IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

CONSTELLATION DESIGNS, LLC,	§	
	§	
Plaintiff,	§	
	§	
v.	§	
	§	Case No. 2:21-cv-0448-JRG
LG ELECTRONICS, INC., LG ELECTRONICS USA, INC., and LG ELECTRONICS ALABAMA, INC.,	§	
	§	
Defendants.	§	

CLAIM CONSTRUCTION ORDER

In this patent case, Constellation Designs, LLC, alleges infringement by LG Electronics, Inc., LG Electronics USA, Inc., and LG Electronics Alabama, Inc., (together, "LG") of 60 claims from seven related patents. Each of the patents "relates to bandwidth and/or power efficient digital transmission systems and more specifically to the use of unequally spaced constellations having increased capacity." U.S. Patent 8,842,761 at 1:25–28; *see also* U.S. Patent 9,743,290 at 1:41–44; U.S. Patent 10,567,980 at 1:36–39; U.S. Patent 10,693,700 at 1:38–41; U.S. Patent 11,018,922 at 1:51–54; U.S. Patent 11,019,509 at 1:38–41; U.S. Patent 11,039,324 at 1:57–60.

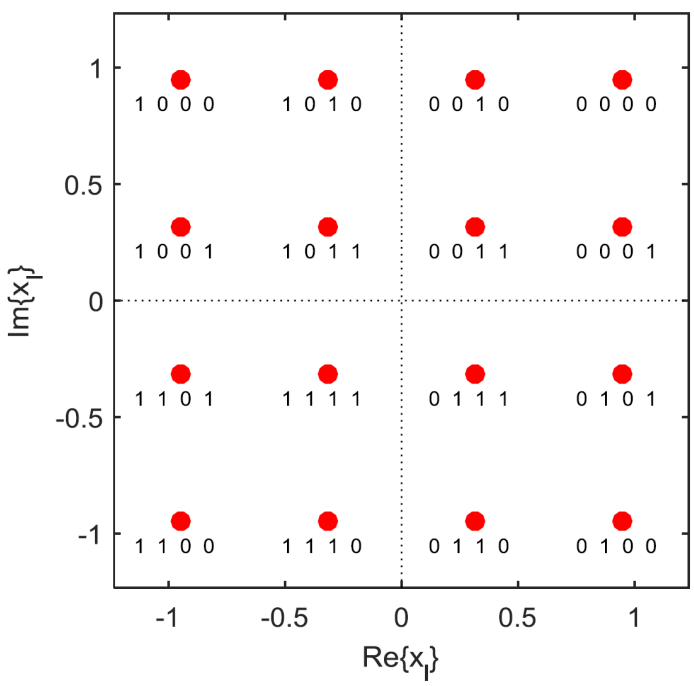
The parties present two disputes about claim scope,[1] with LG contending three terms render certain claims indefinite. Having considered the parties' briefing and arguments of counsel during the February 14, 2023 hearing, the Court rejects that contention.

[1] Constellation's opening brief presents seven disputes. Dkt. No. 75 at i. In its response, LG withdrew its challenges to four of those disputes and did not respond to Constellation's briefing on a fifth. Dkt. No. 81 at 18. *See also* Joint Cl. Constr. Chart, Dkt. No. 83.

I. BACKGROUND

The patents concern the use of unequally spaced constellations in digital communication systems. In the context of such systems, a "constellation" is a set of symbols mapped to the amplitudes of carrier waves during a time slot. *See* '922 Patent at 1:55–67. Generally, a transmitter has a mapper to encode bits into symbols of a constellation and a modulator to generate a signal corresponding to the symbols. *See id.* at 2:51–59. At the receiver, the values of the received amplitudes are demapped to determine the transmitted symbols. *See id.* at 2:59–64.

As an example, quadrature amplitude modulation (QAM) uses two carrier waves of the same frequency that are 90° out of phase: the "in-phase" (or I) carrier and the quadrature (or Q) carrier. Each symbol of the constellation can thus be represented as a point in an I-Q plane based on the amplitudes of the I and Q carriers. For example, an *equally* spaced constellation diagram for a 16 QAM scheme might look like this:



See Non-Uniform Constellations for ATSC 3.0, Dkt. No. 75-4 at 199 (Fig. 3; noting "[t]he constellation points are uniformly located on an orthogonal grid with the same minimum Euclidean distance of points to their closest neighbours"). Here, if both axes are at the maximum amplitudes during a time slot, the demapper at the receiver would likely interpret the symbol as "0000." Similarly, if both carriers are at their minimum amplitudes during a time slot, the demapper would likely interpret the symbol as "1100."

