800	1710–1880 MHz
GSM 1900 (PCS)	1850–1990 MHz

EX1004 at para. [0004].

Thus, as described below, Ramasamy's disclosures regarding the first antenna system operates in “allocated frequency spectrums around the world” explicitly discloses said antenna system operating in the four frequency bands discussed above. Ex. 1004 at para. [0106].

As another example, with respect to Figure 17, Ramasamy further teaches

that:

[T]he antenna 73R is typically a compressed antenna that lies in an XYZ-volume. Such antennas operate in allocated frequency spectrums around the world including those of North America, South America, Europe, Asia and Australia. The cellular frequencies are used when the communication device 1 is a mobile phone, PDA, portable computer, telemetering equipment or other wireless device.

Ex. 1004 at para. [0077].

Ramasamy further teaches that “[t]he antennas operate to transmit and/or receive in allocated frequency bands, for example, bands within the range from 800 MHz to 2500 MHz.” Ex. 1004 at para. [0077].

Ramasamy also teaches that:

the compressed antenna 10₂₈ operates in allocated frequency spectrums around the world including those of North America, South America, Europe, Asia and Australia. The cellular frequencies are used when the communication device 129 is a mobile phone, PDA, portable computer, telemetering equipment or any other wireless device. The antenna 10₂₈ operates to transmit and/or receive as a tri-band device in frequency bands GSM900, GSM1800 and GSM1900. In other embodiments, compressed antennas operate to transmit and/or receive in allocated frequency bands, for example anywhere from 800 MHz to 2500 MHz.”

Ex. 1004 at para. [0106].

This disclosure explicitly lists three frequency bands contained within first and second frequency ranges of the electromagnetic spectrum that are supported by the antenna of Ramasamy. Ex. 1003 at ¶¶69-73.

Figure 27 of Ramasamy further discloses another embodiment having multiple antennas (Rx1 and Rx2) operating in different bands (“Band-1” and “Band-2”). *See* Ex. 1004 at Fig. 27; paras. [0087]-[0093].

Bands within the ranges of 800 MHz to 2500 MHz also include at least three frequency bands contained within first and second frequency ranges of the electromagnetic spectrum, as recited in claim 1 of the '200 patent. For example, as would be readily known to a person of skill in the art, in Europe, the primary GSM frequency bands are 900 MHz and 1800 MHz, while in North America, the primary frequency bands are 850 MHz and 1900 MHz. Ex. 1003 at ¶75. These bands are further divided into smaller sub-bands, which are used to provide coverage in specific geographic areas. Ex. 1003 at ¶75. For example, for WCDMA, networks primarily utilize the frequency bands within the range of 850/1900 MHz, and 900/2100 MHz. Ex. 1003 at ¶75.

One of ordinary skill would find this limitation disclosed in the teachings of Ramasamy and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1003 at ¶¶68-76.

v. 1(d) “the second frequency range being higher in frequency than the first frequency range”

Ramasamy discloses this claim limitation. As explained above, Ramasamy discloses several frequency bands in multiple frequency ranges. A person of ordinary skill would understand that those different ranges necessarily are higher and lower compared to one another. Ex. 1003 at ¶78. Again, Ramasamy teaches that

Such antennas operate in allocated frequency spectrums around the world including those of North America, South America, Europe, Asia and Australia. The cellular frequencies are used when the communication device 1 is a mobile phone, PDA, portable computer, telemetering equipment or other wireless device. The antennas operate to transmit and/or receive in allocated frequency bands, for example, bands within the range from 800 MHz to 2500 MHz.

Ex. 1004 at para [0077].

Bands at 2500 MHz range are greater than bands at the 800 MHz range, and they fall in higher and lower frequency ranges, respectively. Ex. 1003 at ¶79.

One of ordinary skill would find this limitation disclosed in the teachings of Ramasamy and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1003 at ¶¶77-80.

vi. 1(e) “the first antenna being configured to transmit and receive signals from a 4G communication standard”

Ramasamy discloses this claim limitation as interpreted by the Patent Owner. Specifically, the Patent Owner apparently contends that receiving signals “from a 4G communication standard” is the same as receiving signals that operate according to what the 200 patent includes among a 4G communication standard.” Ex. 1005, ¶37. As explained above, signals, including those identified by the ’200 patent as among 4G communication standard signals, are transmitted and received in various bands depending on geographic location, and those bands fall within the ranges disclosed in Ramasamy. Ex. 1003 at ¶¶69-75, 82. Therefore, the antenna of Ramasamy is configured to transmit and receive signals from a 4G communication standard. Ex. 1003 at ¶82.

Again, Ramasamy discloses that “[t]he antennas operate to transmit and/or receive in allocated frequency bands, for example, bands within the range from 800 MHz to 2500 MHz.” Ex. 1004, para. [0077]. The 800-2500 MHz range includes ranges used by LTE as well as ranges falling within “4G” as described in the ’200 patent. Ex. 1003 ¶83; Ex. 1001 at 25:14-23.

In addition, it bears noting that the ’200 patent includes “3G and other advanced services for instance HSDPA, WiBro, WiFi, WiMax, UWB or other high speed wireless standards,” as among those referred to by the ’200 patent as

“4G services” and “might require operation in additional frequency bands corresponding to said 4G standards (for instance, bands within the frequency region 2-11 GHz and some of its sub-regions such as for instance 2-11 GHz, 3-10 GHz, 2.4-2.5 GHz and 5-6 GHz or some other bands).” Ex. 1001, 25:14-23. The ’200 patent further states that “4G” includes technologies such as 3G, WiFi, WiMax “or other high speed wireless standards.” *Id.*⁴ Certainly, the invention of Ramasamy is configured to transmit and receive such high speed signals within the broad scope of the definition of “4G” provided in the ’200 patent. Ex. 1003 at ¶¶84-85.

One of ordinary skill would find this limitation disclosed in the teachings of Ramasamy and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1003 at ¶¶81-86.

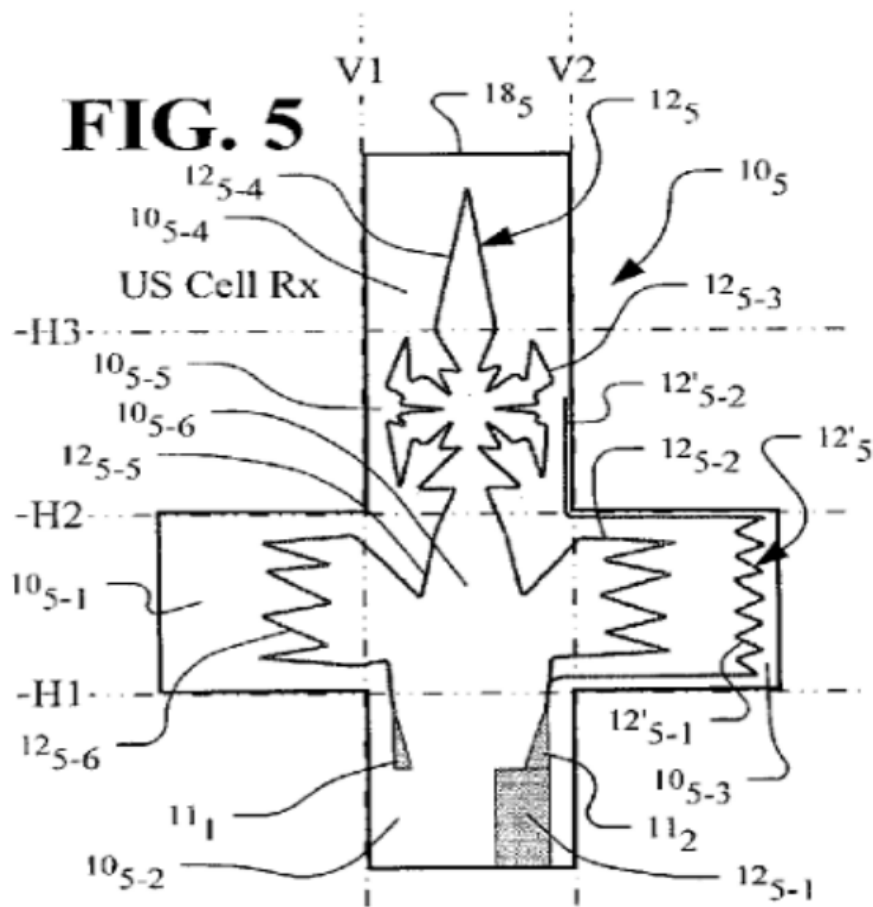
vii. 1(f) “the first antenna defining a first antenna contour comprising an entire perimeter of the first antenna, wherein the first antenna contour has a level of

⁴ As noted above, Dr. Tentzeris explained that this definition by the ’200 Patent is at odds with the traditional applications of the “4G” moniker which does not include, for example, 3G or WiFi. EX1003 at ¶84. However, “the inventor’s lexicography governs” if the specification “reveal[s] a special definition given to a claim term by the patentee that differs from the meaning it would otherwise possess.” *Phillips v. AWH Corp.*, 415 F.3d 13016 (Fed. Cir. 2005). That is not to say that the description in the ’200 patent for “4G” is reasonably certain, and, in the Litigation, Petitioner asserts that “4G communication standard” would not have a reasonably certain meaning at the time of the invention and is therefore indefinite.

complexity defined by complexity factor F_{21} having a value of at least 1.20 and complexity factor F_{32} having a value of at least 1.35; and”

Ramasamy discloses this claim limitation. As explained by Dr. Tentzeris, a POSITA would have recognized that the value of the complexity factors of Ramasamy's antenna systems meets this limitation. Ex. 1003 at ¶85.

