Trials@uspto.gov
571-272-7822

Paper 37
Entered: January 30, 2024

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

AT&T CORP., AT&T COMMUNICATIONS LLC, AT&T SERVICES, INC., AT&T MOBILITY LLC, and AT&T MOBILITY II, LLC.,[1]
Petitioner,

v.

DALI WIRELESS INC.,
Patent Owner.

IPR2022-01212
Patent 8,682,338 B2

Before KARL D. EASTHOM, BARBARA A. BENOIT, and SHARON FENICK, *Administrative Patent Judges*.

EASTHOM, *Administrative Patent Judge*.

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

[1] After the Board joined AT&T Corp., AT&T Communications LLC, AT&T Services, Inc., AT&T Mobility LLC, and AT&T Mobility II, LLC as a Petitioner party to this proceeding based on its petition and motion for joinder in IPR2023-00646, the Board terminated original Petitioner Ericsson, Inc. *See* Papers 23, 29.

I. INTRODUCTION

Ericsson Inc. ("Petitioner") filed a (corrected) Petition pursuant to 35 U.S.C. §§ 311–319 to institute an *inter partes* review of claims 1–12 of U.S. Patent No. 8,682,338 B2 ("the '338 patent"), supported by the Declaration of Henry Houh, Ph.D. Paper 6 ("Pet."); Ex. 1003 ("Houh Declaration"). Dali Wireless, Inc. ("Patent Owner") filed a Preliminary Response with the (first) Declaration of Douglass A. Chrissan, Ph.D. Paper 8 ("Prelim. Resp."); Ex. 2008. The parties also filed pre-institution supplemental briefing authorized by the Board to address a claim construction issue. *See* Paper 11 ("Pet. Pre-inst. Reply")); Paper 15 ("PO Pre-inst. Sur-reply").

After the Institution Decision (Paper 17, "Inst. Dec."), Patent Owner filed a Response (Paper 29, "PO Resp.") with the (second) Declaration of Douglas A. Chrissan, Ph.D. (Ex. 2008, "Chrissan Declaration"), Petitioner filed a Reply (Paper 30, "Reply") with the Reply Declaration of Anthony Henry Houh, Ph.D. (Ex. 1014, "Houh Reply Declaration"), and Patent Owner filed a Sur-reply (Paper 33, "Sur-reply"). Patent Owner deposed Dr. Houh (Ex. 2016) based on the Houh Declaration (not the Houh Reply Declaration). Petitioner deposed Dr. Chrissan (Ex. 1015) based on the Chrissan Declaration. After the briefing, the Board conducted an oral hearing and entered a Transcript thereof in the record.[2] Paper 36 ("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 preponderance of evidence that challenged claims 1–12 of the '338 patent are unpatentable.

[2] The "record" hereinafter refers to the fully developed trial record, which consists of all Papers and Exhibits filed to date.

A. Real Party in Interest

Petitioner identifies itself, Ericsson, Inc., and its "corporate parent Telefonaktiebolaget LM Ericsson" as real parties in interest. Pet. 83 Patent Owner identifies itself as the real party in interest. Paper 3, 1.

B. Related Matters

Petitioner identifies the following *inter partes* review as involving the '338 patent. *CommScope, Inc. v. Dali Wireless, Inc.*, IPR2020-01466, Paper 16 (PTAB Feb. 9, 2021) (institution denied). Pet. 84.

Petitioner identifies the following related district court matters involving the '338 patent: *Dali Wireless, Inc. v. AT&T Corp., et al.*, No. 2:22-cv-12 (E.D. Texas); *Dali Wireless, Inc. v. Cellco Partnership*, No. 6:22-cv-00104 (W.D. Texas). Pet. 83.

Patent Owner refers to another district court matter that involves the '338 patent but does not involve Petitioner: *Dali Wireless, Inc.* v. *CommScope Techs.*, No. 19-952 (Del.), on appeal *Dali Wireless Inc. v. CommScope Techs LLC*, No. 22-1699 (Fed. Cir.). Paper 3, 1; *see also* Prelim. Resp. 15 (citing Ex. 2009).

C. The '338 Patent (Ex. 1001)

The '338 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, 5:52–56.

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

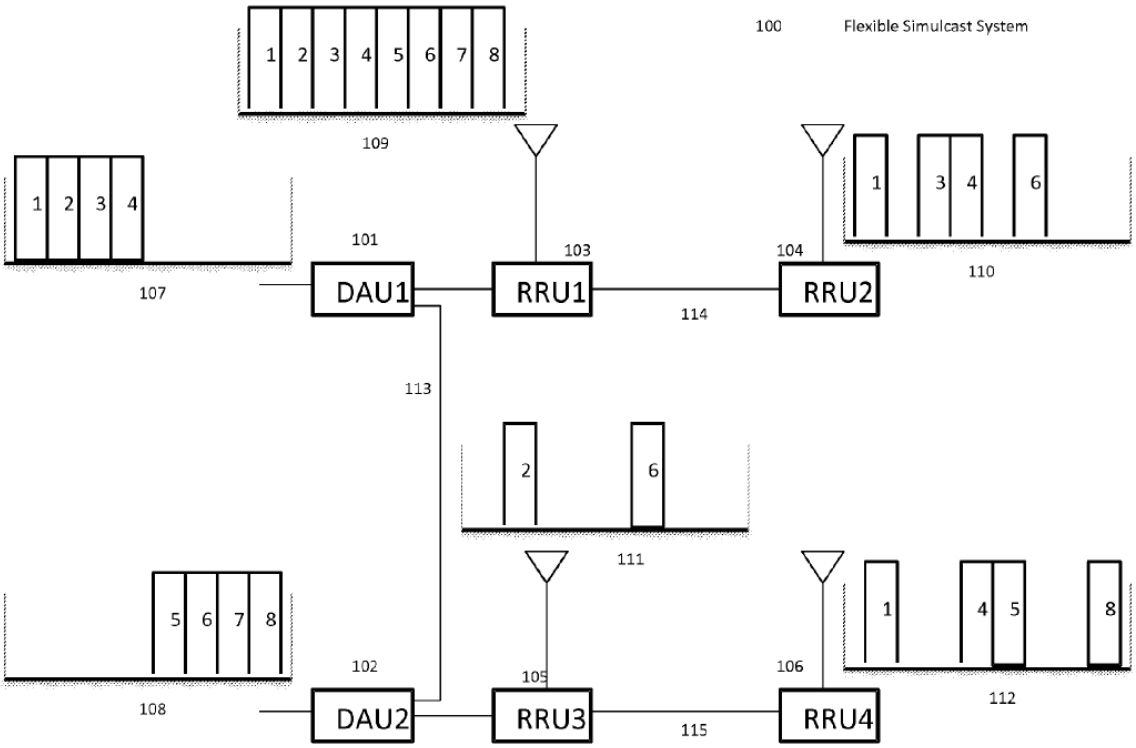


Figure 1 is a block diagram showing the basic structure and an example of a flexible simulcast downlink transport scenario. Ex. 1001, 5:25–28, 5:59–60. Flexible simulcast system 100 system employs digital access units (DAUs) that serve as interfaces to a base station (BTS). *Id.* at 5:60–63. The DAUs (e.g., DAU1, DAU2) connect to the BTS on one end and to multiple radio head units (RRUs) on the other end. *Id.* at 5:63–64, Fig. 1. Software settings within RRU1, RRU2, RRU3, and RRU4 enable particular carriers to be present in each respective downlink output signal 109, 110, 111, 112 (e.g., carriers 1–8 in RRU1, carriers 2 and 6 in RRU3). *See id.* at 6:31–65.

A DAU software control module manages key functions of the DAU and RRU. Figure 7, which follows, illustrates a DAU software control module (Ex. 1001, 11:18–21):

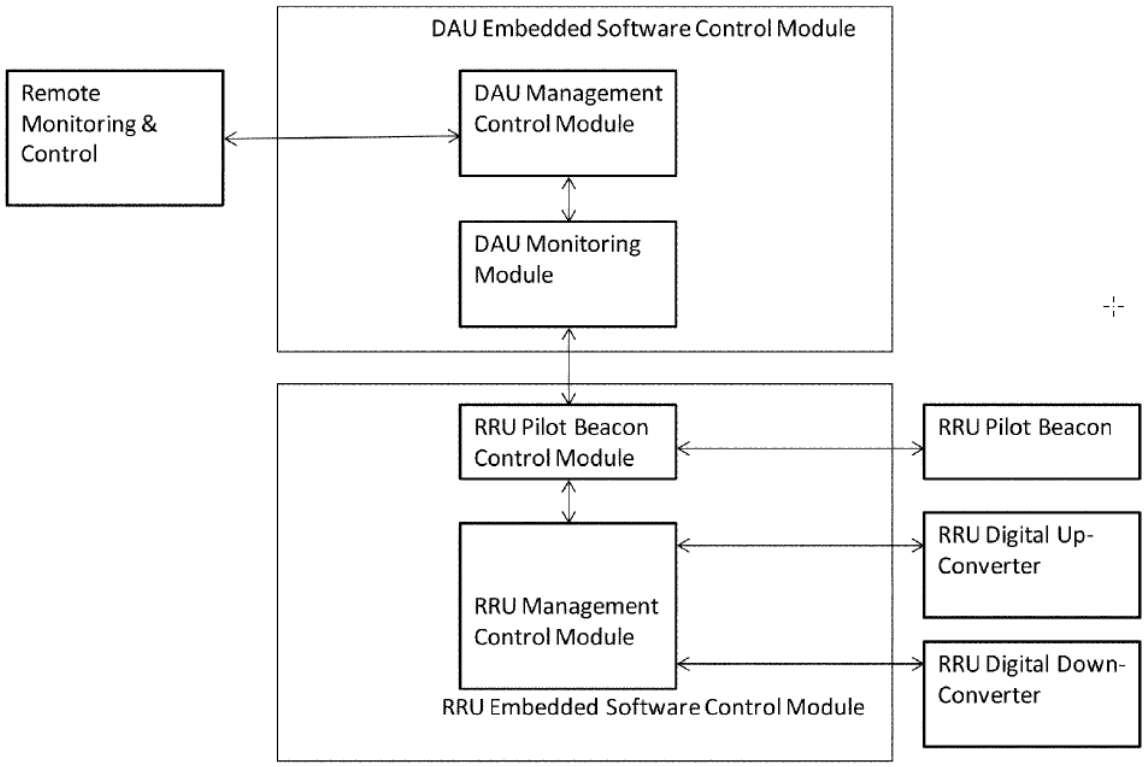


Figure 7: Embedded Software Control Modules

Figure 7 is a block diagram of an embodiment of a DAU software control module, which includes other modules. The modules determine and/or set the appropriate number of radio resources (such as RF carriers, CDMA codes or TDMA time slots) assigned to a particular RRU or group of RRUs to meet desired capacity and throughput objectives. Ex. 1001, 11:21–25. The DAU software control module comprises a DAU monitoring module that detects which carriers and corresponding time slots are active for each RRU. *Id.* at 11:25–28. The DAU embedded software control module also comprises a DAU management control module that communicates with the RRUs over a fiber optic link control channel. *Id.* at

11:28–32. The RRU management control module sets the individual parameters of all the RRU digital up-converters to enable or disable transmission of specific radio resources by a particular RRU or group of RRUs, and also sets the individual parameters of all the RRU digital down-converters to enable or disable processing of specific uplink radio resources by a particular RRU or group of RRUs. *Id.* at 11:32–39.

In one embodiment, an algorithm operating within the DAU monitoring module detects which carriers and corresponding time slots for each carrier are active for each RRU and provides information to the DAU management control module to help determine if "a particular downlink carrier is loaded by a percentage greater than a predetermined threshold." *Id.* at 11:40–46. If that occurs, the DAU management control module adaptively modifies the system configuration to deploy additional radio resources for use by a particular RRU that needs those radio resources within its coverage area. *Id.* at 11:48–53. At the same time, the DAU management control module adaptively modifies the system configuration to remove certain radio resources for use by a particular RRU that no longer needs those radio resources within its coverage area. *Id.* at 11:53–58.

The '338 patent states that "[t]he present invention substantially overcomes . . . limitations of the prior art," describing "the present invention" as providing "automatic load-balancing," among other goals, as follows:

> The advanced system architecture of the present invention provides a high degree of flexibility to manage, control, enhance and facilitate radio resource efficiency, usage and overall performance of the distributed wireless network. This advanced system architecture enables specialized applications and enhancements including flexible simulcast, *automatic traffic*

> *load-balancing*, network and radio resource optimization, network calibration, autonomous/assisted commissioning, carrier pooling, automatic frequency selection, radio frequency carrier placement, traffic monitoring, traffic tagging, and indoor location determination using pilot beacons.

Ex. 1001, 3:51–62 (emphasis added).

D. Illustrative Claim

Illustrative independent claim 1, the sole independent claim, follows (with bracketing information added to conform to Petitioner's nomenclature):

> 1. [*i.*] A method for routing and switching RF signals comprising:
>
> [*ii.*] providing one or more remote radio units, each remote radio unit configured to transmit one or more downlink RF signals and to receive one or more uplink RF signals;
>
> [*iii.*] providing at least one digital access unit configured to communicate with the one or more remote radio units;
>
> [*iv.*] translating the uplink and downlink signals between RF and base band as appropriate;
>
> [*v.*] packetizing the uplink and downlink base band signals, wherein the packetized signals correspond to a plurality of carriers;
>
> [*vi.*] configuring each remote radio unit to receive or transmit a respective subset of the plurality of carriers, each respective subset of the plurality of carriers including a number of carriers;
>
> [*vii.*] reconfiguring each remote radio unit by:
>
> [*a.*] determining a load percentage for each remote radio unit; and
>
> [*b.*] increasing or decreasing the number of carriers in the respective subset of the plurality of carriers based on the load percentage; and

> [*viii.*] routing and switching the packetized signals among the one or more remote radio units via the at least one digital access unit according to a result of the reconfiguring.

E. Asserted Grounds of Unpatentability

Petitioner asserts that claims 1–12 are unpatentable as follows:

Claim(s) Challenged	35 U.S.C §	Reference(s)/Basis
1–3	103[3]	Leng[4]
1–3	103	Leng, Cannon[5]
4–12	103	Leng, Gupta[6]
4–12	103	Leng, Cannon, Gupta

[3] 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 Mach 16, 2013. Because the '338 patent's claims the filing benefit of a provisional application filed on September 14, 2010, Petitioner "assumes the priority date is September 14, 2010" "[s]olely for the purposes of this [*inter partes* review]." Pet. 18. Because this date is before the effective date of the applicable AIA amendment, the pre-AIA version of § 103 applies for purposes of institution.

[4] Leng et al., Pub. No. WO 2009/021359 A1, published Feb. 19, 2009. Ex. 1004. Petitioner filed an English translation of Leng et al. with its Petition as Exhibit 1005. Thereafter, with our permission, Petitioner filed another English translation of Leng et al., also filed as Exhibit 1005. Petitioner filed this later version with a corrected declaration that certifies under penalties of perjury that the translation is correct. *See id.* We refer to this later version and cite it as "Leng."

[5] Cannon et al., U.S. Patent No. 8,270,387 B2, issued Sept. 18, 2012, filed Jan. 13, 2010. Ex. 1006.

[6] Gupta et al., U.S. Pub. No. US 2008/0045254 A1, published Feb. 21, 2008. Ex. 1008.

II. OBVIOUSNESS ANALYSIS

A. Level of Ordinary Skill in the Art

Relying on the Houh Declaration (Ex. 1003), Petitioner asserts that a person of ordinary skill in the art (POSA)

> in September 2010 would have been familiar with reconfiguring remote radio units in a DAS. EX-1003 ¶44. 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-1003 ¶44.

Pet. 18.

Patent Owner

> submits that the above POSA at the time of the '338 patent would have an educational background in electrical engineering and experience in the design of wireless communication systems. More particularly, a POSA 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. 13.

The two proposals are the same proposals we considered in the Institution Decision. Inst. Dec. 9. As found therein, "[t]he two proposals are materially similar." *Id.* As also found therein,

> 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 *John Mezzalingua Associates, LLC v. Dali Wireless Inc.*, IPR2020-01432, Paper 16 at 8 (PTAB Feb. 9, 2021) (institution denied), which involves similar technology, a similar patent (which shares the same specification as the '338 patent), and similar claims. *See* Ex. 2002 (IPR2020-01432 institution decision).

Id.

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). For purposes of this Final Written Decision, based on the record, we adopt the assessment offered by Patent Owner as it is consistent with the '338 patent and the asserted prior art. Even if we were to adopt Petitioner's similar assessment, it would not alter our Final Written 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 the principles set forth by our reviewing court, 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. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312 (Fed. Cir. 2005) (en banc) (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. Determining Load Percentage

a. The Dispute and Adopted Construction

Limitation 1.vii.a recites "determining a load percentage for each remote radio unit." Citing a prior claim construction in a district court proceeding, the parties agree that "load percentage" is "a value representing the portion of available capacity that is in use." *See* Reply 5; Sur-reply 1; Ex. 2009 (Delaware District Court claim construction order), 1 ("load percentage" shall mean "a value representing the portion of available capacity that is in use").[7]

The central dispute at issue is that Patent Owner asserts that "load percentage" is "the amount of load used by a particular remote radio unit relative to the available capacity assigned to that remote radio unit." PO Resp. 14; Sur-reply 1. Petitioner disagrees and asserts that the proper construction of "load percentage" is "the amount of load used by a [remote radio unit] compared to the total load used by the group or network." Reply 9; Pet. 59. To resolve the controversy as to whether the challenged claims would have been obvious in view of the prior art and determine the correct construction of "determining a load percentage for each remote radio unit,"

[7] Petitioner was not a party to the Delaware District Court litigation, but proposed the claim construction from that litigation in Texas District Court litigation. *See* Pet. Pre-inst. Reply 1 n.1 (asserting it "was not a party to the Delaware litigation); Ex. 2001, 3 (Petitioner in Texas District Court proposing that "load percentage" means "'a value representing the portion of available capacity that is in use', according to the construction and reasoning of the Delaware district court").

we need to resolve whether Patent Owner's proposed claim construction improperly narrows the claims and whether Petitioner's proposed claim construction that includes considering the total load used by the network improperly broadens the claims.

In our Institution Decision, we adopted the parties' general agreement that "load percentage" is "a value representing the portion of available capacity that is in use." Inst. Dec. 18. We also determined, based on the respective positions of the parties and the preliminary record, that "load percentage" encompasses "the amount of load used by a remote radio unit compared to the total load on the network" and "an amount of load used by a remote radio unit relative to the total active capacity allocated to the remote radio unit or a group of remote radio units." *See* Inst. Dec. 18.

For this Final Written Decision and on the complete record, we again determine that "load percentage" encompasses 1) "the amount of load used by a remote radio unit compared to the total load on the network" as Petitioner urges. *See* Reply 9 ("Determining the amount of load consumed by each RRU (e.g., carriers used on that RRU) as a proportion of the total load of carriers used in a group or the network, effectively allows the system to determine how to balance loads by reassigning carriers from higher loaded RRUs to lower loaded RRUs in a group.").

Patent Owner urges that load percentage 2) "means the amount of load used by a particular remote radio unit relative to the amount of available capacity assigned to that remote radio unit." PO Resp. 14. With the exception of the emphasized phrase in the following construction, this is similar to what we preliminarily determined that "load percentage" also encompasses in the Institution Decision: "an amount of load used by a

remote radio unit relative to the total active capacity allocated to the remote radio unit or *a group of remote radio units*." Inst. Decision. 18 (emphasis added). For the reasons below and in the Institution Decision, the intrinsic record of the claim language, specification, and prosecution history supports the emphasized part of this construction, namely that load percentage encompasses 3) "an amount of load used by a remote radio unit relative to the total active capacity allocated to *a group of remote radio units*."

As also explained further below, the intrinsic record of the claim language, specification, and prosecution history supports load percentage encompassing Petitioner's construction (numbered 1 above) and does not support limiting the construction to Patent Owner's overly narrow construction (numbered 2 above). Even if we were to adopt Patent Owner's limiting claim construction, we determine that Petitioner shows that the claims would have been obvious under all three constructions (numbered 1, 2, and 3 above) as determined below.

b. The Claim Language

Claim 1 recites "reconfiguring each remote radio unit by: determining a load percentage for each remote radio unit." Based on this language and the balance of the language in claim 1, Petitioner argues that "[c]laim 1 does not specify how to determine a load percentage for each remote radio unit." Reply 5.

As noted above, Patent Owner contends that "load percentage" "should properly be interpreted as the amount of load used by a particular radio unit relative to the amount of available capacity assigned to that particular radio unit." Sur-reply 1; *accord* PO Resp. 16 ("load percentage" is "an amount of active capacity utilized by a remote radio unit relative to

the maximum amount of available capacity allocated to the remote radio unit"). Patent Owner contends that "[t]he plain language of claim 1 . . . supports this interpretation as it clearly recites "reconfiguring each remote radio unit by: determining a load percentage for each remote radio unit; and increasing or decreasing the number of carriers . . . based on the load percentage." *Id.* at 16. Patent Owner also argues that "the load percentage for each individual RRU is . . . determined by considering the number of carriers in use for that RRU *relative to the number of carriers allocated to that RRU*" whether those radio resources are assigned only to that RRU or to multiple RRUs (emphasis added). Sur-reply 5.

Petitioner is correct, the claim language does not specify how to determine a load percentage. *See* Reply 5. It also does not specify determining a load percentage at a remote radio unit relative to the capacity (e.g., number of carriers) assigned to that unit.

c. The Column 11 Embodiment and Prosecution History

Because the specification is the "best source for understanding a technical term in the specification from which it arose, informed, as needed, by the prosecution history," we look to the specification, and find that the embodiment described in column 11, lines 40–58 that determines a load percentage for a carrier assists in understanding what is meant by the phrase "determining a load percentage for each remote radio unit" in the context of the reconfiguring limitation *vi* recited in claim 1. *Phillips,* 415 F.3d at 1315. Both parties recognize the relevance of this embodiment to the reconfiguring limitation *vi* and rely on this embodiment to support their respective understanding of the claim language "determining a load percentage for each remote radio unit." *See* Pet. 14–15 (discussing prosecution history; citing

Ex. 1002, 90, 94); Pet. 11–12 (describing embodiment at Ex. 1001, 11:40–58); PO Resp. 15 (indicating the challenged patent refers to load in terms of a percentage based on teaching of "detecting which carriers and corresponding time slots for each carrier are active for each RRU" and "provide[] information to the DAU Management Control module to help identify when, e.g., a particular downlink carrier is loaded by a percentage greater than a predetermined threshold"; citing Ex. 1001, 11:41–48).