The potential problem is noise, which might cause the received signal to vary from the transmitted signal in one or both directions in the plane. The further apart the symbols on the diagram, the more tolerant the system in interpreting a noisy received signal. *See* '922 Patent at 1:59–61 ("The minimum distance (d_{min}) between constellation points is indicative of the capacity of a constellation at high signal-to-noise ratios (SNRs)."). For this reason, system designers attempt to maximize the spacing between symbols, but the tradeoff is smaller constellations and therefore less-efficient systems. *See id.* at 1:62–63 ("Therefore, constellations used in many communication systems are designed to maximize d_{min}."); Constellation Design via Capacity Maximization, Dkt. No. 75-3 at 1821 (noting "constellations have most often been designed to maximize d_{min}," which "is not necessarily a good measure at low SNRs typical of coded systems, particularly with capacity approaching codes").

The patents concern *unequally* spaced (i.e., "non-uniform") constellations. For example, FIG. 21 of the '922 Patent shows a QAM-64 constellation diagram in which the spacing between the symbols is smallest near the two axes. This specific constellation is beneficial because it allows for the use of low-complexity demappers. *See* '922 Patent at 15:8–12.

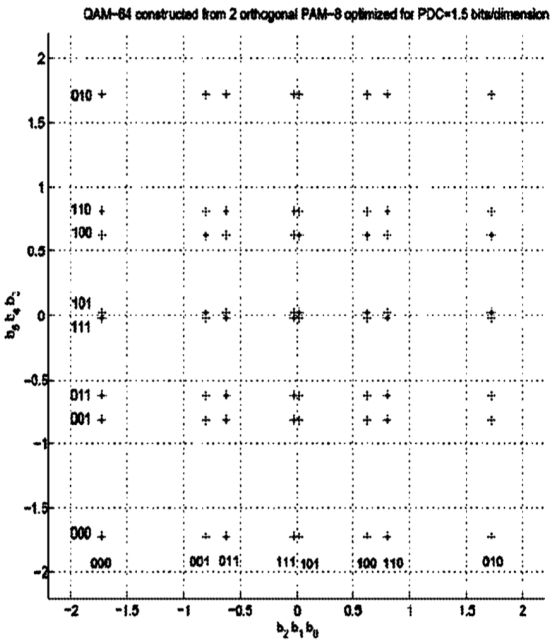


FIG. 1 of the ’922 Patent

The patents more specifically concern processes for selecting optimized unequal constellations based on specific coding rates and SNRs. The patents explain that process with respect to the iterative loop shown in FIG. 5. *See generally* ’922 Patent at 10:5–11:64. At the end of the process, the output constellations have increased capacity relative to conventional constellations for a fixed code rate and modulation scheme. *Id.* at 11:65–12:2.

The claims at issue specify the desired constellations. For example, Claim 1 of the ’922 Patent requires a transmitter with a coder and a mapper “capable of mapping the encoded bits to symbols in a non-uniform quadrature amplitude modulation 1024-point symbol constellation (NU-QAM 1024).” ’922 Patent at 20:65–21:12. The claim then specifies:

> the NU-QAM 1024 constellation comprises an in-phase component and a quadrature component, where each component comprises 32 levels of amplitude such that the amplitudes scaled by a scaling factor are within 0.55 from the following set of amplitudes: -38.424, -31.907, -24.169, -26.796, 38.425, 31.908, -20.038, -19.169, -7.759,

> -7.759, -11.460, -11.460, -4.850, -4.850, −15.014, -15.205, 20.038, 19.170, 15.206, 15.015, 24.170, 26.797, 11.460, 11.460, 1.326, 1.326, 4.849, 4.849, -1.328, -1.328, 7.759, and 7.759.

Id. at 21:13–23. Each claim at issue is similarly structured and concerns either a transmitter that maps symbols to a NU-QAM 1024 constellation or a receiver that demaps the received signal into a NU-QAM 1024 constellation. *See id.* at 24:27–51 (reciting, in Claim 24, a receiver with "a demapper . . . capable of determining likelihoods using the demodulated signal and a non-uniform quadrature amplitude modulation 1024-point symbol constellation (NU-QAM 1024); '324 Patent at 35:38–63 (Claim 24), 39:44–67 (Claim 47), 41:19–37 (Claim 60), 41:57–42:8 (Claim 62).

