

Paper No. ____

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

T-MOBILE USA, INC.
Petitioner

v.

DALI WIRELESS, INC.
Patent Owner

Case IPR2023-00830
U.S. Patent No. 10,334,499
Issued: June 25, 2019
Filed: August 9, 2018

**PETITION FOR *INTER PARTES* REVIEW OF U.S. PAT. NO. 10,334,499
UNDER 35 U.S.C. §§ 311-319 AND 37 C.F.R. § 41.100 ET SEQ.**

TABLE OF CONTENTS

Mandatory Notices.....	1
A. Real Parties-in-Interest.....	1
B. Related Matters.....	1
C. Lead and Back-Up Counsel.....	2
D. Service Information.....	2
Preliminary Matters.....	3
A. Standing.....	3
B. Identification of Challenge.....	3
C. Supporting Declaration	3
D. Fees.....	3
Introduction	4
Summary of the Challenged Patent.....	5
A. Distributed Antenna Systems.....	5
B. The ‘499 Patent Disclosure	5
C. Claims.....	6
D. Prosecution History	7
E. Related IPR Proceedings.....	8
F. The overlap between the ‘499 patent claims and now-cancelled ‘178 patent.....	9
Summary of the Asserted Prior Art	12
A. Primary References	12
1. “Wu”: U.S. Patent Application Pub. No. 2010/0128676.....	12
2. “Hettstedt”: U.S. Patent Pub. No. 2008/0119198	15
B. Secondary References	17

1. “Sabat-426”: U.S. Patent Application Pub. No. 2009/0180426A1	17
2. “Sabat-552”: U.S. Patent No. 6,963,552	18
3. “OBSAI standard”: Reference Point 3 Specification Version 3.1	19
Claim Construction	20
Level of Ordinary Skill	20
Discretionary Issues	21
Argument	21
Ground 1: Wu anticipates claims 1-5, 8-11, 13-16, 18-19	21
A. Independent Claim 1	21
B. Independent Claim 8	37
C. Independent Claim 14	38
D. Dependent Claims	39
1. Claims 2, 9, 19	39
2. Claims 3, 10, and 15.....	42
3. Claims 4, 11, 16 and 13, 18.....	43
4. Claim 5	45
Ground 2: Wu alone or combined with Sabat-426 renders obvious claims 1-5, 8-11, 13-16, 18-19.	46
A. Baseband “unit”	46
B. Claims 4, 11, 16 and 13, 18.....	48
Ground 3: Wu and Sabat-552 render claims 6-7, 12 and 17 obvious.....	49
A. Claims 6, 12, 17.....	49
B. Claim 7	52
Ground 4: The claims are obvious in further view of the OBSAI standard.....	53
Ground 5: Hettstedt anticipates claims 1-5, 8-11, 13-16, 18-19	54
A. Independent Claim 1	54
B. Independent Claim 8	70
C. Independent Claim 14	72

D.	Dependent Claims	73
1.	Claims 2, 9, 19	73
2.	Claims 3, 10 and 15	74
3.	Claims 4, 11, and 16.....	76
4.	Claim 5	76
5.	Claims 13 and 18.....	78
Ground 6:	Hettstedt plus Wu renders obvious claims 1-5, 8-11, 13-16, 18-19....	80
A.	Claims 1, 8, 14.....	80
B.	Dependent Claims 4, 11, 16	84
C.	Dependent Claim 5.....	85
D.	Dependent Claims 13 and 18	86
E.	Dependent Claims 2-3, 9-10, 15, 19	87
Ground 7:	Hettstedt plus Sabat-552 renders obvious claims 6-7, 12, 17	87
Conclusion		88
Claims Listing Appendix		A1
Exhibit List Appendix		A6

TABLE OF AUTHORITIES

Cases	Page(s)
<i>CommScope Techs. LLC v. Dali Wireless, Inc.</i> , IPR2022-01293, Paper 18 (PTAB Mar. 9, 2023)	4, 21
<i>Dali Wireless, Inc. v. T-Mobile US, Inc., et al.</i> , No. 2:22-cv-414 (E.D. Tex.)	1, 21
<i>KSR</i> , 550 U.S. at 417; <i>In re Larson</i> , 340 F.2d 965 (CCPA 1965)	47
<i>Lincoln Engineering Co. v. Stewart-Warner Corp.</i> , 303 U.S. 545 (1938)	47
<i>Ohio Willow Wood Co. v. Alps S., LLC</i> , 735 F.3d 1333 (Fed. Cir. 2013)	35
<i>Papst Licensing GMBH & Co. v. Samsung Elecs. Am., Inc.</i> , 924 F.3d 1243 (Fed. Cir. 2019)	34
<i>Rimfrost AS v. Aker Bioamine Antarctic AS</i> , IPR2018-01178, Paper 34 (PTAB Jan. 13, 2020)	34
<i>VirnetX Inc. v. Apple, Inc.</i> , 909 F.3d 1375 (Fed. Cir. 2018)	34

Mandatory Notices

A. Real Parties-in-Interest

The real parties-in-interest in this Petition are T-Mobile USA, Inc., and T-Mobile US, Inc. (collectively, “T-Mobile”). No other parties have directed, funded, or controlled the filing of this IPR, and this IPR was not filed at the behest of any other party.

B. Related Matters

The PTAB already instituted *inter partes* review against the ‘499 patent in IPR2022-01293, which Petitioner seeks to join, based on the same “Wu” prior art reference asserted in the present petition. *See CommScope Techs. LLC v. Dali Wireless, Inc.*, IPR2022-01293, Paper 18 (PTAB Mar. 9, 2023). The PTAB also instituted *inter partes* review in *Ericsson, Inc. v. Dali Wireless, Inc.*, IPR2022-01419, Paper 11 (PTAB Mar. 9, 2023). The Board may also consider IPR2020-01430 a related matter. That IPR, however, did not assert the “Wu” reference in any of its grounds and did not involve the present petitioner.

The challenged patent was asserted against petitioner T-Mobile in a complaint in *Dali Wireless, Inc. v. T-Mobile US, Inc., et al.*, No. 2:22-cv-414 (E.D. Tex.), which was served on October 24, 2022.

C. Lead and Back-Up Counsel

Lead Counsel	Backup Counsel
Philip P. Caspers, Reg. No. 33,227 Capella Tower, Suite 4200 225 South Sixth Street Minneapolis, MN 55402 pcaspers@carlsoncaspers.com Phone: 612.436.9617 Fax: 612.436.9605	Samuel A. Hamer, Reg. No. 46,754 Capella Tower, Suite 4200 225 South Sixth Street Minneapolis, MN 55402 shamer@carlsoncaspers.com Phone: 612.436.9615 Fax: 612.436.9605

D. Service Information

Please address all correspondence and service to all counsel listed above.

Petitioner consents to service by email at the email addresses listed.

Preliminary Matters

A. Standing

Petitioner certifies that IPR is available for the '499 Patent; Petitioner is not barred or estopped.

B. Identification of Challenge

Petitioner requests invalidation of claims 1-19.

	Claims	Basis for Unpatentability
Ground 1	1-5, 8-11, 13-16, 18-19	Anticipation: Wu
Ground 2	1-5, 8-11, 13-16, 18-19	Obviousness: Wu alone or plus Sabat-426
Ground 3	6-7, 12, 17	Obviousness: Wu plus Sabat-552
Ground 4	1-19	Obviousness: Any of grounds 1-3 in further view of the OBSAI standard
Ground 5	1-5, 8-11, 13-16, 18-19	Anticipation: Hettstedt
Ground 6	1-5, 8-11, 13-16, 18-19	Obviousness: Hettstedt plus Wu
Ground 7	6-7, 12, 17	Obviousness: Hettstedt plus Sabat-552

C. Supporting Declaration

Petitioner submits a declaration from Dr. Acampora (EX-1003) as that declaration was filed originally in IPR2022-01293.

D. Fees

Petitioner authorizes the Patent Office to charge Deposit Account No. 502880 for the fee set forth in 37 C.F.R. § 42.15(a) and any other required fees.

Introduction

The PTAB has already instituted *inter partes* review of the ‘499 Patent on the same grounds as the present Petition in *CommScope Techs. LLC v. Dali Wireless, Inc.*, IPR2022-01293 (“CommScope IPR”). This Petition is accompanied by a Motion for Joinder to, and seeks institution on the same grounds supported by an identical declaration from the same expert as, the CommScope IPR.

Further, when faced with the same Wu reference in an IPR instituted against parent Patent No. 10,080,178, Patent Owner cancelled all claims, and the PTAB entered final judgment against Patent Owner. The Wu reference invalidates the ‘499 patent claims for the same reasons the materially identical ‘178 patents claims were found unpatentable.

Summary of the Challenged Patent

A. Distributed antenna systems

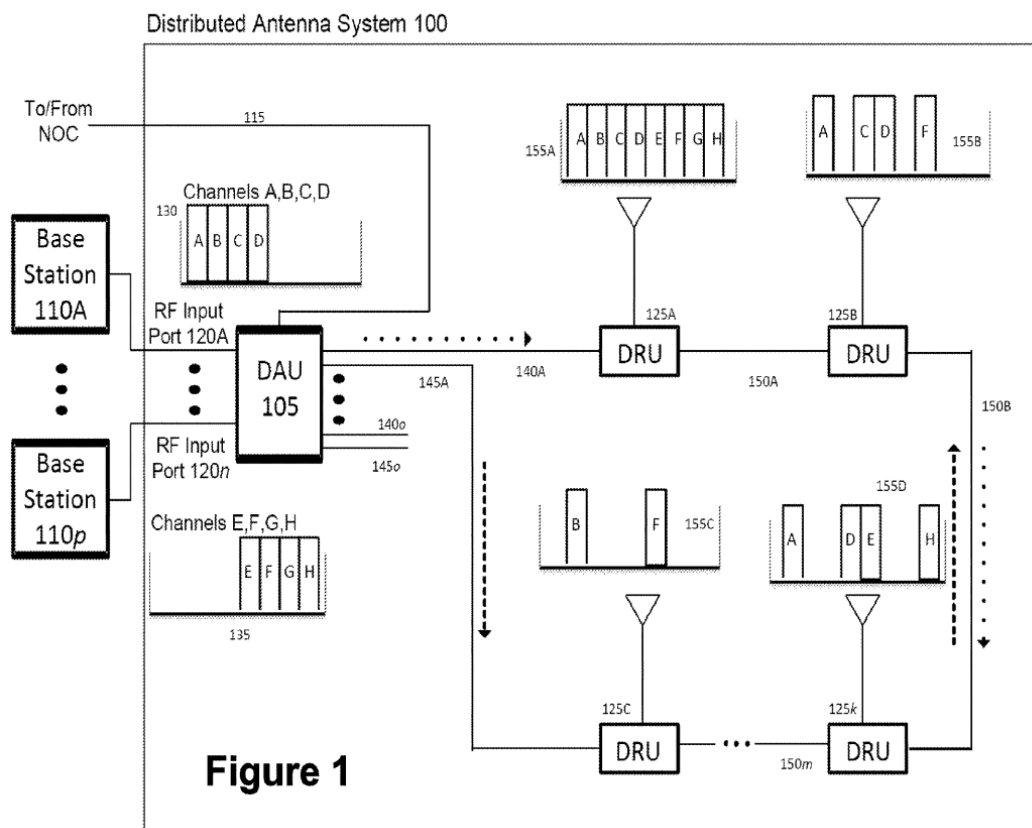
A distributed antenna system (“DAS”) extends wireless coverage to devices in hard-to-reach areas, e.g., inside of a building, tunnel, or other region shielded by terrain from cell towers. EX-1003 ¶¶38-41. The conventional elements of a DAS include a central host unit and a plurality of remote antenna units distributed throughout the desired coverage area and coupled by cables to the host unit. *Id.* A base station provides its signal to the central host unit, and the host unit relays them to the remote antenna units to be re-broadcast closer to the end-user devices (e.g., cell-phones). *Id.*

B. The ‘499 patent disclosure

The ‘499 patent relates to a Distributed Antenna System (DAS) in which the amount of “radio resources” assigned to each remote unit can be changed over time. EX-1001 at 4:10-31. The preferred embodiment of the ‘499 patent uses the conventional DAS elements of a central host unit (which the specification calls a “digital access unit”) and remote units (which the specification calls “digital remote units”).

The digital access unit (DAU) connects to base stations. *Id.* at 4:40-44.

Figure 1 shows an example of a downlink (base station to DRU) transport scenario:



DAU 105 receives a downlink input signal, containing carriers A-D, from base station 110a. *Id.* at 5:62-66. DAU 105 receives a second downlink input signal, containing carriers E-H, from base station 110p. *Id.* at 5:66-6:2. The number of channels to be used at each DRU is assigned by the DAU and need not be equal. *Id.* at 5:28-31.

C. Claims

The claims recite: a “baseband unit” and “signal source.” Neither appears in the specification. The “baseband unit” appears to refer to the digital access unit and “signal source” refers to the base station.

There are 3 independent claims (1, 8, 14). They recite similar limitations

written as a system (claim 1), component (claim 8), and method (claim 14). Claim 1 is representative of the independent claims. EX-1003 ¶¶45-48. The Claims Appendix lists the text of each claim and labels each element (1A, 1B, 1C, etc.).

D. Prosecution history

Before the first office action, Patent Owner cancelled the original claims and filed new claims 10-29. EX-1002 at A97-104. In the first office action, the examiner rejected the independent claims based on double patenting. EX-1002 at A121-A126. The examiner explained that application claim 10 was simply using “different wordings” to claim “similar elements” to claim 10 of Patent Owner’s related ‘178 patent. *Id.* at A125; EX-1012. The examiner identified, for example, that Patent Owner changed the initial claim element from “a host unit” (‘178 patent) to “baseband unit” (‘499 patent), but then proceeded to recite the similar claim limitations. EX-1002 at A125. Patent Owner terminally disclaimed the ‘499 patent to the ‘178 patent. *Id.* at A176, A163-164.

The examiner then allowed the claims. EX-1002 at A198-A199. The Notice of Allowance identified two references (Sulzberger and Boldi). *Id.* With no discussion of any other references, the examiner extrapolated that none of the art taught the following elements about sending a “second” set of radio resources where the “number” of radio resources is “different”:

However, in consideration of the claim amendments/remarks and the terminal disclaimer filed April 17, 2019, and further search, no prior art reference or a combination of prior art references disclose or suggest the combination of limitations specified in the independent claims including:

“wherein the baseband unit is configured to send a digital representation of a second set of radio resources to the first remote unit at a second point in time, the second set of radio resources for transmission at the antenna of the first remote unit;” and “wherein a number of radio resources in the first set of radio resources is different from a number of radio resources in the second set of radio resources,” in claim 10.

Id. The examiner cited these same elements when allowing the parent of the ’499 patent (the ’178 patent), which as discussed in the next section, the PTAB determined was an error because the Wu reference teaches these elements. EX-1037 at A1355-1356.

E. Related IPR proceedings

There are two prior IPRs involving the “Wu” reference.

First, the ’499 patent claims priority and is terminally disclaimed with respect to Patent Owner’s U.S. Patent No. 10,080,178 (’178 patent, EX-1012). See EX-1002 at A163. The PTAB instituted IPR against all claims of the ’178 patent based, inter alia, on the Wu reference. EX-1013 at 21-38. Patent Owner cancelled all claims. EX-1014 at 2-3. The PTAB issued a final adverse judgment. *Id.*

Second, the ‘499 patent has an overlapping specification with Patent Owner’s U.S. Patent No. 9,531,473 (‘473 patent, EX-1016). *Compare* EX-1001 with EX-1016. The PTAB’s final written decision found all challenged claims invalid based on Wu. EX-1017 at 15-37.

F. The overlap between the ‘499 patent claims and now-cancelled ‘178 patent

Claim 1 of the ‘499 patent is materially identical to now-cancelled claim 10 of the ‘178 patent other than terminology changes (e.g., changing “host unit” to “baseband unit”):

‘499 patent (EX-1001)	‘178 patent (EX-1012)
1. A system for transporting wireless communications, comprising:	10. A system for transporting wireless communications, comprising:
a baseband unit;	a host unit;
a plurality of signal sources, including at least a first signal source and a second signal source;	
a plurality of remote units, including at least a first remote unit and a second remote unit;	a plurality of remote units, including at least a first remote unit and a second remote unit;
wherein the baseband unit comprises a plurality of interfaces to communicatively couple the baseband unit to the plurality of signal sources;	wherein the host unit comprises at least one interface to communicatively couple the host unit to at least one signal source;
wherein the baseband unit is configured to receive a plurality of radio resources from the first signal source and the second signal source;	wherein the host unit is configured to receive a plurality of downlink channel signals from the at least one signal source;

	wherein the host unit is configured to send digital representations of the plurality of downlink channel signals to the plurality of remote units;
wherein the baseband unit is configured to send a digital representation of a first set of radio resources to the first remote unit at a first point in time, the first set of radio resources for transmission at an antenna of the first remote unit;	wherein the host unit is configurable to send digital representations of a first set of downlink channel signals to the first remote unit at a first point in time, the first set of downlink channel signals for transmission at an antenna of the first remote unit;
wherein the baseband unit is configured to send a digital representation of a second set of radio resources to the first remote unit at a second point in time, the second set of radio resources for transmission at the antenna of the first remote unit;	wherein the host unit is configurable to send digital representations of a second set of downlink channel signals to the first remote unit at a second point in time, the second set of downlink channel signals for transmission at the antenna of the first remote unit;
wherein a number of radio resources in the first set of radio resources is different from a number of radio resources in the second set of radio resources; and	wherein a number of downlink channel signals in the first set of downlink channel signals is different from a number of downlink channel signals in the second set of downlink channel signals; and
wherein the baseband unit is configured to receive digital signals from each of the plurality of remote units.	wherein the host unit is configured to receive digital signals from each of the plurality of remote units.