Specifically, this column 11 embodiment describes the following:

> detect[ing] which carriers and corresponding time slots for each carrier are active for each RRU[;]
>
> provid[ing] information . . . to help identify when, e.g., a particular downlink carrier is loaded by a percentage greater than a predetermined threshold[;]
>
> [if the threshold is exceeded] adaptively modif[ying] the system configuration to slowly begin to deploy additional radio resources (such as RF carriers, CDMA codes or TDMA time slots) for use by a particular RRU which need those radio resources within its coverage area[; and]
>
> [a]t the same time, in at least some embodiments [the system] adaptively modif[ying] the system configuration to slowly begin to remove certain radio resources (such as RF carriers, CDMA codes or TDMA time slots) for use by a particular RRU which no longer needs those radio resources within its coverage area.

Ex. 1001, 11:40–58.

The column 11 embodiment describes using information about which carriers and time slots are active for each remote radio unit to help identify when a particular downlink carrier is loaded by a percentage greater than a predetermined threshold. In other words, the load percentage of the particular downlink carrier is compared to a predetermined threshold to determine if the load percentage is greater than the threshold. Based on a

comparison, the system configuration is adaptively modified to deploy additional RF carriers (or other types of radio resources) for use by a particular remote radio unit that needs the additional radio resources within its coverage area. In some embodiments, the system configuration at the same time also is adaptively modified to slowly remove certain RF carriers (or other types of radio resources) from use by a particular remote radio unit that no longer needs those radio resources within its coverage area. Thus, the column 11 embodiment discloses "reconfiguring each remote radio unit by: determining a load percentage for each remote radio unit; and increasing or decreasing the number of carriers in the respective subset of the plurality of carriers based on the load percentage," as recited in claim 1.

In addition, this embodiment makes clear that in the situation where a carrier is shared by multiple remote radio units, "determining a load percentage *for* each radio unit" includes within its breadth "determining a load percentage" for *a carrier that is active on a group of RRUs in the network* for the reasons discussed further below. *See* Reply 5–7 (discussing carriers shared by RRUs); Ex. 1001, Fig. 1 (showing shared carriers). In that case, the determined load percentage will be the same for each RRU in the network with respect to that carrier (e.g., 60%) based on the specification's per carrier calculation.[8]

[8] As discussed in Section II.B.1.g., Patent Owner's arguments raise issues with how to calculate load percentage. For example, this carrier-sharing disclosure shows the error in one argument put forward by Patent Owner: In a simple hypothetical situation where only one carrier is active and shared in the network, Patent Owner's calculation results in a load percentage of 100% for each RRU, because there is one carrier "in use" for each RRU, and one carrier allocated to each RRU. *See* Sur-reply 5 (arguing "the load percentage for each individual RRU is still determined by considering the

When amending the application claim to add the "reconfiguring each remote radio unit" limitation (and other limitations), the Applicant identified what is now the column 11 embodiment as supporting the claim 1 amendments and distinguishing the prior art. *See* Ex. 1002, 90 (amending claim 1), 93–94 (citing application ¶ 52[9], Figs. 1, 2, 7); *see also* Pet. 14–15 (discussing prosecution history; citing Ex. 1002, 90, 94). The Applicant indicated:

> As discussed in the specification, in an embodiment, the DAU monitoring module detects which carriers and corresponding time slots for each carrier are active for each RRU. If a particular carrier is loaded by a percentage greater than a predetermined threshold, the DAU management control module adaptively modifies the system configuration to deploy additional radio resources for use by a particular RRU that needs those radio resources within its coverage area. Similarly, the DAU management control module adaptively modifies the system configuration to remove radio resources initially allocated for use by a particular RRU that no longer needs those radio resources within its coverage area. (See the specification, paragraph [0052], and FIGS. 1, 2, and 7.)

Ex. 1002, 93–94.

Notably, this is the only explicit reference in the written description of the '338 patent to a percentage of load and there are no references to "load percentage" per se. *See* PO Resp. 15 (identifying the column 11 embodiment as where the challenged patent "refers to load in terms of a percentage"; stating "[t]o maximize the capacity of the radio resources

---

number of carriers in use for that RRU relative to the number of carriers allocated to that RRU—regardless of whether that RRU happens to share a certain carrier with another RRU").

[9] Application paragraph 52 corresponds to the embodiment described in column 11, lines 42–58 of the challenged patents. *Compare* Ex. 1002, 150–51 (Application ¶ 52 as filed), *with* Ex. 1001, 11:40–58.

across the DAS network, the '338 patent teaches a DAU configured to 'detect[] *which carriers and corresponding time slots for each carrier are active for each RRU*, provide[] information to the DAU Management Control module to help identify *when, e.g., a particular downlink carrier is loaded by a percentage greater than a predetermined threshold* whose value is communicated to the DAU Management Control module by the DAU's Remote Monitoring and Control function.' Ex. 1001 at 11:41-48.").

Additional descriptions of the embodiment of column 11 further support our understanding of the phrase "for each remote radio unit." This is because the load percentage of the carrier (which may be active on several RRUs) that is compared to the threshold is used for adaptively configuring the resources for individual remote radio units. Ex. 1001, 11:48–58. The load percentage of the downlink carrier is "for each remote radio unit" also in the sense that number of carriers used by particular remote radio units is increased or decreased based on the load percentage for that carrier. Ex. 1001, 11:48–58, 13:20–22 ("increasing or decreasing the number of carriers in the respective subset of the plurality of carriers *based on the load percentage*") (emphasis added).

Specifically, as noted above, the column 11 embodiment describes using information related to which carriers and corresponding time slots for each carrier are active for each remote radio unit to help identify when a particular downlink carrier is loaded by a percentage greater than a predetermined threshold.

As found above, the column 11 embodiment expressly describes identifying a load percentage for a downlink carrier, which is a radio resource that may be used across multiple RRUs. *See, e.g.,* Ex. 1001, 6:34–

36 (describing "the presence of all 8 carriers means that RRU 1 is potentially able to access the full capacity of both base stations feeding DAU1 and DAU2"), Fig. 1 (showing carriers 1–8 being used across the system). As such, the column 11 embodiment also supports Petitioner's construction that determining a load percentage for each remote radio unit can involve available capacity of resources in the total system. *See also* Ex. 1001, 6:31–7:4 (describing the capacity of an remote radio unit as the number of carriers that the remote radio unit is configured to access).

We apply this understanding to the claim constructions proposed by Patent Owner and Petitioner. Patent Owner's proposed construction of "determining a load percentage"—"the amount of load used by a particular radio unit relative to the amount of available capacity assigned to that particular unit"—excludes the column 11 embodiment. The proper construction of the claim terms must capture the breadth of the challenged patent's relevant disclosure—including the column 11 embodiment, which does not require a load percentage of individual remote radio units to be calculated relative to their individual active use of carriers to be determined. *Cf. Vitronics Corp. v. Conceptronic, Inc.*, 90 F.3d 1576, 1583 (Fed. Cir. 1996) (noting that a claim construction excluding a preferred embodiment "is rarely, if ever, correct"). For this reason, in addition to other reasons articulated below, we do not agree with Patent Owner's proposed claim construction that overly narrows the claim scope. Rather, we determine that claim 1 encompasses, but is not limited to, Patent Owner's proposed construction—the amount of load used by a particular radio unit relative to the amount of available capacity assigned to that particular radio unit.

On the other hand, Petitioner's proposed claim construction, which encompasses the consideration of system information in determining the load percentage, is consistent with the column 11 embodiment that determines a load percentage for system-wide radio resources used by each remote radio unit.

To be clear, the column 11 embodiment, sheds light on, but does not limit, the proper breadth of determining load percentage, which Petitioner's claim construction includes. *See Liebel-Flarsheim Co. v. Medrad, Inc.*, 358 F.3d 898, 906 (Fed. Cir. 2004) ("Even when the specification describes only a single embodiment, the claims of the patent will not be read restrictively unless the patentee has demonstrated a clear intension to limit the claim scope using words or expressions of manifest exclusion or restriction.").

d. Load Percentage and Balancing

Load balancing and load percentage are intertwined concepts. Load balancing a load in a circuit involves equalizing the load—i.e., attempting to render each load to be an approximately equal proportion of the total load consumed in the network.[10] As found in the next section, the "present invention" of the '338 patent "provides" and "enables" "load-balancing" (Ex. 1001, 3:52–59), which the record shows typically involves determining

[10] As noted in the Institution Decision (Inst. Dec. 15 n.7), a trade dictionary defines "balance" as follows: "To equalize loads, voltages, or signals between two circuits or components." THE ILLUSTRATED DICTIONARY OF ELECTRONICS, Gibilisco, Stan (2001). Ex. 3003; *see also* Ex. 3002 ("balanced circuit" is "[a] circuit in which there are substantially equal currents, either alternating or direct, in all main wires and substantially equal voltages between main wires and between each main wire and neutral (if one exists)." THE AUTHORITATIVE DICTIONARY OF IEEE STANDARDS TERMS, 7th Ed., IEEE Std. 100-2000, pp. 81–82, 11 Dec. 2000, doi: 10.1109/IEEESTD.2000.322230, *available at* https://ieeexplore.ieee.org/document/4116787.

a proportion of load relative to the entire network. *See supra* note 10 (trade definitions related to load balancing); *infra* note 18 (definitions of distribute and related definitions as including the concept of proportioning or dividing); Reply 8–9 (citing Ex. 1015, 95:23–24 (Dr. Chrissan testifying that "load balancing" is "a very broad term"), 97:10–20); Ex. 1014 ¶¶ 6, 9, 10 (Dr. Houh testifying that "[d]etermining the amount of load consumed by each RRU (e.g., carriers used on that RRU) as a proportion of the total load of carriers used in a group or the network, effectively allows the system to determine how to balance loads by reassigning carriers from higher loaded RRUs to lower loaded RRUs in a group.").

Similar to Dr. Houh's testimony (Ex. 1014 ¶ 10), Patent Owner's declarant, Dr. Chrissan, testifies that "*load typically means usage* and balancing can mean *leveling the usage across available resources*. So I would say *load balancing generally refers to leveling usage across available resources*." Ex. 1015, 97:16–20. Therefore, Dr. Chrissan's and Dr. Houh's testimonies support Petitioner's claim construction because it directly ties the concept of "load balancing" to "leveling usage," which implies creating equal percentages of used load across available remote radio units or resources in general. Stated another way, claim 1 refers to determining a "load percentage," which broadly is a proportion of load (e.g., power in use) at an RRU relative to the total load of RRUs (e.g., total power in use) in the network, with load balancing typically involving spreading the proportion (across the RRUs) evenly. *See also* Ex. 2009, 10 (District Court reasoning that "there are other definitions of percentage including 'proportion.'"). More simply, "determining a load percentage for each remote radio unit

includes" includes determining the percentage of power in use (load) for each remote radio unit.

As noted above, Patent Owner agrees that "[d]etermining the load used by a radio unit relative to the load used by all of the radio units in the network under Petitioner's construction *may be employed to balance or equalize the load in use across the network.*" PO Resp. 18 (emphasis added) (citing Ex. 2015 ¶¶ 41–42).

Determining the amount of load consumed by each RRU (e.g., carriers used on that RRU) as a proportion of the total load of carriers used in the system effectively allows the system to determine how to balance loads by redistributing carriers from higher loaded RRUs to lower loaded RRUs in a group. For example, attempting to balance the load where all the RRUs are in a group and covering the same large room of mobile telephones (e.g., cafeteria, concert hall) minimizes the power handled by higher loaded RRUs, while still providing network access to the mobile telephones in the room. *See* Ex. 1001, 11:21–25 (describing assigning RF carriers to "a particular RRU or a group of RRUs"), 8:63–9:10 (describing different RRUs handling the same carrier and merging the signal from one carrier at two RRUs, signifying the two RRUs cover the same approximate area), Figs. 4–5 (illustrating overlapping antenna coverage for two RRUs and three RRUs).

e. Load Balancing as Part of the "Present Invention"

The '338 patent specification states that "the present invention" "enables" "automatic traffic load-balancing," "network and radio resource optimization," "radio frequency carrier placement," "traffic monitoring," and other features to "overcome[] limitations in the prior art." Ex. 1001, 3:51–59. In addition, the '338 patent refers to a "key function [a]s

determining and/or setting the appropriate amount of radio resources (such as RF carriers, CDMA codes or TDMA time slots) assigned to a particular RRU *or group of RRUs* to meet desired capacity and throughput objectives." Ex. 1001, 11:21–25 (emphasis added); *see, e.g.,* Pet. 11 (relying on same passage). Patent Owner concedes that "[t]he '338 patent's disclosure [is] about assignment of radio resources to a particular RRU *or a group of RRUs*." *See* Sur-reply 5 (emphasis added).

Therefore, the '338 patent indicates that "the present invention" enables "load balancing," "traffic monitoring," "resource optimization," with a "key function" thereof enabling radio resource assignment for a group of remote radio units. *See* Ex. 1001, 3:51–59, 11:21–25. When a patent refers to what "the present invention" or "the invention" "enables" as the '338 patent does, it helps set the scope for what the claimed invention "includes." *See Edwards Lifesciences LLC v. Cook Inc.*, 582 F.3d 1322, 1330 (2009) (relying on and characterizing *SciMed Life Sys., Inc. v. Advanced Cardiovascular Sys. Inc*. 242 F.3d 1337, 1343 (Fed. Cir. 2001) as "construing term to include feature characterized as 'the present invention'" and *Honeywell Int'l, Inc. v. ITT Indus., Inc.*, 452 F.3d 1312, 1318 (Fed. Cir. 2006) as "construing claim term to include fuel filter because '[o]n at least four occasions, the written description refers to the fuel filter as "this invention" or "the present invention"'").

In *Honeywell*, the court held that "the claim term 'fuel injection system component' is limited to a fuel filter" because the specification referred to a "fuel filter" as "this invention" or the "present invention." *See* 452 F.3d at 1318. These two terms are related by virtue of the common term "fuel." Here, the description of the term "load balancing" as part of the

"present invention" does not rise to the level of limiting "load percentage" as it does in *Edwards, SciMed Life,* and *Honeywell*. Rather, the specification is simply a guide that shows what "load percentage" means via the common term "load" based on the description of "load balancing" as included in the "present invention," with *Edwards, SciMed Life,* and *Honeywell* implicating it as an important related feature. "[T]he specification 'is always highly relevant to the claim construction analysis. Usually, it is dispositive; it is the single best guide to the meaning of a disputed term.'" *Phillips*, 415 at 1315 (internal citations omitted).

In other words, although *Edwards, SciMed Life,* and *Honeywell,* stand for the proposition that using terms such as "the invention" or "the present invention" to describe a disclosed term (e.g., fuel filter, load balancing) in order to construe a related claim term (e.g., fuel injection system component, load percentage) may in some cases *limit* the scope of the related claim term, together, *Phillips*, *Edwards, SciMed Life,* and *Honeywell* generally stand for the proposition that describing a disclosed term as "the present invention" renders that description important in construing a closely related claim term.

That is, the claim term at issue, "load percentage," closely relates to what the "present invention" enables, "load balancing," by virtue of the common term "load" and the meaning of the terms. For example, as indicated in the previous section, Dr. Chrissan, Patent Owner's expert declarant, generally recognizes the connection between "load balancing" and "load percentage," by testifying that "*load typically means usage* and balancing can mean *leveling the usage across available resources*. So I would say *load balancing generally refers to leveling usage across available resources*." Ex. 1015, 97:16–20 (emphasis added). Mathematically,

"leveling load usage across resources" in relation to the claim term "load percentage for each remote radio resource" implies the ability to provide substantially equal load percentages or proportions for each remote radio resource. *See, e.g.*, *supra* note 10 (defining "balance" as follows: "To equalize loads, voltages, or signals between two . . . components."); Ex. 2009, 10 (District Court construing "load percentage" and finding "there are other definitions of percentage including 'proportion' that are not of such mathematical specificity").

Moreover, as a general rule, "there is a strong presumption against a claim construction that excludes a disclosed embodiment." *See In re Katz Interactive Call Processing Patent Litig.*, 639 F.3d 1303, 1324 (Fed. Cir. 2011). Even if "load balancing" is simply a desirable feature or objective, it is part of what the "present invention" enables as an important feature or objective of its disclosed embodiments and therefore informs the meaning of "load percentage" because of the common term "load." *Cf. Leibel-Flarsheim Co. v. Medrad, Inc.*, 358 F.3d 898, 908 (Fed. Cir. 2004) (the "fact that a patent asserts that an invention achieves several objectives does not *require* that each of the claims be construed as *limited* to structures that are capable of achieving all of the objectives" (emphasis added)).

Petitioner persuasively shows that its claim construction of "load percentage" enables the disclosed invention's objectives of load balancing and resource optimization using information from the RRUs in a network. *See* Pet. 59 (asserting that the disputed limitation reads on Leng's automatic load balancing that "most efficiently distributes network resources using the combination of load information of the RRHs") (citing Ex. 1003 ¶¶ 104–106), 65 (arguing that "a [person of ordinary skill in the art] understood that

Leng's disclosure of the relative loading of each RRH can be converted to a load percentage") (citing Ex. 1003 ¶ 118); Pet. Pre-inst. Reply 3 (asserting the recited "load capacity" determination for each RRU can be made based on available capacity of RRU, a group of RRUs, or total system, and can be determined using throughput, number of connections, number of users, number of carriers, or power); Reply 8 (determining carriers used divided by total load of carriers in a group allows load balancing by reassigning carriers from higher to lower loaded carriers).[11]

Therefore, Petitioner's construction is consistent with the disclosed embodiments or goals enabled by the present invention, including automatic load balancing and resource distribution.

f. The Combined Embodiments

Patent Owner attempts to import limitations from different embodiments in the specification to improperly narrow proper scope of "load percentage."

Turning to the specification, Patent Owner recognizes that "the '338 patent refers to load in terms of a percentage." PO Resp. 15. In support, Patent Owner quotes the '338 patent as teaching a DAU configured to

> detect[ ] ***which carriers and corresponding time slots for each carrier are active for each RRU***, provide[ ] information to the DAU Management Control module to help identify ***when, e.g., a particular downlink carrier is loaded by a percentage greater than a predetermined threshold*** whose value is communicated to the DAU Management Control module by the DAU's Remote Monitoring and Control function.

[11] We cite to the pre-institution briefing in limited circumstances only to provide background for this claim construction issue, where there is no material difference between the parties' pre-institution and post-institution briefing in relation to this claim construction issue.

Id. (alterations in original) (quoting Ex. 1001, 11:41–48). The column 11 embodiment describes a particular "carrier" load as a percentage related to a "threshold," and neither the carrier nor threshold are claimed in the context of determining "load percentage." In addition, the description of the carrier and threshold are only part of an example ("e.g.") option of the embodiment that the proper construction of load percentage does not require by implication or otherwise. Moreover, the embodiment does not describe dividing the number of carriers used by an RRU by the number of carriers assigned to that RRU to determine the load percentage, contrary to Patent Owner's arguments that attempt to limit the construction of "load percentage." *See* Sur-reply 5 (arguing "the load percentage for each individual RRU is . . . determined by considering the number of carriers in use for that RRU relative to the number of carriers *allocated to that RRU*" (emphasis added)).

Patent Owner also relies upon the specification's description of a scenario when

> "a company meeting were suddenly convened in the area of the enterprise corresponding to the coverage area of RRU2" (Ex. 1001 at 8:21–25), that particular RRU would be overloaded as the amount of load used by that RRU relative to the allocated load capacity available to that RRU may be around 91%, which is above a predetermined value of 90%. PO Resp. 15–16.

(quoting Ex. 1001, 8:21–25).[12] According to Patent Owner, "[t]he DAU Management Control Module can determine the active capacity used relative

[12] Patent Owner also argues that Petitioner's claim construction of load balancing "does not inform whether a particular radio unit is overloaded." PO Resp. 18. This statement is not correct, if, for example, prior to balancing, a particular RRU load carries 90% (e.g. over a threshold) of the

to the maximum available capacity allocated for that radio unit, i.e., how much the radio unit is loaded," so that "there would be 9% of the maximum capacity available, thereby necessitating an increase in the number of carriers assigned to that radio unit." *Id.* at 16 (citing Ex. 2015 ¶19).

This column 8 example does not limit the full scope of "load percentage," because the specification does not even mention load percentage at the cited passage that Patent Owner relies upon.[13] Rather, at the cited passage at column 8, the specification merely describes swapping all eight carriers assigned to low-load RRU1 for four carriers assigned to high-load RRU2 (with some of the carriers overlapping), without any description of a percentage calculation or any description of how the DAU determines an overload condition exists for the carriers, let alone a description of measuring load in terms of carriers used relative to carriers assigned to a specific RRU. *See* Ex. 1001, 8:14–24, Fig. 1. Rather, the relied-upon passage in the '338 patent generally describes a bulk transfer of carrier capacity (four carriers for eight) based on somehow determining a sudden convention of users at RRU2. *See id.*

Therefore, even if, as Patent Owner urges, one combines the two embodiments such that the load percentage and threshold description for single carrier at column 11 applies to the sudden convention of users as described at column 8, the broad recitation of "load percentage" in the

---

total load, it informs the system of overloading so that the system provides load balancing in response.

[13] The prosecution history also does not limit the claim scope. *See* Ex. 1002, 89–95 (amending claim 1 to recite "determining a load percentage of each remote radio unit" among other features without further clarifying load percentage); PO Resp. 10–11 (summarizing prosecution history).

challenged claims in light of the column 11 embodiment and the load balancing objectives of the '338 patent dictates that these examples do not limit the challenged claims to exclude consideration of the total network load in determining load percentage.

