

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

T-MOBILE USA, INC.¹
Petitioner,

v.

DALI WIRELESS INC.,
Patent Owner.

IPR2022-01345
Patent 11,006,343 B2

Before KARL D. EASTHOM, SHARON FENICK, and JOHN R. KENNY,
Administrative Patent Judges.

EASTHOM, *Administrative Patent Judge.*

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 314

¹ The Board joined T-Mobile USA, Inc. (petition filed in IPR2023-00820) as a (Petitioner) party to this proceeding and terminated 1) original Petitioner Ericsson Inc. and 2) joined-Petitioner CommScope Technologies, LLC. (petition filed in IPR2023-00832). *See* Papers 22–24 and 33.

I. INTRODUCTION

Petitioner, T-Mobile USA, Inc., joined the proceeding after original Petitioner, Ericsson Inc. (now terminated, *supra* note 1), filed a (corrected) Petition pursuant to 35 U.S.C. §§ 311–319 to institute an *inter partes* review of claims 1–22 of U.S. Patent No. 11,006,343 B2 (Ex. 1001, the “’343 patent”), supported by the (corrected) Declaration of Henry Houh, Ph.D (Ex. 1012). Paper 11 (“Pet.”).² Dali Wireless, Inc. (“Patent Owner”) filed a (corrected) Preliminary Response supported by the Declaration of Douglas A. Chrissan, Ph.D (Ex. 2001). Paper 7 (“Prelim. Resp.”).³ The then-parties also filed supplemental briefing authorized by the Board (Ex. 3001) to address a claim construction issue. *See* Paper 9 (Petitioner’s Reply (“Pet. Reply”)); Paper 10 (Patent Owner’s Sur-reply (“PO Sur-reply”)).

After the Institution Decision (Paper 13, “Inst. Dec.”), Patent Owner filed a Response (Paper 21, “PO Resp.”) with the (second) Declaration of Douglas A. Chrissan, Ph.D. (Ex. 2016), Petitioner filed a Reply (Paper 27, “Reply”) with the Reply Declaration of Henry Houh, Ph.D. (Ex. 1034), and Patent Owner filed a Sur-reply (Paper 31, “Sur-reply”). After the briefing, the Board conducted an oral hearing and entered a Transcript thereof in the record.⁴ Paper 43 (“Tr.”).

For the reasons set forth in this Final Written Decision pursuant to 35 U.S.C. § 318(a), we determine that Petitioner demonstrates by a

² *See* Ex. 3002 (ordering Petitioner to file, *inter alia*, a corrected Petition and corrected Houh Declaration).

³ *See* Ex. 3001 (authorizing Patent Owner to file a corrected Preliminary Response).

⁴ The “record” hereinafter refers to the fully developed trial record, which consists of all Papers and Exhibits filed to date.

preponderance of evidence that challenged claims 1–22 of the ’343 patent are unpatentable.

A. Real Party in Interest

For Petitioner, “[t]he remaining real parties-in-interest are T-Mobile USA, Inc., and T-Mobile US, Inc. (collectively, ‘T-Mobile’).” Paper 39, 1. Patent Owner identifies itself as the real party-in-interest. Paper 3, 1.

B. Related Matters

Patent Owner identifies the following current district court infringement action as involving the ’343 patent: *Dali Wireless, Inc. v. Corning, Inc.*, 6:22-cv-01314 (W.D. Tex.). Paper 40, 1.

The parties also identify the following matters as dismissed or otherwise resolved: *Dali Wireless, Inc. v. Ericsson Inc.*, 6:22-cv-1313 (W.D. Tex.); *Dali Wireless, Inc. v. Cellco P’ship*, No. 2:23-cv-002 (E.D. Tex.); *Dali Wireless, Inc. v. T-Mobile US, Inc.*, No. 2:22-cv-414 (E.D. Tex.); *Dali Wireless, Inc. v. Cellco Partnership*, No. 6-22-cv-00104 (W.D. Tex.); *Dali Wireless, Inc. v. Corning, Inc.*, No. 6-22-cv-01314 (W.D. Tex.); *Dali Wireless, Inc. v. Verizon Corporate Services Group, Inc.*, No. 6-23-cv-00060 (W.D. Tex.). See Paper 39, 1; Paper 40, 1.

In addition to the joined *inter partes* proceedings identified above (note 1), the parties assert that the following *inter partes* reviews involve related patents that include the same specification as the ’343 patent: *CommScope Tech. LLC v. Dali Wireless Inc.*, IPR2020-01473, Paper 18 (PTAB Mar. 12, 2021 (granting institution on challenged claims of U.S. Pat. No. 10,080,178 B2 (the “’178 patent”)) (the “1473-IPR”); *John Mezzalingua Ass’cs LLC v. Dali Wireless Inc.*, IPR2018-01430, Paper 15 (PTAB Feb. 9, 2021 (decision denying institution of U.S. Pat. No. 10,344,499 B2 (the “’499

patent”) (the “1430-IPR”). *See* Ex. 1004 (the 1473-IPR institution decision); Ex. 1019 (1430-IPR denial of institution); Pet. Reply 2 n.1 (asserting that “[t]he ’499 [p]atent, ’343 [p]atent and ’178 [p]atent share an identical specification”); Prelim. Resp. 14–15 (discussing the ’499 patent and 1430-IPR).

Other *inter partes* reviews relate to the instant proceeding: *Ericsson Inc. v. Dali Wireless Inc.*, IPR2022-01212, Paper 37 (PTAB Feb. 1, 2023) (finding claims 1–12 of U.S. Pat. No. 8,682,338 B2 unpatentable) (the “1212-IPR”); *John Mezzalingua Associates, LLC v. Dali Wireless Inc.*, IPR2020-01432, Paper 16 (PTAB Feb. 9, 2021) (institution denied for patent with similar technology) (the “1432-IPR”) (Ex. 2006); *Commscope Tech’s LLC v. Dali Wireless Inc.*, IPR2018-00571, Paper 53 (PTAB Aug. 12, 2019) (final written decision) (the “571-IPR”) (Ex. 1006).

Our reviewing court in the Federal Circuit affirmed the final written decision in the 571-IPR. *Dali Wireless Inc. v. CommScope Techn’s LLC*, No. 2020-1045, 2023 WL 5740247, slip op. at **3–4, 8 (Fed. Cir. 2023) (finding that “Wu’s host unit 230 and matrix switch already function together as part of the base station, 240, to route channels to remote units. (emphasis added)) (“CommScope”). *See* Ex. 1039 (*CommScope*).

C. The ’343 Patent (Ex. 1001)

The ’343 patent describes a reconfigurable distributed antenna system (DAS) that provides flexibility to manage, control, re-configure, enhance, and facilitate the radio resource efficiency, usage, and performance of a distributed wireless network. Ex. 1001, 4:29–33.

Figure 1, reproduced below, shows an embodiment of the reconfigurable DAS:

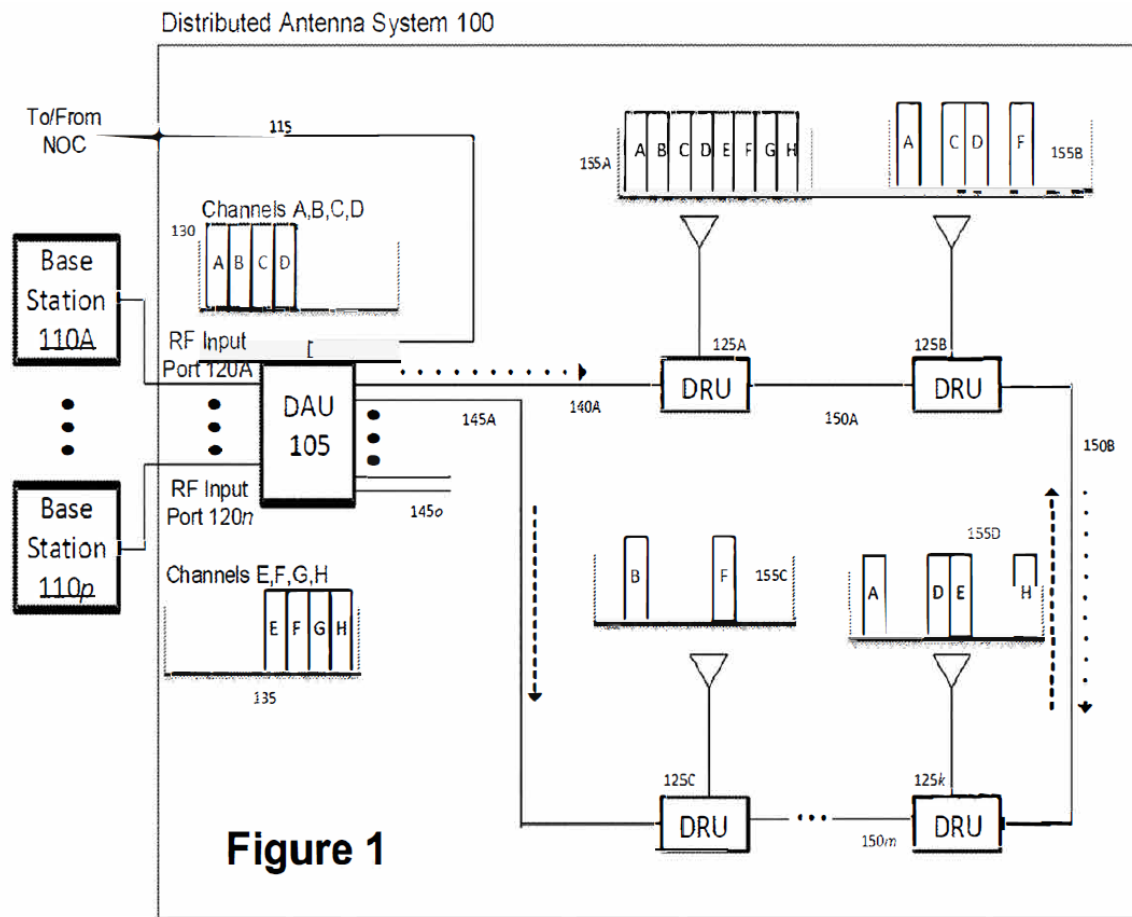


Figure 1 is a block diagram showing the basic structure of a reconfigurable distributed antenna system (DAS) 100. Ex. 1001, 4:33–37, code (57). Reconfigurable DAS system 100 employs remote radio units (DRUs, or “interchangeably” RRUs) and digital access units (DAUs). *Id.* at 4:42–55. DAUs serve as interfaces between one or more base stations (BTS) (not depicted) and the RRUs. *Id.* Software settings within DRU 125A and DRU 125B, for example, enable particular carriers to be present in each respective downlink output signal 155A, 155B (e.g., carriers A–H in DRU 125A, carriers A, C, D, and F in DRU 125B). *See id.* at 6:23–65.

The DAU communicates configuration information to set “the appropriate amount of radio resources (such as RF carriers, CDMA codes or TDMA time slots) assigned to a particular DRU or group of DRUs to meet desired capacity and throughput objectives.” Ex. 1001, 12:5–9. In other words, DAUs send configuration information and allocate radio resources as needed for the DRUs. *See id.* at 5:30–33, 8:14–35, 12:58–64 (“[T]he DAU Management Control module can adaptively modify the system configuration to begin to deploy . . . additional radio resources (such as RF carriers, CDMA codes and TDMA time slots) for use by a particular DRU which need those radio resources within its coverage area.”).

In one embodiment, a DAU detects which carriers and corresponding time slots for each carrier are active and determines if a particular downlink carrier exceeds a load by a percentage greater than a predetermined threshold. Ex. 1001, 12:50–64. If the latter occurs, the DAU adaptively modifies the system configuration to deploy additional radio resources for use by a particular DRU that needs those radio resources within its coverage area. *Id.* At the same time, the DAU management control module adaptively modifies the system configuration to slowly remove certain radio resources for use by a particular DRU that no longer needs those radio resources within its coverage area. *Id.* at 12:63–13:2.

D. Illustrative Claim

Independent claims 1 and 12 are materially similar and illustrative of the claimed subject matter. Claim 1 follows (with bracketing information added to conform to Petitioner’s nomenclature):

1. [pre] A system to transport wireless communications, comprising:
 - [1.a] a digital access unit;

[1.b] a plurality of signal sources, including at least a first signal source and a second signal source;

[1.c] a plurality of remote units, including at least a first remote unit and a second remote unit;

[1.d] wherein the digital access unit comprises a plurality of interfaces to communicatively couple the digital access unit to the plurality of signal sources;

[1.e] wherein the digital access unit is configured to receive a plurality of radio resources from the first signal source and the second signal source;

[1.f] wherein the digital access unit is configured to send a digital representation of a first set of radio resources to the first remote unit at a first point in time, the first set of radio resources for transmission at an antenna of the first remote unit;

[1.g] wherein the digital access unit is configured to send a digital representation of a second set of radio resources to the first remote unit at a second point in time, the second set of radio resources for transmission at the antenna of the first remote unit;

[1.h] wherein a number of radio resources in the first set of radio resources is different from a number of radio resources in the second set of radio resources at least based on dynamic load balancing and resource management; and

[1.i] wherein the digital access unit is configured to receive digital signals from each of the plurality of remote units.

E. Asserted Grounds of Unpatentability

Petitioner asserts that claims 1–22 are unpatentable as follows:

Claim(s) Challenged	35 U.S.C §	Reference(s)/Basis
1–3, 5–10, 12–14, 16–21	103(a) ⁵	Wu ⁶
4, 11, 15, 22	103(a)	Wu, Cannon ⁷

II. OBVIOUSNESS ANALYSIS

A. Level of Ordinary Skill in the Art

Relying on the Houh Declaration (Ex. 1012), Petitioner asserts that a person of ordinary skill in the art (POSA)

in February 7, 2011 would have been familiar with reconfiguring remote radio units in a DAS. EX-1012, ¶38. A POSA would have gained knowledge of these concepts through a mixture of training and work experience, such as by having a Bachelor’s degree in electrical engineering and four years of experience; or by obtaining a Master’s degree in electrical engineering, but having only one to two years of experience; or by having no formal education but experience in cellular communications of at least eight years. EX-1012, ¶38.

Pet. 16.

⁵ The Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011) (“AIA”), amended 35 U.S.C. § 103, was effective on March 16, 2013. Petitioner “does not challenge the claimed priority of February 7, 2011” for purposes of the Petition. Pet. 16; *see also* Prelim. Resp. 4 (agreeing with the priority date of February 7, 2011). Because this priority date is before the effective date of the applicable AIA amendment, the pre-AIA version of § 103 applies for purposes of institution.

⁶ Wu et al., US Pub. No. 2010/0128676 A1, published May 27, 2010, filed Nov. 11, 2009. Ex. 1007.

⁷ Cannon et al., U.S. Pub. No. US 2010/0177760 A1, published July 15, 2010, filed Jan. 13, 2010. Ex. 1017.

Patent Owner agrees that

a [person of ordinary skill in the art] at the time of the '343 patent would have an educational background in electrical engineering and experience in the design of wireless communication systems. More particularly, a [person of ordinary skill in the art] would be person with a bachelor's degree in electrical engineering (or a similar technical degree or equivalent work experience) and at least 3 years of experience working with wireless communication systems.

PO Resp. 12.

The two proposals are materially similar. Nevertheless, Patent Owner's proposed level of ordinary skill is more similar to the Board's adopted level of skill (as proposed by a different petitioner) in the 1432-IPR. *See* Ex. 2006 (1432-IPR institution decision).

Determining the level of ordinary skill in the art involves various factors, including the "type of problems encountered in the art; prior art solutions to those problems; rapidity with which innovations are made; sophistication of the technology; and educational level of active workers in the field." *In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995) (citation omitted). The prior art of record also reflects the level of ordinary skill in the art. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001).

As we did in the Institution Decision, we adopt the assessment offered by Patent Owner, modified to insert "about" in place of the open-ended "at least," which provides no upper bound on the level of experience of one of ordinary skill in the art, as it is consistent with the '343 patent and the asserted prior art. Even if we were to adopt Petitioner's similar assessment, it would not alter our decision.

B. Claim Construction

In *inter partes* reviews, the Board construes claims using the same claim construction standard employed in a civil action under 35 U.S.C. § 282(b). 37 C.F.R. § 42.100(b) (2020). Under *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312 (Fed. Cir. 2005) (en banc), the “words of a claim ‘are generally given their ordinary and customary meaning,’” as would have been understood by a person of ordinary skill in the art in question at the time of the invention. *Id.* (quoting *Vitronics Corp. v. Conceptronic, Inc.*, 90 F.3d 1576, 1582 (Fed. Cir. 1996)). “In determining the meaning of the disputed claim limitation, we look principally to the intrinsic evidence of record, examining the claim language itself, the written description, and the prosecution history, if in evidence.” *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 469 F.3d 1005, 1014 (Fed. Cir. 2006) (citing *Phillips*, 415 F.3d at 1312–17).

1. Digital Representation of Radio Resources

a. Claim Construction of Radio Resources at Institution

Prior to institution, Patent Owner proposed construing “radio resources” as “RF carriers, CDMA codes, TDMA time slots, and other information defining or describing the way data is being transmitted by a remote unit but do not include the user payload data that is transmitted.” Prelim. Resp. 17. Patent Owner argued that the ’343 patent specification supports its construction by describing “RF carriers, CDMA codes, or TDMA time slots” as examples of “radio resources.” *See id.* at 15–16 (quoting Ex. 1001, 12:6–7, 12:60–64, 12:67–13:2). In the Institution Decision, after briefing by the parties, we determined that “radio resources include RF carriers, CDMA codes, and TDMA time slots, even if the

carriers, codes, and/or slots include underlying transmitted payload data.”
Inst. Dec. 14. We determined it was unnecessary to decide if radio resources include “information defining or describing the way data is being transmitted by a remote unit but do not include the user payload data that is transmitted,” reasoning that Petitioner did not rely on that information in asserting that Wu teaches “radio resources.” *Id.*

As we noted in the Institution Decision (Inst. Dec. 11), the specification identifies RF carriers, CDMA codes and TDMA time slots as examples of radio resources in several places. For example, a “key function is determining and/or setting the appropriate amount of radio resources (*such as RF carriers, CDMA codes or TDMA time slots*) assigned to a particular DRU or group of DRUs to meet desired capacity and throughput objectives.” Ex. 1001, 12:5–10 (emphasis added); Inst. Dec. 11 (quoting same). As another example, “the DAU Management Control module can adaptively modify the system configuration to begin to deploy, typically . . . slowly, additional radio resources (*such as RF carriers, CDMA codes or TDMA time slots*) for use by a particular DRU which need those radio resources within its coverage area.” Ex. 1001, 12:59–64 (emphasis added); Inst. Dec. 11 (quoting same); *accord* Ex. 1001, 12:64–13:2 (describing “certain radio resources (*such as RF carriers, CDMA codes or TDMA time slots*)” (emphasis added)).

After a review of the parties’ briefing and for the reasons discussed below, we incorporate by reference our preliminary analysis and claim construction of “radio resources” in our Institution Decision and determine that the full record supports that construction. Inst. Dec. 9–14. Therefore, radio resources include “RF carriers, CDMA codes, and TDMA time slots,

even if the carriers, codes, and/or slots include underlying transmitted payload data.” *Id.* at 14.

b. “send a digital representation of a [first/second] set of radio resources to the first remote unit”

Petitioner contends that the plain and ordinary meaning of the claim term above applies and construes “digital representation of a radio resource” as “the digitized form of a radio resource.” *See* Reply 3, 6–7. Patent Owner disagrees and argues that “the proper construction of the claim term ‘digital representation of radio resources’ as understood by a [person of ordinary skill in the art] in light of the ’343 patent specification includes digital information defining or describing the radio resources to be used for transmitting data over the air via the antenna of a remote radio unit.” Sur-reply 3; PO Resp. 13.⁸

Patent Owner states that it “does not agree with th[e Board’s] construction for the term ‘radio resources[]’ [as set forth in the Institution Decision], but proposes here the proper construction for a different term related to the ‘digital representation’ of sets of radio resources.” PO Resp. 14–15. Specifically, Patent Owner seeks to construe “send a digital representation of a [first/second] set of radio resources to the first remote unit” as recited in limitations 1.f. and 1.g. *Id.* As noted above, Patent Owner contends that these claim limitations “include[] sending digital

⁸ As noted, Patent Owner argues that the term “digital representation of radio resources” *includes* “digital information defining or describing the radio resources to be used for transmitting data over the air via the antenna of a remote radio unit.” In context, however, Patent Owner argues that the term *requires* such digital information, because Patent Owner also argues that “Wu does not disclose digital representations of radio resources under the proper construction of the term.” *See, e.g.,* Sur-reply 1.

information defining or describing a set of radio resources to be used for transmitting data over the air via the antenna of a remote radio unit.” *Id.* at 13 (citing Ex. 2016 ¶¶ 39–43). Patent Owner explains that “digital representations of radio resources define or describe how the DRU should be configured to transmit RF signals, by means of, e.g., carriers or time slots, at the antenna of the remote unit.” *Id.* at 17–18.

Petitioner disagrees. Reply 2–7. Petitioner contends that “the plain and ordinary meaning applies.” *Id.* at 3. According to Petitioner, the phrase “digital representation” is not in the specification and the specification reveals no special meaning for it. *Id.* Petitioner also contends that Patent Owner’s declarant, Dr. Chrissan, agrees with “multiple judges” “construing the same concept” that the “plain and ordinary meaning controls.” *Id.* (citing Ex. 1038, 146:3–22 (testifying “the term ‘digital representation’ is both [the] plain and ordinary meaning and informed in light of the PTAB,” and “I do not see that I mentioned any lexicography . . . on the part of the patentee”); Ex. 1030, 10–11, Ex. 1035, 2)).

Petitioner contends the plain meaning of “‘digital’ refers to data expressed in digits (i.e., 0s and 1s) as opposed to analog,” and the plain meaning of “‘representation’ is simply ‘something that represents’ which itself is broadly defined as to indicate, describe, communicate by signs or symbols, depict, represent, delineate.” Reply 3–4 (citing Ex. 1031, 3, 6, 9, 12–13). Petitioner also points to the ’343 patent specification, which states that “[t]he RF input signals are separately down-converted, **digitized**, and converted to baseband (using a Digital Down-Converter) by the DAU. . . . [and] are then translated to optical signals . . . [and] **delivered to different DRU’s**” *Id.* at 4 (quoting Ex. 1001, 5:1–8).