Both claims recite the same functionality about sending a “first” and “second” set where the number of radio resources or channels is “different.”

The '499 patent's other independent claims are materially identical to the '178 patent claims as are many dependent claims. EX-1003 ¶¶47-59 (comparing the claims). The following claims overlap:

Independent claims	
'499 patent	'178 patent
1	10
8	1
14	15

Dependent claims	
'499 patent	'178 patent
2, 9, 19	8, 11, 19, 22
3, 10, 15	21, 23, 30
6, 12, 17	28
7	28
13, 18	26

Summary of the Asserted Prior Art

A. Primary References

1. “Wu”: U.S. Patent Application Pub. No. 2010/0128676

Wu (EX-1005) was filed Nov. 11, 2009. It is 102(e) art. Wu describes carrier transport systems for use by wireless operators to transport signals from base stations into wireless coverage areas. EX-1005 ¶¶0003-0004. Wu notes that wireless service providers utilize various bands of frequencies. *Id.* ¶0003. Each service provider uses one or more carrier channels within their frequency bands to carry voice or other data. *Id.*

Wu discloses that known systems digitizes entire frequency bands from base stations and that then transmit the digitized signals to remote transceiver units (RTUs). *Id.* ¶¶0004-0005. Wu explains that such systems lack “fine grained control” and the ability to allocate carrier channels from one cell region to another in response to various events or conditions. *Id.*

Wu, therefore, discloses an improved system that allows fine-grained control over carrier channels from a single band or multiple bands by splitting carrier channels from their bands and routing channels “individually, collectively as shown, or in arbitrary groups” to RTUs as desired using a matrix switch according to a routing policy, where the routing policy can be updated or reconfigured as desired. *Id.* ¶0049; *see also id.* ¶¶0009, 0011, 0038-0039, 0047. Wu discloses that

“more channels” can be allocated when needed to increase the bandwidth available in a particular region. *Id.* ¶¶0046; ¶¶0039-45.

Figure 1 of Wu shows its carrier transport system:

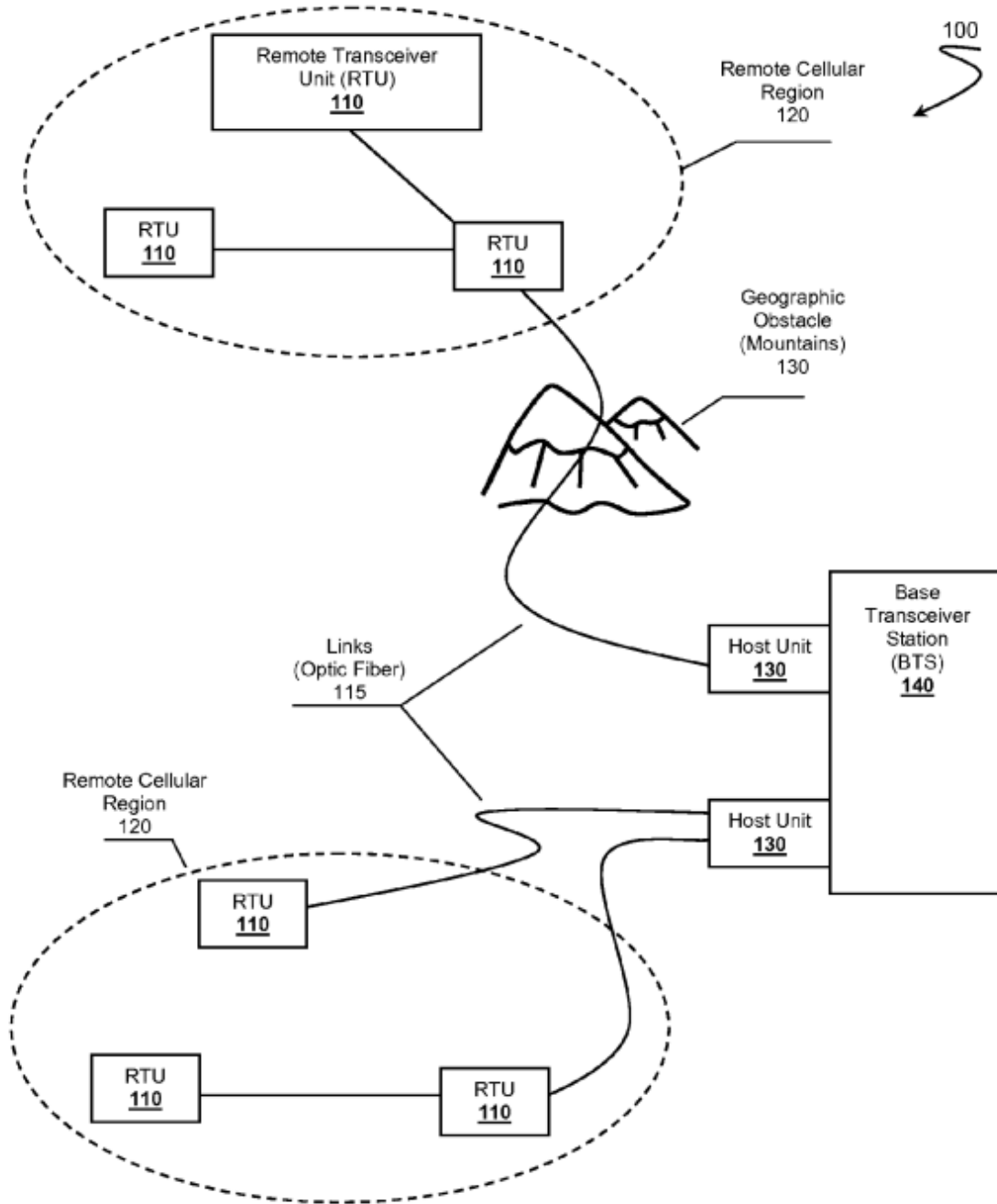


Figure 1

EX-1005 Fig. 1.

Figure 2 of Wu shows the matrix switch 250 that, in combination with units 230, can route different groups of channels to different remote transceiver units 410. *Id.* ¶¶0038-40.

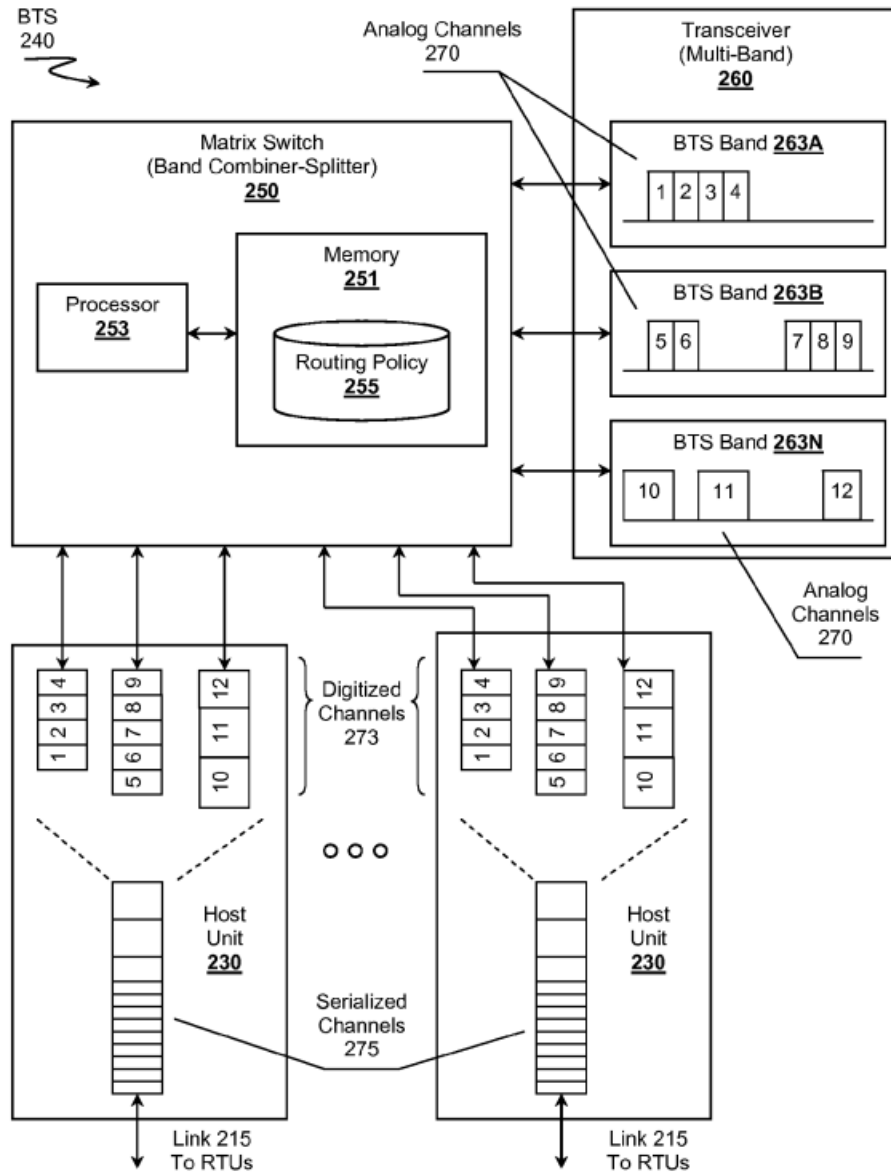


Figure 2

EX-1005 Fig. 2. Figure 4 shows the units 430 can be co-located within a single unit:

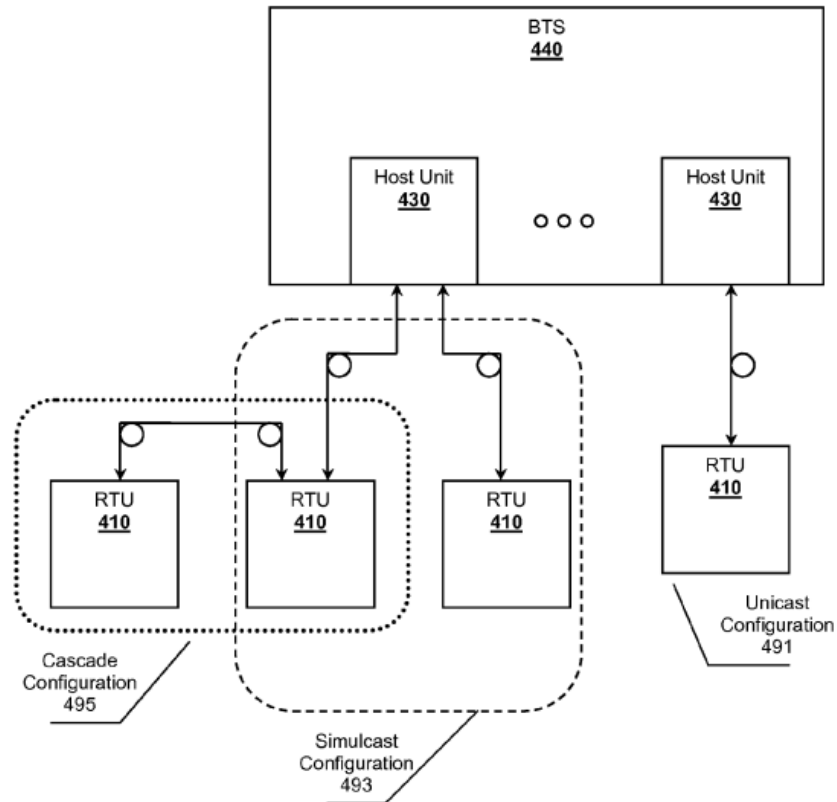


Figure 4

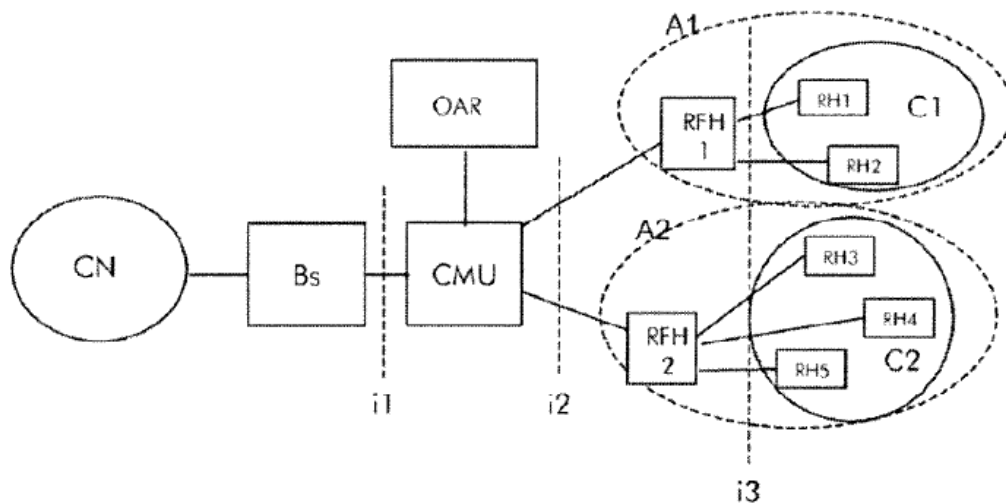
EX-1005 Fig. 4.

2. “Hettstedt”: U.S. Patent Pub. No. 2008/0119198

“Hettstedt” (EX-1006) published May 22, 2008. It is 102(b) art. Hettstedt discloses a “method and a system for wireless cellular indoor communications with improved cell and load balancing management.” EX-1006 ¶0008.

Hettstedt achieves this by adding a “cell management unit” (CMU) that can de-activate, shift, and activate carriers for the distributed radio heads (thus changing the number of carriers). *Id.* ¶¶0029, ¶¶0043-0044. Figure 3 illustrates the system:

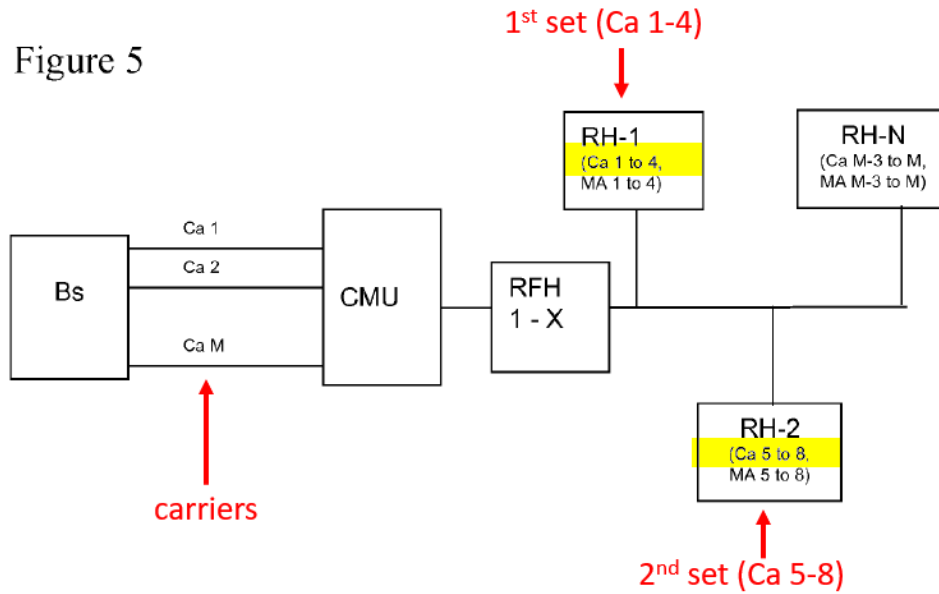
Figure 3



EX-1005 Fig. 3. Bs is a base station or “a number of base stations.” *Id.* ¶¶0039, ¶¶0027, ¶¶0054 (eight base stations). “RH1-RH5” are remote radio heads. *Id.* ¶¶0039. Circles A1-A2 are “indoor location area[s]” where the radio heads are distributed. *Id.* ¶¶0051; ¶¶0002. i1-i3 are digital interfaces. *Id.* ¶¶0040.

