

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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APPLE INC., HTC CORPORATION, and HTC AMERICA, INC.,  
Petitioner,

v.

INVT SPE LLC,  
Patent Owner.

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IPR2018-01581<sup>1</sup>  
Patent 7,848,439 B2

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Before THU A. DANG, KEVIN F. TURNER, and BARBARA A. BENOIT,  
*Administrative Patent Judges.*

BENOIT, *Administrative Patent Judge.*

JUDGMENT  
Final Written Decision  
Determining No Challenged Claim Unpatentable  
35 U.S.C. § 318(a)

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<sup>1</sup> Apple Inc., who filed a petition in IPR2019-00959, has been joined as a petitioner in IPR2018-01581. Paper 13.

## I. INTRODUCTION

In this *inter partes* review instituted pursuant to 35 U.S.C. § 314, Apple Inc., HTC Corporation and HTC America, Inc. (collectively, “Petitioner”) challenge the patentability of claim 8 of U.S. Patent No. 7,848,439 B2 (Ex. 1001, “the ’439 patent” or “the challenged patent”), owned by INVT SPE LLC (“Patent Owner”). We have jurisdiction under 35 U.S.C. § 6. This Final Written Decision is entered pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. This Final Written Decision is entered concurrently with a final written decision in IPR2018-01555 that challenges the patentability of claims 1–7 of the ’439 patent.

For reasons discussed herein, Petitioner has not shown by a preponderance of the evidence that claim 8 is unpatentable.

### A. Procedural History

HTC Corporation and HTC America, Inc. filed a Petition requesting *inter partes* review of the challenged claim. Paper 1 (“Pet.” or “Petition”). Patent Owner filed a Preliminary Response to the Petition. Paper 6. On April 1, 2019, after considering the information presented in the Petition and the Preliminary Response, we instituted an *inter partes* review of the challenged claim on the sole ground asserted by Petitioner. Paper 9 (“Dec.”).

Subsequent to the Decision on Institution, Apple Inc. (“Apple”) filed a petition asserting the same unpatentability ground on which we instituted review and timely filed a motion for joinder. IPR2019-00959, Paper 1 (Petition); Paper 13, 5. We determined that Apple’s petition met the threshold of institution and that joinder of Apple to this proceeding was appropriate. Paper 13, 12. Accordingly, we granted Apple’s motion. *Id.*

Patent Owner filed a Response (Paper 14; “PO Resp.”), to which Petitioner filed a Reply (Paper 23; “Pet. Reply”). In response, Patent Owner filed a Sur-reply (Paper 31; “PO Sur-reply”). A hearing was held on January 8, 2020. *See* Paper 34 (“Tr.”).

*B. Real Parties in Interest*

The Petition identifies HTC Corporation and HTC America, Inc. as real parties in interest and the petition in IPR2019-00959 identifies Apple Inc. as a real party in interest. Pet. 1; IPR2019-00959, Paper 1, 1. Patent Owner identifies INVT SPE LLC as the real party in interest. Paper 3, 2.

*C. Related Matters*

As required by 37 C.F.R. § 42.8(b)(2), each party identified various judicial or administrative matters that would affect or be affected by a decision in this proceeding. Pet. 1–2; Paper 3 (Patent Owner’s Mandatory Notice), 2–3; IPR2019-00959, Paper 1, 1.

The parties identify the following district court cases: *INVT SPE LLC v. HTC Corporation, HTC America, Inc.*, No. 2:17-cv-03740 (D. N.J.); *INVT SPE LLC v. ZTE*, No. 2:17-cv-06522 (D.N.J.); *INVT SPE LLC v. Apple, Inc.*, No. 2:17-cv-03738 (D.N.J.); *Inventergy, Inc. v. HTC Corporation*, No. 2:17-cv-00200 (D. Del.); *Inventergy, Inc. v. Apple, Inc.*, No. 2:17-cv-00196 (D. Del.). Pet. 1; Paper 3, 2; IPR2019-00959, Paper 1, 1. Petitioner also identifies U.S. International Trade Commission Investigation No. 337-TA-1138, styled *Certain KTE- and 3G-Compliant Cellular Communications Devices*. IPR2019-00959, Paper 1, 1. Patent Owner identifies ten *inter partes* review proceedings that various petitioners requested. Paper 3, 2–3.

#### *D. The Challenged Patent*

The '439 patent, titled "Communication Apparatus, Communication System, and Communication Method," describes techniques for adaptive modulation and coding that result in improved spectrum usage in mobile communications between a handset and a base station. Ex. 1001, code (57) (Abstract), 1:10–26.

##### *1. The Written Description*

The patent describes techniques for a wireless communication orthogonal frequency division multiplexing (OFDM) system that transmits high-speed data using a large number subcarrier frequency bandwidths. *Id.* at 1:10–14. The patent explains the concept of adaptive modulation and coding (AMC) is "to change modulation and coding parameters in transmission based on channel characteristics at [the] current time." *Id.* at 1:65–67. "With OFDM, adaptivity . . . refers to adaptivity at two domains of time domain and frequency domain." *Id.* at 1:67–2:2.

The patent identifies two types of AMC used in conventional OFDM. *Id.* at 2:3. The first type of AMC is adaptivity based on individual OFDM subcarriers, which is difficult to implement due to the number of subcarriers. *Id.* at 2:3–12. The second type of AMC in OFDM is adaptivity based on groups of subcarriers, and the patent refers to groups of subcarrier as subbands. *Id.* at 2:12–21. The patent indicates that in prior art subband AMC: "a subband indicates a subcarrier group comprised of subcarriers in neighboring positions on the frequency domain." *Id.* at 2:19–21. The conventional method of adaptivity based on subbands (groups of subcarriers) reduced the difficulty of implementing adaptivity and reduced feedback overhead. *Id.* at 4:56–60. But, these conventional methods were not able

“to effectively utilize diversity performance between subbands,” which the patent indicates “is an important method for improving wireless transmission quality.” *Id.* at 4:56–60.

The patent describes creating subband groups based on a predefined rule and selecting a modulation and coding scheme for the entire subband group, instead of doing so for a subband (group of subcarriers). *Id.* at 5:39–45, 8:57–60 (“On the receiving side, differences with subband adaptivity of the related art shown in FIG. 4B is that the unit of adaptive demodulation and coding is a subband group rather than a subband.”). The patent provides three examples of how subbands are to be grouped (combining neighboring subbands, combining subbands spaced at intervals, and combining all of the subbands) and indicates additional methods are possible. *Id.* at 10:29–33.

## 2. *The Challenged Claim*

Petitioner challenges independent claim 8 in the ’439 patent. Claim 8, reproduced below with brackets noting Petitioner’s identifiers, is illustrative of the claimed subject matter:

8. A communication apparatus comprising:

[8a<sup>2</sup>] a channel estimating section that carries out a channel estimation per subband;

[8b] a parameter deciding section that decides modulation parameters and coding parameters per subband group comprised of a plurality of the subbands based on a result of the channel estimation per subband;

[8c] a parameter information transmission section that transmits, to a communicating party, parameter information indicating the modulation parameters and the coding parameters decided at the parameter deciding section;

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<sup>2</sup> Petitioner’s limitation references are used for clarity and brevity.

- [8d] a receiving section that receives a signal containing data modulated and encoded on a per subband group basis at the communicating party using the modulation parameters and the coding parameters of the parameter information transmitted at the parameter information transmission section;
- [8e] a data obtaining section that demodulates and decodes the received signal received at the receiving section on a per subband group basis using the modulation parameters and the coding parameters decided at the parameter deciding section, and obtains the data contained in the received signal; and
- [8f] wherein the parameter deciding section decides the coding parameters in such a manner that a number of information bits obtained by assigning a weight per subband group to a sum of information bits that are able to be assigned to all of the subbands within the subband group, is assigned to the subband group.

Ex. 1001, 13:65–14:26.

### *3. The Prosecution History*

The PCT application that issued as the '439 patent on December 7, 2010 was filed on November 18, 2005 with twelve claims. Ex. 1001, code (22); Ex. 1002, 476–481 (PCT claims). The '439 patent claims priority to a 2004 Chinese patent application. Ex. 1001, code (30); *see* Paper 6 (Patent Owner's Preliminary Response), 5; Pet. 13. On February 2, 2010, the Examiner rejected the application's independent claims and some dependent claims as anticipated by the application's description of OFDM AMC prior art. Ex. 1002, 232–241 (citing Figs. 3A–3B (labeled prior art) and enumerated passages in the Background Art section). Application independent claim 1, for example, recited:

A communication apparatus comprising:  
a channel estimating section that carries out a channel estimation per subband;

- a parameter deciding section that decides modulation parameters and coding parameters per subband group comprised of a plurality of the subbands, based on the channel estimation result;
- a parameter information transmission section that transmits to a communicating party, parameter information that is information for the modulation parameters and the coding parameters decided at the parameter deciding section;
- a receiving section that receives a received signal containing data modulated and encoded per subband group at a communicating party using the modulation parameters and the coding parameters of the parameter information transmitted at the parameter information transmission section;
- a data obtaining section that demodulates and decodes the received signal received at the receiving section per subband group using the modulation parameters and the coding parameters decided at the parameter deciding section, and obtains the data contained in the received signal.

Ex. 1002, 476. According to the Examiner, however, some of the dependent claims would be allowable if written in independent form. Ex. 1002, 239.

The Examiner indicated that the prior art of record did not teach or suggest:

the parameter deciding section decides the coding parameters in such a manner that the number of information bits obtained by assigning a weight to the sum of the number of information bits that are able to be assigned to all of the subbands within the subband group, is assigned to the subband group.

Ex. 1002, 239 (identifying limitations in application claims 2 and 8); *see* Ex. 1001, 14:21–26 (patent claim 8).

In response, the Applicant amended the application claims to include one or the other of the identified allowable subject matter. Ex. 1002, 212–223. The Examiner allowed the claims in response to Applicant's

amendment, and in the Notice of Allowability identified allowable subject matter as including:

the parameter deciding section decides the coding parameters in such a manner that the number of information bits obtained by assigning a weight to the sum of the number of information bits that are able to be assigned to all of the subbands within the subband group, is assigned to the subband group [claim 8[f]]

Ex. 1002, 202; *see* Ex. 1001, 14:21–26 (patent claim 8). The '439 patent issued in due course. Ex. 1002, 190 (Issue Notification).

*E. Instituted Ground of Unpatentability*

We instituted *inter partes* review of claim 8 based on the sole ground of unpatentability asserted in the Petition. Dec. 43. Petitioner challenges claim 8 of the '439 patent as unpatentable under 35 U.S.C. § 103<sup>3</sup> over the following references:

U.S. Patent No. 6,904,283 B2, filed April 17, 2001, issued June 7, 2005 (Ex. 1003, “Li”);

U.S. Patent No. 7,221,680 B2, filed September 1, 2004, issued May 22, 2007 (Ex. 1004, “Vijayan”);

U.S. Patent No. 6,721,569 B1, filed September 29, 2000, issued April 13, 2004 (Ex. 1005, “Hashem”); and

U.S. Patent No. 5,596,604, filed August 17, 1993, issued January 21, 1997 (Ex. 1006, “Cioffi”).

Pet. 3. Petitioner indicates that the effective filing date of the challenged claim is no earlier than November 19, 2004 priority date and contends that each of the references are prior art to the challenged claim. Pet. 14

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<sup>3</sup> The Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112–29, 125 Stat. 284, 287–88 (2011), revised 35 U.S.C. § 103 effective March 16, 2013. Because the challenged patent was filed before March 16, 2013, we refer to the pre-AIA version of § 103.

(effective filing date), 17 (Li), 20 (Vijayan), 23 (Hashem), 25 (Cioffi). More specifically, Petitioner asserts the following ground:

| Claim Challenged | 35 U.S.C. § | References                  |
|------------------|-------------|-----------------------------|
| 8                | 103         | Li, Vijayan, Hashem, Cioffi |

Dec. 7–8, 43; *see* Pet. 3 (identification of asserted ground).

## II. ANALYSIS

### A. Legal Standards

To prevail in challenging the claim, Petitioner must demonstrate by a preponderance of the evidence that the claim are unpatentable. 35 U.S.C. § 316(e) (2012); 37 C.F.R. § 42.1(d) (2017). “In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable.” *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3) (requiring *inter partes* review petitions to identify “with particularity . . . the evidence that supports the grounds for the challenge to each claim”)); *see also* 37 C.F.R. § 42.104(b) (requiring a petition for *inter partes* review to identify how the challenged claim is to be construed and where each element of the claim is found in the prior art patents or printed publications relied on). This burden never shifts to Patent Owner. *See Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015) (citing *Tech. Licensing Corp. v. Videotek, Inc.*, 545 F.3d 1316, 1326–27 (Fed. Cir. 2008)) (discussing the burden of proof in *inter partes* review). Furthermore, Petitioner cannot satisfy its burden of proving obviousness by employing “mere conclusory statements.” *In re Magnum Oil Tools Int’l, Ltd.*, 829 F.3d 1364, 1380 (Fed. Cir. 2016).