In contrast, Petitioner's claim construction is consistent with the descriptions of the embodiments of columns 8 and 11 and captures broad objectives of the disclosed invention, including load balancing. For example, Petitioner states as follows:

> Determining the amount of load consumed by each RRU (e.g., carriers used on that RRU) as a proportion of the total load of carriers used in a group or the network, effectively allows the system to determine how to balance loads by reassigning carriers from higher loaded RRUs to lower loaded RRUs in a group. For example, the '338 Patent provides the examples of attempting to balance the load where all the RRUs are in a group and covering the same large room of mobile telephones (e.g., cafeteria, concert hall) minimizes the power handled by higher loaded RRUs, while still covering the same mobile telephones. *See* EX-1001, 11:21–25 (describing assigning RF carriers to "a particular RRU or a group of RRUs"), 8:63–9:10 (describing different RRUs handling the same carrier and merging the signal from one carrier at two RRUs, signifying the two RRUs cover the same approximate area), Figs. 4–5 (illustrating overlapping antenna coverage for two RRUs and three RRUs). EX-1014 ¶10.

Reply 8.

Therefore, the record supports Petitioner's claim construction and does not support Patent Owner's claim construction based on limiting the via the combination of two narrow disclosed embodiments.

g. Patent Owner's Other Arguments

Patent Owner's hypothetical explanations to support its construction of determining "load percentage" do not counter the unambiguous

description of load percentage for a carrier in the column 11 embodiment. For example, Patent Owner argues that if the system allocates four "carriers 5 to 8" to an RRU, but the RRU only detects two "carriers 6 and 7 . . . are *active or in use*, then the load percentage for that RRU is 50%—regardless of whether any of those carriers 5 to 8 are being used by other RRUs." Sur-reply 5. But Patent Owner does not explain sufficiently how to determine if carriers 6 or 7 are "active" or "in use," or what that means. *See id.* In Patent Owner's example, "in use" might mean that carriers 6 and 7 are fully loaded (i.e., over a threshold) or loaded at only 10% (e.g., in terms of detected power or bandwidth usage). *See* Ex. 1001, 11:41–48 (adding another carrier if a carrier load is over a threshold).

Similarly, extending Patent Owner's example calculation in the Sur-reply that determines load percentage by dividing carriers used or active by the number of carriers assigned to the RRU (Sur-reply 5), if an RRU has ten carriers assigned to it, a load percentage of 90% may mean one carrier is empty and nine are fully loaded (i.e., over a specified threshold according to the column 11 embodiment), or it may mean that all 10 carriers are in use at a level of 90% (or it may mean that some combination of carriers exceed 90% use and others are only used in a minor capacity so that the average load across all the RRUs is 90%). *See id.* In the example of an unused carrier at an RRU when the RRU is otherwise loaded at 90%, Patent Owner's explanations contemplate assigning another unused carrier to an RRU that does not need it. *See* PO Resp. 15–16; Sur-reply 5; Ex. 1001, 11:41–48 (adding another carrier if a carrier is over a threshold). That is, Patent Owner argues that "claim 1 is directed to determining the load percentage of a particular RRU to decide whether to increase or decrease the

number of carriers for that particular RRU." Sur-reply 5–6. Therefore, according to Patent Owner's claim construction arguments in the Sur-reply, in some of the situations described above, Patent Owner's claim construction contemplates adding a carrier for a particular RRU even if all the carriers on that RRU are not fully loaded (e.g., not over a threshold) such that the RRU does not need an additional carrier to handle the load. Nothing in the '338 patent specification supports this anomalous result flowing from Patent Owner's claim construction. *See* Reply 6–7 (persuasively arguing for similar reasons that the '338 patent's disclosure of multiple RRUs sharing a carrier does not comport with Patent Owner's claim construction).

During the Oral Hearing, after questioning about determining what "in use" means, Patent Owner conceded that its claim construction for a single RRH includes "*capacity in any form* in the numerator, and . . . *available capacity in any form* in the denominator." Tr. 34:13–16; *see also id.* at 33:13–34:16 (panel questioning about what "in use" means and Patent Owner conceding that "in use" "permits all those interpretations," namely "fully used, full, or . . . partially used").

Therefore, Patent Owner's arguments do not support its claim construction.

h. The District Court

As Petitioner argues, the Delaware District Court did not adopt Patent Owner's initial (more restrictive) proposal (which it proposes here), finding that Patent Owner "has proposed a number of constructions" and "agreed" that "a value representing the portion of available capacity that is in use" "is appropriate" as the meaning of "load percentage." *See* Ex. 2009, 9; Reply 10 (citing same). By not specifying the numerator or denominator involved

in load percentage or load "proportion," the District Court's claim construction does not preclude either parties' proposed constructions here. *See* Ex. 2009, 9.

Petitioner's position is consistent with the District Court's claim construction, because the District Court's claim construction leaves open what the numerator and denominator of "load percentage" is and what "available capacity" is. *See* Ex. 2009, 9–10. As Petitioner also argues, in the District Court (Ex. 2009), Patent Owner initially proposed "its restrictive construction of '*load percentage*' as '[t]he amount of active capacity utilized by a remote radio unit relative to the maximum amount of active capacity allocated to the remote radio unit.'" Pet. Pre-inst. Reply 4 (citing Ex. 2009, 9). Petitioner asserts that Patent Owner "then abandoned its proposed broader construction in favor of the agreed construction that '*load percentage*' means 'a value representing the portion of available capacity that is in use' that does not limit the available capacity to only the capacity allocated to the RRU." Reply 10. In its Sur-reply, Patent Owner simply repeats its original proposal but does not dispute that it abandoned its original proposal of "available capacity" that it now re-asserts. *See* Sur-reply 6–7 (repeating what "the proposed construction stated" without addressing the abandonment thereof).

Therefore, the District Court's claim construction supports Petitioner's claim construction.

i. Summary

The record does not support Patent Owner's claim construction, which improperly attempts to limit the proper scope of "load percentage" without clear support in the specification and improperly attempts to incorporate

limitations based on combining two narrow embodiments. Patent Owner agrees that "[d]etermining the load used by a radio unit relative to the load used by all of the radio units in the network under Petitioner's construction *may be employed to balance or equalize the load in use across the network*." PO Resp. 18 (citing Ex. 2015 ¶¶ 41–42). Ultimately, Patent Owner does not dispute that Petitioner's claim construction of load percentage satisfies a stated important goal of the invention, load balancing. We determine that the correct construction encompasses Petitioner's claim construction as noted above in Section II.B.1.a, and analyze the parties' positions under the three claim constructions as also outlined above in Section II.B.1.a.

2. Reconfiguring Limitation

The parties agree that "reconfiguring each remote radio unit" means "changing the configuration of each remote unit." Pet. 17 (citing the decision denying institution in IPR2020-01466, Ex. 1007); PO Resp. 13–14 (same). We adopt this construction as supported by the record.

3. 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 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 Grounds

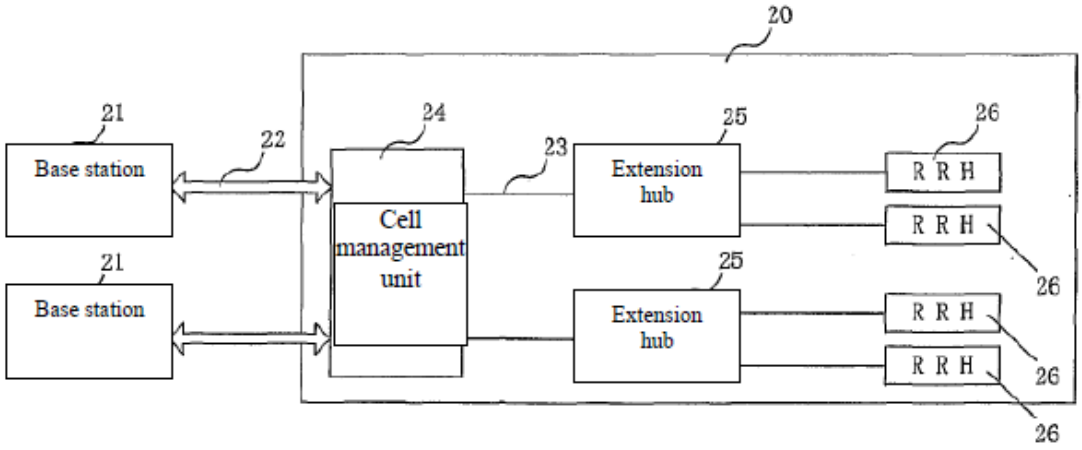
1. Claims 1–3

Petitioner asserts that claims 1–3 would have been obvious under 35 U.S.C. § 103 based on Leng alone or on the combined teachings of Leng and Cannon. Pet. 23, 24–65. Patent Owner disagrees. *See generally* Prelim. Resp.

a. Leng (Ex. 1005; Ex. 2005)

Leng's system relates to a DAS that reassigns carriers to remote radio heads based on real-time load conditions, in order to "balance the load in time and improve the efficiency of the system." Ex. 1005, code (57).

Leng's Figure 2 follows:



In the embodiment of Figure 2 above, "the cell management unit (CMU) 24 is the control center of the distributed antenna system 20, and the cell management unit 24 is connected to the base station 21 and connected to the remote radio heads 26 via the extension hub 25." Ex. 1005, 3:26–28; Ex. 2005, 3:26–28.

Leng's base station switches high-load remote radio heads so that they receive different carriers from low-load remote radio heads to balance the loads across the remote radio heads and mitigate problems in "hot spots." *See* Ex. 1005, 9:1–33; Ex. 2005, 9:1–33.

b. Canon

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 transmit them via an antenna. Ex. 1006, codes (54), (57), ¶ 20.

Cannon's Figure 1 follows:

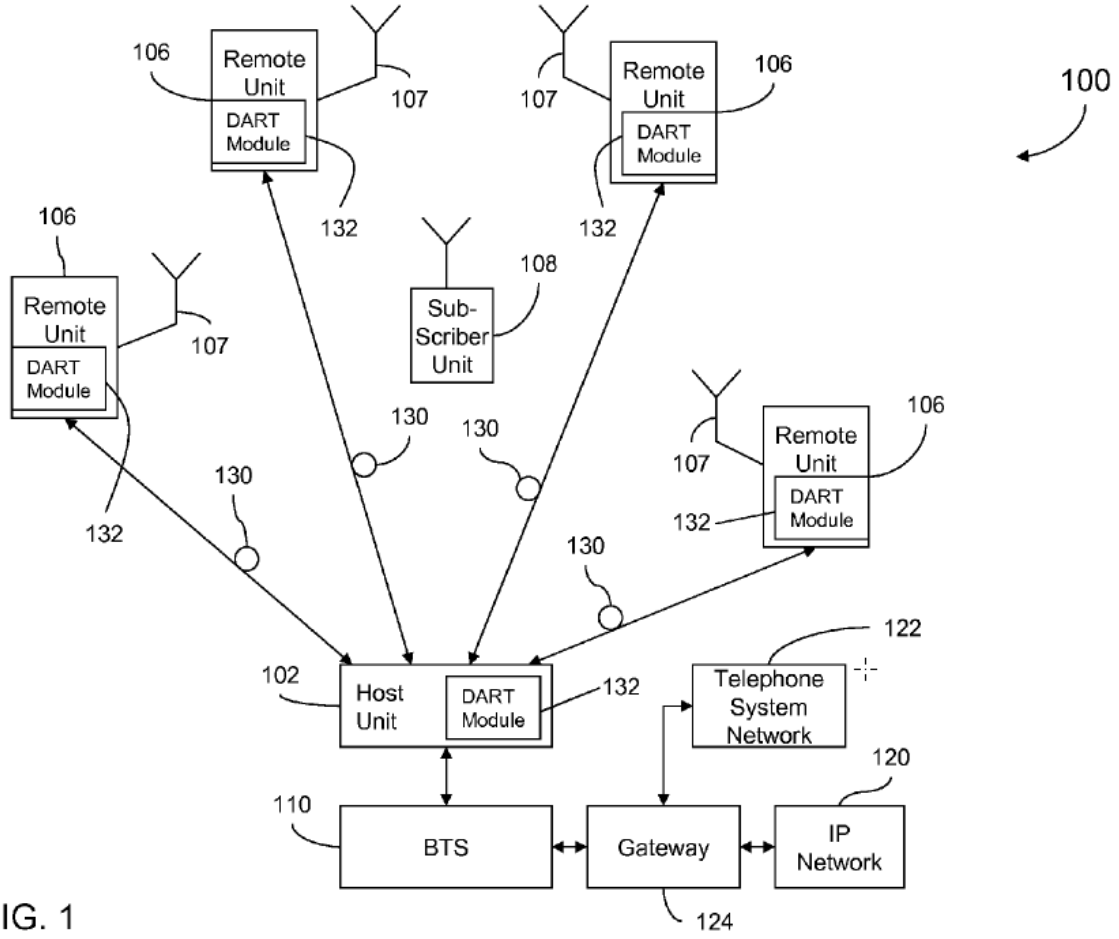


FIG. 1

Figure 1 depicts DAS 100, including host unit 102 and remote units 106. Ex. 1006, 2:59–60. Host unit 102 communicatively couples to at least one base transceiver station (BTS) 110. *Id.* at 3:13–14. Host unit 102 receives downlink signals from BTS 110 and generates transport signals for transmitting to one or more remote units 106. *Id.* at 3:27–30. "[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.* at 3:46–49. "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.* at 3:49–53. "These digital data signals . . . may comprise digital representations of an RF, IF or baseband version of the original RF signal." *Id.* at 3:52–56.

"For example, if a particular communication signal destined for transmission to subscriber unit 108 is a modulated RF signal in the 900 MHz band, then host unit 102 will generate baseband digital samples of the modulated 900 MHz RF signal from BTS 110, which are then distributed by host unit 102 to the remote units 106." Ex. 1006, 3:58–63. "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.* at 3:65–67. 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.* at 3:67–4:3.

A digital to analog radio frequency transceiver (DART) module in each remote unit 106 performs this conversion. Ex. 1006, 4:14–22. 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.* at 4:46–52, 5:39–63, 8:50–57. "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.* at 7:13–15. The DART module includes FPGA 503 (field programmable gate array). *Id.* at 7:15–19, 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. 1006, 9:45–61.

c. Claim 1

Petitioner generally characterizes Leng as describing "the same structure and method for managing resources, including a DAS that reconfigures remote radios based on the load of the radios" and Cannon as describing "the specific details of reconfiguring an RRU in a DAS." Pet. 2.

i. Preamble

Claim 1's preamble recites "a method for routing and switching RF signals comprising." Petitioner contends that to the extent the preamble is limiting, Leng discloses distributing, routing, and switching RF signals from cell management unit 24 to remote radio heads 25.

Petitioner relies on the following in Leng:

> [T]he cell management unit 24 is connected to the base station 21 and connected to the remote radio heads 26 via the extension hub 25 **for distributing downlink radio signals to the remote radio heads 26, collecting uplink radio signals and transmitting them to the base station 21**, and collecting the load information of the distributed antenna system 20 **and reconfiguring the distributed antenna system 20 according to the load information**.

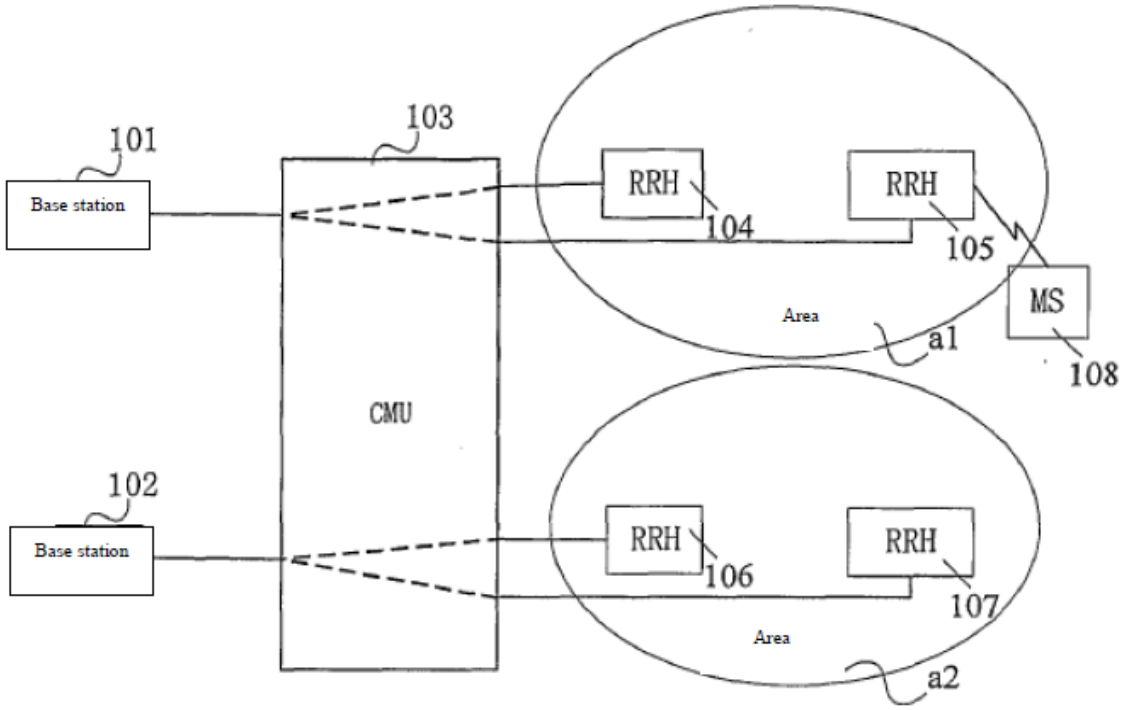
Pet. 39–40 (quoting Ex. 1005, 3:22–25).

Regardless of whether the preamble is limiting, Petitioner's showing for the preamble is persuasive. Patent Owner does not address Petitioner's showing as to this limitation. *See generally* PO Resp.

ii. Limitation ii

Claim 1 recites "providing one or more remote radio units, each remote radio unit configured to transmit one or more downlink RF signals and to receive one or more uplink RF signals." Relying on Leng's Figure 2, Petitioner asserts that Leng discloses providing one or more RRHs 105 (i.e., remote radio units (RRUs) as recited), wherein each RRU/RRH transmits downlink RF signals to, and receives uplink RF signals from, mobile stations such as MS 108. Pet. 40–41. In support, Petitioner quotes Leng as disclosing that "[t]he cell management unit 24 is . . . configured t**o distribute downlink radio signals to the remote radio head 26, collect uplink radio signals and transmit them to the base station 21**." *Id.* at 40 (quoting Ex. 1005, 3:22–24; citing Ex. 1003 ¶ 78).

Leng's Figure 10 follows:



Addressing Leng's Figure 10, Petitioner quotes Leng as disclosing that "**base station 101 transmits carriers C1 and C2, and assigns them to RRH 104 and RRH 105**. The base station 102 transmits carriers C3 and C4, and assigns them to RRH 106 and RRH 107. **The mobile station (MS) 108 is in the area a1 and uses carrier C2.**" Pet. 40–41 (citing Ex. 1005, 9:11–14).

Based on the above disclosures, Petitioner contends that a person of ordinary skill would have

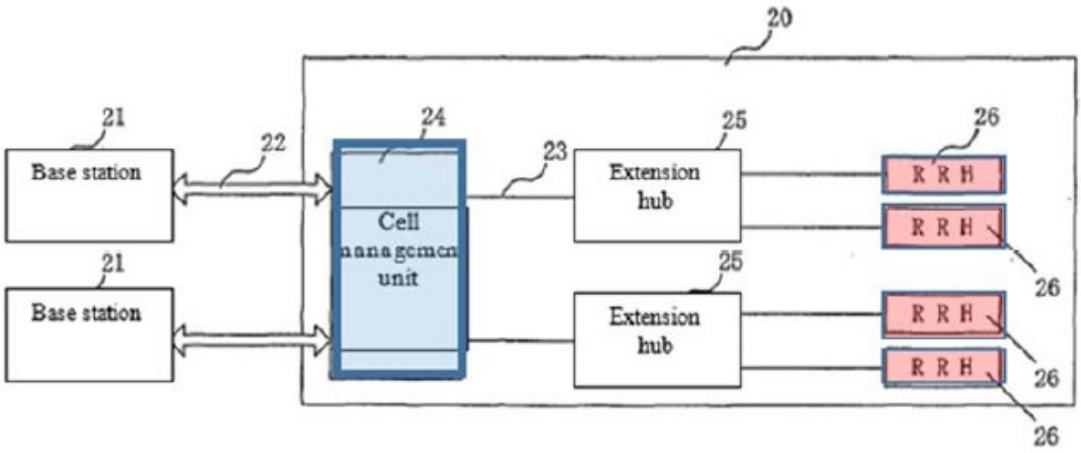
> understood from Leng and an understanding of the function of radio heads that the RRHs form the last leg of the downlink to the mobile stations and the first leg of the uplink from the mobile stations, in which the downlink and uplink radio signals are transmitted to the mobile station and received from the mobile station respectively via the carriers. EX-1003 ¶79.

Pet. 41.

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

iii. Limitation iii

Claim 1 recites "providing at least one [DAS] unit configured to communicate with the one or more [RRUs]." Petitioner relies on the following annotated version of Leng's Figure 2:



As annotated by Petitioner, Leng's Figure 2 above shows cell management unit 24 (blue, DAS), connected to one more remote radio heads 26 (pink, RRUs). Pet. 42 (citing Ex. 1005, Fig. 2; Ex. 1003 ¶ 80).

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

iv. Limitation iv

Claim 1 recites "translating the uplink and downlink signals between RF and base band as appropriate." Petitioner explains that "Leng discloses the RRH converts the downlink digital baseband signals from the transmission medium to an RF signal and the uplink from an RF signal to a

digital baseband signal on the transmission medium." Pet. 42. Petitioner relies on the following annotated version of Leng's Figure 2.

