# In the United States Court of Federal Claims

**No. 14-147C**
**(Filed: January 18, 2017)**

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| **PROBIR K. BONDYOPADHYAY,**<br><br>**Plaintiff,**<br><br>**v.**<br><br>**THE UNITED STATES,**<br><br>**Defendant.** | **Patent Infringement; 28 U.S.C. § 1498; Claim Construction; Person of Ordinary Skill in the Art; Preamble; Ordinary and Customary Meaning; Specification.** |

Probir K. Bondyopadhay, Ph.D., Houston, TX, pro se.

Benjamin C. Mizer, John Fargo, and Alice Suh Jou, U.S. Department of Justice, Civil Division, Commercial Litigation Branch, Intellectual Property Staff, P.O. Box 480, Ben Franklin Station, Washington, D.C. 20044, for Defendant.

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## CLAIM CONSTRUCTION OPINION AND ORDER

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In this action, Plaintiff pro se Dr. Probir K. Bondyopadhyay, the inventor of United States Patent No. 6,292,134 ("the '134 Patent") for a "Geodesic Sphere Phased Array Antenna System," claims that the United States Air Force ("Air Force") infringed his patent by using and manufacturing a portion of a phased antenna array system. This matter comes before the Court for construction of the term "sphere" following a claim construction hearing.[1]

[1] At Plaintiff's request, the Court permitted the parties to supplement their claim construction briefs, and briefing was completed on January 4, 2017. Following the September 28, 2016 claim construction hearing held in Houston, Texas, the Court resolved six motions filed by Plaintiff requesting additional discovery and challenging Defendant's expert. ECF No. 178, 179, 181, 182, 184, and 187.

## Background[2]

### The '134 Patent

The '134 Patent was issued on September 18, 2001, to Plaintiff, inventor Dr. Probir K. Bondyopadhyay, from Application No. 09/513,014 ("the '014 Application") on February 25, 2000. The '014 Application claims priority to provisional Application No. 60/121,874 filed on February 26, 1999. The '134 Patent consists of 30 claims - - independent Claims 1, 14, 19, and 25, and dependent Claims 2-13, 15-18, 20-24, and 26-30. Plaintiff asserts that the Air Force infringed all 30 claims of the '134 Patent.

Claim 1 is illustrative of the invention:

> 1. A geodesic sphere phased array antenna system for multi-satellite communications and tracking, said antenna system comprising:
>
> a geodesic structure derived from an icosahedron having a plurality of planar equilateral triangular faces, each of which is subdivided into multiple smaller planar triangular surface regions and each of the vertices of said multiple triangular planar regions projected outward on to the circumscribing spherical surface defining said geodesic structure with a plurality of substantially equilateral triangular geodesic planar surfaces; a subarray of planar antenna element units mounted on each of said plurality of substantially equilateral triangular geodesic planar surfaces;
>
> transmit and receive signal processing means connected to each said planar antenna element unit of each said triangular subarray for simultaneous transmission and reception of signals; electromagnetic signal feed means connected to each said planar antenna element unit of each said subarray for forming at least one electromagnetic beam in space;
>
> electronic switching means for selectively connecting each said subarray to adjacent subarrays for generating multiple electromagnetic beams in selective diverse directions in space;
>
> electronic phase shifting means connected to each said planar antenna element unit of each said subarray for providing electronic scanning capability to said subarrays of antenna element units connected by said electronic switching means with the phased array communication space being segmented into a plurality of smaller cellular space,
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> each said cellular communication space for electronic scanning being defined by a plurality of discrete chosen directions, corresponding to the said geodesic sphere phased array structure and each said cellular communication

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[2] This background is derived from the appendices attached to the parties' claim construction briefing and the record developed at the claim construction hearing held on September 28, 2016, in Houston, Texas. The Court uses "Tr." to cite the claim construction hearing transcript.

space adapted to be electronically scanned by a plurality of active said contiguous phased subarrays corresponding to the said cellular communication space.

'134 Patent 12:65-13:37.

**Overview of the Invention**

The invention of the '134 Patent is directed to a "geodesic sphere phased array antenna system," used for satellite communications. '134 Patent Abstract. A geodesic sphere phased array antenna system consists of a geodesic sphere with a phased antenna array mounted onto its planar surfaces. A geodesic sphere is a collection of multiple flat planes of various shapes such as triangles, pentagons and hexagons in which the edges of the planes are contiguously linked together to form a sphere. '134 Patent 4:2-6. 5:27-30, 6:4-9. A soccer ball and Disney's Epcot Center's Spaceship Earth "golf ball" are well known examples of geodesic spheres.

A phased array antenna system is a collection of smaller antenna elements that work in a synchronized fashion to create a stronger communication signal than a single antenna alone by harmonizing the signals of multiple smaller antennas. This is accomplished by aligning the "phases" of the smaller antennas - - i.e., the sinusoidal curves that send a communication signal - - which increases the amplitude of that signal. '134 Patent 1:51-57; Haupt Decl. ¶ 32. To align these sinusoidal curves, the antennas in the array are connected by a "feed structure" that energizes, or "feeds," electromagnetic signals to each of the individual antennas in the array. '134 Patent 1:51-57.