The record supports Petitioner’s claim construction. The plain and ordinary meaning of the term in light of the ’343 patent applies as discussed further below.

c. Plain Meaning

“The patentee may demonstrate intent to deviate from the ordinary and accustomed meaning of a claim term by including in the specification expressions of manifest exclusion or restriction, representing a clear disavowal of claim scope.” *Teleflex, Inc. v. Ficosa N. Am. Corp.*, 299 F.3d 1313, 1325 (Fed. Cir. 2002); *see also Home Diagnostics, Inc. v. LifeScan, Inc.*, 381 F.3d 1352, 1358 (Fed. Cir. 2004) (“Absent a clear disavowal in the specification or the prosecution history, the patentee is entitled to the full scope of its claim language.”).

Patent Owner does not assert or show that there is a clear disavowal of the plain meaning of the disputed phrase as construed by Petitioner. *See* PO Resp. 13–18; Sur-reply 3–6.⁹ Patent Owner notes that a district court preliminarily construed “radio resources” according to the

[p]lain and ordinary meaning where the plain and ordinary meaning includes RF carriers, CDMA codes, and TDMA time slots, but does not include the underlying data that is transmitted, Note: when data is modulated on an RF carrier, the RF carrier is a radio resource, but the data modulated on the RF carrier is not a radio resource.

⁹ The prosecution history does not limit the claim scope or shed light on the claim construction at issue. *See* PO Resp. 10–12 (summarizing prosecution history). Petitioner only filed a portion of the prosecution history, but the USPTO patent filing system shows that the issued claims are not original and that the original claim as filed (and later cancelled) does not recite the digital representation phrase at issue here. *See* Ex. 3005 (original claim 1 of the ’343 patent).

PO Resp. 13 n.1 (quoting *Dali Wireless, Inc. v. Cellco Partnership d/b/a Verizon Wireless*, No. 6:22-cv-00104-ADA (W.D. Tex. January 27, 2023)).

Patent Owner contends that “whether ‘digital representations of radio resources’ (or radio resources for that matter) encompasses information defining or describing the way data is transmitted by a remote radio unit has not been considered by the Board [in other proceedings].” PO Resp. 13. The Response does not clearly address whether the term “digital representations of radio resources” has a plain and ordinary meaning. Rather, the Response contends that Patent Owner’s “proposed construction is consistent with the intrinsic evidence.” *Id.* at 15.

The record supports Petitioner’s claim construction that the plain and ordinary meaning applies. As we noted in the Institution Decision, the ’343 patent specification describes “RF carriers, CDMA codes, or TDMA time slots” as examples of “radio resources.” Inst. Dec. 14. Patent Owner quoted these same examples as types of radio resources appearing in the ’343 patent. Prelim. Resp. 19 (quoting Ex. 1001, 12:6–7, 12:60–64, 12:67–13:2). Therefore, it follows the plain meaning of “a digital representation of radio resources,” in light of the ’343 patent specification, and the plain language of claim 1, is, or at least includes, a “digital representation” of “RF carriers, CDMA codes, or TDMA time slots.”

Turning to the plain meaning of “digital representation,” Petitioner explains that the “well-known process of digitization using analog-to-digital converters produces a set of digital samples that accurately describe an input signal.” Reply 10 (citing Ex. 1034 ¶¶ 8, 10) & n.3 (arguing that Patent Owner’s expert, Dr. Chrissan, agrees (citing Ex. 1038, 20:17–21:1 (testifying “an A-to-D converter . . . produces a digital output that represents

its output”)). Dr. Chrissan’s testimony supports Petitioner’s argument and shows further that the digitization of analog signals is a well-known concept that includes samples of the underlying analog signal (including the carrier) that represent that signal. *See* Ex. 1038, 20:17–21:1 (testifying that “an A-to-D converter that works correctly with a high enough sampling rate produces a digital output that represents its input” and therefore, “whatever characteristics the input has should still be represented in the digital values that are created, again, based on the input at the A-to-D”).

Petitioner’s explanation is the most natural reading of the claim phrase and comports with our original claim construction of what “radio resources” encompasses in this trial and numerous other similar constructions including at the PTAB and in district courts. *See* Inst. Dec. 9–12 (citing Ex. 1019, 9–12 (discussing the Board’s decision in IPR2020-01430); 13–14 n.8 (Ex. 2013 (Markman Order, Del.), 8; Ex. 2015 (Markman Transcript, Del.), 2–3)¹⁰ As Petitioner notes, two district courts determined that “radio resources” do not require “configuration information.” Reply 5 (citing Ex. 1032, 8–11; Ex.1033, 3). As Petitioner also argues, one district court recently determined that “radio resources is fundamentally different from configuration information.” *See* Ex. 1032, 9; Reply 5 (citing Ex. 1032, 9–11).

¹⁰ Although two district courts included “other information” in their claim construction, the courts did not limit the term to this “other information.” *See* Ex. 2013, 8 (construing “radio resources” as “RF carriers, CDMA codes, TDMA time slots, and other information used by the remote radio units to apportion RF signals in order to transmit underlying data to and from an antenna of a remote radio unit, but do not include the underlying data that is transmitted”); Ex. 2015, 3 (same).

Patent Owner argues that its “proposed construction is consistent with the intrinsic evidence,” because the ’343 patent specification states that a “‘key function’ in the invention in the invention is determining or setting the appropriate amount of radio resources by setting individual parameters at the DRU which control the use of specific radio resources.” PO Resp. 15 (citing Ex. 1001, 12:5–14, 12:29–39, 12:58–13:2). But even if Patent Owner’s construction is consistent with the ’343 patent specification, this does not limit the plain meaning of the term, because as Petitioner argues, there is no clear disavowal of the plain meaning of the disputed term in the ’343 patent specification. *See* Reply 3.

Moreover, as we preliminarily determined in the Institution Decision, the ’343 patent’s description of a “key function” of a DAU supports our preliminary claim construction of radio resources, because the specification states that a “key function is determining and/or setting the appropriate amount of *radio resources (such as RF carriers, CDMA codes or TOMA time slots)* assigned to a particular DRU or group of DRUs to meet desired capacity and throughput objectives.” Inst. Dec. 11 (emphasis added) (quoting Ex. 1001, 12:5–10). By providing digital representations of radio resources, Petitioner’s claim construction allows for “determining and/or setting the appropriate amount of *radio resources (such as RF carriers, CDMA codes or TOMA time slots)* assigned to a particular DRU or group of DRUs to meet desired capacity and throughput objectives.” *See* Ex. 1001, 12:5–10.

Patent Owner contends that “the ’343 patent specification explains that the DAU configures the software settings within the DRU by remotely turning on or off individual carriers via gain control parameters, enabling or

disabling carriers or time slots at the antenna port of the DRU.” PO Resp. 15 (citing Ex. 1001, 6:33–47, 7:46–52). Patent Owner also argues that “[t]he specification further describes this concept in its discussion of deploying radio resources as part of a ‘control channel via a control protocol’ between the DAU and the DRU.” *Id.* (citing Ex. 1001, 12:15–37). Patent Owner also argues that “[t]he specification . . . describes how the DAU configures and reconfigures the DRU with respect to its usage of radio resources.” *Id.* at 16 (citing Ex. 1001, 12:58–13:2).

These disclosures fail to arise to the level of a clear disavowal of the plain meaning of a digital representation of radio resources. In addition, contrary to the citations by Patent Owner, the specification does not describe control information as a radio resource. Rather, the relied-upon specification distinguishes the “control channel via a control protocol” and “control information,” from that which it controls, namely “specific radio resources” that the control information “enable[s] or disable[s].” *See* PO Resp. 15–16 (quoting Ex. 1001, 12:15–37). In other words, the DAU Management Control module, which Patent Owner relies upon, “modifi[es] the system configuration to begin to deploy . . . additional radio resources.” *See id.* at 16–17 (quoting Ex. 1001, 12:58–13:2). And the challenged claims do not recite a control channel, a control protocol, control information, or reconfiguring of a DRU. Also, in line with our reasoning here, according to Patent Owner, a district court rejected Patent Owner’s claim construction of radio resources, stating that “*power settings, gain settings, resource block information, and RF carrier information (e.g., which carriers to use, the center frequency, the number of resource blocks, etc.) are not ‘radio resources.’*” PO Resp. 14 n.1 (citing *Dali Wireless, Inc. v. AT&T Corp.*, No.

2:22-cv-00012-RWS-RSP, ECF No. 145 (E.D. Tex. May 18, 2023)) (emphasis added); *accord* Ex. 1032, 10 (determining that “power settings, gain settings, resource block information, and RF carrier information (e.g., which carriers to use, the center frequency, the number of resource blocks, etc.) are not ‘radio resources’”).

Patent Owner also argues that “the digital representation of a radio resource *is not merely* the digitized form of a radio resource, but rather includes information defining or describing how radio resources are to be used in over the air transmission as well as information identifying radio resources.” PO Resp. 16 (emphasis added); *see also* Ex. 2016 ¶ 42 (same). Here, Patent Owner and Dr. Chrissan appear to concede that “the digital representation of a radio resource” *at least includes* “the digitized form of a radio resource.” *See* PO Resp.16; Ex. 2016 ¶ 42. In addition, Patent Owner’s argument that “the digital representation of a radio resource . . . includes information defining or describing how radio resources are to be used . . . as well as information identifying radio resources” implies that a “radio resource” is the same as “information defining how radio resources are to be used” and “information identifying radio resources.” *See id.* For the reasons outlined above, the specification does not support this strained reading of the term “radio resources” as including the specific “information” about “how [they] are to be used.” Rather, the specification provides clear examples of what “radio resources” encompass, including with respect to a “key function,” specifically describing “radio resources (such as RF carriers, CDMA codes or TOMA time slots).” Ex. 1001, 12:5–10.

d. Digital Information

As noted above, Patent Owner argues that

the proper construction of the claim term ‘digital representation of radio resources’ as understood by a [person of ordinary skill in the art] in light of the ’343 patent specification includes digital information defining or describing the radio resources to be used for transmitting data over the air via the antenna of a remote radio unit.

PO Resp. 13; Sur-reply 3.

Patent Owner also argues that Petitioner’s construction is faulty because “Petitioner contends that the digitized form of a TDMA time slot is a digitized signal during the specified time slot.” Sur-reply 5 (citing Reply 7). Patent Owner argues that “the digitized form of *the data or payload* signal” is “not the radio resource TDMA slot.” *Id.* (emphasis added). Patent Owner presents a similar argument with respect to CDMA codes, as discussed below. *Id.* at 5–6.

These arguments are unavailing. Patent Owner attempts to equate the underlying “data or payload signal” in the time slot with “a digitized signal during the specified time slot.” *See* Sur-reply 5. As Patent Owner indicates, however, Petitioner argues that “applying an analog to digital converter to a signal *during a specified timeslot* is an example of creating a digital representation of that timeslot radio resource.” Reply 7 (citing Ex. 1034 ¶ 9) (emphasis added). In other words, Petitioner persuasively argues that according to the specification, a digital representation of the signal *during a specified timeslot* is a radio resource. *See id.* (citing Ex. 1034 ¶ 9).

As Dr. Houh persuasively explains, “[u]sing more carriers, more time slots, or more CDMA codes allows the base station to modulate more information into signals for wireless transmission.” Ex. 1034 ¶ 9 (testifying that “[a] person of ordinary skill] would easily recognize that applying an analog to digital converter to such a signal during a specified timeslot is an

example of creating a digital representation of that timeslot radio resource” and “disagree[ing] with the statement by Patent Owner” (citing PO Resp. 17; Ex. 2016 ¶ 42)).

Patent Owner’s declarant, Dr. Chrissan, testifies that “as explained above in the patent specification, radio resources can include CDMA codes or TDMA time slots, in which case the digital representations of such radio resources include information identifying such codes (e.g. as specific pseudorandom binary sequences) or time slots (e.g. as specific slot indices).” Ex. 2016 ¶ 42. But Dr. Chrissan does not testify that a digital representation of specified TDMA time slots only represents “payload” data of that time slot, which Patent Owner argues is the result of Petitioner’s claim construction, as indicated above. *See* PO Resp. 17 (citing Ex. 2016 ¶ 42). Therefore, Dr. Chrissan does not support Patent Owner’s payload-based argument that Petitioner’s claim construction is faulty. Moreover, Dr. Chrissan does not provide any supporting evidence showing that the specification describes the information upon which he relies, namely information “identifying such codes (e.g. as specific pseudorandom binary sequences) or time slots (e.g. as specific slot indices).” *See* Ex. 2016 ¶ 42; *see also id.* ¶¶ 39–43.

Patent Owner’s argument that focuses on characterizing the sampled signal as merely the data or payload does not undermine Petitioner’s claim construction, because Petitioner relies on digitizing particular TDMA time slots as a digitization of a radio resource, not simply the data therein. *See* Sur-reply 5. In addition, even if an anomaly exists as to a TDMA (or CDMA) as a digitized radio resource, this does not show that the ’343 patent specification disavows the plain meaning of the “digital representation of

radio resources,” especially where the specification does not use that term and the patent clearly lists “TDMA time slots” and “CDMA codes” as examples of a radio resource. Ex. 1001, 12:7–8. Moreover, as indicated above, claim 1 is not an original claim, and the prosecution history does not shed light on whether it covers all three disclosed examples of radio resources (RF carriers, TDMA time slots, CDMA codes). *Supra* note 9; PO Resp. 9–11; Ex. 1013; Ex. 1001, 12:5–10. In any event, notwithstanding Patent Owner’s arguments, Petitioner’s claim construction includes all three examples.

Further regarding CDMA codes, Patent Owner argues that the “are already in digital format and there is no need to digitize them.” Sur-reply 5. Therefore, Patent Owner argues that this shows that “Petitioner’s interpretation is incorrect.” *Id.* Contrary to this argument, even if claim 1 captures an inherent feature of disclosed examples of radio resources (e.g., CDMA codes that are in digital form already) under Petitioner’s claim construction, this does not show that the plain meaning of the claim phrase under that construction does not imply. Stated differently, the challenged claims do not specifically recite CDMA codes (or TDMA time slots). Therefore, the claim phrase at issue, “the [DAU] is configured to send a digital representation of . . . radio resources,” simply captures within its breadth sending digitized radio resources, including the examples of radio resources listed in the specification, namely digitized TDMA time slots, CDMA codes, and RF (analog) carriers.

In other words, claim 1 does not read on a DAU configured to send merely an analog carrier or other analog signal as a radio resource. As an example showing the contrast, in the 1212-IPR, claim 1 of Patent Owner’s

challenged patent there recites “configuring each remote radio unit to receive or transmit a . . . plurality of carriers.” 1212-IPR, Ex. 1001, 13:13–16.¹¹ This claim comparison demonstrates the difference between receiving or transmitting a carrier in its analog form, which is a radio resource, and sending a digital representation of a radio resource. The comparison also demonstrates that the inventors attempted to capture different claim scopes, namely the digital representation of radio resources, which include, as examples, digital representations of carriers, TDMA codes, and CDMA codes, versus carriers, which include analog carriers.

Similar to its configuration arguments here, in a recent district court hearing, Patent Owner argued that “‘CDMA codes’ and ‘TDMA time slots’ are configuration information, and therefore this construction [of radio resources] is ‘asymmetrical’ by including these within the scope of ‘radio resources’ but excluding other configuration information from that scope.” See Ex. 1032, 10 n.6. The court dismissed this argument, reasoning that CDMA codes and TDMA “are not ‘configuration information,’ because “each of ‘RF carriers, CDMA codes, and TDMA time slots’ is a way of *subdividing capacity*—either by frequency, codes, or time—and there *is a finite number of each* available for use by a system.” *Id.* (emphasis added). This finding dovetails with the testimony of Dr. Houh and Petitioner’s construction, because it shows that a finite number of codes, time slots, and carriers, are simply types of radio resources.

¹¹ The two patents share some of the same inventors and overlap in relevant disclosure regarding radio resources, but the specifications are not exactly the same. See 1212-IPR, Ex. 1001, 11:57–57 (describing “certain radio resources (such as RF carriers, CDMA codes or TDMA time slots”).

In *Hytera Commc'ns Co. v. Motorola Sols., Inc.*, 841 F. App'x 210, 212–213 (Fed. Cir. 2021), the court explains that, in TDMA, a “frequency band is divided into a series of recurring periods of time” so that different radios can use the same frequency band. *Id.* at 213.¹² The TDMA radio resource in *Hytera* is similar to the TDMA resource in the '343 patent.

Hytera describes TDMA systems and timeslots as follows:

TDMA refers to a method of dividing a frequency band in a communications system into multiple channels. In a TDMA system, a frequency band is divided into a series of recurring periods of time, which are called “frames.” The frames are further divided into multiple time intervals, which are called “timeslots.” *Each timeslot reflects a brief period of time during which a radio can transmit or receive communications.*

Before a radio can receive or transmit data on a TDMA channel, it must ensure that it is synchronized with a timeslot in the frame. As described in the prior art, to achieve synchronization, a radio tunes to a frequency, takes a sample of a transmitted signal, processes information from the signal, and compares it to known information in order to identify a timeslot. Prior to the '991 patent, a number of synchronization methods were known in the art. For example, the ETSI-DMR standard¹ provides that the signal information is a “TDMA Channel (TC) bit” that is transmitted between timeslots and “informs the receiving device whether the next timeslot to be received is timeslot 1 or timeslot 2.” '991 patent col. 1 ll. 41–44. As another example, the ANSI/TIA 136 standard utilizes synchronization patterns embedded in the signal during each timeslot to indicate the timeslot number. *See, e.g.,* J.A. 1642 col. 1l. 31–col. 2. l. 9.

¹² The unrelated '991 patent under challenge in *Hytera* was filed on Dec. 9, 2008, published on Oct. 2, 2012, and relies on a provisional filing date of Oct. 3, 2008, with “Prior Pub. Data US 2010/0086092 AI Apr. 8, 2010.” *See* IPR IPR2017-02183, Ex. 1001. This is prior to the agreed-upon priority date of the '343 patent. *See supra* note 5 (priority date of February 7, 2011).

Hytera, 841 F. App'x at 212–213 (emphasis added).¹³

Hytera's description that “[e]ach timeslot reflects a brief period of time during which a radio can transmit or receive communications,” 841 F. App'x at 212 (emphasis added), further supports Petitioner's view that a digital representation of a signal during a specified timeslot is a digital representation of a radio resource (a TDMA time slot for a frequency band) according to the plain and ordinary meaning and known standards at the time of filing of the '343 patent.

g. Related PTAB Proceedings and Federal Circuit Decision

A related proceeding involving a challenged patent with relevant overlapping disclosure with the '343 patent, the 571-IPR, involved a similar limitation, “wherein the host unit is capable of sending a digital representation of any downlink signal it receives to any of the plurality of remote units.” Ex. 1006, 6 (involving challenges to U.S. Patent No. 9,531,473 B2, the “'473 patent”). In the 571-IPR, the Board noted that “Patent Owner argues that the broadest reasonable interpretation of the term ‘downlink signal’ is ‘radio resource,’ and that “radio resources may be, for example, ‘RF carriers, CDMA codes, or TDMA time slots.’” *Id.* at 14 (quoting 571-IPR, Paper 32 (Patent Owner Response), 6–7).¹⁴

¹³ As quoted above, according to well-known standards, when a system employs TDMA, a “‘TDMA Channel (TC) bit’ . . . is transmitted between timeslots and ‘informs the receiving device whether the next timeslot to be received is timeslot 1 or timeslot 2.’” *Id.* (emphasis added). It is not clear if Patent Owner relies on this type of standards information as a digital representation of a radio resource.

¹⁴ At the time of 571-IPR (i.e., petition filed prior to Nov. 13, 2018), the broadest reasonable claim construction standard applied. *See* Ex. 1006, 2, 8–9. Neither party argues that the different claim construction standard in

As noted above (Section I.B), Patent Owner appealed the Board’s final written decision in that case to the Federal Circuit and did not prevail. *See* Ex. 1039 (*CommScope*). In determining whether Wu discloses or renders obvious a “host unit . . . capable of sending a *digital representation of a specific downlink signal* it receives to a specific one of the plurality of remote units,” the Federal Circuit in *CommScope* read the claim phrase onto Wu, agreeing with the Board that “Wu’s matrix switch allows *individual carrier channels* to be routed, via host units, to specific connected remote units.” Ex. 1039, 3–4, 8 (finding that “*Wu’s* host unit 230 and matrix switch already function together as part of the base station, 240, *to route channels to remote units*” (emphasis added)). In other words, our reviewing court in *CommScope* upheld the Board’s finding that Wu discloses or renders obvious a “host unit . . . capable of sending a digital representation of a specific downlink signal it receives to a specific one of the plurality of remote units,” where Wu’s host unit and matrix switch route *carrier channels*. *See id.* at 4, 8–10. *CommScope* shows that a digital representation of a downlink signal includes a digital representation of a carrier channel, in line with our claim construction.

In another Board case, the 1430-IPR, the challenged patent shares a common specification with the ’343 patent, and claim 1 there similarly recites “wherein the baseband unit is configured to send a digital

the 571-IPR is material to an issue here, including the collateral estoppel issue discussed below. In the 571-IPR, addressing the meaning of “downlink signal,” the Board stated that “Patent Owner notes that the ’473 patent describes the receipt of groups of radio resources in composite signals,” indicating that downlink signals as claimed there include radio resources even under a district court claim construction standard. *See* Ex. 1006, 14.

representation of a first/second set of radio resources to the first remote unit at a first/second point in time.” *See* 1430-IPR, Paper 10 (the “1430 Prelim. Resp.”), 8. Patent Owner argues that “[t]he terms ‘digital representation of a [first/second] set of radio resources’ claimed in the ’343 patent are materially different from the term ‘downlink channel signals’ claimed in [another] patent,” U.S. Patent No. 10,080,178 B2 (the “’178 patent,” (Ex. 1002)), and by extension, the “digital representation of any downlink signal” recited in the ’473 patent claims addressed in the Federal Circuit’s *CommScope* decision. *See* PO Resp. 22 (citing Ex. 2016 ¶¶ 45–47); Ex. 1002 (the ’178 patent); Ex. 1039, 3 (*CommScope* decision addressing the ’473 patent and the claim phrase “sending a digital representation of any downlink signal”).

