UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

QUALCOMM INCORPORATED and
ZYXEL COMMUNICATIONS CORPORATION[1],

Petitioner,

v.

UNM RAINFOREST INNOVATIONS,

Patent Owner.

PTAB Case No. IPR2021-00375
Patent 8,265,096 B2

PATENT OWNER'S NOTICE OF CROSS-APPEAL

[1] ZyXEL Communications Corporation was joined as a petitioner in this proceeding based on a petition and motion for joinder filed in IPR2021-00734, which were granted.

NOTICE OF CROSS APPEAL TO THE FEDERAL CIRCUIT

Pursuant to 35 U.S.C. §§ 141, 143, and 319, and 37 C.F.R. § 1.983, Patent Owner UNM Rainforest Innovations hereby cross-appeals to the United States Court of Appeals for the Federal Circuit from the Final Written Decision entered by the Patent Trial and Appeal Board ("Board") on July 15, 2022 (Paper 68) and from all orders, decisions, rulings, and opinions related thereto. Petitioner filed an initial notice of appeal on September 12, 2022 (Paper 69). This cross-appeal is timely under 37 C.F.R. § 90.3(a) and Rule 4(a)(3) of the Federal Rules of Appellate Procedure.

In accordance with 37 C.F.R. § 90.2(a)(3)(ii), Patent Owner states that the issues for cross-appeal include, but are not limited to:

1. Whether the Board erred in concluding that claims 1-4, 6, and 7 of the U.S. Patent No. 8,265,096 B2 are unpatentable as obvious over U.S. Pub. No. 2009/0067377 A1 ("*Talukdar*") and U.S. Pub. No. 2007/0155387 A1 ("*Li*"); and
2. any further findings or determinations by the Director or the Board supporting or relating to the issues above, including the Board's consideration of expert testimony, prior art, and other evidence on record; the Board's claim constructions and applications thereof; and the Board's

factual findings, conclusions of law, and other determinations supporting or related to the issues listed above.

A copy of this Notice of Cross-Appeal is being filed simultaneously with the Board and the Clerk's Office for the United States Court of Appeals for the Federal Circuit along with the required docketing fee.

Dated: September 16, 2022

Respectfully submitted,

/s/ *Jay P. Kesan*

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UNM RAINFOREST INNOVATIONS

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. §§ 90.2(a)(1) and 104.2(a), the undersigned hereby certifies that, in addition to being filed electronically through the Patent Trial and Appeal Board's E2E system, the foregoing PATENT OWNER'S NOTICE OF CROSS-APPEAL was filed on September 16, 2022, the same day as the filing of the above-identified documents in the United States Patent and Trademark Office (USPTO), with the Director of the United States Patent and Trademark Office, at the following address:

Director of the United States Patent and Trademark Office
Office of the General Counsel United States Patent and Trademark Office
Madison East, 10B20, 600 Dulany Street
Alexandria, Virginia, 22314

Dated: September 16, 2022

/s/ Jay P. Kesan
Jay P. Kesan

CERTIFICATE OF SERVICE (Fee)

Pursuant to 37 C.F.R. §§ 90.2(a) and Federal Circuit Rule 15(a)(1), the undersigned hereby certifies that on September 16, 2022, the requisite fee for appeal of the foregoing PATENT OWNER'S NOTICE OF CROSS-APPEAL was filed by CM/ECF in the United States Court of Appeals for the Federal Circuit

Dated: September 16, 2022

/s/ Jay P. Kesan
Jay P. Kesan

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. §§ 42.6(e)(4) and 42.25(b), the undersigned certifies that on September 16, 2022, a complete copy of the foregoing PATENT OWNER'S NOTICE OF CROSS-APPEAL was filed electronically through the Patent Trial and Appeal Board's PTABE2E System and provided, via electronic service, to the Petitioner by serving the correspondence address of record.

Dated: September 16, 2022

/s/ Jay P. Kesan
Jay P. Kesan

CERTIFICATE OF COMPLIANCE

Pursuant to 37 CFR § 90.3(a) and Rule 4(a)(3) of the Federal Rules of Appellate Procedure, the undersigned certifies that the notice of cross appeal is filed with the Director of the United States Patent and Trademark Office within 14 days of Petitioner's filing of its Notice of Appeal on September 12, 2022 (Paper 69).

Dated: September 16, 2022

/s/ Jay P. Kesan
Jay P. Kesan

IPR2021-00375
Paper 68
Final Written Decision

Trials@uspto.gov
571-272-7822

Paper 68
Entered: July 15, 2022

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

QUALCOMM INCORPORATED and
ZYXEL COMMUNICATIONS CORPORATION,[1]
Petitioner,

v.

UNM RAINFOREST INNOVATIONS,
Patent Owner.

IPR2021-00375
Patent 8,265,096 B2

Before KRISTEN L. DROESCH, BARBARA A. PARVIS, and CHARLES J. BOUDREAU, *Administrative Patent Judges*.

DROESCH, *Administrative Patent Judge.*

JUDGMENT
Final Written Decision
Determining Some Challenged Claims Unpatentable
Granting Patent Owner's Motion to Amend
Denying Patent Owner's Motion to Exclude
35 U.S.C. § 318(a)

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[1] ZyXEL Communications Corporation was joined as a petitioner in this proceeding based on a petition and motion for joinder filed in IPR2021-00734, which was granted.

I. INTRODUCTION

We have authority to hear this *inter partes* review under 35 U.S.C. § 6, and this Final Written Decision is issued pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73 (2019). For the reasons that follow, Petitioner has established by a preponderance of the evidence that claims 1–4, 6, and 7 of U.S. Patent No. 8,265,096 B2 (Ex. 1001, "'096 Patent") are unpatentable.

A. Procedural History

Qualcomm Incorporated ("Qualcomm") filed a Petition requesting an *inter partes* review of claims 1–4 and 6–8 ("challenged claims") of the '096 Patent. Paper 1 ("Pet."). Qualcomm concurrently filed a Motion for Joinder seeking to join as a petitioner in *Intel Corp. v. UNM Rainforest Innovations*, IPR2020-01576. (Paper 3, "Qualcomm's Motion for Joinder," "Mot. Joinder"). UNM Rainforest Innovations ("Patent Owner") filed a Preliminary Response. Paper 8 ("Prelim. Resp."). Pursuant to our authorization, Qualcomm filed a Reply to the Preliminary Response (Paper 10) to address discretionary denial under 35 U.S.C. § 314(a), to which Patent Owner filed a Sur-reply (Paper 12).

Pursuant to 35 U.S.C. § 314, we instituted trial on July 19, 2021, as to all of the challenged claims of the '096 Patent and dismissed Qualcomm's Motion for Joinder as moot.[2] Paper 14 ("Institution Decision" or "Dec.").

ZyXEL Communications Corporation ("ZyXEL") filed a petition for *inter partes* review and a Motion for Joinder in IPR2021-00734, requesting

[2] Prior to instituting this proceeding, IPR2020-01576 was terminated upon granting a joint motion to terminate. *Intel Corp. v. UNM Rainforest Innovations*, IPR2020-01576, Paper 9.

that ZyXEL be joined as a petitioner in IPR2021-00375. *ZyXEL Commc'ns Corp. v. UNM Rainforest Innovations*, IPR2021-00734, Papers 1, 3. After considering the parties' papers, we instituted trial in IPR2021-00734, granted ZyXEL's Motion for Joinder, and added ZyXEL as a petitioner to IPR2021-00375. *ZyXEL Commc'ns Corp. v. UNM Rainforest Innovations*, IPR2021-00734, Paper 17. A copy of that decision was entered in this record. Paper 18.

After institution of trial, Patent Owner filed a Response (Paper 38, "PO Resp."), to which Qualcomm and ZyXEL (collectively "Petitioner") filed a Reply (Paper 40, "Pet. Reply"), to which Patent Owner filed a Sur-reply (Paper 43, "PO Sur-reply").

Patent Owner also filed a Motion to Amend (Paper 37, "Mot. Amend"), to which Petitioner filed an Opposition (Paper 41, "Pet. Opp. MTA"). Pursuant to Patent Owner's request (*see* Mot. Amend 1), we issued Preliminary Guidance (Paper 42, "PG") on Patent Owner's Motion to Amend. Patent Owner filed a Reply (Paper 64, "PO Reply MTA") to Petitioner's Opposition, to which Petitioner filed a Sur-reply (Paper 65, "Pet. Sur-reply MTA").

Petitioner relies on a first Declaration of Sumit Roy, Ph.D. (Ex. 1002) to support its Petition. Patent Owner relies on two Declarations of Branimir Vojcic, D.Sc. (Exs. 2001, 2013) to support its Response. Petitioner relies on a second Declaration of Dr. Roy (Ex. 1039) to support its Opposition to the Motion to Amend.

Dr. Roy and Dr. Vojcic were cross-examined during trial, and transcripts of Dr. Roy's deposition (Ex. 2015) and Dr. Vojcic's deposition (Ex. 1038) are included in the record.

Patent Owner filed a Motion to Exclude Evidence (Paper 55, "PO Mot. Excl.), to which Petitioner filed an Opposition (Paper 57, "Pet. Opp. Mot. Excl."), to which Patent Owner filed a Reply (Paper 61, "PO Reply Mot. Excl.").

Oral argument was held on May 12, 2022. A transcript of the oral argument is included in the record. Paper 66.

B. Real Parties in Interest

Qualcomm states that Qualcomm Incorporated is the real party in interest and further identifies its customers Dell Technologies Inc., Dell Inc., and EMC Corporation as additional real parties in interest. *See* Pet. 2.

ZyXEL states that ZyXEL Communications Corporation is a real party in interest. *ZyXEL Commc'ns Corp. v. UNM Rainforest Innovations*, IPR2021-00734, Paper 1, 2–3. ZyXEL also identifies ZyXEL Communications Inc. as a U.S. subsidiary of ZyXEL Communications Corporation, but indicates that ZyXEL Communications Corporation does not believe that ZyXEL Communications Inc. qualifies as a real party in interest. *Id.*

Patent Owner states that the University of New Mexico Board of Regents is an additional real party in interest. *See* Paper 6, 2.

C. Related Matters

The parties indicate the following matters may affect or be affected by a decision in this proceeding: *UNM Rainforest Innovations v. Industrial Technology Research Institute*, No. D-202-CV-2021-02803 (N.M. 2d. Judicial District Court May 4, 2021); *UNM Rainforest Innovations v. ASUSTek Computer, Inc.*, No. 6:20-cv-00142-ADA (W.D. Tex.); *UNM*

Rainforest Innovations v. Dell Technologies, Inc., No. 6:20-cv-00468-ADA (W.D. Tex.); *UNM Rainforest Innovations v. D-Link Corp.*, No. 6:20-cv-00143-ADA (W.D. Tex.); *UNM Rainforest Innovations v. TP-Link Technologies Co.*, No. 6:19-cv-00428-ADA (W.D. Tex.); and *UNM Rainforest Innovations v. ZyXEL Communications Corp.*, No. 6:20-cv-00522-ADA (W.D. Tex.). *See* Pet. 2–3; Paper 6, 2; Paper 11, 1.

D. The ’096 Patent (Ex. 1001)

The ’096 Patent relates to methods for constructing frame structures for orthogonal frequency-division multiple access (OFDMA) systems. *See* Ex. 1001, 1:16–19.

Figure 6A of the ’096 Patent is reproduced below:

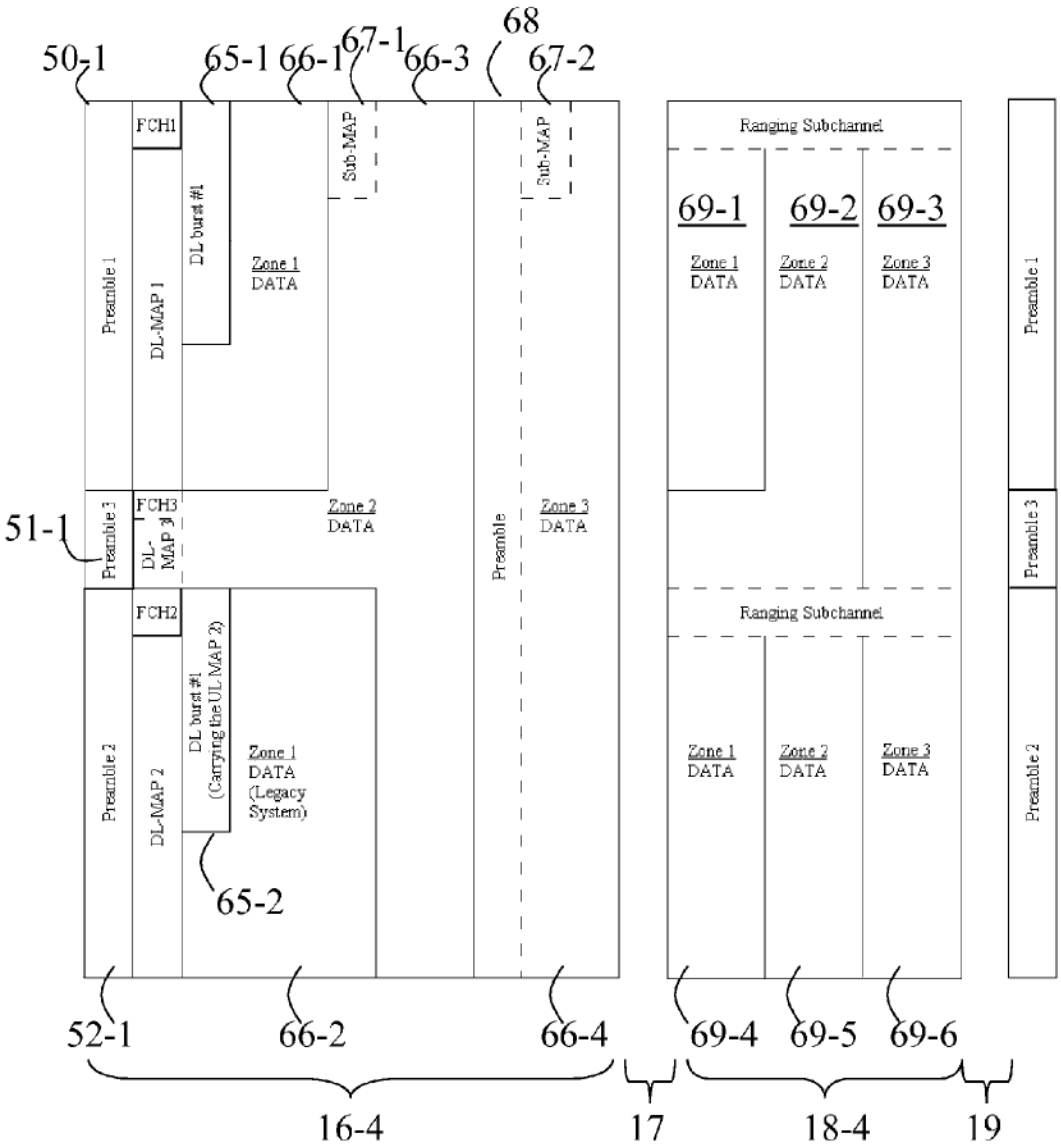

Figure 6A illustrates an OFDMA frame structure supporting high mobility and having a scalable bandwidth. *See* Ex. 1001, 4:1–3, 6:66–7:2. The frame structure includes downlink (DL) sub-frame 16-4 and uplink (UL) sub-frame 18-4. *See id.* at 7:5–7. The frame structure includes added regions related to zones 3 for high-mobility environments. *See id.* at 7:2–5. In DL sub-frame 16-4, a first added region includes preamble 68, a sub-MAP 67–2 and DATA 66-4. *See id.* at 7:5–7. In UL sub-frame 18-4, a

second added region includes DATA 69-3 and 69-6 (zones 3). *See id.* at 7:7–8. DATA 66-4, 69-3, and 69-6 may be allocated for the extended OFDMA system under high mobility. *See id.* at 7:8–10. DL sub-frame 16-4 is divided according to mapping information in DL-MAP 1, DL-MAP 2, and DL-MAP 3, and UL sub-frame 18-4 is divided according to the map information in UL-MAPs in DL burst #1 65-1 and/or 65-2. *See id.* at 7:10–14. A portion of the guard band that overlaps data zones 69-1 and 69-2 in UL sub-frame 18-4 may be used to transmit data in the extended system. *See id.* at 7:14–17. "As compared to the zones in the data region of the DL sub-frame 16-4 or the UL sub-frame 18-4 of the old/legacy system or the new/extended system, the placements of the pilot symbols may be denser, [and] the OFDMA symbol periods may be shorter . . . in zones 3 of UL sub-frame 18-4 or DL sub-frame 16-4 for the extended system under high mobility." *Id.* at 7:21–27.

E. Illustrative Claims

Claims 1 and 8 are independent, and claims 2–4, 6, and 7 depend ultimately from claim 1. Claims 1 and 8 are illustrative and reproduced below:

> 1. A method of constructing a frame structure for data transmission, the method comprising:
>
> generating a first section comprising data configured in a first format compatible with a first communication system using symbols;
>
> generating a second section following the first section, the second section comprising data configured in a second format compatible with a second communication system using symbols, wherein the first communication system's symbols and the second communication system's

symbols co-exist in one transmission scheme and wherein:

the second format is compatible with the second communication system configured to support higher mobility than the first communication system, wherein each symbol in the second communication system has a shorter symbol period than that in the first communication system;

generating at least one non-data section containing information describing an aspect of data in at least one of the first section and the second section; and

combining the first section, the second section and the at least one non-data section to form the frame structure.

8. A method of constructing a frame structure for data transmission, the method comprising:

generating a first section comprising data configured in a first format compatible with a first communication system using symbols;

generating a second section following the first section, the second section comprising data configured in a second format compatible with a second communication system using symbols, wherein the first communication system's symbols and the second communication system's symbols co-exist in one transmission scheme and wherein the second communication system has pilot symbols that are denser than those in the first communication system;

generating at least one non-data section containing information describing an aspect of data in at least one of the first section and the second section; and combining the first section, the second section and the at least one non-data section to form the frame structure.