The CMU distributes a set of carriers to each radio head. Figure 5 is exemplary:

Figure 5



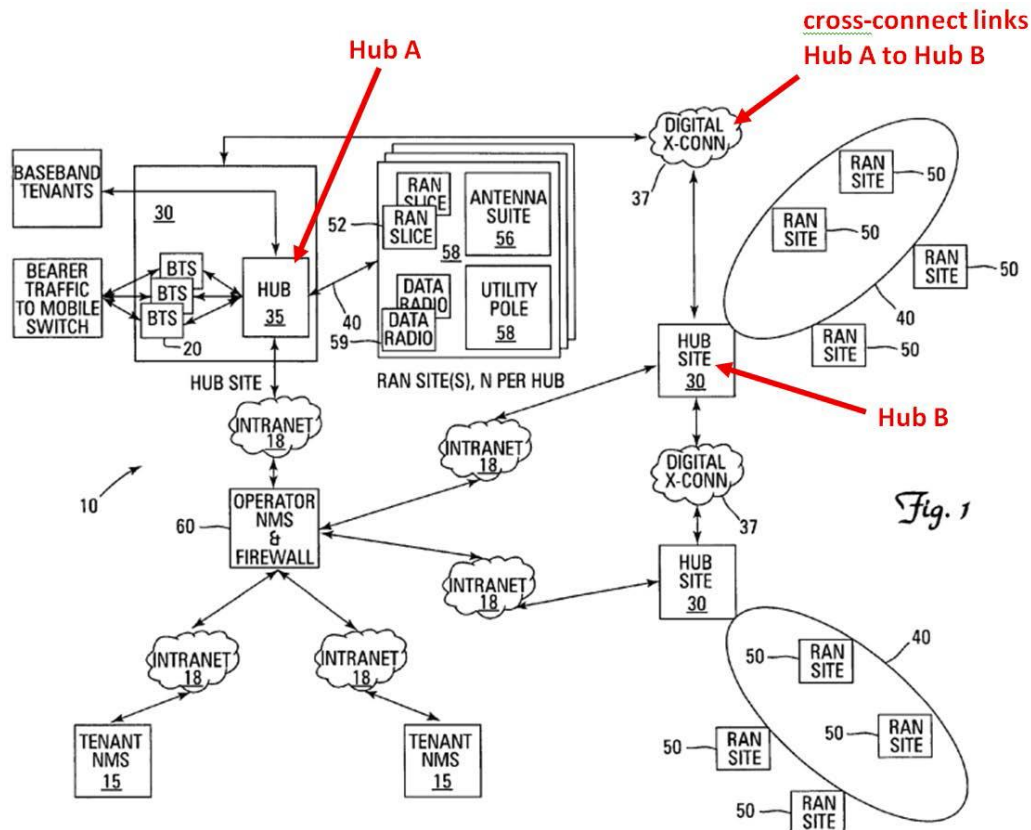
Id. The CMU uses addressing to distribute the carriers. *Id.* ¶0028. The CMU distributes (a) carriers 1-4 to RH-1 using MAC addresses 1-4 (“MA1 to MA4”) and (b) carriers 5-8 to RH-2 using MAC addresses 5-8. EX-1005 ¶0053.

The CMU changes the sets of carriers during load balancing. *Id.* ¶0042, ¶0044. The CMU de-activates the un-used carriers at the radio heads with low load (thus reducing the number of carriers in their sets) and activates the shifted carriers at the radio head with high load (thus increasing the number of carriers in their sets). *Id.* ¶0044, ¶0029.

B. Secondary References

1. “Sabat-426”: U.S. Patent Application Pub. No. 2009/0180426A1

Sabat-426 discloses a DAS that combined in a single baseband hub unit (1) a programmable switch for dynamic capacity allocation to remote antenna units and



3. “OBSAI standard”: Reference Point 3 Specification Version 3.1

The OBSAI standard (EX-1008) is a 102(b) printed publication. EX-1018 ¶¶3-13. The OBSAI organization published specifications that described a standardized protocol for communicating between components in a wireless communication system and specifically for communicating digital baseband representations of base station signals between a baseband module and a remote radio module. EX-1003 ¶¶73-75, ¶¶79-80; EX-1008. “Reference Point 3” or “RP3” is OBSAI’s name for the interface between a baseband module and an RF module. EX-1008 14:2-3; Ex. 1003 ¶75. Exhibit 1009 is a related prior art

publication by OBSAI that provides context for where the RP3 interface (defined in EX-1008) is found within a reference system architecture. EX-1009 17 (Fig. 3.2-1); EX-1018 ¶¶5-10; EX-1003 ¶¶75-76.

Claim Construction

Petitioner presently believes the plain meaning is enough to resolve this petition. Petitioner submits a claim construction order from district court that construed “radio resources” and “is configured to.” EX-1059 3-4. The court gave “radio resources” the following construction.

“radio resources”

Plain and ordinary meaning where the plain and ordinary meaning includes RF carriers, CDMA codes, and TDMA time slots, but does not include the underlying data that is transmitted.

Note: when data is modulated on an RF carrier, the RF carrier is a radio resource, but the data modulated on the RF carrier is not a radio resource.

EX-1059 3-4.

Level of Ordinary Skill

A person of ordinary skill in the art (POSITA) would have a bachelor’s degree in electrical engineering (or equivalent field) *with* 2-3 years of work experience in wireless communications. EX-1003 ¶¶20-22.

Discretionary Issues

This Petition presents the same grounds and arguments against the ‘499 patent and is supported by the same expert declaration as the already instituted CommScope IPR which Petitioner seeks to join. This Petition is accompanied by a motion for joinder.

Discretionary denial is not warranted because (1) in the related litigation against Petitioner, *Dali Wireless, Inc. v. T-Mobile US, Inc., et al.*, No. 2:22-cv-414 (E.D. Tex.), no trial date has been set and (2) the PTAB has already found the identical arguments and grounds present compelling evidence of unpatentability. EX-1019 at 2. The PTAB already found it highly likely that Wu invalidates claim 1 in the ‘499 patent. *CommScope Techs. LLC v. Dali Wireless, Inc.*, IPR2022-01293, Paper 18 at 6-7, 17 (PTAB Mar. 9, 2023) (Institution Decision). The Board specifically found the challenge based on the Wu reference met the compelling case standard. *Id.* at 17.

Argument

Ground 1: Wu anticipates claims 1-5, 8-11, 13-16, 18-19

A. Independent Claim 1

Wu anticipates claim 1. Figs. 1, 2, and 4 of Wu are reproduced below (with annotations).¹

¹ All annotations and emphasis added.

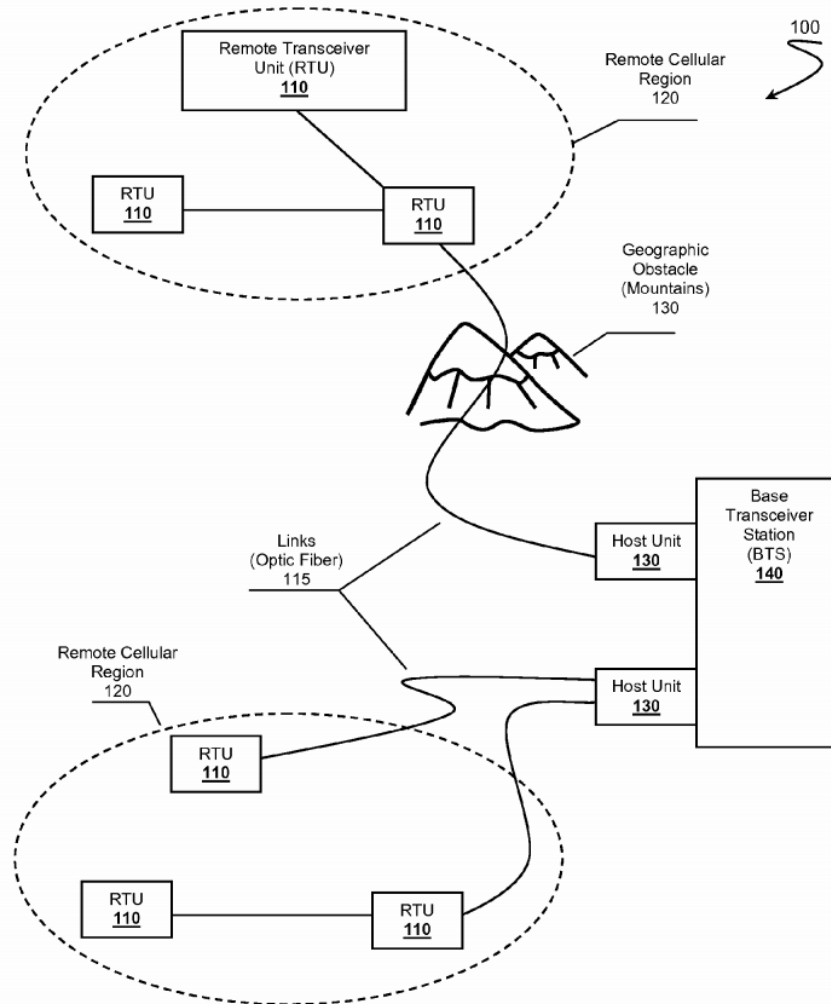


Figure 1

“baseband unit” or
“baseband controller”
of ‘499 patent claims

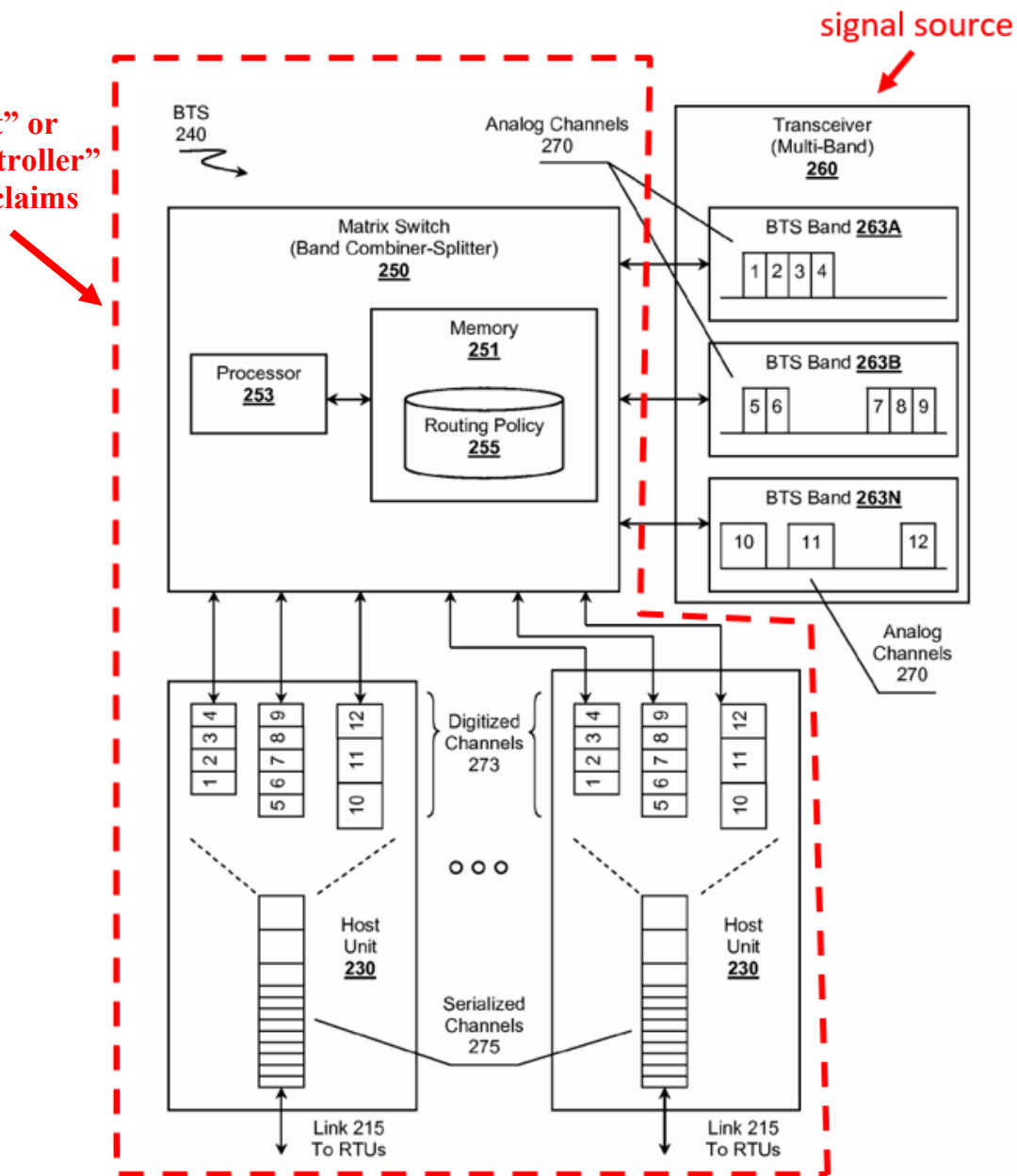
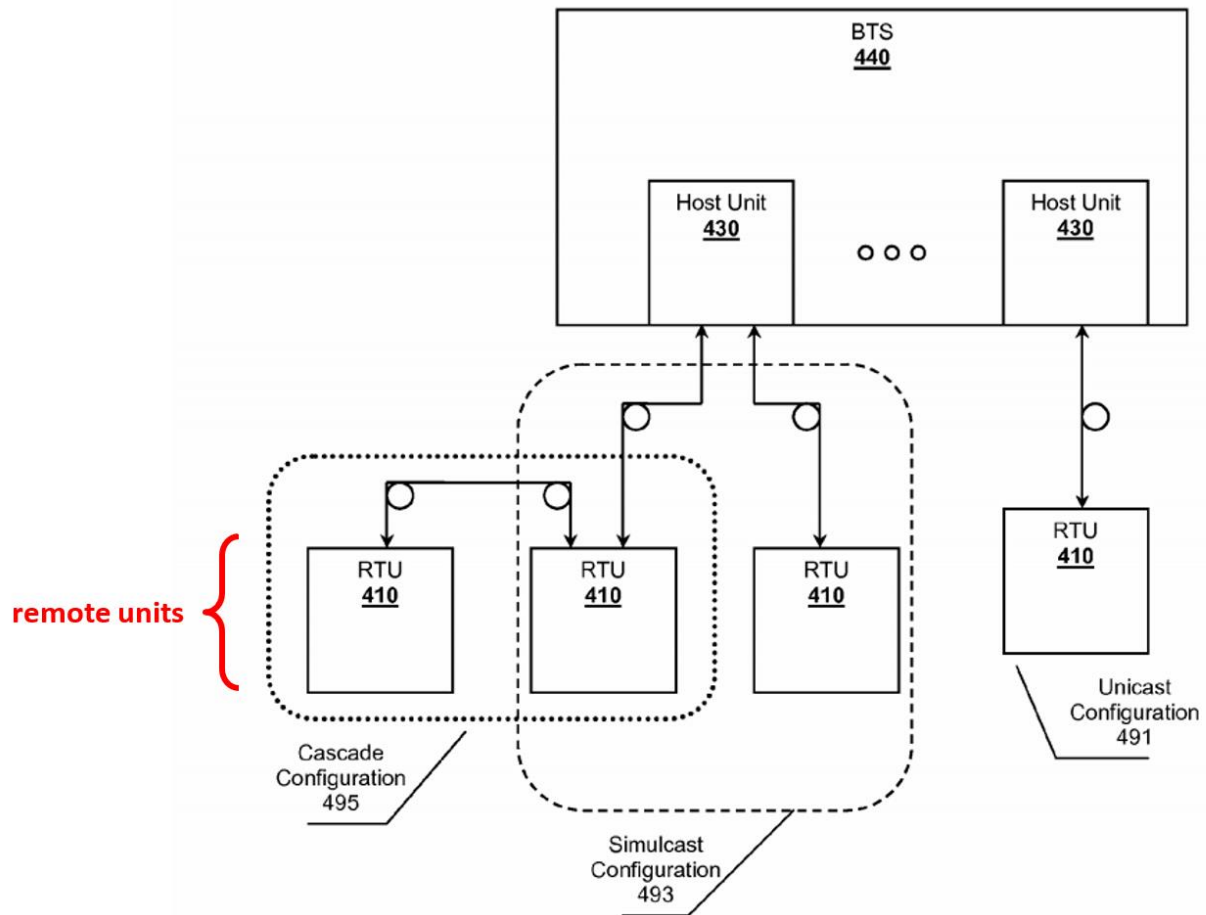


Figure 2



1. Element 1A

“A system for transporting wireless communications, comprising:”

Wu teaches this because it discloses “[a] better carrier channel transport system” for wireless technologies. EX-1005 ¶0009; *see also* ¶0002 (“[t]he field of the invention is *wireless* carrier channel technologies.”); EX-1003 ¶101.