For this comparison, Patent Owner turns to another Board decision, a denial of institution in the 1430 IPR, involving the ’499 patent. *See* Ex. 1019. According to Patent Owner, “[t]he Board in [the 1430 IPR] found that downlink channel signals and radio resources are mutually exclusive, i.e., radio resources do not include ‘downlink channel signals.’” *Id.* at 22–23 (citing Ex. 1019, 10–12, 17–19). This is a mischaracterization of the Board’s holding in IPR2020-01430. *See* Ex. 1019, 18–19 (holding that “Oh discloses only underlying data that arrived in the radio resource as included in the ‘incoming communication traffic’” and determining on that basis “that Petitioner has not demonstrated a reasonable likelihood of success that it would prevail”).

Moreover, in that case, Patent Owner argued that “[t]he proper construction of ‘radio resources’ to a [person of ordinary skill in the art] is ‘wireless resources such as RF carriers, CDMA codes, or TDMA time

slots.” 1430 Prelim. Resp. 16–17 (citing 1430-IPR, Ex. 1001 (challenged patent), 12:5–9). Contrary to its arguments here, Patent Owner did not argue that the term “digital representation” dictated a different construction for the term “radio resources.” *See id.* at 16–18. As indicated above, the Board credited Patent Owner’s representations and denied institution in that case. *See* Ex. 1019, 11 (“[W]e agree with Patent Owner that the ’499 patent’s exemplary explanation that radio resources may be “RF carriers, CDMA codes or TDMA time slots” appears more useful in determining how to construe ‘radio resources.’”).

Patent Owner directs attention to other *inter partes* reviews. *See* PO Resp. 25–26 & n. 2 (citing Ex. 2006).¹⁵ Contrary to Patent Owner’s arguments, these other proceedings do not squarely address or shed light on claim construction issues here. *See id.*

¹⁵ For example, Patent Owner also asserts that “[t]o the extent that Petitioner equates ‘radio resources’ to ‘carriers,’ the Board has also already considered the same Wu reference asserted in this IPR with respect to another one of Patent Owner’s patents, U.S. 9,820,171 B2, which included the ‘carriers’ claim limitation.” PO Resp. 26 n.2 (citing Ex. 2006 (IPR2020-01432, Paper 16 (PTAB Feb. 9, 2021) (denying institution)). Patent Owner argues that “[t]here, the Board also did not find a reasonable likelihood of success in the assertion of the Wu reference for patentability challenges to the ’171 patent.” *Id.* at 26 (citing Ex. 2006). These observations do not shed any light on an issue here. In that case, the Board found that another reference, Oh, does not disclose the reconfiguring limitation. *See* Ex. 2006, 11 (construing “‘reconfiguring at least one of the plurality of radio units” (claim 1) to be ‘changing the configuration of at least one of the plurality of radio units’”), 16 (“agree[ing] with Patent Owner that Petitioner does not establish Oh discloses the ‘reconfiguring each remote radio unit’ limitation”), 22 (denying institution).

h. Summary

The record supports Petitioner’s claim construction that “digital representation of a radio resource” is “the digitized form of a radio resource.” The record does not support limiting the claim construction of “digital representation of a radio resource” to require “sending digital information defining or describing a set of radio resources to be used for transmitting data over the air via the antenna of a remote radio unit,” as Patent Owner urges. In any event, even if the record supports this claim construction, Petitioner shows that Wu satisfies both claim constructions as determined below.

2. Other Terms

At this stage, no need exists to construe any other claim terms expressly to resolve the parties’ disputes. *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))).

C. Principles of Law

A patent claim is unpatentable under 35 U.S.C. § 103 “if the differences between the subject matter sought to be patented 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 said subject matter pertains.” 35 U.S.C. § 103 (2011); *accord KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007) (quoting similar language in pre-AIA version of 35 U.S.C. § 103). The question of obviousness involves resolving the basis of underlying factual determinations including

(1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and when in evidence (none on this preliminary record), (4) when in evidence, objective indicia of nonobviousness. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

D. Analysis of the Ground Based on Wu

Petitioner asserts that claims 1–3, 5–10, 12–14, and 16–21 would have been obvious under 35 U.S.C. § 103 based on Wu. Pet. 21–66. Patent Owner disagrees. PO Resp. 26–38.

1. Wu (Ex. 1007)

Wu, titled “Carrier Channel Distribution System,” describes a system that communicates signals between base transceiver stations (BTSs) and remote transceiver units (RTUs), providing fine-grained control for this communication, splitting carrier channels, and routing only some channels to RTUs according to a routing policy. Ex. 1007, codes (54), (57), ¶¶ 9, 11, 38–44. A BTS receives signals within a plurality of frequency bands, each of which may comprise multiple channels. *Id.* ¶¶ 11, 35, 37, 38. Figure 2 of Wu, reproduced below, is a block diagram of a BTS:

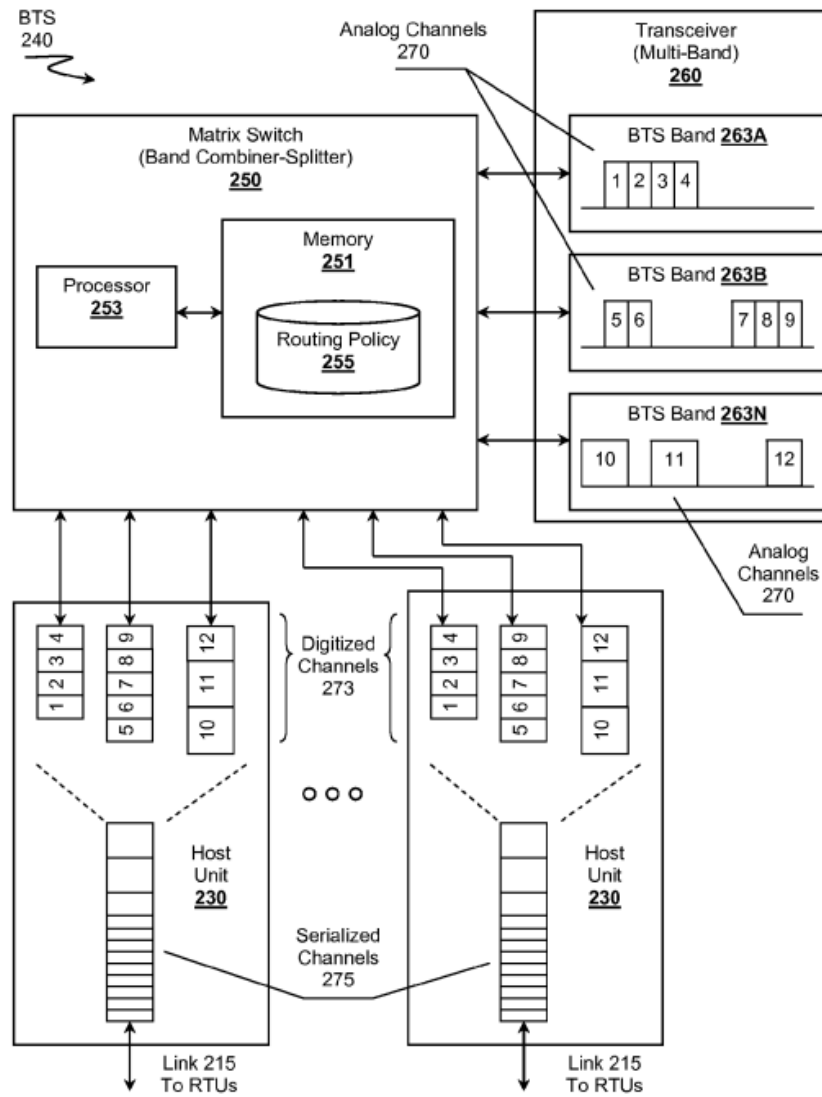


Figure 2

Figure 2 shows base transceiver station (BTS) 240 including multi-band transceiver 260, matrix switch 250, and host units 230. Ex. 1007 ¶¶ 15, 34–36. Transceiver 260 receives signals on BTS bands 263A through 263N, and each may include multiple channels 270, e.g., channels 270 labelled 5 through 9 in BTS band 263B. *Id.* ¶¶ 35, 37. Transceiver 260 forwards the received channels 270 to matrix switch 250 that routes them according to routing policy 255 to host unit 230, which further distributes

them to RTUs over links 215. *Id.* ¶ 38. The system is bi-directional: Host units transmit and receive serialized digitized channels with encapsulated data over optic fiber links to and from RTUs. *Id.* ¶¶ 36, 49, 54, 56, Figs 5–1, 5–2. The RTUs convert the digitized signals into analog for wireless transmission from boosters to wireless devices. *Id.* ¶¶ 3, 4, 36, 54, Fig. 3. Wu also discloses that some signals may be received at an RTU with another RTU acting as intermediary. *Id.* at Figs. 1, 4, ¶¶ 33, 51.

RTUs and hosts include FPGAs (field programmable gate arrays). Ex. 1007 ¶¶ 54–56, Figs. 5–7. “An FPGA can also be used to frame, combine, divide, synchronize, or otherwise manage the carrier channels.” *Id.* ¶ 55. In one embodiment, “[a]n RTU having similar structure of the host unit of FIG. 6 . . . mirrors a host unit's functionality,” wherein the “system can be bi-directional in nature.” *Id.* ¶ 56.

The system reconfigures policy 255 in order to change the routing of channels to the various RTUs. Ex. 1007 ¶¶ 48, 49. The system routes, allocates, or distributes channels based on anticipated requirements of areas at a certain time of day or based on current traffic loads. *Id.* ¶¶ 43, 44. Transmissions between host units and RTUs preferably occur according to the CPRI Standard. *Id.* ¶¶ 31, 49.

2. Claims 1 and 12

Petitioner asserts that Wu would have rendered independent claims 1 and 12 obvious. Pet. 21. As indicated above, method claim 12 is materially similar to system claim 1.

As background relevant to Petitioner's showing for claim 1, Wu's Figure 1 follows:

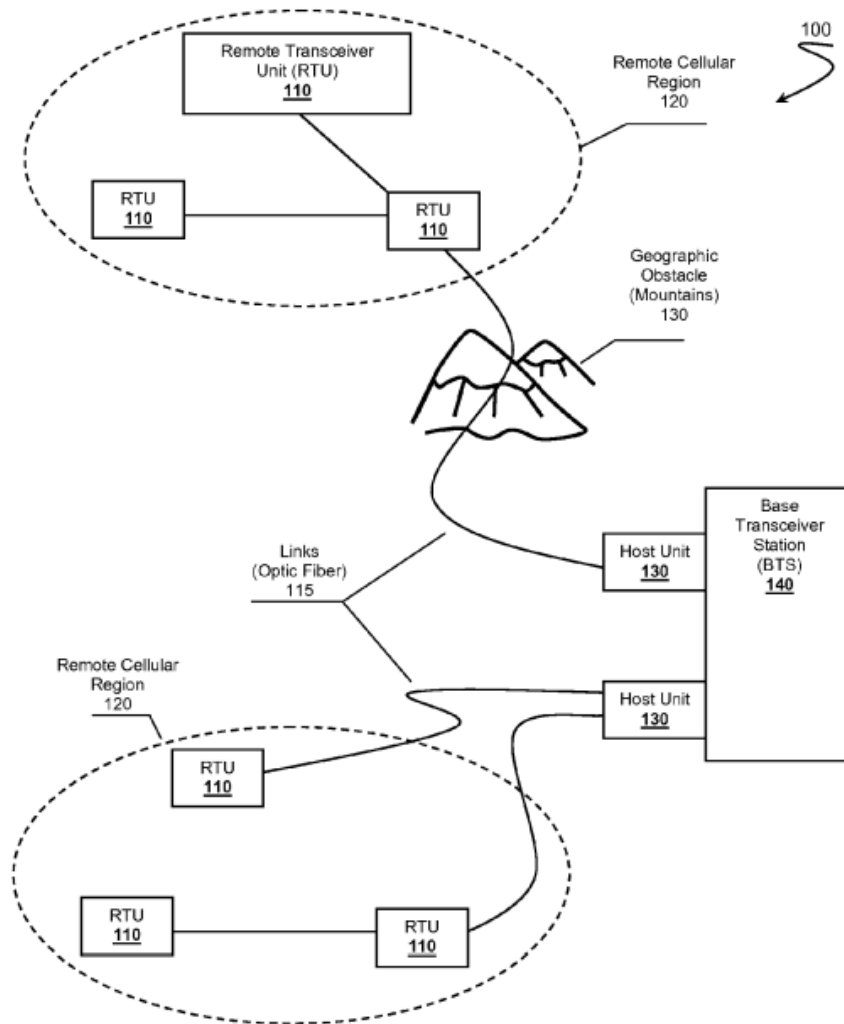


Figure 1

As discussed further below, Petitioner generally reads the claimed “signal sources” onto different transceivers 260 in Wu’s BTSs, the claimed “DAU” on Wu’s matrix switch 250 and host units 230 in Wu’s BTSs, and the claimed remote units on Wu’s RTUs. *See* Pet. 27–28.

a. Preamble

Claim 1’s preamble recites “[a] system to transport wireless communications, comprising.” Petitioner contends that Wu discloses the

preamble. Pet. 27. Petitioner relies on Wu’s “wireless carrier channel technologies” including “apparatus, systems and methods in which a carrier channel distribution system can route individual carrier channels to Remote Transceiver Units (RTUs).” *Id.* (quoting Ex. 1007 ¶¶ 2, 11; citing Ex. 1012 ¶ 54).

Petitioner’s showing for the preamble is persuasive. Patent Owner does not address Petitioner’s showing as to this limitation. *See generally* PO Resp.

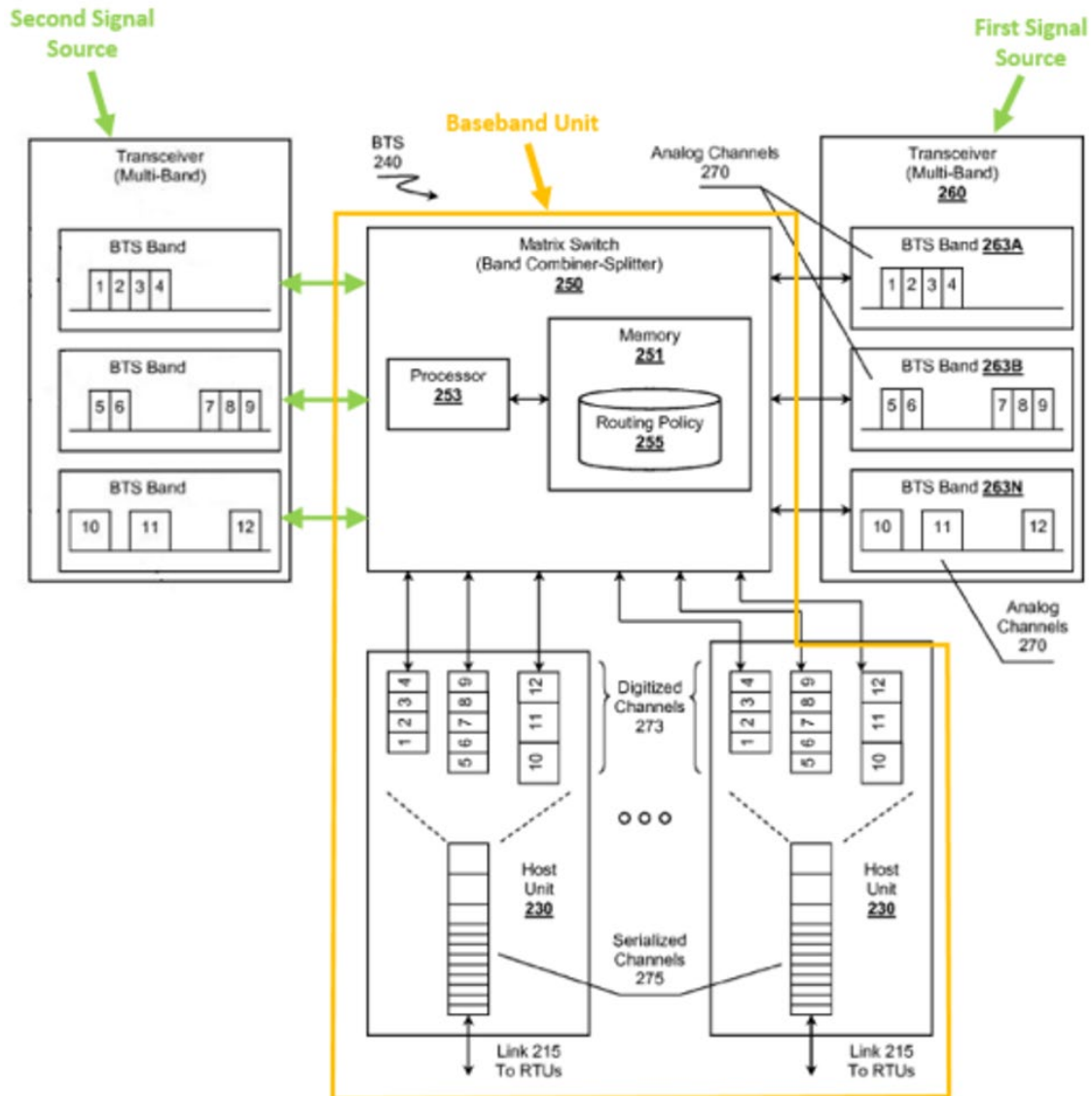
b. Limitation 1.a

Limitation 1.a recites “a digital access unit” (DAU).

Petitioner’s Showing

Petitioner contends that “Wu discloses a digital access unit in the form of a matrix switch 250 and host units 230.” Pet. 28.

Wu's Figure 10, as annotated by Petitioner, follows (Pet. 28):



Wu's Figure 2 as annotated by Petitioner shows BTS 240, which includes transceivers 260 as the claimed "first signal source" and "second signal source" (green lettering) of limitation 1.b (addressed below), and matrix switch 250 and host units 230 (inside yellow box) as the claimed "digital access unit" or DAU of limitation 1.a.¹⁶ Pet. 28 (citing Ex. 1007

¹⁶ As explained further below, addressing limitation 1.b, Petitioner adds another signal source on the left-hand side of Wu's matrix switch 250 in

¶ 15); *see also id.* at 25–26 (citing Ex. 1007 ¶¶ 15, 31, 34–38. 49; Ex. 1012 ¶51). In other words, Petitioner reads the claimed DAU onto the combination of matrix switch 250 and host units 230. *Id.* at 28–29 (citing Ex. 1007 ¶¶ 15, 35–38, Fig. 2; Ex. 1012 ¶ 57).

To further support its showing, the Petition notes that in the 571-IPR (Ex. 1006), the Board found that “Wu discloses the claimed host unit [digital access unit] as a combination of the matrix switch and host units,” and that “it would have been obvious to place the functionality of both Wu’s matrix switch and host units in a single unit.” Pet. 29 (quoting Ex. 1006, 21, 22); *see also id.* at 22 (asserting the claims involved in the 571-IPR are “substantially similar” to the claims at issue here and “found unpatentable by the Board over Wu”). Subsequently, as noted above (§ II.B.1.g), the Federal Circuit affirmed the Board’s final written decision in the 571-IPR in *CommScope* finding, *inter alia*, that “Wu’s host unit 230 and matrix switch already function together as part of the base station, 240, to route channels to remote units.” Ex. 1039, 8 (emphasis omitted).

Patent Owner’s Arguments

Referring to annotated Figure 2, Patent Owner argues that Petitioner “draws an arbitrary box around Wu’s Matrix Switch 250 and multiple Host Units 230s as meeting the claimed [DAU].”¹⁷ PO Resp. 35 (citing Pet. 27–

Figure 2, which corresponds to Wu’s teaching of multiple signal sources (transceivers 260). Pet. 30 (citing Ex. 1007 ¶ 34). Consequently, annotated Figure 2 above shows two signal sources interfacing matrix switch 250 (a component of the claimed DAU according to Petitioner). *See id.* at 31–32.

¹⁷ Patent Owner actually argues that “Petitioner draws an arbitrary box around Wu’s Matrix Switch 250 and multiple Host Units 230s as meeting the *claimed central baseband unit*.” PO Resp. 35 (emphasis added). Claim 1 does not recite a “central baseband unit.”

28). Patent Owner explains that “in the ’343 patent, the signal source (e.g., base station) is separate from the baseband unit (e.g., Digital Access Unit or DAU).” *Id.* at 38 (citing Ex. 1001, 4:43–45 (“The DAU 105 serves as an interface between associated base stations (BTS) 110A-B and a plurality of digital remote units (DRU) 125A-n, although only four DRU's are shown in FIG. 1.”)); *see also* Ex. 1001, Fig. 1 (illustrating base stations 110 and DAU 105). Patent Owner contends that “Petitioner’s rearrangement of Wu’s components makes the transceiver 260 the ‘signal source,’ and then makes the Matrix Switch 250, **which is already inside the base station 240**, part of the Host Unit 230’s functionality.” PO Resp. 38 (citing Pet. 27–28) (emphasis omitted). Patent Owner summarizes that “[i]nterpreting Wu in this way requires *rearranging* the components in a way that is contrary to the ’343 patent’s claimed architecture where the base station is separate from the baseband unit.” *Id.* (emphasis added).

Analysis Including Consideration of Other Arguments

Patent Owner’s arguments are unavailing. As Petitioner argues, Petitioner does not “rearrange” any components in Wu. Reply 26–27. Contrary to Patent Owner’s arguments, the ’343 patent does not *require* that “the signal source (e.g., base station) is separate from the baseband unit (e.g., Digital Access Unit or DAU).” *See* PO Resp. 38; Reply 27 (noting that “[t]he claims do not say the DAU must be “separate” from the signal source”). Even if the claims somehow require this separation, Petitioner relies on separate components or modules in Wu as detailed above. *See also* Reply 27 (persuasively arguing “Wu teaches that its transceiver 260 (the signal source) can be ‘remotely coupled’ to the BTS 240 containing the

matrix switch and host units, which is an example where the signal source is separate from the DAU (citing Ex. 1007 ¶ 34; Ex. 1038, 84:17–85:3)).