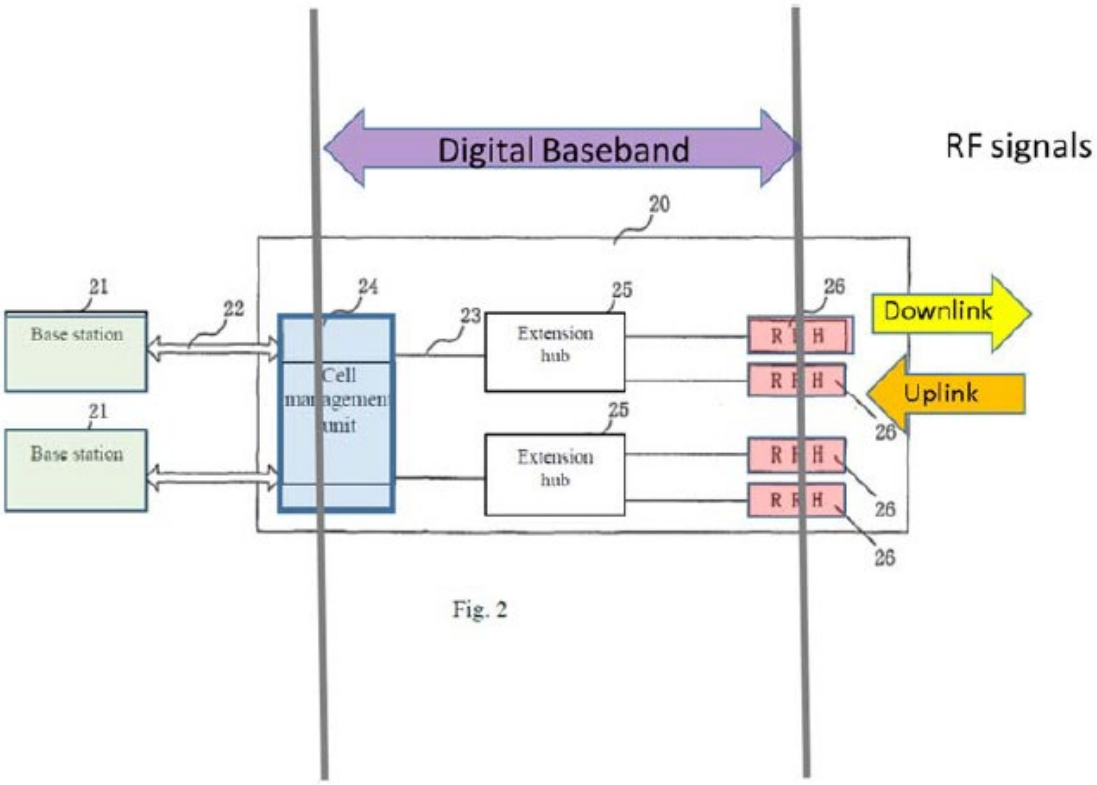


Fig. 2

Petitioner annotates Leng's Figure 2 to show uplink (orange), downlink (yellow), and digital baseband (purple) signals. Pet. 43. Petitioner quotes Leng's description of its RRHs:

> The remote radio heads (RRHs) 26 are used for **digital filtering, analog/digital-to-analog conversion**, and analog front-end functions. The transmission medium 23 of the distributed antenna system 20 may be an optical fiber or a UTP/STP cable, etc., the transmission network may be Gigabit Ethernet, and the **transmitted radio signals are digital baseband signals**.

Pet. 43 (quoting Ex. 1005, 3:34–38; citing Ex. 1003 ¶ 81).

Petitioner alternatively contends that Cannon teaches converting between RF and baseband, and it would have been obvious to employ this conversion technique in Leng's system because sampling baseband signals

minimizes the sampling rate needed to digitize the full band as compared to the original RF signal. Pet. 46 (citing Ex. 1006, Fig. 1; Ex. 1003 ¶¶ 85–86).

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

v. Limitation v

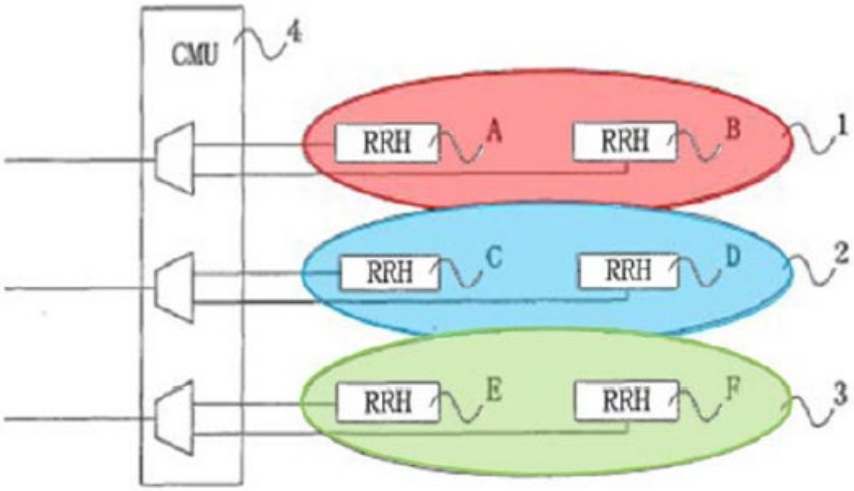
Claim 1 also recites "packetizing the uplink and downlink base band signals, wherein the packetized signals correspond to a plurality of carriers." Petitioner quotes Leng as disclosing that "**cell management unit 24 updates the radio signal route by reconfiguring the I/Q packet addresses and updating the routing table** stored in the cell management unit 24 and the extension hub 25 according to the new topology determined" to create packets out of a plurality of carriers. Pet. 47 (quoting Ex. 1005, 6:19–21; citing Ex. 1003 ¶ 88). Petitioner also quotes Leng as disclosing "**multiple carriers** and multiple base stations, of which the RRHs can also support multiple carriers." *Id.* (quoting Ex. 1005, 3:39–43; citing Ex. 1003 ¶ 87). Petitioner also quotes Leng as describing an example of a "Gigabit Ethernet link . . . support[ing] five carriers" and as disclosing that "[t]he number of carriers supported depends on the wireless technology used and its operating bandwidth." *Id.* at 48 (quoting Ex. 1005, 3:40–43; citing Ex. 1003 ¶ 89).

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

vi. Limitation vi

Claim 1 also recites "configuring each remote radio unit to receive or transmit a respective subset of the plurality of carriers, each respective subset of the plurality of carriers including a number of carriers." Petitioner contends that Leng's RRHs (i.e., RRUs) receive a subset of one or more carriers of available carriers. Pet. 48. As indicated above with respect to limitation *v*, Petitioner relies on several statements in Leng to show that each RRU supports multiple carriers.

Petitioner provides an annotated version of Leng's Figure 4, which follows:



Leng's Figure 4, as annotated with different colors by Petitioner, illustrates RRHA and RRHB supporting carrier 1 (red), RRHC and RRHD supporting carrier 2 (blue), and RRHE and RRHF supporting carrier 3 (green). Pet. 49 (citing Ex. 1005, 3:19–20; Ex. 1003 ¶ 91).

Petitioner explains as follows:

> Although the example in FIG 4 shows each RRH using one carrier, Leng discloses that "the RRHs can also support multiple carriers." EX-1005 3:39–40. Thus, a POSA understood

> that each RRH can be configured with a subset of the plurality of carriers 1–3, where the subset includes a number of carriers, e.g., carriers 1–2. EX-1003 ¶92.

Pet. 49.

Addressing related limitation *vii*, Petitioner also notes that Leng states that "the RRHs can also support multiple carriers." Pet. 60 (quoting Ex. 1005, 3:31–32). Patent Owner does not dispute that Leng discloses that its "RRHs can . . . support multiple carriers." *See* PO Resp. 45 (citing Pet. 60). Although limitation *vi* does not specify that a "number" is greater than 1, Leng discloses the limitation even if the number is greater than 1.

Petitioner alternatively adds that it would have been obvious to employ multiple carriers in Leng, based on teachings in Cannon. Pet. 49–50. Petitioner relies on Cannon's disclosure that each FPGA in a DART module (stored in Cannon's remote units) can be programmed to handle multiple carriers, reading on a subset of the plurality of carriers. *Id.* (citing Ex. 1006, 6:47–55, 7:47–64; Ex. 1003 ¶ 93). Petitioner relies on reasons to combine Cannon with Leng as including the following: Cannon teaches that FPGAs are adjustable by using simple programming to meet the changing needs of a user, with dynamic reassignment of a DAS with multiple carriers allowing for real-time load distribution without interrupting the service, where the modification of Leng could be achieved predictably with a reasonable likelihood of success. *See id.* at 35–38 (citing Ex. 1006, 6:47–55, 7:47–64, 9:45–47, Fig. 6; Ex. 1003 ¶¶ 72–74). As indicated above in discussing limitation *iv*, Petitioner also asserts that Cannon's method of digitizing the baseband to alter carrier frequencies minimizes the sampling rate. *See id.* at 46 (citing Ex. 1006, Fig. 1; Ex. 1003 ¶ 86).

Petitioner's showing for this limitation is persuasive. Patent Owner does not address Petitioner's showing specifically as to this limitation. *See generally* PO Resp. To the extent Patent Owner generally argues a lack of sufficient reasons to combine Leng and Cannon with a reasonable expectation of success, and asserts Leng does not disclose a plurality of carriers, these arguments overlap with or repackage arguments that we address and find unavailing in the next subsection.

vii. Limitation vii

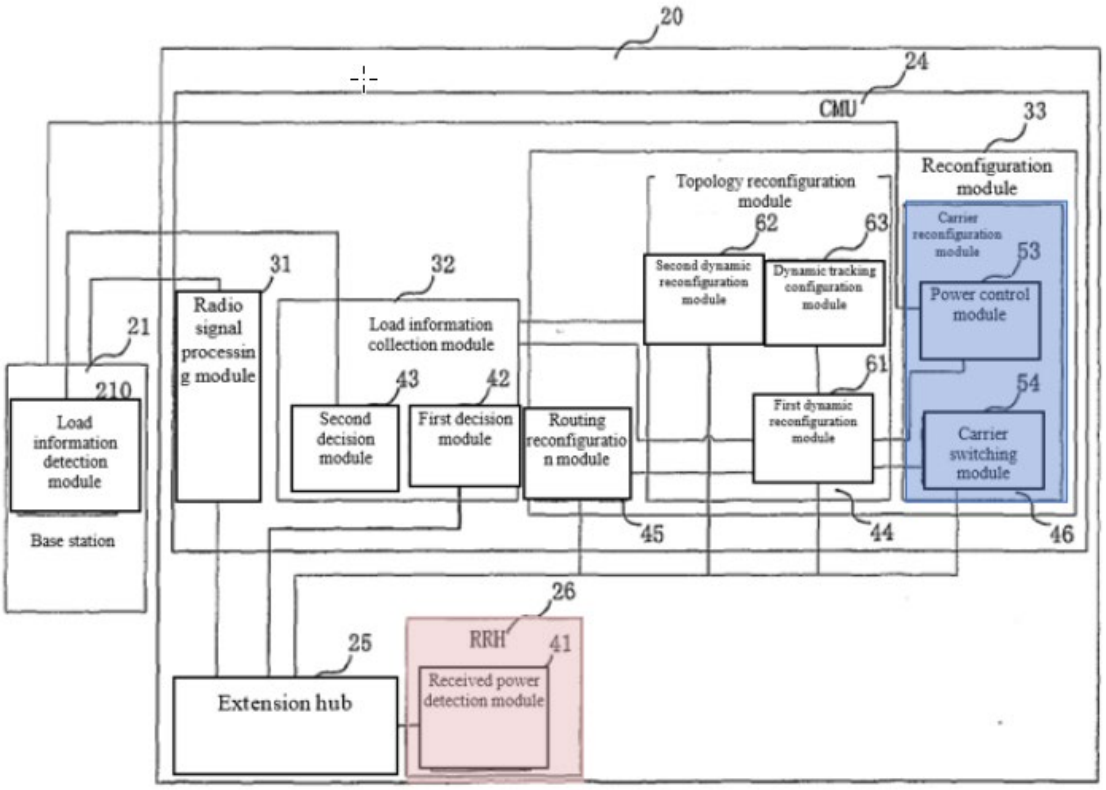
Reconfiguring

Limitation *vii* recites "reconfiguring each remote radio unit by: [*a*] determining a load percentage for each [RRU]; and [*b*] increasing or decreasing the number of carriers in the respective subset of the plurality of carriers based on the load percentage." As indicated above, Petitioner reads the claimed RRUs onto Leng's RRHs. Pet. 51–52. Petitioner also asserts that Leng discloses reconfiguring the RRUs, or that the combined teachings of Leng and Cannon would have rendered limitation *vii.a* obvious. Pet. 51–55 (citing Ex. 1005, 4:11–17 (disclosing a "reconfiguration module 33, configured to . . . reassign carriers . . . and reconfigure the routing of radio signals.")). According to Petitioner, "Leng discloses the RRHs are notified to switch carrier frequencies *and the RRHs switch their carriers* quicker than the base station reassigns the mobile stations to the switched carriers." *Id.* at 50 (emphasis added). Petitioner quotes the following passage of Leng for support:

> The carriers of the corresponding low-load remote radio heads may be a neighboring available carrier. If there is no neighboring available carrier, the base station switches the mobile station to a specific target carrier after a predetermined delay time, with the

> target carrier being a low-load target carrier to which the RRH corresponding to the mobile station should be switched according to the determined new topology. Obviously, the delay time should be greater than the time for *the RRH to switch carriers* in order to switch the mobile station to the target carrier *after the RRH has switched to the target carrier*.

Pet. 50–51 (emphasis added) (quoting Ex. 1005, 9:5–10; citing Ex. 1003 ¶ 95). Petitioner annotates Leng's Figure 15 (with coloring) to support its showing, as follows (Pet. 51):



According to Petitioner, Leng's Figure 15 illustrates how carrier switching module 54 (blue) notifies high-load RRH 26 (pink) to switch to another carrier corresponding to a low-load RRH according to topology module 62. Pet. 51 (citing Ex. 1005, 10:21–27, Fig. 15; Ex. 1003 ¶ 96).

Patent Owner argues that Leng discloses reassigning, not reconfiguring, "because Leng does not explicitly or inherently teach

changing any settings or parameters of the radio units themselves." PO Resp. 27. Patent Owner asserts that "Leng suggests that the CMU ***notifies the RRHs to switch carrier frequencies***. *Id.* at 28 (citing Ex. 1005, 13:15–16).

Patent Owners' argument verifies that the parties agree that Leng's RRHs switch the carriers. Ex. 1005, 13:15–16; PO Resp. 27; Pet. 50. Leng repeats this switching description at other instances. *See* Ex. 1005, 11:19–21 (describing "a carrier switching module 54, configured to notify the high-load remote radio heads to switch carriers to carriers of corresponding low-load remote radio heads according to the new topology determined by the topology reconfiguration module 44"). Therefore, as Petitioner argues, the fact that Leng's system notifies the RRHs to switch the carriers shows the claimed reconfiguration of the RRHs. *See* Pet. 50–52 (citing Ex. 1005, 9:6–10; citing Ex. 1003 ¶¶ 95–97).

Nevertheless, Patent Owner argues that Leng "does not disclose any actual change of any specific parameters or settings inside the RRH," and "all of the reconfiguration modules disclosed in Leng are contained in the CMU, not the RRH." PO Resp. 28. This argument confuses the fact that Leng *does not describe how* the RRHs switch the carriers, with the fact that Leng describes that the RRHs switch the carriers. *Notifying the RRHs to switch carriers* shows that the RRHs respond by performing a reconfiguration via some type of switching therein.

Patent Owner acknowledges that "Leng discloses that the CMU includes a reconfiguration module 33 . . . for reconfiguring the topology along with a carrier switching module 54 *that notifies the RRHs to switch carriers as illustrated in some exemplary figures of Leng*." PO Resp. 29

(citing Ex. 1005, Fig. 14). Petitioner similarly relies on Leng's disclosure that "switching module 54" in "carrier reconfiguration module 46" is configured "to *notify the high-load remote radio heads to switch carriers* to carriers of corresponding low-load remote radio heads according to the new topology determined by the topology reconfiguration module 44" (Ex. 1005, 11:17–21 (emphasis added)). Reply 16 (citing Ex. 1005, 10:21–27, 11:17–21; Ex. 1003 ¶ 64).

Petitioner also characterizes Leng as disclosing that "the RRHs switch their carriers quicker than the base station reassigns the mobile stations to the switched carriers." *Id.* at 17 (citing Ex. 1005, 9:5–10 ("Obviously, the delay time should be greater than the time for the RRH to switch carriers in order to switch the mobile station to the target carrier *after the RRH has switched to the target carrier*." (emphasis added); Ex. 1003 ¶ 95). Petitioner notes that the '338 patent similarly does not specify clearly how it causes a reconfiguration in the remote radio head, with Patent Owner's declarant pointing to an FPGA as a possible mechanism for reconfiguration. *See id.* at 18–19 (citing Ex. 1015, 63:6–17 (testifying that "an FPGA is one possible design to implement a digital up converter and/or a digital down converter according to the '338 patent, which . . . I believe . . . are software programmable and frequency selective"); 65:14–66:3 (testifying that an "FPGA is one possible architecture to implement the '338 patent")).

As Petitioner persuasively shows, *notifying* the radio heads to switch carriers results in "reconfigur[ing] each remote radio unit," by "changing the configuration [i.e., by switching] of each remote unit" to accommodate the reassigned carrier. *See supra* § II.B.2 (claim construction of the reconfiguring limitation); Pet. 50–52 (citing Ex. 1003 ¶ 95; Ex. 1005, Fig.

15). As explained above, notifying a remote radio head to switch carriers causes it to reconfigure itself to enable it to receive and transmit the reassigned carriers. *See* Ex. 1003 ¶¶ 94–96 (persuasively testifying that Leng discloses reconfiguring as claimed).

During the Oral Hearing, asked why Leng's system sends a notification "if it's not going to change anything" in the RRH, Patent Owner contended as follows: "So the notification can be the actual switching of the carrier. So it's notified by sending a switch[ed] carrier. It's not notifying it to change any parameters or configuration of the remote radio unit." Tr. 40:17–20. The record does not support the contention that Leng discloses that a switched carrier is itself a notification or vice versa. If the notification only tells the remote radio unit that it is receiving a new carrier without causing a change in the remote radio unit, the notification serves no purpose. The record does not support this constrained reading of Leng, and Petitioner's showing is persuasive. *See* PO Resp. 27–33.

As the Reply shows, Leng's base station implements a "delay . . . time greater than the time for the RRH to switch carriers" because the system switches the carriers in the mobile station "after the RRH has switched to the target carrier." Reply 17–18 (quoting Ex. 1005, 9:5–10; Ex. 1003 ¶ 95); *see also* PO Resp. 43 (citing same passage in Leng). Based on this disclosure, Dr. Houh testifies that "Leng discloses the RRH are notified to switch carrier frequencies and the RRH switch their carriers quicker than the base station reassigns the mobile stations to the switched carriers." Ex. 1003 ¶ 95 (citing Ex. 1005, 9:6–10). Therefore, this notice logically provides the requisite time for the Leng's RRHs to reconfigure themselves to switch their carriers prior to switching the mobile units carriers. *See id.* In other words, "the

time for the RRH to switch carriers" implies that the RRH reconfigures itself during that time in order to handle the new carriers. *See* Ex. 1005, 9:9. Petitioner's reading, supported by the testimony of Dr. Houh, is the most natural reading of how Leng's system operates. *See In re Preda*, 401 F.2d 825, 826 (CCPA 1968) ("[I]n considering the disclosure of a reference, it is proper to take into account not only specific teachings of the reference but also the inferences which one skilled in the art would reasonably be expected to draw therefrom.").[14]

Patent Owner cites another prior art reference that Petitioner does not rely upon, Hettstedt, but which Patent Owner characterizes as disclosing changing the addresses of carrier packets to effectuate switching, in an effort to describe how Leng's system works. PO Resp. 33. Patent Owner does not assert that Hettstedt teaches notifying the remote radio heads to switch. *See id.* Therefore, Hettstedt is not helpful as a comparison to determine how Leng's notification system operates. *See id.* Patent Owner also presents arguments relying upon another prior art reference that Petitioner does not rely upon, Wu, as "similar to Leng," based on a finding by the Board in another case regarding Wu. Sur-reply 11 (citing Ex. 1007, 22). Like Hettstedt, Wu is immaterial here because it is does not disclose clearly what Leng discloses in terms of notifying or reconfiguring. *See* Ex. 1007, 22 (discussing Wu's routing policy and finding that "Wu suffers from the same deficiency as Hettstedt and Oh" (another prior art reference not at issue here)).

[14] Contrary to Patent Owner's characterization, this is not an inherency issue but rather an issue as to what an artisan of ordinary skill would infer from the notification and reconfiguration teachings of Leng under the guidance of *Preda*. *See* PO Resp. 27.

Determining a Load Percentage

Limitation *vii.a* recites reconfiguring each remote radio unit "by: determining a load percentage for each remote radio unit." Petitioner relies on numerous teachings in Leng that describe load distribution and load balancing as teaching or suggesting determining a load percentage to balance or distribute the load. *See* Pet. 56–59, 64–65.

As examples for load balancing and distribution that imply or suggest determining a load percentage, Petitioner provides the following quotations from Leng:

> The distributed antenna system 20 is reconfigured [by] the CMU 24 based on the collected load information, instead of via manual configuration during service interruption by the administrator based on the expected situation as based on the prior art. This thus allows the distributed antenna system 20 to be **dynamically reconfigured in a timely and efficient manner based on the real-time load distribution, balancing the load and improving the system efficiency in a timely manner**, while greatly improving the convenience, real-time nature and accuracy of the configuration, and without service interruption, ensuring the continuity of services.

Pet. 56–57 (quoting Ex. 1005, 4:5–10).

> Clearly, by using the distributed antenna system provided by this embodiment, for areas where communication traffic varies greatly, such as auditoriums, conference halls, etc., **it is possible to dynamically allocate radio frequency resources according to the current traffic condition, and greatly balance the traffic load** and improve system efficiency.

Id. at 57 (quoting Ex. 1005, 4:24–27).

Petitioner also relies on Leng's power detection at each RRH: "The remote radio heads 26 comprise a received **power detection module 41 configured to detect the total broadband power received by the remote**

radio heads 26 and transmit the detected power value to the load information collection module 32." Pet. 57 (quoting Ex. 1005, 5:13–15).

Based on these teachings and other teachings in Leng, Petitioner argues that a person of ordinary skill in the art

> *understood using a load percentage* (i.e. the amount of load used by RRH compared to the total load on the network) to determine a new network topology to most efficiently distribute network resources for load balancing using the combination of load information of the RRHs as is one disclosed purpose of Leng.