A claim is unpatentable under 35 U.S.C. § 103 if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, would have been obvious at the time the invention was made to a person having ordinary skill in the art to which the subject matter pertains. *KSR Int’l Co. v. Teleflex, Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) objective evidence of nonobviousness.<sup>4</sup> *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

*B. Level of Ordinary Skill in the Art*

The parties dispute the level of ordinary skill in the art. The level of ordinary skill in the art is “a prism or lens through which . . . the Board views the prior art and claimed invention” to prevent hindsight bias. *Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001). In determining the level of ordinary skill, various factors may be considered, including the “types of problems encountered in the art; prior art solutions to those problems; rapidity with which innovation are made; the sophistication of the technology; and educational level of active workers in the field.” *In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995) (internal quotation and citation omitted). Generally, it is easier to establish obviousness under a higher level of ordinary skill in the art. *Innovation Toys, LLC v. MGA Entm’t, Inc.*, 637 F.3d 1314, 1323 (Fed. Cir. 2011) (“A less sophisticated

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<sup>4</sup> Patent Owner has not offered objective evidence of nonobviousness. *See generally* PO Resp.; PO Sur-reply.

level of skill generally favors a determination of nonobviousness . . . while a higher level of skill favors the reverse.”).

Relying on declaration testimony of Dr. Zhi Ding (Ex. 1007), Petitioner contends that one of ordinary skill in the art “had a bachelor degree in electrical engineering, computer science, or an equivalent field, plus at least three years of experience working in the fields of wireless communication systems, communication networks, and signal processing.” Pet. 13 (citing Ex. 1007 ¶ 61). To determine whether to institute this *inter partes* review, we adopted this level of ordinary skill, which Patent Owner did not dispute in its Preliminary Response. Dec. 9–10.

In its Response, Patent Owner disputes the type of experience Petitioner proposes for the level of ordinary skill and contends that one of ordinary skill in the art only need experience in “wireless communications.” PO Resp. 15. Specifically, Patent Owner contends that one of ordinary skill in the art need not have “experience with general ‘communication networks’ or ‘signal processing’ outside of wireless communication systems (such as with wired communication systems).” PO Resp. 15.

For support, Patent Owner cites to declaration testimony of Dr. Branimir Vojcic (Ex. 2101) stating:

I believe that a person skilled in the art of the technology described in the '439 patent would at least have both a bachelor's degree in Electrical Engineering (or an equivalent field) and three (3) years' experience in wireless communications or an MSc degree in Electrical Engineering (or an equivalent field) and one (1) year of experience in wireless communications.

Ex. 2101 ¶ 22; *see* PO Resp. 15 (citing Ex. 2101 ¶ 22). Because Dr. Vojcic does not provide reasoning or analysis to support his opinion, however, we accord little weight to his opinion. *See In re Acad. of Sci. Tech Ctr.*, 367

F.3d 1359, 1368 (Fed. Cir. 2004) (“[T]he Board is entitled to weigh the declarations and conclude that the lack of factual corroboration warrants discounting the opinions expressed in the declarations.”); *see also* 37 C.F.R. § 42.65(a) (“Expert testimony that does not disclose the underlying facts or data on which the opinion is based is entitled to little or no weight.”).

Patent Owner indicates that the challenged patent indicates “its ‘Technical Field’ pertains to ‘*wireless* communication orthogonal frequency division multiplexing (OFDM) system[s].” PO Resp. 15 (citing Ex. 1001, 1:13–14). In its entirety, the challenged patent describes its technical field as:

The present invention relates to a communication apparatus, communication system, and communication method, and particularly relates to a communication apparatus, communication system and communication method carrying out adaptive modulation and coding in adaptive transmission technology in Subcarrier communication systems—that is, in wireless communication orthogonal frequency division multiplexing (OFDM) system.

Ex. 1001, 1:7–14.

In reply, Petitioner and Dr. Ding maintain the position that one of ordinary skill in the art would have had experience in “wireless communication systems, communication networks, and signal processing.” Pet. Reply 2 (citing Ex. 1016 ¶ 62); Ex. 1016 ¶ 61. Unlike Dr. Vojcic, Dr. Ding explains the basis on which he formed his opinion:

To determine the characteristics of a person of ordinary skill in the art, I considered the prior art and the various approaches in the prior art, the types of problems encountered, the solutions to those problems, the problems encountered by the inventor, and the rapidity with which innovations were made. I also considered the sophistication of the technology involved and the educational background and experience of those actively working in the relevant field at the time of the invention. Finally,

I placed myself back at the time of the alleged invention and considered the technology available at that time, the students whom I have trained and taught, and the engineers and other professionals with whom I worked or interacted in the relevant industries, and their level of education, activities, and sophistication.

Ex. 1016 ¶ 60. Furthermore, Dr. Ding explained that “wired and wireless communication engineering” perform common steps (such as “encoding/decoding, modulation/demodulation, and multiplexing/demultiplexing”) and “must transmit and receive data over distortive channels that can degrade the performance of data communications.”

Ex. 1016 ¶ 62; *see* Pet. Reply 2 (citing Ex. 1016 ¶ 62). On this basis, Dr. Ding concludes that “[t]here is not strict separation between wired and wireless communication engineering.” Ex. 1016 ¶ 62.

Furthermore, we credit Dr. Ding’s testimony that “the principles of OFDM apply equally well to both wireline communication systems such as DSL and to wireless communication systems such as WiFi and cellular” on which Petitioner relies. Ex. 1016 ¶ 64; *see* Pet. Reply 3 (citing Ex. 1016 ¶ 64). We do so because Dr. Ding’s testimony includes factual corroboration that supports his well-reasoned explanation. Ex. 1016 ¶ 64 (“OFDM is a flexible and efficient modulation technique that is at the heart of major wireless and wired standards. In fact, the concept of multicarrier modulations used by OFDM was practically applied in both wireline applications such as ADSL<sup>5</sup> and older wireless applications such as

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<sup>5</sup> Jacky S. Chow, Jerry C. Tu, and John M. Cioffi, “A Discrete Multitone Transceiver System for HDSL Applications,” *IEEE Journal on Selected Areas in Communications*, Vol. 9, No. 6, pp. 895–908 (Aug. 1991) (Ex. 1018).

Kathryn or Kineplex<sup>[6]</sup> well before the priority date of the '439 Patent. Frequency-selective attenuation (fading) is a problem in both ADSL and wireless communications, and a POSITA would have been familiar with how OFDM handles this problem in both implementations.”); *see Acad. of Sci. Tech Ctr.*, 367 F.3d at 1368; *see also* 37 C.F.R. § 42.65(a).

In weighing the evidence and arguments provided by both parties, we find that a preponderance of the evidence supports a finding that the experience of one of ordinary skill in the art would have included “experience working in the fields of wireless communication systems, communication networks, and signal processing.” We are persuaded that there is not a strict distinction between wireless and wired communication systems because of the common problems and solutions—such as the use of OFDM techniques to address attenuation issues and common steps discussed above.

We also note that both Patent Owner and Petitioner agree that one of ordinary skill in the art would have had a bachelor’s degree in electrical engineering, computer science, or an equivalent field. Pet. 13; PO Resp. 15. We credit Dr. Ding’s testimony that such an education would have typically included courses “pertaining to the principles of communication networks and signal processing applicable to both wireline and wireless communication systems” and would have used textbooks “discussing both wireline and wireless communication systems.” Ex. 1016 ¶ 66; *see* Pet. Reply 3–4 (citing Ex. 1016 ¶ 66).

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<sup>6</sup> N.M. Maslin, “High data rate transmissions over h. f. links,” *Radio and Electronic Engineer*, Vol. 52, No. 2, pp. 75-87 (Feb. 1982) (Ex. 1019).

As Petitioner notes, the level of ordinary skill is not limited to the technical field stated in the patent but considers a number of factors, such as “(1) the educational level of the inventor; (2) type of problems encountered in the art; (3) prior art solutions to those problems; (4) rapidity with which innovations are made; (5) sophistication of the technology; and (6) educational level of active workers in the field.” *Daiichi Sankyo Co. v. Apotex, Inc.*, 501 F.3d 1254, 1256 (Fed. Cir. 2007); *see* Pet. Reply 3 (citing *Daiichi Sankyo*, 501 F.3d at 1256). Patent Owner does not contest the level of ordinary skill in its Sur-reply. *See generally* Sur-reply 1–27.

Based on the evidence of record, we maintain the determination of the level of ordinary skill in the art applied in our Decision to Institute—one of ordinary skill in the art would have had a bachelor degree in electrical engineering, computer science, or an equivalent field, plus at least three years of experience working in the fields of wireless communication systems, communication networks, and signal processing.

### *C. Claim Construction*

In an *inter partes* review filed before November 13, 2018, claim terms in an unexpired patent are given their broadest reasonable construction in light of the specification of the patent. *See* 37 C.F.R. § 42.100(b); *see also* *Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2142 (2016) (affirming that USPTO has statutory authority to construe claims according to 37 C.F.R. § 42.100(b)).<sup>7</sup>

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<sup>7</sup> The Office changed the claim construction standard used in *inter partes* review proceedings. 37 C.F.R. § 42.100(b) (2019). As stated in the Federal Register notice, however, the new rule applies only to petitions filed on or after November 13, 2018. *See* Changes to the Claim Construction Standard for Interpreting Claims in Trial Proceedings Before the Patent Trial and

Under the broadest reasonable construction standard, claim terms are presumed to have their ordinary and customary meaning as would be understood by one of ordinary skill in the art in the context of the entire disclosure. *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). An inventor may provide a meaning for a term that is different from its ordinary meaning by defining the term in the specification with “reasonable clarity, deliberateness, and precision.” *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994). In addition, the broadest reasonable construction of a claim term cannot be so broad that the construction is unreasonable under general claim construction principles. *Microsoft Corp. v. Proxyconn, Inc.*, 789 F.3d 1292, 1298 (Fed. Cir. 2015), *overruled on other grounds by Aqua Prods., Inc. v. Matal*, 872 F.3d 1290 (Fed. Cir. 2017) (en banc) (“A construction that is unreasonably broad and which does not reasonably reflect the plain language and disclosure will not pass muster.” (internal quotation marks and citation omitted)). We apply these principles in our analysis.

Furthermore, only claim terms that are in controversy need to be construed and only to the extent necessary to resolve the controversy. *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999); *see also Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (applying *Vivid Techs.* in the context of an *inter partes* review). Both parties assert, and we agree, that no terms need to be

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Appeal Board, 83 Fed. Reg. 51,340, 51,340 (Oct. 11, 2018) (stating “[t]his rule is effective on November 13, 2018 and applies to all IPR, PGR and CBM petitions filed on or after the effective date”). The Petition was filed on August 22, 2018 (Paper 5) and, therefore, the new rule does not impact this matter.

construed expressly for this Decision. PO Resp. 16; Pet. Reply 5; Tr. 9:15–10:2 (Petitioner’s counsel); 29:24–26 (Patent Owner’s counsel).

#### *D. Prior Art Disclosures*

This section presents findings concerning the scope and content of the prior art asserted by Petitioner.

##### *1. State of the Art at the Time of the Invention*

The challenged patent generally relates to improving communication between cellular telephones (also known as user equipment (“UE”) and mobile terminals) and base stations within a cellular network. Ex. 1001, 1:7–14, 2:54–60, 5:32–45; Ex. 1007 ¶ 32 (Dr. Ding Declaration); PO Resp. 3; Pet. 4 (citing Ex. 1007 ¶ 32). The coverage area of a cellular network is divided into many “cells,” each served by a base station that communicates with the cellular telephones within the cell. Ex. 1007 ¶ 33; Pet. 4 (citing Ex. 1007 ¶ 33). Base stations must be capable of simultaneously communicating with number cellular telephones so that cellular telephone users do not experience interference from other callers. Ex. 2101 ¶ 8 (Dr. Vojcic Declaration); PO Resp. 4 (citing Ex. 2101 ¶ 8). The signal flow from the cellular telephone to the base station is called the uplink, and the signal flow from the base station to the cellular telephone is called the downlink. Ex. 1007 ¶ 33; Pet. 4 (citing Ex. 1007 ¶ 33).

Orthogonal Frequency Division Multiplexing (OFDM) is a way to allocate bandwidth to transmit and receive data signals. Ex. 1007 ¶ 36; Pet. 4 (citing Ex. 1007 ¶ 36); PO Resp. 4. With OFDM, a transmitter can divide its allocated frequency band into orthogonal (non-overlapping) subcarriers to transmit signals in each transmittal time slot. Ex. 1001, 1:18–33; Ex. 1007 ¶¶ 36–37; Pet. 4 (citing Ex. 1007 ¶¶ 36–37); PO Resp. 4. The

orthogonality between subcarriers helps increase the number of cellular telephones that can be simultaneously supported in the cell. Ex. 1001, 1:22–24; PO Resp. 4 (citing Ex. 1001, 1:22–24).

Figure 1 of the challenged patent is set forth below.