LG challenges these six claims as indefinite for two reasons. First, LG argues two terms in Claim 47 of the '324 Patent lack antecedent basis and are therefore indefinite. Second, LG contends "scaling factor" in each of the claims renders the claims boundless and therefore indefinite.

II. GENERAL LEGAL STANDARDS

A. Generally

"[T]he 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). As such, if the parties dispute the scope of the claims, the court must determine their meaning. *See, e.g.*, *Verizon Servs. Corp. v. Vonage Holdings Corp.*, 503 F.3d 1295, 1317 (Fed. Cir. 2007); *see also Markman v. Westview Instruments, Inc.*, 517 U.S. 370, 390 (1996), *aff'g*, 52 F.3d 967, 976 (Fed. Cir. 1995) (en banc).

Claim construction, however, "is not an obligatory exercise in redundancy." *U.S. Surgical Corp. v. Ethicon, Inc.*, 103 F.3d 1554, 1568 (Fed. Cir. 1997). Rather, "[c]laim construction is a matter of [resolving] disputed meanings and technical scope, to clarify and when necessary to

explain what the patentee covered by the claims . . . ." *Id.* A court need not "repeat or restate every claim term in order to comply with the ruling that claim construction is for the court." *Id.*

When construing claims, "[t]here is a heavy presumption that claim terms are to be given their ordinary and customary meaning." *Aventis Pharm. Inc. v. Amino Chems. Ltd.*, 715 F.3d 1363, 1373 (Fed. Cir. 2013) (citing *Phillips*, 415 F.3d at 1312–13). Courts must therefore "look to the words of the claims themselves . . . to define the scope of the patented invention." *Id.* (citations omitted). The "ordinary and customary meaning of a claim term is the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention, i.e., as of the effective filing date of the patent application." *Phillips*, 415 F.3d at 1313. This "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.*

Intrinsic evidence is the primary resource for claim construction. *See Power-One, Inc. v. Artesyn Techs., Inc.*, 599 F.3d 1343, 1348 (Fed. Cir. 2010) (citing *Phillips*, 415 F.3d at 1312). For certain claim terms, "the ordinary meaning of claim language as understood by a person of skill in the art 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." *Phillips*, 415 F.3d at 1314; *see also Medrad, Inc. v. MRI Devices Corp.*, 401 F.3d 1313, 1319 (Fed. Cir. 2005) ("We cannot look at the ordinary meaning of the term . . . in a vacuum. Rather, we must look at the ordinary meaning in the context of the written description and the prosecution history."). But for claim terms with less-apparent meanings, courts consider "those sources available to the public that show what a person of skill in the art would have understood disputed claim language to mean . . . [including] the words of the claims themselves, the remainder of the specification, the

prosecution history, and extrinsic evidence concerning relevant scientific principles, the meaning of technical terms, and the state of the art." *Id.*

B. Indefiniteness

"[A] patent is invalid for indefiniteness if its claims, read in light of the specification delineating the patent, and the prosecution history, fail to inform, with reasonable certainty, those skilled in the art about the scope of the invention." *Nautilus, Inc. v. Biosig Instruments, Inc*., 572 U.S. 898, 901 (2014). The claims "must be precise enough to afford clear notice of what is claimed," but that consideration must be made while accounting for the inherent limitations of language. *Id.* at 908. "Indefiniteness must be proven by clear and convincing evidence." *Sonix Tech. Co. v. Publ'ns Int'l, Ltd.*, 844 F.3d 1370, 1377 (Fed. Cir. 2017).

"[A] claim could be indefinite if a term does not have proper antecedent basis where such basis is not otherwise present by implication or the meaning is not reasonably ascertainable." *Halliburton Energy Servs., Inc. v. M-I LLC*, 514 F.3d 1244, 1249 (Fed. Cir. 2008). But "[w]hen the meaning of the claim would reasonably be understood by persons of ordinary skill when read in light of the specification, the claim is not subject to invalidity upon departure from the protocol of 'antecedent basis.'" *Energizer Holdings, Inc. v. I.T.C.*, 435 F.3d 1366, 1370 (Fed. Cir. 2006); *see also Trover Grp., Inc. v. Dedicated Micros USA*, No. 2:13-CV-1047-WCB, 2015 WL 1263358, at *9 (E.D. Tex. Mar. 19, 2015) (Bryson, J., sitting by designation) (noting that, despite the "clumsy" absence of antecedent basis, "a person of ordinary skill in the art would readily understand the meaning of the claim.").