Figure 1 of the '134 Patent illustrates the invention and depicts a planar triangle 22 studded with a subarray of antenna elements which, when contiguously linked together, form the geodesic sphere structure:

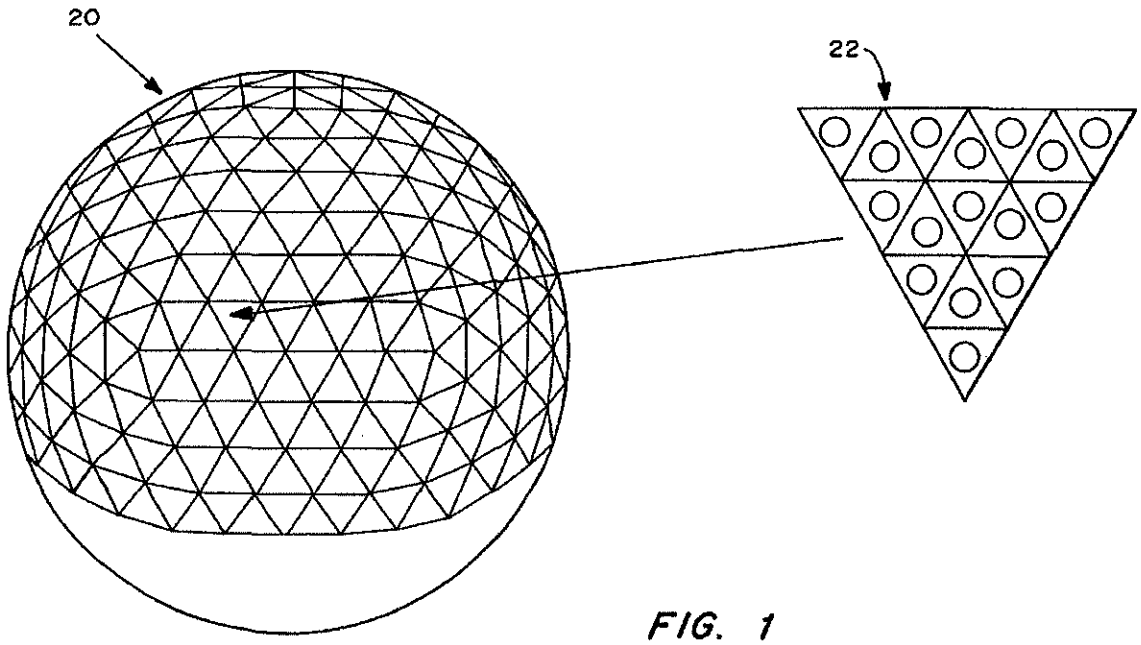


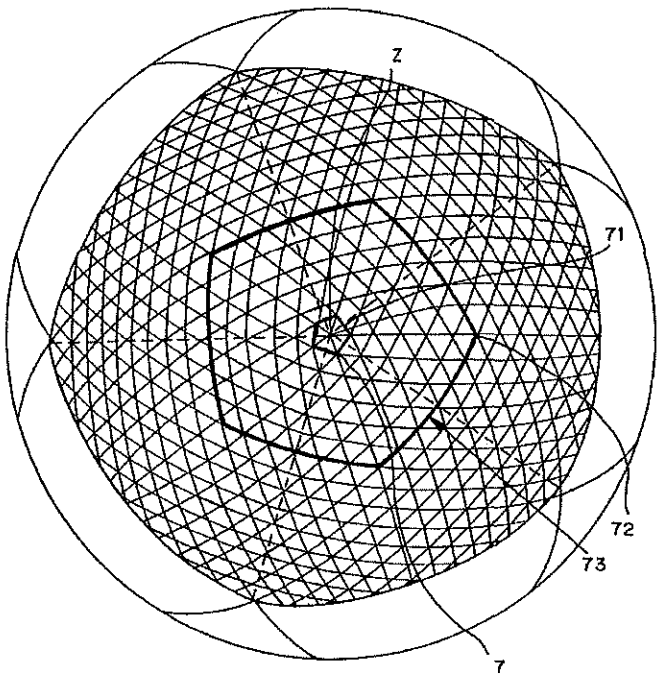

FIG. 1

'134 Patent Fig. 1 ("FIG. 1 is an exploded view showing a phased array antenna of the present invention which comprises substantially equilateral triangular-shaped subarrays of antenna elements mounted on the faces of a geodesic sphere structure with one of the triangular subarrays broken away and enlarged for purposes of illustration . . . .").