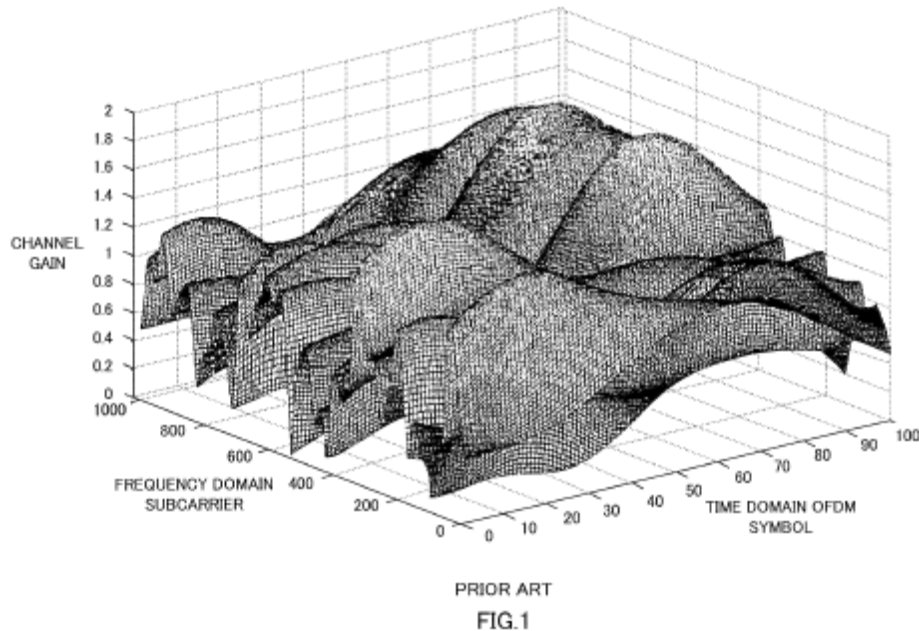
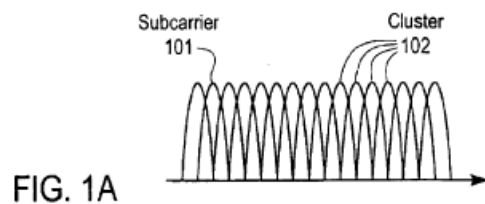


Figure 1 shows an example of OFDM channel characteristics. Ex. 1001, 6:52–53. The “two horizontal axes respectively indicate OFDM symbols on the time domain and subcarrier numbers on the frequency domain, and the vertical axis indicates channel gains corresponding to OFDM symbols and subcarriers.” Ex. 1001, 1:58–61. “OFDM channels fluctuate[] in both time domain and frequency domain. . . .” Ex. 1001, 1:62–63. As Dr. Ding explains, “the signal bandwidth can be divided into hundreds of orthogonal subcarriers along the frequency axis and a number of OFDM symbol intervals along the time axis.” Ex. 1007 ¶ 37. “In each subcarrier for each OFDM symbol interval, the [base station] can transmit a data symbol to a UE.” Ex. 1007 ¶ 37.

## 2. Disclosure of Li

Li is a U.S. patent titled “Multi-Carrier Communications with Group-Based Subcarrier Allocation” that describes an OFDMA cellular communication system in which subcarriers are partitioned into groups (called “clusters”) and groups are allocated to a subscriber (i.e., user equipment). Ex. 1003, code (54) (Title), 3:5–17; *see id.* at code (57) (Abstract), 2:13–22, 3:18–23, 3:30–38, Fig. 1B.

Li’s Figure 1A is set forth below.



Li’s Figure 1A illustrates multiple subcarriers (one of which is labeled as subcarrier 101) and cluster 102 of four subcarriers. *Id.* at 5:18–20; *see id.* at 2:31 (indicating Figure 1A depicts subcarriers and clusters). Li explains that a cluster is “a logical unit that contains at least one physical subcarrier.” *Id.* at 5:18–20. “A cluster can contain consecutive or disjoint subcarriers.” *Id.* at 5:21–22. “The mapping between a cluster and its subcarriers can be fixed or reconfigurable,” in which case “the base station informs the subscribers when the clusters are redefined.” *Id.* at 5:22–25.

Li describes the subscriber role in an example process. “For downlink channels, each subscriber first measures the channel and interferences information for all the subcarriers and then selects multiple subcarriers with good performance (e.g., a high signal-to-interference plus noise ratio (SINR)) and feeds the information on these candidate subcarriers to the base station.” *Id.* at 3:18–23. Li explains that the “feedback may comprise channel and interference information (e.g., signal-to-interference-plus-noise-

ratio information) on all subcarriers or just a portion of subcarriers. In case of providing information on only a portion of the subcarriers, a subscriber may provide a list of subcarriers ordered starting with those subcarriers which the subscriber desires to use, usually because their performance is good or better than that of other subcarriers.” *Id.* at 3:23–29.

Li also describes the role of the base station in that example process.

Upon receiving the information from the subscriber, the base station further selects the subcarriers among the candidates, utilizing additional information available at the base station, e.g., the traffic load information on each subcarrier, amount of traffic requests queued at the base station for each frequency band, whether frequency bands are overused, and/or how long a subscriber has been waiting to send information. In one embodiment, the subcarrier loading information of neighboring cells can also be exchanged between base stations. The base stations can use this information in subcarrier allocation to reduce inter-cell interference.

*Id.* at 3:30–41.

Li also indicates that in an embodiment, “the selection by the base station of the channels to allocate, based on the feedback, results in the selection of coding/modulation rates. Such coding/modulation rates may be specified by the subscriber when specifying subcarriers that it finds favorable to use.” *Id.* at 3:42–45.

Li indicates that, for both uplink and downlink transmission, “the base station makes the final decision of subcarrier allocation for each subscriber.” *Id.* at 3:64–65.

Li’s Figure 1B is set forth below.

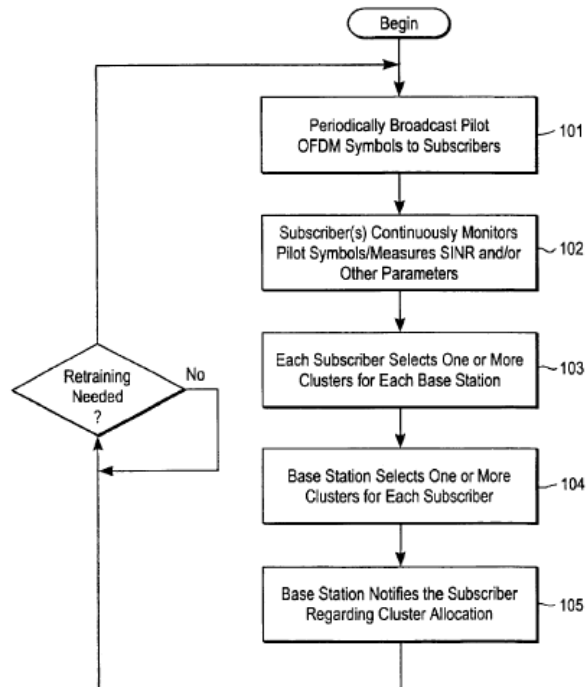


FIG. 1B

Li's Figure 1B depicts an example process for allocating clusters of subcarriers to subscribers (user equipment). *Id.* at 5:29–30. “[E]ach base station periodically broadcasts pilot OFDM symbols to every subscriber with its cell (or sector),” as shown in processing block 101. *Id.* at 5:35–38. “Next, each subscriber continuously monitors the reception of the pilot symbols and measures the SINR and/or other parameters . . . of each cluster,” as shown in processing block 102. *Id.* at 5:46–50. “Based on this information, each subscriber selects one or more clusters with good performance . . . and feeds back the information on these candidate clusters to the base station,” as shown in processing block 103. *Id.* at 5:50–54. “Upon receiving the feedback from a subscriber, the base station further selects one or more clusters for the subscriber among the candidates,” as shown in processing block 104. *Id.* at 6:18–20. To do so, the base station uses additional information available at the base station, such as “traffic load

information on each subcarrier, amount of traffic requests queued at the base station for each frequency band, whether frequency bands are overused, and how long a subscriber has been waiting to send information.” *Id.* at 6:20–25.

“After cluster selection, the base station notifies the subscriber about the cluster allocation through a downlink common control channel or through a dedicated downlink traffic channel if the connection to the subscriber has already been established,” as shown in processing block 105. *Id.* at 6:30–34. The base station also may inform the subscriber about the appropriate modulation/coding rates. *Id.* at 6:34–36. “From time to time,” the process is repeated, as shown in processing block 106. *Id.* at 6:63–65.

Li also describes an embodiment in which “each base station transmits pilot symbols simultaneously, and each pilot symbol occupies the entire OFDM frequency bandwidth.” *Id.* at 7:37–39. “A subscriber estimates the SINR for each cluster from the pilot symbols.” *Id.* at 7:50–52. “The estimated SINR values may be ordered from largest to smallest SINRs and the clusters with large SINR values are selected.” *Id.* at 7:56–58. “In one embodiment, the subscriber always tries to send the information about as many clusters as possible from which the base station chooses.” *Id.* at 7:63–65.

“The estimated SINR values are also used to choose the appropriate coding/modulation rate for each cluster as discussed above. By using an appropriate SINR indexing scheme, an SINR index may also indicate a particular coding and modulation rate that a subscriber desires to use.” *Id.* at 7:66–8:3.

Li describes an exemplary base station that “assigns desirable clusters to the subscriber making the request” and, in one embodiment, takes into

consideration the total traffic load on the cluster as well as the SINR. *Id.* at 11:10–15; *see id.* at Fig. 13 (depicting a base station with a cluster scheduling and load allocation controller), 11:16–45 (describing a base station with a cluster scheduling and load allocation controller).

In a section titled “Group-Based Cluster Allocation,” Li describes partitioning clusters of subcarriers into groups such that each group can include multiple clusters. *Id.* at 11:46–49. Figure 6 is set forth below.

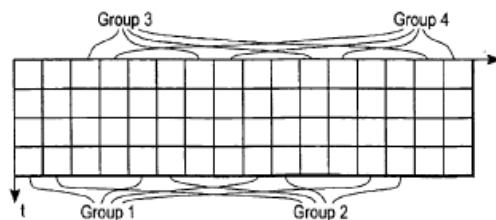


FIG. 6

Li’s Figure 6 shows four groups (Group 1–Group 4) “with arrows [lines] pointing to clusters that are in each group as a result of partitioning.” *Id.* at 11:49–52. Li explains the goals of group-based clustering allocation include “reducing the data bits for cluster indexing, thereby reducing the bandwidth requirements of the feedback channel (information) and control channel (information) for cluster allocation.” *Id.* at 11:62–66.

### 3. Disclosure of Vijayan

Vijayan is a U.S. patent titled “Multiplexing and Transmission of Multiple Data Streams in a Wireless Multi-Carrier Communication System” that describes techniques for multiplexing and transmitting multiple data streams in a wireless multi-carrier communication system. Ex. 1004, code (54) (Title), code (57) (Abstract), 1:18–21.

Vijayan indicates that multiple carriers for data transmission can be provided by orthogonal frequency division multiplexing (OFDM), which “effectively partitions the overall system bandwidth into multiple orthogonal

subbands.” *Id.* at 1:23–29. Vijayan notes that the subbands also may be referred to as “tones, carriers, subcarriers, bins, and frequency channels.” *Id.* at 1:29–30. “With OFDM, each subband is associated with a respective subcarrier that may be modulated with data.” *Id.* at 1:30–32.

In this context, Vijayan describes the problem of a wireless device performing “[c]ontinuous demodulation and decoding of the high-rate composite stream to recover just one or few data streams of interest consumes significant amounts of power.” *Id.* at 1:63–66. Vijayan explains that this “can greatly shorted the ‘ON’ time for the wireless devices, which is undesirable.” *Id.* at 1:66–67. According to Vijayan, there is a need for “techniques to transmit multiple data streams in a multi-carrier system such that they can be received by wireless devices, with minimal power consumption.” *Id.* at 2:1–4; *see id.* at 2:8–11.

Vijayan describes techniques for processing each data stream “separately based on a coding and modulation scheme (e.g., an outer code, an inner code, and a modulation scheme) selected for that stream to generate a corresponding data symbol stream,” which allows a wireless device to individually recover the data stream. *Id.* at 2:11–16. Vijayan describes sending a data stream on a separate physical layer channel (PLC), which also may be called a data channel or a traffic channel. *Id.* at 4:15–19. “The data stream for each PLC is encoded and modulated based on a coding and modulation scheme selected for that PLC.” *Id.* at 4:43–45.

#### *4. Disclosure of Hashem*

Hashem is a U.S. patent titled “Dynamic Sub-Carrier Assignment in OFDM Systems” that describes techniques “for selecting and signaling the

identity of sub-carriers to be used for transmission of data in a radio communication system.” Ex. 1005, code (54) (Title), code (57) (Abstract).

Hashem describes transmission of data in a radio-frequency communication system between a base station and a remote unit. *See, e.g., id.* at 4:1–4, Fig. 1. In this context, Hashem describes the base station selecting an optimum link mode, which is used to encode and modulate data transmitted to the remote unit. *Id.* at 4:66–5:15. Hashem also indicates that “[o]verhead on the forward link from the base station to the remote unit can be reduced if the remote unit calculates the optimum Link Mode itself, using an algorithm similar to that used by the Link Mode evaluator” in the base station. *Id.* at 6:49–59.