Pet. 59 (emphasis added) (citing Ex. 1003 ¶ 106).[15]

Petitioner also explains that "[t]o the extent [Patent Owner] argues that Leng does not disclose determining a load percentage for each remote radio unit, a [person of ordinary skill] understood that Leng's disclosure of the relative loading of each RRH can be converted to a load percentage using well-known simple mathematical conversions." Pet. 65 (citing Ex. 1003 ¶ 118)).[16]

---

[15] The phrase "a [person of ordinary skill in the art] understood" in the context of this obviousness ground over Leng raises an obviousness issue with respect to the load percentage term. *See* Pet. 59. Patent Owner agrees that Petitioner's use of this phrase raises obviousness: "Petitioner's new argument appears to be one of obviousness as it states *a '[person of ordinary skill in the art] understood* that . . . .'" Sur-reply 8–9 (emphasis added) (quoting Reply 12).

[16] As noted in the Institution Decision, this particular quotation with respect to obviousness is in a Petition section that addresses claim 3, which depends from claim 1. Inst. Dec. 45 n.12. As further noted in the Institution Decision (*id.*), claim 3 recites and refers back to the "load percentage" introduced in claim 1, so that Petitioner's showing for the obviousness of claim 3's load percentage is applicable to its showing as to the "load percentage" as recited in claim 1, because it is part of Petitioner's showing with respect to this claim element. *See also infra* § II.D.1.d (addressing Petitioner's unchallenged obviousness showing for claim 3, which applies here).

In summary, Petitioner alleges that one of ordinary skill in the art would have understood that Leng discloses or suggests determining the load consumed (e.g., power consumed) by each RRH relative to the total load (e.g., total power available to a single RRH or across all RRHs in the network) in order to efficiently balance or distribute resources (e.g., equally). *See* Pet. 56–65. As part of this showing, Petitioner contends that balancing or distributing loads for each RRH results in determining proportions of the total power across one or more RRHs to distribute or balance, which in turn implies or suggests determining a percentage because that determination is simply using a known mathematical way to represent the proportion. *See id.*

Analysis of Petitioner's Claim Construction of Load Percentage

Patent Owner responds that Petitioner fails to show that Leng teaches a load percentage under either of the parties' claim constructions. *See* PO Resp. 20–26. With respect to Petitioner's claim construction, Patent Owner asserts that Petitioner's "interpretation of 'load percentage' does not meet the agreed upon definition adopted by the Board because it does not include information about the amount of ***available*** capacity." PO Resp. 25. According to Patent Owner, "Leng's 'real-time load distribution focuses on the amount of load used by all of the RRHs across the entire network, but nothing about a key aspect of the correct definition of load percentage, which is how much capacity is available or unused."[17] *Id.*

[17] Patent Owner argues that Petitioner improperly argues for the first time in its Reply that Leng renders "determining a load percentage" obvious under Patent Owner's narrow claim construction. *See* Sur-reply 8–9 (citing Reply 11–14). This is not correct. Petitioner raised an obviousness issue as to "load percentage" in its Petition in addressing the same claim term under its

Patent Owner's arguments turn on its interpretation of "available capacity," which is part of Patent Owner's claim construction, but is not an explicit claim term. *See* PO Resp. 25–26; *supra* § II.B.1.a (Claim Construction). Nevertheless, as Petitioner argues, the phrase in question, which the parties agreed to in District Court and also is not an explicit claim term, is "available capacity that is *in use*." Reply 10–11 (emphasis added); *supra* § II.B.1.a (showing parties' agreement); Ex. 2009, 1. As Petitioner persuasively explains, "[b]ecause the 'available capacity that is in use' is not limited to only the RRH, the available capacity in use can include the available capacity used by a group of RRHs or the entire network." *Id.* at 11. That is, Petitioner persuasively explains that shifting load from one RRH to another is distributing or balancing part of the total "available capacity in use" by RRHs in the network.

Contrary to Patent Owner's arguments, the scope of Petitioner's claim construction is included in the Board's claim construction. *See supra*

---

own claim construction with respect to claim 1 and also with respect to Patent Owner's narrow claim construction with respect to claim 3 as noted above. *See* Pet. 59, 65; *supra* notes 15–16. Also, Petitioner's Reply is proper because Petitioner responds to Patent Owner's proffered narrow claim construction that the Board adopted as an alternative with respect to claim 1 in the Institution Decision. *See* Inst. Dec. 18; Reply 11–14; *supra* § II.B.1 (adopting same); Reply 11–14. Moreover, the Reply largely repeats or repackages what is in the Petition and does not advance any new obviousness theory, except to the extent it explicitly folds the analysis of claim 3 into responding to Patent Owner's arguments regarding Patent Owner's narrow claim construction for claim 1, which is proper both in Reply and in the Petition for the reasons noted. *See* Reply 11–14; *supra* notes 15–16; *infra* note 19 (identifying the repackaged arguments). Thus, this argument in the Reply "properly expands on and is a fair extension of its previously raised . . . argument." *Rembrandt Diagnostics, LP v. Alere, Inc.*, 76 F.4th 1376, 1385 (Fed. Cir. 2023).

§ II.B.1.a (Claim Construction); Inst. Dec. 18 (same—construing "load percentage" per Petitioner's proposal to include "the amount of load used by a remote radio unit compared to the total load on the network"—the available capacity in use is in the denominator—i.e., the total load on the network's remote radio units); PO Resp. 25 (arguing otherwise); Reply 10–11 (applying Petitioner's proposed construction as it did in the Petition). Contrary to Patent Owner's arguments, in applying Petitioner's claim construction, we did not limit the non-claim term "available capacity in use" to "unused" capacity assigned to a single remote radio head. *See* PO Resp. 25; Inst. Dec. 18.

Patent Owner also argues that claim 1 "does not claim generic load balancing or load balancing based on the type of overall network load distribution disclosed in Leng." PO Resp. 26. The issue, however, is whether claim 1 reads on Leng's load balancing and distribution techniques or reads on what Leng fairly suggests regarding those techniques.

Recognizing that Patent Owner does not have the burden, we determine that Patent Owner's argument does not clearly dispute, let alone undermine, Petitioner's showing that Leng's load balancing and distribution techniques meet the claimed "determining a load percentage" under Petitioner's claim construction that we agree for the reasons discussed above falls within the proper scope of the claim. *See* PO Resp. 25 ("At best, Leng's 'real-time load distribution' focuses on the amount of load used by all of the RRHs across the entire network but nothing about a key aspect of the correct definition of load percentage, which is how much capacity is available or unused. Indeed, as Petitioner equates its interpretation to Leng's

disclosure of 'real-time load distribution' over the entire network, Leng does not disclose the adopted definition of 'load percentage.'").

In a section of its Response entitled "Leng does not disclose "determining a load percentage" under *Patent Owner's construction* of "load percentage" (PO Resp. 21), Patent Owner argues that "'load information' in Leng does not meet *Petitioner's definition* for 'load percentage'" and also argues, without specificity, "many" other "passages" relied upon by Petitioner in Leng "do not do not even disclose a load percentage under Petitioner's construction" (*id.* at 24 (emphasis added)).

These arguments are unavailing because they focus on isolated teachings in Leng, rely on how Patent Owner interprets "available capacity," and otherwise fail to address or undermine the totality of Petitioner's showing, which relies on Leng's load balancing and distribution techniques, as noted above. *See* PO Resp. 24–25. As one isolated example, Patent Owner argues that Leng's "'[r]eal-time load distribution' means how the load is distributed across the system, e.g., how much load is distributed to each of the various RRHs; *not the amount of load used by an RRH compared to the total load on the network*." *Id.* at 23 (emphasis added) (citing Ex. 2015 ¶ 63). Contrary to this attorney argument, Dr. Chrissan's cited testimony does not support the emphasized portion of the argued interpretation of Leng. Rather, Dr. Chrissan testifies that Leng's "real-time load distribution" "involves *the amount of load used by an RRH and the total amount of load of all of the RRHs across the entire network*." *Id.* (emphasis added). Determining the loads for a single RRH and the total across RRHs in light of well-known load balancing and distribution

techniques implies a comparison thereof, otherwise there is no reason to determine both.

The Petition also quotes Leng as obtaining "fine-grained load information (specific to each RRH)." Pet. 58 (quoting Ex. 1005, 5:27–30). The Petition also explains that Leng's "remote radio heads 26 comprise a received power detection module 41 configured to detect the total broadband power received by the remote radio heads 26 and transmit the detected power value to the load information collection module." *Id.* at 57 (quoting Ex. 1005, 5:13–15). Therefore, Leng's power detection system detects the numerator and denominator in a typical load balancing scenario—the power at each remote radio head and the total power across all the radio heads, respectively. *See supra* note 10 (trade dictionaries showing that balancing a load generally includes creating equal voltage or current on each component—e.g., so that the each RRH in Leng consumes an equal percentage of the current, voltage, or power of the load); Reply 8–9 (citing Ex. 1015, 95:23–24 (testifying that "load balancing" is "a very broad term"), 97:10–20)); Ex. 1014 ¶¶ 6, 9, 10 ("Determining the amount of load consumed by each RRU (e.g., carriers used on that RRU) as a proportion of the total load of carriers used in a group or the network, effectively allows the system to determine how to balance loads by reassigning carriers from higher loaded RRUs to lower loaded RRUs in a group."); Ex. 1015, 97:16–20 (Dr. Chrissan testifying that "load typically means usage and balancing can mean *leveling the usage across available resources*. So I would say load balancing generally refers to leveling usage across available resources."). Similarly, load distribution, which Leng describes, typically involves determining proportions to distribute, wherein a percentage is a

proportion. *See* Ex. 2009, 10 (District Court finding that "there are other definitions of percentage including 'proportion'").[18] As noted above, Dr. Chrissan supports this finding by testifying that "real-time load distribution" "involves *the amount of load used by an RRH and the total amount of load of all of the RRHs across the entire network*." Ex. 2015 ¶ 63 (emphasis added).

The Petition also quotes Leng as "greatly balanc[ing] the load" and "dynamically allocat[ing] frequency resources" "based on real time load information." Pet. 57 (citing Ex. 1005, 4:24–27). The Petition explains that Leng uses "a combination of load information." Pet. 58 (quoting Ex. 1005, 7:26–27). The Petition contends that a person of ordinary skill in the art 1) "understood Leng discloses load balancing, the use of a load percentage (i.e. the amount of load used by RRH compared to the total load on the network) . . . to . . . distribute network resources using the combination of load information of the RRHs" and 2) "understood using a load percentage (i.e. the amount of load used by RRH compared to the total load on the network) to determine a new network topology to most efficiently distribute

[18] As noted in the Institution Decision (Inst. Dec. 47 n.13), "distribute" means "[t]o divide and dispense in portions; parcel out." Synonyms include "distribute, divide, dispense, dole, deal, ration." THE AMERICAN HERITAGE DICTIONARY OF THE ENGLISH LANGUAGE (1976), 383 (stating that "[t]hese verbs [i.e., synonyms] mean to give something as a portion or share"). Ex. 3004. According to another source, the words "distributed; distributing" mean "to divide among several or many : APPORTION." MERRIAM-WEBSTER ONLINE DICTIONARY AND THESAURUS, *available* at www.merriam-webster.com/dictionary/distribute. The words "apportioned; apportioning" mean "to divide and share out according to a plan *especially* : to make a proportionate division or distribution of. Representatives are *apportioned* among the states." *Id.*, *available at* www.merriam-webster.com/dictionary/distribute. Ex. 3005.

network resources for load balancing using the combination of load information of the RRHs as is one disclosed purpose of Leng." *Id.* at 59 (citing Ex. 1003 ¶¶ 105, 106).

Relying on Dr. Houh's testimony, Petitioner provides a simple load balancing example to summarize what Leng discloses:

> [I]f the total amount of available capacity in use by a group of radios is "X", each radio in the group will use a portion of the available capacity in use. In other words, for a group with two radios, a load balanced configuration can have each radio using 50% of X. This would represent a load percentage for each radio of 50%.

Pet. 59 (quoting Ex. 1014 ¶ 14). This explanation is persuasive and Leng supports it based on the summary of Petitioner's showing above. In summary, by showing that Leng's system discloses load balancing and load distribution, and by showing that these techniques imply or at least suggest determining a load percentage to a person of ordinary skill in the art, Petitioner persuasively shows that Leng discloses and renders obvious determining a load percentage under Petitioner's claim construction, which we agree for the reasons discussed above falls within the proper scope of the claim.

Analysis of Patent Owner's Narrow Claim Construction of Load Percentage

Petitioner also contends that Leng discloses or renders obvious determining a load percentage even under Patent Owner's narrow claim construction, namely "an amount of load used by a remote radio unit relative to the total active capacity allocated to the remote radio unit." *See supra* § II.B.1. Patent Owner contends that Petitioner does not assert obviousness with respect to this narrow claim construction. PO Resp. 20 (citing Pet. 56–

59). As noted above, however, Petitioner raises this issue including with respect to claim 3, which captures Patent Owner's narrow claim construction. *See supra* notes 15–17; *infra* note 19 (determining that the Petition raises obviousness and the Reply is proper because it responds to Patent Owner's narrow claim construction position that we largely adopted in the Institution Decision and the Final Written Decision).

Specifically as to Patent Owner's narrow claim construction, the Petition asserts that a person of ordinary skill in the art

> understood that to properly redistribute resources to balance loading you would need to know which of the multiple carriers on each of the RRHs are being used. If this was not done, a carrier which was in use may be transferred to augment a "hot spot" overloading the carrier causing an unexpected disconnection of the user(s) using the carrier that was transferred.

Pet. 65 (citing Ex. 1003 ¶ 117).[19] The Petition also asserts that "[t]o the extent Leng . . . does not disclose determining a load percentage for each remote radio unit," "it would have been obvious and routine to perform the conversion into a load percentage," where a person of ordinary skill in the art "understood that Leng's disclosure of the relative loading of each RRH can be converted to a load percentage using well-known simple mathematical conversions." *Id.* (citing Ex. 1003 ¶¶ 118–119). In its Reply, Petitioner bolsters the argument and contends that "[a person of ordinary skill in the art] understood that in order to determine that a RRH was a hot

[19] As noted above (note 17), the Reply essentially repackages this argument directed to claim 3 in the Petition, and the Sur-reply correctly characterizes it as "one of obviousness," but erroneously refers to it as "Petitioner's new argument." Sur-reply 8–9 (citing Reply 12). It is only "new" in the sense that the Reply explicitly folds it into the analysis of claim 1 in response to Patent Owner's arguments regarding its claim construction. *See* Reply 11–12; *supra* notes 15–16.

spot or in a high load area, an amount of active capacity utilized by a RRH relative to the maximum amount of active capacity allocated to the RRH would be determined, and if it exceed[s] some threshold, it would be considered a hot spot" and "[t]hus, . . . understood that distinguishing between a high-load and a low-load RRH[] required evaluating the loading of all the RRHs and comparing the load of each RRH to some threshold value." Reply 12–13 (citing Ex. 1014 ¶ 17).

The record persuasively supports this obviousness rationale. As noted above, Petitioner points to Leng's description of determining thresholds and possible "hot spots," including "areas where communication traffic varies greatly, such as auditoriums, conference halls, etc.," such that "it is possible to dynamically allocate radio frequency resources according to the current traffic condition, and greatly balance the traffic load and improve system efficiency." *See* Pet. 57 (quoting Ex. 1005, 4:24–27), 63 (citing Ex. 1005, 11:22–26 (disclosing "spectrum resources may be appropriately assigned to mobile hot spots through the continuous dynamic reassignment of carriers in remote radio heads"); Ex. 1003 ¶ 116). Petitioner explains further that to address such hot spots, Leng discloses reassigning carriers "to balance load and to increase the availability of resources." *Id.* at 63. And as Petitioner persuasively argues, an artisan of ordinary skill would have considered detecting carrier loading and RRH loading using simple mathematical load percentage calculations so that the system does not drop users and/or reassign over-loaded carriers, which Petitioner shows is similar to the '338 patent's description of hot spots and thresholds. *See id.* at 65; Reply 12–13 (citing Ex. 1001, 1:32–37; Ex. 1003 ¶ 117; Ex. 1014 ¶¶ 15–17). After considering the arguments and evidence above and below, we determine that

Petitioner's analysis persuasively satisfies Patent Owner's narrow claim construction 2) and also claim construction 3), because Petitioner shows that Leng's system spreads resources based on the available capacity of carriers for a single RRU and multiple RRHs, respectively, with the load percentage an obvious mathematical representation of Leng's calculations based on load used and allocated capacity. *See* Pet. 63–65; Reply 11–13; *supra* § II.B.1.a.

Patent Owner does not address the totality of Petitioner's showing including this obviousness rationale, instead focusing on alleging that Leng's passages in isolation do not disclose determining a load percentage, as discussed further below. *See* PO Resp. 21–24; Sur-reply 8–9.

In addition, as also indicated above, the Petition shows that Leng's "remote radio heads 26 comprise a received power detection module 41 configured to detect **the total broadband power received by the remote radio heads 26 and transmit the detected power value to the load information collection module**." Pet. 57 (quoting Ex. 1005, 5:13–15). The Petition also shows that "Leng . . . discloses collecting various other types of information and data and using it to dynamically determine if the carriers need to be reallocated to other RRHs to balance load and to increase the availability of resources where there are 'hot spots.'" *Id.* at 63 (quoting Ex. 1005, 11:22–26; citing Ex. 1003 ¶ 116). Petitioner also shows that Leng discloses that "**for areas where communication traffic varies greatly, such as auditoriums, conference halls, etc., it is possible to dynamically allocate radio frequency resources according to the current traffic conditions and greatly balance the traffic load and improve system efficiency.**" *Id.* at 64–65 (quoting Ex. 1005, 4:18–27).

In addition to its reliance on Leng's balancing and distribution techniques and other disclosures as noted above in connection with Petitioner's claim construction, Petitioner quotes Leng as determining a power threshold for each RRH:

> [T]he cell management unit 24 receives the power information detected and transmitted by the RRH 26, compares it with a predetermined threshold, and then decides whether to reconfigure the intelligent distributed antenna system**.** This embodiment does not require any changes to the base station and allows fine-grained load information (specific to each RRH) to be obtained.

Pet. 57–58 (quoting Ex. 1005, 5:27–30).

Distributing and balancing a load as Leng does (as summarized above) in conjunction with comparison to a predetermined power thresholds implies knowledge of the distributed load proportion for each RRH. *See infra* note 18 ("distribute" means "[t]o divide and dispense in portions; parcel out," synonyms include "distribute, divide, dispense, dole, deal, ration," "distributed; distributing" means "to divide among several or many" or apportion, which means "to divide and share out according to a plan especially : to make a proportionate division or distribution of.").

To reconfigure carriers to distribute or balance the load, Leng's system detects threshold power information including the total broadband power for each radio head and similar information about hot spots at individual radio heads, and discloses flexibility in combining load information. *See* Pet. 57–58 (citing Ex. 1005, 5:13–15, 5:27–30, 6:1–4, 6:23–25; Ex. 1003 ¶ 104), 63 (citing Ex. 1005, 5:13–15, 1:22–26, Ex. 1003 ¶ 115).

Leng's disclosure of determining when each RRH exceeds a power threshold as a metric for reconfiguring carriers shows that Leng's system

knows (i.e., determines) the power *used* at that RRH relative to the total power potentially *available* for that RRH (i.e., a proportion or percentage thereof). This disclosure in Leng teaches or suggests the determination of whether the calculated metric exceeds the "threshold" of a carrier as disclosed in the '338 patent that Patent Owner relies upon to support its claim construction. *See* PO Resp. 15 (quoting Ex. 1001, 11:41–48); *supra* § III.B.1. Therefore, as Petitioner argues with respect to claims 1 and 3, Leng discloses or suggests determining the load percentage even under Patent Owner's narrow claim construction, where the load percentage is simply a mathematical construct that represents the same thing as exceeding a power threshold (e.g., the threshold is 75% of the total power an RRH can handle).

Again, in response, Patent Owner attacks Leng's teachings separately. *See* PO Resp. 21–24 (listing Leng's disclosures and arguing that "[n]one of these citations in Leng disclose 'a value representing the portion of available capacity that is in use' or the amount of load used by a radio unit relative to the total amount of capacity available to that radio unit."); Sur-reply 8–9 (similar arguments and not addressing obviousness). Patent Owner does not address Petitioner's showing based on the totality of Leng's disclosures or as summarized above or Petitioner's obviousness showing.

For example, Patent Owner argues that Leng's teaching that "'power detection module 41 . . . detect[s] the total broadband power received by the remote radio heads 26 and transmit the detected power value to the load information collection module'. . . . does not meet the claimed 'load percentage' as properly defined." PO Resp. 23 (citing Ex. 2015 ¶ 62). But Petitioner does not rely solely on this teaching as indicated above. Rather, Petitioner relies on what Leng fairly teaches or suggests to one of ordinary

skill in the art, as discussed above. In addition, Dr. Chrissan and Patent Owner fail to address the full context of the cited teaching in Leng fairly. In particular, at the cited paragraph, Dr. Chrissan testifies as follows:

> Leng states that "load information collection module 32 comprises a first decision module 42 configured to receive the power value transmitted by the received power detection module 41 and notify the reconfiguration module 33 to reconfigure the distributed antenna system according to the power value when the power value exceeds a threshold value."

Ex. 2015 ¶ 62 (quoting Ex. 1005, 5:16–19). Then Dr. Chrissan concludes that "[a person of ordinary skill in the art] would understand that this power value is not the same thing as a load percentage of a radio unit, i.e., 'a value representing the portion of available capacity that is in use.'" *Id.* But Dr. Chrissan's isolation of what the "power value" represents to the exclusion of what the "threshold" represents in relation to that power value simply avoids the issue. *See id.* As determined above, Leng's disclosure of determining when each RRH's power value exceeds a power threshold shows that Leng's system knows (i.e., determines) the power *used* at that RRH relative to the total power potentially *available* for that RRH (i.e., a proportion or percentage of the total power the RRH can handle), which satisfies Patent Owner's claim construction. *See* PO Resp. 21 (equating "a value representing the portion of available capacity that is in use" with "the amount of load used by a particular RRH relative to the total amount of available capacity for that RRH").

Based on the foregoing discussion, in light of the knowledge of an artisan of ordinary skill in the art, Petitioner persuasively shows that Leng discloses and renders obvious determining the load percentage under Patent

Owner's claim construction of the term. We additionally incorporate herein our similar analysis of claim 3 in Section 11.D.1.d, below.

Increasing or Decreasing the Number of Carriers

Limitation *vii.b* recites "reconfiguring each remote radio unit by . . . increasing or decreasing the number of carriers in the respective subset of the plurality of carriers based on the load percentage." Petitioner contends that Leng discloses this limitation or that the combined teachings of Leng and Cannon would have rendered it obvious. Pet. 59–60.