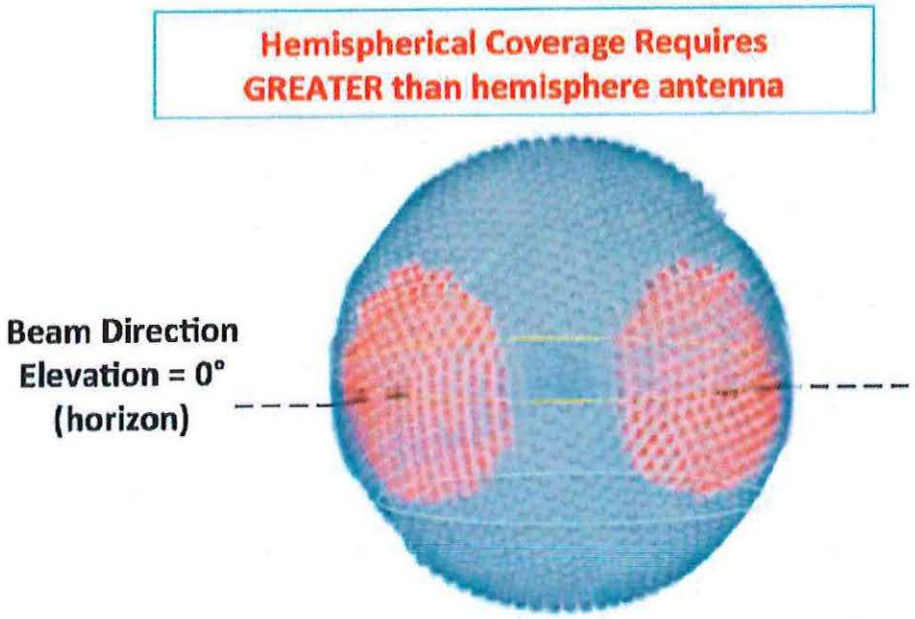
That the phased antenna array is mounted onto a sphere - - as opposed to any other shape - - is significant to how the invention works because a sphere permits the antenna system to scan for and transmit communication signals in any direction along the sphere's surface. As such, a geodesic sphere phased array antenna, if built to completion, would be capable of providing hemispheric coverage from one side of the sphere to the other and "tracking and communicating with one or multiple satellites in all kinds of earth orbits anywhere in the entire sky . . . ." '134 Patent 3:67-4:1. In contrast, single antennas - - such as satellite dishes - - must be manually steered to face a specific direction in order to send a signal to a specific satellite. Haupt Decl. ¶ 31. Therefore, the coverage range for a single antenna is much smaller than the geodesic sphere phased array antenna, and a single antenna would require constant manual intervention to adjust the signal direction to reach the desired satellite. Id.

A stronger electromagnetic beam, focused in a direction, is capable of traveling "across great distances and at very precise angles" to communicate with specific satellites. Id. at ¶ 27. The communication signal from the antenna to the satellite is strongest when the electromagnetic beam that signals communications projects perpendicularly outward from the plane of the phased array antenna elements. Stuart Decl. ¶ 41. Figure 7 of the '134 Patent depicts a geodesic sphere phased array antenna, with a portion of the antenna energized and the beam projecting out towards the viewer:

FIG. 7



'134 Patent Fig. 7 ("FIG 7 is a view of the geodesic sphere created from the icosahedron of FIG 5(a) and showing the energized portion of the geodesic sphere array of a plurality of contiguous subarrays that forms an electromagnetic beam along its broadside (zenith) direction towards a vertex of the geodesic sphere . . . ."). In Figure 7, the electromagnetic beam is in the cellular communication space 71 and would project out from the Figure directly toward the viewer. For a geodesic sphere phased array antenna to provide coverage over an entire hemisphere - - from horizon to horizon - - the area covered by such antenna must be greater than a hemisphere because there must be energized phased array antenna elements 73 below the "equator" line in order to project the electromagnetic beam towards the cellular communication space 71 located on the horizon. See Haupt Decl. ¶ 35. In the following graphic, Defendant's expert, Dr. James Stuart, illustrated the energized antenna elements in red both above and below the equator line of the "sphere" to project an electromagnetic beam towards the horizon:




Stuart Decl. ¶ 44, Figure 10.[3]

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[3] The Court accepted Dr. James Stuart as an expert in electrical engineering, antenna design, antennas for satellite communications, and phased array antennas. Tr. 203. Dr. Stuart holds a B.S. in Physics from the University of Washington, master's degrees in operations research and electrical engineering, as well as a Ph.D. in systems engineering from the University of Southern California. Stuart Decl. ¶ 4. Dr. Stuart has more than 40 years of experience with satellite telecommunications and phased array antennas. Tr. 182. Dr. Stuart was formerly the project manager for the NASA Jet Propulsion Laboratory, where he was the head of a Mars mission and designed an Earth orbiter which had a phased array antenna attached. Since his time at the NASA Jet Propulsion Laboratory, Dr. Stuart founded and managed more than six companies in the field

The "main objective" of the '134 Patent was to create a "low cost phased array antenna architecture that will provide communication coverage over the entire hemisphere." '134 Patent 3:49-52. According to the '134 Patent:

> The most important aspect of this invention is the cellular scanning idea wherein the energized portion of the phased array, consisting of the appropriate number of contiguous subarrays that sets up an electromagnetic beam in a given direction, changes with the direction of the beam. The key point of the invention is to limit the electronic scanning requirement for any of these beams to a cellular communication space which in a preferred configuration, could be bounded and defined by the adjacent vertices of the geodesic sphere. The geodesic sphere phased array antenna may be so constructed that this scanning requirement is less than 10° off broadside within a conical scanning space.

Id. at 10:17-28.

In other words, the invention calls for an increased number of planar surfaces with phased array antenna elements to be mounted onto the geodesic sphere. This increase in planar surfaces permits communication signals to be sent and received from multiple locations simultaneously along the sphere's surface. '134 Patent 4:15-26; Haupt Decl. ¶ 34. In addition, the greater number of planar surfaces divides the hemispheric communication space into smaller "cellular communication spaces," thus limiting the area that a subarray of antenna elements must scan to transmit and receive signals to "less than 10° off broadside within a conical scanning space." '134 Patent 10:27-28. As a result, a given communication signal from the invention described in the '134 Patent would be stronger and more precise than an antenna that must scan at wider angles to transmit and receive communication signals.

The lower cost of the antenna comes from using modular planar surfaces to construct the geodesic sphere. If damaged, these flat surfaces are easier to replace because each surface is identical, as compared to replacing curved antennas on a normal sphere that would need to be tailored to fit a specific area on a curved surface. '134 Patent 3:22-26, 56-63.