#### 5. *Disclosure of Cioffi*

Cioffi is a U.S. patent titled “Multicarrier Modulation Transmission System with Variable Delay.” Ex. 1006, code (54) (Title). According to Cioffi, “[a] transmission system using multicarrier modulation applies FECC (forward error correcting code) coding and codeword interleaving differently to input signals from different data channels to produce encoded data signals having different reliabilities and different coding delays.” *Id.* at code (57) (Abstract). Cioffi explains that “in a transmission system using multicarrier modulation, FDM (frequency division multiplex) carriers spaced within a usable frequency band of a transmission channel, forming a set of subchannels, are modulated at a block or symbol transmission rate of the system.” *Id.* at 1:16–21.

After describing various embodiments in detail in reference to Figures 1–4, Cioffi indicates that other variations may be made. *Id.* at 10:48–52; *see id.* at 4:66–10:47 (detailed description of Figs. 1–4). As one

example, Cioffi indicates that “the allocation of numbers of bits to subchannels may also be weighted in accordance with other factors such as sources of interference.” *Id.* at 10:53, 10:58–60.

### *E. Independent Claim 8 Limitations*

In general, in its combination of Li, Vijayan, Hashem, and Cioffi, Petitioner relies a combination of Li and Vijayan for many of the limitations recited by independent claim 8.<sup>8</sup> *See generally* Pet. 31–68. Petitioner additionally relies on Hashem’s teaching that signaling overhead can be reduced if the remote unit calculates the optimum link mode using an algorithm similar to the one used by the base station. Pet. 46 (citing Ex. 1005, 6:50–53, 7:1–3). Petitioner further relies on Cioffi for teaching weighting per subchannel. Pet. 30.

In this context of Petitioner’s combination of the four references, we discuss the scope and the content of the prior art as well as differences between the prior art and the limitations of claim 8. Then we address

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<sup>8</sup> During the trial, Petitioner made general references asserting the claim would have been obvious over the AMC background described in the ’439 patent. Tr. 6:15–7:3 (Petitioner’s counsel: “So this is all in the applicant’s admitted prior art of the ’439 patent. So what is the purported invention of the ’439 patent? . . . [T]he purported improvement of the ’439 patent is that you take the subbands of the prior art, which were already just a collection of subcarriers, and you . . . group them together by creating subbanding groups. And then you apply adaptive modulation and coding at the subband group level, instead of at the subband level. You are basically taking bundles of subcarriers and further bundl[ing] them together to create bigger bundles and applied modulation and coding at that level. Petitioner submits that is not a real invention. It’s obvious to take bundles of subcarriers and just make them bigger. And do what you’ve’ already been doing in the prior art.”). That issue, however, is not before us. The issue before us is whether the subject matter of the challenged claim would have been obvious over Petitioner’s asserted combination of Li, Vijayan, Hashem, and Cioffi.

Petitioner's reasons to combine the references with particular reference to the parameter deciding section [8b] and whether Petitioner has demonstrated by a preponderance of the evidence that the subject matter of claim 8 as a whole would have been obvious.

*1. "communication apparatus" and "channel estimating section" [8a]*

In its combination, Petitioner relies on Li for disclosing a communication apparatus that includes "a channel estimating section that carries out a channel estimation per subband," as recited in claim 8. Pet. 31–36 (citing Ex. 1003, 5:18–27, 5:62–64, Figs. 1A, 1B, 3, 4; Ex. 1007 ¶¶ 103–04). Li uses the term "subscriber" to refer to a cellular handset, which is a synonym for "user equipment," "mobile terminal," or "cellular telephone." Ex. 1003, 3:12–17 ("Within each cell, the allocation for individual subscribers (e.g., mobiles) is . . ."); Ex. 1007 ¶ 32 (testifying that cellular telephones are also known as "mobile terminals or user equipment ('UE')"). To improve clarity, we refer to Li's subscriber also as Li's user equipment or UE.

Based on Li's unambiguous disclosure, we find that Li's subcarrier cluster (cluster 102 in Figure 1A) that includes multiple subcarriers teaches the recited subband. Ex. 1003, 5:18–27, Fig. 1A; *see* Pet. 31 ("Li discloses a subband (cluster 102) that includes multiple subcarriers 101."); Pet. 31–32 (citing Ex. 1003, 5:18–27, Fig. 1A; Ex. 1007 ¶¶ 103–04). We also agree with Petitioner's expert, Dr. Ding, that Li's SINR (signal-to-interference plus noise ratio) is a channel characteristic. Ex. 1007 ¶ 106 ("obtaining channel characteristics, such as SINR, for each cluster"); Pet. 34 (citing Ex. 1007 ¶ 106). Li describes a subscriber (i.e., user equipment) that measures the SINR of each subcarrier cluster and reports these SINR

measurements to the base station through an access channel using Li's processing block 102 in Figure 1B, channel/interference estimation processing block 301 in Figure 3, or SINR estimation processing block 401 in Figure 4. Ex. 1003, 5:18–27, 5:62–64, Figs. 1A, 1B, 3, 4. What naturally follows is that Li's measurement of the SINR of each cluster discloses or suggests performing channel estimation per subband.

For these reasons, we find that Li's processing block 102 shown in Figure 1B of Li, channel/interference estimation processing block 301 in Figure 3, or SINR estimation processing block 401 in Figure 4, each disclose or suggest the recited “a channel estimating section that carries out a channel estimation per subband” [8a]. Ex. 1003, 5:62–6:6, 7:50–55, 8:54–56, 9:12–15, 9:55–60, 12:44–56, Figs. 1B, 3, 4.

## 2. “*parameter deciding section*” [8b]

Petitioner relies on a combination of Li, Vijayan, and Hashem for disclosing “a parameter deciding section that decides modulation parameters and coding parameters per subband group comprised of a plurality of the subbands, based on a result of the channel estimation per subband” [8b] (“the parameter deciding limitation”). Pet. 36 (“Li in combination with Vijayan and Hashem discloses [this] element.”). Petitioner relies on Hashem to fill the prior art difference that the base station of Li and the base station of Vijayan decide the modulation and coding parameters to be used in the transmission limitation [8c], the receiving limitation [8d], and the data obtaining limitation [8e] required by claim 8. *See* Pet. 48.

### *a. Li's Disclosure*

Petitioner relies on Li as disclosing a parameter deciding section that decides modulation parameters and coding parameters *per subband* based on

a result of the channel estimation per subband<sup>9</sup> and on Vijayan for deciding modulation parameters and coding parameters *per subband group* comprised of a plurality of the subbands.

Li's cluster ordering and rate prediction processing block 303 in Figure 3 of Li and power difference ordering and group selection processing process block 405 in Figure 4 each identify coding and modulation rates to be requested from the base station for a cluster as a result of the SINR channel estimation. Ex. 1003, 5:62–6:6, 7:50–55, 8:61–65; 9:35–46, 9:55–67, 12:44–56; *see* Pet. 40. What naturally follows from our finding that the recited subbands read on Li's clusters is that one of ordinary skill in the art would understand Li's coding and modulation rates requested per cluster based on SINR channel estimation to disclose or suggest determining one or more modulation parameters and one or more coding parameters per subband (clusters), based on a result of the channel estimation per subband

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<sup>9</sup> In its Petition, Petitioner appeared to rely on Li as disclosing a parameter deciding section that decides modulation parameters and coding parameters per subband *group* based on a result of the channel estimation per subband. Pet. 40 (“Accordingly, Li discloses a UE (a subscriber) comprising a parameter deciding section (block 303 or block 405) that decides one or more modulation parameters and one or more coding parameters per subband group comprised of a plurality of the subbands (clusters), based on a result of the channel estimation per subband (the SINR estimation).”). In reply to Patent Owner's Response, however, Petitioner disavowed its reliance on Li for teaching “modulation parameters and coding parameters per subband *group*” but relied on Li only for deciding parameters per *subband*. Pet. Reply 10 (“[Patent Owner] spends pages arguing that Li does not teach ‘modulation parameters and coding parameters per subband *group*. . . . Petitioners, however, rely on Vijayan for this limitation, not Li.”); Tr. 12:11–14 (Petitioner's counsel confirming Petitioner relies only on Li for “teaching assigning modulation and coding at the subband or cluster level” and relying on “Vijayan to go up to the subband group level.”).

(the SINR estimation). *See* Ex. 1007 ¶ 118 (Dr. Ding testifying that one of ordinary skill in the art would have understood Li’s coding/modulation rates to constitute one or more modulation parameters and one or more coding parameters.).

Li’s user equipment requests from the base station the modulation and coding rates for the cluster. Ex. 1003, 7:66–8:4 (describing the UE using “an SINR index . . . to indicate a particular coding and modulation rate that a [UE] desires to use”), 8:66–9:4 (describing the UE as requesting clusters and modulation/coding rates from the base station), 9:67–10:3 (“Once the clusters have been selected, the [UE] requests the selected clusters and the coding/modulation rates with processing block 406.”). Li’s base station “assigns desirable clusters to the [UE] making the request.” Ex. 1003, 11:10–12 (describing an exemplary base station); *see* Ex. 1003, 3:30–41, 3:42–45 (“[T]he base station makes the final decision of subcarrier allocation for each [UE].”).

Accordingly, we find that Li discloses deciding modulation parameters and coding parameters *per subband* based on a result of the channel estimation per subband.

#### *b. Vijayan’s Disclosure*

Petitioner relies on Vijayan for deciding modulation parameters and coding parameters *per subband group* comprised of a plurality of the subbands. More specifically, Petitioner relies on Vijayan’s OFDM system in which the base station allocates a group of physical layer channels (“PLCs”) for downlink transmission and applies joint modulation and coding parameters for each PLC. Pet. 40–41; *see* Pet. 20.

Vijayan uses the terms “subband” and “subband groups” differently than the ’439 patent. In Vijayan, the term “subband” is associated with a single subcarrier and a “subband group” refers to a group of subcarriers. *See, e.g.*, Ex. 1004, 1:30–32 (“With OFDM, each subband is associated with a respective subcarrier that may be modulated with data.”); 8:14–17 (“In one subband grouping scheme, each group contains  $N_{\text{spg}}$  consecutive usable subbands . . .”). Vijayan describes a PLC that is assigned to, in Vijayan’s lexicon, subband groups to minimize transmission time. Ex. 1004, 9:64–66 (“To minimize transmission time, an active PLC may be assigned as many subband groups as possible while conforming to the maximum bit rate.”).

Accordingly, we agree with Petitioner’s undisputed position that a subband group in Vijayan that associates subcarriers discloses a recited subband and that a PLC in Vijayan that associates Vijayan’s subband groups (i.e., recited subbands) discloses a recited subband group. Ex. 1004, 1:29:32, 8:16–17, 9:64–66; *see* Pet. 20–21 (quoting Ex. 1004, 1:29–32, 8:16–17, 9:64–66, 10:7–13), 40–41 (quoting Ex. 1004, 9:64–66, 10:7–13).

Vijayan indicates that “[t]he data stream for each PLC is encoded and modulated based on a coding and modulation scheme selected for that PLC.” Ex. 1004, 4:43–45, 13:14–16, Table 1 (associating a modulation scheme and an inner code rate to each of eight modes used to encode and modulate a data stream); Pet. 41 (quoting Ex. 1004, 4:43–45). In other words, Vijayan describes applying the same modulation scheme and the same inner code rate to subbands that make up the PLC. Understanding the recited “subband group comprised of a plurality of the subbands” reads on Vijayan’s PLC made up of subband groups (using Vijayan’s term) and that Vijayan’s base station assigns the parameters, we find that Vijayan discloses “decid[ing]

modulation parameters and coding parameters per subband group<sup>10</sup> comprised of a plurality of the subbands,” as recited in claim 8.

Notably, however, Vijayan does not describe selecting modulation parameters and coding parameters for the PLC based on the result of a channel estimation per subband as required by claim 8. Nor does Petitioner assert that Vijayan describes doing so on that basis. *See* Pet. 40–46.<sup>11</sup>

*c. Hashem’s Disclosure*

Petitioner further relies on Hashem’s disclosure “that signaling overhead can be saved if the [user equipment] calculates the optimum Link Mode (and thus the modulation and coding parameters)” instead of the base station. Pet. 47 (citing Ex. 1005, 2:52–54, 6:50–53, 7:1–3; Ex. 1007 ¶ 133); *see* Pet. 46–48 (citing Ex. 1005, 2:52–54, 4:11–15, 6:50–53, 7:1–3; Ex. 1007 ¶¶ 130, 132–35).

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<sup>10</sup> As noted previously, the recited “subband” reads on Vijayan’s “subband group.”

<sup>11</sup> We acknowledge that the Petition includes, for this limitation, an introductory statement that “Vijayan further discloses that a joint modulation parameter and a joint coding parameter is decided for each subband group based on a result of a channel estimation per subband, as taught in the ’439 Patent.” Pet. 40. Petitioner, however, does not further address “based on a result of a channel estimation per subband,” and in its Reply concerning the parameter deciding limitation, Petitioner relies on Vijayan as “teach[ing] deciding a joint modulation and coding parameter for a claimed subband group.” Pet. 40–46; Pet. Reply 11, 34. Thus, we do not understand Petitioner to argue that Vijayan discloses doing so “based on a result of a channel estimation per subband” and view Petitioner’s introductory statement in its Petition as unsupported or a clerical error. *See* Pet. 40.