III. THE LEVEL OF ORDINARY SKILL IN THE ART

The level of ordinary skill in the art is the skill level of a hypothetical person who is presumed to have known the relevant art at the time of the invention. *In re GPAC*, 57 F.3d 1573,

1579 (Fed. Cir. 1995). In resolving the appropriate level of ordinary skill, courts consider the types of and solutions to problems encountered in the art, the speed of innovation, the sophistication of the technology, and the education of workers active in the field. *Id.* Importantly, "[a] person of ordinary skill in the art is also a person of ordinary creativity, not an automaton." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 421 (2007).

Here, Constellation alleges a skilled artisan at the time of invention "would have a Bachelor of Science degree or higher in Electrical or Computer Engineering or Science with 3 or more years of experience designing or working with digital communication systems." Dkt. No. 75 at 5 (citing Jones Decl., Dkt. No. 76-1 ¶ 85). LG does not challenge this level of ordinary skill in its response. Accordingly, the Court adopts this skill level for its analysis.

IV. THE DISPUTED TERMS

A. "the NU-QAM 1024" and "the LDPC code" ('324 Patent, Claim 47)

Term	Plaintiff's Construction	Defendants' Construction
"the NU-QAM 1024"	Not Indefinite. Alternatively, "a NU-QAM 1024"	Indefinite. Alternatively, "a non-uniform quadrature amplitude modulation 1024-point symbol constellation (NU-QAM 1024)." Dkt. No. 81 at 17.
"the LDPC code"	Not Indefinite. Alternatively, "a LDPC code"	Indefinite. Alternatively, "a Low Density Parity Check (LDPC) code." Dkt. No. 81 at 17.

LG argues these terms are indefinite because they lack antecedent basis. A skilled artisan, suggests LG, would be unclear as to what constellation and code "the NU-QAM 1024" and "the LDPC code" refer. Dkt. No. 81 at 17. It then criticizes Constellation for failing to cite any evidence

supporting the contention "the terms have 'obvious and definite scope in light of the intrinsic evidence.'" *Id.* (quoting Dkt. No. 75 at 12).

These terms are not indefinite. For one, even though it has the burden of showing indefiniteness by clear and convincing evidence, LG presents no evidence a skilled artisan would not understand the scope of these terms or claims. Regarding "the NU-QAM 1024," the claim itself defines the constellation. Further, despite LG's contrary suggestion, nothing about the context of the claim suggests either term is referring to a constellation or code from a different claim. Here, despite the lack of antecedent basis, "a person of ordinary skill in the art would readily understand the meaning of the claim." *Trover Grp., Inc.*, 2015 WL 1263358, at *9.

The parties' alternative constructions are correct and have the same scope. Accordingly, no further construction is required for these terms.

B. Whether the "Scaling Factor" Terms Are Indefinite ('922 Patent, Claims 1, 24; '324 Patent, Claims 24, 47, 60, 62)

Each of these claims concerns either a transmitter with a mapper or a receiver with a demapper to either generate or receive, respectively, signals corresponding to specific constellations. Each claim limits the constellation as having "the amplitudes scaled by a scaling factor" and within some range. For example, in Claim 1 of the '922 Patent:

> the NU-QAM 1024 constellation comprises an in-phase component and a quadrature component, where each component comprises 32 levels of amplitude such that the amplitudes *scaled by a scaling factor* are *within 0.55 from the following set of amplitudes*: -38.424, 1.907, -24.169, -26.796, 38.425, 31.908, -20.038, -19.169, -7.759, -7.759, -11.460, -11.460, -4.850, -4.850, −15.014, -15.205, 20.038, 19.170, 15.206, 15.015, 24.170, 26.797, 11.460, 11.460, 1.326, 1.326, 4.849, 4.849, -1.328, -1.328, 7.759, and 7.759.

'922 Patent at 21:13–22 (emphasis added).

LG contends these claims are indefinite under 35 U.S.C. § 112 ¶ 2 (pre-AIA) because of the "scaling factor" language. According to LG, "the asserted claims do not provide any guidance or bounds on the value of the scaling factor." Dkt. No. 81 at 13. Because "the 'scaling factor' could, in theory, be any number from negative infinity to positive infinity," "the claim language fails to delineate the constellations 'which the applicant regards as his invention.'" *Id.* Moreover, it argues, each claim requires the values to be within a certain range, which themselves can be scaled. *Id.* "The claims thus layer one infinite number of possibilities onto another." *Id.* at 14.