Ex. 1001, 8:32–54, 9:6–25.

F. Patentability Challenges and Asserted Prior Art

Petitioner asserts the following challenges to the patentability of claims 1–4 and 6–8:

Claim(s) Challenged	35 U.S.C. §[3]	Reference(s)/Basis
1–4, 6, 7	103	Talukdar,[4] Li[5]
8	103	Talukdar, Nystrom[6]

II. PATENT OWNER'S MOTION TO EXCLUDE EXHIBIT 1002

Before we address patentability of the challenged claims, we first address Patent Owner's Motion to Exclude Dr. Roy's Declaration (Ex. 1002) filed with the Petition and relied upon to support the Petition. Patent Owner moves to exclude Dr. Roy's Declaration on the basis that it violates Federal Rules of Evidence (FRE) 702 and 703. *See* PO Mot. Excl. 1–3, 8.

Petitioner contends that Patent Owner's Motion to Exclude Dr. Roy's Declaration should be denied because Patent Owner's Motion failed to identify the objections in the record as required by 37 C.F.R. § 42.64(c) and failed to timely file an objection as required by 37 C.F.R. § 42.64(b)(1) in order to preserve its objection. *See* Pet. Opp. Mot. Excl. 1–8. Petitioner contends that, pursuant to 37 C.F.R. § 42.64(b)(1), Patent Owner was required to file any objection to Dr. Roy's Declaration within ten business days of institution of trial. *See id.* at 2–3. We instituted trial on July 19, 2021. *See* Dec. Petitioner contends that Patent Owner has waived its objection. *See* Pet. Opp. Mot. Excl. 1, 3–4.

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[3] Petitioner challenges patentability under pre-AIA 35 U.S.C. § 103. Pet. 23, 28, 30.
[4] Ex. 1012, US 2009/0067377 A1, published Mar. 12, 2009 ("Talukdar").
[5] Ex. 1001, US 2007/0155387 A1, published July 5, 2007 ("Li").
[6] Ex. 1017, US 2007/0104174 A1, published May 10, 2007 ("Nystrom").

Patent Owner asserts that Patent Owner did not become aware of the evidentiary problem with Ex. 1002 until Dr. Roy's deposition on December 6, 2021. *See* PO Reply Mot. Excl. 2. Patent Owner contends that it filed objections one day later in its Patent Owner Response filed on December 7, 2021. *See id.* (quoting Paper 28[7], 34). Patent Owner also asserts that it filed objections on December 16, 2021, in Paper 31.[8] *See id.* Patent Owner contends that it "filed its Motion to Exclude [] referring to its objections to EX1002 raised both in its Patent Owner's Response [] and Objections to Evidence." *Id.*

A motion to exclude evidence must be filed to preserve a prior objection to evidence and must identify the objections in the record. 37 C.F.R. § 42.64(c). An objection to evidence submitted prior to the institution of the trial, including evidence submitted with a petition to institute *inter partes* review, must be filed within ten business days of the institution of the trial. 37 C.F.R. § 42.64(b)(1). Once a trial is instituted, any objection must be filed within five business days of the service of evidence to which the objection is directed. *Id.* The objection must identify the grounds for the objection with sufficient particularity to allow for correction in the form of supplemental evidence. *Id.* An objection to deposition evidence "must be made during the deposition." 37 C.F.R. § 42.64(a).

[7] Patent Owner quotes Paper 28 which was expunged and replaced with Paper 38. *See* Ex. 3001.
[8] Paper 31 was expunged and replaced with Paper 39.

As an initial matter, we do not consider Patent Owner's arguments presented in the Patent Owner Response to be an objection. The pertinent portions of the Patent Owner Response are reproduced as follows:

> The technical aspect of the Roy declaration (EX1002) should be discounted in their entirety because they do not reflect the work of Dr. Roy. Instead, the technical aspects of the Roy declaration are a carbon copy of the report of another expert in another proceeding. Patent Owner intends to request authorization from the Board to file a motion to strike the technical aspects of the Roy declaration in their entirety.

PO Resp. 34. Patent Owner's arguments fail to comply with the requirement to identify the objection with sufficient particularity to allow for correction because the arguments do not mention an objection nor contend that Dr. Roy's Declaration is inadmissible. *See* PO Resp. 34; 37 C.F.R. § 42.64(b)(1).

Patent Owner initially filed on December 16, 2021, a paper entitled "Patent Owner's Objection to the Expert Report of Dr. Roy (Ex. 1002)" (Paper 39) explaining: "[b]ased on the deposition testimony taken on Dec. 6, 2021 (EX2015), EX1002 is objectionable and inadmissible as incomplete, irrelevant, misleading, improper expert testimony and lacking authenticity under F.R.E. 106, 401, 403, 702, and 901." Paper 39, 1. Patent Owner's Objection complies with the requirement to identify the objection with sufficient particularity to allow for correction. *See id.*; 37 C.F.R. § 42.64(b)(1). Patent Owner's Objection, however, is untimely. Dr. Roy's Declaration (Ex. 1002) was submitted with the Petition, but Patent Owner's Objection was not filed within 10 business days of the July 19, 2021, institution of trial. Patent Owner did not seek leave to file a motion to waive the timing requirement of 37 C.F.R. § 42.64(b)(1).

Patent Owner's Reply to the Motion to Exclude and Patent Owner's Objection both assert that Dr. Roy's December 6, 2021, deposition is the pertinent measurement date. In particular, Patent Owner

> assert[s] the following objection to evidence proffered by Petitioner [] submitted on December 23, 2021[9], and related deposition testimony taken on December 6, 2021. These objections are being provided within 10 business days of receipt of the evidence to which the objection is related and are thus timely pursuant to 37 C.F.R. § 42.64(b)(1).

Paper 39, 1; *see* PO Reply Mot. Excl. 2 ("Patent Owner [] did not become aware of the evidentiary problem with EX1002 until the deposition of Dr. Roy, which . . . did not take place until Dec. 6, 2021.").

Patent Owner mischaracterizes the Board's Rule because 37 C.F.R. § 42.64(b)(1) does not provide for new objections to evidence based on the date of related evidence. Even if 37 C.F.R. § 42.64(b)(1) permitted new objections based on the date of related evidence, once a trial is instituted, any objection must be filed within five business days. Even assuming that the December 6, 2021, deposition date could be a pertinent measurement date, Patent Owner's Objection filed December 16, 2021, was not filed within five business days as required by 37 C.F.R. § 42.64(b)(1). Again, Patent Owner did not seek leave to file a motion to waive the timing requirement of 37 C.F.R. § 42.64(b)(1).

For the foregoing reasons, Patent Owner does not direct us to timely filed objections to Dr. Roy's Declaration (Ex. 1002). Under these circumstances, we will not waive the requirements for timely objection.

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[9] Ex. 1002 was filed on December 28, 2020.

Accordingly, we conclude that Patent Owner's Motion to Exclude should be denied on this basis.

In any event, even if Patent Owner's Objections had been timely filed, and thus preserved by Patent Owner's Motion to Exclude, Patent Owner's arguments presented in the Motion to Exclude are unpersuasive. Patent Owner argues that FRE Rules 702 and 703 require that the expert has reliably applied the principles and methods to the facts of the case and that the expert is not merely a mouthpiece for another non-testifying expert. *See* PO Mot. Excl. 1–2; PO Reply Mot. Excl. 5. According to Patent Owner, Rule 703 "does not allow the mere adoption of a hearsay document without independent analysis." PO Mot. Excl. 2. Patent Owner contends that Dr. Roy's Deposition testimony confirmed that Dr. Roy failed to apply the principles and methods to the facts of the case and simply adopted wholesale the expert opinion of another non-testifying expert, namely, that set forth in a declaration of Dr. Robert Akl submitted in support of Intel Corporation's petition in IPR2020-01576, filed as Exhibit 1028 in this proceeding. *See id.* Patent Owner asserts that "[c]ourts routinely require expert witnesses to properly support their work and opinions." *Id.* at 3. In support of its arguments, Patent Owner asserts that the United States Court of Appeals for the Second Circuit affirmed a district court's exclusion of an expert opinion where the expert merely reviewed and made minor revisions to an opinion provided to him by plaintiff's counsel. *See id.* (citing *Puppolo v. Welch*, 771 Fed. Appx. 64 (2d Cir., June 20, 2019) (summary order). In support of its arguments, Patent Owner also quotes *United States v. Tomasian*, 784 F.2d 782, 786 (7th Cir. 1986); *Crowley v. Chait*, 322 F.Supp.2d 530, 553 (D.N.J. 2004); 29 Charles Alan Wright & Victor James Gold, *Federal*

Practice and Procedure § 6273, at 312 (1997). Patent Owner contends that "Dr. Roy simply signed off on an expert report provided to him by counsel with effectively no substantive changes" and "fail[ed] to cite the original expert report in his materials considered list." *Id.* at 4; PO Reply Mot. Excl. 4 (citing Ex. 1002, 10–12). Patent Owner asserts that there are no substantive differences whatsoever between Dr. Roy's Declaration and Dr. Akl's Declaration, only edits regarding punctuation, enumeration, changing "POSITA" to "POSA," and two or three paraphrasing efforts. *See* PO Mot. Excl. 4–8 (citing PO Mot. Excl. Attachment A 53–55, 57–113). Patent Owner contends that Dr. Roy did not perform his own independent analysis and is submitting the work product of another expert as his own as pretense for submitting the substance of a hearsay document. *See id.* at 8; PO Reply Mot. Excl. 5.

In the Opposition, Petitioner contends that the substance of Dr. Roy's Declaration is largely the same as Dr. Akl's Declaration because it is required by the rules of joinder, and Dr. Roy confirmed that he has read and agrees with Dr. Akl's opinions. *See* Pet. Opp. Mot. Excl. 1, 8–9. Petitioner contends that Patent Owner's arguments ignores the joinder requirements, and that if Dr. Roy's Declaration had not been substantively identical to Dr. Akl's Declaration, it may have introduced new issues and the basis for denying joinder. *Id.* at 8–9 (quoting Mot. Joinder 6 n.1; citing *Celltrion, Inc. v. Genentech, Inc.*, IPR2018-01019, Paper 11 at 14 (PTAB Oct. 30, 2018). Petitioner asserts Patent Owner's claim that Petitioner tried to hide the substantive similarity of Dr. Roy's Declaration to Dr. Akl's Declaration is meritless because the Petition and Qualcomm's Motion for Joinder acknowledged the substantive similarity, and Dr. Roy acknowledged that he

used Dr. Akl's Declaration as the basis for his Declaration. *See id.* at 9 (quoting Pet. 5 n.1; Ex. 2015, 55:3–4, citing Mot. Joinder). Petitioner argues that Patent Owner's Motion to Exclude ignores that Dr. Roy reviewed Dr. Akl's Declaration in its entirety and agreed with Dr. Akl's opinions. *See id.* (citing Ex. 2015[10], 111:18–112:5).

Patent Owner also argues that Dr. Roy's credibility has been diminished by not disclosing or citing Dr. Akl's Declaration as the basis for his Declaration and misrepresenting under oath his own work in drafting the Declaration. PO Mot. Excl. 1, 2, 4; PO Reply Mot. Excl. 4 (quoting Ex. 2015, 60:2–61:10; citing Ex. 1002, 10–12), 5. Patent Owner contends that Dr. Roy testified that: (1) he wrote Section IX, "The Challenged '096 Patent" as well as Section X, Overview of the Prior Art References; (2) he performed analysis on Talukdar and Nystrom; (3) his Declaration reflected his own analysis of Li, Nystrom, and Talukdar, and claimed he spent >20 hours on drafting his opinion and iterative revisions; (4) he used the same process for the detailed invalidity analysis; and (5) he only took a quick look at Dr. Akl's Declaration and contributed himself to the drafts of the Declaration. *See* Mot. Excl. 4 (quoting Ex. 2015, 60:2–61:10), 5 (quoting Ex. 2015, 71:5–72:4), 6 (quoting Ex. 2015, 81:11–82:6), 6–7 (quoting Ex. 2015, 107:11–14), 7 (quoting Ex. 2015, 110:14–111:17); *see also* PO Reply Mot. Excl. 4 (arguing Dr. Roy considered Dr. Akl's Declaration and briefly read it before writing his own Declaration, quoting Ex. 2015, 110:14–111:17).

[10] Petitioner incorrectly cites Exhibit 2013.

Petitioner contends that Patent Owner's arguments go to the weight not the admissibility of Dr. Roy's Declaration. *See* Pet. Opp. Mot. Excl. 10–11. Petitioner contends that Patent Owner's arguments also do not diminish the weight that should be given to Dr. Roy's Declaration. *See id.* at 11. According to Petitioner, Patent Owner's "argument that Dr. Roy misrepresented his involvement in making edits to his Petition Declaration is belied by the fact that Dr. Roy candidly acknowledged that he 'used the Akl report as the basis of his report.'" *Id.* at 11 (quoting Ex. 2015, 55:3–4).

In the Reply, Patent Owner contends that "Dr. Roy . . . *made no mention of the Akl Report whatsoever,* until specifically asked about it. And even then, he only said he considered it and briefly read it before writing his own report." PO Reply Mot. Excl. 4 (citing Ex. 2015, 110:14–111:17).

Even if Patent Owner's objections were timely, we would deny Patent Owner's Motion to Exclude because Dr. Roy's testimony should not be excluded under Federal Rules of Evidence 702 and 703. Rule "702 imposes a special obligation upon a trial judge to 'ensure that any and all scientific testimony . . . is not only relevant, but reliable,'" which is a "basic gatekeeping obligation." *Kumho Tire Co. v. Carmichael*, 526 U.S. 137, 147 (1999) (quoting *Daubert v. Merrell Dow Pharm., Inc.*, 509 U.S. 579 (1993)). The policy considerations for excluding expert testimony, such as those implemented by *Daubert*'s gatekeeping framework, are less compelling in bench proceedings such as *inter partes* reviews than in jury trials because, unlike a lay jury, the Board has significant experience in evaluating expert testimony. Accordingly, the danger of prejudice in this proceeding would be considerably lower than in a lay jury trial and the wholesale exclusion of a witness's declaration is rarely called for in a proceeding before the Board.

Furthermore, Patent Owner's arguments challenging the credibility of Dr. Roy go to the weight that should be given to Dr. Roy's Declaration testimony, not the admissibility of the Declaration. In our patentability analysis that follows, we account for the evidence that Dr. Roy's Declaration is substantially the same as Dr. Akl's Declaration, the supporting evidence cited therein, as well as Dr. Roy's deposition testimony in determining the appropriate weight to give Dr. Roy's testimony when weighing the record evidence.

III. ANALYSIS OF PATENTABILITY CHALLENGES

A. Claim Construction

The Board applies the same claim construction standard as applied in federal courts in a civil action under 35 U.S.C. § 282(b), which is generally referred to as the *Phillips* standard. *See* 37 C.F.R. § 42.100(b) (2020); *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc). Under the *Phillips* standard, words of a claim are generally given their ordinary and customary meaning. *Phillips*, 415 F.3d at 1312.

Petitioner identifies the following claim constructions, entered by the court in *UNM Rainforest Innovations v. Apple Inc.*, No. 1:20-cv-00351 (W.D. Tex.) (Ex. 1011),[11] as consistent with the positions advanced in the Petition:

Claim Term or Phrase	Construction
"frame structure"	"a single structure comprising one or more frames, wherein each frame may have one or more subframes"

[11] Patent Owner previously asserted the '096 Patent in *UNM Rainforest Innovations v. Apple Inc.*, No. 1:20-cv-00351 (W.D. Tex.), which was ultimately dismissed. *See* Pet. 3 n.1.

"data/ non-data"	"[p]lain-and-ordinary meaning"
"communication system"	"[p]lain-and-ordinary meaning, where the plain-and-ordinary meaning is 'a combination of hardware and software that transmits and receives data according to one or more communication standards'"
"symbol"	"[p]lain-and-ordinary meaning, wherein the plain-and-ordinary meaning means 'a transmissible unit of information'"
"wherein the first communication system's symbols and the second communication system's symbols co-exist in one transmission scheme"	"[p]lain-and-ordinary meaning[,] where the plain-and ordinary meaning is 'wherein symbols of the first communication system and symbols of the second communication system exist together in one transmission scheme'"
"support higher mobility than"	"support higher relative velocity between a transmitter and a receiver than"
"symbol period"	"the time it takes to transmit one symbol"
"at least one of […] and […]"	"[...] and/or [...]"
"pilot symbols that are denser than"	"more pilot symbols per unit time than, wherein a unit time is the symbol period of the first communication system"

See Pet. 22–23 (alterations in original). Patent Owner identifies the same claim terms or phrases construed by the court. *See* PO Resp. 9–10.

As demonstrated in the analysis below, we need not construe any claim term or phrase. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) ("[W]e need only construe terms 'that are in controversy, and only to the extent necessary to resolve the controversy.'" (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))).

B. Level of Ordinary Skill in the Art

Petitioner asserts:

> As of 2007, a person of ordinary skill in the art ("POSA") in the field of the '096 patent would have had a Bachelor's degree in electrical engineering, computer engineering, or a related field, and around two years of experience in the design or development of wireless communication systems, or the equivalent.

Pet. 21 (citing Ex. 1002 ¶¶ 49–51). Patent Owner offers a slightly different description as follows:

> At the relevant time, a person of ordinary skill in the art in the technical field of the '096 patent would have had at least a Master's Degree in Computer Engineering or Electrical Engineering, or equivalent work experience, along with at least 1 year of experience related specifically to wireless communications, including knowledge of MIMO [(multiple-input, multiple-output)] and OFDM [(orthogonal frequency-division multiplexing)].

PO Resp. 8 (citing Ex. 2001 ¶ 17).