**Prosecution History of the '134 Patent**

The '134 Patent prosecution history is brief. The '134 Patent was issued with no Examiner rejections and only cited two prior art references from 1995 - - U.S. Patent Nos. 5,386,953 and 5,457,465. The prosecution history also shows that the Examiner only spent approximately 10 minutes searching for relevant prior art references. In support of the Notice of Allowance of the '134 Patent, the Examiner stated in full:

> The closest prior art, Stuart and Collier et al., do(es) not teach or make obvious the following limitations(s):

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of space and satellite communications. Tr. 181. Dr. Stuart has also authored two textbooks on satellite communications and published over 200 professional technical papers on satellites, space systems and satellite technologies. Stuart Decl. ¶¶ 14-15, 17.

> In regard to claim 1, a subarray of planar antenna element units mounted on each of said plurality of substantially equilateral triangular geodesic planar surfaces.
>
> In regard to claim 14, a plurality of said geodesic planar surfaces each having mounted thereon a subarray of planar antenna element units.
>
> In regard to claim 19, each said geodesic planar surface having mounted thereon a subarray of planar antenna element units.
>
> In regard to claim 25, each having mounted thereon a subarray of planar antenna element units.

Def.'s Br. App., at GA136-37.

## Discussion

### Jurisdiction

This Court has subject-matter jurisdiction over this action pursuant to 28 U.S.C. § 1498(a), which provides in relevant part:

> Whenever an invention described in and covered by a patent of the United States is used or manufactured by or for the United States without license of the owner thereof or lawful right to use or manufacture the same, the owner's remedy shall be by action against the United States in the United States Court of Federal Claims for the recovery of his reasonable and entire compensation for such use and manufacture.

28 U.S.C. § 1498(a) (2012). Because Plaintiff is the inventor and owner of the '134 Patent, and accuses the Air Force of making and using a geodesic sphere phased array antenna as claimed in the '134 Patent without lawful rights, this Court has jurisdiction.

### Legal Standards for Claim Construction

The "bedrock principle" of patent law is that "'the claims of a patent define the invention to which the patentee is entitled the right to exclude.'" Phillips v. AWH Corp., 415 F.3d 1303, 1312 (Fed. Cir. 2005) (en banc) (quoting Innova/Pure Water, Inc. v. Safari Water Filtration Sys. Inc., 381 F.3d 1111, 1115 (Fed. Cir. 2004)). The meaning of claim language is often apparent on its face, but can be complicated by the human failings of the written word and the inclusion of highly technical terminology. Id. The Supreme Court clarified that claim construction involves a mixed question of law and fact, with a court, as a matter of law, construing claims in light of the intrinsic record of the patent - - the claims, specification and patent prosecution history - - and making factual findings with respect to the extrinsic record - - such as expert testimony, analogous case law, and dictionaries. Teva Pharms. USA, Inc. v. Sandoz, Inc., 135 S.Ct. 831, 840-41 (2015) (vacating Lighting Ballast Control LLC v. Philips Elecs. N. Am. Corp., 744 F.3d 1272 (Fed. Cir. 2014) (en banc)).

Claim terms should be given their ordinary and customary meaning as used in the field of invention. Phillips, 415 F.3d at 1312-13; Vitronics Corp. v. Conceptronic, Inc., 90 F.3d. 1576, 1582 (Fed. Cir. 1996). The ordinary and customary meaning is the meaning a claim term would have to a skilled artisan at the time of the invention - - the effective filing date of the patent application. Phillips, 415 F.3d at 1313 (citing Innova, 381 F.3d at 1116). A person of ordinary skill in the art is "deemed to read the claim term not only in the context of the particular claim in which the disputed term appears, but in the context of the entire patent, including the specification." Id. "In some cases, the ordinary meaning of claim language . . . may be readily apparent even to lay judges, and claim construction in such cases involves little more than the application of widely accepted meaning of commonly understood words." Id. at 1314. A claim can depart from its ordinary meaning only if the inventor has explicitly assigned it a separate meaning. Id. at 1316.

To construe claims, a court objectively looks at public sources, such as the patent itself, its prosecution history, or technical dictionaries available at the time, that show what a skilled artisan would have understood the disputed claim language to mean. Innova, 318 F.3d at 1116. In Phillips, the Federal Circuit clarified that courts should first review the "intrinsic" record of the patent. 415 F.3d at 1314-17. Intrinsic evidence consists of the patent claims, specification, and the patent's prosecution history. Id. at 1314; IMS Tech., Inc. v. Haas Automation Inc., 206 F.3d 1422, 1433 (Fed. Cir. 2000).

As the claims define the invention, the claim language is the most important source for a Court to consider in construing the claim terms. Phillips, 415 F.3d at 1312. The second most critical source of intrinsic evidence is the patent specification, which "contain[s] a written description of the invention and of the manner and process of making and using it . . . ." 35 U.S.C. § 112 ¶ 1 (2006). The "specification 'is always highly relevant to the claim construction analysis. Usually it is dispositive; it is the single best guide to the meaning of a disputed term.'" Phillips, 413 F.3d at 1315 (quoting Vitronics, 90 F.3d at 1582)). The third source of intrinsic evidence is the prosecution history, which consists of "the complete record of the proceedings before the Patent Office and includes the prior art cited during examination of the patent." Id. at 1317. The prosecution history is less useful in claim construction, however, because it can itself be ambiguous as it represents ongoing negotiations between the patent applicant and the Patent Office. Id.; see Inverness Med. Switz. GmbH v. Warner Lambert Co., 309 F.3d 1373, 1380-82 (Fed. Cir. 2002).