For example, Figure 5 of Ramasamy discloses an antenna defining a first antenna contour comprising an entire perimeter of the antenna and having the following shape:

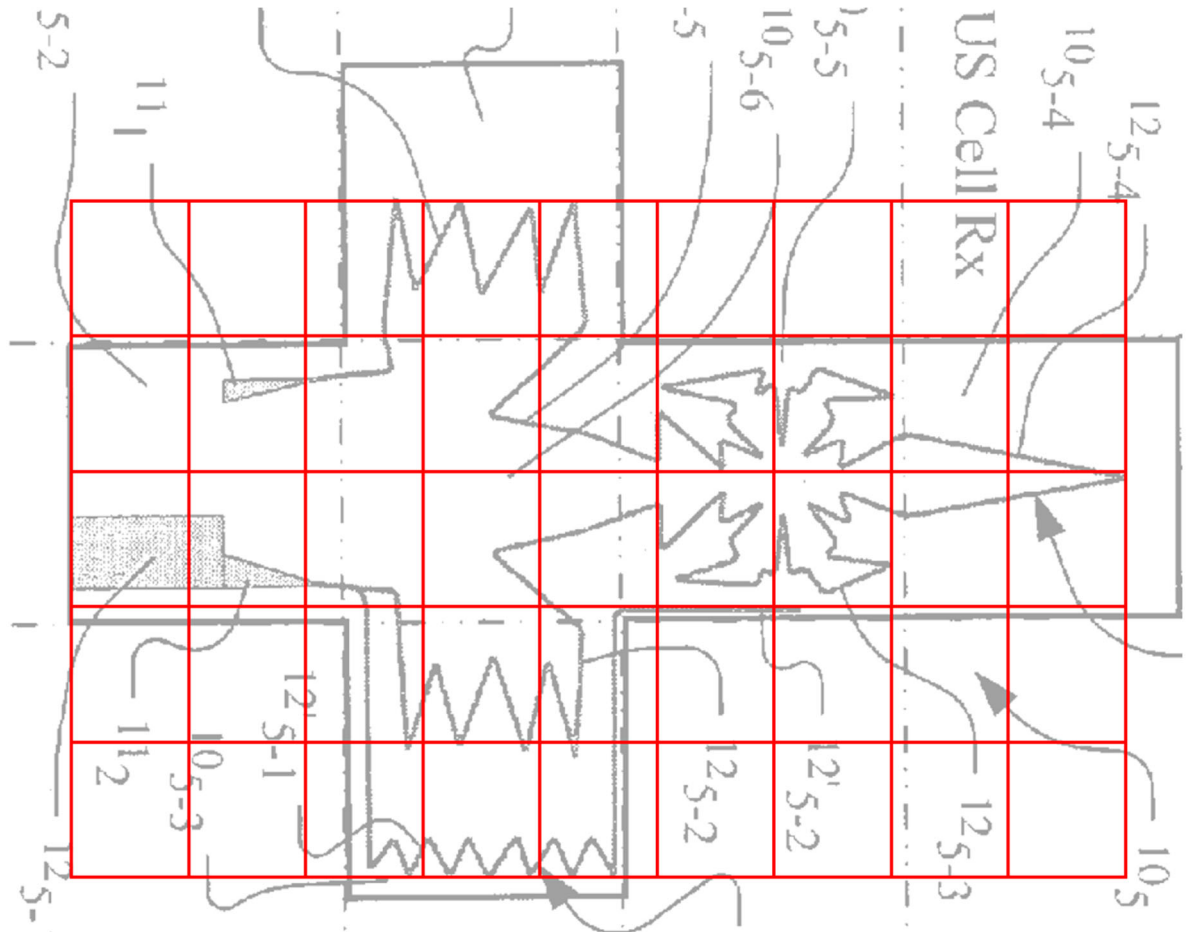


Ex. 1004, Fig. 5.

As explained above, the '200 Patent provides instructions for how to calculate the claimed “complexity factors” for an antenna.⁵

Per the '200 Patent, in order to determine the “complexity factor” for the antenna contour of the system disclosed in Ramasamy, the first step is to perfectly tessellate the antenna rectangle nine columns and a number of rows (that is odd and greater than one and less than or equal to nine) that results in an aspect ratio closest to one, in order to create the second grid (“G₂”). *See* Ex. 1001 at 17:26-18:3. This has been done below, where the antenna of Figure 5 has been tessellated into a 9x5 grid.

⁵ It appears that different complexity factor calculations could be carried out on the same antenna shape using the methods described in the '200 patent. For at least this reason, Petitioner believes that the claim term is indefinite. Nevertheless, for the purposes of the present Petition, one such calculation is provided to show that the contour of the antenna of Ramasamy meets the “complexity factor” limitations of this claim.



Ramasamy, FIG. 5 (annotated, tessellated into G₂, 9x5 grid).

In the annotated figure above, the Ramasamy antenna is in an unfolded state to show the tessellation. This is consistent with the patent owner’s infringement allegations in the Litigation, where Patent Owner created grid layouts by unfolding the antennas in the accused products to calculate complexity factors.

The complexity factor calculations could also be conducted on the antenna of Ramasamy in a folded state. Based on such an analysis, the “complexity factor” F_{21} and the “complexity factor” F_{32} would yield results that are at least 1.20 and 1.35 respectively. *See* Ex. 1003 at ¶92.

For example, folding section 10₅₋₄ and 10₅₋₅ perpendicular to sections 10₅₋₁ and 10₅₋₃ will dramatically reduce the amount of unused space in the antenna rectangle (i.e. cells that do not contain any part of the antenna contour). For instance, in the demonstrative figure above of the unfolded antenna using the G₂ grid, 12 of 18 cells that do not contain any part of the antenna contour would be eliminated by folding those sections (depicted in red in the figure below). This would increase the density of the antenna contour within the grid, thereby increasing the complexity factor. For purposes of the demonstrative figures, the analysis shows the unfolded antenna, but the same analysis can be equally applied to a folded antenna with consistent results. Ex. 1003 at ¶92.

This is explained in the disclosure below:

Thus, the antenna rectangle is tessellated perfectly with 9 by $(2n+1)$ cells of grid G_2 , wherein n is an integer larger than zero (0) and smaller than five (5).

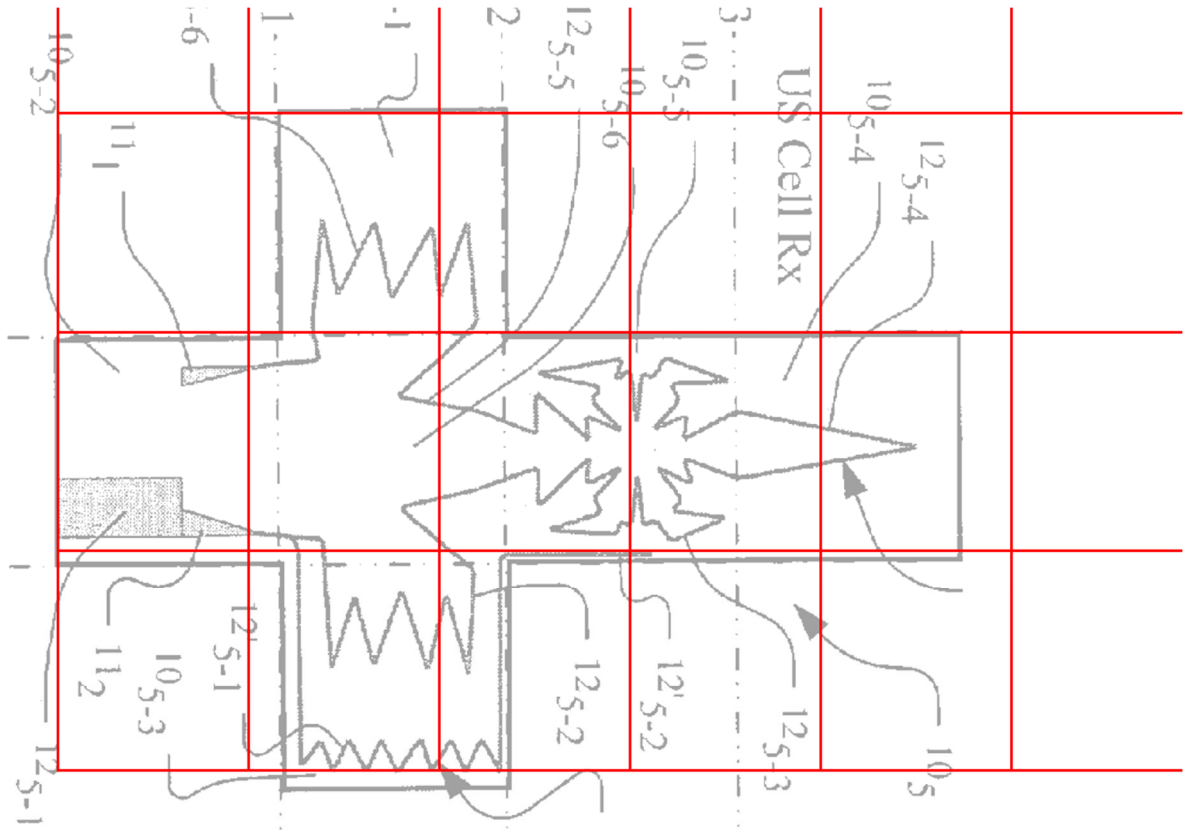
-41-

combining four (4) cells of the grid G_2 . Each cell of the grid G_1 consists of a 2-by-2 arrangement of cells of grid G_2 . Therefore, a cell of the grid G_1 has a cell width equal to twice (2) the width of a cell of the second grid (W_2) (i.e., $W_1=2\times W_2$); and a cell height (H_1) equal to twice (2) the height of a cell of the second grid (H_2) (i.e., $H_1=2\times H_2$).

Since grid G_2 tessellates perfectly the antenna rectangle with an odd number of columns and an odd number of rows, an additional row and an additional column of cells of said grid G_2 are necessary to have enough cells of the grid G_1 as to completely cover the antenna rectangle.

Ex. 1001 at 18:8-23.

Therefore, because G_1 is obtained by combining four cells of G_2 (and adding an additional column and an additional row), when a 9x5 grid is used for G_2 the result is the following grid for G_1 , shown below. Ex. 1003 at ¶94.



Ramasamy, FIG. 5 (annotated, in a G_1 grid).