We adopt Patent Owner's definition of a person of ordinary skill in the art because it is consistent with the level of skill reflected by the '096 Patent Specification and the asserted prior art, but our conclusions would be the same under Petitioner's definition.

C. Principles of Law

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 skill in the art; and (4) if in evidence, so-called secondary considerations. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

D. Entitlement of Challenged Claims to Earlier Effective Filing Date

Petitioner contends that the ’096 Patent is not entitled to the earlier effective filing date of Provisional Application No. 60/929,798 (Ex. 1009, “’798 Provisional Application”), filed on July 12, 2007. *See* Pet. 19. Petitioner asserts that the ’798 Provisional Application does not contain any disclosure relating to a second communication system that had a shorter symbol period or denser pilot symbols, as recited in claims 1–4 and 6–8 of the ’096 Patent. *See id.* (citing Ex. 1009; Ex. 1002 ¶¶ 86–88). According to Petitioner, the ’798 Provisional Application “did not contain written description support for the challenged claims, and September 17, 2007, is their earliest possible priority date.” *Id.*

Petitioner meets its initial burden of production (*see* Pet. 19, 23, 25–27), thereby shifting the burden of production to Patent Owner to show entitlement of the challenged claims to the July 12, 2007 filing date. *See Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1379–80 (Fed. Cir. 2015); *Research Corp. Techs., Inc. v. Microsoft Corp.*, 627 F.3d 859, 870–71 (Fed. Cir. 2010). For a claim in a later-filed application to be entitled to the filing date of an earlier application, the earlier application must provide written description support for the claimed subject matter. *Anascape, Ltd. v. Nintendo of Am. Inc.*, 601 F.3d 1333, 1337 (Fed. Cir. 2010). To satisfy the written description requirement, “a prior application itself must describe an invention, and do so in sufficient detail

that one skilled in the art can clearly conclude that the inventor invented the claimed invention as of the filing date sought." *Lockwood v. Am. Airlines, Inc.*, 107 F.3d 1565, 1572 (Fed. Cir. 1997); *see also VasCath v. Mahurkar*, 935 F.2d 1555, 1563–64 (Fed. Cir. 1991) ("[T]he applicant must [] convey with reasonable clarity to those skilled in the art that, as of the filing date sought, he or she was in possession of the invention . . . now claimed."), *Ariad Pharm. Inc. v. Eli Lilly & Co.*, 598 F.3d 1336, 1352 (Fed. Cir. 2010) (en banc) ("[I]t is the specification itself that must demonstrate possession.").

Patent Owner contends that the '096 Patent is entitled to the July 12, 2007, earlier effective filing date of '798 Provisional Application. *See* PO Resp. 10–11, 16. Patent Owner provides a chart of the limitations for each of claims 1–4 and 6–8 of the '096 Patent, along with citations to, and reproductions of, certain portions of the '798 Provisional Application along with corresponding explanations. *See id.* at 16–27; Ex. 2001 ¶ 52. The following pertinent portions of Patent Owner's claim chart for claim 1 are reproduced below:

c. the second format is compatible with the second communication system configured to support higher mobility than the first communication system, wherein each symbol in the second communication system has a shorter symbol period than that in the first communication system;	The provisional discloses that the second format compatible with 802.16m is designed to support higher mobility, *i.e.*, speed at which the mobile unit is moving, and uses symbols that are shorter (*i.e.* the bandwidth is larger) than the symbols in 802.16e. ▪ New standard 802.16m is being developed for next generation wir communication • Enhanced spectrum efficiency • Higher speed EX2002 ('096 Provisional) at 2. Both, "spectrum efficiency" and "higher speed" are advantages of the second communication system. The former implies higher data speed, which clarifies the meaning of "higher speed" as referring to a higher velocity mobile unit. ▪ Frequency planning • Occupy the same band class as 802.16e • A 802.16m channel uses multiple (L) contiguous 802.16e channels • L BS's share the same 802.16m zone with L*B bandwidth (802.16e BW with B) EX2002 ('096 Provisional) at 3. A POSITA would have known at the time of the provisional application that by use of the following formulas a "shorter symbol period" can be shown for the second system. N = number of subcarriers K = number of samples in the cyclic prefix $$T_s = \frac{N+K}{3B}$$ $$T_{sL} = \frac{N_L + K_L}{B}$$ Where T_s is the symbol period of the second system and T_{SL} is the symbol period of the legacy system.

	By explicitly disclosing that the bandwidth of the second system is larger, the provisional application clearly supports the claim requirement that the second system has a shorter symbol period. **Proposed structure A** Cell search by 16m user • Baseband BW of L*B • Detect 16e preamble with BW of B • Decode FCH/MAP to decide the location of 16m zone • Retrieve 16m zone with BS with BW of L*B 16m user 16e preamble cell sea B_F=B Preamble in 16e MAP indication o 16m zone B_F=B 16m zone location Decode 16m zone B_F= B_F be the bandwidth LPF EX2002 ('096 Provisional) at 4.

PO Resp. 19–20; Ex. 2001 ¶ 52 (same). Similarly, the following pertinent portions of Patent Owner's claim chart for claim 8 are reproduced below:

b. generating a second section following the first section, the second section comprising data configured in a second format compatible with a second communication system using symbols, wherein the first communication system's symbols and the second communication system's symbols co-exist in one transmission scheme and wherein the second communication system has pilot symbols that are denser than those in the first communication system;	*See* 1b. The District Court in *UNM Rainforest Innovations v. Apple Inc.*, No. 1-20-cv-00351 (W.D. Tex.) construed the claim term "pilot symbols that are denser than" as "more pilot symbols per unit time than, wherein a unit time is the symbol period of the first communication system." EX1011 (Apple Claim Construction Order). Given that construction, the provisional discloses the limitation regarding pilot density by pointing to increased density (in the temporal dimension) as a natural result of reduced symbol period – as shown above. Further, the goal of achieving "higher speed" in conjunction with the proposed dual-system frame structure would suggest modifying density of pilots in one of the systems as a solution to the problem caused by increased Doppler shifting due to high speed.

Patent Owner presented an identical table and substantially identical arguments in its Preliminary Response. *Compare* Prelim. Resp. 24–37, *with* PO Resp. 16–28.

In the Institution Decision, after considering the Petition and Preliminary Response, we explained, by way of example, that "Patent Owner and its declarant Dr. Vojcic do not provide underlying facts to support the contention that a person of ordinary skill in the art 'would have known at the time of the provisional application that by use of the following formulas a "shorter symbol period" can be shown for the second system.'" Dec. 26. We further found that Patent Owner does not provide the factual basis for the formulas:

$$T_s = \frac{N + K}{3B} \text{ and } T_{sL} = \frac{N_L + K_L}{B}.$$

Id. We also found that "Patent Owner also does not explain whether there is an assumption that N and N_L and K and K_L are the same for the second system and the legacy system." *See id.* at 27.

To address the preliminary findings in the Institution Decision, Patent Owner directs attention to Dr. Vojcic's testimony in a Supplemental Declaration (Ex. 2013). *See* PO Resp. 29. According to Patent Owner, Dr. Vojcic testifies that a person of ordinary skill in the art "as of July 2007, would have known that TSYM = TGI + TDFT = N/Fs + K/Fs, where TDFT is the IDFT/DFT period, TGI is the length of the cyclic prefix (also called guard interval), N is the number of carriers." *Id.* (quoting Ex. 2013 ¶ 19); *see* PO Sur-reply 6. Patent Owner contends that "OFDM, the origin of this formula, dates back to the 1970s." PO Resp. 29 (citing Ex. 2013 ¶ 20). Patent Owner asserts that a seminal paper from 1971 informs a person of

ordinary skill in the art "that 'the symbol period is the product of the sampling period Δt and the number of samples N, TDFT = N Δt.'" *Id.* (reproducing Ex. 2013 ¶ 21; quoting Ex. 2013 ¶ 22); *see* PO Sur-reply 6. Patent Owner asserts that a paper by Cimini in 1985 establishes that Δt = 1/Fs. PO Resp. 29 (quoting Ex. 2013 ¶ 25[12]); *see* PO Sur-reply 6. Patent Owner asserts the Cimini paper also shows a modulo extension, which present day systems refer to as a cyclic prefix or guard interval, and the bottom of Figure 8 of the Cimini paper shows the length of a block is now N+1 long, where 1 is the length of the guard interval, which is K. *See* PO Resp. 29 (quoting Ex. 2013 ¶ 26[13]). Patent Owner contends that, consequently, a block is now N+K long, and including this extension, the length of a block is TSYM = TGI + TDFT. *See id.* at 30; Ex. 2013 ¶ 27. Patent Owner also provides the example of IEEE 802.11a standard where the number of carriers N is 64. *See* PO Resp. 30–31 (reproducing Ex. 2013 ¶¶ 28–33); PO Sur-reply 6. According to Patent Owner, "[b]ased on these disclosures and examples, 'a [person of ordinary skill in the art] as of at least 1999 would have been able to calculate the symbol period of an OFDM system as TSYM = TGI + TDFT = N/Fs + K/Fs = (N+K)/Fs.'" PO Resp. at 31 (quoting Ex. 2013 ¶ 34[14]).

Patent Owner further asserts that Dr. Vojcic

> provides a logical explanation based on the fact that "a [person of ordinary skill in the art] would understand that OFDM systems are sensitive to frequency errors and Doppler shifts and that Intercarrier interference in OFDM increased with Doppler shift. Thus, in a system with higher mobility intercarrier

[12] Patent Owner incorrectly cites Ex. 2013 ¶ 24.
[13] Patent Owner incorrectly cites Ex. 2013 ¶ 25.
[14] Patent Owner incorrectly cites Ex. 2013 ¶ 32.

> spacing should be increased, or equivalently, OFDM symbol duration should be decreased."

PO Resp. 31–32 (citing Ex. 2013 ¶ 35). Based on a figure in another paper, Dr. Vojcic asserts that "a [person of ordinary skill in the art] would understand that the symbol duration in a high mobility 802.1m system needs to be shorter than in the legacy system 802.1e, *e.g.*, L times, or, equivalently, the inter-carrier spacing needs to be larger L times." *See id.* at 32 (citing Ex. 2013 ¶ 36). According to Patent Owner, Dr. Vojcic's testimony is

> directly responsive to the Board's question of "whether there is an assumption that N and N_L and K and K_L are the same for the second system and the legacy system" and directly relates to slide 3/9 of the provisional application . . . "where it is stated that subcarriers bandwidth (*i.e.*, spacing) in a legacy system 16.e is B, while in 16.m system it is B*L, *i.e.*, L times larger."

Id. (quoting Ex. 2013 ¶ 37). Patent Owner also reproduces a portion of paragraph 37 of Dr. Vojcic's Declaration as follows:

> *Therefore, a POSITA would understand that the number of subcarriers N, and therefore the number of samples in the cyclic prefix, K, in both systems are the same in the provisional disclosure, taking into account the arrangement in the example L=3 in the provisional application at 3/9.* Thus, it also follows that $T_s = (N+K)/3B$ is 3 times shorter than $T_{sL} = (N_L+K_L)/B$. However, this example in the provisional should not be read as limiting, as a POSITA would understand that there are other possible arrangements such that T_s is shorter than T_{sL} while the number of subcarriers is not necessarily the same.

PO Resp. 32–33 (reproducing Ex. 2013 ¶ 37).

Patent Owner also argues that Petitioner's witness Dr. Roy "admitted that a shorter symbol period inherently implies that there are more pilot signal symbols per unit time." PO Resp. 33. In support of its argument,

Patent Owner reproduces the following portion of Dr. Roy's deposition testimony:

> **Q.** Would a shorter symbol period also imply that you will get more pilot signal symbols per unit of time?
>
> **A.** So depending on how you -- there's a nuance how you framed that question -- yes, because if we mean by, by "density," you know, the number of pilot symbols per unit time -- so let's say I have two designs in which I have a symbol duration T and then I have a symbol duration T/2. If I keep the same number of pilots in the T symbol duration compared to the T/2, I would get more pilots per unit time. But per symbol duration, the number of pilots are the same. So ---
>
> **Q.** A POSITA would have understood that at the time of Li?
>
> **A.** A POSITA would have understood that, yes.

Id. at 33 (reproducing Ex. 2015, 74:5–75:1). According to Patent Owner, "Dr. Roy thereby explicitly confirms that the disclosure . . . implicitly shows denser pilot symbols (based on the construction of 'pilot symbols that are denser than' as 'more pilot symbols per unit time than, wherein a unit of time is the symbol period of the first communication system.')." *Id.*; *see also* PO Sur-reply 9 (similar argument, reproducing Ex. 2012, 74:5–75:1[15]).

In the Reply, Petitioner points out that Patent Owner's table relies exclusively on the disclosure of "higher speed" on slide 2 of 9 of the '798 Provisional Application to support the following elements of claim 1 and 8: (1) "the second communication system configured to support higher mobility than the first communication system;" (2) "each symbol in the second communications system has a shorter symbol period than that in the first communication system;" and (3) "wherein the second communication

[15] Patent Owner incorrectly cites to Ex. 2012, 71:22–72:20.

system has pilot symbols that are denser than those in the first communication system." *See* Pet. Reply 6–7 (quoting PO Resp. 19–20, 27). Petitioner asserts that Dr. Vojcic interprets the single reference to "higher speed" in the '798 Provisional Application as meaning "higher mobility." *See id.* at 7 (citing PO Resp. 19[16]). According to Petitioner, "Dr. Vojcic's declaration provides insufficient factual basis to support his interpretation that 'higher speed' means 'higher mobility,' particularly given his deposition testimony." *Id.* Petitioner contends that Dr. Vojcic, in the Declaration,

> interprets higher speed to mean higher mobility because he states that spectrum efficiency "**implies** higher data rate," . . . but testified that "increased spectrum efficiency" would mean to a [person of ordinary skill in the art] "transmission of more bits per unit bandwidth," and "confirmed that increased spectrum efficiency does **not** require higher data rate."

Id. at 7–8 (quoting Ex. 1038, 8:13–22, 9:12–10:2). Petitioner asserts "Dr. Vojcic also testified that a [person of ordinary skill in the art] would generally interpret 'faster' as relating to lower latency or higher data transfer rate, **neither** of which relate to mobility." *Id.* at 8 (citing Ex. 1038, 7:12–8:2, 9:12–10:9). According to Petitioner, "[b]ecause Dr. Vojcic's assumption that 'higher speed' means 'higher mobility' is the only disclosure of 'the second communication system configured to support higher mobility' within the '798 Application, the Application fails to provide sufficient written description support for this reason alone." *Id.*

Petitioner further contends that even if a person of ordinary skill in the art would have interpreted "higher speed" to mean "higher mobility," Dr. Vojcic's analysis for the remainder of element 1[c] requires a person of

[16] Petitioner incorrectly cites to page 20 of the Patent Owner Response.

ordinary skill in the art to apply specific equations to calculate symbol period using specific assumptions not found in the '798 Provisional Application. *See* Pet. Reply 8. Petitioner contends that Patent Owner's use of the equations provided in Dr. Vojcic's first declaration to show that the second symbol period is shorter rests on an unsupported assumption. *See id.* at 9. According to Petitioner, "[t]he supplemental declaration expressly confirms that these equations would result in a shorter symbol period only **if the POSITA chose** values for N and N_L specifically to result in a shorter symbol period." *Id.* Patent Owner reproduces Dr. Vojcic's testimony that a person of ordinary skill in the art "would understand that there are other **possible** arrangements such that T_s is shorter than T_{sL} while the number of subcarriers is not necessarily the same." *Id.* (quoting Ex. 2013 ¶ 37). Petitioner contends that Patent Owner's position that the second system would have a shorter symbol period relies on the circular logic that the second symbol period for the second system would be smaller if, and only if, a person of ordinary skill in the art chose values for N and N_L that would result in a shorter symbol period. *See id.* Petitioner notes that Dr. Vojcic conceded in his deposition that a person of ordinary skill in the art could also choose values for N and N_L that would result in the second system having a longer symbol period. *See id.* (citing Ex. 1038, 28:9–14). Petitioner contends that Dr. Vojcic could not point to any other disclosure in the '798 Provisional Application besides "higher speed" listed in slide 2 that would teach a person of ordinary skill in the art to choose specific values for N and N_L. *See id.* at 9–10 (citing Ex. 1038, 30:12–33:3). According to Petitioner,

> Dr. Vojcic's entire justification for claiming that the second communication system in the '798 Application supports higher mobility, for applying specific equations which do not appear anywhere in the '798 Application, and for requiring the POSITA to choose values within those equations (for N and N_L) is the single reference to "higher speed."

Id. at 10.

In the Sur-reply, Patent Owner asserts that both "spectrum efficiency" and "higher speed" are explicitly listed in the provisional application as advantages of the second communication system, where enhanced spectrum efficiency means higher data speed, and "higher" speed refers to a higher velocity mobile unit. *See* PO Sur-reply 4 (reproducing a portion of Ex. 2002, 2); *see also id.* at 7 (citing Ex. 2002, 2). Patent Owner reproduces Dr. Vojcic's testimony from the first Declaration and contends that

> [i]n the context of this level of knowledge of someone of skill in the art, the disclosure of the '798 application that the new (second) communications system would have "higher spectrum efficiency" and "higher speed" discloses to a [person of ordinary skill in the art] that that <u>the second communication system necessarily has a shorter symbol period than that in the first communication system.</u>

Id. at 4–5 (reproducing a portion of Ex. 2001 ¶ 52). Petitioner also contends that

> the goal of achieving "higher speed" in conjunction with the proposed dual-system frame structure—a [person of ordinary skill in the art] would understand—teaches modifying density of pilots in one of the systems as a solution to the problem caused by the increased Doppler shifting due to the high speed.

Id. at 9.