After consideration of the intrinsic evidence, if a court still finds the claim term to be ambiguous, it can look to extrinsic evidence which "consists of all evidence external to the patent and prosecution history, including expert and inventor testimony, dictionaries, and learned treatises." Markman v. Westview Instruments, Inc., 52 F.3d 967, 980 (Fed. Cir. 1995) (en banc), aff'd, 517 U.S. 370 (1996). However, such external evidence is "less significant than the intrinsic record in determining the 'legally operative meaning of claim language.'" C.R. Bard, Inc. v. U.S. Surgical Corp., 388 F.3d 858, 862 (Fed. Cir. 2004) (quoting Vanderlande Indus. Nederland BV v. Int'l Trade Comm'n, 366 F.3d 1311, 1318 (Fed. Cir. 2004)).

**Level of Skill in the Art**

The relevant field of art for the '134 Patent is phased array antennas. Haupt Decl. ¶¶ 24-25; Stuart Decl. ¶¶ 30-33. Defendant defined a person of ordinary skill in the art to be a person

with a master's degree in electrical engineering, physics, or the equivalent, with at least eight years of relevant work experience with phased array antennas, noting that additional relevant work experience may substitute for formal education. Def.'s Br. 17. Plaintiff asserted that any "competent antenna engineer" would be capable of understanding the term "sphere" in the '134 Patent. Pl.'s Br. 1 (ECF No. 137). The Court adopts the parties' substantially similar definitions of a person of ordinary skill in the art to be a person with a master's degree in electrical engineering, physics, or the equivalent, with at least eight years of relevant work experience with antennas. The Court recognizes that additional relevant work experience in phased array antennas, including satellite communications, may substitute for formal education.

**Effective Filing Date**

The filing date on the face of the '134 Patent is February 25, 2000, with a priority date claimed to the '134 Patent's provisional application No. 60/121,874 filed February 26, 1999. For the purposes of claim construction only, the Court accepts Defendant's unrebutted position that the effective filing date of the '134 Patent is February 26, 1999, the date most favorable to Plaintiff.

**Claim Construction of the Term "Sphere"**

The parties dispute the meaning of the term "sphere" as it appears in all 30 claims of the '134 Patent:

| Plaintiff's Proposed Construction | Defendant's Proposed Construction |
|---|---|
| "spherical"<br><br>Pl.'s Br. 1 (ECF No. 137) | "greater than a hemisphere so as to provide the phased array antenna with hemispherical or wider coverage"<br><br>Def.'s Br. 1 |

The crux of the parties' dispute is what portion of the surface area of a sphere is sufficient to qualify as a "geodesic sphere phased array antenna system" as claimed in the '134 Patent. Plaintiff argues that it could be "ten (10%), fifty percent (50%) or more up to even [one] hundred percent (100%)" depending "on the specific applications . . . for which the spherical phased array antenna is built and utilized." Pl.'s Br. 2 (ECF No. 137). Defendant counters that the intrinsic and extrinsic evidence regarding the '134 Patent limits the term "sphere" to structures that are "greater than a hemisphere so as provide the phased array antenna with hemispherical or greater communication coverage." Def.'s Br. 20.

**The Preambles to Claims 1, 14, 19, and 25 are Limiting**

Defendant argues that the preambles in independent Claims 1, 14, 19, and 25 which describe the geodesic structure as a "sphere" limit all claims to "sphere" shaped structures. Def.'s Br. 20-22. In arguing that the preamble is limiting, Defendant seeks to limit the structure of the '134 Patent to a geodesic sphere and no other shape. The preambles for each of the four independent Claims 1, 14, 19, and 25, are identical and provide:

> A geodesic sphere phased array antenna system for multi-satellite communications and tracking, said antenna system comprising . . .

'134 Patent 12:65-67, 14:32-34, 15:20-22, 16:14-16 (emphasis added).

Generally, the preamble of a claim does not limit the scope of a patent claim if it "merely states the purpose or intended use of an invention . . . ." Pacing Techs., LLC v. Garmin Int'l, Inc., 778 F.3d 1021, 1023-24 (Fed. Cir. 2015) (internal citation and quotation marks omitted). However, a preamble may limit the scope of a patent claim if it acts as a necessary component of the claimed invention by providing an antecedent basis from which limitations in the body of the claim are derived. Id. at 1024. The preamble is also limiting if it "recites essential structure that is important to the invention or necessary to give meaning to the claim." Bicon, Inc. v. Straumann Co., 441 F.3d 945, 952 (Fed. Cir. 2006) (internal quotation marks omitted) (citing NTP, Inc. v. Research in Motion, Ltd., 418 F.3d 1282, 1305-06 (Fed. Cir. 2002)). There is no "litmus test" governing when the preamble should be deemed limiting. Catalina Mktg. Int'l, Inc. v. Coolsavings,com, Inc., 289 F.3d 801, 808 (Fed. Cir. 2002). Rather, whether the preamble is limiting depends "on the facts of each case in light of the claim as a whole and the invention described in the patent." Storage Tech. Corp. v. Cisco Sys., Inc., 329 F.3d 823, 831 (Fed. Cir. 2003); Bicon, 441 F.3d at 952.