2. Element 1B

“a baseband unit”

The combination of the matrix switch 250 and units 130, 230 in Wu make up the baseband unit of Claim 1. The combination of the switch 250 and units 230

make up a system that manages baseband communications to and from the plurality of RTUs on behalf of the operator's signal source (transceiver 260 of the BTS). In Wu, the host units 130, 230 communicate with the remote RTUs using either OBSAI or CPRI standardized protocols, both of which transport signals as digital baseband signals. EX-1005 ¶¶0031, 0049-0050; EX-1003 ¶¶102-104; EX-1008 55 ("I&Q data format ...to be mapped into the payload..."), 59-60 ("each I&Q sample"). Wu's host units (230) are illustrated and described as including downconverters and analog-to-digital converters (ADCs) for converting incoming analog downlink RF signals into digital baseband data (I&Q samples) for transport to RTUs. EX-1005 Fig. 6-2, ¶¶0049, 0054-0055; EX-1003 ¶103. When reading the '499 claims on Wu, the matrix switch is included in the claimed baseband unit, while the multiband transceiver corresponds to a signal source. EX-1003 ¶105.

Wu's host units (130, 230, 430) and matrix switch are a baseband "unit" because they are described as being within the BTS in FIGS. 4 and 2 of Wu. Figure 2 shows the matrix switch is included in the system between the host units and the transceiver. EX-1005, Figs. 4, 2; EX-1003 ¶105. Further, the PTAB already repeatedly found that Wu disclosed that the matrix switch and host units combined can be a single "unit." EX-1017 at 21-22; EX-1013 at 27-28. The same Patent Owner attempted to claim a "host unit" that selectively routes radio resources. The PTAB invalidated all the challenged claims, finding, "Wu discloses

the claimed host unit as a combination of the matrix switch and host units.” EX-1017 at 21 (“Identity of terminology is not required”), EX-1017 at 18, 20-22; EX-1013 at 27-28. The PTAB agreed with this “persuasive” annotation of Wu:

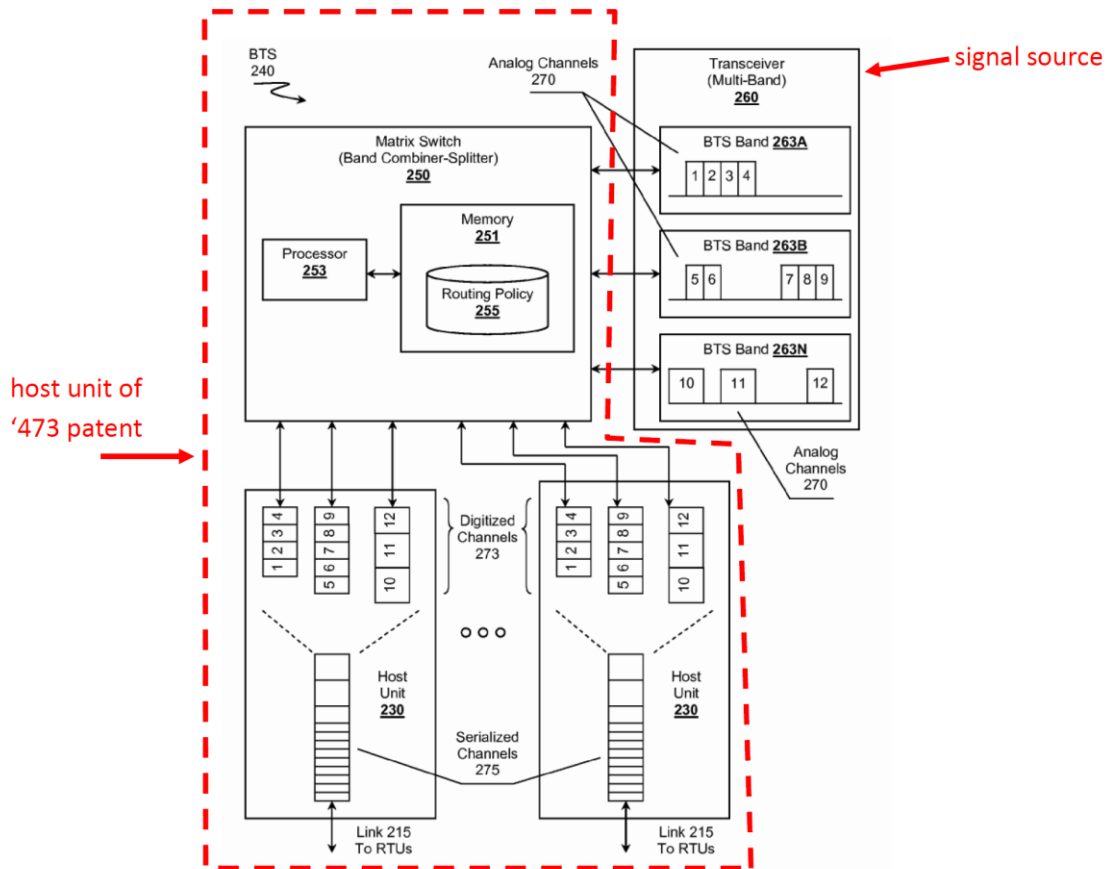


Figure 2

EX-1017 at 18. By the same analysis, Wu’s matrix switch 250 and the host units 250 also correspond to a baseband “unit” as claimed by the ‘499 patent.

3. Element 1C

“a plurality of signal sources, including at least a first signal source and a second signal source”

Wu’s Figure 2 shows that matrix switch 250 communicates with a multi-band transceiver 260, which is a signal source. The multiband transceiver 260 delivers signals to the matrix switch representing multiple frequency bands (each band including multiple carrier channels). EX-1005 ¶¶0034, 0035-0039, Fig. 2. Wu also discloses that the system can be coupled to “more than one of multi-band transceiver 260.” EX-1005 ¶0034. Therefore, Wu discloses the *first and second signal source*. EX-1003 ¶106. The PTAB agreed that Wu discloses this limitation when it instituted IPR of Claim 29 of the ‘178 patent, which also recited a plurality of signal sources. EX-1012 18:13-17; EX-1013 at 38; EX-1015 at 54 (Section D).

4. Element 1D

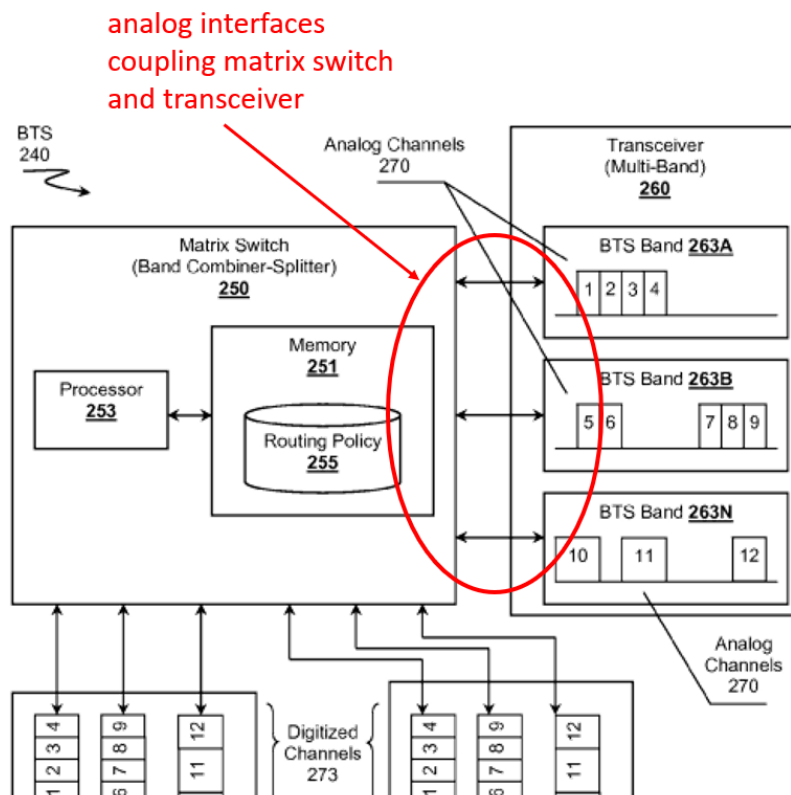
“a plurality of remote units, including at least a first remote unit and a second remote unit”

Wu’s remote transceiver units (RTUs 110, 310, 410) are *a plurality of remote units*. See, e.g., EX-1005 Fig. 1, ¶0030, ¶0033, ¶0011; EX-1003 ¶107.

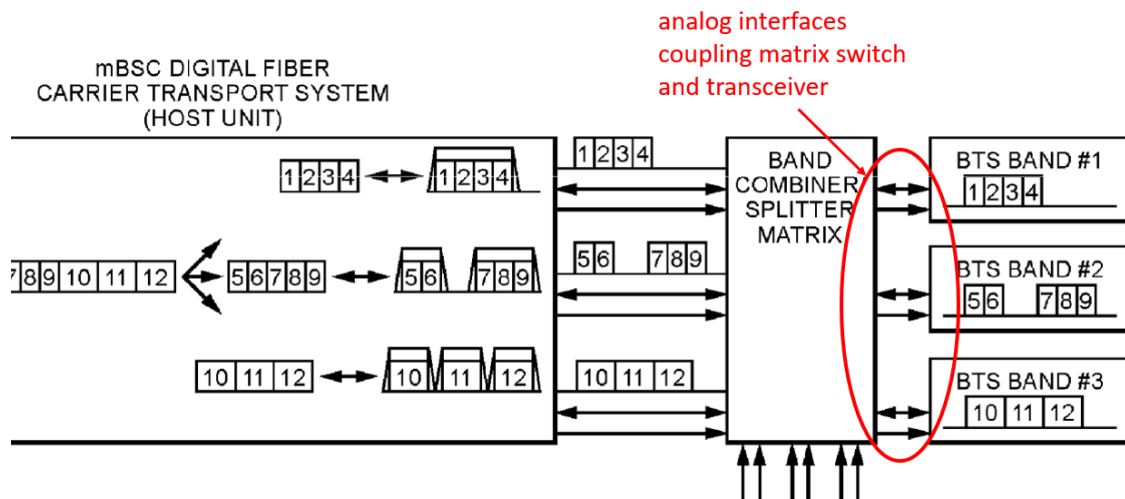
5. Element 1E

“wherein the baseband unit comprises a plurality of interfaces to communicatively couple the baseband unit to the plurality of signal sources”

Figures 2 and 5-2 of Wu illustrate that the matrix switch 250 includes multiple interfaces to the transceiver 260 which couple the matrix switch (part of the claimed *baseband unit*) to the transceiver (one of the claimed *signal sources*).



EX-1005 Fig. 2.



EX-1005 Fig. 5-2. The communication links shown, e.g., in Figures 2 and 5-2, between the matrix switch and the transceiver 260 inherently include an interface in the matrix switch for communicating over these lines to/from the multi-band transceiver. EX-1003 ¶108. Further, where multiple transceivers 260 are included as taught in ¶0034, additional interfaces at the matrix switch would necessarily be provided. EX-1003 ¶108. The PTAB agreed that Wu discloses this limitation when it instituted IPR of Claim 29 of the ‘178 patent, which also recited interfaces to a plurality of signal sources. EX-1012 18:13-17; EX-1013 at 38; EX-1015 at 54 (Section D).

6. Element 1F

“wherein the baseband unit is configured to receive a plurality of radio resources from the first signal source and the second signal source”

Wu’s matrix switch 250 receives a plurality of downlink analog carrier channels in multiple bands from the multi-band transceivers 260. EX-1005

¶¶0034-0039, Fig. 2; EX-1003 ¶¶109-110. Per the ‘499 patent specification, analog carrier channels are examples of radio resources. See, e.g., EX-1001 12:6-7 (“radio resources (such as RF carriers, CDMA codes or TDMA time slots)”); EX-1003 ¶¶109-110. Downlink carrier channel signals are shown as channels 1-12 in Figure 2. EX-1005 Fig. 2, ¶0038. Wu also discloses that there can be multiple multi-band transceivers connected to the matrix switch. EX-1005 ¶0034 (“more than one of multi-band transceiver 260”). In that case, the matrix switch would receive analog channels (*radio resources*) from first and second signal sources. EX-1003 ¶109.

7. Element 1G

“wherein the baseband unit is configured to send a digital representation of a first set of radio resources to the first remote unit at a first point in time, the first set of radio resources for transmission at an antenna of the first remote unit”

Wu discloses that the combination of matrix switch and host units provide fine grained control to send digital representations of the downlink channel signals (*radio resources*) individually or “in arbitrary groups” (which are sets) to RTUs. EX-1005 ¶¶0009, 0011, 0038-0039, 0047, 0049, Claim 16 (“a set of carriers”); EX-1003 ¶¶111-113. Host units also include analog-to-digital converters for creating digitized representations of the carrier signals for transport to the RTUs. EX-1005 ¶0030, ¶0054, Fig. 6-2 (“ADC”); EX-1003 ¶111.

Wu also describes that from time to time the number of channels routed to an RTU may change by means of a routing policy that includes rules for reacting to events and conditions. EX-1005 ¶¶0038-0047, ¶0039 (“...to ensure proper coverage given various conditions...[including] usage, load, weather, events...”); ¶0041 (“The rules of policy 255 can include one or more criterion representing a trigger...”). The triggered routing actions include, e.g., “to allocate more channels” to a region “to increase the bandwidth available.” *Id.* ¶0046. The period of time prior to satisfying the triggering criterion is an example of “at a first point in time” as claimed. EX-1003 ¶112.

Wu discloses that the RTUs provide “wireless coverage” to cellular regions or cell area. EX-1005 ¶¶0030, 0004. It is well understood that “wireless” communications are transmitted using an antenna and that there are antennas associated with the RTUs for providing the wireless coverage within their area. EX-1003 ¶113.

8. Element 1H

“wherein the baseband unit is configured to send a digital representation of a second set of radio resources to the first remote unit at a second point in time, the second set of radio resources for transmission at the antenna of the first remote unit;”

As explained above, Wu describes a routing policy that includes rules for reacting to events and conditions. EX-1005 ¶¶0038-0047. The triggered routing actions include, e.g., “to allocate more channels” to a region “to increase the

bandwidth available.” *Id.* ¶0046. The time after the matrix switch (part of the *baseband unit*) reacts to a triggering condition to allocate and send more channels to an RTU to increase the bandwidth available, is an example of sending a second set of radio resources to the remote unit at “a second point in time” as recited in this limitation. EX-1003 ¶¶114-115. The remaining limitations regarding, e.g., “digital representations” and an “antenna” are satisfied for the same reasons as in Element 1G.

9. Element 1I

“wherein a number of radio resources in the first set of radio resources is different from a number of radio resources in the second set of radio resources”

Wu’s routing policy can trigger the system “to allocate more channels” to a region “to increase the bandwidth available” in response to conditions. EX-1005 ¶0046. This means that the number of channel signals in the first set (prior to triggering event) is different (fewer) than the number of channel signals in the second set (after triggering event), satisfying this limitation. EX-1003 ¶116.

10. Element 1J

“wherein the baseband unit is configured to receive digital signals from each of the plurality of remote units.”

Wu discloses that the system is bi-directional, meaning the RTUs send digital representations of uplink signals over the fibers to units 230. EX-1005 ¶¶0036, 0049; EX-1003 ¶¶117-119. The RTUs include analog-to-digital converters

so the RTUs can digitize signals for digital transport upstream to the host units 230. *See, e.g.*, EX-1005 at Fig. 7-2 (RTU “ADC” elements); ¶0056 (for uplink, the RTU “mirrors” functionality of unit 230 in downlink). The functionality of the unit 230 in the downlink that is “mirrored” by the RTU in the uplink includes creating a digital representation of the uplink RF signals received from subscribers. *See id.* ¶0049; EX-1003 ¶¶117-119. Therefore, Wu satisfies this limitation.

11. Prior Decision by PTAB

For all the elements, the PTAB should consider the prior institution decision for the parent to the ‘499 patent (the ‘178 patent). *See* EX-1013. The prior IPR already determined the issue of whether there was a reasonable likelihood that Wu anticipated a materially identical claim (‘178 claim 10), i.e., whether IPR should be instituted based on Wu.² *Id.* 21-31. The prior IPR is final and not subject to re-litigation (adverse judgment entered with no appeal). EX-1014. Thus, the PTAB should apply issue preclusion (i.e., collateral estoppel) to prevent Patent Owner from re-litigating the same issues about whether to institute. The PTAB and Federal Circuit recognize issue preclusion arises from prior IPRs. *Rimfrost AS v.*

² Petitioner expects issue preclusion would also apply post-institution. The prior IPR decided both the issue whether to institute and whether to cancel the claims, which would be at issue after institution.