We agree with Petitioner's arguments that Patent Owner's position is premised on the '798 Provisional Application's disclosure of one advantage

of the 802.16m standard being "higher speed," which Patent Owner equates with "higher mobility." We further agree with Petitioner that Dr. Vojcic's testimony that "higher speed" means "higher mobility" is not supported by a sufficient underlying factual basis and is belied by Dr. Vojcic's deposition testimony regarding the meaning of "spectrum efficiency" and "higher speed." *See* Ex. 2001 ¶ 52; Ex. 1038, 7:12–8:2, 8:13–22, 9:12–10:9. In the absence of a sufficient factual basis to support equating "higher mobility" with the disclosure of "higher speed," there also is insufficient factual basis to support Dr Vojcic's following relied upon declaration testimony: (1) a person of ordinary skill in the art would have known at the time of the invention that a shorter symbol period can be shown for the second 802.16m system based on the following formulas: $T_s = (N+K)/3B$ and $T_{sL} = (N_L+K_L)/B$ (Ex. 2001 ¶ 52; PO Resp. 19); (2) a person of ordinary skill in the art would understand that the symbol duration in a high mobility 802.1m system needs to be shorter than in the legacy 802.1e system, e.g., L times, or that the inter-carrier spacing needs to be larger L times (Ex. 2013 ¶ 36; PO Resp. 32); and (3) a person of ordinary skill in the art would understand that the number of subcarriers N and the number of samples in the cyclic prefix K in both the 802.1m and legacy systems are the same in the provisional disclosure, taking into account the arrangement in the example L=3, and "[thus], it also follows that $T_s = (N+K)/3B$ is 3 times shorter than $T_{sL} = (N_L+K_L)/B$" (Ex. 2013 ¶ 37; PO Resp. 33). Especially compelling is Dr. Vojcic's deposition testimony that it is only the disclosure of "higher speed" in the '798 Provisional Application that would lead a person of ordinary skill in the art to choose to make the second system symbol period a particular value in relation to the first system symbol period. *See*

Ex. 1038, 30:12–33:3; Pet. Reply 9–10. Also compelling is Dr. Vojcic's deposition testimony that it is possible that a person of ordinary skill in the art could choose values for N and N_L so that the symbol period of the second system is longer than the legacy system. *See* Ex. 1038, 28:9–14; Pet. Reply 9.

For all of the foregoing reasons, there is insufficient written description support in the '798 Provisional Application for "the second communication system configured to support higher mobility than the first communication system," and "each symbol in the second communication system has a shorter symbol period than that in the first communication system," as recited in claim 1.

Regarding the limitations of independent claim 8, Dr. Vojcic's testimony that the goal of achieving "higher speed" in conjuction with the proposed dual system frame structure would suggest modifying the density of pilots in one of the systems as a solution to the problem caused by increased Doppler shifting (Ex. 2001 ¶ 52 (addressing limitation 8[c]) is also predicated on "higher speed" meaning "higher mobility." *See, e.g.*, Ex. 2013 ¶ 36 (connecting issues of Doppler shift with higher mobility). For the same reasons as explained immediately above addressing the limitations of claim 1, there is insufficient factual basis to support Dr. Vojcic's aforementioned testimony.

We also do not agree with Patent Owner's contention that Petitioner's witness Dr. Roy "admitted that a shorter symbol period inherently implies that there are more pilot signal symbols per unit of time." PO Resp. 33 (reproducing Ex. 2015, 74:5–75:1). Patent Owner's argument overlooks that Dr. Roy's testimony is conditioned on the number of pilot symbols being the

same for a T symbol duration compared to a T/2 symbol duration. *See* Ex. 2015, 74:16–19 ("If I keep the same number of pilots in the T symbol duration compared to the T/2, I would get more pilots per unit time.").

For all of the foregoing reasons, there is insufficient written description support in the '798 Provisional Application for "the second communication system has pilot symbols that are denser than those in the first communication system," as recited in claim 8.

Accordingly, Patent Owner has not met its burden of production in coming forward with evidence or argument to show possession of the invention in the '798 Provisional Application, and, therefore, the '096 Patent is not entitled to an earlier effective filing date of the '798 Provisional Application.

E. Unpatentability of Claims 1–4, 6, and 7 over Talukdar and Li

1. Overview of Talukdar (Ex. 1012)

Petitioner asserts Talukdar is entitled to the earlier effective filing date of Provisional Application No. 60/956,031 (Ex. 1013), filed on August 15, 2007, and is prior art to the '096 Patent under pre-AIA 35 U.S.C. § 102(e). *See* Pet. 23. Petitioner provides a claim chart including citations to paragraphs of the provisional application that provide written description support for claim 1 of Talukdar. *See id.* at 25–27. Patent Owner does not dispute that Talukdar is entitled to an earlier effective filing date of August 15, 2007. *See* PO Resp. 10, 16.

Talukdar discloses media access control (MAC) frame structures in wireless communication systems with improved latency support. *See* Ex. 1012 ¶ 1. In Talukdar, a wireless communication system includes one or more base units that serve remote units within a serving area. *See id.* ¶ 24.

Remote units may be fixed or terminal. *See id.* Remote units may also be referred to as mobile stations. *See id.* Base units transmit downlink signals to remote units on at least a portion of the same resources. *See id.* ¶ 25. Remote units communicate with one or more base units via uplink communications signals. *See id.* The wireless communication system may implement more than one communication technology, as is typical of systems upgraded with new technology. *See id.* ¶ 26. One or more base units may be legacy technology base stations such as IEEE 802.16(e) protocol base stations, while other base stations may be newer generation technologies such as IEEE 802.16(m) protocol base stations. *See id.* ¶ 27. According to Talukdar, it is generally desirable for new technologies to be backward compatible with legacy technology. *See id.*

Figure 7 of Talukdar is reproduced below.

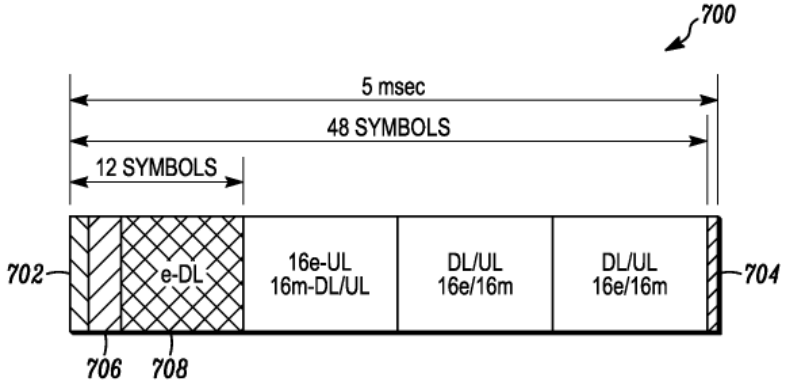


Figure 7 depicts hybrid frame 700 having equal size sub-blocks designed to serve both 802.16(e) and 802.16(m) data traffic in the same 5 millisecond interval. *See* Ex. 1012 ¶ 51. Frame 700 contains preamble 702 and receive transmit transition gap (RTG) 704. *See id.* The first block is a 802.16(e) downlink (DL) region starting with a 1-symbol preamble followed by 802.16(e) MAPs 706 and a 802.16(e) DL traffic resource region 708. *See*

id. The other three blocks are a combination of DL or uplink (UL) 802.16(e) and 802.16(m) regions. *See id.*

2. Overview of Li (Ex. 1016)

Li discloses a system and method for Orthogonal Frequency Division Multiple Access (OFDMA) scheduling and adaptation to combat fast fading. *See* Ex. 1016 ¶ 10. Li discloses a communications system that includes one or more nodes arranged to communicate over wireless communications media. *See id.* ¶¶ 25, 28, Fig. 1. The nodes can include fixed devices and mobile devices. *See id.* ¶¶ 26–27. One embodiment of the system and method includes a scheduling/adaptation scheme in which different OFDMA symbol durations are employed for slow and fast subscribers. *See id.* ¶¶ 10, 22. In an embodiment, the communication system is arranged to schedule slow subscribers with smaller subcarrier spacing and longer OFDM symbol durations and to schedule fast subscribers with larger subcarrier spacing and shorter OFDM symbol durations. *See id.* ¶ 22. The communications system groups multiple subscribers in adjacent time-frequency locations of the OFDMA frame based on their speed, which reduces inter-subcarrier interference (ICI). *See id.* Once the communications system and/or node detects that a subscriber exceeds a threshold speed, the subscriber is designated as a fast subscriber and grouped together with multiple fast subscribers. *See id.* ¶ 36. The communications system and/or node schedules OFDM channel resources to accommodate both fast and slow subscribers by employing two OFDM symbol durations and two subcarrier spacings. *See id.* The communications system and/or node assigns a fast subscriber a symbol duration that is half the duration of the slow subscriber duration. *See id.* ¶ 38.

Figure 5 of Li is reproduced below.

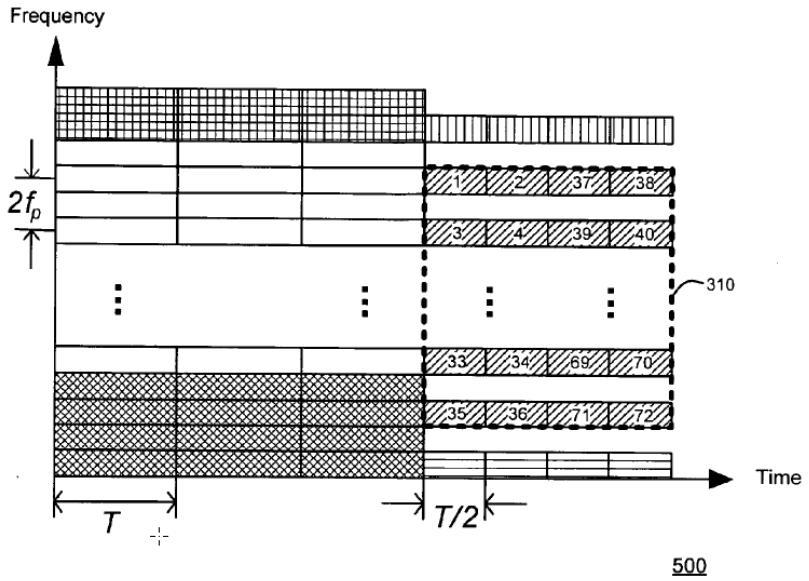


Figure 5 depicts a frame structure. *See* Ex. 1016 ¶ 33. Li discloses for a given time slot T and N adjacent subcarriers with a total bandwidth of Nf_p, the communications system and/or node can transmit OFDM symbols of N subcarriers with subcarrier spacing f_p to a slow subscriber. *See id.* ¶ 35. Li further discloses that, using the same frequency and time resource, the communications system and/or node transmits to the fast subscriber two OFDM symbols with N/2 subcarriers each in two time slots with T/2 each where the subcarrier spacing is $2f_p$. *See id.*

3. Analysis

Petitioner contends the combination of Talukdar and Li teaches, suggests, and renders obvious all the limitations recited in claim 1 and dependent claims 2–4, 6, and 7. *See* Pet. 33–60. For the reasons that follow, we are persuaded that Petitioner has established by a preponderance of the evidence that the combination of Talukdar and Li renders obvious the subject matter of claims 1–4, 6, and 7.

a. Claim 1

"A method of constructing a frame structure for data transmission"

Petitioner contends that Talukdar teaches or suggests the preamble "[a] method of constructing a frame structure for data transmission" based on Talukdar's disclosure of a hybrid frame for data transmission that supports both 802.16(e) and 802.16(m) remote units. *See* Pet. 33 (quoting Ex. 1012 ¶¶ 30, 51; citing Ex. 1002 ¶ 109); Ex. 1012, Fig. 7.

Patent Owner does not dispute Petitioner's assertions addressing the preamble. *See* PO Resp. 34–45. Nonetheless, the burden remains on Petitioner to demonstrate unpatentability. *See Dynamic Drinkware*, 800 F.3d at 1378.

Based on the entire record, we find that Talukdar teaches the preamble recitation. *See* Pet. 33.

"generating a first section comprising data configured in a first format compatible with a first communication system using symbols"

Petitioner contends that Talukdar teaches or suggests "generating a first section comprising data configured in a first format compatible with a first communication system using symbols," based on Talukdar's disclosure of generating a frame with a first 802.16(e) DL traffic region 708 comprising data configured in a format compatible with a 802.16(e) remote unit. *See* Pet. 33–36 (reproducing Ex. 1012, Fig. 1; Ex. 1012, Fig. 7 (color added); citing Ex. 1012 ¶¶ 24, 25, 27, 29, 30, 47, 48, 51; Ex. 1002 ¶¶ 111–117).

Patent Owner does not dispute Petitioner's assertions addressing this limitation. *See* PO Resp. 34–45. In any event, the burden remains on Petitioner to demonstrate unpatentability. *See Dynamic Drinkware*, 800 F.3d at 1378.

Based on the entire record, we find that Talukdar teaches "generating a first section comprising data configured in a first format compatible with a first communication system using symbols." *See* Pet. 33–36.

"generating a second section following the first section, the second section comprising data configured in a second format compatible with a second communication system using symbols"

Petitioner contends that Talukdar teaches or suggests "generating a second section following the first section, the second section comprising data configured in a second format compatible with a second communication system using symbols," based on Talukdar's disclosure of generating a second 16e-UL/16m-DL/UL traffic section within the hybrid frame following the e-DL section and comprising data configured in a format compatible with a 802.16(m) remote unit. *See* Pet. 36–39 (reproducing Ex. 1012, Fig. 7 (color added); citing Ex. 1012 ¶¶ 27, 29, 30, 46–48, 51; Ex. 1002 ¶¶ 118–124).

Patent Owner does not dispute Petitioner's assertions addressing this limitation. *See* PO Resp. 34–45. Nonetheless, the burden remains on Petitioner to demonstrate unpatentability. *See Dynamic Drinkware*, 800 F.3d at 1378.

Based on the entire record, we find that Talukdar teaches "generating a second section following the first section, the second section comprising data configured in a second format compatible with a second communication system using symbols." *See* Pet. 36–39.

"wherein the first communication system's symbols and the second communication system's symbols co-exist in one transmission scheme"

Petitioner contends that Talukdar teaches or suggests "wherein the first communication system's symbols and the second communication system's symbols co-exist in one transmission scheme," based on Talukdar's disclosure "because symbols for the 802.16(e) and 802.16(m) remote units–contained within the e-DL and 16e-UL/16m-DL/UL sections, respectively–co-existed in hybrid frame 700." Pet. 39 (quoting Ex. 1001, 4:20–24; citing Ex. 1012, Fig. 7; Ex. 1002 ¶ 122; Ex. 1010, 28, 41 ('096 Patent file history)). Petitioner asserts that Li also teaches this limitation based on Li's description of a frame that includes symbols for both slower moving and faster moving subscriber stations. *See id.* 39–40 (quoting Ex. 1016 ¶¶ 15, 22; citing Ex. 1016 ¶ 39, Fig. 5; Ex. 1002 ¶¶ 123–124).

Patent Owner contends that Li does not teach this limitation because Li does not disclose that any particular one of the nodes depicted in Figure 1 may include multiple communication systems. *See* PO Resp. 35 (citing Ex. 1016 ¶¶ 26–27; Ex. 2001 ¶ 62). Patent Owner asserts that Li also does not teach that any particular one of the nodes communicates with two or more sets of subscribers where the subscribers in the two sets use different communication systems. *See id.* at 35–36 (reproducing Ex. 1016, Fig. 1). According to Patent Owner, "*Li* never discloses that this could be done across multiple communication systems. 'All descriptions are always in the context of only one communications system, 802.16e.'" *Id.* at 36 (quoting Ex. 2001 ¶ 63); *see id.* at 36–37 (quoting Ex. 1016 ¶¶ 33, 36, 40; citing Ex. 1002 ¶ 123). Patent Owner further contends that all relevant embodiments in Li disclose that any one individual frame has a fixed symbol

duration and subcarrier spacing throughout the frame. *See id.* at 38–40 (reproducing Ex. 1016, Figs. 3, 6; quoting Ex. 1016 ¶¶ 33, 40; citing Ex. 2001 ¶¶ 66–67).

We do not agree with Patent Owner's arguments because Patent Owner addresses the teachings of Li alone instead of addressing the combined teachings of Talukdar and Li, as proposed by Petitioner. One cannot show non-obviousness by attacking references individually. *See In re Merck & Co.*, 800 F.2d 1091, 1097 (Fed. Cir. 1986) ("Non-obviousness cannot be established by attacking references individually where the rejection is based upon the teachings of the combination of references."). We understand Petitioner to rely on Talukdar for teaching the first communication system symbols and the second communication system's symbols co-existing in one transmission scheme, as modified in view of Li's teaching of a frame that includes symbols for slower moving and faster moving subscriber stations. *See* Pet. 39.

Based on the entire record, we find that Talukdar alone teaches "wherein the first communication system's symbols and the second communication system's symbols co-exist in one transmission scheme." *See* Pet. 39–40.

"the second format is compatible with the second communication system configured to support higher mobility than the first communication system"

Petitioner asserts that Talukdar renders obvious "the second format is compatible with the second communication system configured to support higher mobility than the first communication system," based on Talukdar's disclosure of a wireless system which included both 802.16(e) and 802.16(m) units that include both fixed and mobile units. *See*

Pet. 40–41 (quoting Ex. 1012 ¶¶ 24, 27; citing Ex. 1012, Fig. 1; Ex. 1002 ¶¶ 125–126). According to Petitioner,

> [a]t a minimum, a [person of ordinary skill in the art] would have found it obvious for wireless system 100 to have included a mobile 802.16(m) remote unit and a fixed or slower-moving 802.16(e) remote unit, given this disclosure that system 100 included 802.16(e)- and 802.16(m)-compliant remote units, and included fixed and mobile remote units.