3. “*parameter information transmission section*” [8c];  
“*receiving section*” [8d]; and “*a data obtaining section*” [8e]

Claim 8 requires (i) transmission of the parameter information decided at the parameter deciding section recited in limitation [8b] to “a communicating party” (recited in limitation [8c]); (ii) using the transmitted parameter information at the communicating party to modulate and encode data on a per subband group basis (recited in limitation [8d]); (iii) receiving a signal containing the data modulated and encoded at the communicating party (recited in limitation [8d]); and (iv) demodulating and decoding the received signal to obtain the data contained in the received signal (recited in limitation [8e]).

These limitations in Petitioner’s combination require (i) Li’s user equipment to transmit the parameter information decided at the parameter deciding section (and specifically the parameter information for subband groups based on the combination of Li and Vijayan in parameter deciding limitation [8b] to the base station (recited in limitation [8c]); (ii) the base station to use the transmitted parameter information to modulate and encode on a per subband group basis a signal transmitted to the user equipment (recited in limitation [8d]); (iii) the user equipment to receive the signal (recited in limitation [8d]); and (iv) the user equipment to demodulate and decode the signal by using the parameter information to obtain the data contained in the received signal (recited in limitation [8e]).

For these limitations, Petitioner relies on a combination of Li and Hashem for disclosing “a parameter information transmission section that transmits, to a communicating party, parameter information indicating the modulation parameters and the coding parameters decided at the parameter deciding section” [8c]. Pet. 48–52. Petitioner relies on a combination of Li

and Vijayan as disclosing “a receiving section that receives a signal containing data modulated and encoded on a per subband group basis at the communicating party using the modulation parameters and the coding parameters of the parameter information transmitted at the parameter information transmission section” (recited in limitation [8d]). Pet. 52. Petitioner relies on a combination of Li and Vijayan as disclosing “a data obtaining section that demodulates and decodes the received signal received at the receiving section on a per subband group basis using the modulation parameters and the coding parameters decided at the parameter deciding section, and obtains the data contained in the received signal” (recited in limitation [8e]). Pet. 58.

*a. “parameter information transmission section” [8c]*

Li describes using an SINR indexing scheme for the subscriber to report to the base station “a particular coding and modulation rate that the subscriber desires to use.” Ex. 1003, 7:66–8:5. Li also describes the cluster request processing block 304 and processing block 406 as transmitting modulation and coding parameters to the base station. Ex. 1003, 8:66–9:2, 9:43–46, 9:67–10:31; *see* Pet. 48–52. On this basis, we find that Li discloses the user equipment transmitting to a communicating party (i.e., the base station) the modulation parameters and the coding parameters determined by the user equipment.

Because Li’s base station, not the subscriber, assigns the desirable clusters to the user equipment, Petitioner relies on Hashem for disclosing “that signaling overhead can be saved if the [user equipment] decides and transmits the modulation and coding parameters, instead of the [base station].” Pet. 51 (citing Ex. 1005, 2:52–54, 6:50–53, 7:1–7; Ex. 1007

¶ 142). According to Petitioner, “it would have been obvious to [a skilled artisan] to have the [user equipment] of Li decide and transmit parameter information indicating modulation and coding parameters decided at block 303 or block 405 in Li to the [base station]” in view of Hashem’s teaching that signaling overhead can be saved by doing so. Pet. 52.

*b. “receiving section” [8d]*

Li describes techniques directed to subcarrier allocation for data traffic channels and describes establishing “a data link between the base station and the subscriber.” Ex. 1003, 5:11–12, 6:42–48; Pet. 45–46. Li further describes the user equipment receiving pilot signals from the base station. Ex. 1003, 12:1–3. Li also describes the base station using for downlink channels the modulation parameters and the coding parameters received from the subscriber. Ex. 1003, 3:18–23, 54–58. On this basis, we find that one of ordinary skill in the art would have understood Li to disclose or suggest a receiving section that receives a signal containing data modulated and encoded at the communicating party using the modulation parameters and the coding parameters of the parameter information transmitted at the parameter information transmission section.

Notably, as discussed previously, Li does not modulate and encode data “on a per subband group basis.” As discussed previously, Vijayan, however, describes that the base station transmits a signal containing data modulated and encoded on a per subband group basis. Ex. 1004, 18:4–7 (teaching a unit that receives the modulated signal transmitted by the base station), 4:43–45 (teaching the data stream for the PLC is encoded and modulated based on the scheme selected for that PLC).

Petitioner contends one of ordinary skill in the art would have combined Li and Vijayan such that Vijayan's signal modulated and encoded at the subgroup level transmitted by the base station would have been received by Li's subscriber and, thus, disclose or suggest the requisite receiving section. Pet. 52–58. Petitioner contends that one of ordinary skill in the art would have done so “in order to reduce feedback overhead” and reduce signaling overhead. Pet. 57–58.

*c. “a data obtaining section” [8e]*

Li's user equipment demodulates and decodes the signal received from the base station to obtain the data contained in the received signal. *See, e.g.,* Ex. 1003, 6:42–45, 7:47–49. Vijayan's user equipment does so for the received signal that was modulated and encoded for the PLC (that reads on the recited subband group). Ex. 1004, Figs. 5A–5C, 4:43–45, 4:52–57, 5:10–13, 6:52–57, 11:39–41, 12:6.

Accordingly, we find that Li discloses or suggests “a data obtaining section that demodulates and decodes the received signal received at the receiving section using the modulation parameters and the coding parameters decided at the parameter deciding section, and obtains the data contained in the received signal” and Vijayan discloses or suggests doing so “on a per subband group basis” as required by claim 8.

Petitioner contends that Li's user equipment as modified by Vijayan would have a data obtaining section required by claim 8 “in order to obtain the downlink data contained in the received signal.” Pet. 63. Petitioner also contends that the modulation parameters and the coding parameters used in the downlink transmission would have been decided at Li's user equipment (based on Hashem's disclosure as discussed previously). Pet. 63–64.

Petitioner concludes that one of ordinary skill in the art would have combined Li and Vijayan in the manner proposed because “the signaling overhead is reduced if the modulation and coding parameters are applied to the entire subband group, as taught in Vijayan, and transmitted by the mobile device, as taught in Li (and Hashem).” Pet. 64.

4. *“assigning a weight per subband” [8f]*

Petitioner relies on a combination of Li, Vijayan, and Cioffi for disclosing a particular manner for how the parameter decision section decides the coding parameters—“the parameter deciding section decides the coding parameters in such a manner that a number of information bits obtained by assigning a weight per subband group to a sum of information bits that are able to be assigned to all of the subbands within the subband group, is assigned to the subband group,” as recited in claim 8. Pet. 64–68.

Petitioner continues to rely on its combination of Li and Vijayan for “the parameter deciding section decides the modulation parameters and the coding parameters per subband group comprised of the subbands,” as discussed above (and Hashem for Li’s user equipment to performing the required deciding). Petitioner additionally asserts that each of Li and Vijayan individually “teach deciding the coding parameters in such a manner that the number of information bits that are able to be assigned to all of the subbands within the subband group is not exceeded.” Pet. 64 (citing Ex. 1003, 7:33–35; Ex. 1004, 9:35–42); *see* Pet. Reply 34 (restating Petition position). Petitioner relies on Cioffi for teaching “assigning a weight per subchannel (subband) to a sum of information bits that are able to be assigned to the subchannel.” Pet. 66; Pet. Reply 34 (“Petitioners are relying upon Cioffi for the weighting limitation.”). Thus, collectively, Li, Vijayan,

and Cioffi, according to Petitioner, “render obvious . . . ‘assigning a weight per subband group to a sum of information bits that are able to be assigned to all of the subbands within the subband group,’” “is assigned to the subband group.” Pet. 65, 68.

We do not agree that Petitioner has shown that Li discloses or suggests deciding the coding parameters in such a manner that the number of information that are able to be assigned to all of the subbands within the subband group is not exceeded. Petitioner relies on Li’s disclosure:

The coding/modulation rate can be adaptively changed according to the channel conditions observed at the receiver after the initial cluster allocation and rate selection.

Ex. 1003, 7:33–35; Pet. 64 (quoting Ex. 1003, 7:33–35). This passage states that the coding/modulation rate can be adaptively changed based on certain channel conditions, but does not address assigning a maximum number of information bits. Even setting aside that Petitioner does not rely on Li for the deciding coding parameters per subband group, as required by the claim, Petitioner and Dr. Ding do not sufficiently tie the Li’s disclosure to the requisite claim language— “assigning a weight per subband group to a sum of information bits that are able to be assigned to all of the subbands within the subband group, is assigned to the subband group.” Pet. 65 (citing Ex. 1007 ¶ 253); Pet. Reply 34 (citing Ex. 1016 ¶ 148); *see* Ex. 1007 ¶ 252 (Dr. Ding does not add further explanation or supporting facts than those appearing in the Petition); Ex. 1016 ¶ 148 (Dr. Ding does not add further explanation or supporting facts than those appearing in the Petition); *see also* Pet. Reply 10 (“[Patent Owner] spends pages arguing that Li does not teach ‘modulation parameters and coding parameters per subband group.’ . . . Petitioners, however, rely on Vijayan for this limitation, not Li.”)

On the other hand, however, Vijayan discloses the following:

The maximum bit rate indicates the maximum number of information bits that may be transmitted in each OFDM symbol for one PLC. The maximum bit rate is typically set by the decoding and buffering capabilities of the wireless devices. Constraining each PLC to be within the maximum bit rate ensures that the PLC can be recovered by wireless devices having the prescribed decoding and buffering capabilities.

Ex. 1004, 9:35–42. Based on a plain reading, Vijayan describes setting a maximum bit rate for each PLC (which in Petitioner’s combination corresponds to the recited subband group). On this basis, we find that Vijayan discloses or suggests deciding coding parameters in such a manner that the number of information bits that are able to be assigned to all of the subbands within the subband group is not exceeded, as Petitioner contends. *See* Pet. 64 (quoting Ex. 1004, 9:35–42; emphasis added). We note that Vijayan does not disclose or suggest “decid[ing] the coding parameters in such a manner that *a number of information bits obtained by assigning a weight per subband group to a sum of information bits* that are able to be assigned to all of the subbands within the subband group, *is assigned to the subband group*, nor does Petitioner assert Vijayan does so. Ex. 1001, 14:21–26 (emphases added); *see* Pet. 64–68 (relying on Li, Vijayan, and Cioffi in combination); Pet. Reply 34 (“Petitioners are relying upon Cioffi for the weighting limitation.”).

Cioffi discloses the following:

For example, the numbers of bits allocated to the different subchannels may be determined also to take into account factors other than the SNR monitored at the receiver, for example subchannels at low frequencies may be assigned relatively fewer bits to reduce the effects of interference with POTS signals, and *the allocation of numbers of bits to subchannels may also be*

*weighted in accordance with other factors such as sources of interference.*

Ex. 1006, 10:53–60 (emphasis added). In stating “the numbers of bits allocated to the different subchannels may be determined also to take into account factors other than the SNR monitored at the receiver,” Cioffi discloses or suggests allocating a number of information bits to a subchannel based on factors other than signal to noise ratio.<sup>12</sup> Ex. 1006, 10:53–55. Cioffi further indicates a more particular manner of allocating the number of information bits to a subchannel—by assigning a weight “in accordance with other factors such as sources of interference.” Ex. 1006, 10:58–60 (“the allocation of numbers of bits to subchannels may also be weighted in accordance with other factors such as sources of interference”). On this basis we find that Cioffi discloses or suggests assigning a weight per subchannel to a sum of information bits that are able to be allocated to a subchannel, albeit Cioffi does so in the context of a “plain old telephone service”<sup>13</sup> and not for a cellular network. *See* Pet. 66 (“Cioffi thus teaches assigning a weight per subchannel (subband) to a sum of information bits that are able to be assigned to the subchannel.”); Pet. 65–66 (discussing Ex. 1006, 10:53–60); *cf.* PO Resp. 70 (“Cioffi teaches, at most, assigning a weight per subcarrier.”).

Petitioner and Patent Owner dispute whether the recited subband reads on Cioffi’s subchannel. Petitioner contends that Cioffi’s subchannel corresponds to the recited subband. *See, e.g.,* Pet. 66. In any case, Cioffi

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<sup>12</sup> Ex. 1006, 5:65–67 (“each carrier or subchannel carrying a number of bits in each symbol period that depends on the characteristics (e.g. signal to noise ratio or SNR) of the subchannel”).

<sup>13</sup> Ex. 1006, 1:49 (“POTS (plain old telephone service)”).

does not disclose or suggest assigning a weight per subband group, as recited in claim 8. *See* PO Resp. 71 (“Even if the Petition were correct and Cioffi’s subchannels were equivalent to the subbands of the ’439 Patent, Cioffi would then teach only weighting on a per subband basis, rather than on a per subband group basis.”).

In sum, Petitioner relies on (i) Vijayan teaching deciding coding parameters in such a manner that the number of information bits that are able to be assigned to all of the subbands within the subband group is not exceeded; (ii) Cioffi teaching of applying weights to a subchannel, which is not a subband group; (iii) Vijayan teaching deciding parameters per subband group; and (iv) Li teaching “coding/modulation rate can be adaptively changed according to the channel conditions.”