Petitioner also notes that the '343 patent describes a DAU as “an interface between associated base stations (BTS) 110A-B and a plurality of digital remote units (DRU) 125A-n.” Reply 24 (quoting Ex. 1001, 4:42–46). Petitioner explains that similarly, “Wu’s DAU ([host] units 230 in combination with the matrix switch [250]) are the interface between Wu’s RTUs and the transceivers of the base stations.” *Id.* (citing Ex. 1007, Fig. 2, ¶¶ 38, 54; Ex. 1038, 81:18–82:5). Wu supports Petitioner, because Wu’s Figure 2 shows matrix switch 250 and host unit 230 connected between base station transceiver 260 and a “[l]ink 215 to RTUs.” Ex. 1007, Fig. 2; Pet. 25 (annotating Ex. 1007, Fig. 2), 28 (similar annotation as reproduced above). In addition, Wu states that “each BTS 240 . . . could be remotely coupled to transceiver 260.” Ex. 1007 ¶ 34.

Patent Owner also argues that Wu’s “Host Unit is only capable of sending carrier channel signals provided by the matrix switch to all remote units connected to it. Wu does not provide any selectivity to target specific RTUs or which radio resources get assigned to which specific RTU connected to each Host Unit.” PO Resp. 38.

Patent Owner asserts that Wu does not disclose the claimed DAU because

the system architecture of Wu is not capable of targeting or selecting specific RTUs because as shown in Wu’s Figure 1, there are multiple RTUs connected to each Host Unit such that the Host Unit sends *all* the signals it receives to all RTUs connected to it as there is no selective switch equipped in the Host Unit.

Id. at 36 (emphasis omitted).

Patent Owner's arguments that focus on the host unit in isolation fail because as explained above and further below, Petitioner persuasively relies on the combination of Wu's matrix switch and host unit to satisfy any targeting required by claim 1, and alternatively, collateral estoppel prevents Patent Owner from raising this argument. Moreover, the claimed DAU does not require it to be "capable of targeting or selecting specific RTUs." *See* PO Resp. 38. Patent Owner does not specify a claim limitation that requires this targeting. As Petitioner argues, "the plain language 'digital access unit' says nothing about targeting/selecting specific RTUs." Reply 24. Claim 1 supports Petitioner.

Assuming for the sake of argument that Patent Owner implicitly invokes limitations 1.f and 1.g (discussed below more fully), these limitations require that the "digital access unit is configured to send . . . [first/second] radio resources to a first remote unit" at different points in time. However, no limitation in claim 1 requires sending any remote radio resources to another remote unit. Also, no limitation precludes sending the same resources to other remote radio resources, including the second remote radio unit as recited in limitation 1.c. Therefore, claim 1's DAU does not require the targeting of resources that Patent Owner argues.

Even if it did, Petitioner shows that Wu "does teach the capability to target specific RTUs." Reply 25. Petitioner relies on Wu, as "giv[ing] an express example of targeting specific RTUs such as a 'first RTU' or 'second RTU.'" *Id.* (quoting Ex. 1007 ¶ 47 (routing "first carrier channel to a first RTU . . . a second carrier channel . . . to a second RTU")). Petitioner also explains that Wu describes "targeting specific 'remote regions' such as a 'victim,' 'residential,' or 'first' region." *Id.* (quoting Ex. 1007 ¶¶ 43, 46).

As Petitioner explains, “[t]he RTUs in each of these remote regions are specific remote units.” *Id.* Therefore, Petitioner persuasively shows that Wu’s matrix switch 250 is “configurable to route the digitized channels 273 [*digital representation of radio resources*] ‘individually, collectively . . . , or in arbitrary groups’ (*a first set*) to a first RTU [*first remote unit*].” Pet. 33 (quoting Ex. 1007 ¶ 49 (alteration in original); citing Ex. 1004, 28; Ex. 1012 ¶ 64)).

Collateral Estoppel

As indicated above, Petitioner also raises collateral estoppel, asserting that the Board already found that Wu discloses or teaches materially the same DAU limitation as claimed here based on the final written decision in the 571-IPR. *See* Reply 25 (citing Ex. 1006 (Paper 53, final written decision in the 571-IPR)); *see also* Pet. 22, 28–29.

Our reviewing court sanctions common law collateral estoppel as it applies to prior *inter partes* review judgments. *See, e.g., MaxLinear Inc. v. CF CRESPE LLC*, 880 F.3d 1373, 1377 (Fed. Cir. 2018) (remanding to the Board to consider applying collateral estoppel based on prior IPR judgments even though the judgments involved *different* prior art and dependent claims *not considered in the prior judgments*, holding that “the sole remaining question at issue is whether the dependent claims 4, 6–9, and 21, *not addressed in the earlier IPRs*, are unpatentable”) (emphasis added)). *VirnetX Inc. v. Apple, Inc.*, 909 F.3d 1375, 1378 (Fed. Cir. 2018) (“Apple is correct that VirnetX is collaterally estopped by our Rule 36 judgment in *VirnetX I* from relitigating the question of whether RFC 2401 was a printed publication.”); *M2M Solutions LLC v. Amazon.com, Inc.*, Nos. 2022-1122, 2022-1124, slip op. at 8–9 (Fed. Cir. Feb. 22, 2023) (holding that

collateral estoppel applies because “this same issue was actually litigated in the ’1892 IPR and agree[ing] with the Board that M2M is collaterally estopped from arguing that Kloba failed to disclose ‘consumer usage information’ as required by claims 1 and 20 of the ’477 patent”) (citing *Ohio Willow Wood Co. v. Alps South, LLC*, 735 F.3d 1333, 1342 (Fed. Cir. 2013) (“Our precedent does not limit collateral estoppel to patent claims that are identical.”)).

Correctly applying collateral estoppel (issue preclusion) requires finding the following: (1) a prior action presents an identical issue; (2) the prior action actually litigated and adjudged that issue; (3) the judgment in that prior action necessarily required determination of the identical issue; and (4) the prior action featured full representation of the estopped party. *VirnetX*, 909 F.3d at 1377 (citing *Stephen Slesinger, Inc. v. Disney Enterprises, Inc.*, 702 F.3d 640, 644 (Fed. Cir. 2012)).

We find and determine that the final written decision in the 571-IPR and the Federal Circuit’s *CommScope* (Ex. 1039) decision affirming that final written decision satisfies the conditions for applying collateral estoppel because the 571-IPR presented and litigated the identical and necessary issue of whether Wu discloses some of materially the same claim limitations at issue here as discussed further below, and Patent Owner had full representation throughout the proceedings.

Setting aside the factors of issue preclusion for a moment, the final written decision and our reviewing court’s affirmance of it in *CommScope* (Ex. 1039) is persuasive authority that supports Petitioner’s showing that Wu discloses the disputed DAU limitations. In addition, issue preclusion prevents Patent Owner from re-litigating the same issue of whether Wu

discloses materially the same disputed limitation. *See* Reply 24; Ex. 1006, 6–7 (final written decision reproducing claim 11 of the ’473 patent in the 571-IPR, revealing that the claimed “host unit” recited there is materially similar to the claimed “digital access unit” recited here in claims 1 and 12), 21 (holding that “Wu discloses the claimed host unit as a combination of the matrix switch and host units”); Ex. 1039, 8–11 (the court in *CommScope* finding that “Wu’s host unit 230 and matrix switch already function together as part of the base station, 240, *to route channels* to remote units (emphasis added)); Reply 25 (arguing (prior to the *CommScope* decision) that issue preclusion prevents Patent Owner from re-litigating the DAU issue based on PTAB’s final written decision (citing Ex. 1006, 17–18, 20–22)).

CommScope further held that Wu discloses “wherein the host unit is *capable of sending a digital representation of any downlink signal it receives to any of the plurality of remote units*” from Wu’s host unit and matrix switch where “*Wu’s host unit 230 and matrix switch already function together as part of the base station, 240, to route channels to remote units.*” Ex. 1039, 3, 8 (emphasis added).

In particular, the court in *CommScope* found as follows:

Dali does not dispute that Wu’s matrix switch can allocate certain carrier channels to a certain host unit, Appellant’s Opening Br. at 16 (conceding that Wu’s matrix switch performs this function), or that Wu’s host units can send the channels to the remote units according to the routing policy in the matrix switch. Wu’s disclosures support the Board’s findings. Wu repeatedly teaches selectively routing certain channels to certain remote units. Wu at ¶ 11 (“The [matrix] switch preferably routes the individual channels, individually or combined, to RTUs according to a routing policy. The routing policy can be reconfigured as desired.”); id. at ¶ 38 (noting that the matrix switch can split “individual channels 1–12 . . . into individual

channels or groups of channels” via an “appropriate host unit 230”); *id.* at ¶ 40 (noting that the routing policy in the matrix switch determines “how analog channels 270 should be routed to host units 230 for further distribution to RTUs”); *id.* at ¶ 47 (noting that the policy inside the matrix switch can route a single carrier channel to a first RTU and a second carrier channel to a different RTU or group the channels together for routing to another RTU); *id.* (noting that the routing policy may “route, distribute, or allocate channels 270 collectively, as groups, individually, or in other desirable configurations.”

Ex. 1039, 9.

Based on the foregoing discussion, Petitioner’s collateral estoppel showing is persuasive.

Patent Owner does not address Petitioner’s collateral estoppel argument specifically. *See generally* Sur-reply. As discussed above, Patent Owner argues with respect to a similar claim term in another patent, the ’178 patent, that “downlink channel signals” (which is materially similar to the claim term at issue in *CommScope*) are not “radio resources.” PO Resp. 22 (citing Ex. 1019, 10–12, 17–19; Ex. 2016 ¶¶ 45–47 (in turn citing Ex. 1002)); *supra* § I.B.1.g.

Patent Owner also argues that “‘downlink channel signals’ are the user payload data signals that are not included in the meaning of ‘digital representation of radio resources.’” PO Resp. 23. To support its arguments, Patent Owner relies on general descriptions for optimizing bandwidth and data rates in the ’343 patent specification, but none of these citations support Patent Owner’s argument that a downlink carrier signal is not a type of radio resource. PO Resp. 22 (citing Ex. 1019, 10–12, 17–19); *supra* § I.B.1.g. As set forth in the block quote from *CommScope* above and as discussed above in connection with claim construction (Section I.B.1.g), *CommScope* found to the contrary of Patent Owner’s arguments, treating Wu’s *carriers* as

falling within the scope of “a digital representation of any downlink signal” as recited in the limitation in dispute there. Ex. 1039, 3, 8. Accordingly, collateral estoppel Patent Owner precludes Patent Owner from arguing that Wu does not disclose the claimed “digital access unit is configured to send a digital representation of . . . radio resources.”

Summary

Based on the foregoing discussion, Petitioner collateral estoppel precludes Patent Owner from arguing the noted limitations involving the claimed DAU of limitation 1.a and the limitations reciting “wherein the digital access unit is configured to send a digital representation of” “radio resources” within limitations 1.f and 1.g (discussed further below). Even if collateral estoppel did not apply, Petitioner’s showing for limitation 1.a is persuasive for the reasons outlined above.

c. Limitations 1.b and 1.d

Limitation 1.b recites “a plurality of signal sources, including at least a first signal source and a second signal source,” and limitation 1.d recites “wherein the digital access unit comprises a plurality of interfaces to communicatively couple the digital access unit to the plurality of signal sources.” As indicated above in discussion Petitioner’s annotated version of Wu’s Figure 2, Petitioner relies on Wu’s teaching of multiple signal sources (transceivers 260). *See supra* note 16 (noting that Petitioner shows that Wu discloses multiple signal sources and Petitioner depicts two interfacing Wu’s matrix switch 250 in annotated Figure 2); Pet. 30 (citing Ex. 1007 ¶ 34). Petitioner explains that Wu’s “multi-band transceiver 260 is preferably configured to receiv[e] or to transmit wireless signals within a plurality of frequency bands as represented by bands 263A, 263B, through 263N” and

that “[e]ach of bands 263 preferably comprises multiple channels.” Pet. 29–30 (quoting Ex. 1007 ¶ 35) (second alteration in original). Petitioner further explains that “Wu discloses that matrix switch 250 (a component of the digital access unit) is communicatively coupled to a plurality of BTS Bands 263A-263N from each of the first and second transceivers 260 and a [person of ordinary skill in the art] understood that each communication coupling includes an interface.” *Id.* at 31–32 (citing Ex. 1007 ¶ 42, Fig. 2).

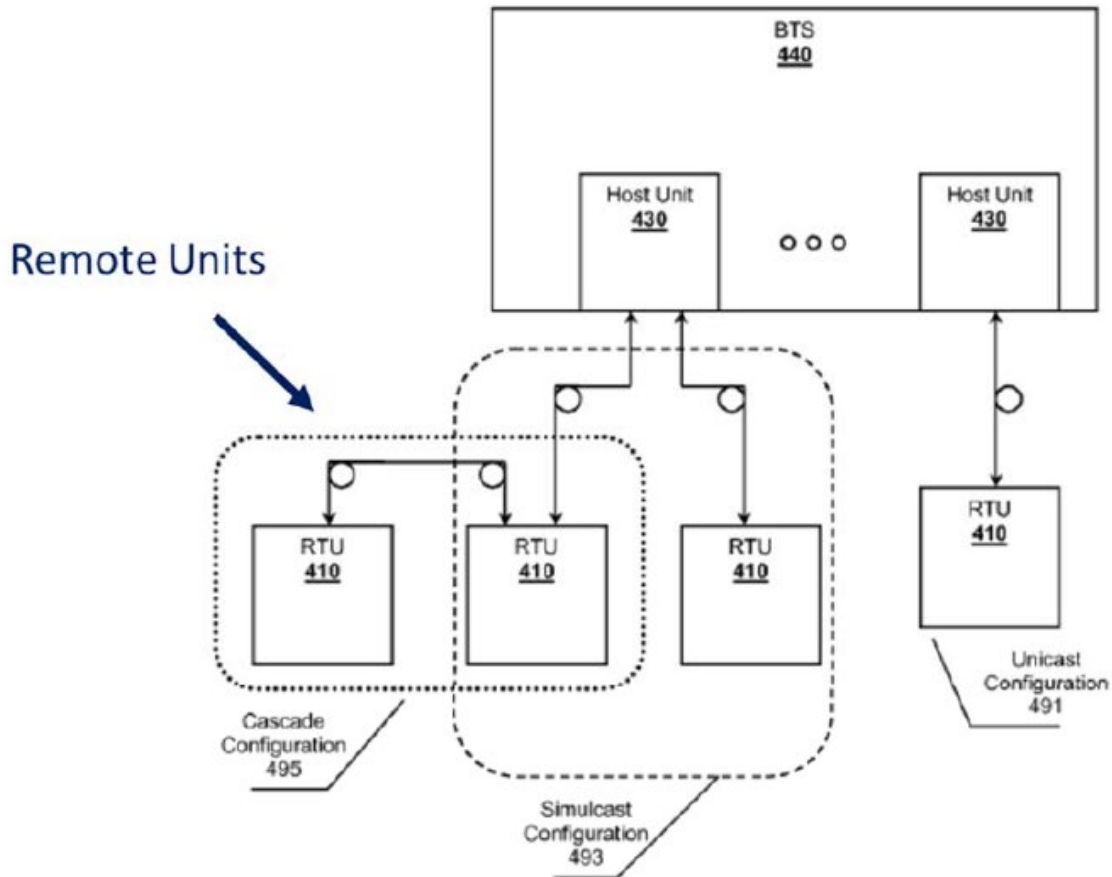
Summary

Based on the foregoing discussion, Petitioner’s showing for these limitations are persuasive. Patent Owner does not address Petitioner’s showing as to this limitation. *See generally* PO Resp.

d. Limitation 1.c

Limitation 1.c recites “a plurality of remote units, including at least a first remote unit and a second remote unit.” Petitioner contends that Wu’s Figures 1 and 4 illustrate Wu’s system, which comprises a plurality of RTUs 110 [*a first remote unit and a second remote unit*].” Pet. 30 (citing Ex. 1007, Fig. 1, ¶¶ 31–33; Ex. 1012 ¶ 61).

Petitioner relies on the following annotated version of Wu’s Figure 4:



As reproduced above, Petitioner modifies Wu's Figure 4 to identify how the claimed "remote units" read on Wu's RTUs 410. Pet. 31 (annotating Ex. 1007, Fig. 4; citing Ex. 1012 ¶ 61).

Petitioner's showing for this limitation is persuasive. Patent Owner does not address Petitioner's showing as to this limitation. *See generally* PO Resp.

e. Limitation 1.e

Claim 1 recites "wherein the digital access unit is configured to receive a plurality of radio resources from the first signal source and the second signal source." Drawing attention to its annotated version of Wu's Figure 2 above, Petitioner contends that "matrix switch 250 receives analog channels 270 [radio resources] including channels 1–12 from each of the

BTS Bands 263 of the first and second transceivers 260.” Pet. 32 (citing Ex. 1007 ¶¶ 35–38, Fig. 2) (emphasis omitted, alteration in original). Petitioner contends that a person of ordinary skill in the art “understood that the carrier channels 1–12 are radio resources as recited in the [c]hallenged [c]laims.” *Id.* (citing Ex. 1012 ¶ 63).

Patent Owner does not dispute Petitioner’s showing. Rather, Patent Owner focuses on its claim construction argument that “Wu does not disclose the claim limitations ‘send a digital representation of a [first/second] set of radio resources to the first remote unit.’” *See* PO Resp. 29–31 (emphasis omitted, alteration in original). We address this line of argument in our claim construction and in discussing limitations 1.a above and 1.f and 1.g below.

Based on the foregoing discussion, Petitioner’s showing for this limitation is persuasive.

f. Limitation 1.f

Limitation 1.f recites “wherein the digital access unit is configured to send a digital representation of a first set of radio resources to the first remote unit at a first point in time, the first set of radio resources for transmission at an antenna of the first remote unit.”

Petitioner’s Showing

Petitioner contends that Wu discloses “that the combination of matrix switch 250 and units 230 [*digital access unit*] digitize the carrier channels [*radio resources*] and send digital representations of the channels 273 to the RTUs.” Pet. 33 (quoting Ex. 1007 ¶ 49). Petitioner also explains that “Wu . . . describes that the number of channels routed to an RTU may change by means of a routing policy that includes rules for reacting to events and

conditions such as usage, load, weather, etc.” *Id.* (citing Ex. 1007 ¶¶ 38–47; Ex. 1012 ¶ 65). Petitioner quotes Wu as teaching that “[t]he rules of policy 255 can include one or more criterion representing a trigger” and “[w]hen the criteria are met, matrix switch 250 can take appropriate routing action.” *Id.* (quoting Ex. 1007 ¶ 41) (first alteration in original). Petitioner further contends that “Wu explains that the routing actions may include allocating more channels to a region to increase the bandwidth available at a first point in time.” *Id.* (citing Ex. 1007 ¶ 46; Ex. 1012 ¶ 66).

Petitioner contends that “Wu discloses that the RTUs provide ‘wireless coverage’ to remote cellular regions.” Pet. 33 (citing Ex. 1007 ¶¶ 4, 30). Petitioner also contends that a person of ordinary skill in the art would have “understood that ‘wireless coverage’ requires transmission of communications using an antenna, and that there are antennas associated with each RTU for transmitting radio resources.” *Id.* (citing Ex. 1012 ¶ 67).

Patent Owner’s Arguments

Patent Owner’s arguments all rely on its claim construction of a digital representation of radio resources, which we do not adopt. Specifically, Patent Owner argues that Wu does not disclose that “the digital access unit is configured to send a digital representation of a [first/second] set of radio resources to the first remote units,” because this limitation “is understood . . . to include ‘sending digital information defining or describing a set of radio resources to be used for transmitting data over the air via the antenna of a remote radio unit.’” PO Resp. 27 (citing Ex. 2016 ¶¶ 39–43). As another example, Patent Owner argues that with respect to the ’343 patent disclosure, “software settings within the radio units are configured to implement the assignment of radio resources,” and “the system

configuration of the RRU is changed to “remove . . . certain radio resources . . . *for use by a particular DRU*” which no longer needs those radio resources within its coverage area.” *Id.* at 29 (quoting Ex. 1001, 12:64–13:2; citing Ex. 1001, 6:57–7:1, 12:58–64). Patent Owner presents similar arguments on pages 29–32 of the Response. For example, Patent Owner argues that “Wu’s digitized carrier channels that Petitioner maps this claim limitation to, however, are not digital representations of a first/second set of radio resources,” because “[t]hese ‘channels’ that Wu receives from the BTS and routes to the RTUs are not digital information that define or describe how the RTU should be configured to transmit RF signals.” *See id.* at 29–30; *see also id.* at 31 (arguing that “Wu’s RTU’s are fundamentally different from the ’343 patent’s reconfigurable remote radio units in which its settings can be dynamically changed in accordance with updated radio resource information used for radio transmissions”).

Analysis Under Petitioner’s Claim Construction

Patent Owner’s arguments are unavailing because we do not adopt Patent Owner’s claim construction. Wu’s digitized/sampled channels are a digital representation of a first set of radio resources under Petitioner’s claim construction (and also under Patent Owner’s claim construction as discussed below). As Petitioner argues, “Wu discloses that analog carrier channel signals received from the transceiver are digitized by analog-to-digital converters in units 230 and that the carrier channels are sent in digital form to the remotes.” Reply 10 (citing Ex. 1007 ¶¶ 30, 54, Fig. 6–2 (“ADC”); Ex. 1034 ¶ 10). The record supports Petitioner’s showing as summarized above.

Reconfiguring Argument

Despite Patent Owner's arguments that "Wu's RTU's are fundamentally different from the '343 patent's reconfigurable remote radio units in which its settings can be dynamically changed," the challenged claims do not require reconfiguring an RRU or changing of any software settings. *See* PO Resp. 31. Challenged claim 1 is in contrast to a challenged claim in one of Patent Owner's related patents, wherein the Board denied institution because it determined that Petitioner failed to show that the asserted prior art discloses "reconfiguring" in a limitation reciting that term. Ex. 2006, 11 (construing "'reconfiguring at least one of the plurality of radio units' (claim 1) to be 'changing the configuration of at least one of the plurality of radio units'"), 16 ("agree[ing] with Patent Owner that Petitioner does not establish Oh discloses the 'reconfiguring each remote radio unit' limitation"), 22 (denying institution).