Similarly, the '200 patent teaches that the third grid (“ G_3 ”) is also created from G_2 . This is explained in the disclosure below:

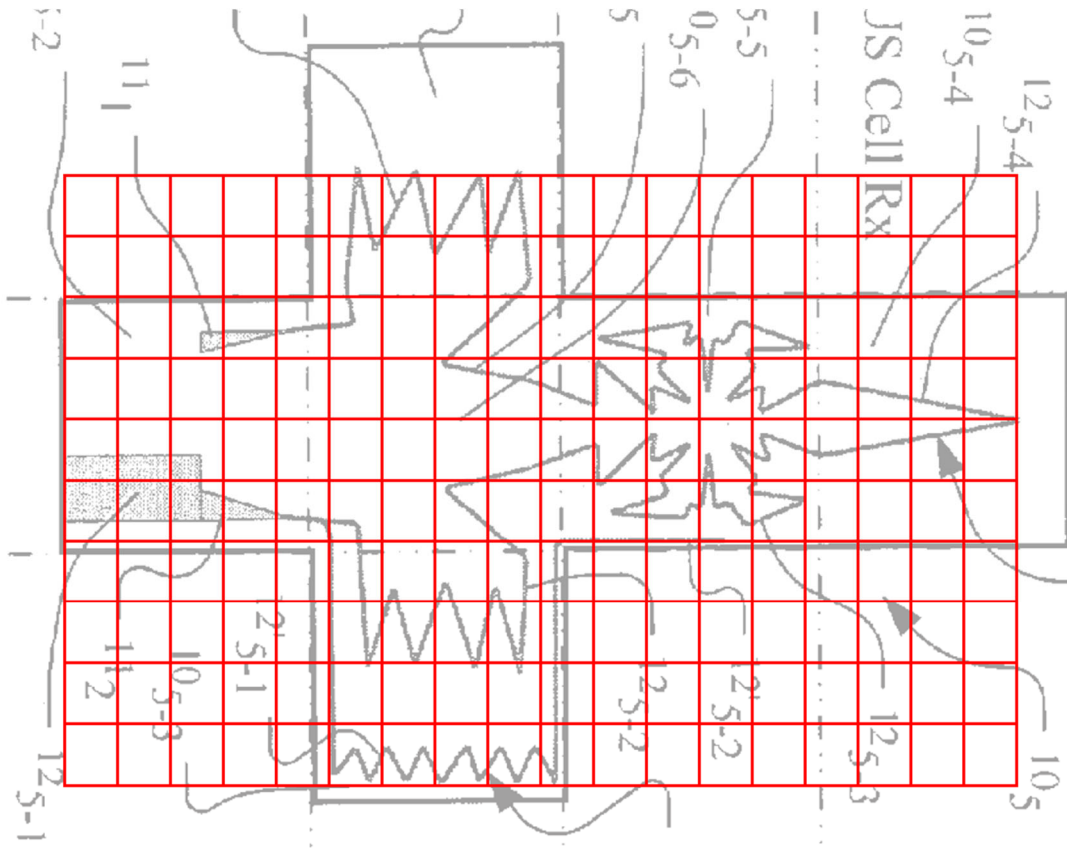
A third grid (or grid G_3) is readily obtained by subdividing each cell of grid G_2 into four cells, with each of the cells having a cell width (W_3) equal to one half ($\frac{1}{2}$) of the width of a cell of the second grid (W_2) (i.e., $W_3 = \frac{1}{2} \times W_2$); and a cell height (H_3) equal to one half ($\frac{1}{2}$) of the height of a cell of the second grid (H_2) (i.e., $H_3 = \frac{1}{2} \times H_2$).

Therefore, since each cell of the grid G_2 is replaced with 2-by-2 cells of the grid G_3 , then 18 by $(4n+2)$ cells of grid G_3 are thus required to tessellate completely the antenna

rectangle.

Ex. 1001 19:62-20:5.

Therefore, because G_3 is obtained by subdividing each cell of G_2 into four cells, when a 9×5 grid is used for G_2 the result is the following grid for G_3 , shown below. Ex. 1003 at ¶96.



Ex. 1004 at FIG. 5 (annotated, in a G_3 grid).

The '200 patent then teaches computing the “complexity factor” F_{21} and the “complexity factor” F_{32} using these grids. The first step is to determine three different “N” values – one for each grid. In this regard, the '200 patent teaches the following:

The complexity factor F_{21} is computed by counting the number of cells N_1 of the grid G_1 that are at least partially inside the antenna rectangle and include at least a point of the antenna contour (in the present invention the boundary of the cell is also part of the cell), and the number of cells N_2 of the grid G_2 that are completely inside the antenna rectangle and include at least a point of the antenna contour, and then applying the following formula:

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

Ex. 1001 at 19:13-25.

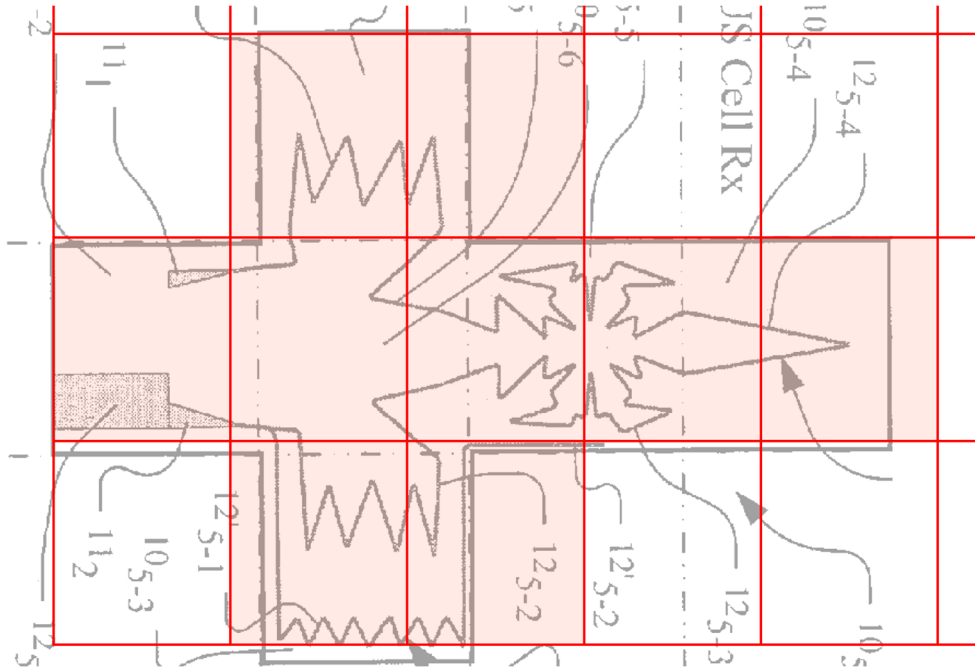
The complexity factor F_{32} is computed by counting the number of cells N_2 of grid G_2 that are completely inside the antenna rectangle and include at least a point of the antenna contour, and the number of cells N_3 of the grid G_3 that are completely inside the antenna rectangle and include at least a point of the antenna contour, and applying then the following formula:

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

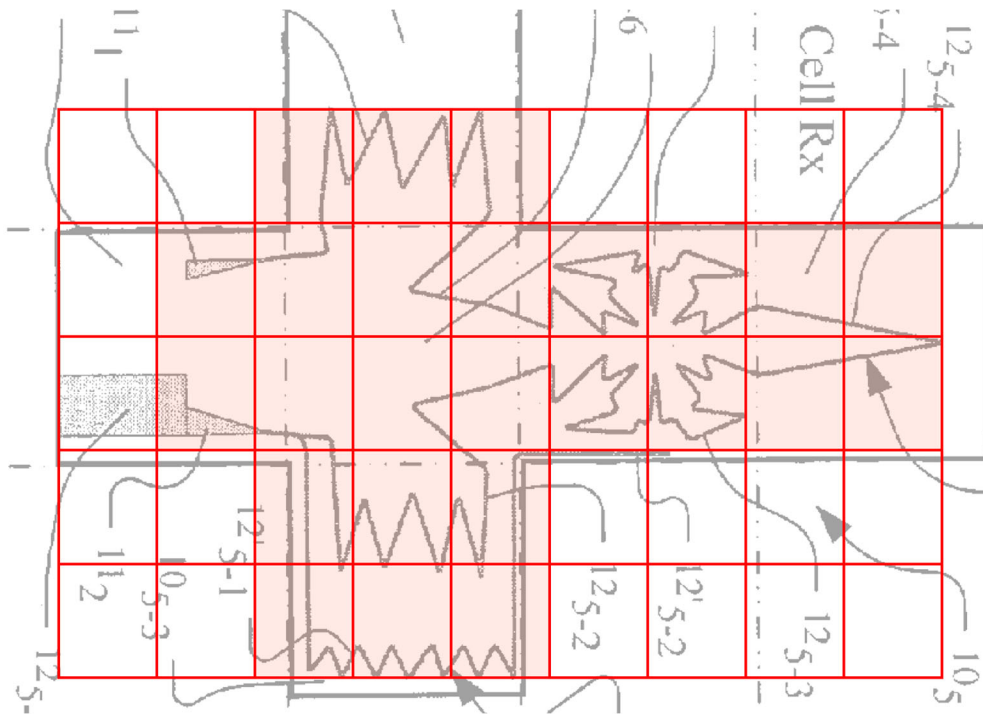
Ex. 1001 at 20:5-17.

Applying these instructions from the specification of the '200 patent, the following N values are obtained for the antenna contour of the antenna system

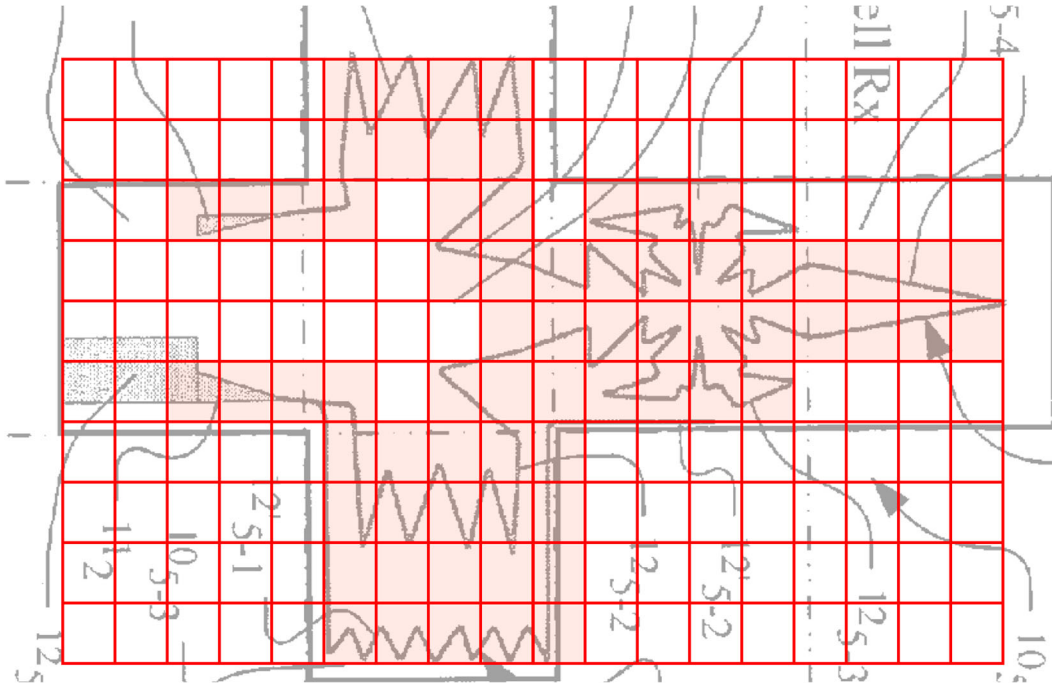
shown in Ramasamy. Ex. 1003 at ¶98.