Here, the preambles of the independent claims are limiting because they define the structure of the phased array antenna system claimed to be a geodesic sphere. For example, the first subpart of independent Claim 19 reads:

> a geodesic structure derived from a regular polyhedron having a plurality of planar faces to form a geodesic three dimensional structure with a plurality of said geodesic planar surfaces each said geodesic planar surface having mounted thereon a subarray of planar antenna element units;

'134 Patent 15:24-29 (emphasis added). The general claiming of the invention's structure as a "regular polyhedron" and a "three dimensional structure" would give no indication to a person of ordinary skill in the art what the overall shape or structure of the antenna system is. Indeed, the term "regular polyhedron" discloses nothing more than a multi-faced solid. An illustration of this general term could be a radically different shape than a geodesic sphere - - for example, the prior art's truncated pyramid in Figure 3a:

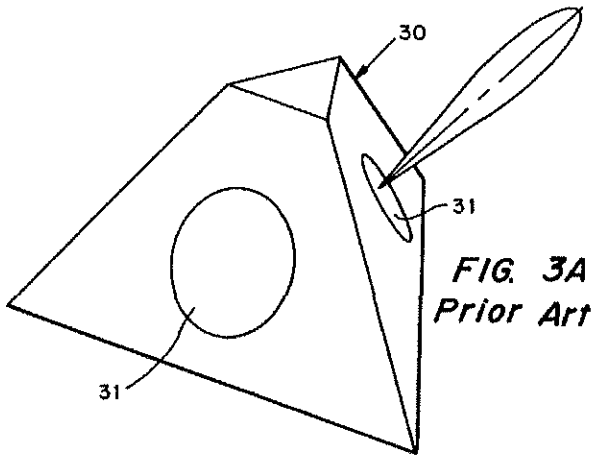



FIG. 3A
Prior Art

'134 Patent Figure 3a, 6:60-64 ("Multi-planar phased array antenna structures of the prior art are shown in Figure 3a . . . . Three planar phased arrays 31 are mounted on the three sides of a pyramid 30 for scanning the entire hemispherical communication space are shown in Figure 3a . . . ."). As such, the preambles that describe the phased array antenna system as a geodesic sphere are a "necessary component of the claimed invention" because they provide the antecedent basis to understand the shape or structure of the geodesic three-dimensional structures described in the subparts of the independent claims. See Pacing Techs., 778 F.3d at 1024.

The term "geodesic sphere phased array antenna structure" is recited and reiterated with identical language in the sixth subparts of each independent claim, providing:

> each said cellular communication space for electronic scanning being defined by a plurality of discrete chosen directions, corresponding to the said geodesic sphere phased array structure and each said cellular communication space adapted to be electronically scanned by a plurality of active said contiguous phased subarrays corresponding to the said cellular communication space.

'134 Patent 13:30-37, 14:60-67, 15:48-55, 16:40-47 (emphasis added). The "said" "geodesic sphere phased array structure" explicitly refers back to the preamble language that defines the independent claims to be "geodesic sphere phased array antenna system[s]." '134 Patent 12:65-67, 14:32-34, 15:20-22, 16:14-16. This repetition of "geodesic sphere" in the sixth subpart would signal to a person of ordinary skill in the art that the shape of the "phased array antenna system" must be a geodesic sphere as stated in the preamble. Proveris Sci. Corp. v. Innovasystems, Inc., 739 F.3d 1367, 1373 (Fed. Cir. 2014); Bicon, 441 F.3d at 952.

Finally, each of the 26 dependent claims of the '134 Patent refer to their corresponding independent claims as "geodesic sphere phased array antenna" structures. This indicates that the preamble limits the claims to "geodesic sphere" structures rather than any other shaped structure. For example, dependent Claim 21 recognizes independent Claim 19 to be a geodesic sphere and adds limitations only pertinent to a sphere structure:

> 21. The geodesic sphere phased array antenna as set forth in claim 19 where each of the said regular planar surfaces of the polyhedron is further subdivided into

planar triangular surfaces forming pyramidal structures with their common vertices projected radially outwards onto the circumscribing sphere and each of said triangular planar surfaces is fitted with subarrays of antenna elements.

'134 Patent 15:61-67 (emphasis added).

The title of the '134 Patent and the specification further support finding that the only phased array antenna structure claimed is in the shape of a geodesic sphere. The title of the '134 Patent is "Geodesic Sphere Phased Array Antenna System," and the Detailed Description of the Invention portion of the '134 Specification refers to the "present invention" as being a "geodesic sphere phased array antenna." '134 Patent 6:24-25; Deere & Co. v. Bush Hog, LLC, 703 F.3d 1349, 1358 (Fed. Cir. 2012).

In sum, three factors persuade the Court that the preambles recited in independent Claims 1, 14, 19, and 25 limit all claims to sphere shaped structures. First, the body of the independent Claims 1, 14, 19, and 25 each derive meaning from the term "sphere" in their preambles. Second, every dependent claim refers to its corresponding independent claims as "geodesic sphere phased array antenna." Third, the '134 Specification defines the "present invention" as a "geodesic sphere phased array antenna."

**The Claims**

As stated above, the "bedrock principle" of patent law is that "'the claims of a patent define the invention to which the patentee is entitled the right to exclude.'" Phillips, 415 F.3d at 1312 (quoting Innova, 381 F.3d at 1115). As such, the Court first looks to the claim language itself when construing claim terms before considering other intrinsic evidence. Id. ("[T]he claims are 'of primary importance, in the effort to ascertain precisely what is patented.'" (quoting Merrill v. Yeomans, 94 U.S. 568, 570 (1876)).