Patent Owner's Claim Construction

As indicated above, Patent Owner argues that "the proper construction" of "send a digital representation of a [first/second] set of radio resources to the first remote unit . . . includes sending digital information defining or describing a set of radio resources to be used for transmitting data over the air via the antenna of a remote radio unit." PO Resp. 13.

Petitioner shows that Wu meets this claim limitation under Patent Owner's claim construction. Reply 9–10. First, Petitioner notes that Patent Owner's claim "construction refers to the digital representations '*describing*' the radio resources: 'information defining or *describing* a set of radio resources to be used for transmitting data over the air via the antenna of a remote radio unit.'" *Id.* (quoting PO Resp. 17). Then, Petitioner asserts that

“this well-known process of digitization using analog-to-digital converters produces a set of digital samples that accurately describe an input signal.” *Id.* at 10 (citing Ex. 1034 ¶¶ 8, 10). In other words, “[t]he digital samples [of Wu] describe and preserve the shape of the radio carriers (how the carriers have been modulated in phase, frequency and amplitude) so that after transmission over long distance fibers, the modulated analog signal can be recreated at the remote units (by corresponding digital-to-analog converters) prior to transmission over the air by an antenna.” *Id.* (citing Ex.1034 ¶¶ 8, 10).

Dr. Houh’s cited testimony is persuasive and credible. After citing the ’343 patent for its “digitized” teachings, Dr. Houh testifies as follows:

Digitization is well-known and is performed by capturing samples of the incoming signal at regular intervals. The samples represent or record in digital form the shape of the incoming signals. Digitizing and down-converting to baseband does not change the shape of the signal or undo the modulation performed by the base station.² Digitizing merely captures a digital picture or version of the shape of the RF carriers arriving from the base stations. The resulting digital baseband signal preserves the shape of the original base station signal, i.e., the shape of its amplitude, frequency and phase modulations. One of skill in the art would understand that digitizing a signal by taking digital samples of a signal creates a digital representation of that signal. A digital baseband version of RF carrier signals from a base station is a digital representation of those RF carrier signals.

Ex. 1034 ¶ 8. Based on this well-known understanding of what a digitization of an analog signal conveys, Dr. Houh credibly testifies that “Patent Owner’s construction of the digital representation limitation does not distinguish the Wu reference.” *Id.* ¶ 10 (“This well-known process of digitization using analog-to-digital converters produces a set of digital

samples that accurately describe an input signal and are ‘information defining or describing a set of radio resources’ which are ultimately ‘to be used for transmitting data over the air via the antenna of a remote radio unit.’”).

To further support this showing under Patent Owner’s claim construction, in addition to relying on Dr. Houh’s testimony, Petitioner relies on the testimony of Dr. Chrissan. Reply 10 & n.3 (citing Ex. 1034 ¶¶ 8, 10, 11; Ex. 1038, 19:20–21:9, 93:12–20, 153:18–154:12). Petitioner argues that Dr. Chrissan “repeatedly agreed that the digitization process using an analog-to-digital converter will preserve the characteristics of the original signal, i.e., still describe the original signal.” *Id.* (citing Ex. 1038, 19:20–21:9, 93:12–20, 20:17–21:1 (testifying “an A-to-D converter . . . produces a digital output that represents its input”), 153:18–154:12).

Petitioner shows that Dr. Chrissan “conceded that Wu’s RTUs—that receive the digitized channels—are able to ‘recreate’ the original analog signals (radio resources).” Reply 11 (quoting Ex. 1038, 88:3–10, 69:5–8). Dr. Chrissan’s cited testimony supports Petitioner because Dr. Chrissan “agree[s] that the purpose of [Wu’s] system is to re-create a representation of those channels at the outputs of the RTUs.” Ex. 1038, 88:6–8. He also testifies that “the remote units are configured to reconstruct in some way the analog channels 270, as per Wu’s Figure 2 and 3.” *Id.* at 69:5–8. Therefore, as Petitioner argues, Dr. Chrissan’s cited testimony further demonstrates that Wu’s digital samples identify the analog carrier according to Patent Owner’s claim construction.

Patent Owner cites to Dr. Chrissan’s testimony for the proposition that Wu’s RTUs are pass-through devices such that there is “no need” to send a

digital representation of radio resources. *See* PO Resp. 30 (citing Ex. 2016 ¶¶ 50–51). Nevertheless, whether there is the stated need in Wu does not address Petitioner’s showing that digital sampling via an A/D converter describes the original analog carrier. As further discussed below in connection with claim 4, Dr. Chrissan does not address Wu’s paragraphs 55–56 in rendering his conclusion that Wu’s RTUs are “pass-through devices,” rendering the testimony conclusory because it does not address this critical evidence. *See* PO Resp. 30 (citing Ex. 2016 ¶¶ 50–51); Ex. 2016 ¶¶ 50–51 (discussing Ex. 1007 ¶ 50)). In addition, as discussed in the previous paragraph, Dr. Chrissan’s deposition testimony shows that Wu sends and receives a digital representation of a carrier, which describes the carrier, because that is the essence of digital sampling.

Patent Owner also argues that Petitioner “does not show that Wu meets this claim limitation under the proper construction of the claim term, i.e., information about the radio resources themselves and how they are to be used by the DRU to transmit data—for example, information such as software settings and parameters for the DRU.” Sur-reply 7. But Patent Owner’s claim construction does not require “information such as software settings and parameters for the DRU.” *See* PO Resp. 12 (arguing the proper claim construction “includes sending digital information defining or describing a set of radio resources to be used for transmitting data over the air via the antenna of a remote radio unit”). Patent Owner’s arguments do not undermine Petitioner’s showing that Wu’s digitization of carriers describes the underlying radio resource, because as found above and further below, Wu’s system is able to recreate the carriers in analog form.

That is, with further respect to Wu, Petitioner argues that “Wu sends the digitized channels to the RTU as digital baseband signals according to the CPRI standard, which is the same example taught for the preferred embodiment of the ‘343 patent.” Reply 10 (citing Ex. 1007 ¶ 31 (using CPRI standard); Ex. 1010 (CPRI standard), 25 (describing digital base band signals); Ex. 1034 ¶ 11; Ex. 1001, 5:1–2 (describing digitizing signals into baseband). Petitioner also explains that “Wu teaches that the RTUs—that receive the digitized channels—are able to ‘reverse’ the process and convert the digital channels ‘back into analog channels’ for transmission over the air via antennas, which logically means the Wu’s digitized channels did describe the original analog carrier channels.” *Id.* at 11 (quoting Ex. 1007 ¶ 50).

Based on the foregoing discussion, Petitioner persuasively shows that Wu discloses the disputed “digital representations of radio resources” under Petitioner’s claim construction and Patent Owner’s claim construction.

Antenna

In relation to the recited antenna, “the first set of radio resources for transmission at an antenna of the first remote unit,” Patent Owner argues that “the Petition does not specifically address this antenna issue nor does it point to any disclosure in Wu, but rather only states that the phrase ‘wireless coverage’ implies an antenna.” PO Resp. 34. This argument is unavailing. Patent Owner does not dispute that “wireless coverage” as disclosed in Wu implies that Wu’s RTUs use an antenna for wireless coverage as the Petition asserts. *See id.* at 34–35. As Petitioner also argues, Dr. Houh testifies that a person of ordinary skill in the art “understood that ‘wireless coverage’ requires transmission of communications using an antenna, and that there are

antennas associated with each RTU for transmitting radio resources.” Pet. 33 (citing Ex. 1012 ¶ 67). Petitioner also persuasively argues that “[n]umerous references corroborate that the structure to wirelessly transmit a carrier channel is an antenna.” Reply 14 (citing Ex. 1017 ¶ 19 (“wirelessly transmitting and receiving . . . via antenna”); Ex. 1026 3:4–5 (same)).

Petitioner also points out that in an earlier *inter partes* review, the 571-IPR, Patent Owner’s declarant testified that Wu’s RTUs have antennas. See Reply 14 (citing Ex. 1037 ¶¶ 148–149 (“RTUs, after receiving the signals, process them to be sent as RF from their antennas.”)) & n.5 (stating that Wu refers to another reference in its background, Stratford, which discloses that a “carrier signal is . . . transmitted from an antenna” (alteration in original) (quoting Ex. 1027, 3:38–45)).¹⁸ Therefore, Petitioner persuasively shows that each RTU of Wu includes an antenna.

Based on the foregoing discussion, Petitioner’s showing for limitation 1.f is persuasive.

g. Limitation 1.g

Limitation 1.g recites “wherein the digital access unit is configured to send a digital representation of a second set of radio resources to the first remote unit at a second point in time, the second set of radio resources for transmission at the antenna of the first remote unit.”

According to Petitioner,

Wu discloses a system where the digital access unit is configured to send a digital representation of a second set of radio resources to the first remote unit at a second point in time, the second set of radio resources for transmission at the antenna of the first remote unit. As set forth for element [1.f] above, Wu describes

¹⁸ Exhibit 1037 here is a copy of Exhibit 2007 in the 571-IPR, a declaration by Patent Owner’s expert in that proceeding, Harry V. Bims, Ph.D.

a routing policy that includes rules for reacting to various events and conditions. EX-1007, ¶¶0038–47. The routing actions may allocate more channels [*a second set of radio resources*] to an RTU to increase the bandwidth available in the region of the RTU at a time following the triggering event [*a second point in time*]. EX-1007, ¶0046; EX-1012, ¶68.

Pet. 34 (alterations in original).

Patent Owner argues that Wu’s system does not send the first and second set of radio resources to *the same* antenna of the first remote unit (i.e., same antenna of Wu’s RTU). PO Resp. 32–34. Rather, according to Patent Owner, “Wu’s RTU sends different carriers to different boosters” connected to that RTU, which in turn, connect to different antennas. *See id.* at 33.

The record does not support Patent Owner’s arguments. As Petitioner argues, Patent Owner’s “different boosters’ argument fails,” because “Wu teaches there could be just *one* booster [per RTU], which moots PO’s argument.” Reply 17 (citing Ex. 1034 ¶¶ 30–41; Ex. 1007 ¶ 50 (disclosing “one or more boosters” (emphasis added))). As Dr. Houh credibly testifies after analyzing the Manual describing the mBSC booster disclosed in Wu, “[w]hen there is only one booster, necessarily, every set of channels is transmitted by the same booster (and through it to the same inherent antenna).” Ex. 1034 ¶ 31; *see also id.* ¶¶ 19–27 (analyzing the Manual’s mBSC booster (citing Ex. 1028)). Relying on the testimony of Dr. Houh, Petitioner shows that Wu’s disclosed mBSC booster connects to an antenna because it includes an interface line for an antenna. *See* Reply 16–18, 22–23 (citing Ex. 1028, 9; Ex. 1034 ¶¶ 18, 31–43); Ex. 1007 ¶ 50). Petitioner’s showing based on Wu’s disclosure of a single booster option is persuasive.

See Ex.1007 ¶ 50 (disclosing “*one* or more boosters” (emphasis added)); Ex. 1028, 9 (describing mBSC booster).

Petitioner also points out that Patent Owner’s declarant, Dr. Chrissan, “conceded Wu teaches there could be just one booster and that he did not offer an opinion to distinguish that case.” Reply 17 (citing Ex. 1038, 53:10–20 (testifying that “Wu . . . says one or more boosters in paragraph 50”), 56:13–18 (testifying “I do not discuss [in my declaration] the single booster case [as disclosed in Wu] in isolation”). Patent Owner does not dispute that the disclosure of a single booster in Wu meets the antenna limitation at issue. See Sur-reply 12–14 (not directly addressing Petitioner’s showing that because Wu discloses the option of using a single booster, Wu discloses the limitation at issue).¹⁹

Petitioner persuasively explains further as follows: “When there is only one booster, necessarily, every set of channels is transmitted by the same booster (and through it to the same inherent antenna). Whether that single, same booster for both sets connect to one or more than one antenna is irrelevant—the claims cover both.” Reply 18. In other words, challenged

¹⁹ The record does not support Patent Owner’s argument that Petitioner’s reliance on the “*same single antenna*” theory is an improper new argument. Sur-reply 9. The Reply does not change the thrust of the Petition’s showing that Wu discloses sending the two sets of radio resources through the same antenna and merely responds to Patent Owner’s argument. See Pet. 33–34 (referring to Wu’s wireless coverage as disclosing an antenna to address limitation 1.f and referring to that same antenna (“the antenna of the first remote unit.”) in the section heading addressing limitation 1.g); Reply 13–24 (responding to Patent Owner’s arguments with respect to the same antenna by citing to Wu and extrinsic evidence describing Wu’s booster). See *In re Baxter Travenol Labs*, 952 F.2d 388, 390 (Fed. Cir. 1991) (extrinsic evidence may be used to explain what a reference discloses).

claim 1 does not require a single antenna; rather, as Petitioner explains, it requires the capability of sending the first and second resources through the same antenna[s], because claim 1 recites “‘an’ antenna, which allows for any configuration of one or more antennas.” *See id.* at 14; *see also id.* at 13, 18. The single booster necessarily routes all channels (e.g., channels 1–12) from an RTU to the same one or more antennas connected via the single booster output. *See id.* at 17–18 (citing Ex. 1034 ¶¶ 19–27, 31–34; Ex. 1007 ¶ 50; Ex. 1028, 9).

Based on the foregoing discussion, Petitioner persuasively shows that Wu teaches sending a digital representation of a second set of radio resources through the same antenna as the first set of radio resources at each RRU, because Wu discloses, under one option, a single booster for each RRU, thereby satisfying limitation 1.g.

h. Limitation 1.h.

Limitation 1.h “wherein a number of radio resources in the first set of radio resources is different from a number of radio resources in the second set of radio resources at least based on dynamic load balancing and resource management.” Petitioner explains that Wu teaches that a “routing policy may change the configuration of the system ‘to allocate more channels’ to a first RTU in a region ‘to increase the bandwidth available’ in the region in response to conditions,” and in these situations, Wu discloses that “a number of radio resources in the first set of radio resources is different from a number of radio resources in the second set of radio resources at least based on dynamic load balancing and resource management.” Pet. 35 (citing Ex. 1007 ¶ 46; Ex. 1012 ¶ 69).

Patent Owner does not address Petitioner's showing directly with respect to this limitation but focuses on its multiple booster theory to address the "same antenna" issue discussed above in connection with limitations 1.f and 1.g. *See* PO Resp. 33 (arguing that "Wu's RTU sends different carriers to different boosters"); Sur-reply 11–14.

Based on the foregoing discussion, Petitioner's showing for limitation 1.h is persuasive.

i. Limitation 1.i

Limitation 1.i recites "wherein the digital access unit is configured to receive digital signals from each of the plurality of remote units." Petitioner contends that Wu "explains that the system is bi-directional such that the units 230 (components of the digital access unit) may receive digital representations of uplink signals from each of the plurality of RTUs." Pet. 37 (citing Ex. 1007 ¶¶ 36, 49) (emphasis omitted). Petitioner also contends that "Wu discloses that the RTUs include analog-to-digital converters for digitizing received signals for digital transport to the host units 230." *Id.* citing (Ex. 1007 ¶ 56; Ex. 1012 ¶ 74).

Patent Owner does not address Petitioner's showing with respect to this limitation. *See generally* PO Resp.

Based on the foregoing discussion, Petitioner's showing for this limitation is persuasive.

j. Summary

Based on the record and summary above, Petitioner's showing with respect to system claim 1 is persuasive. As noted above, independent method claim 12 is materially the same as independent system claim 1. Petitioner relies on its showing for claim 1 to address claim 12. Pet. 41.

Patent Owner does not present separate arguments for claim 12. *See generally* PO Resp. Accordingly, we determine that Petitioner shows by a preponderance of evidence that claims 1 and 12 would have been obvious over Wu.

3. Claims 2, 3, 5–10, 12–14, and 16–20

Claims 2, 3, 5–10, 12–14, and 16–20 depend directly from independent claims 1 or 12. Petitioner contends that these claims would have been obvious over the teachings of Wu. Pet. 38–53. In support, Petitioner relies on the testimony of Dr. Houh, and provides citations to specific teachings in Wu. *Id.* On this record, Petitioner persuasively maps the added limitations of claims 2, 3, 5–10, 12–14, and 16–20 to Wu and provides persuasive reasons to modify Wu’s teachings for certain limitations with a reasonable expectation of success for purposes of institution. *See id.*

Patent Owner does not address Petitioner’s showing for these claims. *See generally* PO Resp.

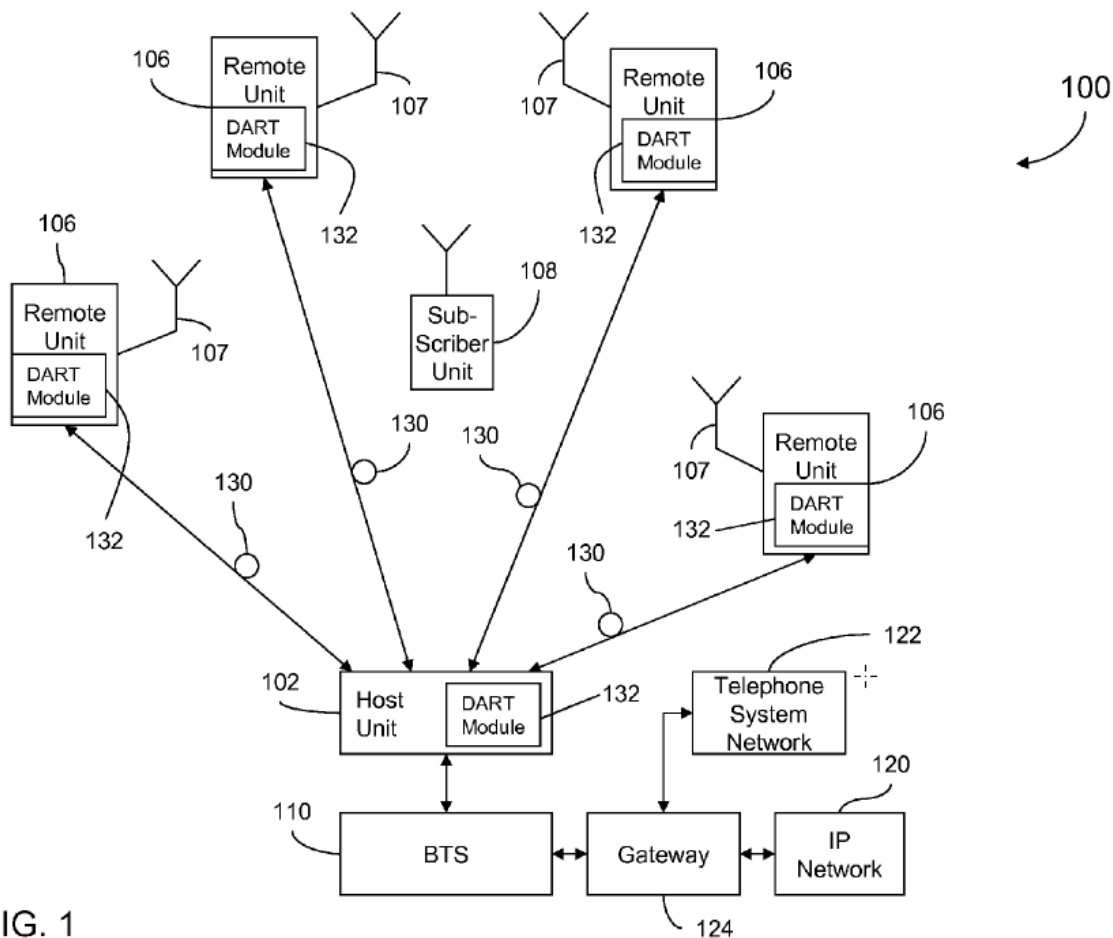
Based on the foregoing discussion, we determine that Petitioner shows by a preponderance of evidence that claims 2, 3, 5–10, 12–14, and 16–20 would have been obvious over Wu.

E. Analysis of the Ground Based on Wu and Cannon

Petitioner generally asserts that claims 4, 11, 15, and 22, which depend from independent claims 1 or 12, would have been obvious over the combined teachings of Wu and Cannon. Pet. 61–66. In support, Petitioner relies on the testimony of Dr. Houh, and provides citations to teachings in Wu and Cannon. *Id.* Patent Owner generally argues these dependent claims together, focusing on claim 4 and noting claim 14’s “similar feature.” *See* Prelim. Resp. 50, 42–53.

1. Cannon (Ex. 1017)

Cannon, titled “Systems and Methods for Improved Digital RF Transport in Distributed Antenna Systems,” describes a DAS system with a base station that transmits RF signals to remote units, which reconstruct the RF signals and transmits them via an antenna. Ex. 1017, codes (54), (57), ¶ 20.²⁰ Cannon’s Figure 1 follows:



²⁰ As noted in the Institution Decision, certain portions of the original Petition and original Houh Declaration incorrectly cite to column and line numbers, instead of paragraph numbers, with respect to Cannon, U.S. Pub. No. 2010/0177760 A1 (Exhibit 1017). See Inst. Dec. 1 n.1, 17–18 n.9; Ex. 3002. Accordingly, the Board ordered Petitioner to file a corrected Petition and Houh Declaration (in red-line form) citing to Exhibit 1017. See Inst. Dec. 1 n.1, 17–18 n.9; Ex. 3002.