Aker Bioamine Antarctic AS, IPR2018-01178, Paper 34 at *31-33 (PTAB Jan. 13, 2020); *Papst Licensing GMBH & Co. v. Samsung Elecs. Am., Inc.*, 924 F.3d 1243, 1249 (Fed. Cir. 2019). Even if the PTAB does not apply preclusion, the prior decision is highly persuasive authority. The four elements of issue preclusion are met. *VirnetX Inc. v. Apple, Inc.*, 909 F.3d 1375, 1377 (Fed. Cir. 2018) (listing elements).

Element (1): The prior action presents an identical issue.

The prior IPR involved the same patent specification (the parent patent), same reference (Wu), same ground (anticipation), and same claim limitations (compare ‘178 claim 10 to ‘499 claim 1). The prior IPR petition further involved the same features in Wu as the present IPR. *See* EX-1015. Thus, the prior IPR presented an identical issue: whether there is a reasonable likelihood these features of Wu disclose materially identical claim limitations such that IPR should be instituted.

Element (2): The prior action actually litigated and adjudged that issue.

Patent Owner opposed institution, and the PTAB rejected Patent Owner’s arguments and instituted IPR. EX-1038; EX-1013. Thus, the prior action litigated and adjudicated the issue of whether to institute based on Wu.

Element (3): The judgment in that prior action necessarily required determination of the identical issue.

The judgment in the prior IPR required determination of the issue (whether to institute IPR). There would have been no basis to enter adverse judgment if the PTAB had not first instituted IPR.³

Element (4) The prior action featured full representation of the estopped party.

Patent Owner had counsel in the ‘178 IPR. EX-1039; EX-1038.

Finally, if Patent Owner argues preclusion does not apply because claim 1 of the ‘499 patent contains some different language than claim 10 of the ‘178 patent, that is wrong. The Federal Circuit has held: “Our precedent does not limit collateral estoppel to patent claims that are identical. ...If the differences between the unadjudicated patent claims and adjudicated patent claims do not materially alter the question of invalidity, collateral estoppel applies.” *Ohio Willow Wood Co. v. Alps S., LLC*, 735 F.3d 1333, 1342 (Fed. Cir. 2013). Patent Owner made the following changes from the non-cancelled claim 10 of the ‘178 patent to the present claim 1 of the ‘499 patent:

³ 37 C.F.R. § 42.73(b)(2) only results in adverse judgment when there is a “trial,” i.e., IPR was instituted. 37 C.F.R. § 42.73(b)(2) (“Cancellation...such that the party has no remaining claim in *the trial*”), 37 CFR § 42.2 (“A trial begins with...*institution* of the trial.”).

- (i) Renamed the “host unit” a “baseband unit”
- (ii) Renamed the “downlink channel signals” as “radio resources”
- (iii) Rephrased the “at least one” signal source/interface as a “plurality” of signal sources/interfaces.

None of these “materially” alter the analysis. Wu, as shown above, still anticipates. This is the quintessential case where the differences are not material. First, the *same* features of Wu that the parties litigated in the prior IPR also disclose (i)-(iii). The prior IPR analyzed the “unit” formed by the combination of Wu’s host units and matrix switch, which Wu teaches operates at *baseband*. The prior IPR analyzed Wu’s downlink carrier channels, and the ‘499 patent teaches carrier channels are the preferred embodiment of *radio resources*. EX-1001, 4:27-38. The prior IPR analyzed Wu’s disclosure for a “*plurality*” of signal sources and interfaces because a dependent claim (Claim 29) recited this identical feature, and the PTAB found Wu disclosed this. Second, the examiner did not credit differences (i)-(iii), but rather issued a double patenting rejection. Third, nothing in the intrinsic record suggests the differences are material. Nothing in the surrounding claim language suggest they are material (the recited functionality is all the same). Nothing in the specification suggest they are material (the specification teaches the preferred embodiment of a *radio resource* is the previously-recited downlink channel signal and never recites a *baseband* unit).

B. Independent Claim 8

Claim 8 tracks the language of claim 1 but with a different preamble that recites a “baseband controller.” It does not appear this preamble is a limitation. The body of the claim never refers to it, instead, reverting to the terminology of claim 1, a “baseband unit.” The specification never mentions a “baseband controller.” If it is a limitation, the combination of the matrix switch and host units in Wu is a disclosure of a baseband controller because the matrix switch (part of the *baseband unit*) using its routing policy “controls” where the digital baseband representations of the carrier channels are distributed and used in the wireless communication system. *See, e.g.*, EX-1005 ¶¶0009 (“fine grained **control** over carrier channels”); ¶¶0039-0040; EX-1003 ¶¶120-129.

Element 8B is taught for the same reasons as Element 1E.

Element 8C is taught where it teaches the host units 230 (part of the claimed “*baseband unit*”) each include a digital optical cable interface for communicating with RTUs (the claimed “remote units”) using the standardized OBSAI or CPRI interface protocols. EX-1005 ¶¶0031, 0049-0050, Figs. 1, 2, 4, 5; EX-1003 ¶124.

Element 8D is taught for the same reasons as Element 1F.

Element 8E is taught for the same reasons as Element 1G.

Element 8F is taught for the same reasons as Element 1H.

Element 8G is taught for the same reasons as Element 1I.

Therefore, claim 8 is unpatentable for the same reasons as claim 1. Further, claim 8 is materially identical to claims 10 and 1 of the '178 patent that were previously litigated and canceled in the '178 patent IPR. Therefore, issue preclusion equally applies to claim 8.

C. Independent Claim 14

Claim 14 track claim 1 except written as a method. Using Wu's systems results in performing the method of claim 14. Claim 14 does not include any limitation not already present in claim 1.

If the preamble recites a limitation (Element 14A), Wu discloses it. Wu's system is a DAS because it includes a central unit (Wu's matrix switch/host units) that transport base station signals (from Wu's multi-band transceiver) to a plurality of remote antenna units (Wu's RTUs) distributed within a desired coverage area to extend the RF coverage of the base station into the coverage area. The host units in Wu include analog-to-digital converters "ADCs" that convert carrier channels to digital baseband signals for distribution to the RTUs of Wu's system. EX-1003 ¶¶130-135.

Element 14B is taught for the same reasons as Element 1F.

Element 14C is taught for the same reasons as Element 1G.

Element 14D is taught for the same reasons as Element 1H.

Element 14E is taught for the same reasons as Element 1I.

Therefore, claim 14 is unpatentable for the same reasons as claim 1.

Further, claim 14 is materially identical to claims 10 and 15 of the ‘178 patent that were previously litigated and canceled in the ‘178 patent IPR. Therefore, issue preclusion equally applies to claim 14.

D. Dependent Claims

1. Claims 2, 9, 19⁴

“wherein the baseband unit is configured to packetize each digital representation of a radio resource”

Wu discloses these limitations by teaching that the host units 230 and the RTUs communicate the digitized downlink carrier channel signals using either of the protocols provided in the OBSAI standard or the CPRI standard. *See* EX-1005 ¶¶0031 (“Suitable standards include...CPRI....OBSAI...”), ¶¶0049, ¶¶0050; EX-1003 ¶¶73-98, ¶¶136-144 (explaining OBSAI packetizing), ¶¶145-157 (explaining CPRI packetizing).

The OBSAI protocol (EX-1008) is based on packetizing communications between a local baseband module and a remote RF module (remote radio unit RRU). EX-1008 at 24 (“The protocol stack is based on a *packet concept*...”), 24 (Figure 9 showing “Address” included in each packet), 42-44, 48, 77-78; Figures

⁴ Claim 2 is representative of claims 9, 19. This applies to each of the following sections listing multiple dependent claims.

25, 49-50; EX-1009 at 53 (“Addressing Principles”); EX-1003 ¶¶137-138. Figure 11 shows the packet:

7 4.2.1 Message Overview

8 A fixed message format is used for all data that is transferred over the
9 RP3 or RP3-01 (see Section 6) bus. Figure 11 shows the message

[...]

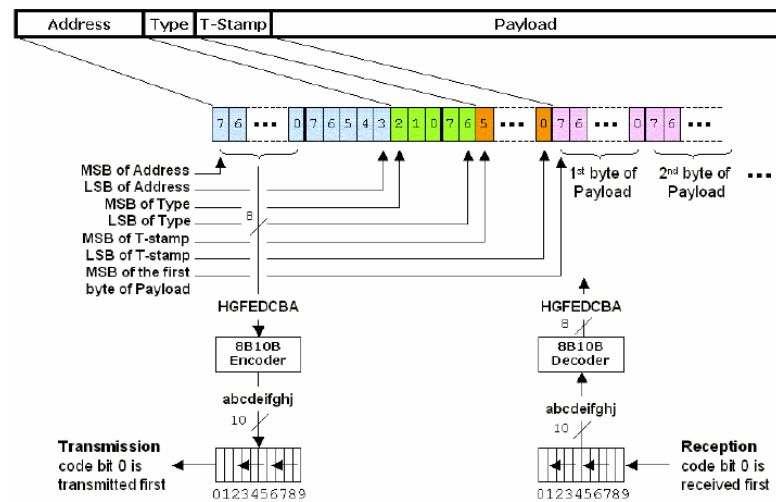


Figure 11: Message format of RP3 protocol stack.

EX-1008 at 26. The address of the packet identifies the remote unit intended to receive the packet. EX-1003 ¶¶139-140.

The CPRI protocol also teaches packetizing digital representations of the downlink carrier signals. EX-1003 ¶¶145-157. The CPRI standard defines a specific protocol for mapping and framing the IQ payload data into defined CPRI frames for transmission over the CPRI link. EX-1003 ¶¶146-153. The CPRI protocol discloses the use of destination addresses for more complex networked topologies (e.g., chained remotes as taught by Wu). EX-1003 ¶¶154-155; EX-1007

at 84 (6.3.2. and 6.3.3) (“address table...used for switching...addresses to all REs”).

Therefore, claims 2, 9 and 15 are anticipated by Wu because Wu teaches to use the OBSAI standard or the CPRI standard between units 130, 230 and the RTUs, both of which standards define protocols that packetize IQ (i.e. baseband) representations of radio resources for transmission to remote RF units from digital baseband units, and both further teach the use of addressing to route the packets to intended remote RF antenna devices. EX-1003 ¶158.

The PTAB has already agreed multiple times that Wu discloses packetizing, e.g., when it instituted IPR of Claim 11 of the ‘178 patent (which also recited packetizing) and when it issued its final decision finding unpatentable claims 14 and 16 of the ‘473 patent. EX-1012 15:33-35; EX-1013 at 31; EX-1017 at 32-34 (finding use of CPRI teaches “packetizing”). Further, these claims are materially identical to claims 11, 8, and 19 of the ‘178 patent that were previously litigated and canceled in the ‘178 patent IPR. Therefore, issue preclusion equally applies to these claims.

2. Claims 3, 10, and 15⁵

“wherein the digital representation of the first set of radio resources includes destination information identifying the first remote unit and the digital representation of the second set of radio resources includes destination information identifying the first remote unit”

Wu discloses these limitations for the same reasons given above for Claims 2, 9, 19. That is, by teaching that units 230 and the RTUs communicate the digitized downlink channel signals using either the OBSAI or the CPRI standards (both before and after increasing the number of carriers sent to an RTU), Wu

⁵ Claim 15 includes similar language to claims 3 and 10. Claim 15, however, refers (in error) to “the second remote unit” which lacks antecedent basis. If the claim is construed to be referring to “the first remote unit,” it is invalid for the same reasons as claims 3 and 10. If construed to mean “a second remote unit,” then it would still be invalid for the reasons discussed in this section and because the addressing schemes taught by Wu (e.g., OBSAI’s) place an address in each message packet for the intended recipient. The messages for a first RTU will include the first RTU’s address, and the messages for a second RTU will include the second RTU’s address. Wu also teaches that the same set of carrier channels can be sent to multiple RTUs (“simulcast”). EX-1005 ¶¶0012; ¶0051; EX-1003 ¶¶159-160.

teaches including destination information identifying the intended remote unit in both sets of carriers. As discussed above, both protocols teach the use of addresses within the packets of data to route signals to the correct node within the network. EX-1003 ¶¶159-160, ¶¶136-157; EX-1008 at 24 (showing “Address” included in each packet by Application layer and used by transport layer to route messages), 42-44 , 48 (“The application layer is also responsible for insertion of the message header: address, type, and timestamp fields.”); 77-78 (Figs. 49, 50); EX-1007 at 84 (6.3.2. and 6.3.3) (“address table used for switching...addresses to all REs”).

Notably, claims 3, 10, and 15 are not patentably distinct from claims 21, 23, and 30 of the ‘178 patent that was previously litigated and then canceled in the ‘178 patent IPR. *See, e.g.*, EX-1012 Claim 21 at 16:37-41. Therefore, Patent Owner should be estopped from arguing claims 3, 10, 15 are patentable.

3. Claims 4, 11, 16 and 13, 18

“wherein the first set of radio resources is a subset of the plurality of radio resources and includes at least some radio resources from the first signal source and at least some radio resources from the second signal source”

“wherein the plurality of radio resources include a first composite signal from the first signal source and a second composite signal from the second signal source, and the baseband unit is configured to form the digital representation of the first set of radio resources from a first subset of the first composite signal and a second subset of the second composite signal.

Wu teaches that the signals from the multiband transceiver are composite signals as each band includes multiple carrier channels. EX-1005 ¶0011

(“Preferred frequency bands comprises more than one carrier channel per band.”);

¶0035. Figure 2 shows this:

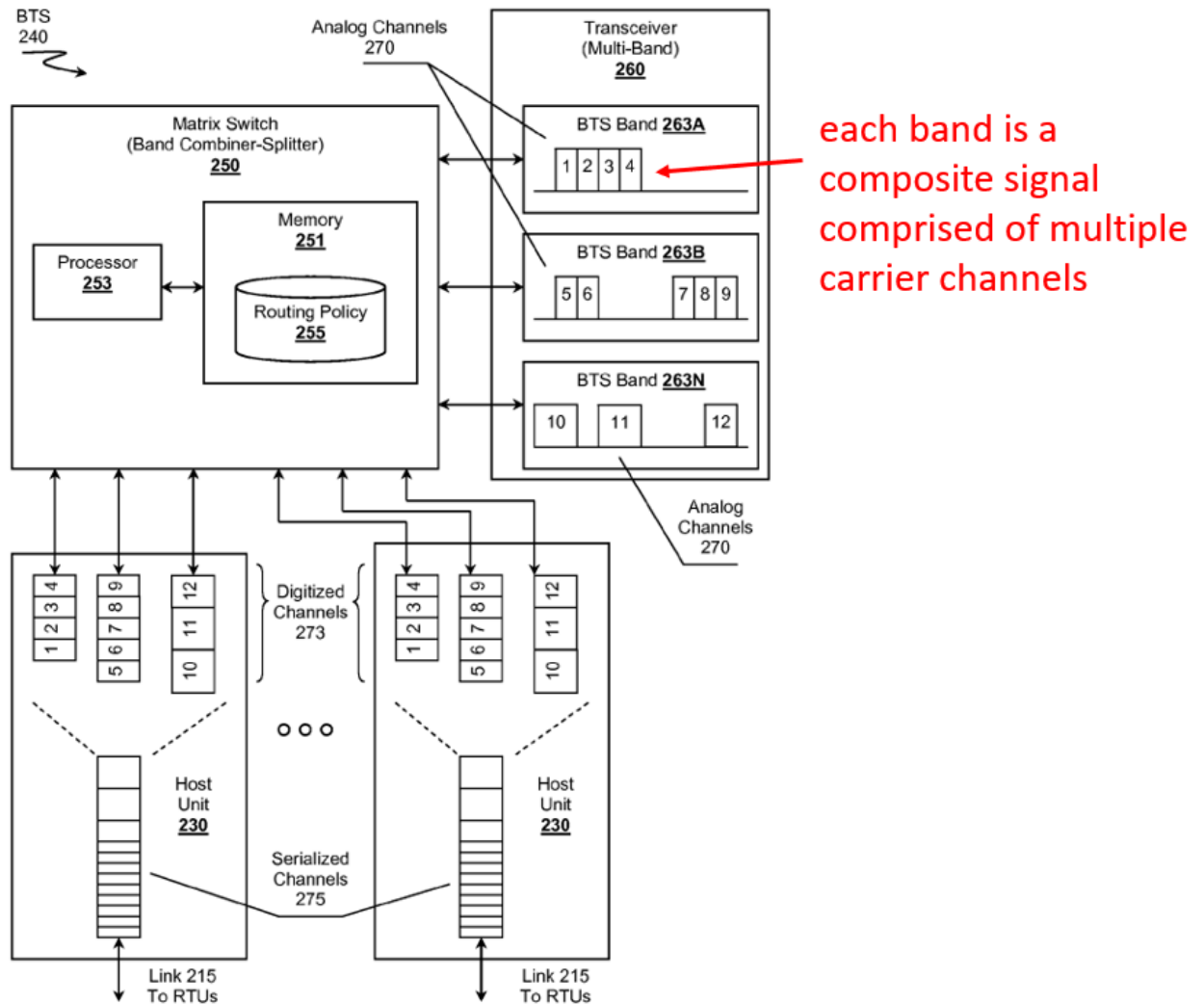


Figure 2

Wu teaches that the bands input to the matrix switch can come from multiple multi-band transceivers (i.e., multiple *signal sources*). EX-1005 ¶0034. Wu also teaches that the carrier channels received by the matrix switch “can be routed or allocated according to policy 255 individually, collectively as shown, or in

arbitrary groups.” EX-1005 ¶¶0049, 0047. Wu explains that this ability allows channels from different bands to be split from their bands and grouped together for routing with channels from different bands to an RTU. EX-1005 ¶¶0047. These teachings together, i.e., (i) the multi-channel bands can be coming from multiple signal sources and (ii) any individual carrier channel can be split and combined with channels from a different band, discloses to a POSITA that the radio resources sent to a remote unit can comprise some of the channels from multiple signal sources as recited in these claims. EX-1003 ¶¶161-162.