$$N_1 = 9$$



$$N_2 = 25$$



$$N_3 = 69$$

Finally, plugging these “N” values into the complexity factor formulas provided in the specification of the ’200 patent provides the following results:

$$F_{21} = 1.474$$

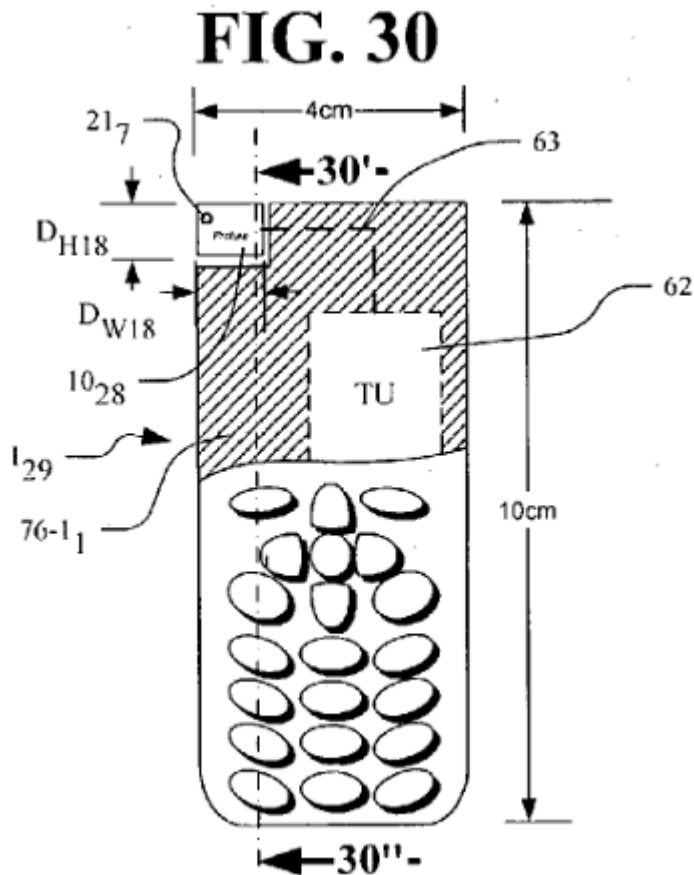
$$F_{32} = 1.465$$

Therefore, this limitation is disclosed in the teachings of Ramasamy and its incorporated disclosures. Ex. 1003 at ¶¶87-100.

viii. 1(g) “a second antenna proximate to a first long side of the ground plane rectangle”

Ramasamy discloses this claim limitation. As explained above with regard to the first antenna limitation, layer 76-1₁ in Ramasamy is a ground plane and the layer 76-1₂ is a power supply plane. Figure 30, reproduced below, shows a front

view of the wireless device, including a front view of the ground plane. Ex. 1004
at Fig. 30.



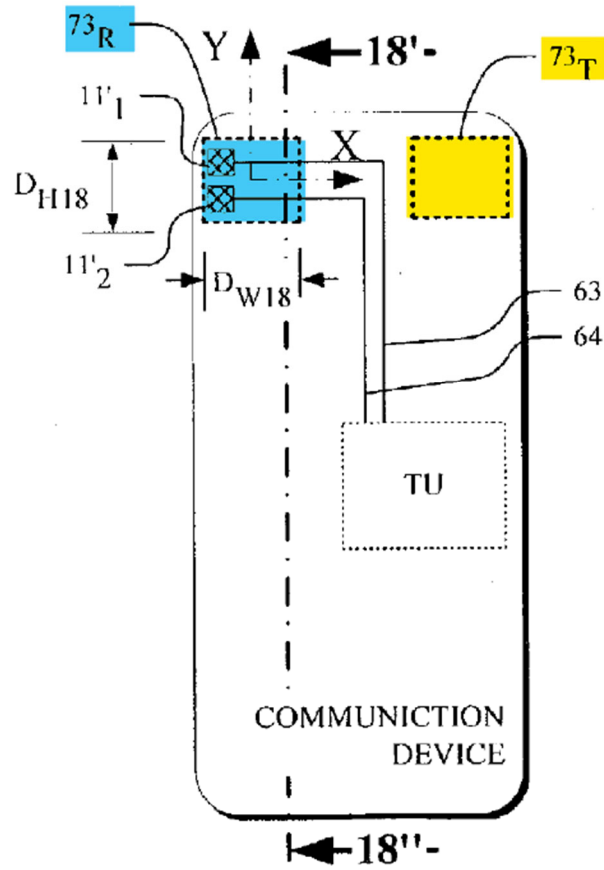
As explained above (*see* discussion of element 1(b)), any rectangle that touches at least one point of the ground plane would meet the definition of a ground plane rectangle in the '200 patent.

Ramasamy discloses a second antenna proximate to a first long side of a ground plane rectangle. As noted above, Figure 17 of Ramasamy shows the locations of antennas 73R and 73T positioned at the corners of the ground plane 76-1₁ (shown in Figure 18), meaning that the antennas in this embodiment are

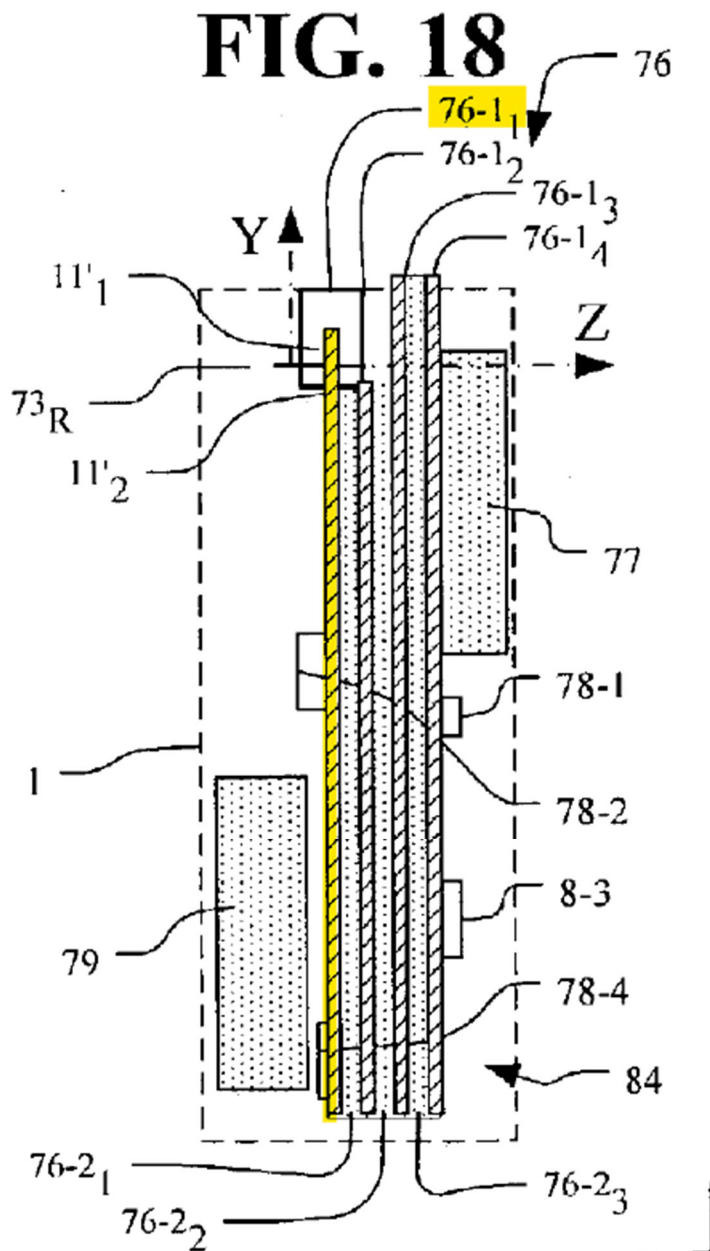
each proximate to both the short side and the long side of the ground plane

rectangle. Ex. 1003 at ¶104; Ex. 1004 at [0078].

FIG. 17



Ex. 1004 at Fig. 17 (highlighting added).

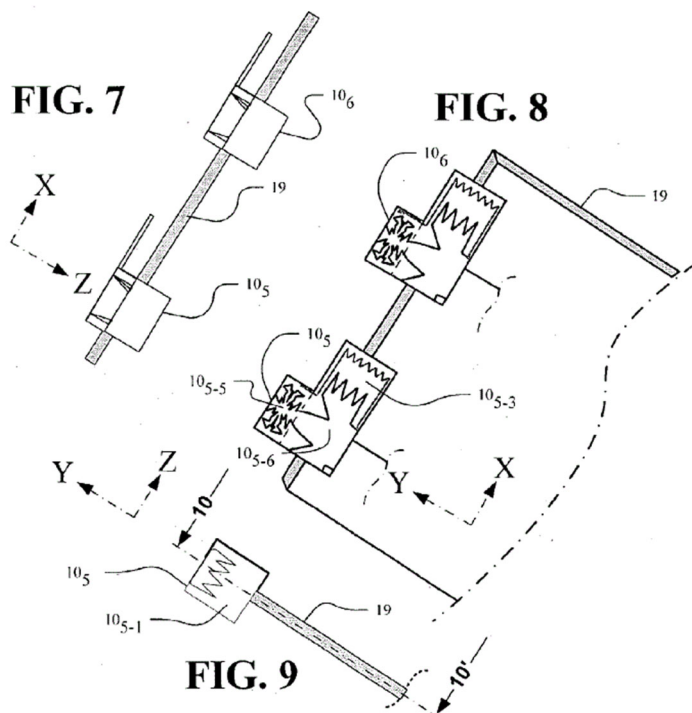


Ex. 1004 at Fig. 18 (highlighting added).