Figure 1 above depicts DAS 100, including host unit 102 and remote units 106. Ex. 1017 ¶ 18. Host unit 102 communicatively couples to at least one base transceiver station (BTS) 110. *Id.* Host unit 102 receives downlink RF signals from BTS 110 and generates transport signals for transmitting to one or more remote units 106. *Id.* ¶ 20. “[T]he downlink and uplink transport signals transmitted between host unit 102 and remote units 106 over communication links 130 are generated by digitizing the downlink and uplink RF signals, respectively.” *Id.* ¶ 21. “In other words, the downlink and uplink transport signals are not analog RF signals but instead are digital data signals representing digital RF samples of a modulated RF signal.” *Id.* “These digital data signals . . . may comprise digital representations of an RF, IF or baseband version of the original RF signal.” *Id.*

By way of example, “host unit 102 will generate baseband digital samples of [a] modulated 900 MHz RF signal from BTS 110” and then distribute it to remote units 106. Ex. 1017 ¶ 21. “At the remote units, the digital samples of the modulated RF signal are converted from digital into an analog RF signal to be wirelessly radiated from the antennas 107.” *Id.* For the uplink, “analog RF signals received at remote unit 106 [from the subscriber units] are digitally sampled to generate digital RF data samples for the uplink transport signals.” *Id.*

A digital to analog radio frequency transceiver (DART) module in each remote unit 106 and host unit 102 perform respective conversions for uplink and downlink signals. Ex. 1017 ¶¶ 22–23. DART modules in remote units are specific for a particular frequency band, but may be reprogrammed to meet the changing needs of the end user. *Id.* ¶¶ 22, 46. “DART Module 500 [in Figure 5] may operate as either a Host DART or a Remote DART

module such as respective DART Modules 308 and 208.” *Id.* ¶ 36. The DART module includes FPGA 503 (field programmable gate array). *Id.* ¶ 36, Fig. 5.

Because FPGA 503 is a field programmable device, it can be adjusted to meet changing needs of the end user. For example, the center frequencies f_{c1} and f_{c2} can be reprogrammed into FPGA 503 in order to shift the locations of spectral regions 451 and 452 within spectrum 400. Similarly BW1 and BW2 may be adjusted to accommodate larger or narrower bandwidths. The number and/or position of timeslots within frame 460 provisioned for each discrete spectral region can also be reconfigured. As mentioned previously, the number of individual signal paths for handling additional spectral regions may be increased by configuring the FPGA with additional digital up converters and digital down converters. In one embodiment, a plurality of predefined configuration builds are stored in a memory, for example within a SeRF Module. In such an embodiment, a DART Module's FPGA can be reconfigured by pushing a new build image onto the FPGA.

Ex. 1017 ¶ 46.

2. Claims 4 and 15

Claim 4 recites “[t]he system of claim 1, wherein the dynamic load balancing and resource management dynamically adjusts a capacity of at least the first remote unit.” Claim 15 depends from method claim 12 and recites materially the same limitations as claim 4. Petitioner relies on its showing for claim 4 to address claim 15. *See* Pet. 54–66. The parties’ briefs treat these claims together. *See* PO Resp. 39–50; Reply 27–36; Sur-reply 14–16. Accordingly, we address claims 4 and 15 together.

a. Claims 4 and 15 Based on Wu and Cannon

To address claims 4 and 15, Petitioner alleges that it would have been obvious to modify Wu based on Cannon’s teachings to include adjusting a

programmable FPGA in remote radio units. *See* Pet. 61–63; PO Resp. 39–50; Reply 27–36; Sur-reply 14–16.²¹

i. The Petition’s Showing

As indicated above, Petitioner contends that “Wu in combination with Cannon . . . renders obvious a system wherein the dynamic load balancing and resource management dynamically adjusts a capacity of at least the first remote unit.” Pet. 61. Petitioner contends that Wu’s matrix switch 250 “may be configured using the routing policy, 255, to dynamically reroute or reallocate the radio resources [*adjust capacity*] to the RTUs [*of the first remote unit*] based on changing network conditions such as traffic rate, a consumed bandwidth, current traffic load, call rate, and load balancing.” *Id.* at 61–62 (added emphasized claim language original) (citing Ex. 1007 ¶¶ 41–44). Petitioner contends that “Wu describes that the carrier channels can be routed as desired based on the usage and load.” Pet. 59 (citing Ex. 1007 ¶ 39). Petitioner also refers to its showing with respect to claim 1 and contends that “Wu discloses programming a network routing policy to allocate carrier channels to different RTUs through a Matrix Switch 250 based on the loading demands in various scenarios such as sporting events.” *Id.* (citing Ex. 1007 ¶¶ 45–47).

To address changing settings with a remote unit, Petitioner contends that Cannon’s system dynamically adjusts a capacity of a remote unit by changing an FPGA in the remote unit. *See* Pet. 61–63 (citing Ex. 1012 ¶¶ 125–128; Ex. 1017 ¶ 46, Figs. 1, 5).

²¹ Although it appears that claims 4 and 15 do not require changes to the RTU, this issue is not before us.

Petitioner reproduces Cannon's Figure 1, which follows:

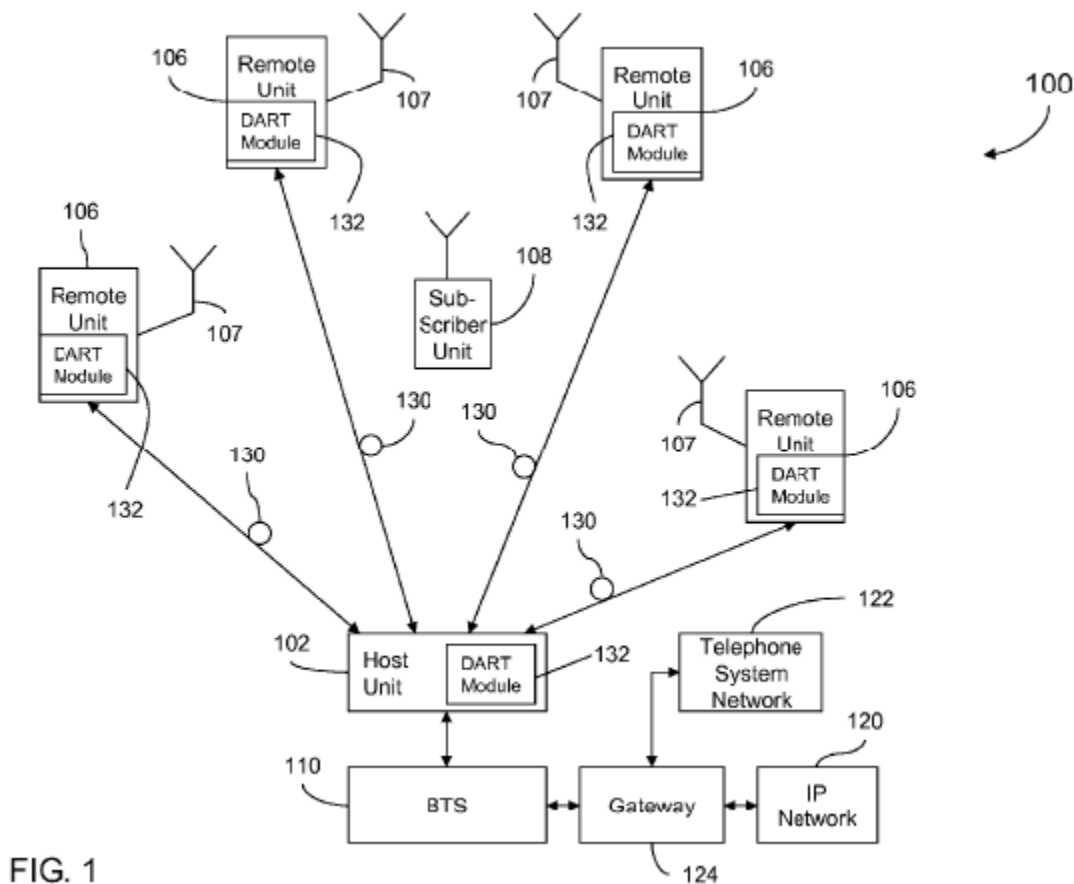


FIG. 1

Cannon's Figure 1 above shows DART (digital to analog frequency transceiver) module 132 in each host 102 and remote unit 106. Petitioner explains that each DART module "contains a field programmable gate array (FPGA) 503." Pet. 62–63. Petitioner also explains that "[e]ach FPGA is programmable to automatically configure the remote unit itself to alter *both the bandwidths and the frequencies* that are processed by the remote unit" to "adjust a capacity of the at least the first remote unit." *Id.* at 63 (citing Ex. 1017 ¶ 46; Ex. 1012 ¶ 126) (first emphasis added). Petitioner also relies on Cannon's "disclos[ure] that the FPGAs are adjusted 'to meet changing needs of the end user.'" *Id.* (quoting Ex. 1017 ¶ 46; citing Ex. 1012 ¶ 126). Petitioner contends that it would have been obvious to combine Cannon and

Wu, as both references “are . . . directed to dynamically allocating frequency spectrum in a DAS.” *Id.* at 58. Petitioner also contends that, like the ’343 patent, Wu and Cannon both “provide examples of mobile subscribers communicating with a remote radio unit of a DAS.” *Id.* (citing Ex. 1001, Fig. 1; Ex. 1007, Fig. 1; Ex. 1017, Fig. 1; Ex. 1012 ¶ 122).

Petitioner argues that the ’343 patent and Wu each describe reconfiguring remote units based on the load of each unit, and Cannon and the ’343 patent employ FPGAs, DUCs (digital up converters), and DDCs (digital down converters). Pet. 58–59 (citing Ex. 1001, 6:36–46, 7:32–46; 10:13–27; Ex. 1012 ¶ 122; Ex. 1007 ¶¶ 11, 39, 44; Ex. 1017, Fig. 6, ¶¶ 42, 34, 46–47). Petitioner contends that it would have been obvious to employ Cannon’s “beneficial” FPGA in Wu’s remote radio units because that allows for a simple programming adjustment to meet the changing needs of the end user, including to change the carriers, where Wu similarly teaches altering remote radio units by altering its carriers based on usage and load. *See id.* at 59 (citing Ex. 1017 ¶¶ 34, 42, 46, 47, Fig. 6; Ex. 1012 ¶ 122), 62–63 (similar). Petitioner also contends that using an FPGA as Cannon teaches would have predictably enhanced Wu’s real-time load distribution technique by “improving the efficiency of the system” and “achieving reassignment on line without interrupting the service.” *Id.* at 61 (citing Ex. 1012 ¶ 124).

Petitioner contends that Cannon’s system is similar to the ’343 patent system, “which discloses dynamically adjusting a gain control parameter of integrated frequency selective DUCs and DDCs in the DRUs as well as reconfiguring a FPGA in each DRU to determine which carrier signals will be in the downlink.” Pet. 63 (citing Ex. 1001, 6:38–46, 7:32–46; Ex. 1012 ¶ 127).

Petitioner contends that a person of ordinary skill in the art would have been “motivated to modify the teachings of Wu to include a FPGA in the remote radio unit (RTUs) as taught by Cannon because. . . there are only a few finite ways to reconfigure a radio by changing its carrier frequency[, and] Cannon discloses one such suitable way to reconfigure the carrier frequency of the remote radio is the use of a FPGA and requires only a programming change.” Pet. 59–60 (citing Ex. 1012 ¶ 123).

ii. Patent Owner’s General Arguments

Addressing claims 4, 11, 15, and 22 as a group, Patent Owner contends that “[t]he Petition fails to articulate a sufficient motivation to combine Wu and Cannon, much less articulate a reason for why a [person of ordinary skill in the art] would see a need to modify Wu.” PO Resp. 40. Patent Owner contends that “Petitioner offers no affirmative evidence to show why a [person of ordinary skill in the art] would have felt the need to modify Wu.” *Id.* at 41.

Patent Owner recognizes that “Petitioner points to . . . the use of FPGAs [in Cannon] to meet the changing needs of the end user by, for example, *reprogramming the center frequencies, spectral regions and bandwidths with predefined configurations builds stored in memory.*” PO Resp. 42 (citing Ex. 1017, 9:45–61) (emphasis added). Patent Owner also recognizes that “Petitioner asserts that the ‘use of FPGA was an accepted, known and predictable mechanism to adjust carrier frequencies . . . in remote radio units.’” *Id.* (quoting Pet. 61) (alteration in original). Nevertheless, Patent Owner asserts that Petitioner’s rationale amounts to relying on an “obvious design choice” rationale. *Id.* (quoting *Fanduel, Inc. v. Interactive Games LLC*, 966 F.3d 1334, 1343–44 (Fed. Cir. 2020) (finding a “gap”

between the identification of a well-known concept and the “beneficial application of that concept” to another system is not filled by calling the addition “an obvious design choice”)).

For the reasons below, Petitioner’s arguments are persuasive and Patent Owner’s counter arguments are unavailing. As found and discussed further below, Petitioner provides specific reasons with factual underpinnings to combine the reference teachings and persuasively show the obviousness of dependent claims 4, 11, 15, and 22, with a reasonable expectation of success. After considering the full record, we determine that Petitioner’s showing of obviousness as outlined above and as discussed further below is persuasive.

iii. Motivation to Combine

We credit Dr. Houh’s testimony that a person of ordinary skill in the art would have been motivated to combine Canon’s teachings regarding FGPA’s in remote units with Wu. Ex. 1012 ¶¶ 122–124. As Dr. Chrissan acknowledges, Wu discloses that its RTUs have FGPA’s, and FGPA’s can be adjusted. Ex. 1038, 71:1218, 72:8–15, 76:4–15; Ex. 1007 ¶¶ 55–56, Figs. 7–1, 7–2. Wu further teaches that the channels transmitted by its RTUs need to be adjusted for changing needs. Ex. 1007 ¶ 46 (“Allocating channels...as conditions change.”). Although Wu teaches that its matrix switch can adjust which channels are sent to the RTUs, Wu does not expressly teach all the details for how the FPGA in the RTUs adjusts to process the different channel sets from the matrix switch. Wu, however, recognizes that an “FPGA can also be used to . . . otherwise manage the carrier channels.” Ex. 1007 ¶ 55. Wu also teaches that the “RTU unit ha[s] a similar structure of the host unit of Fig. 6 that mirrors a host unit’s functionality.” *Id.* ¶ 56.

Cannon explains how to adjust an FPGA in a remote unit to process different channels. Cannon describes that using a FPGA includes DUCs and DDCs that can be programmed with a center frequency and bandwidth to reconfigure the carrier of the RRH. Ex. 1012 ¶ 122; Ex. 1017 ¶ 47, Fig. 6; *see also* Ex. 1012 ¶¶ 113–124; Ex. 1017 ¶ 19, 21–22, 34, 36, 46. Therefore, Cannon fleshes out Wu’s teaching that an “FPGA can also be used to . . . otherwise manage the carrier channels” (Ex. 1007 ¶ 55), and the “RTU unit ha[s] a similar structure of the host unit of Fig. 6 that mirrors a host unit’s functionality” (*id.* ¶ 56). Further, Cannon teaches a reason for applying its teachings regarding managing carrier channels in FGPA’s in remote units: to allow each remote unit to be simply adjusted to meeting the changing needs of an end user with only a programming change. Ex. 1012 ¶ 123; Ex. 1017 ¶ 46. As part of this managing of carrier channels to meet the user’s changing needs, Cannon teaches adjusting the number, position, and bandwidths of carrier frequencies and spectral regions by programming the FGPA’s in remote units. Ex. 1017 ¶¶ 34, 35, 46. These combined teachings would have motivated a person of ordinary skill in the art to combine Canon’s teachings regarding FGPA’s in remote units with Wu’s teachings regarding FGPA’s in remote units. Ex. 1012 ¶¶ 122–124.

*iv. Alleged Contrasting Approaches in Wu and Cannon
and Reconfigurable Arguments*

Patent Owner argues that a person of ordinary skill in the art “would not have felt the need to modify [Wu’s and Cannon’s] two contrasting approaches.” PO Resp. 43 (citing Ex. 2016 ¶¶ 58–59). According to Patent Owner, the Petition fails to show a motivation for “replacing Wu’s configuration and reconfiguration approach with Cannon’s alleged

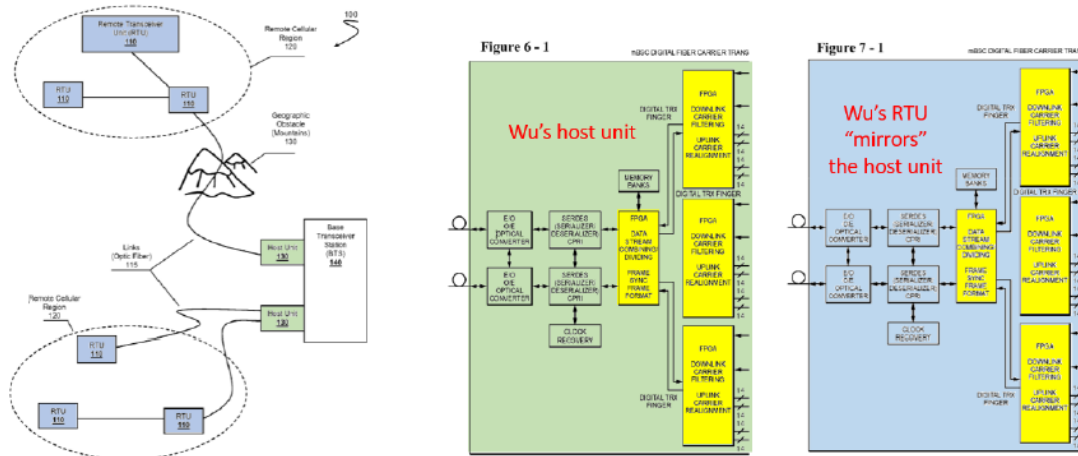
decentralized approach.” *Id.* (citing Pet. 60–61). Patent Owner explains that “[t]he key reason Petitioner offers for why a [person of ordinary skill in the art] would have been motivated to do so is that Wu teaches reconfiguring the radio units based on user load and Cannon teaches a programmable FPGA to meet the changing needs of the end user,” but “this reason is misplaced, conclusory, and does not sufficiently show a motivation to combine.” *See id.* (citing Pet. 60–61). Patent Owner also argues that Wu’s RTUs are “pass-through devices that are not configurable.” *See id.* at 39; *accord id.* at 30 (citing Ex. 2016 ¶ 51).

Patent Owner’s arguments are unavailing. Petitioner contends that it is not “replacing Wu’s routing policy with Cannon’s FPGAs.” Reply 29. Rather, according to Petitioner, “Cannon and Wu are compl[e]mentary,” because “Wu’s matrix switch uses its routing policy to route different channels to the RTUs and then Wu’s RTUs use their FPGAs as taught by Cannon to correctly process the different channels for transmission.” *Id.* (emphasis omitted). Petitioner further explains that neither Cannon nor Wu use “centralized” or “decentralized” labels, and the references use similar approaches, namely “both use the approach where the host and remotes have mirror functionality such that the host is configured to send the relevant/desired channels to the remotes and the remotes are configured to reverse the process using an FPGA.” *See id.* at 29–30 (persuasively comparing Wu’s and Cannon’s approaches based on cited and annotated teachings and figures in the references).

Petitioner also argues persuasively that the record does not support Patent Owner’s assertion that “Wu’s RTUs are merely ‘transparent, pass-through devices that are not configurable.’” Reply 34 ((quoting PO Resp.

39). Petitioner provides persuasive evidence in the form of an annotated figures from Wu showing that Patent Owner’s argument relies on a “false assumption that only one part of a system can be configured (e.g., Wu’s matrix switch or RTU).” *Id.* at 33 (annotating Fig. 5–1 of Wu and showing that “Wu allows for configuring . . . the (a) matrix switch . . . to transmit the desired analog channels to the host unit, (b) host unit . . . to convert only the desired channels from analog to serialized digital channels, and (c) RTUs . . . to reverse the process and convert the serialized digital channels back to the original, desired analog channels)” (citing Ex. 1038 69:14–21)). Petitioner adds that “Wu’s Figure 7-1 shows that each RTU contains FPGAs, which are configurable as taught by Cannon.” *Id.* at 34. Petitioner also shows that, similar to Wu, “Cannon’s remotes are configured such that the FPGAs in their DART modules reverse the processes to transmit the correct signal.” *Id.* at 31 (citing Ex. 1017 ¶¶ 23–24, 27, 36, 45–46). Petitioner also shows that “Cannon configures the system in two places (host and remotes)” and “[l]ike Cannon, Wu shows the host and RTUs include modules with FPGAs.” *Id.*

Petitioner provides the following annotated version of Wu's Figure 5 to support its showing (Reply 31):



As annotated above, Wu’s Figure 6–1 (middle) depicts host unit (green) with several FPGAs (yellow), Wu’s Figure 7–1 (right) depicts Wu’s RTU (blue) with several FPGAs (yellow), and Figure 1 (left) shows host units and RTUs connected in a network. Petitioner explains that “[l]ike Cannon, for downlink, Wu’s host unit(s) is configured to ‘optimally digitize desirable channels’ and ‘filters out unused white space within bands.’” Reply 32 (quoting Ex. 1007 ¶ 49). Petitioner also explains that “[l]ike Cannon, Wu’s RTU ‘employs a reverse process’ [(Ex. 1007 ¶ 50)] that ‘mirrors a host unit’s functionality’ [(*id.* ¶ 56)] with FPGAs (Figure 7-2). EX1007.” *Id.* (further annotating Wu’s Fig. 5–1 to “show[] the RTU employing the reverse process for annotated channels 5–9”).²²

²² Petitioner also relies on Patent Owner’s declarant, Dr. Chrissan, who supports Petitioner by conceding during his deposition that Wu’s RTU’s have adjustable FPGAs. Reply 28 (citing Ex. 1038, 71:12–18 (agreeing that Wu’s RTUs have FPGAs), 72:8–15 (conceding that the “P” in “FPGA” “generally means that it is programmable such that it can have its hardware

Patent Owner does not dispute Petitioner’s showing that Wu’s FPGAs are reconfigurable or that Wu’s FPGA in its RTU mirrors the functionality of the FPGA in the host. Rather, Patent Owner argues that this showing is “beside the point.” Sur-reply 15–16 (“The fact that Wu’s RTUs also perform a reverse process in terms of serializing, digitizing, or filtering out unused white space within bands is beside the point.” (citing Reply 30–33)). Patent Owner abandons its Response argument that Wu’s RTUs are not reconfigurable and contends that “[Patent Owner] *does not dispute that Wu’s RTU can be reconfigured* for the irrelevant ‘reverse processes’ as discussed above (e.g., serializing, digitizing, etc.).” *Id.* at 16 (emphasis added). Patent Owner clarifies that “[u]nlike Cannon, Wu does not disclose reconfiguration inside the RTU *for the purpose of reallocating carrier channels.*” *Id.* at 15 (emphasis added).