4. Claim 5

“wherein the baseband unit and at least one of the plurality of signal sources are part of a baseband controller.”

Wu teaches this limitation by disclosing that the matrix switch and host units (together the *baseband unit*) can be located within the same structure as the multiband transceiver (a *signal source*). This is shown in Wu’s Figs. 2 and 4. Wu uses the term “BTS 240” to refer to all of the elements shown in Fig. 2. That same designation is provided in Fig. 4 for BTS 440, which also shows that the host units are integral to BTS 440.

Notably, the ‘499 specification never uses the term “baseband controller” and never identifies any distinction between a baseband unit and a baseband controller. Nevertheless, if a baseband “controller” adds any limitation beyond a baseband “unit” Wu discloses it. As discussed above for claim 8, the entire goal of

Wu is to enable the disclosed system (matrix switch and host units) to provide “fine grained *control*” over the carrier channels. EX-1005 ¶¶0009; 0039-0040.

Wu’s matrix switch and host units provide this control by implementing a “routing policy” that dictates where the digital baseband representations of the carrier channels are distributed. EX-1003 ¶¶163-164.

Ground 2: Wu alone or combined with Sabat-426 renders obvious claims 1-5, 8-11, 13-16, 18-19.

A. Baseband “unit”

Patent Owner may argue Wu’s matrix switch 250 and units 230 do not form a baseband “unit” because they are shown in Figure 2 in different “boxes.” As a preliminary point, Wu’s Figure 4 shows the host units 430 inside a single BTS unit and demonstrates that Wu understood and disclosed that the matrix switch 250 and units 230 could be part of the same unit. Figure 1 also suggests that the units 130 are physically attached to the BTS where the matrix switch is located as shown in Figure 2. EX-1003 ¶165.

Regardless, it would have been obvious based on Wu alone or in combination with Sabat-426 to place the functionality of both components (matrix switch and units 230) within a single housing or unit. EX-1003 ¶¶166-168. The PTAB already analyzed this same issue in multiple prior IPRs and agreed combining Wu’s matrix switch and host units would have been obvious based on Wu itself or Sabat-426. EX-1017 22; EX-1013 33-34.

“The mere aggregation of a number of old parts or elements which, in the aggregation, perform or produce no new or different function or operation than that theretofore performed or produced by them, is not patentable invention.” *Lincoln Engineering Co. v. Stewart-Warner Corp.*, 303 U.S. 545, 549 (1938). When two references “in combination did no more than they would in separate, sequential operation,” “the patent fail[s] under § 103.” *KSR*, 550 U.S. at 417; *In re Larson*, 340 F.2d 965, 968 (CCPA 1965) (“a one piece construction ...would be merely a matter of obvious engineering choice.”).

Combining the matrix switch and host units of Wu would be obvious based on Wu alone because placing them together would merely result in them both performing the same sequence of operations to produce the same predictable result as when separate. EX-1003 ¶166. A POSITA would have been motivated to do so to reduce the system complexity, reduce installation costs by simplifying installation, and minimize errors in coupling separate components. *Id.* A POSITA would have had a reasonable expectation of success because no new functionality is required, merely grouping Wu’s already-disclosed components into a single unit or housing. *Id.*

Alternatively, Sabat-426 taught to combine into a single hub unit, both (a) a programmable switch for dynamic capacity allocation to remote antenna units and (b) digital interfaces to the remote antenna units. See EX-1010 (“Sabat-426”) Fig.

6, ¶¶0046-47 (programmable switch in hub), ¶0031-0032 (hub incorporates interface for digital distribution to the digital remote radios), ¶0037 (digital interfaces to remote units); EX-1003 ¶167. It would have been obvious to apply this teaching from Sabat-426 to Wu’s system for the same reasons given above (i.e., to reduce the system complexity and installation costs and minimize errors in coupling separate components). EX-1003 ¶168. This argument applies to all grounds based on Wu made in this Petition.

B. Claims 4, 11, 16 and 13, 18

Patent Owner may argue Wu does not expressly state the system can route some radio resources from multiple transceivers to an RTU. Petitioner disagrees, as set forth above, but regardless, this would have been obvious based on Wu. Wu teaches the desirability of “fine grained control” over individual carriers to prevent “unnecessary congestion” on transport links in the system (e.g., links between RTUs and the host units). EX-1005 ¶0005. This motivated Wu to describe the matrix switch that can split out only the desired channels from different bands which can be combined and routed as an arbitrary group to an RTU. This same motivation applies equally whether the signals are received from one or multiple transceivers and would have motivated a POSITA to combine only the desired channels from multiple bands for routing to an RTU even when received from different transceivers. EX-1003 ¶¶169-170. An additional motivation would have

been to allow multiple operators to share the system and thereby reduce costs. EX-1003 ¶¶170.

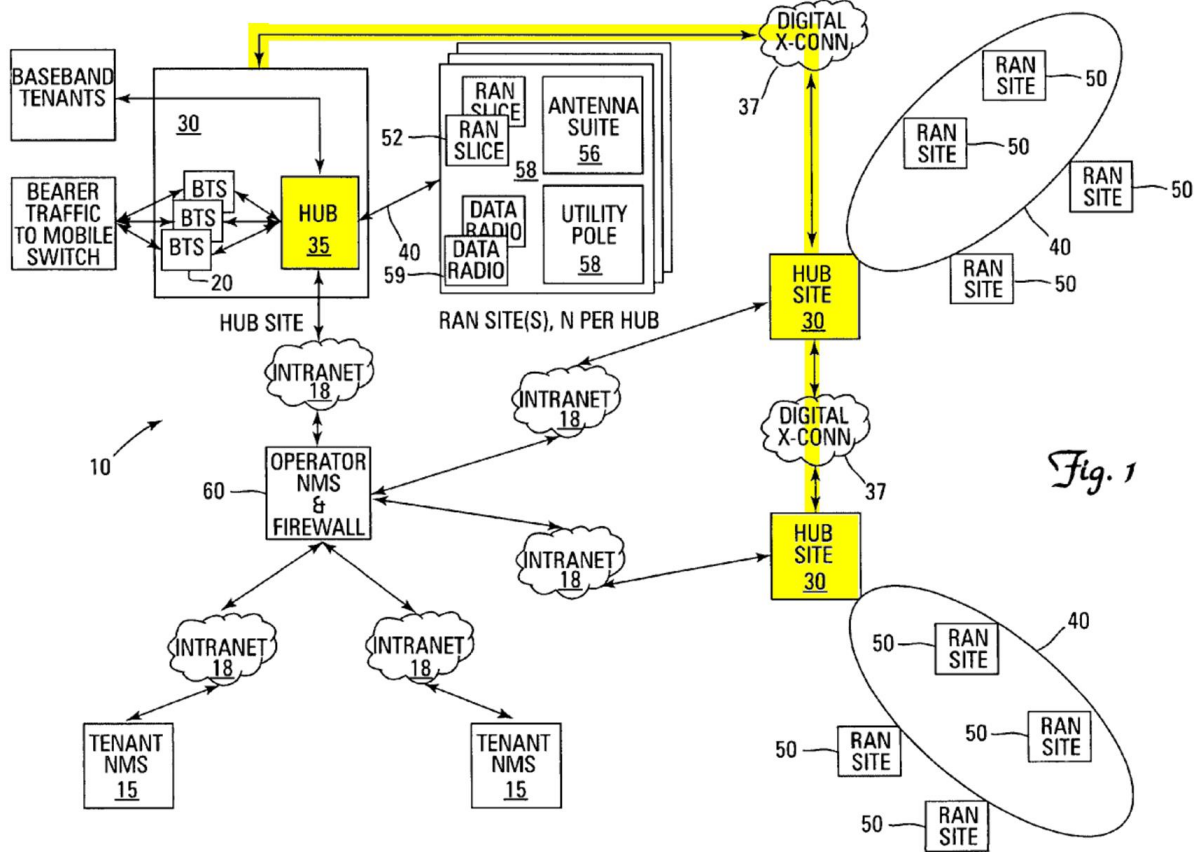
Ground 3: Wu and Sabat-552 render claims 6-7, 12 and 17 obvious

A. Claims 6, 12, 17:

“wherein the baseband unit further comprises at least one interface to communicatively couple the baseband unit to one or more additional baseband units.”

“receiving at the baseband unit, from at least one additional baseband unit, a second plurality of radio resources.”

Wu does not disclose that the matrix switch/unit 230 (a *baseband unit*) is coupled to another matrix switch/unit 230 (*additional baseband unit*). In the same art, however, U.S. Patent No. 6,963,552 (“Sabat-552”) (EX-1011) disclosed that central hubs (35) in a digital wireless RF distribution system can be coupled to other hubs through digital cross connects 37 so that a base station connected at one hub site can have its signal digitized and transmitted to any of the remote units coupled to any of the other hubs in the system. EX-1011 Figs. 1, 3, 6:55-61; EX-1003 ¶¶171-172. Figure 1 of Sabat-552, shows hub 35 at left can route radio resource signals from its base stations 20 not only to its own remote RAN sites but also to the RAN sites of two additional hubs by virtue of being communicatively coupled to the additional hubs via digital cross-connection.



Sabat-552 identifies advantages to interconnecting multiple hubs 35, which would have motivated a POSITA to modify Wu to couple a first matrix switch/unit 230 with a second matrix switch/unit 230. EX-1003 ¶173. Sabat-552 teaches that interconnecting the hubs 35 enables a base station (20) located at one hub site (30) to transmit its associated signal to “any” RAN Unit 50, meaning not only any remote antenna unit directly connected to its hub 35, but also to any remote unit site coupled indirectly through another hub 35, which avoids the cost of building additional base stations and distribution networks. EX-1003 ¶173. Sabat-552 also teaches that its design enables the system including the RAN units to be easily

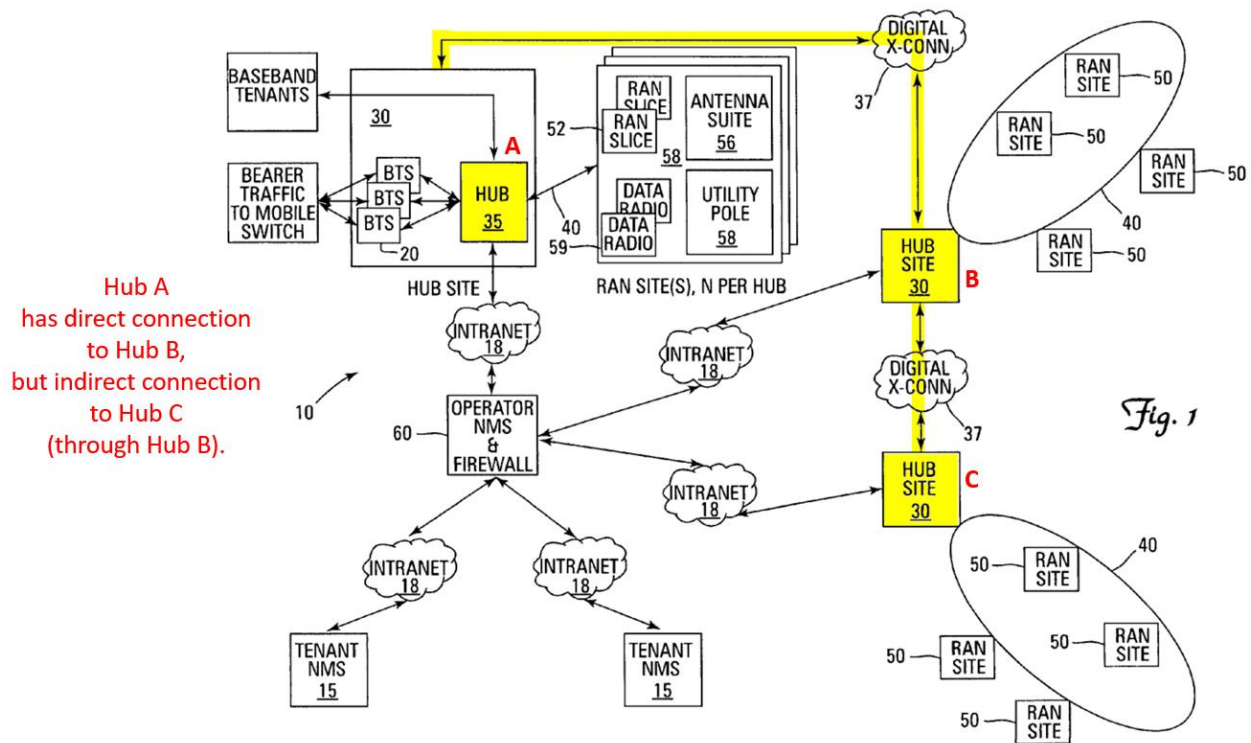
shared among service providers, reducing costs. EX-1011 2:48-58; 3:65-4:5; EX-1003 ¶173. Therefore, it would have been obvious to couple Wu’s matrix switch/unit 230 with another matrix switch/unit 230 to allow signals input to the first matrix switch to be communicated to RTUs that connect with a different matrix switch to reduce equipment costs and share infrastructure among service providers. *Id.* ¶¶174-175. A POSITA would have had a reasonable expectation of success because the element merely requires duplicating an already disclosed structure (the matrix switch/host unit) and providing a cabled interface between them. *Id.* The ‘499 patent does not disclose any unconventional structures for connecting the DAUs (*baseband units*) but merely teaches using a fiber optic cable. EX-1001 9:44-45 (“DAU 400 and DAU 405 are daisy-chained through the fiber optic cable 440.”). Making fiber optic cable connections between components was well known. EX-1003 ¶174.

The PTAB already analyzed this same issue when instituting a prior IPR and agreed there was a reasonable likelihood the combination of Wu and Sabat-552 rendered this limitation obvious. EX-1013 at 35-38 (addressing ‘178 patent, claim 26 (“additional host units”)).

B. Claim 7:

“The system of claim 6 wherein the one or more additional baseband units includes a plurality of additional baseband units, and the baseband unit is connected to at least a first one of the plurality of additional baseband units through a direct connection and at least a second one of the plurality of additional baseband units through an indirect connection.”

The combination of Wu and Sabat-552 renders claim 7 obvious for the reasons given regarding claim 6 and because the arrangement disclosed by Sabat-552 includes hubs that are connected to other hubs directly and indirectly. Fig. 1 shows this:



EX-1011 Fig. 1. Hub (A) at upper left in Fig. 1 has a direct connection to the upper hub at right (B) and an indirect connection to the lower hub at right (C).

EX-1011 6:55-61; EX-1003 ¶176. A POSITA would be motivated to make this

combination and have a reasonable expectation of success for the same reasons given above for claim 6.

Finally, the added limitations in claims 6, 7, 12, and 17 are materially identical to those in claim 28 (and claim 26) of the ‘178 patent that were previously litigated and canceled in the ‘178 patent IPR. See EX-1012 at 18:7-12 (claim 28: “the host unit is connected to at least one of the plurality of *additional host units* through a *direct* connection and at least one of the plurality of additional host units through an *indirect* connection”), 17:7-8 (claim 26: “...one or more additional host units”). Therefore, issue preclusion applies.

Ground 4: The claims are obvious in further view of the OBSAI standard

All claims recite a “baseband” unit. Dependent claims 2, 9, and 19 recite “packetizing” the digital representations. Dependent claims 3, 10, and 15 recite including destination information with the digital representations. The above analysis in Grounds 1-3 explains that Wu expressly teaches to use the OBSAI standard protocol to communicate which inherently relies on packetizing (into OBSAI “messages”) baseband signals (I&Q samples) and which include destination addresses. Wu does not regurgitate details of the OBSAI standard. If for that reason it is argued that these claims are not anticipated by Wu, these claims are obvious for the reasons given in Grounds 1-3 in further light of the OBSAI standard (EX-1008). It would have been obvious to combine Wu with the OBSAI

standard because Wu expressly teaches to use the OBSAI standard and because using a standard protocol can save time and expense of development, eliminates risk from the development process, permits the use of off-the-shelf components, and allows communication with third party equipment. EX-1005 ¶¶0031, ¶¶0049-50. EX-1003 ¶177. A POSITA would have a reasonable expectation of success because the OBSAI protocol was an already developed, standardized protocol. EX-1003 ¶177.