Petitioner quotes Leng as describing (with respect to Figure 3) "**a reconfiguration module 33, configured to determine a new topology, reassign carriers among the corresponding remote radio heads, and reconfigure the routing of radio signals according to the load information collected by the load information collection module 32**." Pet. 60 (quoting Ex. 1005, 4:11–17).

Petitioner also relies on Leng's "example of switching carriers between each RRH in Figures 4 and 5 based on the load information." Pet. 60 (citing Ex. 1005, 3:18–22). Petitioner concedes that Figures 4 and 5 depict only one carrier per RRH, but notes that "Leng discloses that 'the RRHs can also support multiple carriers.'" *Id.* (citing Ex. 1005, 3:31–32). Therefore, according to Petitioner, a person of ordinary skill "understood that each RRH can be configured to use more than one carrier and thus the number of carriers in the subset assigned to each RRH may be decreased or increased as appropriate based upon load." *Id.* (citing Ex. 1003 ¶ 108). As noted above, Petitioner generally addresses multiple carriers for RRUs in addressing limitations *v* and *vi*.

Petitioner alternatively asserts that even if Leng does not disclose limitation *vii.b*,

> Cannon expressly discloses that each FPGA in a DART module could be programmed to handle multiple carriers which would include a subset of the plurality of carriers that can either be increased or decreased. EX-1006 6:47–55; 7:47–64; EX-1003 ¶110. A POSA would be motivated to combine the teachings of Leng with the teachings of Cannon as discussed above to increase or decrease number of carriers used by a remote radio unit based on the load percentage. EX-1003 ¶110.

Pet. 60. In other words, Petitioner relies on several reasons to combine Cannon and Leng as summarized above to address limitation *vii*. *See, e.g.*, *supra* § II.D.c.vi (addressing limitation *vi* reciting multiple carriers).

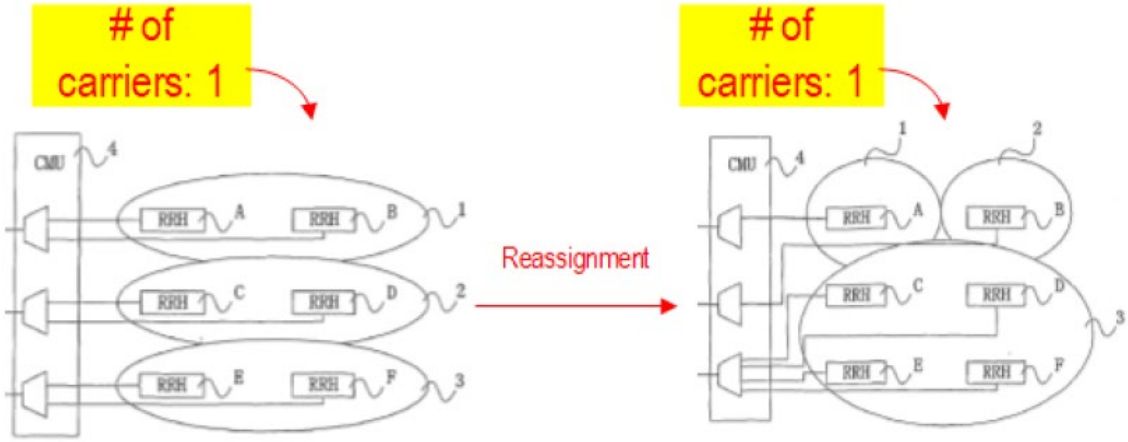
Patent Owner relies on its unavailing arguments that Leng does not disclose determining a load percentage to support its showing that Leng discloses limitation *vii.b.* PO Resp. 44.

Focusing on Leng alone, Patent Owner argues that "Leng does not disclose its carrier reassignment scheme in which more than one carrier is assigned to an RRH at a time, and thus does not disclose increasing or decreasing the number of carriers." PO Resp. 45. Patent Owner acknowledges that Petitioner relies upon Leng's disclosure that "*RRHs can . . . support multiple carriers*." PO Resp. 45 (quoting Ex. 1005, 3:39–43; citing Pet. 60). According to Patent Owner,

> [b]ased on this sentence alone, however, it is unclear whether Leng discloses that each RRH can be assigned multiple carriers concurrently and whether Leng's carrier reassignment scheme can be applied to multiple carriers in a manner that results in "increasing or decreasing the number of carriers in the respective subset of the plurality of carriers" for an RRH. Ex. 2008 ¶ 50.

Id. at 45–46. Patent Owner further argues that Petitioner only points to disclosures in Leng "in which a single carrier is assigned or reassigned to

each RRH." *Id.* (citing Pet. 60; Ex. 1005, 3:18–22, 13:6–7 ("exchanges the assigned carriers of high-load remote radio heads with those of low-load remote radio heads"). In its Sur-reply, Patent Owner points to Leng's Figures 4 and 5, which shows a result wherein Leng's reassigns 3 carriers to different groups of RRHs, which Patent Owner contends shows that "the number of carriers for each of RRHs A-F *is fixed* at a single carrier both before and after reassignment." Sur-reply 19.[20] Patent Owner annotates Figures 4 and 5 to illustrate its argument, as follows:



Leng's Figures 4 and 5, as annotated by Patent Owner to show that each RRH A–F in Leng only processes one carrier, represent one example of a reassignment of carriers 1–3 between remote radio heads RRH A–F in Leng. *See* Sur-Reply 19.

Patent Owner's arguments are unavailing. In general, as discussed further below, Leng's system continually and dynamically reassigns carriers as part of its reconfiguration scheme. *See, e.g.*, Ex. 1005, 8:15–9:22, Fig. 9

[20] Patent Owner's point that Leng's RRHs in Figures 4 and 5 only support a single carrier before and after the reassignment appears to be an improper response in the Sur-reply to the Reply because it does not respond to a new argument in the Reply. Nevertheless, we exercise discretion and address it.

(switching carriers between high load and low load areas), 11:26 (disclosing that "spectrum resources may be appropriately assigned to mobile hot spots through the continuous dynamic reassignment of carriers in remote radio heads"). In other words, as Petitioner generally shows, the fact that RRHs handle multiple carriers is part and parcel of the reconfiguration scheme, so that even if Leng's system assigns an RRH one carrier initially in certain embodiments such as Figures 4 and 5, Leng's dynamic load balancing system also can add a carrier to it depending on the load, resulting in multiple carriers. *See id.* There is no requirement in claim 1 to assign or reassign "multiple carriers concurrently," contrary to Patent Owner's arguments. *See* PO Resp. 45.

As discussed above in connection with Leng's delay time in switching carriers, Petitioner points to Leng's embodiment at page 9 and quotes Leng as disclosing a delay time to "switch carriers"—i.e., a reconfiguration involving plural carriers. Pet. 50–51 (quoting Ex. 1005, 9:9–10). Near the cited passage, Leng specifically notes that the base station "switches the RRH 105 to carrier C3" (Ex. 1005, 9:19) after having assigned "carriers C1 and C2 . . . to RRH 104 and RRH 105" (*id.* at 9:12). Therefore, this reassignment (i.e., switch) involves a decrease of one carrier, satisfying disputed limitation *vii.b*. In addition, after reconfiguring RRH 105 so that is has one carrier C3, "the RRH 105 is switched to carriers C3 and C4," resulting in an increase of one carrier, also satisfying disputed limitation *vii.b*. *Id.* at 9:21.

Figures 4 and 5 also support Petitioner. As illustrated and described above, these figures represent reassigning carrier 1 so that RRH A and RRH B no longer share carrier 1. As Figure 5 represents, after the reassignment,

RRH A uses carrier 1 exclusively and RRH B uses carrier 2 exclusively—there is no sharing of carrier 1 or carrier 2. This reassignment implies that after the system takes carrier 1 away from RRH B, RRH B does not have any carrier for a short time during the switching transition when the system quickly adds carrier 2 to RRH B, as Figure 5 represents. *See* Pet. 50–51 (noting "the time for the RRH to switch carriers" (quoting Ex. 1005, 9:6–10)). Therefore, Leng discloses that RRH B increases its carriers from zero to one during the short transition time, satisfying the disputed limitation of claim 1.[21]

Alternatively, Leng satisfies the disputed limitation because after the first reassignment represented by Figure 5 as described above, as indicated above, Leng generally contemplates adding another carrier to RRHs, such as RRH B, depending on load conditions, as explained above. That is, as the parties recognize, Leng states that "*RRHs can . . . support multiple carriers*." PO Resp. 45 (quoting Ex. 1005, 3:39–43; citing Pet. 60). This means, as Petitioner argues, that Leng generally contemplates adding another carrier to an RRH at some point in time depending on load conditions to handle a hot spot or otherwise balance the load. *See* Pet. 60 (citing Ex. 1005, 3:31–32; Ex. 1003 ¶ 108). As Petitioner concedes, Leng's Figures 4 and 5 are simply examples of RRHs handling a single carrier. *See id.* However, Leng

[21] Even if the system adds a carrier to an RRH before it subtracts an existing carrier, Leng meets the disputed limitation. For example, in that scenario, RRH B increases its carriers to two (carriers 1 and 2) for a short time before Leng's system reassigns shared carrier 1 exclusively to RRH A as Figure 5 represents. And even if the system reassigns the carriers simultaneously, then there is a short time when RRH A and RRH B have zero carriers assigned to them, so that the reassignment involves an increase in the number of carriers to one for RRH A and RRH B.

supports Petitioner's assertion that Leng discloses adding a carrier to an RRH because RRHs potentially carry multiple carriers, and Leng also generally discloses that "spectrum resources may be appropriately assigned to mobile hot spots through *the continuous dynamic reassignment of carriers in remote radio heads*." Ex. 1005, 11:25–26. In other words, Leng's system continually reevaluates load conditions and reassigns carriers based on the load conditions, even with respect to Figure 5, as Petitioner shows. *See* Pet. 57 ("Clearly, by using the distributed antenna system provided by this [Figure 3] embodiment, for areas where communication traffic varies greatly, such as auditoriums, conference halls, etc., it is possible to dynamically allocate radio frequency resources according to the current traffic condition, and greatly balance the traffic load and improve system efficiency." (quoting Ex. 1005, 4:24–27)).[22] Therefore, with respect to Figure 5, one of the RRHs may include multiple carriers as Leng generally discloses, which occurs as a result of Leng's system dynamically increasing the number of carriers for an RRH based on load conditions. *See id.* at 57, 59–60 (citing Ex. 1005, 4:11–17; Ex. 1003 ¶ 107).[23]

Moreover, the '338 patent describes "RF carriers or channels," and Figure 1 shows "specific *frequency bands* or RF carriers." *See* Ex. 1001, 7:17–24 (the width of the band signifying RF spectrum or bandwidth).

---

[22] Figures 4 and 5 illustrate a "principle of reconfiguration" that applies to Figure 3. Ex. 1005, 11–19.

[23] When "there is no neighboring available carrier" (e.g., none in RRH A or RRH C–F in Fig. 5), because the auditorium and all available carriers are at full load, Leng's system contemplates assigning to RRH B (or any RRH) a "low-target carrier to which the RRH corresponding to the mobile station should be switched according to the determined new topology." *See* Ex. 1005, 9:5–8.

Because a carrier in the '338 patent includes or is a frequency band, the notion of adding carriers in the plural as a distinction over adding a single carrier or a portion thereof is somewhat arbitrary, because in all cases, the system adds unspecified bandwidth. *See id.* at Fig. 1. In any case, for the reasons noted above, Petitioner's showing is sufficient even if there is more than an arbitrary distinction between a carrier or channel portion, a single carrier, or two carriers.

As indicated above, Petitioner alternatively argues that "[t]o the extent PO argues that Leng does not expressly disclose how the carrier frequency is reconfigured at an RRH, Cannon discloses reconfiguring the carrier frequency of a remote radio unit using the same method described in the '338 Patent." Pet. 51 (citing Ex. 1003 ¶ 98).

Petitioner annotates (with coloring) Cannon's Figure 1 as follows:

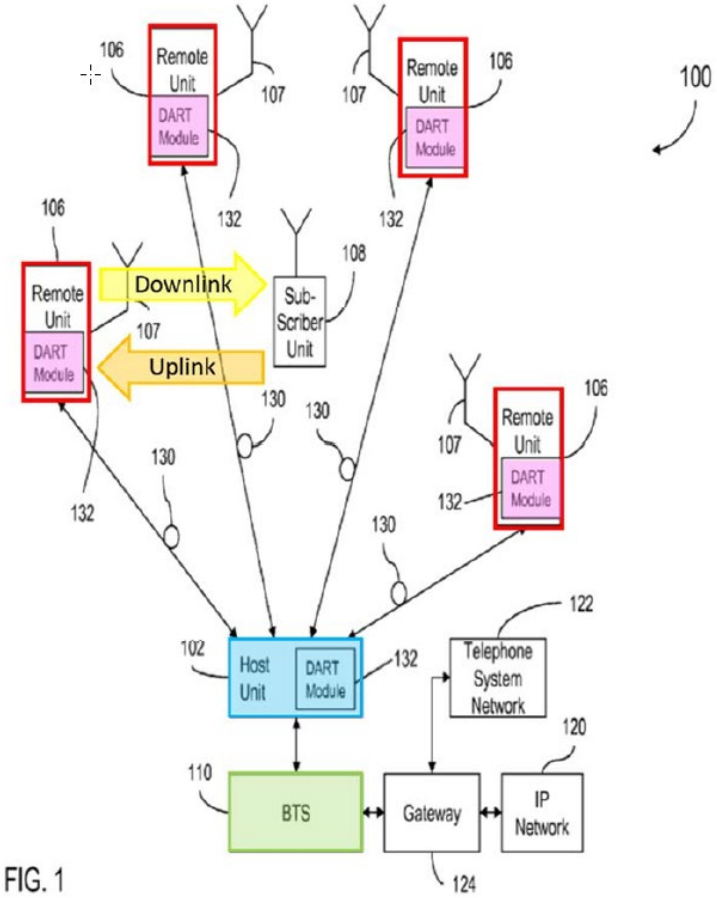


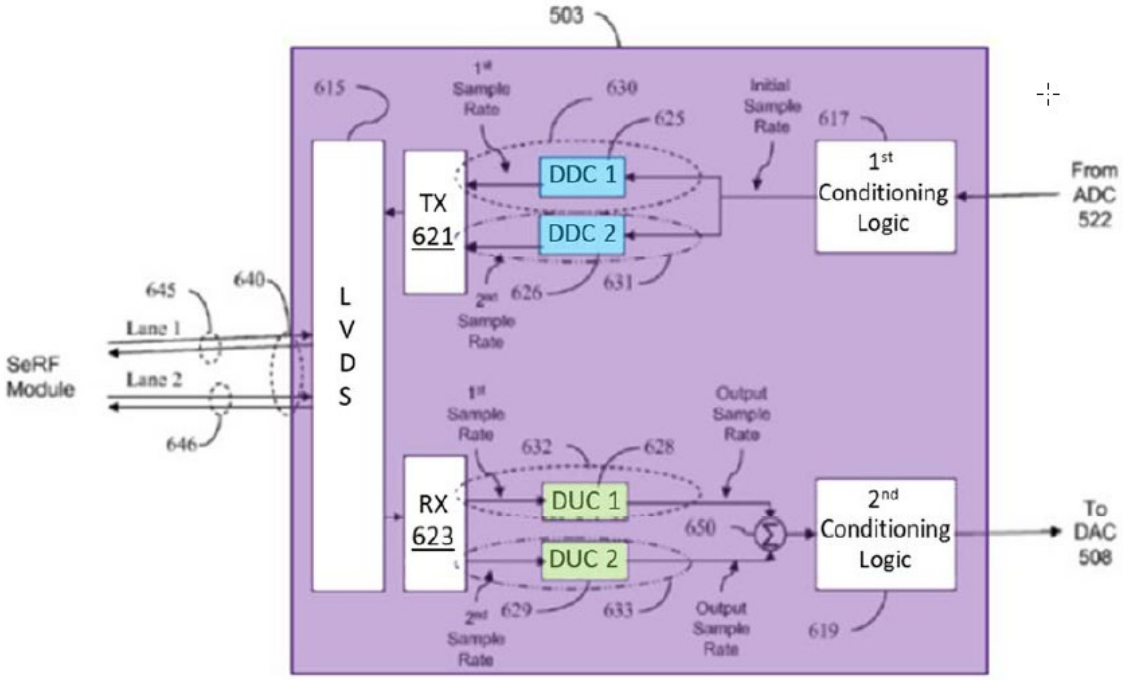
FIG. 1

Cannon discloses that

> [i]n the embodiment shown in FIG. 1, **each remote unit 106 and host unit 102 comprises a digital to analog radio frequency transceiver (DART) module 132 configured to conserve the available bandwidth** of the communication links 130 by **separating and individually processing spectral regions of interest from a larger RF spectrum**.

Pet. 53–54 (quoting Ex. 1006, 4:4–11); citing Ex. 1003 ¶ 99).

Petitioner annotates (with coloring) Cannon's Fig. 6 as follows:



According to Petitioner, Figure 6 illustrates Cannon's remote unit FPGA 503, which includes DUCs (digital up converters) 632 and DDCs (digital down converters) 630 "that can be programmed with a center frequency and bandwidth *to reconfigure the carrier* of the remote radio unit." Pet. 54 (emphasis added) (citing Ex. 1006, Fig. 6; 8:45–9:10; Ex. 1003 ¶ 100).

Petitioner contends that the combined teachings of Leng and Cannon suggest reconfiguring a remote radio including by increasing the number of carriers (according to limitation *vii.b* as discussed below). Specifically, Petitioner contends that a person of ordinary skill in the art

> would be motivated to modify the teachings of Leng to include a FPGA in the remote radio unit as taught by Cannon because 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 Leng teaches that the needs of the end user can be determined by the load of the remote radios. Specifically, a

> POSA understood that Leng teaches to reconfigure a remote radio unit in a DAS by changing the carriers of the remote radio unit based on the relative load of the remote radio unit, and that there are only a few finite ways to reconfigure a radio by changing its carrier frequency. 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. EX-1003 ¶75.

Pet. 37–38.

Petitioner also explains that Leng "does not provide the details of how the frequency of the RRH is changed," so that an artisan of ordinary skill would have turned to Cannon's FPGA details to implement such changes with a beneficial method of programming to shift carrier frequencies to reallocate loads according to the changing needs of a user as Cannon suggests. *See* Pet. 37. As noted above in discussing limitation *vi*, Petitioner provides other reasons for combining these references. For example, Petitioner notes that Cannon teaches that FPGAs are adjustable by using simple programming to meet the changing needs of a user, with dynamic reassignment of a DAS with multiple carriers allowing for real-time load distribution without interrupting the service, where the modification of Leng could be achieved predictably with a reasonable likelihood of success. *See id.* at 35–38 (citing Ex. 1006, 6:47–55; 7:47–64, 9:45–47, Fig. 6; Ex. 1003 ¶¶ 72–74). As indicated above in discussing limitations *iv* and *vi*, Petitioner also asserts that Cannon's method of digitizing the baseband to alter carrier frequencies minimizes the sampling rate. *See id.* at 46 (citing Ex. 1006, Fig. 1; Ex. 1003 ¶ 86).

Patent Owner responds that Petitioner "fails to articulate a sufficient motivation to combine Leng and Cannon." PO Resp. 35. Patent Owner contends that Petitioner "does not articulate ***why*** a [person of ordinary skill

in the art] would have been motivated to modify Leng." *Id.* Immediately before this latter argument, however, Patent Owner acknowledges that Petitioner asserts that 1) a person of ordinary skill in the art "would . . . have considered the use of Cannon's FPGA radio units to be beneficial to Leng," and 2) Leng's use of an FPGA would aid in "meet[ing] the changing needs of a user." *Id.*

Nevertheless, Patent Owner asserts that "[t]he end user that Cannon is referring to is not the same type of mobile end users that Leng's objectives are directed to," because "Cannon is referring to the operator of the DAS network as the end user." PO Resp. 37 (1006, 9:45–61). To support this argument, Patent Owner contends that "Cannon's claim 11 recites a transceiver wherein a first and second spectral region are *user selectable* from a plurality of pre-built logic circuit configurations," and "Cannon's claim 12 recites a transceiver where in a center frequency and bandwidth size are *reconfigurable*." *Id.* (emphasis added) (citing Ex. 1006, 13:20–25).

This argument does not help Patent Owner. If anything, the argument shows that Cannon discloses reconfiguring carrier frequencies in the radio unit's FPGAs, as Petitioner asserts. Contrary to Patent Owner's arguments, even though Cannon's claims 11 and 12 reveal a selectable reconfiguration of carriers by a system operator, this does not imply that the end user of these carrier frequencies that Cannon's column 9 describes is the same user. Logically, a system operator selects frequencies that a subscriber (mobile unit) uses according to changing needs. *Compare* Ex. 1006, 13:20–25, *with id.* at 9:45–61. As Petitioner argues, Cannon generally teaches programming an FPGA in remote radios to handle a number of carrier frequencies. Reply 26; Pet. 36 (citing Ex.1006 6:47:55; 7:47–64; Ex. 003 ¶72). Petitioner

persuasively shows that Cannon's simple programming meets the changing needs of the user of an RRU/RRH, provides better sampling of desired spectrum, and provides dynamic reassignment of multiple carriers, thereby allowing for real-time load distribution without interrupting the service. Pet. 35–39; *see also* Reply 25 (similar). Even though Cannon's FPGA system is reconfigurable by an operator as Patent Owner argues, a person of ordinary skill in the art would have recognized that the system ultimately meets the changing needs of Leng's end subscriber users. *See* Ex. 1006, Fig. 1 (showing subscriber units 108), 1:29–54 (describing "wireless subscriber units" within Leng's "improved systems" that solve prior art problems of "wasted" "fiber bandwidth"), 9:45–61 (implying that end users are individuals corresponding to such subscriber units based on this improved use of the full range of fiber bandwidth frequency spectrum by reconfiguring FPGAs and increasing "the number of individual signal paths for handling additional spectral regions").