Plaintiff asserts that "sphere" means "spherical" because "[w]hat portion of the spherical surface is actually involved depends on the specific applications (in terms of radar or communications applications) for which the spherical phased array antenna is built and utilized." Pl.'s Br. 2 (ECF 137). Plaintiff contends that "spherical" can encompass as little as 10% of a sphere's surface. Id. Plaintiff, however, does not point to any claim language to support his assertions.

The ordinary and customary meaning of the term "sphere" readily connotes the shape of a round ball. Phillips, 415 F.3d at 1314 ("In some cases, the ordinary meaning of claim language . . . may be readily apparent even to lay judges, and claim construction in such cases involves little more than the application of the widely accepted meaning of commonly understood words."); Omega Eng'g, Inc. v. Raytek Corp., 334 F.3d 1314, 1323 (Fed. Cir. 2003) ("We indulge a heavy presumption that claim terms carry their full ordinary and customary meaning, unless the patentee unequivocally imparted a novel meaning to those terms or expressly relinquished claim scope during prosecution." (internal citations and quotation marks omitted)). Based on the claims, a person of ordinary skill in the art would understand that the geodesic sphere phased array antenna is less than a full sphere if ground-based and would take the form of a complete sphere if deployed for use in outer space. See, e.g., '134 Patent 14:28-32. Here, the ordinary and customary meaning

of "sphere" supports Defendant's construction that the geodesic sphere phased array antenna system should be at least "greater than a hemisphere" for the phased array antenna structure to reflect the commonly understood shape of a sphere, while accounting for ground-based applications. Phillips, 415 F.3d at 1314.

Moreover, accepting Plaintiff's construction of "sphere" as "spherical" would result in converting a noun - - "sphere" - - into the adjective "spherical." Such a construction would fail to give meaning to the term "sphere" as a noun that defines the overall structure of the claimed phased array antenna. In re Hyatt, 708 F.2d 712, 714 (Fed. Cir. 1983) ("A claim must be read in accordance with the precepts of English grammar.").

As such, the ordinary and customary meaning of the term "sphere" as it appears in all claims of the '134 Patent supports Defendant's construction that the term "sphere" should be construed as "greater than a hemisphere so as to provide the phased array antenna hemispherical or wider coverage." Def.'s Br. 1.

**The Specification**

The specification repeatedly states that the "present invention" of the '134 Patent is a geodesic sphere phased array antenna that must be greater than a hemisphere so as to provide "hemispherical or wider coverage":

- "This invention relates, in general, to phased array antennas which provide hemispherical or wider coverage for multi-satellite communications and more particularly to a phased array antenna mounted on a geodesic sphere and adapted for multi-band communications with satellites in earth orbits including low earth orbits, medium earth orbits, and geo-stationary orbits." '134 Patent 1:8-14 (emphasis added).

- "It is the main objective of the present invention to create a low cost phased array antenna architecture that will provide communication coverage over the entire hemisphere." Id. at 3:49-52.

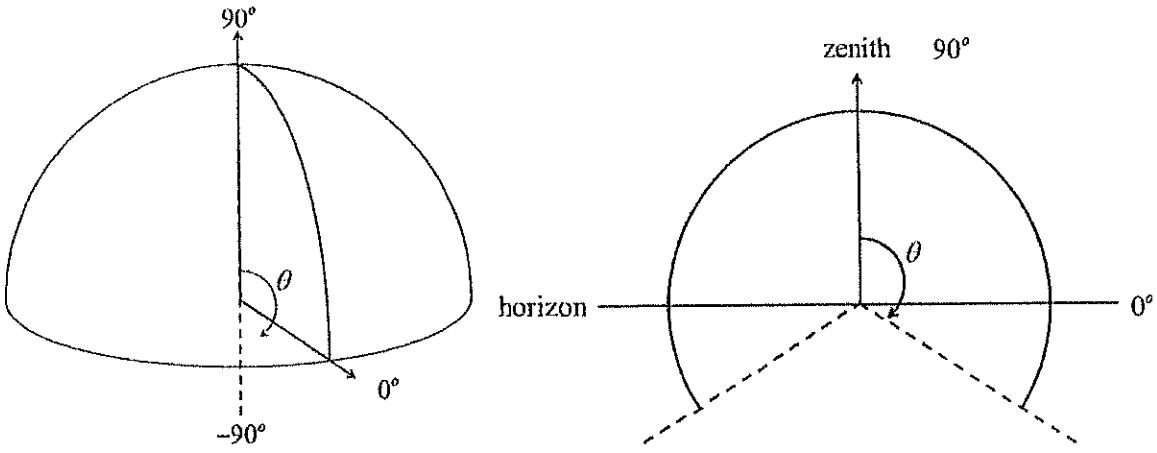
- "The geodesic sphere phased array antenna to be constructed for hemispherical coverage will be larger than the hemisphere but less than a full sphere. Depending on the array antenna gain required for specific applications, the geodesic sphere array structure may extend in elevation space from -45° through +90° (zenith) which is ¾th sphere." Id. at 8:29-34.

The most probative portion of the '134 Specification precisely defining the amount of a sphere's surface area claimed in the '134 Patent is the following:

> The geodesic sphere phased array antenna structure is designed to provide greater than hemispherical coverage and in the present invention, the elevation angle of the structure extends from +90° through -θ° where θ° could be 45° to 30°.

'134 Patent 6:36-40.