Patent Owner also responds that “Petitioner misunderstands [Patent Owner’s] argument regarding the contrast between Wu’s centralized approach and Cannon’s decentralized approach.” Sur-reply 14. Patent Owner explains that it “is not alleging that Petitioner is ‘replacing’ Wu’s routing policy with Cannon’s FPGA.” *Id.* at 14–15. Rather, Patent Owner asserts that “*there is no need for [Wu’s] RTU to be reconfigured*” (*id.* at 15 (emphasis added)), because Wu’s RTUs “can transmit whatever channels the matrix switch sends to them” (*id.* at 14), as Wu’s “channels are already managed and sent by the matrix switch” (*id.* at 15).

In summary, Patent Owner concedes that Wu’s RTUs are reconfigurable for some purposes but maintains its argument that Wu’s

configuration changed after it is delivered to an end customer and placed in a device”), 76:4–15 (similar testimony).

RTUs are “pass-through devices” in the sense that they process whatever frequencies that Wu’s matrix switch sends to them without a “need[]” to change any settings in the RTUs. *See* PO Resp. 39; Sur-reply 14–15. As discussed further below, as Petitioner argues, Wu does not disclose that its RTUs are pass-through devices, relying partly on its showing that Wu’s RTUs are reconfigurable (which Patent Owner does not dispute). Reply 34 (noting that Wu’s RTUs reverse the process of digitization by employing FPGAs (citing Ex. 1007, Fig. 7-1)).

Whether Wu *discloses* reconfiguring its RTUs *for the purpose of reallocating carriers* is not germane to the obviousness inquiry at issue, because Petitioner relies the combined teachings of Wu and Cannon for that purpose, as discussed above. *See, e.g.*, Reply 34 (summarizing the showing based on the combination). As noted above, Patent Owner agrees with Petitioner that Cannon’s and Wu’s RTUs are reconfigurable. *See* Sur-reply 15 (conceding that “Cannon does disclose *reconfigurable* DART modules in both the Host Unit and the Remote Unit” (emphasis added)), 16 (“not disput[ing] that Wu’s RTU can be reconfigured”).

Petitioner relies on Cannon for its “details” as to how to reconfigure FPGAs in RTUs, whereas Wu’s teachings are sparse on those details. *See* Reply 29 (arguing that “Cannon fleshes out Wu’s teaching that an “FPGA can also be used to . . . otherwise manage the carrier channels” (citing Ex. 1007 ¶ 55) (alteration in original)), 28 (“Wu does not expressly teach all the details for how the FPGA in the RTUs adjusts to process the different channel sets from the matrix switch.”). As discussed above, and also further below, Petitioner provides persuasive and uncontradicted evidence showing that Wu’s and Cannon’s remote units are reconfigurable for several purposes

(which Patent Owner does not dispute), and also shows that the combined teachings of Wu and Cannon teach reconfiguring an FPGA in an RTU for the purpose of reallocating carriers.

In addition, Petitioner shows that Cannon's method provides benefits to Wu's system by providing reconfigurable bandwidths for Wu's carriers *using programming* at the RTUs. Specifically, the Petition shows that "[e]ach FPGA [in Cannon] is programmable to automatically configure the remote unit itself to alter *both the bandwidths and the frequencies* that are processed by the remote unit [*adjust a capacity of the at least the first remote unit*]." Pet. 63 (citing 1017 ¶ 46; Ex. 1012 ¶ 126) (emphasis and claim 4 language added in original). Cannon's paragraph 46 supports Petitioner, by stating that "BW1 and BW2 *may be adjusted to accommodate larger or narrower bandwidths*." Ex. 1017 ¶ 46 (emphasis added). Relying on the same paragraph in Cannon, Dr. Houh also supports Petitioner. Ex. 1012 ¶ 126 (testifying that "[e]ach FPGA is programmable to automatically configure the remote unit itself to alter *both the bandwidths and the frequencies* that are processed by the remote unit [*adjust a capacity of the at least the first remote unit*]," and "Cannon discloses that the FPGAs are adjusted 'to meet changing needs of the end user'" (citing and quoting Ex. 1017 ¶ 46) (emphasis and claim 4 language added in original)). In addition, Petitioner points out that Cannon's method "conserve[s] the available bandwidth of the communication links 130 by separating and individually processing spectral regions of interest from a larger RF spectrum." Pet. 55 (citing Ex. 1017 ¶ 21; Ex. 1012 ¶ 115).

Patent Owner does not address this benefit of a *programmable* adjustable bandwidth in Wu's RTU as a beneficial option as suggested by

Cannon. *See generally* PO Resp.; Sur-reply. Petitioner recognizes that Wu’s system also alters bandwidths on the host, but as noted, Petitioner also shows that Cannon’s modification providing alteration of bandwidths at the RTUs using easily programmable FPGAs provides details regarding implementation of Wu’s “manage[ment of] the carrier channels” using an FPGA (Ex. 1007 ¶¶ 55–56) at the remote device. Even if we were to find Patent Owner is correct that Wu’s remote devices are transparent, pass-through devices, Petitioner shows that the combination provides an obvious alternative to Wu’s system. *See* Pet. 53 (showing specific details of FPGA 503), 60–61 (arguing known benefits of software programming for frequency selection (citing Ex. 1012 ¶ 124); Reply 34 (citing Ex. 1007 ¶ 49).²³ As the testimony of Dr. Houh shows, adding bandwidth to a carrier

²³ Wu’s method appears generally to adjust bandwidths by adding or subtracting carriers and it also filters out unused white space at the host, whereas Cannon’s method describes how to alter the bandwidths surrounding carriers using FPGA filtering (programming) and also how to eliminate the bandwidth between spectral regions at baseband, which also allows for better sampling rates at either the host or the remote units. *Compare* Ex. 1007 ¶ 49 (providing an envelope around one or more carriers), *with* Ex. 1017 ¶ 17 (discarding information between relevant spectral regions and re-sampling based on the relevant spectral regions), ¶ 21 (conserving bandwidth) ¶ 23 (similar), ¶ 29 (similar), ¶ 32 (similar describing “bandwidth conservation”), ¶ 46 (adjusting bandwidths to be narrower or wider), Fig. 4A (eliminating non-relevant spectral region 450 and adjusting BW1 and BW2 (¶ 29)). Petitioner generally cites to efficiency gains and points to conserved bandwidth, but Petitioner does not specifically cite lower sampling rates due to the conserved (lower) bandwidths as a benefit. Even though this lower sampling rate is arguably another detail flowing from Cannon’s teachings, we do not consider it as part of Petitioner’s showing for motivation given that the parties do not specifically address it in this proceeding. *See* Pet. 55 (conserving bandwidths (citing Ex. 1017 ¶ 21), 61 (efficiency gains).

including by adjusting the remote unit via simple programming provides resources in an efficient manner, which is within the claim scope of dynamically adjusting a capacity of the remote unit, as claim 4 requires. *See* Ex. 1012 ¶ 126; Ex. 1001, code (57) (describing “field reconfigurable . . . multi-modulation schemes (modulation-independent), multi-carriers, *multifrequency bands* and multi-channels” (emphasis added)); *See* Pet. 61–63 (programming benefits).

In summary as to the FPGA programming benefit, even though Wu is silent as to how or whether it selects frequencies by changing RTU settings, this does not undermine Petitioner’s showing that it would have been obvious to select frequencies and adjust their bandwidths by reconfiguring FPGAs using simple programming in Wu’s RTUs to meet the changing needs of a user. *See* Pet. 61–63; Reply 28 (“Wu further teaches the channels transmitted by RTUs need to be adjusted for changing needs”) (citing Ex. 1007 ¶ 46 (“Allocating channels . . . as conditions change.”)). Although Wu discusses modifying bandwidths and carriers at the host end, Wu does not specifically disclose it does so by using programming, which is one reason why a skilled artisan would have turned to Cannon for its FPGA details under Petitioner’s showing. *See* Ex. 1007 ¶¶ 49, 50, 55, 56; Pet. 59–60; Reply 27 (“The petition explained Cannon’s FPGA teachings allow remote units to be “*simply adjusted*” to meet changing needed with “*only a programming change*.” (citing Pet. 59–60)).

Petitioner also shows that it would have been obvious to implement changes for resource allocation at the RTU and/or the host side, where both references have reconfigurable FPGAs at both locations. *See* Reply 33 (Patent Owner’s “argument has a false assumption that only one part of a

system can be configured (e.g., Wu’s matrix switch or RTU).”). That is, even if, as Patent Owner argues, Wu’s RTU accepts all frequencies sent to it by the matrix switch according to Patent Owner’s arguments, Wu does not show how its RTU only accepts and processes certain frequencies (e.g., within the three frequency bands depicted in Figures 6–1, 7–1, and 7–2). *See* Reply 28 (annotating and joining Wu’s Figures 7–1 and 7–2 together). For example, Wu does not explain the “details” of how its RTUs tune to the frequencies it receives at the RTU’s FPGA in Figure 7–1 and then pass those frequencies to one of the three different analog hardware transmitters in Figure 7-2. *See* Reply 28 (“Wu does not expressly teach all the details for how the FPGA in the RTUs adjusts to process the different channel sets from the matrix switch.”), 34 (“Cannon is providing more detail about adjusting FPGAs, not supplying the teaching to change carriers.”).

Moreover, the record does not support Patent Owner’s argument that Wu’s RTUs are pass-through devices that automatically tune to a whole range of frequencies within the three bands specified in Figure 7-2. As noted above, Patent Owner agrees some “reverse” processing occurs to deserialize the digital signals and recreate RF signals. *Sur-reply* 15–16. It is not clear how Wu’s RTU is able to tune to frequencies transmitted to it within the three bands disclosed bands without any tuning changes at the RTU while also rejecting other frequencies that are not within the three bands. *See* Reply 23 (annotating Figs. 7-1 and 7-2 and showing Bands 1–3). On the other hand, Cannon describes that “DART modules in a remote unit are specific for a particular frequency band . . . regardless of the modulation technology being used” so that “remote unit 106 is configurable to any of the above frequency bands and technologies as well as any new technologies or

frequency bands that are developed.” Ex. 1017 ¶ 25. And “the DART module *has been programmed to recognize that spectral regions* 451 and 452 contain information to be transported over DAS 100.” *Id.* ¶ 29 (emphasis added). The “digitized RF spectrum 400 . . . is processed by either a Host or Remote DART module of one embodiment.” *Id.*

Wu supports Petitioner’s observation that Wu is short on details of reconfiguring FPGAs and its schematic circuitry to provide such alleged automatic tuning (assuming for the sake of argument that the tuning is somehow automatic—e.g., without any configuration of the FPGAs) whereas Cannon provides details for such reconfiguring. That is, Wu devotes only two short paragraphs to describe the operation of Wu’s FPGAs in the schematic circuitry associated with the host unit and the remote units. *See* Ex. 1007 ¶¶ 55–56 (briefly describing Figs. 6 and 7 of Wu). In paragraphs 56–57, Wu specifically states that (like Cannon’s system), the RTU “ha[s] similar structure of the host unit of FIG. 6 and . . . mirrors a host unit’s functionality” including with respect to “otherwise manag[ing] the carrier channels.” *See id.*

Petitioner relies on this general teaching in Wu that the RTU mirrors the host unit’s functionality. *See* Reply 31 (annotating Wu’s Figures 1, 5–1, 7–1 as reproduced above). In support of this showing, Petitioner cites to Wu’s paragraphs 55 and 56 and Figure 7-1, each of which describe reconfiguring an FPGA. *Id.* at 29 (citing Ex. 1007 ¶ 55), 32 (arguing that “Wu’s RTU ‘employs a reverse process’ . . . that ‘mirrors a host unit’s functionality’ . . . with FPGAs” (quoting Ex. 1007 ¶¶ 50, 56; citing Ex. 1007, Fig. 7-2)). As also noted above, Patent Owner does not dispute that Wu teaches reconfiguring FPGAs, Patent Owner only disputes the “purpose”

for the reconfiguration. Sur-reply 15–16 (alleging “Wu does not disclose reconfiguration of the RTU for the relevant purpose of reallocating carrier channels”).

Petitioner recognizes that “Wu teaches that the matrix switch can adjust which channels are sent to the RTUs,” and Petitioner cites to Wu for its teaching that “[a]n FPGA can also be used to . . . otherwise *manage the carrier channels*.” Reply 28–29 (emphasis added) (alteration in original) (quoting Ex. 1007 ¶ 55). Although cited paragraph 55 begins by discussing a *host unit*’s FPGA, the reference in the final sentence of that paragraph to “[a]n FPGA” is generic. *See* Ex. 1007 ¶ 55. In any event, even if that reference to an FPGA is not generic, as noted above, Petitioner reproduces and annotates Wu’s Fig. 7-1 (which depicts a remote unit’s FPGA that “mirrors” a host unit) and cites to paragraph 50, and paragraph 56, which refer to an FPGA in the remote units, and which state that Wu’s RTU “employs a reverse process” and Wu’s RTU “mirrors a host unit’s functionality,” respectively. Reply 32 (quoting Ex. 1007 ¶¶ 50, 56). In other words, Petitioner shows that this “mirroring” by the RTU in paragraph 56 includes the functionality of the FPGA in paragraph 55, which “can . . . also be used to . . . *otherwise manage the carrier channels*.” *See id.*; Ex. 1007 ¶¶ 55–56.

Patent Owner addresses Wu’s paragraph 55 but does not address Petitioner’s reliance on Wu’s paragraph 56 and Petitioner’s showing with respect to annotated Figure 7-1, which at least suggest that Wu’s RTUs help to “otherwise manage the carrier channels” according to the discussion above. *See* Sur-reply 14 (arguing that Wu’s disclosure “is in regard to the host unit, *not the RTU*” (citing Ex. 1007 ¶ 55); Ex. 1007 ¶¶ 55–56.

Therefore, Patent Owner’s argument that “Wu’s RTUs do not need to be reconfigured as they can transmit whatever channels the matrix switch sends to them” is attorney argument lacking an evidentiary citation in the record to support it. *See* Sur-reply 14 (no citation). Although Patent Owner cites to Dr. Chrissan’s testimony for the proposition that Wu’s RTUs are pass-through devices, Dr. Chrissan’s cited testimony is conclusory as Dr. Chrissan does not address Wu’s paragraphs 55–56 or otherwise sufficiently explain the factual basis for the conclusion that Wu’s RTUs are merely pass-through devices. *See* PO Resp. 30 (citing Ex. 2016 ¶¶ 50–51); Ex. 2016 ¶¶ 50–51.

In other words, as Petitioner persuasively shows, Wu discloses reconfiguring an RRU without “*expressly teach[ing] all the details* for how the FPGA in the RTUs adjusts to process the different channel sets from the matrix switch.” Reply 28 (emphasis added); *see also* Pet. 59 (arguing that “Wu . . . describes reconfiguring each RTU based on the load of each unit” without explaining how Wu performs the reconfiguring) (citing Ex. 1007 ¶¶ 11, 39, 44; Ex. 1012 ¶ 12)). Therefore, Petitioner turns to Cannon to teach a “suitable way to reconfigure the carrier frequency of the remote radio” by “us[ing an] FPGA[, which] *requires only a programming change.*” Pet. 60 (citing Ex. 1012 ¶ 123). Moreover, as Petitioner shows, “[e]ach FPGA is programmable to automatically configure the remote unit itself to alter *both the bandwidths and the frequencies that are processed by the remote unit*” in order to “meet the changing needs of the user.” *Id.* at 62–63 (citing Ex. 1017 ¶ 46; Ex. 1012 ¶ 126). Petitioner also persuasively shows that “Cannon explains how to adjust an FPGA in a remote unit to process different channels.” As an example, Petitioner explains that “Cannon . . .

teaches an FPGA can contain DUCs/DDCs to isolate the correct amount of bandwidth (e.g., in Wu, channels 1 individually vs. channels 1–4 collectively) and correct center frequency (e.g., in Wu, frequency 1 vs. frequency 2). Reply 29.

The record supports Petitioner’s persuasive rationale for combining the teachings of Wu and Cannon. At cited paragraph 46, Cannon teaches adjusting an FPGA’s carrier center frequencies and the bandwidths “*to accommodate larger or narrower bandwidths*” “to meet changing needs of the end user.” See Ex. 1017 ¶ 46; Pet. 62–63 (citing Ex. 1017 ¶ 46; Ex. 1012 ¶ 126). Petitioner notes that Wu also teaches adjusting bandwidths, whereas Cannon teaches details about adjusting FPGAs and optimizing bandwidth. See Pet. 62–63; Reply 34. Even if we were to agree with Patent Owner’s assertion that Wu’s system already provides accommodation for all the carriers it receives without modifying its RTU’s FPGAs *for that purpose*, Patent Owner does not address Petitioner’s persuasive showing that Cannon’s FPGA reconfiguration teachings provide a suitable option for reallocating carriers using simple programming of an FPGA.

In *Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1374 (Fed. Cir. 2019), the court stated that

[a] motivation to combine may be found “explicitly or implicitly in market forces; design incentives; the ‘interrelated teachings of multiple patents’; ‘any need or problem known in the field of endeavor at the time of invention and addressed by the patent’; and the background knowledge, creativity, and common sense of the person of ordinary skill.”

Id. (quoting *ZUP, LLC v. Nash Mfg., Inc.*, 896 F.3d 1365, 1371 (Fed. Cir. 2018) and *Plantronics, Inc. v. Aliph, Inc.*, 724 F.3d 1343, 1354 (Fed. Cir. 2013)). Under similar circumstances, the court found that Board relied on

“enough evidence to support a finding that a person of ordinary skill in the art would have turned to Nelson, a well-known data compression textbook, *to better understand or interpret O’Brien’s compression algorithms*”). *Id.* (emphasis added). *Realtime Data* is on point because as discussed above, Petitioner shows persuasively that a person of ordinary skill in the art would have turned to Cannon “to better understand or interpret,” *id.*, Wu’s reprogramming of its FPGA in a remote radio unit using simple programming.

In *CyWee Grp. Ltd. v. ZTE (USA), Inc.*, No. 2021-1855, 2024 WL 187918 at *5 (Fed. Cir. Jan. 18, 2024), our reviewing court held that a petitioner can show sufficient motivation by showing that there is “a known technique to address a known problem using ‘prior art elements according to their established functions,’” (citing *Intel Corp. v. PACT XPP Schweiz AG*, 61 F.4th 1373, 1380 (Fed. Cir. 2023) (“*PACT*”) and quoting *Intel Corp. v. Qualcomm Inc.*, 21 F.4th 784, 799–800 (Fed. Cir. 2021) (“*Qualcomm*”), ‘unless its actual application is beyond’ a skilled artisan’s capability” (citing *PACT*, 21 F.4th at 799–800 and quoting *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007)). In that case, the court found motivation sufficient based on expert testimony that showed certain benefits and also showed that “because [a prior art reference] *does not explicitly disclose algorithms* to evaluate the orientation of its sensors, a skilled artisan would look to a method for mathematically determining sensor orientation.” *Id.* at *5 (emphasis added). Therefore, *CyWee* is also on point because Petitioner’s evidence shows that Wu does not discuss the details of reconfiguring the RTU’s FPGA, and it further shows that an artisan of ordinary skill would have turned to Cannon for those details to solve a similar problem of routing

the desired carriers to an RTU in a predictable fashion using well-known simple programming techniques while providing certain benefits such as adjusting the desired carriers and conserving and adjusting bandwidths to meet the changing needs of a user to provide efficiency gains. *See* Pet. 58–63 (citing Ex. 1012 ¶¶ 124–128).

As indicated above, *CyWee* relied on *PACT*, 61 F.4th at 1381. *PACT* reasoned that that “[i]f there’s a known technique to address a known problem using ‘prior art elements according to their established functions,’ then there is a motivation to combine . . . [and] ‘[i]t’s not necessary to show that a combination is the best option, only that it be a suitable option.’” *Id.* (fourth alteration in original). As Petitioner shows, Cannon reveals use of a known FPGA technique according to its established functions of simple programming to provide improvement in transport during a carrier reassignment such as in Wu, where both prior art references employ FPGAs to provide resources to remote units. *See* Pet. 60–63 (arguing the use of FPGAs would predictably achieve reassignment on line without interrupting the service (citing Ex. 1012 ¶ 124)).

Moreover, *PACT* faulted the Board for reasoning that is remarkably similar to Patent Owner’s arguments here, namely, that Wu *already addresses* the problem of providing additional resources to an RTU so there would have been no reason to turn to Cannon. *PACT* rejected that reasoning, as follows:

The Board rejected Intel’s known-technique rationale. The Board stated that “[i]f . . . Kabemoto *already addresses* [the] problem [of cache coherency] through the use of a known technique similar to that of Bauman’s, [it] fail[ed] to see why one of ordinary skill in the art would regard Bauman’s technique as an obvious improvement to Kabemoto.” . . . *The Board’s*

reasoning belies its conclusion. That Kabemoto and Bauman address the same problem and that Bauman's cache was a known way to address that problem is precisely the reason that there's a motivation to combine under KSR and our precedent.

PACT, 61 F.4th at 1380 (emphasis added) (quoting Board's final written decision) (all but last alterations in original). *PACT* further reasoned that "contrary to the Board's suggestion, Intel *never had to show that replacing Kabemoto's secondary cache with Bauman's secondary cache was an 'improvement' in a categorical sense.*" *Id.* (emphasis added). Rather, "Intel just had to show that Bauman's secondary cache was a 'suitable option' to replace Kabemoto's secondary cache." *Id.* (quoting *Qualcomm*, 21 F.4th at 800). Here, Cannon's simple programming of a remote unit with an FPGA is at least a suitable option when providing radio resources in the form of different carriers and adjustable bandwidths as in Wu. *See* Pet. 60 (arguing that "Cannon discloses one . . . way to reconfigure the carrier frequency of the remote radio is the use of a FPGA and requires only a programming change" (citing Ex. 1012 ¶ 123)).