Patent Owner also argues that a person of ordinary skill reading Leng "would not have seen any deficiency or a need to seek the additional teachings of Cannon." PO Resp. 36. According to Patent Owner, "Petitioner's expert Dr. Houh testified that Leng's disclosures did not have any deficiencies for achieving its objectives and that a [person of ordinary skill] would have no problem implementing Leng to meet its goals," and "Petitioner's expert also testified that reconfiguring carriers in Leng was so basic that a [person of ordinary skill] would not need to look elsewhere to implement it." PO Resp. 36–37 (citing Ex. 2016, 77:14–20, 88:8–17, 94:22–95:3). In its Sur-reply, Patent Owner advances similar arguments and contends that Leng's and Cannon's reconfiguration approaches are

"redundant," because "[o]nce [Leng's] carrier . . . arrives at the RRH, it has already been reassigned and switched to that RRH." Sur-reply 14.

This line of argument is unavailing and fails to fairly address the thrust of Dr. Houh's testimony and Petitioner's showing. Patent Owner's argument that Leng's and Cannon's reconfiguration approaches are "redundant," because "[o]nce [Leng's] carrier . . . arrives at the RRH, it has already been reassigned and switched to that RRH," fails to address how Leng's RRH is able to process a new carrier if Leng does not teach or suggest that the RRH reconfigures itself to handle that carrier, as Patent Owner otherwise argues. *See* Sur-reply 14.

In any event, with respect to Dr. Houh's cited testimony that Patent Owner relies upon, Dr. Houh testifies that "*if it's found* that Leng *doesn't provide details of how the frequency of the remote radio unit is changed, Cannon does provide those details*." Ex. 2016, 94:16–19 (emphasis added). At another cited passage, Dr. Houh testifies that reconfiguration from one carrier to another is "*pretty basic*" because "if you know how to modulate something to carrier frequency A, you pretty much know how to modulate to the carrier frequency B," but this "*can be done a number of different ways*." *Id.* at 88:13–89:4 (emphasis added). And at another cited passage, Dr. Houh testifies "I can't think of anything," after Patent Owner asks him if "there were any technical deficiencies in Leng's teaching about achieving what you state here in paragraph 54" of the Houh Declaration. *Id.* at 77:16–20 (discussing Ex. 1003 ¶ 54); *see also* Ex. 1003 ¶ 54 (testifying that Leng's "present invention relates to a distributed antenna system [and] . . . a reconfiguration method thereof, which are capable of reallocating a carrier in

time to effectively adapt to a load change when a communication traffic of a region varies greatly" (citing Ex. 1005, code (57)).

As summarized above, Dr. Houh essentially testifies that Cannon provides details for what is "pretty basic" in Leng, and to the extent Leng is not clear in detail as to how to reconfigure carriers at a remote radio head, Cannon teaches one suitable option for how to implement it. Therefore, Petitioner at least shows that Cannon reveals a suitable option for predictably altering the carrier frequencies and the number thereof in a remote radio unit in order to meet the changing needs of a user based on the load in Leng's system using simple programming while providing other benefits (e.g., better sampling). *See* Pet. 38 ("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." (citing Ex. 1003 ¶ 75)), 46 (minimizing sampling rate). "[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.'" *Intel Corp. v. PACT XPP Schweiz AG*, 61 F.4th 1373, 1380 (Fed. Cir. 2023) ("Intel Corp."). In *Intel Corp.*, the court reversed the Board because "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.* at 1381. Rather, "Intel just had to show that Bauman's secondary cache was a 'suitable option' to replace Kabemoto's secondary cache." *Id.* (quoting *Intel Corp. v. Qualcomm Inc.*, 21 F.4th 784, 800 (Fed. Cir. 2021)).

Patent Owner also argues that "even if Leng disclosed reconfiguration of radio units (which it does not), Cannon does not disclose reconfiguring the remote radio unit to change the carriers transmitted or received by the radio unit." PO Resp. 39–40. Patent Owner supports this argument by contending that Petitioner

> miscomprehends Cannon's invention, which is directed to optimizing the use of ***fiber bandwidth*** within a digital DAS 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 40 (citing Ex. 1006, Figs. 1–3, 4:14–5:38, 8:34–9:44).

Patent Owner explains further that "Cannon's invention is concerned with selectively processing only certain spectral regions (that contain signals of interest) of an RF spectrum to optimize the transport of digitized RF signals over optical fiber between the host unit and the remote radio unit within the system." PO Resp. 41 (citing Ex. 1006, 8:34–9:44 (describing serialized transmitters and receivers directing serial data to digital up-converters and down-converters for processing select spectral regions)). Patent Owner also argues 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," so that "Petitioner's alleged motivation to combine Leng and Cannon is premised on a misunderstanding of Cannon." *Id.* at 42 (citing Ex. 2015 ¶ 48). Patent Owner relies on the above arguments to contend that Cannon does not disclose increasing or decreasing the number of carriers. *See* PO Resp. 46–49; Sur-reply 20 (arguing that "Cannon is concerned with handling digitized RF spectrum signals for wire transport, but silent as to increasing or decreasing the

number of carriers for air transport at a radio unit." (citing PO Resp. 46–49)).

The record does not support Patent Owner's arguments. As Petitioner persuasively shows, Leng discloses reconfiguring an RRU without detail and Cannon provides details as to how to accomplish reconfiguring an RRU using simple programming techniques to shift and add carriers according to the needs of a user. 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 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, 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.*

Ex. 1006, 9:45–49 (emphasis added); *see* Pet. 37 (citing Ex. 1006, 8:45–9:10; 9:45–47). These center frequencies processed in base band ultimately are RF carrier frequencies. *See, e.g.*, Ex. 1006, 7:65–67 ("FPGA 503 provides a first path for processing digital signals associated with the radio frequency signals in a first spectral region . . . ."). As Petitioner also argues, for example, Cannon's upconverters process baseband and convert it to convey RF frequency. Pet. 45 ("For processing the downlink signal, the FPGA includes a DUC to convert the digital baseband signal *to an RF signal*

for transmission." (emphasis added) (citing Ex. 1006, 8:6–16; Ex. 1003 ¶ 85)).

Moreover, Patent Owner agrees that "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. 48 (emphasis added) (citing Ex. 1006, 5:39–46). So even though Cannon's system "selective[ly] . . . processes certain spectral regions," as Patent Owner argues, the result of this process is that Cannon's system shifts locations of center frequencies and allows for varying and *increasing* the number of carriers (e.g., two or more) and their associated spectral regions by reconfiguring the FPGA using programming changes in order to meet the changing needs of a user in a predictable fashion as Petitioner persuasively shows and as discussed above. *See, e.g.*, Pet. 35–39 (citing Ex. 1006, 6:47–55; 7:47–64; 8:45–9; 9:45–47; Ex. 1003 ¶¶ 72–76).

Further as to increasing or decreasing carriers, as summarized above, Petitioner contends it would have been obvious (for several reasons, e.g., to meet the changing needs of a user) to increase the number of carriers in reconfiguring Leng's RRUs where Cannon's DART (stored in an RRU and containing an FPGA) increases the number of carriers in an RRU. *See* Pet. 36 (arguing that "Cannon discloses that the number of carriers is not limited to only two, and that the DART can be programmed to handle three or more carriers" (citing Ex. 1006, 6:47–55, 7:47–64; Ex. 1003 ¶ 72), 37–38 (arguing that Leng suggests changing or adjusting the carriers of Cannon's remote radio unit based on the relative load using an FPGA because it provides simple programming), 60 (relying on its previous motivation statements (as summarized above) to combine the references and arguing that a person of

ordinary skill "would be motivated to combine the teachings of Leng with the teachings of Cannon as discussed above to increase or decrease number of carriers used by a remote radio unit based on the load percentage.").

At one of the cited passages of Cannon, Cannon states that "one of ordinary skill in the art after reading this specification would appreciate that the FPGA described in FIG. 6 may be scaled upward to include *additional processing paths for three or more discrete spectral regions*." Ex. 1006, 7:57–61 (emphasis added). As discussed above, the parties do not dispute that Leng's RRHs handle multiple carriers. As also discussed above, Leng generally discloses adding or deleting carriers to RRHs by reconfiguration depending on the load. And Petitioner specifically quotes Cannon for its disclosure 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**," and "[b]ecause **FPGA 503 is a field programmable device, it can be adjusted to meet changing needs of the end user**," by "reconfigur[ing] [it] by pushing a new build image onto the FPGA." Pet. 55–56 (quoting Ex. 1006, 9:45–61). Therefore, even if Leng does not disclose reconfiguring *an RRU* or *reconfiguring it to increase or decrease carriers*, Petitioner persuasively shows that the combination of Cannon and Leng would have rendered that obvious in order to handle the changing needs of the user based on varying load conditions using simple programming of an FPGA.

Accordingly, Patent Owner's arguments that center on the alleged "purpose of Cannon's invention" as "not directed to alteration of the radio capacity or number of carriers" do not undermine Petitioner's showing, because as determined herein, Petitioner relies on the combined teachings of

Cannon and Leng, as opposed to some alleged limiting purpose of "Cannon's invention." *See* PO Resp. 49 (citing Ex. 2008 ¶ 41).

Additionally, Petitioner shows persuasively that Cannon's method and Leng's method are similar to that of the '338 patent. Pet. 52 (citing Ex. 1003 ¶ 98). The record supports Petitioner's argument that the methods are similar. *See* Ex. 1001, 4:20–35 (describing converting only narrow bandwidths of useful information for efficient use of "available optical fiber transport bandwidths"), 7:5–24 (same); Ex. 1003 ¶ 74 (showing the similarities of the three systems), ¶¶ 98–102 (showing that Cannon's method of up-link and down-link conversion is similar to that of the '338 patent).

Patent Owner also asserts that Cannon's system is decentralized, and Leng's system is centralized, so Petitioner's motivation is not "sufficient." PO Resp. 38. Patent Owner argues that a person of ordinary skill in the art would not have "modif[ied] these two contrasting approaches," and Petitioner "trivializes this change in functionality" and merely asserts an "obvious design choice," where Leng's system stores a predefined topology in topology reconfiguration module 44, but Cannon's system "stores its reconfiguration data inside each of the radio heads." *Id.* at 38–39.

The characterization of Leng's system as centralized does not address the disclosure in Leng that the carrier switching module "notif[ies] the high-load remote radio heads to switch carriers" according to a newly-implemented topology. Ex. 1005, 11:19–21; Pet. 30–31; Reply 14–16; Ex. 1003 ¶¶ 64, 74; Ex. 1014 ¶ 20.

In addition, Patent Owner's arguments mischaracterize and do not undermine Petitioner's showing. As Petitioner argues, "the Petition is directed to modifying the teachings of Leng with the teachings of Cannon,

not the physical incorporation of any components from Cannon into Leng." Reply 24. As Petitioner also argues, Patent Owner's declarant acknowledges that the '338 patent teaches a "blended approach," which is similar to Petitioner's proposed combination of Leng's alleged centralized system with Cannon's alleged decentralized system. *See* Reply 25 (citing Ex. 1015, 93:17–95:2). As Petitioner persuasively explains, Leng's DAU controls carrier assignments and notifies the RRHs of them and Cannon's remote radios contain an FPGA for switching carrier frequencies, similar to the '338 patent. *Id.* at 14–16, 26 (citing Ex. 1014 ¶ 28 (testifying that "I agree with" Patent Owner's declarant, and "the '338 Patent discloses that, just like Leng, the DAU controls carrier assignments, and just like Cannon, the remote radios of the '338 Patent contains an FPGA that switches carrier frequencies. (citing Ex. 1015, 93:17–95:2)). Also, as indicated above, Patent Owner argues that Petitioner's arguments regarding this module do not "show any actual reconfiguration inside the RRHs" but does not explain why *notification* of the remote radio heads "to switch carriers" would be needed as disclosed in Leng, if no change in settings in the RRH is effected as a result of that notification. PO Resp. 27–32; PO Sur-reply 9–10; Tr. 40:8–20.

As summarized above, Petitioner provides numerous reasons to combine Leng and Cannon apart from any similarity to the '338 patent system. That is, in addition to alleging that Cannon suggests a suitable method to reconfigure Leng's RRHs, Petitioner shows persuasively that using Cannon's adjustable FPGAs in Leng's RRHs allows for simple programming of these FPGAs to meet the changing needs of users, provide better sampling of desired spectrum, and provide dynamic reassignment of

multiple carriers, thereby allowing for real-time load distribution without interrupting the service. *See* Pet. 35–38, 46.

Patent Owner also argues that Petitioner's proposed modification lacks "any regard or explanation as to whether the modification is compatible with Leng's objectives." PO Resp. 42. Patent Owner submits that because of Leng's alleged timing constraints, a person of ordinary skill in the art "would not expect a reasonable likelihood of success with such a modification." *Id.* (citing Ex. 1005, code (57)). To support this argument, Patent Owner quotes Leng as follows:

> The present disclosure is capable of dynamically reconfiguring the distributed antenna system in ***a timely and effective manner according to the real-time load distribution situation***, balancing the load and improve the system efficiency ***in a timely manner***, and at the same time greatly improving the convenience, ***real-time nature*** and accuracy of the configuration, and realizing ***on line reconfiguration without the interruption of services, ensuring the continuity of services.***

PO Resp. 43 (quoting (quoting Ex. 1005, 2, code (57)).[24] Patent Owner explains that in contemplating Cannon's system, a person of ordinary skill in the art "would understand that loading a new FPGA image in a radio unit every time a carrier reassignment occurs would take too long for Leng's timing needs, which require such carrier switching to occur with minimal delay time." *Id.* at 44 (citing Ex. 2015 ¶¶ 49–54).

Contrary to Patent Owner's arguments, Petitioner persuasively addresses Leng's purposes of balancing and distributing the load in light of Cannon's similar purpose of meeting the changing needs of the user by

[24] We quote the same abstract that Patent Owner quotes, which is a translated version and slightly different than the abstract on the title page of Leng. *Compare* Ex. 1005, 1, code (57), *with id.* at 2, code (57).

implementing software changes in an FPGA in a predictable manner with a reasonable expectation of success. *See* Pet. 36–39, 56–60. As to timing, Leng describes its DAS system as an improvement of prior art DAS "*manual* reconfiguration [systems] based on the expected load distribution." Ex. 1005, 1:27–28 (emphasis added). Leng characterizes these prior art manual reconfiguration systems as too slow: "Obviously, this [prior art] reconfiguration approach does not allow for dynamic reconfiguration in a timely and efficient manner based on real-time traffic assignment, and does not allow for service continuity during reconfiguration." *Id.* Petitioner similarly quotes Leng as characterizing its system as allowing reconfiguration via dynamic reconfiguration "in a timely and efficient manner" "*instead of via manual configuration during service interruption by the administrator* based on the expected situation as based on the prior art." *See* Pet. 56–57 (emphasis added) (quoting Ex. 1005, 4:5–10).

On the other hand, Patent Owner's expert, Dr. Chrissan, testifies that an FPGA restarts as fast as a computer reboots. Ex. 2008 ¶ 44 ("[T]he FPGA restarts . . . similar in manner to how a computer reboots."). Patent Owner maintains that Petitioner's combination involves "***pushing a new build image*** [as Leng teaches] ***onto the FPGA***" of Cannon. *See* PO Resp. 44 (quoting Ex. 1006, 9:53–61; citing Pet. 56). Dr. Chrissan testifies that this FPGA restart time "take[s] you down for a minute, two, three or more." Ex. 2015, 75:22–23.

As Petitioner argues (*see* Reply 20), Cannon expressly teaches an FPGA, and its FPGA system "meet[s] the changing needs of the end user" in a DAS system operating with cellular phone networks to provide bi-directional communications, similar to the system of Leng. *See* Ex. 1006,

1:25–36, 9:46; Pet. 37–38 (citing Ex. 1003 ¶ 75). Therefore, contrary to Patent Owner's arguments, applying Leng's teaching to reconfigure remote radios using FPGAs in remote radios as Cannon suggests satisfies Cannon's goal of meeting the changing needs of a user and Leng's goal of improving reconfiguration of radio resources at least in relation to manual reconfiguration systems. Like the '338 patent, Cannon and Leng also employ an FPGA, suggesting the suitability of FPGAs in DAS networks, contrary to Patent Owner's arguments otherwise. *See* Reply 21–24.

And as Petitioner argues, the '338 patent describes "*slowly* deploy[ing] additional radio resources (such as RF carriers, CDMA codes or TDMA time slots)." Pet. 11 (emphasis added); *see also* Ex. 1001, 11:47–51 (stating that "the DAU . . . adaptively modifies the system configuration *to slowly begin to deploy additional radio resources*" (emphasis added)). In addition, the '338 patent states that "[t]he software settings within RRU1 *are configured either manually or automatically* such that Carriers 1–8 are present in the downlink output signal 109 at the antenna port of RRU1." Ex. 1001, 6:31–34; *see also* Ex. 1003 ¶¶ 35–36 (testifying that the '338 patent discloses manual or automatic configuration). Therefore, the challenged claims do not preclude an FPGA, preclude manual reconfiguration, or require any minimal speed for reconfiguration. Rather, as Petitioner points out, the '338 patent, through a provisional, "discloses the use of an FPGA" to render it "field reconfigurable." Reply 22 (citing Ex. 1012, 4:26–27; Ex. 1014 ¶ 26); *see also id.* at 23 (citing Ex. 1014 ¶ 27). Patent Owner's Sur-reply argument that "the '338 patent uses FPGA for reconfiguration in a different manner" because Petitioner describes that FPGA as "software-programmable" is an attorney argument that lacks in evidentiary support.

See Sur-reply 17. Nothing on this record shows that the '338 patent, Cannon, and Leng employ a well-known FPGA differently, where, as Petitioner notes, the 338 patent's FPGA is "field reconfigurable."[25] Reply 22 (quoting Ex. 1012, 4:26–27; Ex. 1014 ¶ 26); *see also* Reply 18–19, 21–24 (persuasively showing similar use of a generic FPGA in Cannon, Leng, and the '338 patent (citations omitted)). Based on the record, Dr. Houh credibly testifies that because the '338 patent "describes that software-programmable frequency selective DUCs and DDCs could be implemented using an FPGA," Dr. Chrissan's "testimony that 'an FPGA is not the type of device that a [person of ordinary skill in the art] would use for dynamic reconfiguration that may occur frequently in real-time operation of a cellular network' is directly contrary to the express teachings of the '338 [p]atent." Ex. 1014 ¶ 27 (quoting Ex. 2015 ¶ 51); *see also* Ex. 1014 ¶¶ 25–27 (analyzing the '338 patent's FPGA system); Ex. 1003 ¶¶ 98–103 (analyzing Cannon's FPGA system and testifying in general that Cannon's system is similar to that of the '338 patent).

Accordingly, Patent Owner's arguments regarding a reasonable expectation of success based on an alleged speed constraint are not commensurate with the claim scope. Patent Owner's arguments touch on teaching away allegations, because Patent Owner essentially argues that one of ordinary skill in the art would be discouraged from using Cannon's FPGA programming in Leng's remote radio units because the system would be to slow and defeat Leng's alleged purpose of dynamic reconfiguration. *See* PO

[25] Cannon also states that "[a]lthough the example of an FPGA has been used in this specification, other field programmable devices are contemplated as within the scope of embodiments of the present invention." Ex. 1006, 10:14–17.

Resp. 44 (asserting that a person of ordinary skill in the art "would understand that pushing and loading a new build image onto the FPGA inside a radio unit is not a practical solution for dynamic real-time carrier reconfigurations that must occur quickly for Leng"). However, 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*." *Idemitsu Kosan Co., Ltd., v. SFC Co., Ltd.*, 870 F.3d 1376, 1381 (Fed. Cir. 2017) (emphasis added) (citing *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))); *see also In re Self*, 671 F.2d 1344, 1348 (CCPA 1982) ("Many of appellant's arguments fail from the outset because . . . they are not based on limitations appearing in the claims."). Here, the combination remains "suitable for the claimed invention," *see In re Zhang*, 654 F. App'x at 490, because the challenged claims do not recite limitations requiring any type of dynamic reconfiguration or speed.

In addition, Dr. Chrissan's testimony supports Petitioner. That is, Dr. Chrissan testifies that "[w]hile the reprogrammability of an FPGA *offers flexibility to a degree*, loaded images are intended for *fairly static configurations*, *rather than frequent or repetitive reprogramming of the device once deployed*." Ex. 2015 ¶ 51. Dr. Chrissan also testifies that reconfiguring "take[s] you down for a minute, two, three or more." Ex. 1015, 75:22–23. As indicated above, the challenged claims do not require "frequent or repetitive reprogramming." Moreover, an artisan of ordinary skill would have recognized that an interruption of service for a minute or

two is better than interrupting the service based on an overloaded system for longer periods, which Leng's system attempts to resolve. *See* Reply 12 (arguing that Leng's system assigns carriers to accommodate overloaded hot spots and that overloading may cause "unexpected disconnection of the user(s)" (citing Ex. 1014 ¶ 16)). Also, the challenged claims are agnostic as to interruption of service. As indicated above, Petitioner relies on the beneficial ease of programming (i.e., flexibility in Dr. Chrissan's terms) of an FPGA to reconfigure a Leng's remote radio heads to meet the changing needs of a user. *See id.*; Pet. 35–37.

Summary of Limitation *vii*

Based on the foregoing discussion, Petitioner persuasively shows that Leng or the combined teachings of Leng and Cannon discloses or would have rendered obvious limitation *vii*.

viii. Limitation viii

Limitation *viii* recites "routing and switching the packetized signals among the one or more remote radio units via the at least one digital access unit according to a result of the reconfiguring." Petitioner asserts that Leng discloses this limitation, reading the recited "one or more [RRUs]" and "at least one [DAU]" onto Leng's CMUs and RRHs, respectively. Pet. 61 (citing Ex. 4:11–17; Ex. 1003 ¶ 111). Petitioner quotes Leng as disclosing that "cell management unit 24" comprises "reconfiguration module 33," configured to determine a new topology, reassign carriers among the corresponding remote radio heads, and reconfigure the routing of radio signals according to the load information collected by the load information collection module 32." *Id.* (quoting Ex. 1005, 4:11–17). Petitioner explains that Leng's "reconfiguration module of the CMU (DAU) 33 . . . updates the

signal packet address to route the packetized digital base carrier signal to the appropriate RRH (routing and switching the packetized signals)." *Id.* (emphases omitted) (citing Ex. 1003 ¶ 112).