In addition, Ramasamy explains that “FIG. 8 depicts an isometric view of the antennas 10 and 10₆ of FIG. 5 and FIG. 6 folded and mounted on the end of a circuit board 19. The regions 10₅₋₃ is not folded and lies in the same plane as region 10₅₋₆ folded normal to the plane of regions 10₅₋₃ and 10₅₋₆.” Ex. 1004 at

para. [0065]. In that Figure as well, it can be seen that the second antenna is in the corner of the ground plane rectangle, and therefore is proximate to the long side of the ground plane rectangle. Ex. 1004 at para. [0065]; Ex. 1003 at ¶105.

Additionally, the following figures show the positioning of the first and second antennas.



Ramasamy, FIGS. 7-9

Therefore, *Ramasamy* discloses a second antenna proximate to a first long side of the ground plane rectangle and thus discloses this limitation. Ex. 1003 at ¶¶101-107.

ix. 1(h) “and wherein the second antenna is configured to receive signals from a 4G communication standard.”

Ramasamy discloses this claim limitation.

As explained above (*see* limitation 1(c)) Ramasamy discloses that “[t]he antennas operate to transmit and/or receive in allocated frequency bands, for example, bands within the range from 800 MHz to 2500 MHz.” Ex. 1004 at [0077]. The 800-2500 MHz range includes ranges used by communications described as falling within the scope of “4G” by the 200 patent. Ex. 1003 at ¶108.

In addition, as discussed above, the ’200 patent describes “4G” broadly such that it includes technologies such as 3G, WiFi, WiMax “or other high speed wireless standards.” Ex. 1001 at 25:15-23. The invention of Ramasamy is configured to transmit and receive such high speed signals within the broad scope of “4G” provided in the ’200 patent. Ex. 1003 at ¶109.

One of ordinary skill would find this limitation disclosed in the teachings of Ramasamy and its incorporated disclosures taken as a whole. Ex. 1003 at ¶¶108-110.

2. Claim 2

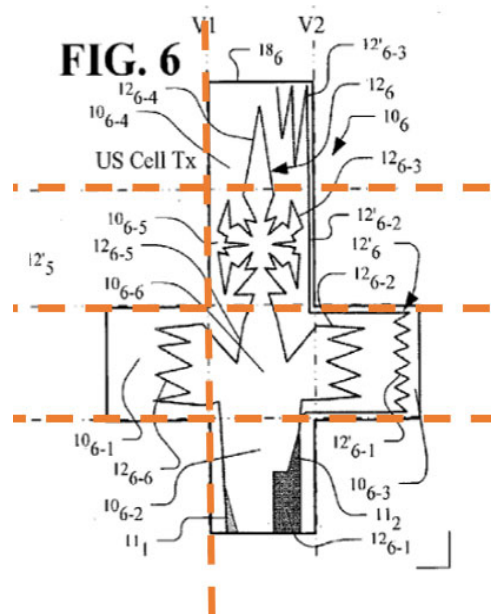
- i. “The wireless device of claim 1 wherein the second antenna defines an antenna box that is a minimum-sized parallelepiped that completely encloses a volume of the second antenna and wherein each face of the minimum-sized parallelepiped is tangent to at least one point of the volume of the second antenna, an orthogonal projection of the antenna box along a**

normal to a face with a largest area of the second antenna defining an antenna rectangle, an aspect ratio of the antenna rectangle being defined as a ratio between a width and a height of the antenna rectangle, and wherein the aspect ratio has a value of at least 2.”

Ramasamy discloses this claim limitation. The '200 patent explains that “[a]n antenna box for the MFWD 100 is herein defined as being the minimum-sized parallelepiped of square or rectangular faces that completely encloses the antenna volume of space and wherein each one of the faced ... is tangent to at least one point of the volume.” Ex. 1001 at 11:35-40. The antenna box is also shown in Figure 1B of the '200 patent, which discloses “antenna box 103 [which] is obtained as a minimum-sized parallelepiped that completely encloses volume 101,” and explains that “the structure of the antenna system comes into contact with each of the six (6) faces of the antenna box 104-109 in at least one point on each face.” Ex. 1001 at 14:1-10. The '200 patent also describes the claimed antenna box in Figure 3, which “shows an example of a structure of an antenna system contained within an antenna box 301.” Ex. 1001 at 27:57-60; *see also id.* Fig. 3. Based upon these disclosures, the antenna box is simply a box that is defined by the volume of the antenna system. *See id.*

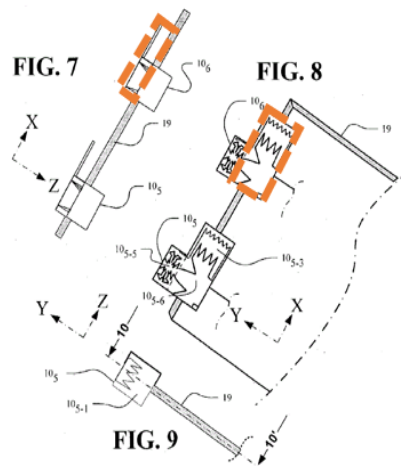
Figure 6 of Ramasamy shows the second antenna in an unfolded state. *See* Ex. 1004 para [0063]. Figure 6 is reproduced below with annotations showing the lines along which the radiation elements and substrate of the antenna are

folded:



EX1001 at Fig. 6 (annotated).

Figures 7, 8 and 9 of Ramasamy depict the antennas of Figures 5 and 6 in a folded state and mounted on the circuit board 19. Ramasamy teaches that “the regions 10₅₋₃ is not folded and lies in the same plane as region 10₅₋₆,” and “the region 10₅₋₅ is folded normal to the plane of regions 10₅₋₃ and 10₅₋₆.” Ex. 1004 para. [0065]. Therefore, Dr. Tentzeris explains that the antenna box that completely encloses a volume of the second antenna and wherein each face of the minimum-sized parallelepiped is tangent to at least one point of the volume of the second antenna would have a side of the size and shape shown in the annotations below. Ex. 1003 at ¶ 115.



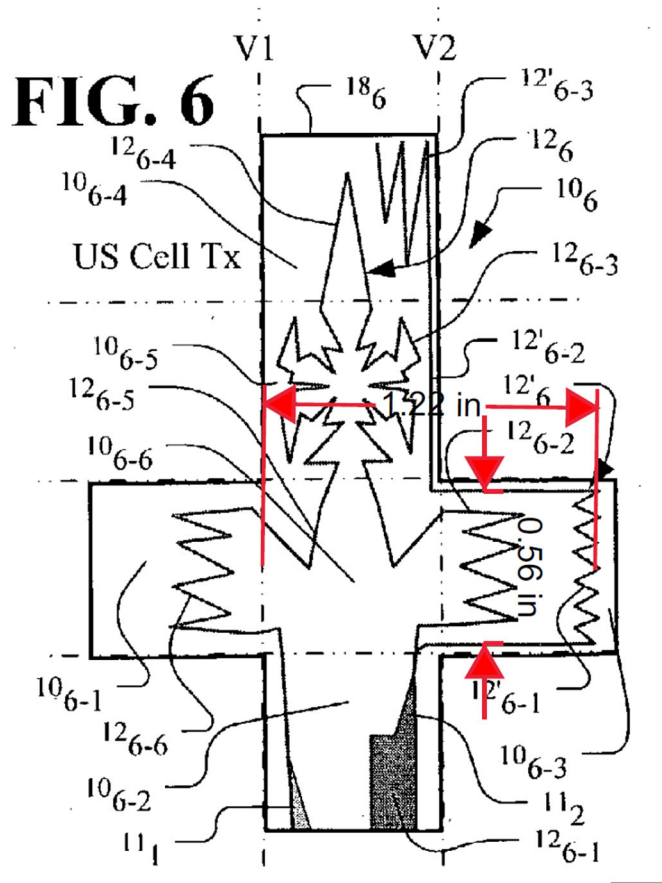
Ex. 1004 at FIGS. 7-9 (annotated).

Claim 2 of the '200 next recites “an orthogonal projection of the antenna box along a normal to a face with a largest area of the second antenna defining an antenna rectangle, an aspect ratio of the antenna rectangle being defined as a ratio between a width and a height of the antenna rectangle, and wherein the aspect ratio has a value of at least 2.” The specification of the '200 patent explains that “the bottom part of Fig. 3 shows an antenna rectangle 351 associated with the antenna box 201,” and “[t]he antenna rectangle 351 contains the antenna contour 350 associated with the antenna element 300.” Ex. 1001 at 28:4-8. Therefore, claim language “orthogonal projection of the antenna box along a normal to a face with a largest area of the second antenna defining an antenna rectangle,” simply means that the antenna rectangle is rectangle defined by the large side of the

antenna box. Ex. 1003 at ¶ 116. This corresponds to the dashed line shown in annotated Figure 8 above. *Id.*

Claim 2 of the '200 patent also recites “an aspect ratio of the antenna rectangle being defined as a ratio between a width and a height of the antenna rectangle, and wherein the aspect ratio has a value of at least 2. The '200 patent explains that “[t]he antenna rectangle has a longer side and a shorter side,” and “[t]he length of the longer side is referred to as the width of the antenna rectangle (W), and the length of the shorter side is referred to as the height of the antenna rectangle (H).” Ex. 1001 at 14:31-35. Dr. Tentzeris explains that this claim limitation merely recites that the antenna rectangle is at least twice as wide as it is tall. Ex. 1003 at ¶ 117.

In Figures 6, 7 and 8, the height of the antenna rectangle of Ramasamy would be defined by the distance between the antenna contour between dashed lines H-1 and H-2 (as the antenna is folded along these lines), and the width of the antenna rectangle of Ramasamy would be defined by the distance from line V1 to the end of the antenna box on the right of the figure. Ex. 1003 at ¶ 118. Figures 6 and 8 show that the antenna rectangle of Ramasamy is at least twice as wide as it is tall, because the antenna system extends from vertical line V1 to the end of the antenna 10₆. *See id.*



Based on the measurements provided by Dr. Tentzeris, the aspect ratio of this antenna rectangle is $1.22:0.56 = 2.17$. Ex. 1003 at ¶ 118.

Therefore, this limitation disclosed in the teachings of Ramasamy and its incorporated disclosures taken as a whole, as they would be understood by a person of ordinary skill in the art at the time of invention. *See id.* at ¶¶ 120-21.