A person of ordinary skill in the art would understand this passage to mean the '134 Patent defines a "sphere" to be a structure that is greater than a hemisphere but less than a sphere because the 90° point of elevation angle θ describes the top, or zenith, of the sphere, and elevation angle θ dips below the horizon to between -30° and -45° degrees. Defendant's expert, Dr. Randy Haupt,[4] depicted this description in two drawings:




Haupt Decl. ¶ 41. The first drawing is a three-dimensional hemisphere. The angle θ is shown as dipping below the horizon, the 0° line, to approximately -30°. The second drawing is a vertical slice through the center of the sphere. It shows a structure greater than a hemisphere in which θ is defined from approximately 90° to -30° on one side of the sphere and from 90° to 210° on the other side, i.e. at a 30-degree angle below the horizon line in all directions. By requiring the geodesic sphere to be between 30° and 45° below the horizon, the '134 Specification unequivocally describes a structure that is greater than a hemisphere but less than a sphere.

Further, the specification only discloses embodiments of the geodesic sphere that are greater than a hemisphere in size. See, e.g, '134 Patent Fig. 1; see Rectractable Techs., Inc. v. Becton Dickinson & Co., 653 F.3d 1296, 1305 (Fed. Cir. 2011) (finding that claims directed to retractable syringe must have a one-piece body and not a multi-piece body because the embodiments in the specification did not "disclose a body that consists of multiple pieces or indicate that the body is anything other than a one-piece body"). Here, the specification includes eight figures disclosing embodiments of geodesic spheres that are greater than a hemisphere. See '134 Patent Figs. 1, 2(a), 5(b), 6(b), 12(b), and 13(a), (b), and (c). For example, Figure 2(a) depicts the following:

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[4] Dr. Randy Haupt is a Professor of Electrical Engineering and Computer Science at the Colorado School of Mines, with 38 years of experience in phased array antennas. He has a Ph.D. in Electrical Engineering from the University of Michigan. In 1993, he was named the Federal Engineer of the Year - - the top engineer employed by the United States Government. He is currently the chair of the Institute of Electrical and Electronics Engineers ("IEEE") Antennas and Propagation Society Fellow Committee, and from 1999 to 2014, was a member of the IEEE Antennas Definitions Working Group that defines government and industry terms for antenna specifications. Haupt Decl. ¶¶ 4-11.

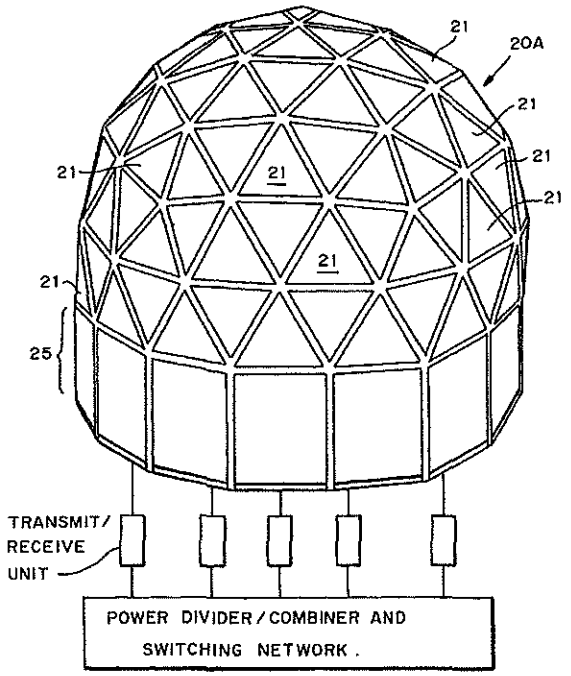


FIG. 2A

The '134 Specification states that Figure 2(a) "is a schematic perspective view of one embodiment of the invention showing an array antenna system mounted on a . . . geodesic structure larger than a hemisphere and with electrical feed structure and signal processing means coupled to the antenna system." '134 Patent 4:53-57.

In addition, the '134 Specification provides Table 1 called a "Quantitative description of the geodesic sphere" that only discloses a description of a "full geodesic sphere" and a "3/4 geodesic sphere," stating:

TABLE 1

Quantitative description of the geodesic sphere

| | (for the full geodesic sphere) | | | (for 3/4th geodesic sphere) |
|---|---|---|---|---|
| frequency ν | number of vertices | number of edges | number of faces | number of faces |
| 1 (icosahedron) | 12 | 30 | 20 | 15 |
| 2 | 42 | 120 | 80 | 60 |
| 3 | 92 | 270 | 180 | 135 |
| 4 | 162 | 480 | 320 | 240 |
| 5 | 252 | 750 | 500 | 375 |
| 6 | 362 | 1080 | 720 | 540 |
| 7 | 492 | 1470 | 980 | 735 |
| 8 | 642 | 1920 | 1280 | 960 |
| 9 | 812 | 2430 | 1620 | 1215 |
| 10 | 1002 | 3000 | 2000 | 1500 |

'134 Patent 8:1-20.

## Conclusion

Based on the ample intrinsic evidence, the Court construes the term "sphere" as present in all claims of the '134 Patent to be "greater than a hemisphere so as to provide the phased array antenna hemispherical or wider coverage."

The Court will conduct a telephonic status conference to discuss further proceedings on **February 8, 2017, at 2:00 p.m. E.S.T.** The Court will initiate the call.

Mary Ellen Coster Williams

**MARY ELLEN COSTER WILLIAMS**
**Judge**