To support its showing regarding "routing and switching the packetized signals" as limitation *viii* recites, Petitioner quotes Leng as follows:

> **The reconfiguration module 33 comprises:** a topology reconfiguration module 44, configured to determine a corresponding new topology according to the load information collected by the load information collection module 32; a routing reconfiguration module 45**, configured to update the radio signal route by reconfiguring the I/Q packet addresses and updating the routing table stored in the cell management unit 24**.

Pet. 62 (quoting Ex. 1005, 5:20–23; citing Ex. 1003 ¶ 112).

Based on the foregoing discussion, Petitioner's showing for this limitation is persuasive. Patent Owner does not address Petitioner's showing with respect to this limitation. *See generally* PO Resp.

xi. Summary of Claim 1

Based on the record and foregoing discussion, Petitioner's showing is persuasive. Accordingly, we determine that Petitioner shows by a preponderance of evidence claim 1 would have been obvious over Leng alone or the combined teachings of Leng and Cannon.

d. Claims 2 and 3

Claims 2 and 3 depend directly from independent claim 1. Petitioner contends that these claims would have been obvious over the combined teachings of Leng and Cannon. Pet. 62–65. In support, Petitioner relies on

the testimony of Dr. Houh, and provides citations to teachings in Leng and Cannon. *Id.*

In particular, claim 2 recites "[t]he method of claim 1 wherein each carrier corresponds to a respective RF band." Petitioner relies on Leng's teaching that "**the RRHs can also support multiple carriers**," and **"[t]he number of carriers supported depends on the wireless technology used and its operating bandwidth.**" Pet. 62 (quoting Ex. 1005, 3:39–43). Petitioner adds that a person of ordinary skill in the art would have "understood that each carrier used by an RRH utilized its own RF band to prevent interference between the carriers." *Id.* (citing Ex. 1003 ¶ 114).

Claim 3 recites "[t]he method of claim 1, wherein determining the load percentage comprises detecting which carriers are active for each remote radio unit." Notably, the plain language of claim 3 does not require a load percentage of each remote radio unit to be determined. As discussed previously, claim 3 uses nearly identical language to the column 11 embodiment in which a load percentage of a particular downlink carrier is determined using information about which carriers are active for each remote radio unit. *See* Ex. 1001, 11:40–48. As indicated above in connection with claim 1, Petitioner relies on several teachings in Leng and contends that claim 3 would have been obvious. *See* Pet. 63–65.

For example, Petitioner relies on Leng's teaching that remote radio heads 26 "**detect the total broadband power received by the remote radio heads 26 and transmit the detected power value to the load information collection module 32.**" Pet. 63 (quoting Ex. 1005, 5:13–15). Petitioner also relies on Leng's disclosure of "collecting various other types of information and data and using it to dynamically determine if the carriers

need to be reallocated to other RRHs to balance load and to increase the availability of resources where there are 'hot spots.'" *Id.* (quoting Ex. 1005, 11:22–26; citing Ex. 1005, 6:1–4 ("The load information detection module 210 is provided in each base station 21 . . . [for] collect[ing] various load information (e.g., throughput, number of connections, number of registered users, etc.").

Leng's "hot spot" scenario involves "dynamically constructing a topology according to the load situation, and spectrum resources may be appropriately assigned to mobile hot spots through the continuous dynamic reassignment of carriers in remote radio heads." Ex. 1005, 11:22–26. Based on these teachings in others, Petitioner contends as follows:

> A [person of ordinary skill in the art] understood that to properly redistribute resources to balance loading you would need to know which of the multiple carriers on each of the RRHs are being used. If this was not done, a carrier which was in use may be transferred to augment a "hot spot" overloading the carrier causing an unexpected disconnection of the user(s) using the carrier that was transferred.

Pet. 65 (citing Ex. 1003 ¶ 117). Leng supports this rationale, by disclosing the reconfiguration of carriers based on the flexible use of different types and combinations of load information, including on a per carrier basis, and including to handle hot spots. *See id.* at 63–65; Ex. 1005, 7:4–6 ("reassign carriers among the corresponding remote radio heads, and reconfigure the routing of radio signals according to the load information"), 6:4–5 ("the load information is more granular (for each 5 carrier, instead of each RRH)"), 6:24–25 ("obtaining load information may be flexibly selected according to the needs of the actual application scenario, or a combination thereof may be applied"), 7:5–6 ("load information collected by the load information collection module 32").

Petitioner also asserts that "[t]o the extent [Patent Owner] argues that Leng does not disclose determining a load percentage for each remote radio unit, a [person of ordinary skill would have] understood that Leng's disclosure of the relative loading of each RRH can be *converted to a load percentage using well-known simple mathematical conversions*." Pet. 65 (citing Ex. 1003 ¶ 118). And Petitioner contends that "[*i*]*t would have been obvious and routine to perform the conversion into a load percentage as known to a POSA as a matter of preference in the method and system of Leng*." *Id.* (citing Ex. 1003 ¶ 119).

In other words, Petitioner contends that claim 3 would have been obvious under Patent Owner's narrow construction of the term "load percentage." Petitioner's showing is persuasive. Distributing and balancing a load implies knowledge of the load proportion for each RRH. *See supra* note 18 ("distribute" means "[t]o divide and dispense in portions; parcel out," synonyms include "distribute, divide, dispense, dole, deal, ration," "distributed; distributing" means "to divide among several or many" or apportion, which means "to divide and share out according to a plan especially : to make a proportionate division or distribution of."). As Petitioner shows, to reconfigure carriers, Leng's system receives the total broadband power for each radio head, receives indications of when a radio head exceeds a power threshold, receives other information about hot spots at individual radio heads, and discloses flexibility in the use of combined load information. Pet. 57–58 (citing Ex. 1005, 5:13–15, 5:27–30, 6:1–4, 6:23–25; Ex. 1003 ¶ 104), 63 (citing Ex. 1005, 5:13–15, 1:22–26, Ex. 1003 ¶ 115). Leng's disclosure of determining when each RRH exceeds a power threshold as a metric for reconfiguring carriers shows that Leng's system

knows the power used relative to the power available for that radio head (i.e., a proportion or percentage thereof), which is similar to exceeding the "threshold" of a carrier as disclosed in the '338 patent and upon which Patent Owner relies upon to support its claim construction. *See* PO Resp. 15 (quoting Ex. 1001, 11:41–48). As Petitioner argues with respect to claims 1 and 3, Leng discloses or suggests determining the load percentage even under Patent Owner's narrow claim construction, where the load percentage is simply a mathematical construct that represents the same thing as exceeding a power threshold (e.g., the threshold is 75% of the total power an RRH can handle).

As we determined in the Institution Decision and as noted above, this showing also applies to claim 1, because claim 3 depends from claim 1 and it refers back to the "load percentage" introduced in claim 1, which does not require a load percentage of each remote radio unit (relative to its own load) to be determined. *See supra* note 17; Inst. Dec. 45 n.12. Patent Owner does not specifically address Petitioner's obviousness showing with respect to claim 3 in its Response.

Based on the record as summarized above, Petitioner persuasively maps the added limitations of 2 and 3 to the asserted prior art and provides persuasive reasons supported by factual underpinnings to modify Leng's teachings with a reasonable expectation of success.

Patent Owner relies on arguments it presents with respect to claim 1. PO Resp. 49. For the reasons stated above in connection with claim 1, Patent Owner's arguments do not undermine Petitioner's showing.

Based on the foregoing discussion, we determine that Petitioner shows by a preponderance of evidence that claims 2 and 3 would have been obvious over Leng alone or the combined teachings of Leng and Cannon.

2. Claims 4–12

Petitioner asserts that claims 4–12, which depend from claim 1, would have been obvious over the combined teachings of Leng and Gupta, or Leng, Cannon, and Gupta. Pet. 65–78. In support, Petitioner relies on the testimony of Dr. Houh, and provides citations to teachings in Leng, Cannon, and Gupta. *Id.*

a. Gupta

Gupta relates to distributing radio resources by connecting a set of base stations (BTS) to one or more common public radio interface (CPRI) switches. Ex. 1008 ¶¶ 17–18, code (57). Gupta's Figure 6 follows:

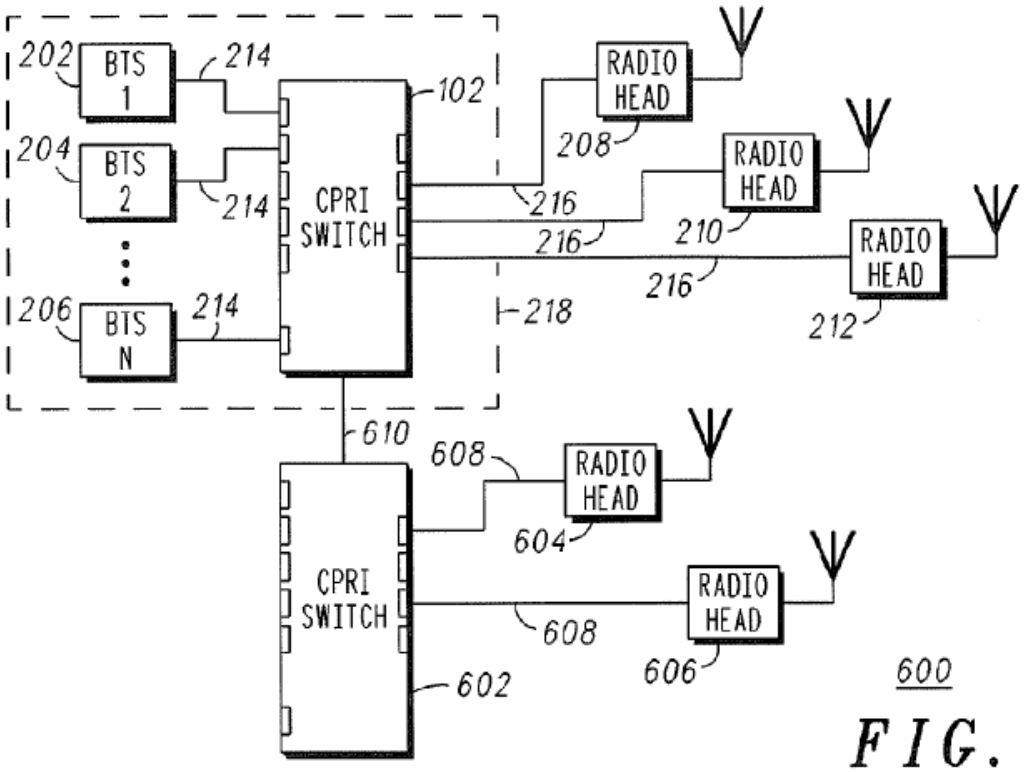
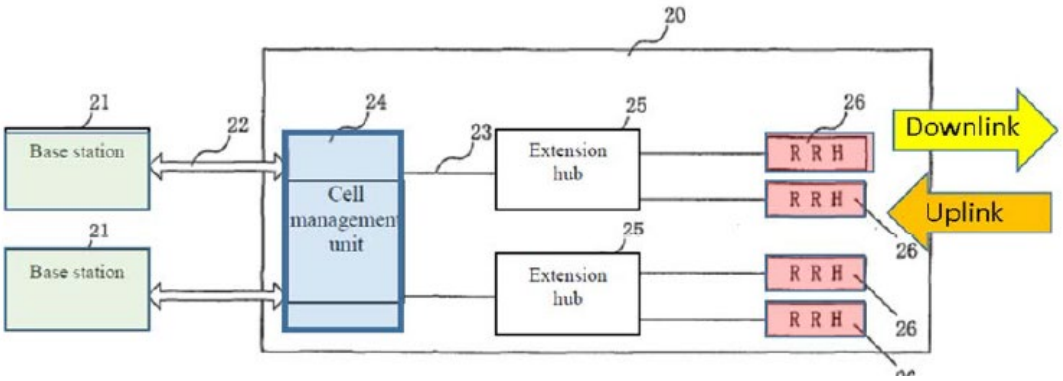


FIG. 6

Figure 6 illustrates set of BTS 202–206 connected to two CPRI switches 102, 608, and the system distributes radio resources from the set of BTS to radio heads 208–212, 604, and 606. *See* Ex. 1008 ¶ 29 ("The first base station 202, the second base station 204, and the third base station 206 can then distribute the communication network data to the fourth RH 604 and a fifth RH 606."). In other words, the CPRI switch allocates resources of one or more base stations to allow high-traffic sites to become capable of utilizing the resources of under-utilized sites. *Id.* ¶ 19. Gupta's architecture reduces infrastructure costs and needs while increasing the effective utilization of the base stations, and allows for integration of different types of base stations using the CPRI switches. *Id.* ¶ 31.

b. Claim 4

Claim 4 recites "[t]he method of claim 1 wherein the at least one digital access unit comprises a first digital access unit and a second digital access unit configured to communicate with each other via a first optical cable." Similar to its showing for claim 1, Petitioner relies on an annotated version of Leng's Figure 2, as follows:



As annotated by Petitioner, Leng's Figure 2 above shows cell management unit (CMU) 24 (blue, DAS), connected to one more remote radio heads 26 (pink, RRUs). *See* Pet. 42 (citing Ex. 1005, Fig. 2; Ex. 1003 ¶ 80 (similar annotation), 67. In other words, Petitioner begins its analysis of claim 1 by reading one of the claim 4's DAS onto Leng's CMU 24. *See id.* at 67–69.

As to the second of claim 4's DAS, Petitioner relies on Gupta's two CPRI switches as described in connection with Gupta's Figure 6, contending that Gupta's "CPRI switches are the functional equivalent of [Leng's] CMU[s]." Pet. 69 (citing Ex. 1003 ¶ 126). According to Petitioner, "Gupta discloses a digital access unit that includes a first CPRI 102 (a first digital access unit) and CPRI 602 (a second digital access unit) configured to communicate with each other via a first optical cable 610." *Id.* (citing Ex. 1003 ¶ 126, Fig. 6 (reproduced above)). Petitioner also explains that "akin to [Leng's] multiple extension hubs, 25, the method and system of Leng

would accommodate a second CMU (DAU) connected via an optical fiber similar to transmission line 23 to attach additional RRHs (remote radio units) and extend the coverage." *Id.* at 68–69 (citing Ex. 1005, 3:20–25, 3:34–37; Ex. 1003 ¶ 125).

Based on the combined teachings of Leng and Gupta, Petitioner contends that a person of ordinary skill in the art

> would be motivated to combine the teachings of Gupta to add a second CMU (*a second digital access unit*) and additional radio heads to the first CMU (*a first digital access unit*) of Leng in order to extend the geographical footprint of the network to achieve the benefits described by Gupta, *e.g.*, reduce the infrastructure costs and needs, while increasing the overall capacity of a set of base stations by increasing the effective utilization of the resources. Thus, a [person of ordinary skill in the art] implementing the teachings of Gupta for their intended purpose and would expect the combination to be successful.

Pet. 69 (citing Ex. 1003 ¶ 127). Petitioner also points out that Gupta's "architecture allows for integration of different types of base stations using the CPRI switches." *Id.* at 67 (citing Ex. 1008 ¶ 31; Ex. 1003 ¶ 123).

Patent Owner contends that "Petitioner does not articulate a reason with any rational underpinning for ***why*** a [person of ordinary skill in the art] would need to look to Gupta to merely connect additional RRHs for extending coverage in Leng's system." PO Resp. 52. According to Patent Owner, a person of ordinary skill in the art "could have simply added additional RRHs to the Extension hubs 25" or "would have added more Extension hubs 25 to support more RRHs." *Id.* at 51, 53. Patent Owner contends that Petitioner does not "articulate[] a reason why a [person of ordinary skill in the art] would have been motivated to modify Leng with Gupta beyond merely mentioning commonalities between the two references." *Id.* at 52–53.

Contrary to Patent Owner's arguments, Petitioner persuasively explains why a person of ordinary skill in the art would have implemented Gupta's teachings to use multiple DAUs. As Petitioner argues, and as summarized above,

> [t]he Petition identifies that Gupta expressly describes the advantages of using multiple CPRI switches connected together to accommodate different types of base stations, including from different wireless providers, while allowing sharing of resources to reduce the infrastructure costs and needs, while increasing the overall capacity of a set of base stations by increasing the effective utilization of the resources.

Reply 27 (citing Pet. 66–67; Ex. 1008 ¶ 31; Ex. 1003 ¶ 123).

Patent Owner contends that this rationale is flawed because a person of ordinary skill in the art "looking to extend coverage could simply add additional RRHs to Extension hubs 25 or add additional Extension hubs with more RRHs." Sur-reply 21 (citing PO Resp. 51–52). Patent Owner also asserts that "Petitioner appears to change its rationale, reasoning that a [person of ordinary skill in the art] would need Gupta's multiple CPRI switches to accept signals from different base station types or wireless providers." *Id.* at 22. Patent Owner also asserts that "there is no indication that Leng is unable to accept signals from different base station types or wireless providers and Petitioner cites none." *Id.*

These arguments do not undermine the rationale for combining Gupta and Leng in the Petition. As summarized above, Petitioner contends that adding CPRIs results in several benefits, including providing for different types of base stations, extending geographical coverage, reducing costs, and increasing the overall capacity. Patent Owner focuses on whether Leng provides capacity, and does not dispute that using Gupta's method of using multiple CPRIs provides the benefits asserted in the Petition, which the

record supports. *See* Pet. 66–67 (citing Ex. 1008 ¶¶ 19, 31; Ex. 1003 ¶¶ 123), 69 (citing Ex. 1003 ¶¶ 126–127).

Patent Owner does not argue that adding extension hubs or RRHs to Leng's system (instead of adding CPRIs as Petitioner alleges Gupta suggests) will increase the effective *capacity* of base stations or provide for the other asserted benefits flowing from using different types of base stations that Gupta's CPRI's accommodate. *See* PO Resp. 50–51. Rather, Patent Owner argues that adding extension hubs or RRHs merely "*extend[s] coverage*" in Leng. *Id.* (emphasis added) (citing Ex. 2015 ¶¶ 65–67). Therefore, the record does not support the thrust of Patent Owner's argument, namely that Leng's system already includes the asserted benefits that flow from adding Gupta's CPRIs to Leng's system.

As Patent Owner argues, the '338 patent explains that adding more base stations provides additional capacity in the form of more carriers. Sur-reply 4 (arguing "the ['338] patent explains that '[t]he presence of all 8 carriers means that RRU1 is potentially able *to access the full capacity of both base stations* feeding DAU1 and DAU2.'" (emphasis added) (quoting Ex. 1001, 6:34–36) and "[t]he '338 patent makes clear that 'capacity' is synonymous with 'carriers'"). In other words, the record shows that providing capacity via adding base stations adds a benefit of more carriers, which does not necessarily occur when only adding RRHs and/or extension hubs to extend the coverage areas (e.g., using the same carriers from the same types of base stations using the same operator). *See* Pet. 78 (addressing claim 11, which ultimately depends from claim 4, and persuasively arguing that "[t]o the extent [Patent Owner] argues that Leng does not expressly disclose a second base station is associated with a

different wireless operator, a [person of ordinary skill] understood that it was common to utilize common DAS infrastructures among different carriers").

Alternatively, even if there is another way to obtain the same result of increased capacity and/or coverage (i.e., to the extent they overlap), Petitioner at least shows that it would have been obvious to employ CPRI switches as a suitable option, even if it is not the best option. *See Intel Corp.*, 61 F.4th at 1380 ("If 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.'").

Contrary to Patent Owner's argument that Petitioner shifts its rationale relative to providing for different types of base stations, the Petition explains that Gupta's CPRI switches provide for different types of base stations. Pet. 67 (citing Ex. 1008 ¶ 31; Ex. 1003 ¶ 123). Also, there is no requirement under obviousness to show that Leng's system does not accommodate different base stations where Leng is silent on the issue, and adding Gupta's CPRIs ensures benefits flowing from accommodating different base stations, including the benefit of providing for different wireless providers, sharing resources, and reducing costs, according to Petitioner's showing. *See id.* at 67, 69 (showing benefits of Gupta's CPRIs), 78 (addressing claim 11, which ultimately depends from claim 4, and persuasively arguing that "[t]o the extent [Patent Owner] argues that Leng does not expressly disclose a second base station is associated with a different wireless operator, a [person of ordinary skill] understood that it was common to utilize common DAS infrastructures among different carriers").

Based on the foregoing discussion, we determine that Petitioner shows by a preponderance of evidence that claim 4 would have been obvious over Leng, Cannon, and Gupta.

c. Claims 5–12

Claims 5–12 depend directly or indirectly from dependent claim 4. Petitioner contends that these claims would have been obvious over the combined teachings of Leng and Cannon. Pet. 69–79. In support, Petitioner relies on the testimony of Dr. Houh, and provides citations to teachings in Leng, Cannon, and Gupta. *Id.* These dependent claims generally relate to configurations or connections to the first and second digital access unit of claim 4, including additional recitations related to first and second base stations or the number of carriers. Petitioner persuasively maps the added limitations of 5–12 to the asserted prior art and provides sufficient reasons to combine the references with a reasonable expectation of success. *Id.*

Patent Owner relies on arguments it presents with respect to claim 4. PO Resp. 53–54 (arguing "[f]or [the] same reasons detailed above [in connection with claim 4]," "the Petition fails to show obviousness" as to claims 5 and 6, and "[s]imilarly," claims 7, 11, and 12, "are also not obvious").

Rather than repeat or summarize Petitioner's showing, we adopt and incorporate Petitioner's showing as our own as persuasive. *See* Pet. 69–79. For the reasons stated above, Patent Owner's arguments do not undermine Petitioner's showing.

Based on the foregoing discussion, we determine that Petitioner shows by a preponderance of evidence that claims 5–12 would have been obvious over Leng, Cannon, and Gupta.

IV. CONCLUSION

For the reasons discussed above, Petitioner has shown by a preponderance of the evidence that claims 1–12 of the '338 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	103	Leng	1–3	
1–3	103	Leng, Cannon	1–3	
4–12	103	Leng, Cannon	4–12	
4–12	103	Leng, Cannon, Gupta	4–12	
Overall Outcome			1−12	

V. ORDER

Accordingly, it is

ORDERED that Petitioner establishes by a preponderance of evidence that challenged claims 1−12 are unpatentable;

FURTHER ORDERED that a copy of this Final Written Decision shall be entered into the record in IPR2023-00646; 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 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

For PETITIONER:

Patrick D. McPherson
Patrick C. Muldoon
D. Joseph English
DUANE MORRIS LLP
pdmcpherson@duanemorris.com
pcmuldoon@duanemorris.com
djenglish@duanemorris.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

---

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).