Id. at 41 (citing Ex. 1002 ¶ 126). Petitioner further contends that a person of ordinary skill in the art

> would have understood Talukdar's disclosure—of a system that included both fixed and mobile remote units and a hybrid frame structure that was generally applicable to the units within that system—to provide a teaching, suggestion, or motivation for generating a hybrid frame that included a first section with data configured in a format compatible with a fixed or slower-moving 802.16(e) remote unit (a "first communication system") and a second section with data configured in a format compatible with a faster-moving mobile 802.16(m) remote unit (a "second format [] compatible with the second communication system configured to support higher mobility than the first communication system").

Pet. 41–42 (alteration in original). Petitioner contends that this frame configuration would have provided the benefit of enabling the hybrid frame to accommodate data for a greater range of remote units within Talukdar's wireless system. *See id.* at 42 (citing Ex. 1002 ¶ 127). Petitioner also asserts that Talukdar's hybrid frame (including a first section configured to be compatible with a fixed 802.16(e) remote unit and a second section formatted to be compatible with a mobile 802.16(m) remote unit) would have been one of a finite number of configuration scenarios that would have been obvious to try because Talukdar expressly discloses that its system

included remote units configured for 802.16(e) or 802.16(m) that were fixed or mobile. *See id.* (citing Ex. 1012 ¶¶ 24, 27; Ex. 1002 ¶ 127).

Patent Owner argues that Talukdar does not disclose high and low mobility. *See* PO Resp. 43. Patent Owner contends that Petitioner's reference to Ahmadi does not cure Talukdar's deficiency. *See id.* (citing Ex. 1018 ¶ 27 (Ahmadi); Ex. 2001 ¶ 73). We do not agree with Patent Owner's arguments because they overlook Petitioner's assertion that Talukdar teaches a wireless system including a 802.16(m) mobile remote unit, and both 802.16(e) and 802.16(m) units including both fixed and mobile units, and Petitioner's assertion that a 802.16(m) mobile remote unit supports higher mobility than a 802.16(e) remote unit that was fixed. *See* Pet. 40–41.

Patent Owner also argues that Petitioner cites only limited support in Talukdar for its position that it would have been obvious to try Talukdar's frame structure 802.16(e) and 802.16(m) for Talukdar's fixed and mobile remote units. *See* PO Resp. 43 (quoting Ex. 1002 ¶ 127). Patent Owner contends that Petitioner's argument is contradicted by Patent Owner's declarant Dr. Vojcic's testimony. According to Patent Owner, Dr. Vojcic testifies:

> A significantly more detailed disclosure would have been required to allow a POSITA to arrive at and realized the importance of this inventive feature without knowledge of the '096 invention itself. Without the impermissible application of hindsight based on the actual disclosure of the '096 patent as a roadmap, it would not easily have been possible to discern the invention of the '096 patent. Dr. Roy's opinion regarding obviousness of this claim limitation is not supported by the limited disclosures in *Talukdar*.

Id. at 43–44 (quoting Ex. 2001 ¶ 74) (internal quotations omitted). We do not agree with Patent Owner's arguments addressing only Petitioner's "obvious to try" rationale because Patent Owner's arguments overlook and do not address Petitioner's rationale that the claimed subject would have been obvious because Talukdar's proposed frame configuration would have provided the benefit of enabling the hybrid frame to accommodate data for a greater range of remote units within Talukdar's wireless system. *See id.*; Pet. 40–42.

Based on Petitioner's citations to Talukdar and Dr. Roy's supporting testimony (Ex. 1002), we are persuaded that Petitioner has set forth sufficient articulated reasoning with rational underpinning to support the conclusion that it would have been obvious to one of ordinary skill in the art to modify Talukdar's hybrid frame that includes a first section with data configured in 802.16(e) format for 802.16(e) fixed remote units and a second section that includes data configured in 802.16(m) format for faster moving 802.16(m) mobile remote units, because it would have provided the benefit of enabling the hybrid frame to accommodate data for a greater range of remote units within Talukdar's wireless system. *See* Pet. 40–42; *KSR*, 550 U.S. at 421.

Petitioner further asserts that Li also teaches or suggests this limitation based on Li's disclosure of using a shorter symbol period to communicate with wireless subscriber stations that were moving at high speeds relative to a base station than slower or fixed subscriber stations. *See* Pet. 42–43 (quoting Ex. 1016 ¶¶ 1, 34, 37; citing Ex. 1012 ¶¶ 24, 27; Ex. 1002 ¶¶ 128–133). According to Petitioner, a person of ordinary skill in the art

> would have found it obvious to modify Talukdar's technique for generating a hybrid frame to include the steps of generating a first section with data configured for a fixed or slower-moving 802.16(e) remote unit (a "first communication system") and a second section with data configured for a faster moving 802.16(m) remote unit (a "second communication system configured to support higher mobility than the first communication system") in view of Li's teaching of 802.16-compliant stations that moved at "substantially different speeds,"

because it amounts to combining prior art elements according to known methods to yield predictable results. *Id.* at 43 (citing *id.* at 48–50); *see id.* at 48–50 (citing Ex. 1016 ¶¶ 10, 34, 35, 37, 38; Ex. 1002 ¶¶ 135, 136, 138). Petitioner also asserts that the combination would have been the use of "a known technique (Li's technique of communicating with faster stations using OFDM symbols with shorter periods) to improve Talukdar's similar method (communicating with mobile remote units using OFDM symbols) in the same way (by reducing inter-subcarrier interference experienced by the mobile units)." *Id.* at 49 (citing Ex. 1002 ¶ 138).

Patent Owner argues that Li does not cure the deficiencies of Talukdar because Li discloses that both the slow and fast subscribers used the same 802.16(e) communication system. *See* PO Resp. 44 (citing Ex. 1002 ¶¶ 128–138; Ex. 2001 ¶ 76). Patent Owner contends that "even 'if one brings the fast moving 802.16e user into the second part of the frame in *Talukdar*, then *Talukdar* (combined with *Li*) would have the same communication system, 802.16e in both parts of the frame.'" *Id.* (quoting Ex. 2001 ¶ 77). Patent Owner argues that, given that both the low and high mobility users employ the same 802.16(e) communication system, the combination does not disclose a second communication system configured

to support higher mobility than the first communication system. *See id.* at 44–45 (quoting Ex. 2001 ¶ 78). We do not agree with Patent Owner's arguments because Petitioner's proposed combination does not include replacing Talukdar's communication system that accommodates both 802.16(e) and 802.16(m) communications with Li's 802.16(e) communication system. *See* Pet. 42–44, 48–50.

Based on Petitioner's citations to Talukdar, Li, and Dr. Roy's supporting testimony (Ex. 1002), we are persuaded that Petitioner has set forth sufficient articulated reasoning with rational underpinning to support the conclusion that it would have been obvious to one of ordinary skill in the art to modify Talukdar's hybrid frame that includes a first section with data configured in 802.16(e) format and a second section with data configured in 802.16(m) format to include generating a first section with data configured for a 802.16(e) fixed remote unit and a second section with data configured for a faster moving 802.16(m) mobile remote unit using symbols with a shorter period because it would improve Talukdar's method in the same way as Li by reducing inter-subcarrier interference experienced by the faster moving mobile remote units. *See* Pet. 48–50; *KSR*, 550 U.S. at 421.

Based on the entire record, we find that Talukdar alone, and, thus, the combination of Talukdar and Li, renders obvious "the second format is compatible with the second communication system configured to support higher mobility than the first communication system." *See* Pet. 40–44, 48–50.

"wherein each symbol in the second communication system has a shorter symbol period than that in the first communication system"

Petitioner contends that Li teaches or suggests "wherein each symbol in the second communication system has a shorter symbol period than that in the first communication system," based on Li's disclosure that a short OFDM symbol duration and larger sub-carrier spacing reduces inter-carrier interference and disclosure of a communications system and/or node that assigns shorter symbol duration and larger sub-carrier spacing to the fast subscribers and longer symbol duration and smaller subcarrier spacing to slow subscribers less prone to ICI. *See* Pet. 44–45 (quoting Ex. 1016 ¶¶ 10, 26, 34, 35, 37, 38; Ex. 1002 ¶¶ 73, 130, 131). Petitioner asserts that Li's Figure 5 shows an OFDM signal in which the base station transmitted OFDM symbols having a duration of T to a slow subscriber but shortened the symbol duration from T to T/2 for a fast subscriber. *See id.* at 45–46 (reproducing Ex. 1016, Fig. 5 (annotations added); quoting Ex. 1016 ¶ 38; citing Ex. 1002 ¶¶ 131–132). According to Petitioner, a person of ordinary skill in the art "would have understood Li to provide a teaching, suggestion, or motivation to modify Talukdar by using shorter symbol periods for a faster-moving 802.16(m) remote unit, because Li disclosed that doing so reduced the inter-subcarrier interference that would be experienced by these units." *Id.* at 46–47 (citing Ex. 1012 ¶ 24; Ex. 1016 ¶¶ 10, 34, 35; Ex. 1002 ¶¶ 130, 135, 136). Petitioner further contends that a person of ordinary skill in the art would have recognized that the combination would yield the predictable and beneficial result of reducing inter-subcarrier interference experienced by faster moving remote units, as taught by Li. *See id.* at 47 (citing Ex. 1002 ¶ 135).

Patent Owner argues that Petitioner mischaracterizes Li's Figure 5 as disclosing a single frame with long and short symbols. *See* PO Resp. 37 (reproducing Ex. 1002 ¶ 123). Patent Owner contends that all relevant embodiments in Li disclose that any one individual frame has a fixed symbol duration and subcarrier spacing throughout the frame. *See id.* at 38–41 (reproducing Ex. 1016, Figs. 3, 6, 8; quoting Ex. 1016 ¶¶ 33, 40, 42; citing Ex. 2001 ¶¶ 66–67). Patent Owner asserts that the long symbols belong to one frame and short symbols to another frame. *See id.* at 41–42 (citing Ex. 2001 ¶ 69). Patent Owner contends that a person of ordinary skill in the art would not have found it obvious to combine the teachings of Li and Talukdar because Li is a single communications system and uses separate frames for slow and fast users with long and short symbols respectively, and therefore is incompatible with Talukdar. *See id.* at 42 (citing Ex. 2001 ¶ 72).

We do not agree with Patent Owner's arguments because the combination proposed by Petitioner involves the modification of Talukdar's frame having a first section in a first format compatible with the first communication system using symbols and a second section in a second format compatible with the second communications system using symbols, as modified by Li's teachings of using shorter symbol periods for faster moving remote units (i.e., a second communication system). Contrary to Patent Owner's suggestion, Petitioner does not propose incorporating Li's frame structure into the teachings of Talukdar. *See* Pet. 40–49.

As explained previously, based on Petitioner's citations to Talukdar, Li, and Dr. Roy's supporting testimony (Ex. 1002), we are persuaded Petitioner has set forth sufficient articulated reasoning with rational underpinning to support the conclusion that it would have been obvious to

one of ordinary skill in the art to modify Talukdar's hybrid frame that includes a first section with data configured in 802.16(e) format and a second section with data configured in 802.16(m) format to include generating a first section with data configured for a 802.16(e) fixed remote unit and a second section with data configured for a faster moving 802.16(m) mobile remote unit using symbols with a shorter period because it would improve Talukdar's method in the same way as Li by reducing inter-subcarrier interference experienced by the faster moving mobile remote units. *See* Pet. 48–50; *KSR*, 550 U.S. at 421.

Based on the entire record, we determine that the combination of Talukdar and Li renders obvious "each symbol in the second communication system having a shorter symbol period than that in the first communication system." *See* Pet. 44–50.

"generating at least one non-data section containing information describing an aspect of data in at least one of the first section and the second section; and

combining the first section, the second section, and the at least one non-data section to form the frame structure"

Petitioner asserts that Talukdar teaches or suggests "generating at least one non-data section containing information describing an aspect of data in at least one of the first section and the second section," based on Talukdar's disclosure of the 802.16(e) DL block starting with a 1-symbol preamble followed by a 802.16(e) MAP. *See* Pet. 50–52 (reproducing Ex. 1012, Fig. 7 (color added); quoting Ex. 1012 ¶¶ 51, 59, 73; citing Ex. 1012 code (57), ¶ 45; Ex. 1002 ¶¶ 69, 139–141; Ex. 1005, 44). Petitioner also contends that Talukdar teaches or suggests "combining the first section, the second section, and the at least one non-data section to form

the frame structure," based on Talukdar's disclosure of combining the e-DL and 16e-UL/16m-DL/UL traffic regions and the DL-MAP message to form hybrid frame 700. *See id.* at 52–53 (quoting Ex. 1012 ¶ 51; citing Ex. 1012, Fig. 7; Ex. 1002 ¶¶ 142–143).

Patent Owner does not dispute Petitioner's assertions addressing these limitations. *See* PO Resp. 34–45. Nonetheless, the burden remains on Petitioner to demonstrate unpatentability. *See Dynamic Drinkware*, 800 F.3d at 1378.

Based on the entire record, we find that Talukdar teaches these limitations of claim 1. *See* Pet. 50–53.

Secondary Considerations

We next consider Patent Owner's proffered evidence of secondary considerations before reaching our conclusion on obviousness as to the subject matter of claim 1. *See WBIP, LLC v. Kohler Co.*, 829 F.3d 1317, 1328 (Fed. Cir. 2016). Patent Owner asserts that there is evidence of commercial success and licensing of the '096 Patent to industry leaders in the wireless chip industry. *See* PO Resp. 53–54 (citing Exs. 2007–2010; IPR2020-01576, Ex. 1028 (confidential patent license agreement filed under seal)). Exhibit 2007 is a notice regarding withdrawn claims entered in *UNM Rainforest Innovations v. Dell Technologies, Inc.*, No. 6:20-cv-00468-ADA (W.D. Tex.). Exhibit 2008 is a notice regarding withdrawn claims entered in *UNM Rainforest Innovations v. ASUSTek Computer, Inc.*, No. 6:20-cv-00142-ADA (W.D. Tex.). Exhibits 2009 and 2010 are a joint motion to dismiss with prejudice, and an order of dismissal, respectively, entered in *UNM Rainforest Innovations v. Apple Inc.*, No. 1:20-cv-00351 (W.D. Tex.). A copy of IPR2020-01576, Ex. 1028 has not been entered in the record of

this proceeding. According to Patent Owner, "[t]hese attractive licenses, negotiated by wireless industry leaders, provide strong evidence of secondary considerations supporting a finding of non-obviousness of the patent[] at issue in this IPR." *Id.* In the Reply, Petitioner contends that Patent Owner made no showing of a nexus, and, therefore, did not establish secondary considerations of non-obviousness. *See* Pet. Reply 22.

Factual inquiries for an obviousness determination include evaluation and crediting of evidence of secondary considerations. *Graham*, 383 U.S. at 17 (1966). "For objective evidence of secondary considerations to be accorded substantial weight, its proponent must establish a nexus between the evidence and the merits of the claimed invention." *ClassCo, Inc. v. Apple, Inc.*, 838 F.3d 1214, 1220 (Fed. Cir. 2016). Ultimately, "[t]he patentee bears the burden of showing that a nexus exists." *WMS Gaming, Inc. v. Int'l Game Tech.*, 184 F.3d 1339, 1359 (Fed. Cir. 1999). Our reviewing court "specifically requires[s] affirmative evidence of nexus where the evidence . . . presented is a license, because it is often 'cheaper to take licenses than to defend infringement suits.'" *Iron Grip Barbell Co. Inc. v. USA Sports, Inc.*, 392 F.3d 1317, 1324 (Fed. Cir. 2004) (quoting *EWP Corp. v. Reliance Universal Inc.*, 755 F.2d 898, 908 (Fed Cir. 1985)).

> When the specific licenses are not in the record, it is difficult for the court to determine if "the licensing program was successful either because of the merits of the claimed invention or because they were entered into as business decisions to avoid litigation, because of prior business relationships, or for other economic reasons."

In re Cree, Inc., 818 F.3d 694, 703 (Fed. Cir. 2016) (quoting *In re Antor Media Corp.*, 689 F.3d 1282, 1294 (Fed. Cir. 2012)).

Exhibits 2007 through 2010 proffered by Patent Owner are not license agreements but rather are documents settling Patent Owner's disputes with several defendants in different District Court proceedings. *See* Exs. 2007–2010. IPR2020-01576, Ex. 1028 is not entered in the record in this proceeding and thus we cannot discern whether the licensee took the license "out of recognition and acceptance of the subject matter claimed" in the '096 patent, or for other reasons. *In re GPAC Inc.*, 57 F.3d 1573, 1580 (Fed. Cir. 1995). Therefore, Patent Owner fails to provide evidence that the license agreement has a nexus to the merits of the claimed invention. Accordingly, Patent Owner's evidence of secondary considerations of non-obviousness is entitled to little weight.

Conclusion Regarding the Analysis of Claim 1

We have considered Patent Owner's arguments that Dr. Roy's Declaration testimony (Ex. 1002) should be given no weight. *See* PO Resp. 34; PO Sur-reply 9–14. Patent Owner's Sur-reply arguments are substantially similar to arguments raised in Patent Owner's Motion to Exclude. *Compare* PO Sur-reply 9–14, *with* PO Mot. Excl. 1, 3–8. After carefully considering Dr. Roy's Declaration testimony (Ex. 1002), in view of the supporting evidence cited therein, as well as Dr. Roy's deposition testimony (Ex. 2015), we decline to give no weight to Dr. Roy's Declaration testimony (Ex. 1002).

After considering the parties' arguments, the entire record, and weighing the evidence of obviousness and the secondary considerations of nonobviousness of the subject matter of claim 1, we determine that Petitioner's showing of obviousness is strong and outweighs the minimally weighted evidence of secondary considerations of nonobviousness.