We are not persuaded that one of ordinary skill in the art would have combined these teachings in the manner required by claim 8—“decid[ing] the coding parameters in such a manner that a number of information bits obtained by assigning a weight per subband group to a sum of information bits that are able to be assigned to all of the subbands within the subband group, is assigned to the subband group.” We are not persuaded that one of ordinary skill in the art would have combined the references to apply Cioffi’s weighting to similarly weight Li’s cluster groups and Vijayan’s subband groups “to take into account interference from neighboring cells.” Pet. 66. To be sure, we recognize Cioffi teaches weighting to take into account sources of interference. Ex. 1006, 10:53–60; Pet. 65–66; Pet. Reply 35–36. On the totality of the record, however, Petitioner’s arguments regarding applying the weighting to subband groups to account for sources of interference fall short. Petitioner does not adequately address why one of ordinary skill in the art would have done so to *a subband group*.

First, Petitioner argues that one of ordinary skill in the art “would have understood that the cluster groups taught by Li and the subband groups taught by Vijayan could be similarly weighted to take into account from neighboring cells” in a cellular network. Pet. 66 (citing Ex. 1007 ¶ 256); Ex. 1007 ¶ 256 (Dr. Ding does not add further explanation or supporting facts than those appearing in the Petition). That one of ordinary skill in the art *could* have applied Cioffi’s weights to subband groups as required by the claim does not explain why one *would* have done so. *Belden Inc. v. Berk-Tek LLC*, 805 F.3d 1064, 1073 (Fed. Cir. 2015) (“[O]bviousness concerns whether a skilled artisan not only could have made but would have been motivated to make the combinations or modifications of prior art to arrive at the claimed invention.”).

Second, Petitioner asserts that one of ordinary skill in the art “would have been familiar with such signal interference issues in both wired telephone systems, such as taught in Cioffi, and cellular networks as taught by Li and Vijayan.” Pet. 66 (citing Ex. 1007 ¶ 257); Ex. 1007 ¶ 257 (Dr. Ding does not add further explanation or supporting facts than those appearing in the Petition). Neither Petitioner nor Dr. Ding explains here adequately why one of ordinary skill in the art would have applied Cioffi’s *subband groups* as required by the claim. *Cf. Personal Web Techs., LLC v. Apple, Inc.*, 848 F.3d 987, 993–94 (Fed. Cir. 2017) (concluding “that reasoning seems to say no more than that a skilled artisan, once presented with the two references, would have understood that they could be combined. And that is not enough: it does not imply a motivation to pick out those two references and combine them to arrive at the claimed invention.”).

Third, Petitioner’s other arguments along these lines are unpersuasive because none addresses the particular manner of applying weights required

by the claim—assigning a weight per subband groups. Pet. 66 (One of ordinary skill in the art “would have recognized that the problem identified in Cioffi (interference from other sources) applies analogously in a cellular network.”); Pet. 66 (In particular, cellular phones experience interference from neighboring cells, which are akin to the “other sources” in Cioffi. Ex. 1007 ¶ 256. [One of ordinary skill in the art] would have further recognized that the solution identified in Cioffi (a weighting factor to reduce the number of information bits transmitted in certain subchannels) also applies analogously in cellular network.”).

Fourth, Patent Owner argues, relying on Dr. Vojcic’s declaration testimony, that Cioffi’s subchannels and carriers are synonyms and, therefore, not groups of carriers as required to read on the recited subband. PO Resp. 70–71 (citing Ex. 1006, 1:16–25, 1:27–30, 6:65–66; Ex. 2101 ¶¶ 43–45). Specifically, Cioffi discloses the following:

As is known, in a transmission system using multicarrier modulation, FDM (frequency division multiplex) carriers spaced within a usable frequency band of a transmission channel, forming a set of subchannels, are modulated at a block or symbol transmission rate of the system. The bits of input data for transmission within each block or symbol period are allocated to the carriers or subchannels so that the bit error rates of the subchannels as monitored at the receiver, are substantially equal.

Ex. 1006, 1:16–25. Patent Owner contends that, “because multiple ‘carriers’ are required to ‘form[] a set of subchannels,’ each carrier must therefore be a subchannel.” PO Resp. 71 (discussing Ex. 1006, 1:16–20). Patent Owner and Dr. Vojcic further identify three passages in Cioffi that each refers to “carriers or subchannels.” PO Resp. 71–72 (citing Ex. 1006, 1:21–25, 1:27–30, 5:65–66; Ex. 2101 ¶¶ 43–45); Ex. 2101 ¶ 44 (testifying that Cioffi uses carriers and subchannels as synonyms; citing 1:21–25, 1:27–30, 5:65–66).

Patent Owner's arguments and Dr. Vojcic's testimony that Cioffi's uses carriers and subchannels as synonyms comport with Cioffi's disclosure and stand unaddressed by Petitioner. *See generally* Pet. Reply 34–36 (arguing that whether Cioffi discloses carriers or subbands is irrelevant). On balance, the weight of the evidence supports a finding that Cioffi teaches applying a weight per carrier (and not a subband or group of carriers). Thus, the difference between Cioffi's disclosure (assigning a weight per carrier, not per subband as Petitioner's asserts) and the claimed subject matter (assigning a weight per subband group) is greater than Petitioner asserted in its Petition. This further undermines Petitioner's position that one of ordinary skill in the art would have applied Cioffi's weighting to Vijayan's subband groups or Li's cluster groups.

Fifth, Petitioner's response to Patent Owner's contention that Cioffi does not teach assigning a weight per subband or subband group further undermines Petitioner's position that one of ordinary skill in the art would have applied Cioffi's weighting to Vijayan's subband groups or Li's cluster groups. Petitioner repeatedly asserts that whether Cioffi teaches assigning a weight per carrier, subband, or subband group does not matter because it is a "straightforward extension" and "description of weighting would be the same regardless of whether the allocation is weighted at the subcarrier, subband, or subband group level." Pet. Reply 35 (citing PO Resp. 70–72; Ex. 1016 ¶ 150) ("Even assuming [Patent Owner] is right, [Patent Owner's] argument is immaterial because Li and Vijayan teach these elements, and assigning a weight per subband or subband group is a straightforward extension of assigning a weight per subcarrier."); Pet. Reply 35–36 (citing Ex. 1016 ¶ 153) (asserting whether Cioffi's weighting factor is applied to subcarriers, subbands, or subband groups is "irrelevant" and that one of

ordinary skill in the art “would have understood that Cioffi’s description of weighting would be the same regardless of whether the allocation is weighted at the subcarrier, subband, or subband group level”); Pet. 36 (concluding, without benefit of Dr. Ding’s testimony, that “[t]he weighting reduces the number of bits assigned; just the unit (subcarrier, subband, or subband group) is different.”).

We note that Dr. Ding’s reply testimony cited by Petitioner in this regard does not provide further explanation or factual support beyond that found in the Petition. *See* Ex. 1016 ¶¶ 150, 153; Pet. Reply 35–36. For this reason, we accord little weight to Dr. Ding’s conclusory testimony. 37 C.F.R. § 42.65(a) (“Expert testimony that does not disclose the underlying facts or data on which the opinion is based is entitled to little or no weight.”)); *see Acad. of Sci. Tech Ctr.*, 367 F.3d at 1368 (“[T]he Board is entitled to weigh the declarations and conclude that the lack of factual corroboration warrants discounting the opinions expressed in the declarations.”); *see also Magnum Oil Tools*, 829 F.3d at 1380 (Petitioner cannot satisfy its burden of proving obviousness by employing “mere conclusory statements.”).

Moreover, the claim requires “assigning a weight” in a particular way—“per subband group.” Thus, in determining whether “assigning a weight per subband group” would have been obvious to one of ordinary skill in the art at the time of the invention, whether Cioffi discloses doing so at the carrier level or subband level affects the difference between the prior art and the claimed subject matter. *See Graham v. John Deere Co.*, 383 U.S. at 17–18 (the question of obviousness is resolved on the basis of underlying factual determinations including (1) the scope and content of the prior art and (2) any differences between the claimed subject matter and the prior art,

among other factors). For the reasons discussed earlier, Cioffi does not disclose assigning a weight per subband group but does so per carrier, not by subband as Petitioner asserted in its Petition. This increases the difference between the scope and content of prior art and the claimed subject matter.

Furthermore, Petitioner does not explain why one of ordinary skill in the art would have assigned Cioffi's weights to subband groups—rather than carriers or subbands—in view of Petitioner's position that one of ordinary skill in the art “would have understood that Cioffi's description of weighting would be the same regardless of whether the allocation is weighted at the subcarrier, subband, or subband group level.” Pet. Reply 36 (citing Ex. 1016 ¶ 153).

For these reasons, in light of the totality of the evidence, we determine that Petitioner does not sufficiently address why one of ordinary skill in the art would have combined these references to perform the requisite assigning a weight per subband group. Thus, we conclude that Petitioner has not shown by a preponderance of the evidence that the combination of Li, Vijayan, Hashem, and Cioffi would have rendered obvious the limitation wherein the parameter deciding section decides the coding parameters in such a manner that a number of information bits obtained by assigning a weight per subband group to a sum of information bits that are able to be assigned to all of the subbands within the subband group, is assigned to the subband group,” as recited in claim 8.

*F. Reason to Combine: parameter deciding section [8b]*

To demonstrate obviousness, “there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.” *KSR*, 550 U.S. at 418. Here Petitioner must demonstrate by a

preponderance of evidence that “a skilled artisan would have had reason to combine the teaching of the prior art references to achieve the claimed invention, and that the skilled artisan would have had a reasonable expectation of success from doing so.” *PAR Pharm., Inc. v. TWI Pharm., Inc.*, 773 F.3d 1186, 1193 (Fed. Cir. 2014). Furthermore, the burden of proving obviousness cannot be satisfied by employing “mere conclusory statements.” *Magnum Oil Tools*, 829 F.3d at 1380.

We start our analysis by summarizing differences between recited parameter deciding section and Petitioner’s asserted prior art of Li, Vijayan, and Hashem discussed above with regard to limitation [8b]. Li discloses user equipment with a channel estimating section that carries out a channel estimation per subband. Li also discloses the user equipment selecting modulation parameters and coding parameters per subband based on a result of the channel estimation per subband, though Li’s selection is not per subband group as required by the claim. Li’s selected parameters are sent to the base station, which makes the assignment of which parameters to use when communicating with the user equipment. Vijayan also discloses a base station deciding modulation parameters and coding parameters but does so per subband group comprised of a plurality of the subbands. Vijayan’s base station selects a mode made up of a specific modulation scheme and a specific inner code rate. Vijayan does not disclose or suggest doing so, however, based on the result of channel estimation per subband. Thus, in Petitioner’s combination, Li’s user equipment does not decide the requisite parameters “per subband group comprised of a plurality of subbands,” as required by claim 1, and Vijayan does not disclose deciding parameters “based on a result of the channel estimation per subband,” as required by claim 8.

To prevail, Petitioner must provide sufficient articulated reasoning with rational underpinning to explain why one of ordinary skill in the art (1) would have combined Vijayan's base station deciding the parameters per subband group with Li's user equipment that selects parameters per subband based on a result of the channel estimation per subband and (2) would have changed the locus of deciding the parameters from the base station to Li's user equipment. A key dispute is whether Petitioner has done so by a preponderance of the evidence.

*1. The Parties' Contentions*

Petitioner contends it would have been obvious for one of ordinary skill in the art "to apply the joint modulation parameter and joint coding parameter per subband group, taught by Vijayan, with the cluster groups taught by Li" and would have done so "in order to reduce feedback overhead" and to reduce overhead signaling. Pet. 45 (emphases omitted). Also, according to Petitioner, "it would have been obvious to [a skilled artisan] to have the subscriber of Li decide and transmit parameter information indicating modulation and coding parameters decided at block 303 or block 405 in Li to the [base station]" "in view of Hashem's teaching" that signaling overhead can be saved by doing so. Pet. 48, 52. On this basis, Petitioner contends that its combination of Li, Vijayan, and Hashem would have disclosed or suggested "a parameter deciding section that decides modulation parameters and coding parameters per subband group comprised of a plurality of the subbands, based on a result of the channel estimation per subband," as recited in claim 8.

Patent Owner contends that Petitioner's combination is insufficient because Petitioner does not explain adequately how the proposed

combination of Li and Vijayan decides modulation parameters and coding parameters per subband group based on the result of the channel estimation per subband. PO Resp. 33–37 (contending Li does not disclose modulation parameters and coding parameters per subband group); PO Resp. 37–39 (contending Vijayan does not disclose modulation parameters “based on the result of the channel estimation per subband”); PO Resp. 40 (contending that none of the references in combination discloses this limitation); PO Resp. 55–65 (contending one of ordinary skill in the art would not have combined Li and Vijayan); PO Resp. 65–69 (contending one of ordinary skill in the art would not have combined Li and Vijayan with Hashem).

Patent Owner’s expert, Dr. Vojcic, disagrees that one of ordinary skill in the art would have combined Vijayan’s parameter coding methods based on subband groups by using the SINR as Li does. Dr. Vojcic testifies that subband groups would not have provided the benefit Petitioner asserts because using the highest SINR of a subband in the subband group or using the lowest SINR of a subband in the subband group would result in wasted bandwidth. Ex. 2103 ¶ 52.