LG does not carry its burden. For one, LG provides no evidence a person of ordinary skill would not understand the meaning of the term or the scope of the claims. Second, LG confuses breadth with indefiniteness. The claims are directed to the relative positions of symbols in the I-Q plane, which is analogous to claiming a table that is twice as long as it is wide. That an infinite number of table sizes (or constellations) would satisfy the limitation does not render the claim impermissibly boundless. When pressed for controlling authority to the contrary during the hearing, LG had none. *See* H'rg Tr., Dkt. No. 93 at 34:4–17.

LG relies primarily on *Light Transformation Techs. LLC v. Lighting Sci. Grp. Corp.*, No. 2:12-cv-826-MHS-RSP, 2014 WL 3402125 (E.D. Tex. July 11, 2014). Dkt. No. 81 at 14–15; *see also* H'rg Tr., Dkt. No. 93 at 26:1–27–2, 34:14–17. Specifically, it analogized to the Court's holding that "axis of light" was indefinite because the specification of the patent at issue did not provide guidance as to which of an infinite number of axes was the recited axis. *Id.*

Light Transformation is easily distinguishable. Representative Claim 1 recited a light transformer comprising:

> a first planar optical window . . . being substantially perpendicular to the *axis of light direction*;

> . . . ; and
>
> a second planar optical window . . . being substantially perpendicular to the *axis of light direction*, the *second planar optical window* further being *symmetrical across the axis of light direction* with the first planar optical window . . . .

Light Transformation, 2014 WL 3402125, at *2 (citing U.S. Patent 8,220,959). The Court concluded:

> [I]t is undisputed that light propagates in three-dimensions on an infinite number of axes. Indeed, the specification illustrates numerous exemplary axes of light directions for any given viewpoint. For example, Figure 7 depicts a number of light rays 710, 720, 730, 740, and 750 propagating "straight from the light source along *an axis* coincident with a radial line defining a radius of the circular reflective interior surface." '959 Patent at 5:12–14 (emphasis added). Based on this figure, a person of ordinary skill in the art would be unable to determine which one of these exemplary axes is the "axis of light direction."

Id. at *8. And because a person of ordinary skill would not know which axis is recited, a skilled artisan would be unable to determine if the first and second planar optical windows were "substantially perpendicular to the axis of light direction," as required by Claim 1.

Here, however, LG presents a different issue. Rather than arguing lack of sufficient specificity analogous to *Light Transformation*, LG stresses the "unbounded" nature of "scaling factor." But an "unbounded" claim is not *per se* indefinite under § 112 ¶ 2. *See, e.g.*, *United Access Techs., LLC v. AT&T Corp.*, 757 F. App'x 960, 971 (Fed. Cir. 2019) ("[T]hat the claim language, at least in theory, covers any [higher frequency] does not render the claim language indefinite, even though the use of very high frequencies would be impractical."). To be sure, there are situations in which the "unbounded" nature of claim language renders a claim indefinite, *see, e.g.*, *MagSil Corp. v. Hitachi Glob. Storage Techs., Inc.*, 687 F.3d 1377, 1383 (Fed. Cir. 2012) (holding invalid, for lack of enablement, a claim reciting a range with a lower threshold but no upper limit);

Med. Instrumentation & Diagnostics Corp. v. Elekta AB, 344 F.3d 1205, 1211 (Fed. Cir. 2003) (noting, in the context of § 112 ¶ 6, "[i]f the specification is not clear as to the structure that the patentee intends to correspond to the claimed function, then the patentee . . . is rather attempting to claim in functional terms unbounded by any reference to structure in the specification"), but this is not one of them. Accordingly, the recitation of "scaling factor" does not render these claims indefinite.

V. CONCLUSION

Disputed Term	The Court's Construction
"the NU-QAM 1024" and "the LDPC code"	Not indefinite.
the "scaling factor" terms	Not indefinite.

The Court **ORDERS** each party not to refer, directly or indirectly, to its own or any other party's claim-construction positions in the presence of the jury. Likewise, the Court **ORDERS** the parties to refrain from mentioning any part of this opinion, other than the actual positions adopted by the Court, in the presence of the jury. Neither party may take a position before the jury that contradicts the Court's reasoning in this opinion. Any reference to claim construction proceedings is limited to informing the jury of the positions adopted by the Court.

SIGNED this 28th day of February, 2023.

ROY S. PAYNE
UNITED STATES MAGISTRATE JUDGE