Accordingly, based on the entire record, Petitioner has established by a preponderance of the evidence that claim 1 is unpatentable under 35 U.S.C. § 103 over Talukdar and Li.

b. Dependent Claims 2–4, 6, and 7

Claims 2–4, 6, and 7 depend from claim 1. Ex. 1001, 8:55–64, 9:1–5. Patent Owner does not address substantively Petitioner's patentability challenges to dependent claims 2–4, 6, and 7. *See* PO Resp. 45–46. Nonetheless, the burden remains on Petitioner to demonstrate unpatentability. *See Dynamic Drinkware*, 800 F.3d at 1378.

We have reviewed Petitioner's contentions and cited supporting evidence addressing how the combination of Talukdar and Li teaches or suggests the additional limitations of claims 2–4, 6, and 7. *See* Pet. 53–60. Based on the entire record, Petitioner has established that the combination of Talukdar and Li teaches or suggests the limitations of claims 2–4, 6, and 7. For the reasons presented by Petitioner, in addition to the reasons explained above addressing claim 1, based on the entire record, Petitioner has established by a preponderance of the evidence that claims 2–4, 6, and 7 are unpatentable under 35 U.S.C. § 103 over Talukdar and Li. *See* Pet. 53–60.

F. Unpatentability of Claim 8 over Talukdar and Nystrom

1. Overview of Nystrom (Ex. 1017)

Nystrom discloses resource allocation and pilot signals of wireless multi-carrier communications systems. *See* Ex. 1017 ¶ 1. "In a cellular multi-user, multi-carrier wireless communications system, the base station must accommodate many users that each experiences different channel characteristics due to fading in both time and frequency. Furthermore,

different users travel at different speeds and thus experience different Doppler shifts." *Id.* ¶ 4.

Figure 1 of Nystrom is reproduced below.

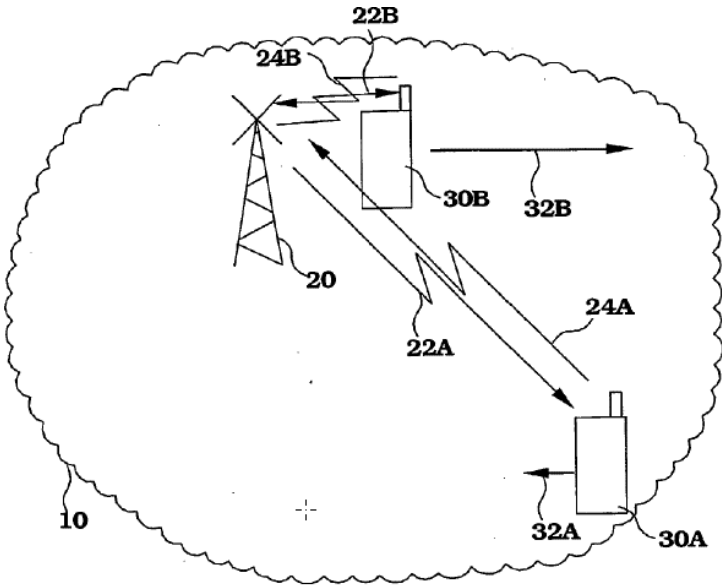


Figure 1 depicts a multi-user wireless communication system. *See* Ex. 1017 ¶ 15. Multi-user wireless communication system 10 includes access point 20 and user equipment 30A and 30B. *See id.* ¶ 29. User equipment 30A is located at a relatively large distance from access point 20, but speed 32A of user equipment 30A is small. *See id.* User equipment 30B is located closer to access point 20, but has high speed 32B. *See id.* Radio conditions for user equipment 30B are probably changing rapidly in time, whereby frequent pilots in time dimension are required. *See id.*

Figure 5A of Nystrom is reproduced below.

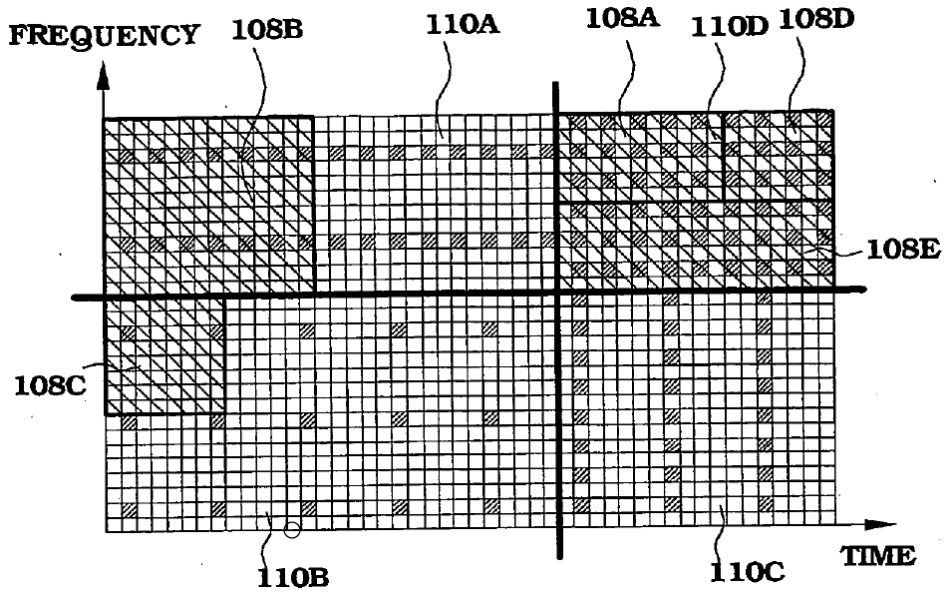


Figure 5A depicts a diagram illustrating pilot structures in time-frequency space and the allocation of different users in subspaces. *See* Ex. 1017 ¶ 20. The entire radio resource space is divided into four rectangular parts 110A–110D. *See id.* ¶ 41. Part 110A has a pilot pattern having a dense occurrence in the time dimension but a more dispersed behavior in the frequency dimension intended for a large Doppler and low delay spread. *See id.* ¶¶ 41–42. Part 110B has a very diluted pilot pattern evenly spread in the time and frequency dimensions intended for a low Doppler and low delay spread. *See id.* Part 110C has a dense pilot pattern in the frequency dimension but a more dispersed pattern in the time dimension and is intended for a low Doppler and high delay spread. *See id.* Part 110D has a very dense pilot structure in both dimensions and is intended for a high Doppler and high delay spread. *See id.* Nystrom discloses that it is beneficial to assign resources for mobile stations with certain fast varying channel or Doppler conditions in the dense parts of the pilot pattern and

users with more slowly varying conditions in the less dense parts. *See id.* ¶ 43.

2. Analysis

Petitioner contends the combination of Talukdar and Nystrom teaches, suggests, and renders obvious all the limitations recited in claim 8. *See* Pet. 60–67. For the reasons that follow, we are not persuaded that Petitioner has established by a preponderance of the evidence that the combination of Talukdar and Nystrom renders obvious the subject matter of claim 8.

Claim 8 is similar to claim 1, with the exception that claim 8 recites "wherein the second communication system has pilot symbols that are denser than those in the first communication system," in place of the claim 1 recitation "wherein each symbol in the second communication system has a shorter symbol period than that in the first communication system." *Compare* Ex. 1001, 9:6–20, *with id.* at 8:32–54. Petitioner contends that the combination of Talukdar and Nystrom renders obvious all the limitations recited in independent claim 8. *See* Pet. 60–67. Petitioner relies on its analysis of the limitations of claim 1 to address the similar limitations of claim 8. *See id.* at 60–61 (incorporating by reference Pet. 33–53).

Petitioner contends that Nystrom teaches or suggests "wherein the second communication system has pilot symbols that are denser than those in the first communication system." *See* Pet. 61–64 (citing Ex. 1002 ¶¶ 157–161). Petitioner asserts that Nystrom discloses that faster moving user equipment needs to receive frequent pilots because of their quickly changing channel conditions. *See id.* at 61–62 (reproducing Ex. 1017, Fig. 1 (color added); quoting Ex. 1017 ¶ 29). Petitioner contends that Nystrom teaches allocating mobile stations to different parts of the radio resource

space with pilot density dependent on their estimated radio conditions to accommodate mobile stations with different speeds. *See id.* at 62 (citing Ex. 1017 ¶¶ 37, 38, 42). Petitioner further contends that Nystrom's base station allocates faster-moving mobile stations resource sub-space with more pilot symbols per unit of time. *See id.* at 61–62 (quoting Ex. 1017 ¶ 41; reproducing Ex. 1017, Fig. 5A; citing Ex. 1002 ¶ 160). Petitioner asserts that Nystrom teaches that mobile stations were allocated different pilot density patterns within the resource space based on their mobility levels. *See id.* at 63–64 (quoting Ex. 1017 ¶ 43).

> Petitioner asserts that a person of ordinary skill in the art
>
> would have found it obvious to incorporate Nystrom's teaching of using denser pilot symbols for faster-moving 802.16(m) mobile stations into Talukdar, because Nystrom expressly provided a teaching, suggestion, or motivation to do so by teaching that denser pilot symbols counteracted the effects of Doppler shift and fading experienced by faster-moving remote units.

Pet. 64 (citing Ex. 1002 ¶¶ 162–163). In support of its assertion, Petitioner contends that Nystrom teaches that mobile stations traveling at faster speeds experienced higher Doppler shift and fading in time and/or frequency. *See id.* (citing Ex. 1017 ¶¶ 4, 29). Petitioner also asserts that Nystrom teaches "that increasing the density of pilot symbols for these mobile stations [traveling at faster speeds] allowed mobile stations to better estimate their channel conditions and to better adapt and compensate for the effects of Doppler shift and fading." Pet. 64–65 (citing Ex. 1017 ¶¶ 37, 42, 43). According to Petitioner, a person of ordinary skill in the art "would have recognized that increasing the density of pilot symbols for a faster-moving remote unit would have yielded the benefits taught by Nystrom—

specifically, enhancing the faster-moving remote unit's ability to perform channel estimation and thus reducing the effects of Doppler shift and fading." *Id.* at 65 (at citing Ex. 1002 ¶ 163). Similarly, Petitioner contends that the combination would have been obvious because it would have amounted to combining prior art elements according to known methods to yield predictable results—"enhancing the faster-moving unit's ability to perform channel estimation"—and the combination would have been the use of a known technique to improve a similar method in the same way—"improving the faster-moving communication system's ability to perform channel estimation, as taught by Nystrom." *Id*. at 67 (citing Ex. 1017 ¶¶ 37, 42, 43; Ex. 1002 ¶ 166).

Petitioner's citations to Nystrom and Dr. Roy's testimony do not disclose sufficiently the underlying factual basis for Nystrom's following asserted teachings, relied upon by Petitioner: (1) denser pilot symbols counteract the effects of Doppler shift and fading experienced by faster-moving remote units; and (2) enhancing or improving the faster-moving unit's ability to perform channel estimation. *See* Pet. 64–65, 67; 37 C.F.R. § 42.65(a)); Dec. 49. As pointed out by Patent Owner, paragraph 4 of Nystrom, cited by Petitioner to support its assertions, only generally discloses:

> In a cellular multi user, multi-carrier wireless communications system, the base station must accommodate many users that each experiences different channel characteristics due to fading in both time and frequency. Furthermore, different users travel at different speeds and thus experience different Doppler shifts.

PO Resp. 48 (quoting Ex. 1017 ¶ 4); *see* Dec. 50 (citing Ex. 1017 ¶ 4; Prelim. Resp. 51–52). Paragraphs 29, 37, 42, and 43 of Nystrom, cited by

Petitioner to support its assertions, do not disclose that denser pilot symbols counteract the effects of Doppler shift and fading experienced by faster-moving remote units; and (2) enhance or improve a faster moving unit's ability to perform channel estimation. *See* Ex. 1017 ¶¶ 29, 37, 42, 43; Dec. 50. Petitioner's assertion that Talukdar and Nystrom similarly disclosed using different OFDM symbols in the time dimension of the same resource space for different systems in one OFDM transmission scheme does not provide a sufficient articulated reasoning with a rational underpinning for combining the teachings of Talukdar and Nystrom. *See* Pet. 65; Dec. 50.

Patent Owner's Response arguments are nearly identical to those presented in the Preliminary Response. *Compare* PO Resp. 46–53, *with* Prelim. Resp. 50–57.

In the Reply, Petitioner contends that "[t]he teachings of Talukdar and Nystrom, as well as the declaration provided by Patent Owner's own expert [Dr. Vojcic], confirm that a [person of ordinary skill in the art] would have been motivated to combine Talukdar and Nystrom as set forth in the Petition." Pet. Reply 15. According to Petitioner, "[a]s noted in the Petition, Nystrom explicitly discloses that denser pilot symbols in the time dimension should be used for higher Doppler applications," and "Nystrom is clear that higher Doppler shift scenarios require pilot symbols that are denser in time, because paragraph 42 explains that users with higher Doppler shift would be assigned to either region 110A or 110D of Figure 5A." *Id.* at 15–17 (reproducing Ex. 1017, Fig. 5A (with Petitioner's annotations); Ex. 1017, Fig. 5 (with Dr. Vojcic's annotations); quoting Ex. 1017 ¶ 42;

citing Ex. 2001 ¶ 93), 20 (citing Ex 1017 ¶ 42, Fig. 5A[17]; Ex. 1002 ¶¶ 160–161). Petitioner asserts that Petitioner's and Dr. Vojcic's "annotated versions of Figure 5A show, regions 110A and 110D – which are the regions intended for high Doppler – have 3 times more pilot symbols per unit time than regions 110B and 110C." *Id.* at 17. Petitioner contends that Patent Owner's witness, Dr. Vojcic confirmed the teaching of Nystrom relied upon by Petitioner when testifying that a person of ordinary skill in the art "would also understand that small/**large Doppler spread** (or **equivalently velocity**) corresponds to low/high time selectivity, requiring low/**high pilot density** over time." *Id.* (quoting Ex. 2001 ¶ 93 (Petitioner's emphasis)).

According to Petitioner,

> [b]ecause Nystrom discloses the use of higher density pilot symbols for higher mobility users, and Talukdar discloses both stationary and mobile stations, a [person of ordinary skill in the art] would have been motivated to combine the teachings of Talukdar and Nystrom by utilizing higher density pilot symbols for the high-mobility 802.16(m) portion of a hybrid frame, while using lower density pilot symbols for a stationary 802.16(e) portion.

See Pet. Reply 18. Petitioner further asserts that "this combination would be motivated by the express teachings of Talukdar and Nystrom." *Id.* Petitioner asserts that Talukdar expressly teaches that the pilot density for the 802.16(e) and 802.16(m) sections of a hybrid frame could be different. *See id.* (quoting Ex. 1012 ¶ 29). Petitioner contends that "[b]ased on this teaching [of Talukdar] alone, [a person of ordinary skill in the art] would have been motivated to combine Talukdar and Nystrom, because Talukdar suggests that pilot structures can be different for the two components of a

[17] Petitioner incorrectly cites Figure 5E.

hybrid frame, and Nystrom teaches appropriate pilot structures for different scenarios." *Id.* (citing Pet. 63–64; Ex. 1002 ¶¶ 163–164). Petitioner also asserts that for a higher mobility 802.16(m) station, which would be subject to higher Doppler effects than a low mobility station, a person of ordinary skill in the art would have found it obvious to try the denser pilot symbols in the time dimension, which Nystrom teaches for high Doppler effect users. *See id.* at 18–19 (citing Ex. 1017 ¶ 42).

Petitioner's Reply arguments providing new reasons why a person of ordinary skill in the art would have been motivated to combine the teachings of Talukdar and Nystrom (i.e., because Talukdar teaches the pilot density for 802.16(e) and 802.16(m) sections of a frame could be different, Nystrom teaches pilot structures for different scenarios, and obvious to try denser pilot symbols) are outside the scope of a proper reply because they were not presented previously in the Petition. *Compare* Pet. Reply 18–19, *with* Pet. 60–68. Although Petitioner is permitted in its Reply to address issues discussed in an institution decision, Petitioner may not submit new arguments that it could have presented earlier to make out a prima facie case of unpatentability. *See* Consolidated Trial Practice Guide[18] ("CTPG") 73. The opportunity to address issues discussed in an institution decision does not mean to proceed in a new direction with a new approach compared to the position taken in the Petition. *See id.* at 74. Furthermore, a reply that raises a new issue or belatedly presents evidence may not be considered. *See id.* Accordingly, we decline to consider Petitioner's belated Reply arguments and evidence asserting new reasons why a person of ordinary skill in the art

[18] Available at https://www.uspto.gov/TrialPracticeGuideConsolidated.

would have been motivated to combine the teachings of Talukdar and Nystrom. Moreover, even if we were to consider Petitioner's new reasons why a person of ordinary skill in the art would have been motivated to combine the teachings of Talukdar and Nystrom, these asserted motivations of a person of ordinary skill in the art amount to attorney argument unsupported by evidence such as Dr. Roy's testimony. *Compare* Pet. Reply 18–19, *with* Ex. 1002 ¶¶ 156–166. Argument of counsel cannot take the place of objective evidence. *See Gemtron Corp. v. Saint-Gobain Corp.*, 572 F.3d 1371, 1380 (Fed. Cir. 2009) (unsworn attorney argument is not evidence).

Petitioner also asserts that the combination of Talukdar and Nystrom would have been obvious as a simple substitution of known elements to obtain predictable results. *See* Pet. Reply 19. According to Petitioner, "[t]he Board preliminarily rejected this rationale because it found that Petitioner failed to show the underlying factual basis for this combination." *Id.*

Petitioner contends that

> [a]lthough the Board is correct that 'Paragraphs 29, 37, 42, and 43 of Nystrom further do not disclose denser pilot symbols enhance or improve a faster moving unit's ability to perform channel estimation,' this would have been well known to a [person of ordinary skill in the art], and Paragraph 3 of Nystrom expressly discloses that teaching.