3. Claim 3

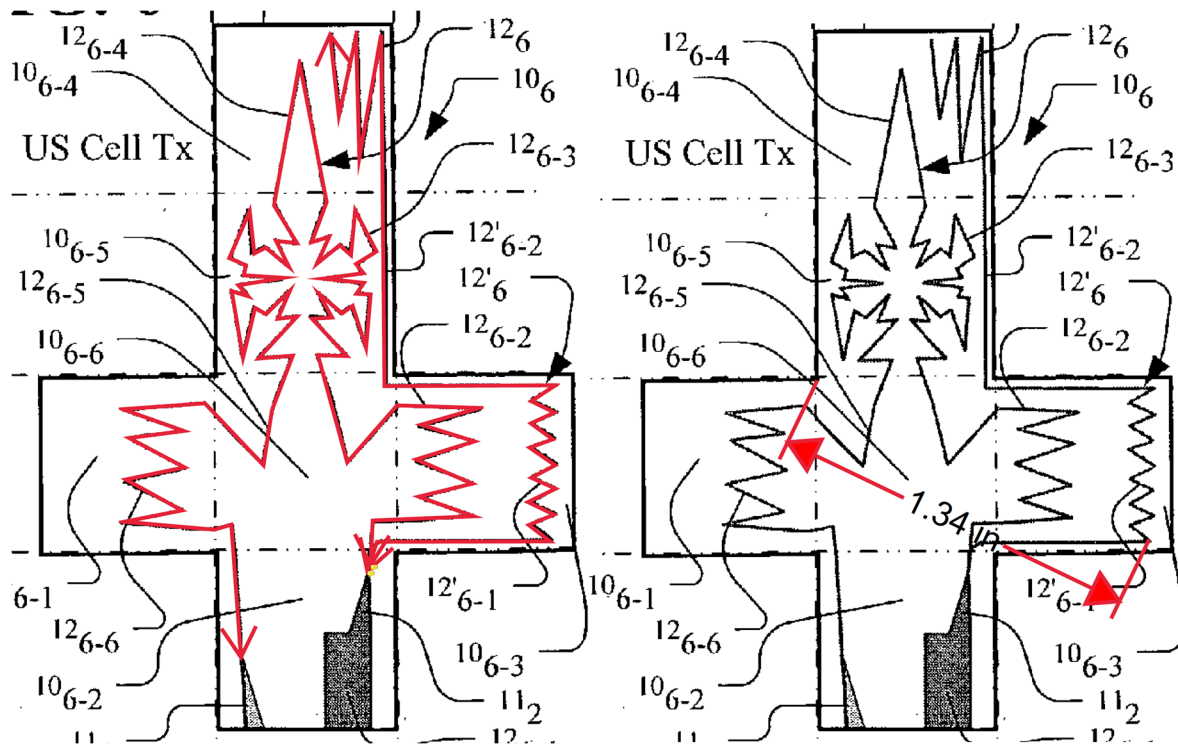
- i. “The wireless device of claim 2 wherein the second antenna defines a second antenna contour comprising an entire perimeter of the second antenna, wherein a

length of the second antenna contour is greater than four times a diagonal of the antenna rectangle.”

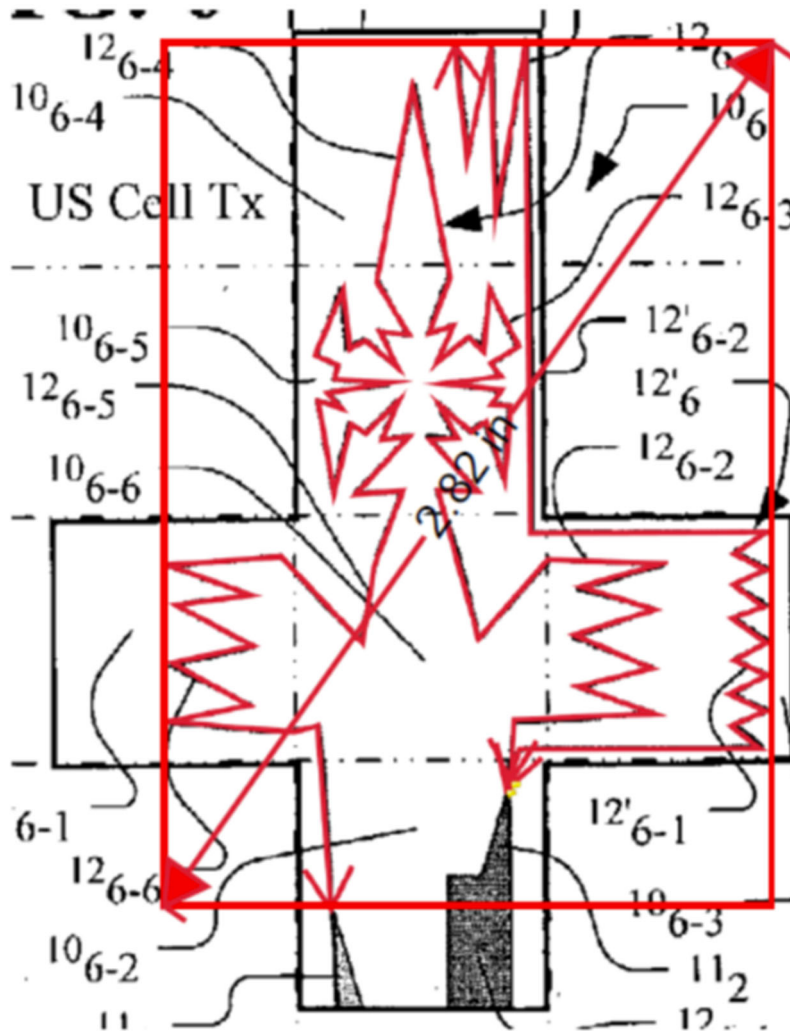
Ramasamy discloses this claim limitation. As explained above (*see* discussion of limitation 1(g) and claim 2), Figure 6 depicts a schematic of the second antenna of Ramasamy (which is also depicted in Figures 7 and 8). As is also discussed above, Ramasamy discloses that in reference to the antenna in Figure 6, “radiation elements 12₆ and 12’₆ and the substrate 186 are intended to be folded along the H1, H2 and H3 horizontal reference lines and the V1 vertical reference line,” and “when folded the antenna 10₆ is compressed and contained within a volume.” Ex. 1004 at ¶ [0063].

Thus, the below annotated versions of Figures 6 and 8 shows in red the antenna rectangle of the second antenna when folded, and in blue the resultant antenna rectangle diagonal.

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Likewise, the length of the antenna contour of the second antenna is also greater than the diagonal of the antenna rectangle of the second antenna when it is unfolded.



Ex. 1004 FIG. 6 (annotated).

As shown above, Figure 6 shows a total perimeter of the contour of 17.1 units (as measured by Adobe Software) which is larger than four times the diagonal of 2.82 units ($4 \times 2.73 = 11.28$). *See* Ex. 1003, at ¶¶127-128.

One of ordinary skill would find this limitation disclosed in the teachings of Ramasamy and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. *Ex.* 1003, at ¶¶122-129.

4. Claim 4

- i. “The wireless device of claim 1 wherein the first antenna is configured to support at least four frequency bands.”**

Ramasamy discloses this claim limitation. For example, as described above in relation to limitation 1(c), Ramasamy discloses the first antenna supporting multiple frequency bands including at least four bands such as US Cell, GSM 900, GSM 1800, and GSM1900(PCS). EX1004 at para. [0004].

Thus, one of ordinary skill would find this limitation disclosed in the teachings of Ramasamy and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1003 at ¶¶ 132-33.

5. Claim 6

- i. 6(pre) “The wireless device comprising”**

Ramasamy discloses this limitation. *See* [1pre].

- ii. 6(a) “an antenna system comprising a ground plane and at least two antennas within the wireless device, the antenna system comprising:”**

Ramasamy discloses this limitation. *See* [1a].

iii. 6(b) “a first antenna configured to provide operation in at least four frequency bands being used by 4G communication standards”

Ramasamy discloses this claim limitation. As explained above (*see* discussion of claim 4), Ramasamy discloses the first antenna being configured to support at least four frequency bands. These frequency bands are all “used by 4G communications standards” as the ’200 patent describes “4G”. Ex. 1003 at ¶¶ 137-38; EX1001 at 25:15-23.

Thus, one of ordinary skill would find this limitation disclosed in the teachings of Ramasamy and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1003 at ¶ 138.

iv. 6(c) “wherein at least two of the at least four frequency bands are contained within a first frequency range and”

Ramasamy discloses this claim limitation. *See* [1c].

v. 6(d) “at least two of the four frequency bands are contained within a second frequency range”

Ramasamy discloses this claim limitation. *See* [1c]. Ramasamy also discloses that two of the four frequency bands fall within the same range. GSM1800 and GSM1900 both fall within a range that includes 1850-1800 MHz. Ex. 1004 at para. [0004]. Therefore, a person of ordinary skill in the art would have found this limitation disclosed in Ramasamy. Ex. 1003 at ¶ 141.

- vi. 6(e) “the first frequency range being lower in frequency than the second frequency range”**

Ramasamy discloses this claim limitation. *See* [1d].

- vii. 6(f) “the first antenna defining a first antenna contour comprising an entire perimeter of the first antenna, and wherein the first antenna contour has a level of complexity defined by complexity factor F_{21} having a value of at least 1.20 and complexity factor F_{32} having a value of at least 1.35; and”**

Ramasamy discloses this claim limitation. *See* [1f].

- viii. a second antenna configured to operate in at least one frequency band being used by a 4G communication standard**

Ramasamy discloses this claim limitation. *See* [1h].

- ix. the second antenna defining an antenna box that is a minimum-sized parallelepiped that completely encloses a volume of the second antenna and wherein each face of the minimum-sized parallelepiped is tangent to at least one point of the volume of the second antenna, an orthogonal projection of the antenna box along a normal to a face with a largest area of the second antenna defining an antenna rectangle, an aspect ratio of the antenna rectangle being defined as a ratio between a width and a height of the antenna rectangle, and wherein the aspect ratio has a value of at least 2**

Ramasamy discloses this claim limitation. *See* [2].