Patent Owner also contends that one of ordinary skill in the art “reading Hashem would not be motivated to have the [user equipment] decide modulation and coding parameters, in place of the base station.” PO Resp. 65. According to Patent Owner, if Hashem’s user equipment decided modulation and coding parameters instead of the base station, all acceptable and unacceptable subcarriers would need to be identified, which would increase overhead. PO Resp. 66–67 (citing Ex. 2101 ¶¶ 59–60; Ex. 1005, 7:25–27).

Patent Owner further contends that Petitioner impermissibly uses the challenged patent as a guide to combine selected teachings of the three

references necessary to achieve the result of the challenged claim. PO Resp. 68. Patent Owner additionally contends that Petitioner does not provide sufficient specificity to show one of ordinary skill in the art “would have found it obvious to modify the teachings of Li with Vijayan or Hashem to arrive at the claimed invention.” PO Resp. 68.

In Reply to Patent Owner’s Response, Petitioner repeats its assertion that one of ordinary skill in the art “would have been motivated to use Vijayan’s joint modulation parameter and joint coding parameter per subband group with Li’s cluster groups” because Li uses SINR values are used in one embodiment to choose an appropriate coding and modulation rate for each cluster and Vijayan teaches that a coding an modulation scheme can be chosen for a subband group. Pet. Reply 20 (citing Ex. 1004, 7:66–67; Ex. 1016 ¶ 158). Petitioner relies on Vijayan’s recognition of the tradeoff between packing efficiency and overhead signaling when allocating more subbands to each PLC. Pet. Reply 20–21 (discussing Ex. 1004, 7:65–8:5). In his Reply Declaration, Dr. Ding opines that, in view of this knowledge of one of ordinary skill in the art, one of ordinary skill in the art would have recognized that applying a joint parameters across a cluster group of Li also would decrease overhead and would have been motivated to do so. Ex. 1016 ¶¶ 162, 165; *see* Pet. Reply 21–22 (citing Ex. 1016 ¶¶ 162, 165; Ex. 1017 57:22–59:23, 60:5–19).

Moreover, in contrast to Dr. Vojcic’s testimony, Dr. Ding testifies that one of ordinary skill in the art would have used an average SINR of all subbands in a subband group (not the highest or lowest SINR as discussed by Dr. Vojcic) and using an average SINR would not have reduced throughput. Ex. 1016 ¶ 177; Pet. Reply 25 (citing Ex. 1016 ¶ 177).

Dr. Ding further asserts using the lowest or highest SINR of a subband in the subband group (discussed by Dr. Vojcic) are “uncommon and impractical” and that using an average SINR (as Dr. Ding himself suggests) is “[a] more realistic scenario.” Ex. 1016 ¶ 177.

In its Sur-reply, Patent Owner maintains its position that Petitioner’s reasons why one of ordinary skill in the art would have combined the three references in the manner required to arrive at the invention are legally insufficient to support a conclusion of obviousness. Sur-reply 1–2; *see generally* Sur-reply 2–22.

## 2. Discussion

In light of the totality of the record, we are not persuaded that Petitioner has demonstrated by the preponderance of the evidence that it would have been obvious to have used Vijayan’s base station techniques of deciding parameters per subband group in Li’s user equipment. *See Harmonic*, 815 F.3d at 1363 (citing 35 U.S.C. § 312(a)(3) (requiring inter partes review petitions to identify “with particularity . . . the evidence that supports the grounds for the challenge to each claim”); *Magnum Oil Tools*, 829 F.3d at 1380 (Petitioner cannot satisfy its burden of proving obviousness by employing “mere conclusory statements.”). We first address Petitioner’s purported reasons to combine Li and Vijayan. Then we address Petitioner’s purported reasons to combine Hashem with Li and Vijayan.

### a. Reason to Combine Li and Vijayan

We agree with Patent Owner that Petitioner’s assertions as to purported reasons one of ordinary skill in the art would have combined Vijayan’s deciding parameters per subband group with Li’s user equipment that selects parameters for subbands based on a result of the channel

estimation per subband on this record are legally insufficient to support a conclusion of obviousness.

Petitioner contends that Li and Vijayan both teach that using groups—cluster groups in Li and subband groups (PLCs) in Vijayan—can reduce feedback overhead and, therefore, one of ordinary skill in the art would have combined the references in the manner Petitioner proposes. Pet. 26–27, 45. Petitioner’s argument seems rooted in the idea that one of ordinary skill in the art would have combined the references based on their similar teachings that subband groups would reduce feedback overhead. As such, Petitioner’s explanation is not persuasive because mere similarity of references does not explain why one of ordinary skill in the art would have been motivated to combine the references as proposed. *Belden Inc. v. Berk–Tek LLC*, 805 F.3d 1064, 1073 (Fed. Cir. 2015) (“[O]bviousness concerns whether a skilled artisan not only could have made but would have been motivated to make the combinations or modifications of prior art to arrive at the claimed invention.”). Furthermore, Petitioner does not explain sufficiently why Vijayan’s teaching of reducing feedback overhead by using groups would have motivated one of ordinary skill in the art to combine the teachings as Petitioner proposes when Li teaches the same. We are not persuaded by Petitioner’s insufficiently developed argument.

Petitioner’s assertion that signaling overhead in Li would be reduced if joint parameters are applied to an entire subband group instead of per cluster also is unpersuasive for two reasons—(i) the overly general nature of Petitioner’s assertions that do not adequately address the specific tradeoffs necessary to arrive at Petitioner’s asserted combination of Li and Vijayan and (2) the conflicting testimony of Dr. Ding and Dr. Vojcic regarding the tradeoff.

*(i) Vijayan's tradeoff teaching*

As noted in the Petition, Petitioner contends one of ordinary skill in the art would apply the joint modulation parameter and joint coding parameter per subband group, taught by Vijayan, with the cluster groups taught by Li and would have done so to reduce overhead signaling. Pet. 44–45. Petitioner relies, in its Petitioner Reply, on Vijayan's teaching that one of ordinary skill in the art would understand the tradeoff between packing efficiency and overhead signaling in assigning subbands to subband groups for further support. *See* Ex. 1004, 7:65–8:5. We note, however, the general nature of Vijayan's tradeoff teaching:

The transmission time for each PLC may be reduced by allocating more subbands to the PLC. For the burst-TDM/FDM scheme, the granularity of the resource allocation may be selected based on a tradeoff between packing efficiency and overhead signaling. In ***general***, smaller granularity results in better packing efficiency but also requires more overhead signaling to indicate the resources allocated to each PLC. The inverse is ***generally*** true with larger granularity.

Ex. 1004, 7:65–8:6 (emphases added).

Petitioner does not acknowledge, nor adequately address the general nature of Vijayan's trade-off teaching, which undermines Petitioner's position that one of ordinary skill in the art would have made the proposed combination to reduce signaling overhead. Pet. Reply 20–21. Vijayan's statement identifies a potential benefit of allocating more subbands to a subband group but also indicates there are costs for doing so—the loss of packing efficiency. Vijayan's general statement about the tradeoff, however, is not sufficient to explain why one of ordinary skill in the art would have chosen to make the particular tradeoff to save overhead signaling at the expense of packing efficiency to use parameters for subband

groups in Li's user equipment. In other words, Petitioner has not presented sufficient evidence or reasoning concerning the specific tradeoff that one of ordinary skill in the art would have considered when making Petitioner's proposed combination and an explanation as to why one of ordinary skill in the art would have selected reduced overhead signaling in view of the specific packing efficiency costs from the combination. For these reasons, the general nature of Vijayan's teaching undermines Petitioner's reliance on that teaching.

Similarly, Vijayan's tradeoff teaching undermines Petitioner's assertion that using "joint modulation and coding parameters per subband group, taught by Vijayan, to further reduce overhead in Li . . . would have been an obvious extension of the prior art." Pet. Reply 21. Neither Petitioner nor Dr. Ding sufficiently address Vijayan's teaching that increasing subbands in a subband group involves a tradeoff between packing efficiency and overhead signaling in asserting the combination would have been an obvious extension of the prior art. Ex. 1004, 7:65–8:5; *see* Pet. Reply 21; Ex. 1016 ¶ 161 ("Understanding the tradeoff between packing efficiency and overhead signaling, as taught in Vijayan, a person of ordinary skill in the art thus would have been motivated to use the joint modulation parameter and joint coding parameter per subband group, taught by Vijayan, to further reduce the overhead signaling in the system of Li.").

Furthermore, Dr. Ding's testimony also relies on Vijayan's tradeoff teaching but does not explain sufficiently the benefits of reducing signaling overhead in view of the packing efficiency costs or why one of ordinary skill in the art would have made the particular tradeoff involved to combine Vijayan's parameters per subband group with Li's parameters per subband based on the result of the channel estimation per subband. Ex. 1007 ¶ 127

(“This combination of Li and Vijayan would reduce feedback overhead. . . . In particular, Vijayan teaches that the transmission time for each PLC (a subband group) may be reduced ‘by allocating more subbands to the PLC.’ Ex. 1004, 7:65–67. Vijayan further recognizes that the granularity of subband allocation leads to a tradeoff between packing efficiency and overhead signaling, since finer granularity ‘requires more overhead signaling to indicate the resource allocated to each PLC.’ Ex. 1004, 8:4–5.”); Ex. 1007 ¶ 128 (“Understanding the tradeoff between packing efficiency and overhead signaling, as taught in Vijayan, [one of ordinary skill in the art] would have understood that the overhead signaling in the system of Li can be further reduced if a joint modulation and a joint coding parameter are applied to the entire cluster group (subband group), as taught in Vijayan, instead of applying distinct modulation parameters and coding parameters for the individual subbands.”).

Because Dr. Ding does not explain why one of ordinary skill in the art would have selected applying subband groups at the cost of packing efficiency in view of Vijayan’s teaching of that tradeoff, we find Dr. Ding’s testimony to be conclusory and accord it minimal weight. 37 C.F.R. § 42.65(a) (“Expert testimony that does not disclose the underlying facts or data on which the opinion is based is entitled to little or no weight.”)); *see also Acad. of Sci. Tech Ctr.*, 367 F.3d at 1368 (“[T]he Board is entitled to weigh the declarations and conclude that the lack of factual corroboration warrants discounting the opinions expressed in the declarations.”).

*(ii) Potential Benefits of Vijayan’s Subband Groups*

Petitioner’s position is undermined further by the conflicting testimony of Dr. Ding and Dr. Vojcic regarding whether one of ordinary

skill in the art would use Vijayan's techniques for assigning parameters to a subband group based on the result of the channel estimation based on subbands.

Patent Owner's expert, Dr. Vojcic, disagrees that one of ordinary skill in the art would have combined Vijayan's parameter coding methods based on subband groups by using the SINR as Li does. Ex. 2101 ¶ 51 (opining one of ordinary skill in the art "would not replace Li's adaptive selection of "appropriate coding/modulation rate[s] for each cluster" with joint "modulation and coding" for all clusters" because "[d]oing so would undermine . . . maximizing performance/throughput and improving reliability at very low SINR."); *see* PO Resp. 57–58 (citing Ex. 2101 ¶ 52). Dr. Vojcic explains that subband groups would decrease throughput of Li's system if the highest SINR of a subband in the subband group or if the lowest SINR of a subband in the subband group were used to determine the parameters for all subbands in the subband group. Ex. 2101 ¶ 52.

Dr. Vojcic supports his conclusion with further credible explanation:

In particular, using a single joint modulation and coding scheme would have significantly reduce[d] Li's throughput. If the joint modulation and coding scheme is selected based on the cluster with the lowest SINR, the throughput in other clusters would be smaller than provided by Li. Conversely, if the joint modulation and coding is selected based on the cluster with the highest SINR, the throughput in that cluster would be as per Li, but other clusters could not be demodulated/decoded, resulting in loss of throughput while wasting frequency and power resources and generating additional interference within the network.

Ex. 2101 ¶ 52.

Dr. Ding, in reply, testifies that one of ordinary skill in the art would have used an average SINR of all subbands in a subband group (not the highest or lowest SINR discussed by Dr. Vojcic) and the average SINR

would not result in reduced throughput. Ex. 1016 ¶ 177; Pet. Reply 25 (citing Ex. 1016 ¶ 177). Dr. Ding asserts using the lowest or highest SINR of a subband in the subband group, as Dr. Vojcic suggests, are “uncommon and impractical” and that using an average SINR is “[a] more realistic scenario.” Ex. 1016 ¶ 177; *see* Pet. Reply 25 (citing Ex. 1016 ¶ 177). For purported support, Dr. Ding testifies:

In fact, the ’439 Patent states that an existing method was to use an average signal-to-noise ratio. Ex. 1001, 9:37–44. The ’439 Patent thus indicates that, under methods existing before the priority date of the ’439 Patent, a person does not necessary assign the modulation and coding scheme based on either of two extremes, the lowest SINR or the highest SINR.

Ex. 1016 ¶ 178; *see* Pet. Reply 25 (repeating Dr. Ding’s testimony verbatim).