Ground 5: Hettstedt anticipates claims 1-5, 8-11, 13-16, 18-19

Hettstedt teaches every limitation of independent claims 1, 8, and 14 and dependent claim 2-5, 9-11, 13, 15-16, 18-19.

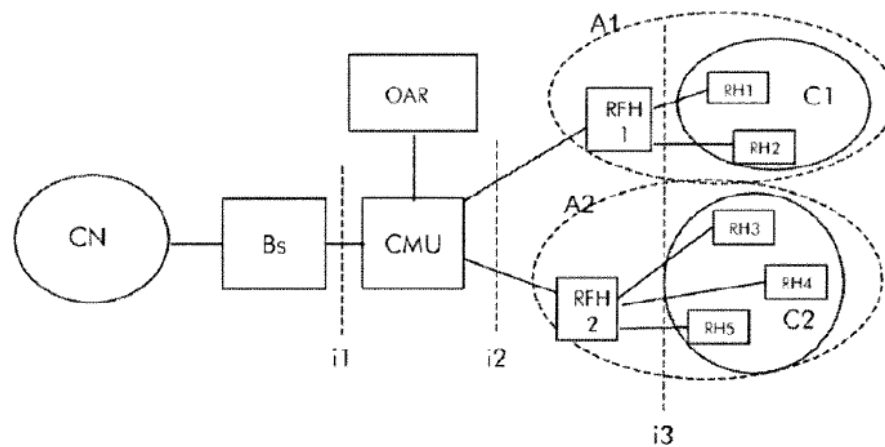
A. Independent Claim 1

1. Element 1A

“A system for transporting wireless communications, comprising...”

Hettstedt discloses a “*system for wireless cellular indoor communications.*” EX-1006 ¶0008. It transports wireless communication between the core network (CN) and radio heads (RHs):

Figure 3



Id. at Fig. 3, ¶¶0039-0041, ¶0050, Figs. 2-6; EX-1003 ¶¶180-183.

2. Element 1B

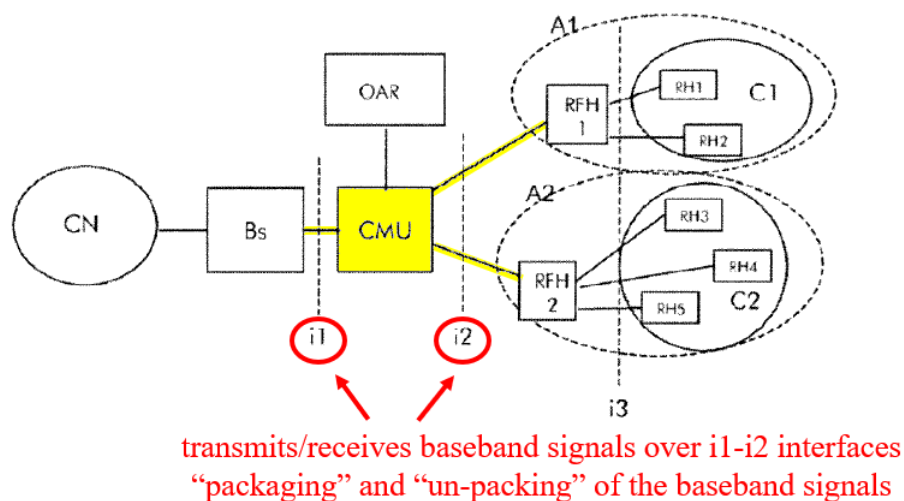
“a baseband unit”

Hettstedt’s cell management unit (CMU) is “a baseband unit.” EX-1003 ¶¶184-190. Hettstedt expressly teaches its system distributes “digital base-band,” and the CMU is the unit that manages this. EX-1006 ¶0030 (“information is distributed in digital *base-band*”), ¶0027, ¶0028, ¶¶0043-0045.

In the downlink direction, the CMU receives signals over the i1 interface using, for example, the CPRI protocol. EX-1006 ¶0040. CPRI provides “digital baseband signals.” EX-1003 ¶186; EX-1007 at 7, 26; EX-1022 ¶0009. The CMU then packages, addresses, and forwards these baseband signals to the radio heads (RHs) as “digital base-band.” EX-1006 ¶0030, ¶0040; EX-1003 ¶186. In the uplink direction, the CMU does the reverse. EX-1006 ¶0041; EX-1003 ¶186.

Thus, the CMU is a unit that (1) receives baseband signals, (2) transmits baseband signals, and (3) operates on baseband signals (e.g., by “packaging” and “addressing” them). EX-1006 ¶0028; EX-1003 ¶187. Here is a summary annotation:

Figure 3



EX-1006, Fig. 3.

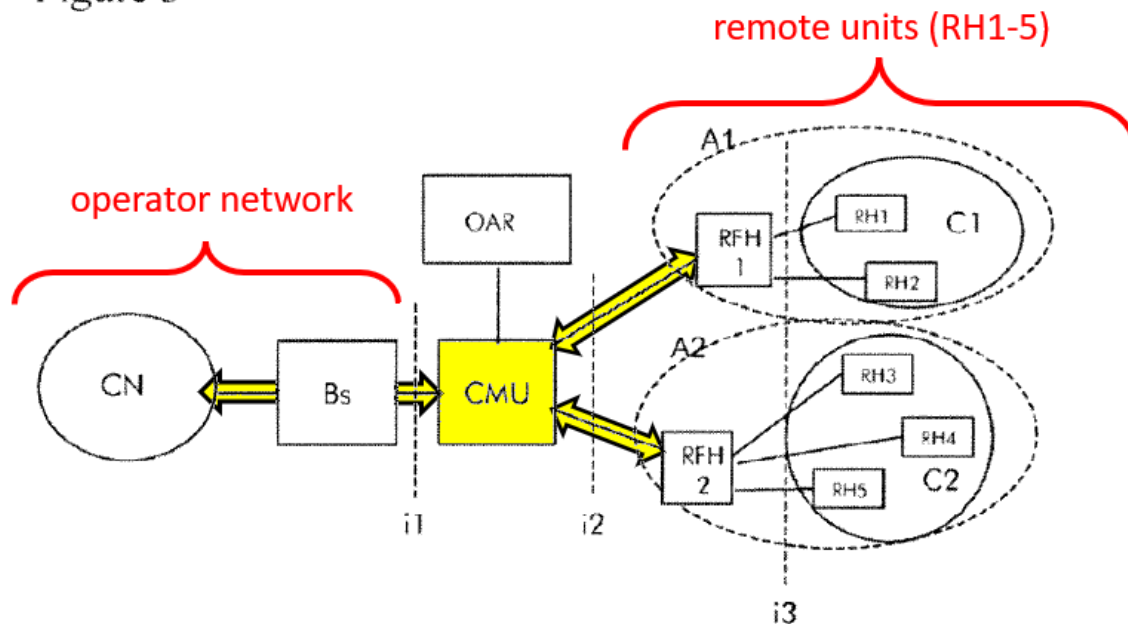
Although construction is not necessary for this term, Hettstedt meets the construction Patent Owner proposed in a prior IPR:

Term	Patent Owner’s construction
baseband unit	a unit that manages baseband communications between an operator network and one or digital remote units

EX-1029 at 25 (Section D). The CMU (“cell management unit”) manages the distribution of “digital base-band” between the (a) core network and operator’s

base station (*operator network*) and (b) remote radio heads with digital interfaces (*digital remote units*):

Figure 3



EX-1006 Fig. 3, ¶¶0030 (“information is distributed in digital base-band”), ¶¶0040-0041, ¶0053; EX-1003 ¶190. The CMU manages the carriers by allocating, packaging, tuning, mapping, addressing, shifting, de-activating, and activating them. EX-1006 ¶¶0043-0045, ¶0050, ¶0028.

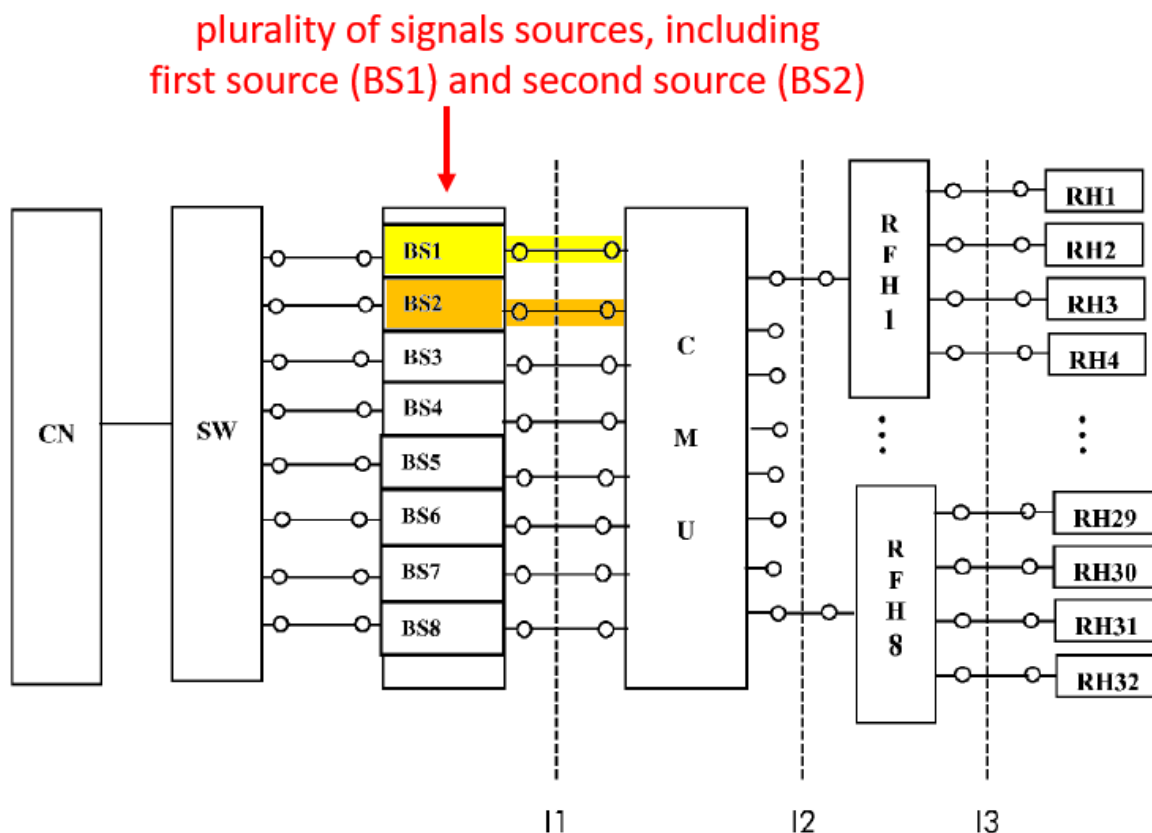
3. Element 1C

“a plurality of signal sources, including at least a first signal source and a second signal source,”

Hettstedt discloses a plurality of base stations (BSs), which satisfies this limitation. EX-1006 ¶0027 (“a number of base stations”); EX-1003 ¶¶191-192.

Figure 6 shows this:

Figure 6



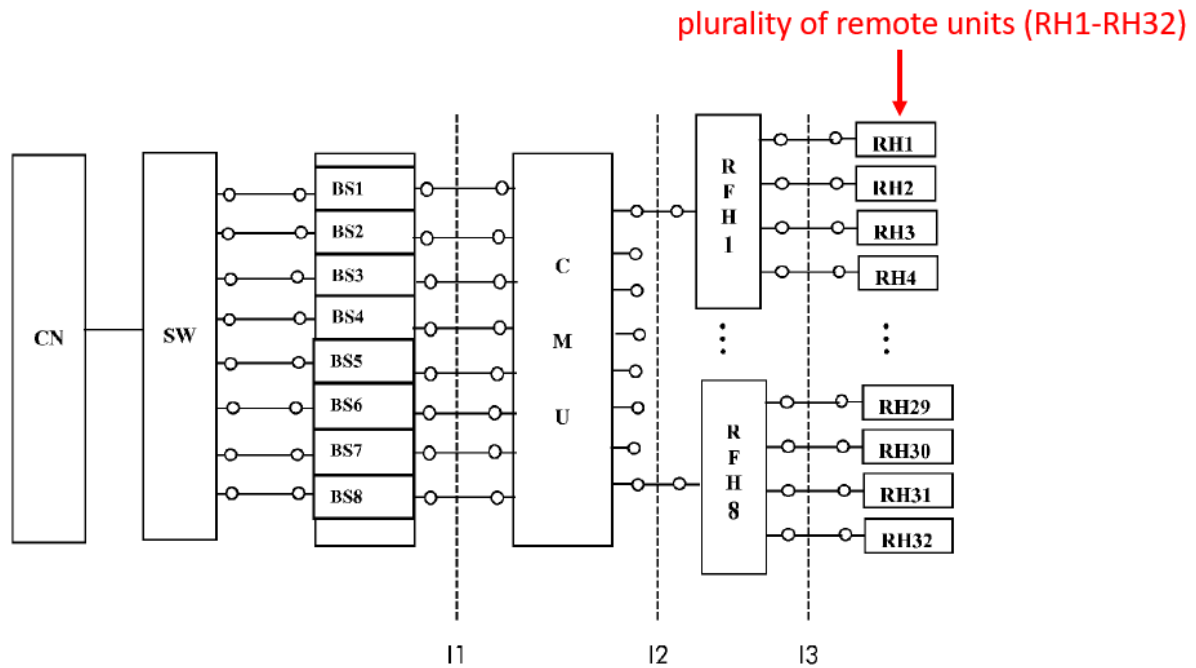
EX-1006 Fig. 6, ¶0054 (“eight base stations BS1 to BS8”). The base stations are the “source” of the carriers. EX-1006 ¶0054 (“base station can provide four carriers....”), ¶0053.

4. Element 1D

“a plurality of remote units, including at least a first remote unit and a second remote unit;”

Hettstedt discloses a plurality of remote radio heads (RHs), which satisfies this limitation. EX-1006 ¶0039, ¶0050, ¶0029, Figs. 3-6; EX-1003 ¶193. Figure 6 shows this:

Figure 6



EX-1006 Fig. 6, ¶¶0053-0054; *see also* Figs. 3-5.

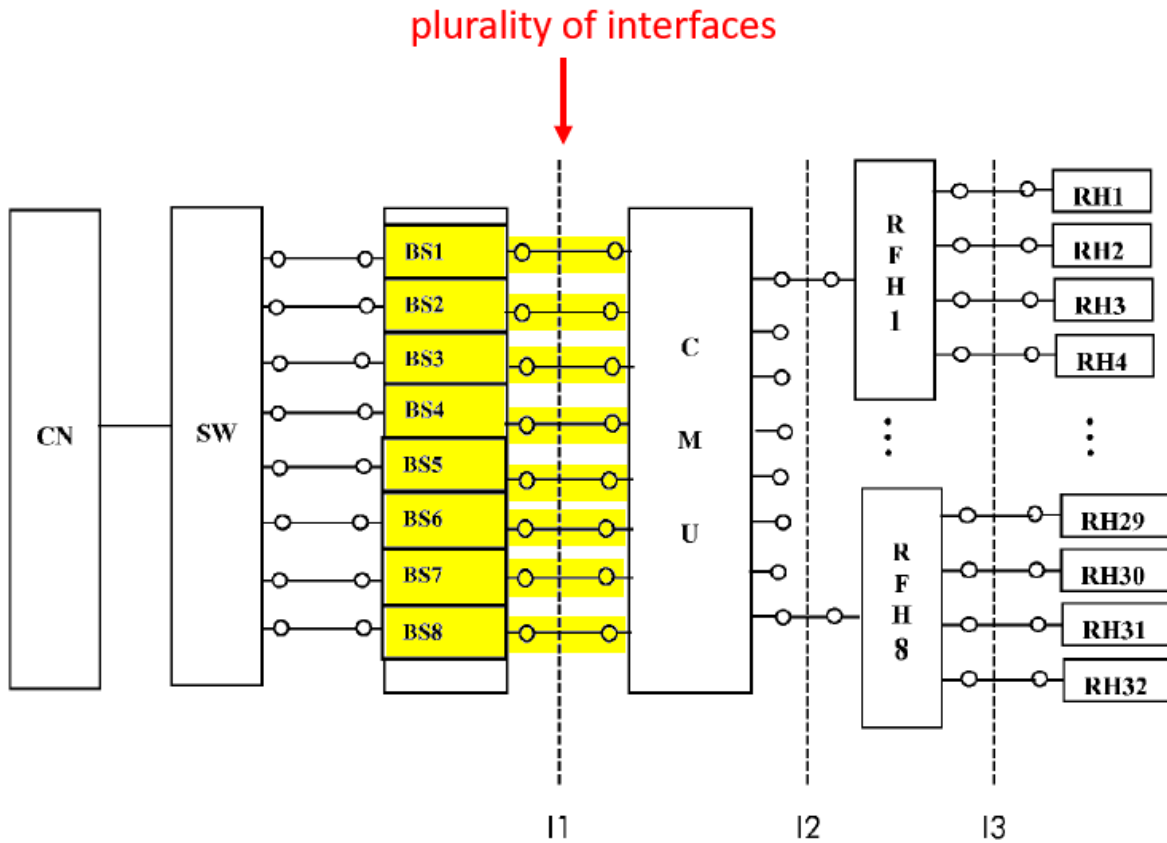
5. Element 1E

“wherein the baseband unit comprises a plurality of interfaces to communicatively couple the baseband unit to the plurality of signal sources.”