In summary, after considering Patent Owner's arguments, we find and determine that Petitioner provides persuasive reasons supported by factual underpinnings to combine the teachings of Wu and Cannon. In addition to showing that Cannon suggests a suitable option to reconfigure Wu's RRUs, Petitioner shows persuasively that an artisan of ordinary skill would have turned to Cannon for its details to meet the changing needs of users by adjusting Wu's FPGAs in its RRUs using simple programming. This modification would have provided dynamic reassignment of carrier frequencies with the added benefit of adjustable bandwidths using simple programming at an RTU, thereby providing dynamic reallocation of radio resources "based on changing network conditions such as traffic rate, a

consumed bandwidth, current traffic load, call rate, and load balancing.” *See* Pet. 62–63 (citing Ex. 1007 ¶¶ 41–44).

v. Different End Users

Patent Owner contends that “Petitioner’s reliance on Cannon’s teaching that FPGAs are used to meet the changing needs of the end user as a reason to combine Wu and Cannon is misplaced,” because the two references refer to different end users. *See* PO Resp. 41–42 (“Cannon is referring to the operator of the DAS network as the end user.” (citing Ex. 1017, p.7 (claims 11 and 12 of Cannon))). This argument is unavailing. Cannon’s dependent claims 11 and 12 do not refer to an operator. In any event, the record does not support the notion that Cannon’s benefits, which may happen to flow to an operator who controls the system, also do not flow to the end mobile subscribers in Cannon and in Wu who use the system. *See* Ex. 1007 ¶ 4 (describing as background solutions for providing coverage to a cell area); Ex. 1017 ¶ 2 (describing as background providing wireless service to wireless subscriber units). In other words, as set forth by Petitioner, Wu’s system as modified by Cannon’s teachings provides benefits by meeting the changing needs of the end user, as discussed above in connection with claims 1 and 4.

vi. Reasonable Expectation of Success

Alleging a failure by Petitioner to show a reasonable expectation of success, Patent Owner argues that using an FPGA in Wu’s system would “take too long for Wu’s dynamic timing needs, which require reassignments to occur with minimal delay time.” PO Resp. 49–50 (citing Ex. 2001 ¶¶ 37,

42–46, 68).²⁴ Patent Owner contends that “Cannon’s radio units Petitioner proposes are not suitable for the dynamic, real-time reassignments that Wu requires.” *Id.* at 49 (citing Ex. 2016 ¶¶ 60–62). Patent Owner argues that “loading a new FPGA image in a radio unit every time a carrier reassignment occurs would interrupt normal operation and take too long for Wu’s dynamic timing needs.” *Id.* at 49.

Contrary to these arguments, as Petitioner argues, Wu does not require instantaneous timing to reassign carriers. As Petitioner argues, “Wu never says the changes must occur ‘with minimal delay’ or ‘quickly.’” Reply 35. As Petitioner also argues, Wu allows for loading new programming. *Id.* (citing Ex. 1007 ¶ 40 (“Policy 255 is . . . programmatic instructions”), ¶ 48 (“pull a new policy 255 from a remote server,” and “policy 255 could be reconfigured by physically replacing memory 251”). Wu also supports Petitioner in that it states that the “[p]olicy is considered reconfigurable if it can be externally updated or modified to reflect changes in its rules *as opposed to having a static set of rules* that are unchanging.” Ex. 1007 ¶ 48 (emphasis added).

As Petitioner also argues, the ’343 patent does not require minimal delay. *See* Reply 35 (arguing “there is no requirement in the claims that the dynamic adjustment must occur in ‘real-time,’ ‘with minimal delay,’ or ‘quickly.’” (citing Ex. 1001, 12:58–64)). Patent Owner’s argument does not

²⁴ According to Patent Owner, the Petition states that “Cannon’s ‘DART module’s FPGA can be **reconfigured by pushing a new build image onto the FPGA.**” *Id.* at 49 (citing Pet. 56; Ex. [1017 ¶ 46]). We are unable to find this specific statement in the Petition, although the internal quotation is in Cannon and it describes how Cannon’s system reconfigures its FPGAs in one embodiment.

point to timing constraints in Wu or in the challenged claims and fails to undermine the Petition’s showing of a reasonable expectation of success. *See* PO Resp. 49–50; Pet. 60–61 (showing predictability and success in the combination); Ex. 1012 ¶ 124 (“A [person of ordinary skill in the art] would also be confident the modification would enjoy a high likelihood of success given the predictable nature and successful history of use of FPGAs and radio transceivers.”).

As noted above, Petitioner argues that an FPGA in a remote unit “is beneficial” because it allows for a simple programming adjustment to meet the changing needs of the end user. Pet. 59 (citing Ex. 1017 ¶¶ 42–43, 46, Fig. 6; Ex. 1012 ¶ 122). At one of the cited passages, Cannon states that

[b]ecause FPGA 503 is a field programmable device, it can be adjusted *to meet changing needs of the end user*. For example, the center frequencies f_{c1} and f_{c2} can be reprogrammed into FPGA 503 in order to shift the locations of spectral regions 451 and 452 within spectrum 400. Similarly BW1 and BW2 may be adjusted to accommodate larger or narrower bandwidths.

Ex. 1017 ¶ 46 (emphasis added). In other words, Cannon shows that an FPGA is fast enough to shift center frequency carriers to meet the changing needs of the user’s remote unit and does not result in interrupting the service. Dr. Houh supports Petitioner and shows that FPGAs require a programming change and are adjustable to meet the changing needs of the user. *See* Pet. 60 (citing Ex. 1012 ¶¶ 123–124), 61 (“Cannon discloses a system wherein the dynamic load balancing and resource management dynamically adjusts a capacity of at least the first remote unit” (citing Ex. 10007 ¶¶ 41–44; Ex. 1012 ¶ 125)). For example, after summarizing the related teachings in Cannon (Ex. 1012 ¶ 122 (citing Ex. 1007 ¶¶ 11, 39, 42–47)), Dr. Houh testifies that “Cannon expressly teaches that the use of a

FPGA allows each remote radio unit to be adjusted to meet the changing needs of the end user, and Wu teaches that the needs of the end user can be determined by the load of the remote radio units.” Ex. 1012 ¶ 123.

Patent Owner’s declarant, Dr. Chrissan, testifies that an FPGA “flash” time is “similar in manner to how a computer reboots.” Ex. 2001 ¶ 70. As Petitioner notes as discussed above, the ’343 patent discloses a similar system to that of Cannon, including use of an FPGA to reprogram frequencies. *See* Pet. 58–59 (citing Ex. 1001, 6:36–46, 7:32–46; 10:13–27; Ex. 1012 ¶ 122; Ex. 1001, 13:45 (“FGPA”)).

As cited by Petitioner, the ’343 patent states that “the DAU Management Control module can adaptively modify the system configuration to begin to deploy, *typically* although not necessarily *slowly*, additional radio resources.” *See* Ex. 1001, 12:58–61 (emphasis added); Reply 35 (citing Ex. 1001, 12:58–64). The ’343 patent also states that “the software settings within DRU 1258 are configured *either manually or automatically* such that Carriers A, C, D and F are present in downlink output signal . . . at the antenna port of DRU 1258.” *Id.* at 6:36–40. In other words, the ’343 patent shows that, similar to Wu, the disclosed invention does not require any set maximum time to deploy additional resources. Also, the ’343 patent shows that FPGAs are suitable for dynamic reconfiguration. *See id.* at 7:43–46. (“[T]he Field Programmable Gate Arrays (FPGA) in the DAU or DRU can be dynamically reconfigured by commands received from the NOC in a manner 45 analogous to software programmability.”); Pet. 59 (citing Ex. 1001, 6:36–46, 7:32–46; 10:13–27; Ex. 1012 ¶ 122).

Claim 4 recites “[t]he system of claim 1, wherein the dynamic load balancing and resource management dynamically adjusts a capacity of at least the first remote unit.” Like the specification as relied upon by Petitioner, claim 4 does not indicate a maximum time required for dynamic balancing or adjustment or automatic configuration.²⁵

Accordingly, Patent Owner’s arguments alleging slow times as a result of the combined teachings are not commensurate with the scope of the claimed invention. *See In re Zhang*, 654 F. App’x 488, 490 (Fed. Cir. 2016) (“While a prior art reference may indicate that a particular combination is undesirable for its own purposes, the reference can nevertheless teach that combination if it remains suitable *for the claimed invention*.”) (emphasis added); *Idemitsu Kosan Co. v. SFC Co.*, 870 F.3d 1376, 1381–82 (Fed. Cir. 2017) (“Evidence concerning whether the prior art teaches away from a given invention must relate to and be *commensurate in scope with the ultimate claims at issue*.”) (emphasis added) (citing *Zhang*, 654 F. App’x at 490).

A related proceeding involving a patent with a common specification with the ’343 patent, U.S. Pat. No. 10,080,178 B2 (the ’178 patent”), supports this view. In that case, Patent Owner informed the Board that “[t]he proper construction for ‘dynamically change’ and ‘dynamically changes’ to a [person of ordinary skill] means ‘adaptively change.’” 1473-IPR, Paper 9 (Preliminary Response), 25. In that case, Patent Owner explained that “the dynamic change *does not occur instantaneously, but*

²⁵ We address claims 11 and 22 below. Claim 11 recites “[t]he system of claim 1, wherein the remote units are automatically configured by the system.” Similar to claims 4 and 15, claims 11 and 22 do not require a set time period for automatic configuration by the system or otherwise.

rather after some event in the networks—such as an indication that network must account for ‘load balancing’ or a ‘change in subscriber needs’—occurs.” *Id.* at 27 (emphasis added). To support the argument that “dynamic” is not even an “automatic” change, Patent Owner informed the Board that

[t]he ’178 patent teaches that the system components, such as the host unit (DAU) and the digital remote units (DRUs), may be configured “manually or automatically” with respect to the sets of downlink channel signals that are sent. *See generally* Ex. 1001 at 6:6–17. By not specifying, *the independent claims of the ’178 patent cover this broader “manual or automatic” scope.*

Id. at 27 (emphasis added).

Based on the foregoing discussion, we find that Petitioner establishes a reasonable expectation of combining Wu and Cannon to meet the scope of claim 4.

vii. Fiber Optics Arguments

Patent Owner contends that “Cannon[’s] invention is about optimizing the use of ***fiber bandwidth*** within a digital DAS rather than changing carriers transmitted or received at the air-interface.” PO Resp. 44. Patent Owner points to “Cannon’s use of optimizing the user of fiber bandwidth by configuring and/or reconfiguring the DART modules inside each respective host unit and remote radio unit that are responsible for processing the digitized signals transported over ***optical cables*** between the two components.” *Id.* at 45 (citing Ex. 1017, Figs. 1–3, ¶¶ 22, 41–45). Based on the alleged optimization of digital signals traveling in “optical cables,” Patent Owner emphasizes that “Cannon’s *purpose* was not for changing or reconfiguring the radio capacity or number of carriers for over-the-air transmission at the radio unit antenna.” *Id.* at 47 (emphasis added) (citing

Ex. 2001 ¶ 67). Patent Owner advances similar arguments based on its allegation that Petitioner relies on a “fundamental misunderstanding” of Cannon. *Id.* at 44; *see also id.* at 44–47.

Patent Owner’s assertion that Cannon’s alleged *purpose* is modifying “***fiber bandwidth***” over “*optical cables*” for digital baseband processing is not the proper focus for the obviousness inquiry at hand. *See* PO Resp. 45. Rather, a prior-art reference “must be considered for everything it *teaches* by way of technology and is not limited to the particular *invention* it is describing and attempting to protect.” *EWP Corp. v. Reliance Universal Inc.*, 755 F.2d 898, 907 (Fed. Cir. 1985); *see also Belden*, 805 F.3d at 1076 (same); *In re Applied Materials, Inc.*, 692 F.3d 1289, 1298 (Fed. Cir. 2012) (“A reference must be considered for everything that it teaches, not simply the described invention or a preferred embodiment.”); *In re Kahn*, 441 F.3d 977, 990 (Fed. Cir. 2006) (“[T]he teaching of the . . . reference is not limited to the specific invention disclosed.”); *In re Heck*, 699 F.2d 1331, 1333 (Fed. Cir. 1983) (“The use of patents as references is not limited to what the patentees describe as their own inventions or to the problems with which they are concerned. They are part of the literature of the art, relevant for all they contain.” (internal quotation marks omitted) (quoting *In re Lemelson*, 397 F.2d 1006, 1009 (C.C.P.A. 1968))); *In re Boe*, 355 F.2d 961, 965 (C.C.P.A. 1966) (“All of the disclosures in a reference must be evaluated for what they fairly teach one of ordinary skill in the art.”).

As set forth above, and as Petitioner persuasively argues, Petitioner relies on the combined teachings of Wu and Cannon, relying on Wu to teach reallocation of carrier resources and relying on Cannon to teach details of

processing the carrier resources and providing for bandwidth optimization for wireless transmission. Reply 34.

As Patent Owner otherwise recognizes, even though Cannon employs optical fibers, “the overall digital RF spectrum *contemplated* in Cannon is a representation of an uplink or downlink signal *intended for wireless reception or transmission by a radio unit.*” PO Resp. 47 (emphasis added) (citing Ex. 1017 ¶¶ 17, 34, 38). That is, Cannon specifically discloses reprogramming an FPGA with, for example, center frequencies f_{c1} and f_{c2} , in order to shift the locations of *spectral* regions and meet the changing needs of the user. Ex. 1017 ¶ 46; *see also* Pet. 58 (arguing that a person of ordinary skill in the art “understood that Cannon teaches that each FPGA could be programmed with a set of *carrier frequencies*” (citing Ex. 1012 ¶¶ 120–121) (emphasis added)). Cannon supports Petitioner by teaching that “the number of individual signal paths for handling additional spectral regions may be increased by configuring the FPGA with additional digital up converters and digital down converters.” Ex. 1017 ¶ 46; *see also* Pet. 62–63 (citing Ex. 1017 ¶ 46).

In other words, even though Cannon describes a method for processing certain spectral regions at baseband over optical fiber as Patent Owner argues, Cannon’s method reallocates RF carrier frequencies for wireless transmission using that method, basically because the shifting at baseband results in a corresponding “carrier” and its “spectrum” that the system transmits wirelessly in the RF range, which is the whole purpose for the shift, as Petitioner shows as summarized above and as discussed further below. For example, as Petitioner contends (Pet. 58 (citing Ex. 1017 ¶¶ 42, 46; Ex. 1012 ¶ 121)), Cannon teaches that

[b]ecause FPGA 503 is a field programmable device, *it can be adjusted to meet changing needs of the end user. For example, the center frequencies f_{c1} and f_{c2} can be reprogrammed into FPGA 503 in order to shift the locations of spectral regions 451 and 452 within spectrum 400. Similarly BW1 and BW2 may be adjusted to accommodate larger or narrower bandwidths. The number and/or position of timeslots within frame 460 provisioned for each discrete spectral region can also be reconfigured.*

Ex. 1017 ¶ 46 (emphasis added).

As Patent Owner acknowledges as noted above, these center frequencies and bandwidths processed in base band ultimately are “*intended for wireless reception or transmission by a radio unit*” as RF carrier frequencies. See PO Resp. 47 (emphasis added) (citing Ex. 1017 ¶¶ 17, 34, 38); Ex. 1017 ¶ 39 (“FPGA 503 provides a first path for processing digital signals *associated with the radio frequency signals* in a first spectral region” (emphasis added)). Similarly, Patent Owner otherwise implies that Cannon’s “purpose” system is “*for reallocating carrier channels.*” Sur-reply 15 (contending that “[u]nlike Cannon, Wu does not disclose reconfiguration inside the RTU *for the purpose of reallocating carrier channels*”) (emphasis added). These arguments support Petitioner’s similar argument that Cannon’s DAC 508 and upconverter 510 process baseband from FPGA 503 and convert it to convey RF frequencies wirelessly. See Pet. 56–57 (“Transmission path 504 continues with RF transmission interface 510 which filters, amplifies, and *upconverts the analog signal for RF transmission.*” (emphasis added) (citing Ex. 1017 ¶ 36; Ex. 1012 ¶ 118)).

Therefore, the record does not support Patent Owner’s argument that Petitioner’s “motivation to combine Wu and Cannon is premised on its

misunderstanding of Cannon and a concept that Cannon simply does not disclose,” because regardless of Cannon’s alleged “purpose” in processing baseband for optical fiber transmission, Cannon “contemplate[es]” receiving or transmitting “uplink or downlink signals *intended for wireless reception or transmission by a radio unit.*” See PO Resp. 47(citing Ex. 1017 ¶ 29) (emphasis added). Ultimately, the main reason for processing signals in baseband in Cannon is to deliver different carrier frequencies to “provide wireless service.” Ex. 1017 ¶ 2.

Although Patent Owner also argues that “Cannon is only directed to the selective processing of certain spectral regions within this spectrum,” it is not clear how this addresses Petitioner’s showing. The challenged dependent claims do not specify a bandwidth for a spectrum. Moreover, Cannon does not limit the “spectrum” to any specific bandwidth or number of carriers. See *id.* (citing Ex. 1017 ¶ 38 (providing for “three or more discrete spectral regions” and noting that the “scaling is limited only by the particular constraints of the underlying hardware used (for example, the number of available gates provided by the FPGA hardware selected by the DART equipment designer”)); see also Ex. 1017 ¶ 26 (“Although FIG. 2 illustrates a single DART module coupled to a SeRF module, a single remote unit housing may operate over multiple bands by possessing multiple DART modules.”), *id.* ¶ 21 (“BTS host unit 102 and remote units 110, 106 each accommodate processing communication signals for multiple bands and multiple modulation schemes simultaneously.”)).

Based on the foregoing discussion, we determine that Patent Owner’s arguments based on an alleged purpose of Cannon do not undermine Petitioner’s showing.

b. Summary

Petitioner persuasively shows that it would have been obvious in view of Cannon to reconfigure Wu's RTUs dynamically with build information to provide resource allocation by programming different bandwidths and carrier frequencies to meet the changing needs of a user with a reasonable expectation of success.

3. Claims 11 and 22

Claim 11 recites "[t]he system of claim 1, wherein the remote units are automatically configured by the system." Claim 22 depends from claim 12 and recites materially the same limitation in method form. Petitioner relies on its analysis of claim 11 to address claim 22. Pet. 63–66.

Petitioner's analysis generally tracks its showing for claim 4, with Petitioner relying on the same reasons to combine Wu and Cannon. *See id.*

With respect to Cannon, to address the "automatically configure" limitation of claims 11 and 22, Petitioner states as follows:

Cannon discloses a digital to analog radio frequency transceiver (DART) module that separates spectral regions of interest of the overall spectrum. In Fig. 5, shown above, the DART module in each remote unit contains a field programmable gate array (FPGA) 503. *Each FPGA is programmable to automatically configure the remote unit itself to alter both the bandwidths and the frequencies that are processed by the remote unit.* Cannon discloses that the FPGAs are adjusted "to meet changing needs of the end user," EX-1017, ¶00469:45-47, and located in the remote units to allow the remote units to be adjusted automatically by using "predefined configuration builds [that] are stored in a memory," such that "a DART Module's FPGA can be reconfigured by pushing a new build image onto the FPGA." EX-1017, ¶00469[]; EX-1012, ¶131.

Pet. 65.

For similar reasons to those discussed in connection with claim 4 in Section II.E.2 above, we determine that Petitioner’s showing for combining the teachings of Wu and Cannon is persuasive. Pet. 63–66. Patent Owner relies on its unavailing arguments with respect to combining Wu and Cannon that we address above in connection with claim 4. *Supra* § II.E.2. Similar to our determined above in connection with claim 4, Petitioner persuasively shows that it would have been obvious in view of Cannon to reconfigure FPGAs in Wu’s RTUs automatically by using build information to program different bandwidths and carrier frequencies to meet the changing needs of a user based on changing load conditions. In addition, as noted above, Patent Owner “*does not dispute that Wu’s RTU can be reconfigured for the irrelevant ‘reverse processes . . . (e.g., serializing, digitizing, etc.)’*” Sur-reply 16 (emphasis added).

4. Summary

Based on the foregoing discussion, we determine that Petitioner shows by a preponderance of evidence that Wu and Cannon would have rendered claims 4, 11, 15, and 22 obvious.

III. RULE ESTOPPEL

Petitioner asserts that estoppel applies under 37 C.F.R. § 42.73(d)(3) based on a prior adverse judgment with respect to a related patent. *See* Pet. 2–6. Patent Owner disagrees that rule estoppel applies. PO Resp. 21–22. Based on Petitioner’s showing of obviousness and common law collateral estoppel with respect to the DAU and digital representation of radio resources limitations of the challenged claims as indicated above, we do not reach alleged estoppel under 37 C.F.R. § 42.73(d)(3).

IV. CONCLUSION

For the reasons discussed above, Petitioner has shown by a preponderance of the evidence that claims 1–22 of the '343 patent are unpatentable, as summarized in the table below.

Claims	35 U.S.C. §	Reference(s)/Basis	Claims Shown Unpatentable	Claims Not shown Unpatentable
1–3, 5– 10, 12– 14, 16– 21	103	Wu	1–3, 5–10, 12–14, 16–21	
4, 11, 15, 22	103	Wu, Cannon	4, 11, 15, 22	
Overall Outcome			1–22	

V. ORDER

Accordingly, it is

ORDERED that Petitioner establishes by a preponderance of evidence that challenged claims 1–22 are unpatentable;

FURTHER ORDERED that a copy of this Final Written Decision shall be entered into the record in IPR2023-00820 and in IPR2023-00832; 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. § 90.2.²⁶

²⁶ 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

For PETITIONER:

Philip P. Caspers
Samuel A. Hamer
CARLSON CASPERS VANDENBURGH & LINDQUIST
pcaspers@carlsoncaspers.com
shamer@carlsoncaspers.com

For PATENT OWNER:

David D. Schumann
Palani P. Rathinasamy
Moses Xie
Timothy Dewberry
FOLIO LAW GROUP PLLC
david.schumann@foliolaw.com
palani@foliolaw.com
moses.xie@foliolaw.com
timothy.dewberry@foliolaw.com

Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding. *See* 84 Fed. Reg. 16654 (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).