- x. and wherein at least one of the first and second antennas is close to a first short side of a ground plane rectangle enclosing the ground plane.**

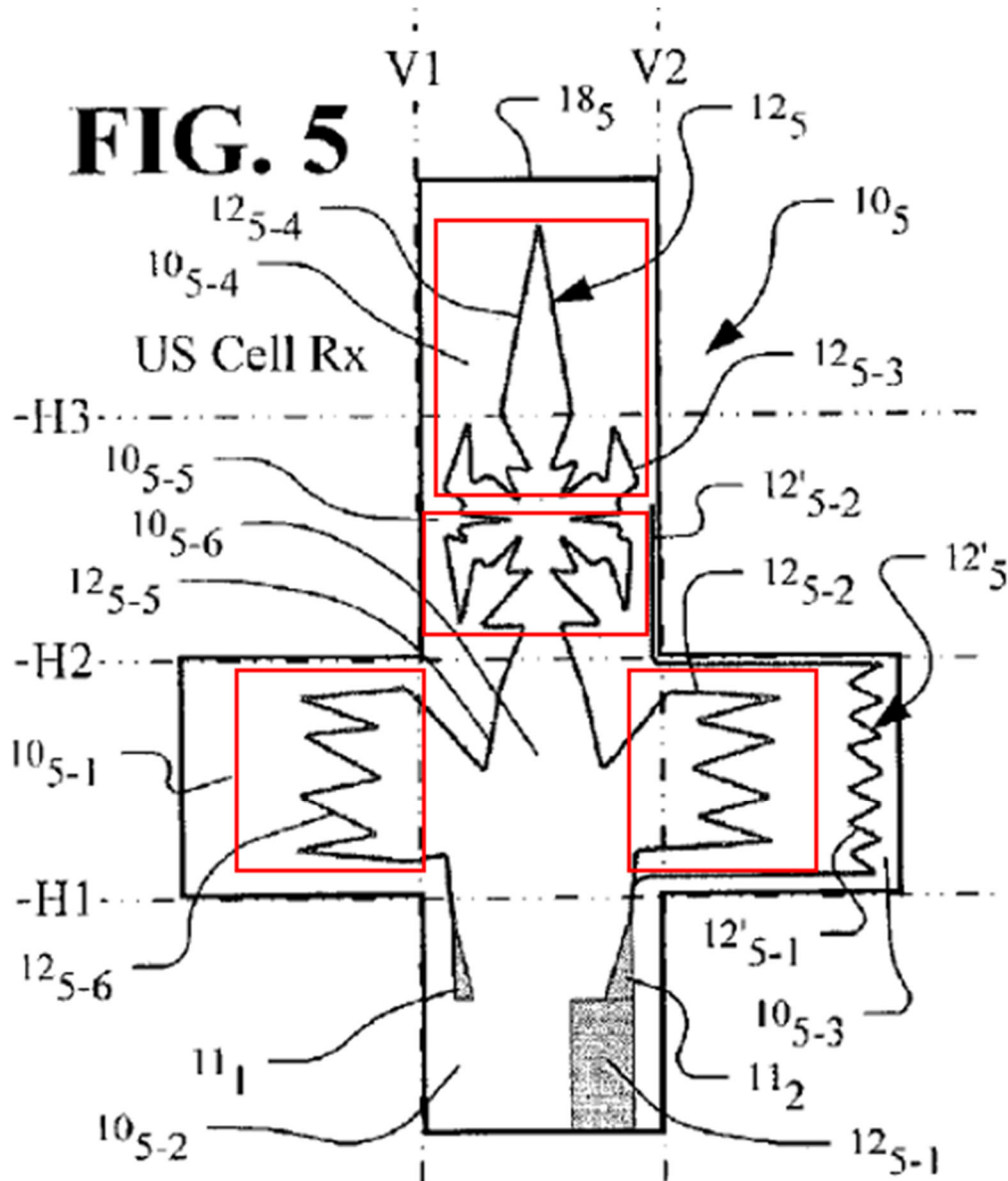
Ramasamy discloses this claim limitation as it discloses the first antenna

being close to a first short side of a ground plane rectangle. *See* [1(b)].

6. Claim 7

- i. “The wireless device of claim 6 wherein the first antenna contour comprises at least 20 segments.”**

Ramasamy discloses this claim limitation as shown below in Figure 5 where each of the four red rectangles contains more than 5 segments (and thus there are more than 20 segments total).



Thus, one of ordinary skill would find this limitation disclosed in the teachings of Ramasamy and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1003 at ¶ 147-48.

7. Claim 9

- i. “The wireless device of claim 6 wherein the second antenna defines a second antenna contour comprising an entire perimeter of the second antenna, wherein a length of the second antenna contour is greater than four times a diagonal of the antenna rectangle.”**

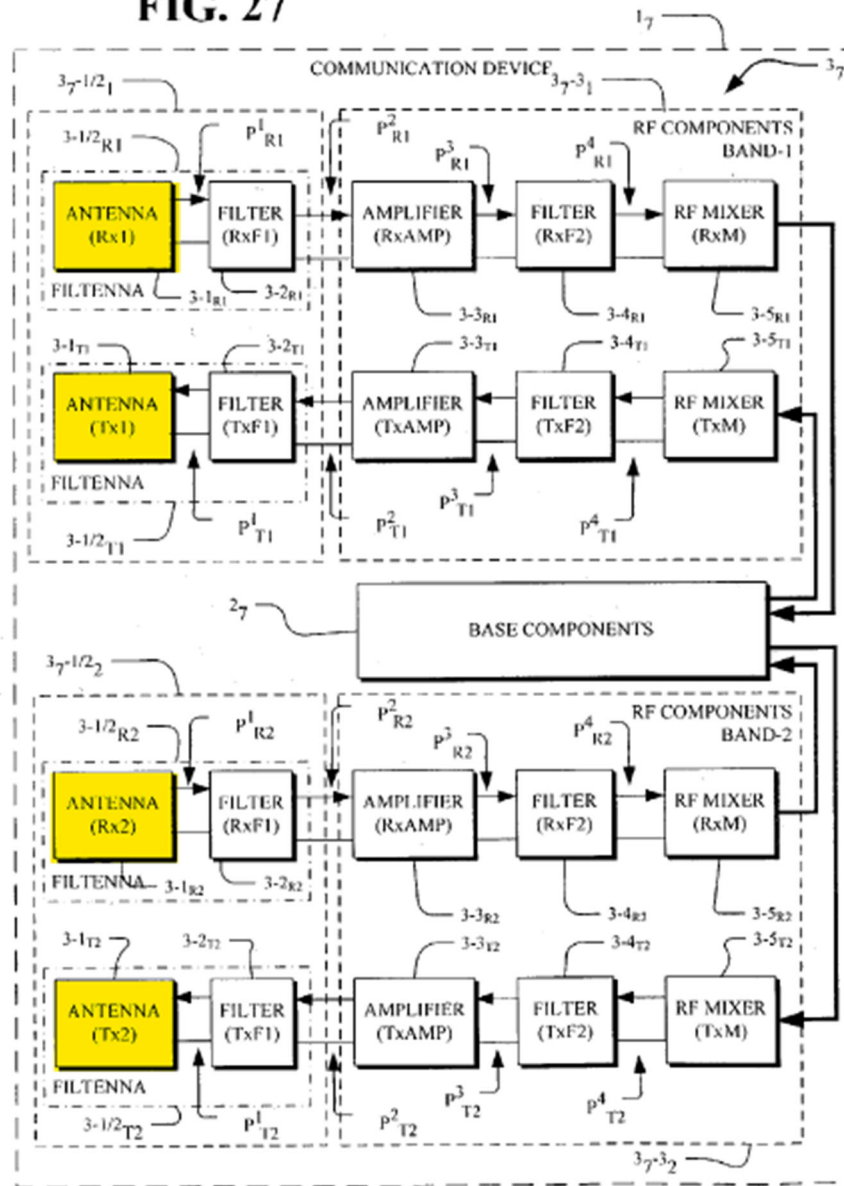
Ramasamy discloses this claim limitation. *See* [3].

8. Claim 10

- i. “The wireless device of claim 6 wherein the antenna system comprises a third antenna configured to provide operation in a wireless communication standard.”**

Ramasamy discloses this claim limitation. For example, Figure 27 of Ramasamy which “depicts a schematic view of a small communication device” shows separate antennas (Rx1, Tx1, Rx2, and Tx2).

FIG. 27



EX1004 at Fig. 27 (highlighting added). Ramasamy also teaches using multiple antennas for different frequency bands. Indeed, Figure 27 above shows different antennas for “Band-1” and “Band-2.” *See id.*; *see also* Ex. 1003 at ¶ 151.

Because Ramasamy discloses at least four frequency bands (see discussion regarding limitation 1(c)), Dr. Tentzeris explains that it would have been at least

obvious to design the antenna system of Ramasamy with at least three antennas to support more of the frequency bands disclosed. Ex. 1003 at ¶ 152. A POSITA would have been motivated to use multiple antennas to provide service for multiple bands as this allows for better isolation for RF front ends in different bands, especially where one signal is weaker than another signal, for example in the case of GPS vs. WiFi. *See id.* at ¶ 153. Dr. Tentzeris also explains that as POSITA would have been motivated to do this as it would result in only minor modification to the existing antenna assemblies. *See id.*

In addition, because Ramasamy defines “4G” to include other services such as WiFi, additional antennas would be needed to support such additional services. *See id.* ¶ 154. For this additional reason, Dr. Tentzeris concludes that it would have been at least obvious to include at least a third antenna in the antenna system of Ramasamy. *See id.*

Thus, one of ordinary skill would find this limitation disclosed in the teachings of Ramasamy and its incorporated disclosures taken as a whole, or in combination with the state of the art at the time of the alleged invention. Ex. 1003 at ¶ 155.

9. Claim 11

i. 11(pre) “A wireless device comprising”

Ramasamy discloses this limitation. *See* [1pre].

- ii. **11(a) “an antenna system comprising a ground plane and at least two antennas within the wireless device, the antenna system comprising”**

Ramasamy discloses this limitation. *See* [1(a)].

- iii. **11(b) “a first antenna configured to provide operation in at least three frequency bands being used by 4G communication standards”**

Ramasamy discloses this limitation. *See* [1(c)].

- iv. **11(c) “the first antenna defining an antenna contour comprising an entire perimeter of the first antenna, the antenna contour comprising at least twenty segments”**

Ramasamy discloses this limitation. *See* [7].