We find Dr. Ding’s testimony that one of ordinary skill in the art would have used an average SINR of all subbands in a subband group (not the highest or lowest SINR as Dr. Vojcic discusses) to be insufficiently supported and counter to the teaching of the ’439 Patent on which it relies. The portion of the ’439 patent on which Dr. Ding relies identifies four existing methods for selecting parameters based on channel characteristics:

for example, ***a method based on a minimum signal to noise ratio of subbands, a method based on an average signal to noise ratio of subbands***, a method based on capacity, or a method based on combinations of an average signal to noise ratio and other statistical characteristics.

Ex. 1001, 9:37–44 (emphases added). Among the existing methods the ’439 patent identifies are using the average SINR and using the minimum SINR. Thus, we find Dr. Ding’s testimony overemphasizes the use of the average SINR, is incomplete concerning other methods, and ignores the ’439 patent’s teaching concerning using the minimum SINR. For this reason, we

accord little weight to his testimony that one of ordinary skill in the art would have used the average SINR. 37 C.F.R. § 42.65(a); *Acad. of Sci. Tech Ctr.*, 367 F.3d at 1368; Pet. Reply 24–27; Ex. 1016 ¶¶ 178–86.

Dr. Ding also challenges Dr. Vojcic’s testimony “that applying joint parameters across all subbands in a subband group would mean that clusters are assigned less-than-ideal parameters,” as Dr. Ding summarizes Dr. Vojcic’s testimony in this regard. Ex. 1016 ¶ 173 (citing Ex. 2101 ¶¶ 47, 52); *see* Pet. Reply 24 (citing PO Resp. 57–58). Dr. Ding testifies:

[T]his is a design tradeoff that [one of ordinary skill in the art] would have understood. [One of ordinary skill in the art] would have recognized (1) the benefit of reduced feedback signaling that would be realized by applying joint parameters; and (2) that benefit would come at a cost of potentially applying non-ideal parameters to some of the allocated clusters.

Ex. 1016 ¶ 173; *see* Pet. Reply 24 (repeating Dr. Ding’s testimony verbatim).

Here, Dr. Ding’s testimony does not provide sufficient explanation to support the conclusion that the benefit would have outweighed the cost of applying non-ideal parameters. For this reason, we accord Dr. Ding’s testimony little weight. 37 C.F.R. § 42.65(a); *see also Acad. of Sci. Tech Ctr.*, 367 F.3d at 1368.

### *(iii) Bodily Incorporation Not Required*

We recognize that it is axiomatic that bodily incorporation is not required. *See, e.g., In re Mouttet*, 686 F.3d 1322, 1332 (Fed. Cir. 2012) (“It is well-established that a determination of obviousness based on teachings from multiple references does not require an actual, physical substitution of the elements.”). To be clear, we are not suggesting that Petitioner must explain how Vijayan’s entire process for multiplexing and transmitting

multiple data streams using “super-frames” could be included in Li’s subcarrier selection system. *See* Ex. 1003, code (57) (Abstract); Ex. 1004, code (57) (Abstract). Rather, we find Petitioner’s explanation to be incomplete because it does not provide an adequate reason that one of ordinary skill in the art would have used Vijayan’s process for assigning parameters per subband group with Li’s assignment of parameters per subband based on a result of channel estimation per subband.

In the particular circumstances of this case, with the complex technology of wireless communications and spectrum utilization, we are not persuaded that Petitioner has met its burden to provide sufficient articulated reasoning with rational underpinning to support Petitioner’s conclusions of obviousness.

*b. Reason to Combine Li and Vijayan with Hashem*

We next consider the legal sufficiency of Petitioner’s assertions as to purported reasons one of ordinary skill in the art would have, based on Hashem’s teaching, Li’s user equipment (rather than a base station) “to decide a joint modulation parameter and a joint coding parameter for all subbands in a subband group (as taught by Vijayan) for the same purpose of saving signaling overhead.” Pet. 48; *see* Pet. 46–48. For the reasons set forth below, we agree with Patent Owner that on this record Petitioner’s rationale is legally insufficient to support a conclusion of obviousness.

Hashem’s “Link Mode” is a transmission parameter that may include a modulation level and a coding rate (among other parameters) and is used to encode a signal transmitted from a base station to a remote unit. Ex. 1005, 4:8–17; *see* Pet. 46 (citing Ex. 1005, 4:11–15). Hashem indicates that signaling overhead on both the forward link and the reverse link can be

reduced if the remote unit calculates the optimum Link Mode itself and transmits the optimum Link Mode to the base station. Ex. 1005, 6:50–59 (discussing the forward link), 7:1–7 (discussing the reverse link).

Dr. Ding opines that, from Hashem’s teachings, one of ordinary skill in the art “would have understood that there can be savings in signaling overhead by moving the Link Mode calculation from the [base station] to the [user equipment] because then the [user equipment] just needs to send an index number for the Link Mode to the [base station], instead of detailed [signal to interference ratio] values that typically require many more information bits to encode.” Ex. 1007 ¶ 133; *see* Pet. 47 (citing Ex. 1007 ¶ 133; repeating Dr. Ding’s testimony). On this basis, Dr. Ding concludes that “it would have been obvious to [one of ordinary skill in the art] to use the [user equipment] of Li to decide a joint modulation parameter and a joint coding parameter for all subbands in a subband group (as taught by Vijayan) for the same purpose of saving signaling overhead.” Ex. 1007 ¶ 134; *see* Pet. 48 (citing Ex. 1007 ¶ 134; repeating Dr. Ding’s testimony).

Dr. Vojcic, however, contradicts Dr. Ding’s testimony and opines that one of ordinary skill in the art would not have implemented Hashem’s techniques into Li’s system because doing so “would significantly increase overhead.” Ex. 2101 ¶ 60; *see* PO Resp. 65–67 (citing Ex. 2101 ¶¶ 57–60). According to Dr. Vojcic, Li teaches reducing overhead signaling in a different manner than Hashem—Li does so by transmitting only a group index for each group of subbands. Ex. 2101 ¶ 58 (“Li teaches reducing overhead signaling by transmitting only a ‘group index’ for each group of clusters. Ex. 1003 at 12:14–16. ‘By transmitting the SINR of all the clusters in the group sequentially, only the group index, instead of all the cluster indices, needs to be transmitted.’ Ex. 1003 at 12:14–16. At the same time,

Li reports the SINR per cluster to maximize the throughput via frequency diversity.”). Dr. Vojcic testifies that Hashem teaches to reduce overhead signaling by using a Link Mode after identifying all acceptable subcarriers and identifying each acceptable and unacceptable subcarrier via a bit mask. Ex. 2101 ¶¶ 59–60. According to Dr. Vojcic, applying this technique in Li’s OFDM system would significantly increase overhead because Li’s system potentially has thousands of subcarriers. *See* Ex. 2101 ¶ 60; PO Resp. 66–67 (citing Ex. 2101 ¶¶ 59–60).

In reply, Petitioner contends that Dr. Vojcic’s analysis is immaterial because Dr. Vojcic and Patent Owner rely on an unnecessary and improper bodily incorporation of Hashem into Li. Pet. Reply 33 (citing PO Resp. 66–67). According to Petitioner, “[t]he relevant point is that Hashem teaches calculating the Link Mode (and thus modulation and coding parameters) at the subscriber. That is all that matters.” Pet. Reply 33.

After considering the full record, we are not persuaded that Petitioner’s analysis rises to the level of articulated reasoning with some rational underpinning required to support Petitioner’s assertion that one of ordinary skill in the art would have moved the parameter deciding function from Li’s or Vijayan’s base station to Li’s user equipment because Hashem indicates one way to decrease signaling overhead is to move the Link Mode calculation to the user equipment. *KSR*, 550 U.S. at 418. To be sure, “[a] reference may be read for all that it teaches, including uses beyond its primary purpose.” *In re Mouttet*, 686 F.3d 1322, 1331 (Fed. Cir. 2012) (citing *KSR*, 550 U.S. at 418–21; *Beckman Instruments, Inc. v. LKB Produkter AB*, 892 F.2d 1547, 1551 (Fed. Cir. 1989)). Yet in the context of complex cellular communications involving thousands of subcarriers, we are not persuaded that Dr. Ding’s testimony is sufficient for us to conclude one

of ordinary skill in the art would have been motivated to modify Li's system such that the user equipment, rather than the base station, decides the modulation and coding parameters as required by the claim.

First, Dr. Vojcic's testimony contradicts and undermines Dr. Ding's testimony, at least to the extent that Dr. Vojcic opines as to the complexity of the cellular communications involved in determining whether to move base station techniques to the user equipment. This implicates a need for greater reasoning to support a conclusion that one of ordinary skill in the art not just *could* have moved the base station function to the user equipment but *would* have done so. *Belden*, 805 F.3d at 1073 (“[O]bviousness concerns whether a skilled artisan not only could have made but would have been motivated to make the combinations or modifications of prior art to arrive at the claimed invention.”)

Second, we note that Hashem also teaches that “[s]ignalling overhead can be reduced in a number of ways” immediately before discussing the particular manner of doing so on which Petitioner relies. Ex. 1006, 6:49–53. Neither Petitioner nor Dr. Ding acknowledge this context of Hashem's teaching, which indicates that there are other ways besides moving the Link Mode calculation to the user equipment to reduce signaling overhead. Although we accord Dr. Ding's testimony some weight, Dr. Ding does not provide sufficiently persuasive explanations as to why one of ordinary skill in the art would have moved the combination's parameter deciding from the base station to the user equipment on the basis of Hashem's teaching that one could do so to reduce signaling overhead. The complexity of cellular communications requires more explanation to support a conclusion that it would have been obvious to do so.

*G. Independent Claim 8 Subject Matter as a Whole*

Moreover, we are not persuaded that the differences between the claimed subject matter and Petitioner's asserted prior art are such that the subject matter, as a whole, would have been obvious at the time the invention was made to a person having ordinary skill in the art to which the subject matter pertains. 35 U.S.C. § 103; *KSR*, 550 U.S. at 406. To arrive at the claimed invention, the differences in Li, Vijayan, and Hashem require Petitioner to piece together the references such that Li's user equipment selects parameters per subband group based on a result of the channel estimation per subband is modified to decide parameters per subband group (as taught by Vijayan) and the locus of deciding those parameters would be moved from the base station to the user equipment.

Thus, Petitioner's combination is not the case of a simple substitution of one feature with another. Rather, these changes permeate the limitations of claim 8, except for "a channel estimating section that carries out a channel estimation per subband" [8a]. Furthermore, Petitioner's proposed combination involves complex technology for efficiently using the spectrum of radio frequencies necessary for cellular communications and requires moving key communication functions involving modulation/demodulation and encoding/decoding of transmitted signals from a base station to user equipment. Petitioner's rationale for why one of ordinary skill in the art would have made Petitioner's combination—general goals of reducing signaling overhead or reducing feedback overhead (Pet. 21, 22, 24)—are insufficient to support a legal conclusion of obviousness. To conclude that one of ordinary skill in the art would have combined Vijayan's subband groups in Li's system based on channel estimation per subband and moved the functions performed by the base station to Li's subscriber requires a

more robust explanation of why one of ordinary skill in the art would have made the particular trade-off to save signaling overhead at the expense of packing efficiency and a more detailed explanation as to why one of ordinary skill in the art would have moved the parameter decision making from the base station to the user equipment. The general assertions made by Petitioner give insufficient weight to the complexity of the technology.

Moreover, Petitioner's combination pieces disparate teachings of three references together without sufficient articulated rationale. *See InTouch Techs., Inc. v. VGO Commc'ns, Inc.*, 751 F.3d 1327, 1349 (Fed. Cir. 2014) (criticizing expert testimony that improperly combined disparate references "like separate pieces of a simple jigsaw puzzle" without sufficiently "explain[ing] what reason or motivation one of ordinary skill in the art at the time of the invention would have had to place these pieces together"). We must "guard against slipping into use of hindsight and to resist the temptation to read into the prior art the teachings of the invention in issue." *Abbott Labs. v. Sandoz, Inc.*, 544 F.3d 1341, 1348 (Fed. Cir. 2008).

### III. CONCLUSION

For these reasons, we are not persuaded that Petitioner has demonstrated by a preponderance of the evidence that Petitioner's combination of Li, Vijayan, Hashem, and Cioffi would have rendered the subject matter of independent claim 8 obvious. Based on the information presented, therefore, we conclude that Petitioner has *not* shown by a preponderance of the evidence that claim 8 of the '439 patent is unpatentable.

In summary:

| <b>Claim</b>               | <b>35 U.S.C.<br/>§</b> | <b>References</b>                    | <b>Claim<br/>Shown<br/>Unpatentable</b> | <b>Claim<br/>Not Shown<br/>Unpatentable</b> |
|----------------------------|------------------------|--------------------------------------|-----------------------------------------|---------------------------------------------|
| 8                          | 103                    | Li,<br>Vijayan,<br>Hashem,<br>Cioffi |                                         | 8                                           |
| <b>Overall<br/>Outcome</b> |                        |                                      |                                         | 8                                           |

#### IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that claim 8 of the '439 patent is *not* held unpatentable;  
and

FURTHER ORDERED that because this is a final written decision,  
parties to the proceeding seeking judicial review of the decision must  
comply with the notice and service requirements of 37 C.F.R. § 90.2.

IPR2018-01581  
Patent 7,848,439 B2

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