Id. (quoting Ex. 1017 ¶ 3), *id.* at 20 (citing Ex. 1017 ¶ 3; Ex. 1002 ¶ 162). Petitioner contends that Dr. Roy provides a detailed factual basis in paragraphs 162 and163 of his Declaration, including a citation to paragraph 3 of Nystrom, for his conclusion that "it was well-known that increasing pilot density improved performance in wireless communications by enhancing the ability of mobile stations to perform channel estimation."

Id. at 19. Petitioner further asserts that "[p]aragraph 42 of Nystrom expressly teaches that higher pilot density regions 110A and 110D of Figure 5A should be used for higher Doppler situations (faster-moving remote units)." *Id.* at 20. According to Petitioner, a person of ordinary skill in the art "would understand that better channel estimation caused by the increased density of pilot symbols per unit time would counteract the effects of Doppler shift, because improved channel estimation improves transmission performance over non-ideal channels." *Id.* (citing Ex. 1002 ¶ 162 for providing multiple references to support the proposition that more pilots per unit time results in better channel estimation and therefore better performance).

Related to the previous arguments regarding what was well-known to a person of ordinary skill in the art as well as the understanding of a person of ordinary skill in the art, Petitioner contends that Patent Owner's Response confirms that a person of ordinary skill in the art would have been motivated to combine Talukdar and Nystrom. *See* Pet. Reply 21. Petitioner contends that, in addressing support for this claim limitation in the '798 Provisional Application, Patent Owner states: "Further, the goal of achieving 'higher speed' in conjunction with the proposed dual-system frame structure would suggest modifying density of pilots in one of the systems as a solution to the problem caused by increased Doppler shifting due to high speed." *Id.* (quoting PO Resp. 27).

Petitioner's argument that "[t]he Board preliminarily rejected this rationale" (Pet. Reply 19) appears to reference the following reasons to combine the teachings of Talukdar and Nystrom presented in the Petition:

> Modifying Talukdar to incorporate Nystrom's pilot density teachings would also have been obvious because it amounted to combining prior art elements according to known methods to yield predictable results. Specifically, the proposed combination would have involved using a denser pilot symbol pattern (**as taught by Nystrom**) for a faster-moving 802.16(m) remote unit by, for example, inserting additional pilot symbols (**as taught by Nystrom**) in the second section of Talukdar's hybrid frame that contained data configured for the faster-moving 802.16(m) remote unit (the "second communication system"). Roy ¶ 166. This would have resulted in enhancing the faster-moving unit's ability to perform channel estimation, which was predictable **in view of Nystrom's teachings**. Nystrom, [0037], [0042]-[0043]; Roy ¶ 166. This modification would also have been the use of a known technique (using symbols with different pilot density patterns to communicate with different communication systems, **as taught by Nystrom**) to improve a similar method (using symbols configured in different formats to communicate with different communication systems, **as taught by Talukdar**) in the same way (by improving the faster-moving communication system's ability to perform channel estimation, **as taught by Nystrom**). *Id*.

Pet. 67 (emphases added). The excerpt of the Petition reproduced above with emphases demonstrates that the rationale to combine the teachings of Talukdar and Nystrom set forth in the Petition was based on the teachings of Nystrom and Talukdar, and not based on what would have been well-known to a person of ordinary skill in the art or based on the understanding of a person of ordinary skill in the art, as set forth in Petitioner's Reply. *Compare* Pet. 67, *with* Pet. Reply 19–20.

Although Petitioner is permitted in its Reply to address issues discussed in the Institution Decision, Petitioner's Reply arguments proceed in a new direction with a new approach compared to the position taken in the

Petition, and is outside the scope of a proper reply. *See* CTPG 73–74; *see id.* at 73. Therefore, we decline to consider Petitioner's belated Reply arguments asserting new reasons to combine the teachings of Talukdar and Nystrom based on what was well known in the art or the understanding of a person of ordinary skill in the art. Moreover, even if we were to consider Petitioner's new citation to Nystrom's paragraph 3 to support its argument that Nystrom expressly teaches denser pilot symbols in the time dimension improve channel estimation, the aforementioned disclosure of Nystrom's paragraph 3 does not address Nystrom's disclosed wireless multi-carrier communication system but instead addresses prior art single-carrier systems. *See* Ex. 1017 ¶ 3. As a result, Nystrom's discussion of using a shorter time interval between successive pilot data to give a more accurate channel estimation but decreased transmission rate is directed to a prior art single-carrier system, and Petitioner does not demonstrate that more accurate channel estimation but decreased transmission rate also is applicable to Nystrom's disclosed multi-carrier system. On this matter, Nystrom discloses for multi-carrier systems, "the principles and requirements for providing channel estimations become . . . more complex than in a single-carrier system since [] continuous[] use of a single communication resource is not ensured." Ex. 1017 ¶ 4.

For all of the foregoing reasons, and after having analyzed the entire record and assigning appropriate weight to the cited supporting evidence, Petitioner has not established by a preponderance of the evidence that claim 8 is unpatentable under 35 U.S.C. § 103 as obvious over Talukdar and Nystrom.

IV. CONTINGENT MOTION TO AMEND

A. Introduction

Contingent on the determination that claims 1–4, 6, and 7 are unpatentable, Patent Owner requests that we cancel claims 1–4, 6, and 7 of the ’096 Patent and replace these claims with proposed substitute claims 44–47, 49, and 50, respectively. *See* Mot. Amend 2, 15 (App’x A). As discussed above in Section III.E., Petitioner has established by a preponderance of the evidence that claims 1–4, 6, and 7 are unpatentable under 35 U.S.C. § 103 over Talukdar and Li. Therefore, we consider Patent Owner’s Motion to Amend.

In the proceeding before us, Patent Owner requested preliminary guidance from the Board in its Motion to Amend. *See* Mot. Amend 1; Notice Regarding a New Pilot Program Concerning Motion to Amend Practice and Procedures in Trial Proceedings under the America Invents Act before the Patent Trial and Appeal Board, 84 Fed. Reg. 9497 (Mar. 15, 2019) (“MTA Pilot Program Notice”). After Petitioner filed its Opposition to the Motion to Amend, the Board issued Preliminary Guidance. *See* PG. Patent Owner filed a Reply to Petitioner’s Opposition to which Petitioner filed a Sur-reply. *See* PO Reply MTA; Pet. Sur-reply MTA.

B. Principles of Law

In an *inter partes* review, amended claims are not added to a patent as a matter of right, but instead must be proposed as a part of a motion to amend. 35 U.S.C. § 316(d). “Before considering the patentability of any substitute claims, . . . the Board first must determine whether the motion to amend meets the statutory and regulatory requirements set forth in 35 U.S.C. § 316(d) and 37 C.F.R. § 42.121.” *Lectrosonics, Inc. v. Zaxcom,*

Inc., IPR2018-01129, Paper 15 at 4 (PTAB Feb. 25, 2019) (precedential). A patent owner bears the burden of persuasion to show: (1) the amendment proposes a reasonable number of substitute claims; (2) the proposed substitute claims are supported in the original disclosure (and any earlier filed disclosure for which the benefit of filing date is sought); (3) the amendment responds to a ground of unpatentability involved in the trial; and (4) the amendment does not seek to enlarge the scope of the claims of the patent or introduce new subject matter. *See* 35 U.S.C. § 316(d); 37 C.F.R. § 42.121(a)(2), (a)(3), (d)(1); *Lectrosonics*, Paper 15 at 4–8. Petitioner, however, "bears the burden of persuasion to show, by a preponderance of the evidence, that any proposed substitute claims are unpatentable." 37 C.F.R. § 42.121(d)(2); *Lectrosonics*, Paper 15 at 4 (citing *Aqua Prods. Inc. v. Matal*, 872 F.3d 1290, 1311 (Fed. Cir. 2017); *Bosch Auto. Serv. Sols. LLC v. Iancu*, 878 F.3d 1027, 1040 (Fed. Cir. 2017)).

C. Analysis

Because the Preliminary Guidance issued in this proceeding is not binding on the Board, we consider anew Patent Owner's Motion to Amend and Petitioner's Opposition, along with Patent Owner's Reply and Petitioner's Sur-reply. We begin our analysis with an overview of proposed substitute claims 44–47, 49, and 50, followed by a discussion of Patent Owner's compliance with the statutory and regulatory requirements for a motion to amend, and then we address Petitioner's assertions of unpatentability of the proposed substitute claims.

1. Overview of Proposed Substitute Claims 44–47, 49, and 50

Proposed substitute independent claim 44, to replace independent claim 1, is reproduced below with underlined text showing Patent Owner's amendments:

> 44. A method of constructing a frame structure for data transmission, the method comprising:
> generating a first section comprising data configured in a first format compatible with a first communication system using symbols;
> generating a second section following the first section, the second section comprising data configured in a second format compatible with a second communication system using symbols, wherein the first communication system's symbols and the second communication system's symbols co-exist in one transmission scheme and wherein:
> the second format is compatible with the second communication system configured to support higher mobility than the first communication system,
> wherein each symbol in the second communication system has a shorter symbol period than that in the first communication system; and
> <u>wherein the second communication system has pilot symbols that are denser than those in the first communication system</u>;
> generating at least one non-data section containing information describing an aspect of data in at least one of the first section and the second section; and combining the first section, the second section and the at least one nondate section to form the frame structure.

Mot. Amend 15–16 (App'x A). Proposed substitute claims 45–47, 49, and 50 are identical to dependent claims 2–4, 6, and 7, respectively, apart from amendments to change the ultimate dependency to proposed substitute claim 44. *See id.* at 16.

2. Reasonable Number of Substitute Claims

Patent Owner's proposal to substitute a single claim for each of challenged claims 1–4, 6, and 7 (*see* Mot. Amend 2) meets the requirement for a reasonable number of substitute claims. *See* 37 C.F.R. § 42.121(a)(3) (establishing a rebuttable presumption that only one substitute claim is needed to replace each challenged claim).

3. Enlargement of Claim Scope

Patent Owner asserts that proposed substitute claim 44 does not seek to enlarge the scope of the originally issued claim 1 because proposed substitute claim 44 is narrower than claim 1 with the addition of a claim element. *See* Mot. Amend 3. Petitioner does not dispute Patent Owner's contention that proposed substitute claim 44 does not seek to enlarge the scope of the claims of the '096 Patent. *See generally* Pet. Opp. MTA. Based on the entire record, we determine that proposed substitute claims 44–47, 49, and 50 do not enlarge the scope of the claims of the '096 Patent. *See* 37 C.F.R. § 42.121(a)(2)(ii) ("A motion to amend may be denied where . . . [t]he amendment seeks to enlarge the scope of the claims of the patent . . . .").

4. Support for Proposed Substitute Claims / New Matter

Patent Owner asserts that the narrowing limitations of proposed substitute claim 44 is supported by the '096 Patent and the original disclosure of Application 12/168,855 (Ex. 1010, "'855 Application"), from which the '096 Patent issued. *See* Mot. Amend 3–4 (citing Ex. 1001, 5:17–18, 5:35–36, 7:23–24, 7:61–8:6, 9:18–20; Ex. 1010 ¶¶ 28, 35, 37); PO Reply MTA 8 (quoting Ex. 1010 ¶ 28; citing Ex. 1010 ¶¶ 35, 37)

Petitioner contends that Patent Owner's Motion to Amend should be denied because it does not comply with the requirement of 37 C.F.R. § 42.121(b) to show support for the entirety of the proposed amended claims. *See* Pet. Opp. MTA 1–4; *see also* 37 C.F.R. § 42.121(a)(2)(ii) ("A motion to amend may be denied where . . . [t]he amendment seeks to . . . introduce new subject matter."). Petitioner points out that the *Lectrosonics* precedential order makes clear that to meet the statutory requirement the motion must set forth written description support for each proposed substitute claim as a whole, not just the features added by amendment. *See id.* at 2 (quoting *Lectrosonics*, Paper 15 at 8). Petitioner contends that Patent Owner's Motion does not attempt to satisfy this requirement, but only purports to show support for the element added by the amendments. *See id.* (citing Mot. Amend 3–6).

In the Preliminary Guidance, we found preliminarily that Patent Owner did not satisfy its burden of establishing that the amendment does not introduce new matter because Patent Owner does not identify sufficient written description support in the originally filed disclosure of the '096 Patent for all of the limitations of the proposed substitute claims. *See* PG 6.

In the Reply to the Opposition, Patent Owner supplements its Motion to Amend by asserting the '855 Application (Ex. 1010) provides written description support for each of the limitations of proposed substitute claims 44–47, 49, and 50 by providing, for each limitation, citations to numerous paragraphs of the '855 Application, and in many cases parenthetical quotations and information addressing the specific disclosures relied upon in the respective cited paragraphs. *See* PO Reply MTA 5–8, 17–20.

In the Sur-reply, Petitioner contends that Patent Owner's attempt to provide a showing of written description support for the original limitations of the proposed substitute claims comes too late. *See* Pet. Sur-reply MTA 2. Petitioner contends that Patent Owner was obligated to present all of its arguments and evidence showing written description support for each limitation of the proposed substitute claims in the Motion to Amend. *See id.* at 2–3 (quoting 37 CF.R. § 42.23(b); *Lectrosonics*, Paper 15 at 8; Trial Practice Guide, 77 Fed. Reg. 48,756, 48,767, (Aug. 14, 2012) ("TPG")). Petitioner asserts that *Lippert Components, Inc. v Days Corp.*, IPR2018-00777, Paper 28 (PTAB Sept. 24, 2019) confirms that Patent Owner's showing is too late. *See id.* at 3 (quoting *Lippert*, Paper 28 at 51).

Petitioner further contends that the Motion to Amend Pilot Program does not alter the PTAB Rules and precedent that prohibit new written description theories on reply. *See id.* at 4 (citing 37 C.F.R. §§ 42.23(b), 42.121; TPG 48,767, *Lectrosonics*; *Lippert*; *Respironics, Inc. v. Zoll Med. Corp.*, IPR2013-00322, Paper 46 (PTAB Sept. 17, 2014)). According to Petitioner, Patent Owner "has presented no argument for why the controlling rules and precedent should not be followed." *Id.* (citing PO Reply MTA 5–13). Petitioner contends that nothing in the MTA Pilot Program Notice alters or suggests an intent to deviate from this well-established precedent on motion to amend practice. *See id.* Petitioner asserts that the MTA Pilot Program Notice cites 37 C.F.R. § 42.121 and *Lectrosonics* and reiterates that a motion to amend must set forth written description support for each substitute claim. *See id.* Petitioner further contends that the MTA Pilot Program Notice does not include any language authorizing or permitting a patent owner to present on reply "new arguments" following the

issuance of preliminary guidance. *See* Pet. Sur-reply MTA 5 (citing MTA Pilot Program Notice 9497). Petitioner, however, contends that the MTA Pilot Program Notice includes language authorizing new arguments if, instead of a reply, the patent owner opts to pursue a revised motion to amend. *See id.* (quoting MTA Pilot Program Notice 9498). According to Petitioner,

> [b]y permitting new arguments only if a patent owner files a revised motion to amend following preliminary guidance, and not if a patent owner files a reply, the Notice makes clear that new arguments, including entirely new written description theories necessary to set forth a prima facie case for written description support, are not permitted on reply.

Id.

We do not agree with Petitioner's arguments that Patent Owner is foreclosed from supplementing its showing that the Motion to Amend meets the statutory and regulatory requirements in the Reply. Petitioner's Opposition and the Preliminary Guidance raised the issue of an insufficiency of Patent Owner's showing of support for the proposed amended claims. *See* Pet. Opp. MTA 1–4. As set forth in the MTA Pilot Program Notice, a reply may respond to the preliminary guidance and to the opposition to the motion to amend. *See* MTA Pilot Program Notice 9501. A patent owner also is permitted to file new evidence, including declarations, with its reply. *See id.* In practical application, a patent owner is permitted to supplement its showing that there is support for the proposed substitute claims in a reply. *See, e.g.*, *Orthofix Med. Inc. v. Spine Holdings, LLC*, IPR2020–01411, Paper 41 at 72–73 (PTAB Feb. 22, 2022).

Petitioner also argues that the Reply does not meet Patent Owner's burden because Patent Owner's "showing of written description consists

exclusively of string citations, with either minimal parenthetical or no further explanation as to [how] the cited materials supports the claims." Pet. Sur-Reply MTA 6 (citing PO Reply MTA 5–20). Petitioner contends that merely providing string citations, without any further explanation as to how the cited material supports the claims as a whole, fails to satisfy Patent Owner's burden. *See id.* at 7 (quoting *Intel Corp. v. Alacritech, Inc.*, IPR2017-01392, Paper 81 at 64–65 (PTAB Nov. 26, 2018); *Greene's Energy Grp., LLC v. Oil States Energy Servs., LLC*, No. IPR2014-00216, Paper 53 at 26 (PTAB May 1, 2015); *Respironics*, Paper 46 at 24; citing *B.E. Tech., L.L.C. v. Google, Inc.*, No. 2015-1827, 2016 U.S. App. LEXIS 20591, *21–22 (Fed. Cir. Nov. 17, 2017)).

We do not agree with Petitioner's arguments. Patent Owner provides citations for each limitation of the proposed substitute claims with parenthetical quotations providing sufficient explanation of support in the '855 Application for each claim limitation. *See* PO Reply MTA 5–20. We have reviewed Patent Owner's citations to the '855 Application for the limitations of proposed substitute claims 44–47, 49 and 50 and find that the '855 Application provides sufficient support for the limitations of proposed substitute claims 44–47, 49 and 50.

Patent Owner also asserts that the additional claim element of proposed substitute claim 44 finds support in the '798 Provisional Application and is entitled to the filing date of the '798 Provisional Application. *See* Mot. Amend 4, 12; PO Reply MTA 9–18. Patent Owner's arguments that the additional claim element of proposed substitute claim 44 finds support in the '798 Provisional Application are substantially identical to Patent Owner's Response arguments that the '096 Patent is entitled to the

filing date of the ’798 provisional Application. *Compare* Mot. Amend. 4–12, *with* PO Resp. 18–19, 27–33. In the Reply, Patent Owner does not provide citations to the ’798 Provisional Application for the other limitations of claims 44–47, 49, and 50. *See* PO Reply MTA 5–8, 18–20.