- v. **11(d) “wherein the antenna contour has a level of complexity defined by complexity factor F_{21} having a value of at least 1.20 and complexity factor F_{32} having a value of at least 1.35”**

Ramasamy discloses this limitation. *See* [1(f)].

- vi. **11(e) “and wherein the first antenna defines an antenna box that is a minimum-sized parallelepiped that completely encloses a volume of the first antenna and wherein each face of the minimum-sized parallelepiped is tangent to at least one point of the volume of the first antenna, an orthogonal projection of the antenna box along a normal to a face with a largest area of the first antenna defining an antenna rectangle, an aspect ratio of the antenna rectangle being defined as a ratio between a width and a height of the antenna rectangle, wherein the aspect ratio has a value of at least 2; and”**

Ramasamy discloses this claim limitation. *See* [2].

- vii. **11(f) “a second antenna configured to provide operation in a first wireless service, the second antenna being proximate to a side of a ground plane rectangle enclosing the ground plane.”**

Ramasamy discloses this limitation. *See* [1(g)].

10. Claim 12

- i. **“The wireless device of claim 11 wherein the first antenna is configured to support at least four frequency bands”**

Ramasamy discloses this limitation. *See* [4].

11. Claim 13

- i. **“The wireless device of claim 11 wherein the first wireless service is a WiFi communication standard.”**

Ramasamy discloses this limitation. As discussed above (*see* limitation 1(e)) the '200 Patent describes “4G” as including the WiFi communication standard (even though traditional application of “4G” would not include the WiFi communication standard. Thus, Ramasamy’s disclosure that the second antenna be configured to receive signals from a 4G communication standard as described by the '200 patent (*see* limitation 1(h)) also discloses that communication standard (the first communication standard per limitation 11(f)) include a WiFi communication standard. Ex. 1003 ¶ 164. Ramasamy also discloses servicing bands in the range of 800-2500 MHz. Ex. 1004 at para. [0077], [0106]. Dr. Tentzeris explains that a POSITA would understand that this range includes use of the antennas to cover WiFi bands (2,01-2,484 MHz). Ex. 1003 at ¶ 165. For this additional reason, a person of

ordinary skill would have understood the disclosure of Ramasamy to include this limitation. *See id.*

12. Claim 15

- i. “The wireless device of claim 11 wherein the antenna system comprises a third antenna.”**

Ramasamy discloses this limitation. *See* [10].

13. Claim 17

- i. “The wireless device of claim 15 wherein the third antenna is configured to provide operation in a second wireless service.”**

Ramasamy discloses this limitation. For example, as discussed above (*see* claim 10), figure 27 of Ramasamy depicts using multiple antennas to provide operations across multiple frequency bands and the reference discloses at least four wireless services. As also discussed above for claim 10, it would have been obvious to a POSITA to use a third antenna to provide service across a second wireless service, such as the second wireless service of Ramasamy. Dr. Tentzeris explains that, in such an implementation, the first antenna would provide service across a third wireless service or across different bands from the second antenna in the first wireless service or across different bands from the third antenna in the second wireless service. *See* Ex. 1003 at ¶ 168. For this reason, Dr. Tentzeris explains that this claim would have been at least obvious in view of the teachings of Ramasamy. *Id.* at ¶¶ 168-69.

14. Claim 18

- i. “The wireless device of claim 17 wherein the second wireless service provides operation in the 902-928 MHz frequency range.”**

Ramasamy discloses this limitation. For example, as discussed above, (*see* limitation 1(c)), Ramasamy discloses its antennas providing operation in multiple frequency ranges including “GSM 900”, which Ramasamy discloses includes “890-960 MHz”. EX1004 at [0004]; [106]. Thus, Ramasamy discloses that the second wireless service provide operation in the 902-928 MHz frequency range (which is included in the 890-960 MHz range of the GSM 900 band). Ex. 1003 at ¶ 170.

15. Claim 19

- i. “The wireless device of claim 15 wherein the antenna system comprises a fourth antenna.”**

Ramasamy at least renders this claim limitation obvious. As explained above, (*see* claim 10) Figure 27 of Ramasamy depicts using different antennas, including different antennas for different frequency bands. Because Ramasamy discloses four different frequency bands, it would have been obvious to design the system of Ramasamy with four antennas. Dr. Tentzeris explains that a person of ordinary skill in the art would have applied the teachings of Ramasamy to design the system with four antennas in order to support the different frequency bands disclosed. Ex. 1003 ¶ 171. In addition, Dr. Tentzeris explains that, if the definition of 4G includes other services such as WiFi (as in the ‘200 patent), a person of ordinary skill would have

understood that additional antennas would be needed to support these additional services. Ex. 1003 at ¶ 172-73. For these reasons, this claim is at least obvious in view of the teachings of Ramasamy taken as a whole or in combination with the knowledge of a POSITA at the time of the invention. *See id.*

16. Claim 20

- i. “The wireless device of claim 19 wherein the fourth antenna is configured to provide operation in a third wireless service.”**

Ramasamy at least renders this limitation obvious. For example, as discussed above (see limitation 1(c)), Ramasamy discloses the antennas being configured to provide operation in multiple different bands and discloses at least four of such bands “US Cell, GSM 900, GSM 1800, GSM1900(PCS).” As also discussed above, (see claim 19), it would have been obvious to use four antennas in the antenna system of Ramasamy to provide service across a fourth frequency band such as in a third wireless service. For this reason, Dr. Tentzeris explains that it would have been obvious for the fourth antenna of Ramasamy to provide operation in a third wireless service. Ex. 1003 at ¶ 174. Dr. Tentzeris also explains that, because the ‘200 patent states that 4G includes other services such as WiFi, a POSITA would have understood that a fourth antenna would be configured to provide operation for such an additional wireless service. *See id.* at 174-75. Thus, Ramasamy discloses that the fourth antenna is configured to provide operation in a third wireless service. *Id.*

X. NO BASIS TO DENY PETITION UNDER 35 U.S.C. §314(A)

As established above, the merits of the Petition are compelling, and the Board should institute trial. The facts do not support the Board exercising its discretion to deny institution. In particular, for the following reasons, denial under *Fintiv* is inappropriate. *Apple Inc. v. Fintiv Inc.*, IPR2020-00019, Paper 11 (PTAB Mar. 20, 2020) (precedential) (“*Fintiv*”).

i. whether the court granted a stay or evidence exists that one may be granted if a proceeding is instituted;

Petitioner intends to move the court to stay the Litigation after filing this Petition. Petitioner has filed IPR petitions against each unexpired asserted claim in the Litigation such that, based on the grounds for invalidity asserted herein, there will be no asserted claim for which a stay would prejudice the Patent Owner in any way if the case were stayed. The stage of the Litigation and potential simplification (resulting from the Board invalidating claims) weighs against the exercise of discretion. At worst, this factor is neutral because the Board “will not attempt to predict” how the district court will proceed. *Sand Revolution II, LLC v. Continental Intermodal Group-Trucking LLC*, IPR2019-01393, Paper 24, 7 (PTAB Jun. 16, 2020).

ii. proximity of the court’s trial date to the Board’s projected statutory deadline for a final written decision;

While the Court has initially set the trial date in the Litigation for July 8, 2024, trial dates are notoriously unreliable and should be an insufficient basis upon which to deny institution. “A court’s general ability to set a fast-paced schedule is not particularly relevant.” *In re Apple Inc.*, No. 20-135, slip op. at 16 (Fed. Cir. Nov. 9, 2020); *DISH Network L.L.C. v. Broadband iTV, Inc.*, IPR2020-01280, Paper 17 at 13-16 (PTAB Feb. 4, 2021). The Federal Circuit found error in the Board’s reliance on the case’s scheduled trial date. *In re Apple Inc.*, No. 20-135, slip op. at 15. It would be error for the Board to speculatively rely upon the current schedule. The Board has repeatedly been persuaded by the uncertainty in litigation timelines. *Sand Revolution*, Paper 24 at 8-9; *see also* IPR2021-00255, Paper 22 at 11-12 (PTAB Aug. 23, 2021). These same uncertainties are present here.

iii. investment in the parallel proceeding by the court and the parties;

Investment in the Litigation is not significant. No depositions have been taken, claim construction has not occurred, and discovery is in its early phases. Thus, this factor weighs in favor of institution. *See, e.g., Nokia of America Corp and Ericsson Inc. v. IPCOM, GMBH & Co. KG*, IPR2021-00533, Paper 10 at (PTAB Aug. 12, 2021) (“If, at the time of institution, the district court has not issued substantive orders related to the patent at issue in the petition, this fact weighs against

exercising discretion to deny institution.”).

iv. overlap between issues raised in the petition and in the parallel proceeding;

The issues raised in this petition are among those raised in the Litigation. This factor, however, should be neutral weighed insofar as, the Plaintiff will almost certainly narrow the asserted claims, from the almost 45 asserted claims across six asserted patents.

v. whether the petitioner and the defendant in the parallel proceeding are the same party;

The Petitioner here and the defendant in the Litigation are the same.

vi. other circumstances that impact the Board’s exercise of discretion, including the merits.

As shown above, the merits are strong such that this factor weighs heavily against discretionary denial.

B. Denial under §314(A) is Inappropriate

As established above, Petitioner has set forth strong Grounds that overwhelmingly establish that the Challenged Claims are not patentable.

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

C. Discretionary Denial is Inappropriate

Discretionary denial is inappropriate and the Board should institute trial.

XI. CONCLUSION

Petitioner respectfully requests that *Inter Partes* review be instituted and that Claims 1-4, 6-7, 9-13, 15, and 17-20 of the '200 Patent be canceled.

Respectfully submitted,

Dated: October 24, 2023

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Certificate Under 37 C.F.R. §42.24(d)

The undersigned certifies that the foregoing Petition for *Inter Partes* Review, excluding any table of contents, mandatory notices under 37 C.F.R. §42.8, certificates of service or word count, or appendix of exhibits, contains 11,994 words according to the word-processing program used to prepare this document (Microsoft Word), which is less than the 14,000 allowed under 37 C.F.R. §42.24(a)(1)(i).

By: / Jared J. Braithwaite /

Jared J. Braithwaite
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Counsel for Petitioner

CERTIFICATE OF SERVICE

The undersigned hereby certifies that a copy of the foregoing Petition for *Inter Partes* Review together with all exhibits and other papers filed therewith was served on Patent Owner, by USPS Express Mail or an equivalent next-day delivery service, directed to the attorneys of record for the patent at the following address:

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