In the Sur-reply, Petitioner contends that Patent Owner’s Motion to Amend expressly attempts to claim entitlement to the filing date of the ’798 Provisional Application, but fails to attempt to show written description support in the ’798 Provisional for all but the allegedly new limitation in proposed amended claim 44. *See* Pet. Sur-reply MTA 5–6 (quoting Mot. Amend 12; PO Reply MTA 9; citing PO Reply MTA 5–8, 17–20). According to Petitioner, Patent Owner’s “failure to comply with 37 C.F.R. § 42.121(b)(2), despite claiming priority to the ’798 Provisional Application for all of the Proposed Amended Claims, is particularly fatal here, given that both the Board’s pre-motion order and Preliminary Guidance expressly directed [Patent Owner] to the *Lectrosonics* precedential decision.” *Id.* at 6 (quoting PG 2, 6). Petitioner contends that the Motion should be denied for this reason alone. *See id.*

Although we agree with Petitioner that Patent Owner does not attempt to provide support in the ’798 Provisional Application for all of the limitations of proposed substitute claims 44–47, 49, and 50, we do not agree that this is a reason to deny the Motion. Petitioner does not direct us to persuasive authority to support its assertion that the Motion should be denied on this basis.

Based on the entire record, Patent Owner has sufficiently shown support in the ’855 Application for each of the proposed amended claims. *See* Mot. Amend 3–4; PO Reply MTA 4–8, 17–20.

5. Responding to a Ground of Unpatentability

Patent Owner contends that proposed substitute claims 44–47, 49, and 50 respond to Petitioner's unpatentability challenge to claims 1–4, 6, and 7 based on Talukdar and Li because the additional claim element of proposed substitute claim 44 responds to this ground of unpatentability. *See* Mot. Amend 2–3. Petitioner does not dispute Patent Owner's contentions that proposed substitute claims 44–47, 49, and 50 are responsive to the grounds of unpatentability in the Petition. *See generally* Pet. Opp. MTA. Based on the entire record, Patent Owner has sufficiently articulated its position for why the added limitations are responsive to the grounds of unpatentability raised in the Petition. *See* Mot. Amend 2–3.

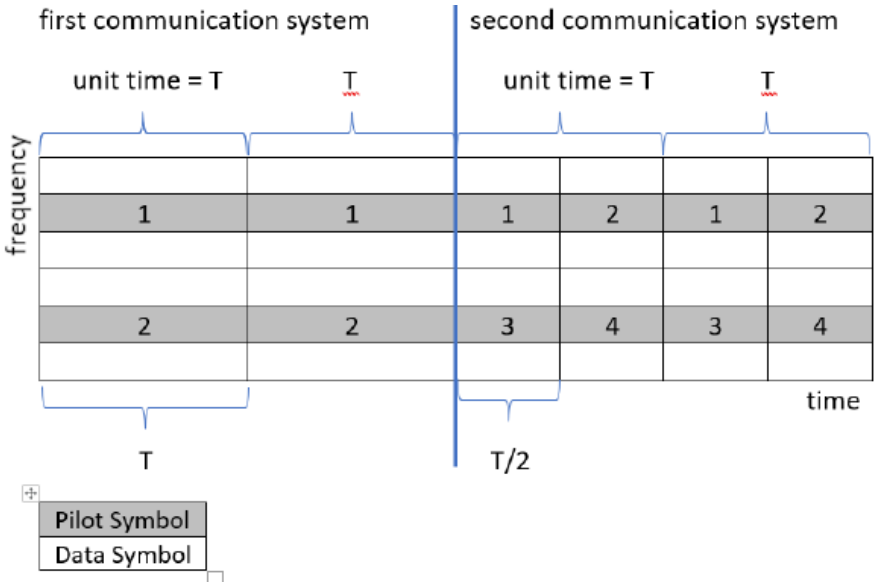
6. Patentability of Proposed Substitute Claims over Talukdar and Li

Petitioner contends that Patent Owner's request to replace claims 1–4, 6, and 7 with proposed substitute claims 44–47, 49, and 50 should be denied because claims 44–47, 49, and 50 are unpatentable as obvious under 35 U.S.C. § 103 over Talukdar and Li. *See* Pet. Opp. MTA 1, 9–15.

First, Petitioner contends that the added limitation in proposed substitute claim 44 does not add any patentably distinct limitation not already present in original claim 1. *See* Pet. Opp. MTA 6. According to Petitioner, "Patent Owner and its expert expressly confirmed that the limitation 'wherein the second system has pilot symbols that are denser than those in the first communication system' is 'a natural result' of reduced symbol period." *Id.* (reproducing PO Resp. 27 (portion of Petitioner's claim chart addressing limitation 8b)). Petitioner contends that Dr. Roy confirms that

> based on the construction of "pilot symbols that are denser than" proposed by both parties to this proceeding (and adopted by the district court in *UNM Rainforest Innovations v. Apple*), any prior art that disclosed the limitation "wherein each symbol in the second communication system has a shorter symbol period than that in the first communication system" would equally disclose "wherein the second system has pilot symbols that are denser than those in the first communication system."

Id. at 7 (citing Ex. 1039 ¶¶ 19–24); *see* Pet. Sur-reply MTA 11. Petitioner asserts that "Dr. Roy explains that because the unit time is defined as the symbol period for the first communication system, the unit time will necessarily be longer than the symbol period of the second communication system," and "[b]ecause pilot symbols are assigned to a specific proportion of the total number of symbols in an OFDM frame, the number of pilot symbols per unit time in the second communication system will necessarily be higher than in the first communication system." Pet. Opp. MTA 7 (citing Ex. 1039 ¶¶ 60–62); *see* Pet. Sur-reply MTA 11. Petitioner reproduces the following example figure produced by Dr. Roy from Dr. Roy's Declaration:



Pet. Opp. MTA 8 (reproducing figure from Ex. 1039 ¶ 61); *see id.* at 12 (reproducing same); Pet. Sur-reply MTA 12–13 (reproducing same), 20 (reproducing same). Petitioner describes Dr. Roy's example figure as follows:

> In this figure, the first communication system (left half of the figure) has a symbol period of T and has **one pilot symbol inserted per every three subcarriers in each slot**. . . . As a result, the first communication system in this example has two pilot symbols per unit time. The second communication system (right half) has a symbol period of T/2 and **the same pilot distribution – one per every three subcarriers**. . . . As indicated by the numbered pilot symbols in the figure, the second communication system has a higher number of pilot symbols per unit time than the first communication system (four vs. two) due to the shorter symbol period.

Pet. Opp. MTA 8 (citing Ex. 1039 ¶ 62 (emphasis added)); *see* Pet. Sur-reply MTA 13 (citing same). Petitioner concludes that

> [b]ecause original claim 1 already included the limitation "wherein each symbol in the second communication system has a shorter symbol period than that in the first communication system," both the above analysis from Dr. Roy and Patent Owner's argument that the new limitation is simply "a natural result of reduced symbol period" confirms that the new limitation does not add anything to the original claims.

Pet. Opp. MTA 8–9.

In the Reply, Patent Owner contends that Petitioner's argument is incorrect that if the disclosure of the '798 Provisional Application teaches denser pilot symbols, then so does Li. *See* PO Reply MTA 22. Patent Owner asserts that the argument is incorrect because the conclusions drawn by a person of ordinary skill in the art would differ based on the different

disclosures of the ’798 Provisional Application and the teachings of Li. *See id.*

We are not persuaded by Petitioner’s contentions that the added limitation to proposed substitute claim 44 is not patentably distinct from the “wherein each symbol in the second communication system has a shorter symbol period than that in the first communication system” recited in claim 1. As an initial matter, as discussed above in Section III.D. addressing entitlement to the filing date of the ’798 Provisional Application, we found that the ’798 Provisional Application does not provide sufficient support for “each symbol in the second communication system has a shorter symbol period than in that in the first communication system,” as recited in claim 1, and “the second communication system has pilot symbols that are denser than those in the first communication system,” as recited in claim 8. In addition to other reasons, we noted that Patent Owner’s argument overlooks that Dr. Roy’s testimony is conditioned on the number of pilot symbols being the same for a T symbol duration compared to a T/2 symbol duration. *See* PO Resp. 33; Ex. 2015, 74:16–19. Similarly, as highlighted in the reproduced description of Dr. Roy’s example figure, Petitioner’s argument that the new limitation of proposed substitute claim 44 (same limitation as claim 8) is a natural result of reduced symbol period also overlooks that Dr. Roy’s testimony is premised on the same number of pilot symbols or pilot symbol distribution (one pilot symbol inserted per every three subcarriers in each slot) for both the first and second communication system symbol periods (T and T/2). *See* Pet. Opp. MTA 8; Pet. Sur-reply MTA 13; Ex. 1039 ¶ 62. For this reason, Petitioner’s argument that “the second system has pilot symbols that are denser than those in the first

communication system" is a "a natural result of reduced symbol period" *only when the same number of pilot symbols or pilot symbol distribution are used for both the first and second communication system time periods (T and T/2)*. Proposed substitute claim 44 does not describe the number of pilot symbols in the first and second communication systems being the same. *See* Mot. Amend 15–16 (App'x. A). Petitioner's belated Sur-reply arguments that OFDM has pilot symbols inserted in a defined proportion of subcarriers, IEEE 802.16 has defined pilot ratios, and Dr. Roy's example uses 33% of the total symbols for pilots (*see* Pet. Sur-reply MTA 11–14 (citing Ex. 1039 ¶¶ 59, 62; Ex. 1038, 33:4–34:3)) does not undercut the fact that Dr. Roy's testimony is premised on the same number of pilot symbols or pilot symbol distribution (one pilot symbol inserted per every three subcarriers in each slot) for both the first and second communication system symbol periods (T and T/2). That OFDM has pilot symbols inserted in a defined proportion of subcarriers, IEEE 802.16 has defined pilot ratios, and Dr. Roy's use of 33% of the total symbols for pilots in his example does not foreclose the use of different numbers of pilot symbols, different pilot ratios, or different percentages of pilot symbols for the first and second communications systems. For these reasons, we are not persuaded by Petitioner's argument that any prior art that disclosed the limitation "wherein each symbol in the second communication system has a shorter symbol period than that in the first communication system" as recited in claim 1, would equally disclose "wherein the second system has pilot symbols that are denser than those in the first communication system," as recited in proposed claim 44.

Relying on its previous argument that the added limitation "wherein the second system has pilot symbols that are denser than those in the first

communication system," of proposed substitute claim 44 is disclosed by any art that would disclose the second communication system having shorter symbol period, based on the construction of "pilot symbols that are denser than," (*see* Pet. Opp. MTA 6–8, 12; Pet. Sur-reply MTA 10–17), Petitioner contends that the combination of Talukdar and Li teaches this limitation because Li discloses each symbol in the second communication system has a shorter symbol period than in the first communication system. *See* Pet. Opp. MTA 9–10, 12 (citing Ex. 1002 ¶¶ 130–133; Ex. 1029 ¶¶ 60–62); Pet. Sur-reply MTA 15, 17, 19. Petitioner contends that Li discloses a higher mobility subscriber station (i.e., a second communication system) experiences a greater degree of interference between subcarriers than a lower-mobility or fixed subscriber station and that using a shorter symbol duration for a faster-moving station helped reduce the inter-subcarrier interference experienced by that station. *See* Pet. Opp. MTA 10–11 (quoting Ex. 1016 ¶¶ 10, 34, 35, 37; citing Ex. 1016 ¶ 26; Ex. 1002 ¶¶ 73, 130–131); Pet. Sur-reply MTA 17–18. Petitioner asserts that Li discloses an example in which the base station assigned to a fast subscriber a symbol duration that is half the duration of the slow subscriber symbol duration. *See* Pet. Opp. MTA 11–12 (reproducing Ex. 1016; Fig. 5 (with annotations); citing Ex. 1016 ¶ 38; Ex. 1002 ¶¶ 131–133); Pet Sur-reply MTA 18–19. Petitioner relies on substantially the same rationale for combining the teachings of Talukdar and Li as those relied upon to address the limitations of claim 1. *Compare* Pet. Opp. MTA 13–15, *and* Pet. Sur-reply MTA 20–23, *with* Pet. 46–48.

In the Reply, Patent Owner contends that Li's teachings related to Figure 5 do not reference pilot symbols at all. *See* PO Reply MTA 24.

Patent Owner asserts that Li only addresses pilot symbols in reference to Figure 7 which illustrates Li's teaching of halving the symbol period, where the number of pilot symbols before and after remain the same. *See id.* at 22–23 (reproducing Ex. 1016 Fig. 7; quoting PG 13). Patent Owner contends that Petitioner's assertion and Dr. Roy's testimony that Li teaches more pilot symbols in the same time period is explicitly contradicted by Figure 7. *See id.* at 23. Patent Owner points out that, in the Preliminary Guidance, the Board noted that Li's Figure 7 top graph has two pilot symbols in the period T and Li's Figure 7 bottom graph also has two pilot symbols in period T. *See id.* Patent Owner further argues that Figure 7 contradicts Petitioner's argument that shortening the symbol period of Li's teaching in Figure 5 implies that there will be more pilot symbols in a given time period. *See id.* at 23–24.

In the Sur-reply, Petitioner clarifies that neither Petitioner nor Dr. Roy relies on an express teaching of *Li* regarding increasing the density of pilot symbols. Petitioner asserts that Li's Figure 7 of Li is the only figure that mentions pilot symbols, and Figure 7 does not teach increasing pilot symbol density, because it illustrates a situation where the symbol period is halved but the number of subcarriers also is halved. *See* Pet. Sur-reply MTA 15. Petitioner reiterates that its position is based on Li's disclosures of using a shorter symbol period for higher mobility communications (including at least Figures 5, 6, and 7). *See id.* Petitioner further argues that Patent Owner's arguments that Li's Figure 7 demonstrates Dr. Roy's illustration is incorrect because it is premised on a flawed assumption. *See* Sur-reply 14. According to Petitioner, Figure 7 does not and cannot teach the hybrid frame taught by the combination of Talukdar and Li because the two separate

frames of Figure 7 are not the single hybrid frame of Talukdar and show different number of subcarriers. *See id.* Petitioner contends that nothing in the teachings of *Li* is limited to halving the number of subcarriers between the two communication systems. *See id.* at 15

As explained above, we are not persuaded by Petitioner's argument that any prior art that discloses the limitation "each symbol in the second communication system has a shorter symbol period than that in the first communication system" as recited in claim 1, would equally disclose "the second system has pilot symbols that are denser than those in the first communication system," as recited in proposed claim 44. For this same reason, we are not persuaded that Li teaches "the second system has pilot symbols that are denser than those in the first communication system," as recited in proposed claim 44, based on Petitioner's showing that Li teaches "each symbol in the second communication system has a shorter symbol period than that in the first communication system." Moreover, Petitioner does not direct us to persuasive evidence to demonstrate that Li teaches the symbol period is reduced while the number of pilot symbols remains the same. *See generally* Pet. Opp. MTA; Pet. Sur-reply MTA.

For all of the foregoing reasons, and after having analyzed the entire record and assigning appropriate weight to the arguments and cited supporting evidence, Petitioner has not established by a preponderance of the evidence that proposed substitute claim 44, and proposed substitute claims 45–47, 49, and 50, dependent therefrom, are unpatentable under 35 U.S.C. § 103 as obvious over Talukdar and Li.

7. Conclusion

Patent Owner has shown: (1) the amendment proposes a reasonable number of substitute claims; (2) the proposed substitute claims are supported in the original disclosure; (3) the amendment responds to a ground of unpatentability involved in the trial; and (4) the amendment does not seek to enlarge the scope of the claims of the patent or introduce new subject matter. Petitioner has not shown by a preponderance of the evidence that proposed substitute claims 44–47, 49, and 50 are unpatentable. Accordingly, Patent Owner's Motion to Amend is *granted*.

V. CONCLUSION[19]

For the foregoing reasons, and after having analyzed the entire record and assigning appropriate weight to the cited supporting evidence, Petitioner has established by a preponderance of the evidence that claims 1–4, 6, and 7 of the '096 Patent are unpatentable, but has not established by a preponderance of the evidence that claim 8 of the '096 Patent is unpatentable. In addition, for the foregoing reasons, and after having analyzed the entire record and assigning appropriate weight to the cited supporting evidence, Patent Owner has met the statutory requirements for a

[19] Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner's attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. *See* 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. § 42.8(a)(3), (b)(2).

motion to amend, and Petitioner has not established by a preponderance of the evidence that proposed substitute claims 44–47, 49, and 50 are unpatentable. Accordingly, Patent Owner's Motion to Amend is *granted*.

VI. ORDER

Accordingly, it is

ORDERED that Petitioner has shown by a preponderance of the evidence that claims 1–4, 6, and 7 are unpatentable;

FURTHER ORDERED that Petitioner has not shown by a preponderance of the evidence that claim 8 is unpatentable;

FURTHER ORDERED that Patent Owner's Motion to Amend is *granted*;

FURTHER ORDERED that Patent Owner's Motion to Exclude is *denied*; 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.

In summary:

Claims	**35 U.S.C. §**	**Reference(s)/Basis**	**Claims Shown Unpatentable**	**Claims Not Shown Unpatentable**
1–4, 6–7	103	Talukdar, Li	1–4, 6, 7	
8	103	Talukdar, Nystrom		8
Overall Outcome			1–4, 6, 7	8

Motion to Amend Outcome	Claim(s)
Original Claims Cancelled by Amendment	1–4, 6, 7
Substitute Claims Proposed in the Amendment	44–47, 49, 50
Substitute Claims: Motion to Amend Granted	44–47, 49, 50
Substitute Claims: Motion to Amend Denied	
Substitute Claims: Not Reached	

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