The CMU (*the baseband unit*) has interfaces to each of the plural base stations (*the plurality of signal sources*), which satisfies this limitation. EX-1003

¶¶194-197. Figure 6 shows this:

Figure 6



EX-1006. Each of the eight connection lines corresponds to dashed line “i1”.⁶

Hettstedt expressly teaches that “i1” refers to a “connection interface.” EX-1006

¶0040. Figure 6 shows there are eight such “connection interfaces,” i.e., the

claimed plurality of interfaces. Hettstedt lists protocols/standards for these

interfaces (Ethernet, CPRI, OBSAI). EX-1006 ¶0040; EX-1003 ¶¶196-197. CPRI

⁶ Each line (o----o) represents a digital line with a connector, which are interfaces

EX-1006 ¶0045 (“connectors of the respective digital lines”); EX-1003 ¶195.

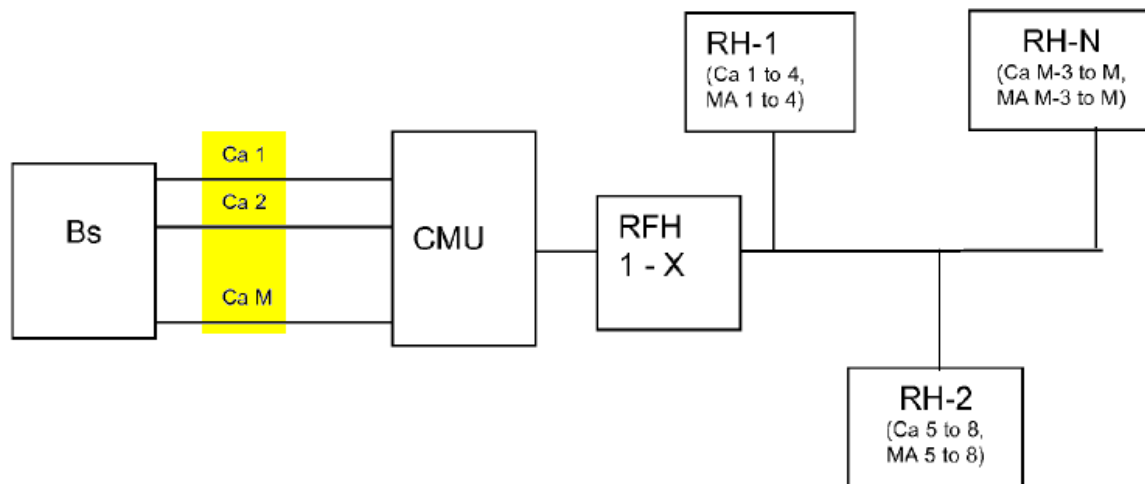
expressly recites an “interface”: “Common Public Radio Interface.” EX-1007; EX-1003 ¶197.

6. Element 1F

“wherein the baseband unit is configured to receive a plurality of radio resources from the first signal source and the second signal source”

Hettstedt’s CMU receives a plurality of “carriers” from each of the base stations, which satisfies this limitation. EX-1003 ¶¶198-202. The CMU, for example, receives “four” carriers from each base station in Figure 6. EX-1006 ¶0054. More broadly, the CMU can receive “M” carriers from any one base station:

Figure 5



EX-1006 Fig. 5, ¶0053.

Hettstedt’s carriers are “*radio resources.*” They are the resources used by Hettstedt *radio* heads. EX-1006 ¶0050 (“remote radio heads are equipped to

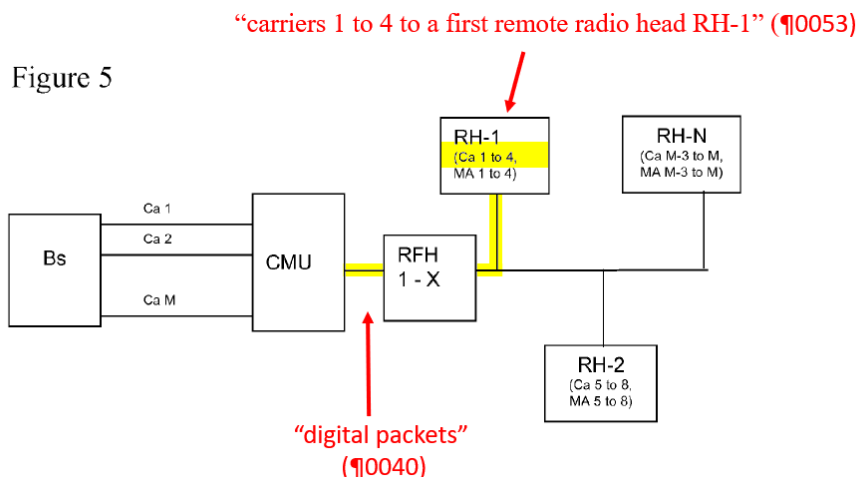
transmit four carriers...”); EX-1007 at 26 (“in the form of in-phase and quadrature modulation”); EX-1003 ¶¶199-202 (see *especially* footnote 3). Each carrier corresponds to a “frequency allocation.” EX-1006 ¶0050 (“Since frequency allocation of each carrier...). The radio heads transmit the carriers to end user mobile devices. EX-1006 ¶0050; EX-1003 ¶199.

Hettstedt parallels the ‘499 patent specification. The ‘499 patent specification teaches that the DAU receives “carriers” from a “base station” and explains RF “carriers” are “radio resources.” EX-1001 at 5:53-6:2, 12:6-7 (“radio resources (such as RF carriers...)”).

7. Element 1G

“wherein the baseband unit is configured to send a digital representation of a first set of radio resources to the first remote unit at a first point in time, the first set of radio resources for transmission at an antenna of the first remote unit”

As an overview, Hettstedt’s CMU is configured to package sets of carriers (*radio resources*) in digital form (the “*digital representation*”) into Ethernet packets and sends them to the radio heads (*remote units*). EX-1006 ¶0040, ¶0053; EX-1003 ¶203, ¶¶204-16. Here is an exemplary annotation of the CMU sending a *first set* (carriers 1-4) to a *first remote unit* (RH-1):

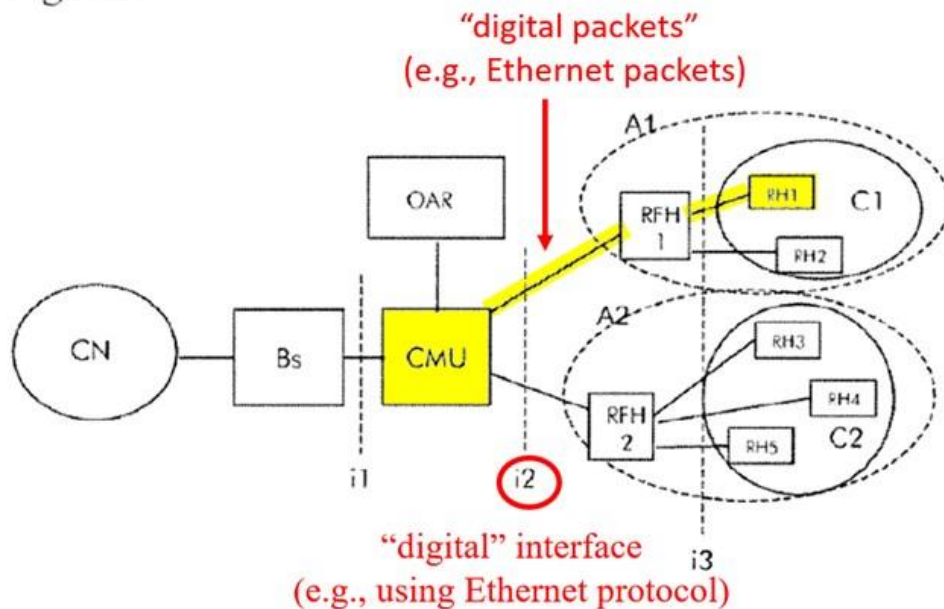


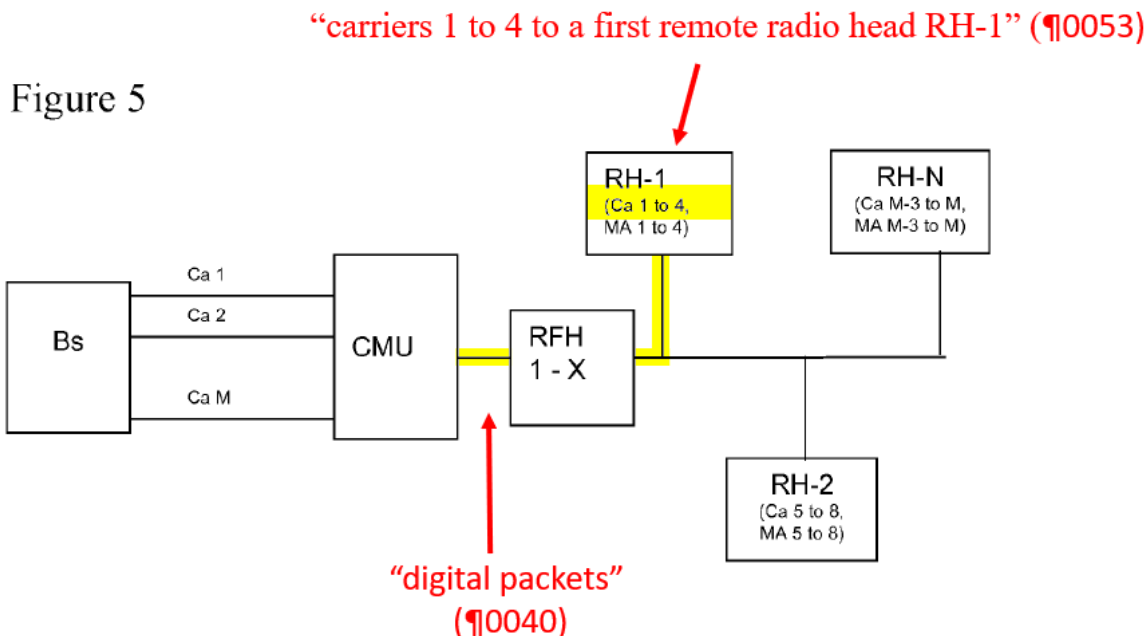
EX-1006 §0040, §0053.

First, CMU allocates each radio head a “set” of the carriers. EX-1003 §204-205. The CMU receives “M” total carriers (e.g., 32 in Figure 6). EX-1006 §0053-0054. Each radio head is equipped, for example, to transmit four of those carriers. EX-1006 §0050, §0053-0054. The CMU allocates which carriers each radio head will transmit. Specifically, the CMU maps “allocations” of carriers (*radio resources*) “to individual radio heads, as identified e.g. through their MAC addresses.” EX-1006 §0045; *see also* EX-1006 §0050 (“frequency allocation of each carrier”), §0028 (“performs the frequency allocation of the remote radio heads”). The CMU fine-tunes these sets by activating, de-activating, and shifting the carriers. *Id.* §0043-44, §0050. Figure 5, above, shows examples of these sets. EX-1006 §0053. Thus, Hettstedt discloses “*first set of radio resources to the first remote unit at a first point in time.*”

Second, CMU packages the sets of carriers in “digital form” into “digital packets” (e.g., “Ethernet packets”) addressed to the individual radio heads. EX-1006 ¶0040, ¶0028, ¶0053. The CMUs uses its mapping functionality (EX-1006 ¶0045), intelligent switching unit (EX-1006 ¶0042), and addressing (EX-1006 ¶0045, ¶0028, ¶0053) to send the digital packets to the desired radio heads. See EX-1003 ¶206. These components are well-known to POSITAs. EX-1003 ¶207. The CMU forwards the digital packets to the radio heads through intermediary hubs over digital interfaces (i2 and i3). EX-1006 ¶0040; EX-1003 ¶208. Thus, Hettstedt discloses that the CMU is “*configured to send a digital representation of a first set of radio resources to the first remote unit.*” Here are two summary annotations:

Figure 3





EX-1006 Figs. 3 and 5; EX-1003 ¶208, ¶206.

Third, Hettstedt’s discloses that the first set of radio resources *is for transmission at an antenna of the first remote unit*. EX-1003 ¶¶209-215, ¶214 (conceding an antenna). Hettstedt’s remote radio heads are “equipped to transmit four carriers over the full RF bandwidth” (¶0050) to mobile station such as “mobile phones” (¶0004). Hettstedt remote radio heads are the “RF air interfaces to users” (¶0050). EX-1006. The fact that Hettstedt’s radio heads are transmitting the carriers over-the-air using radio frequencies inherently involves an antenna. EX-1003 ¶209. The background art corroborates this. EX-1003 ¶¶210-213. Hettstedt’s specification, for example, cites U.S. Patent Publication No. 2005/0157675 that explains (a) radio heads have antennas and (b) antennas are the structure to transmit signals to mobile users. *Compare* EX-1006 ¶0006 with EX-

1036 Fig. 2, ¶¶0017-0018; EX-1003 ¶212. The ‘499 patent’s provisional application acknowledges that radio heads (like Hettstedt) have antennas. See EX-1003 ¶213.

8. Element 1H

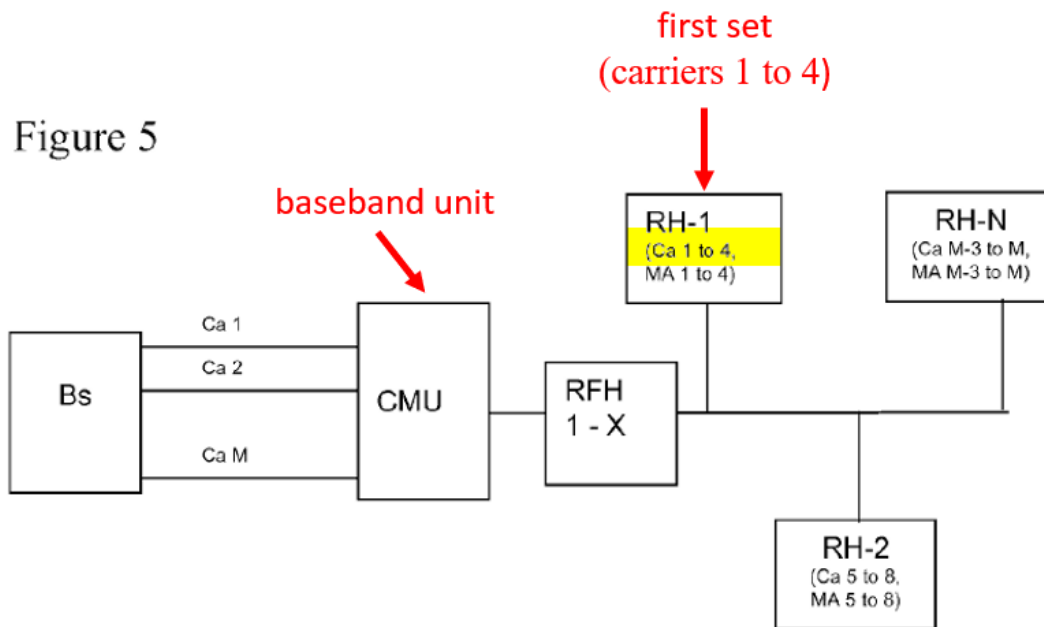
“wherein the baseband unit is configured to send a digital representation of a second set of radio resources to the first remote unit at a second point in time, the second set of radio resources for transmission at the antenna of the first remote unit”

Hettstedt teaches this limitation for the same reason as the prior limitation plus Hettstedt teaching that the CMU de-activates or activates carriers for each radio head as part of load balancing, which results in sending the recited *second set*. EX-1006 ¶¶0043-0045, ¶¶0028-0029; EX-1003 ¶¶217-224.

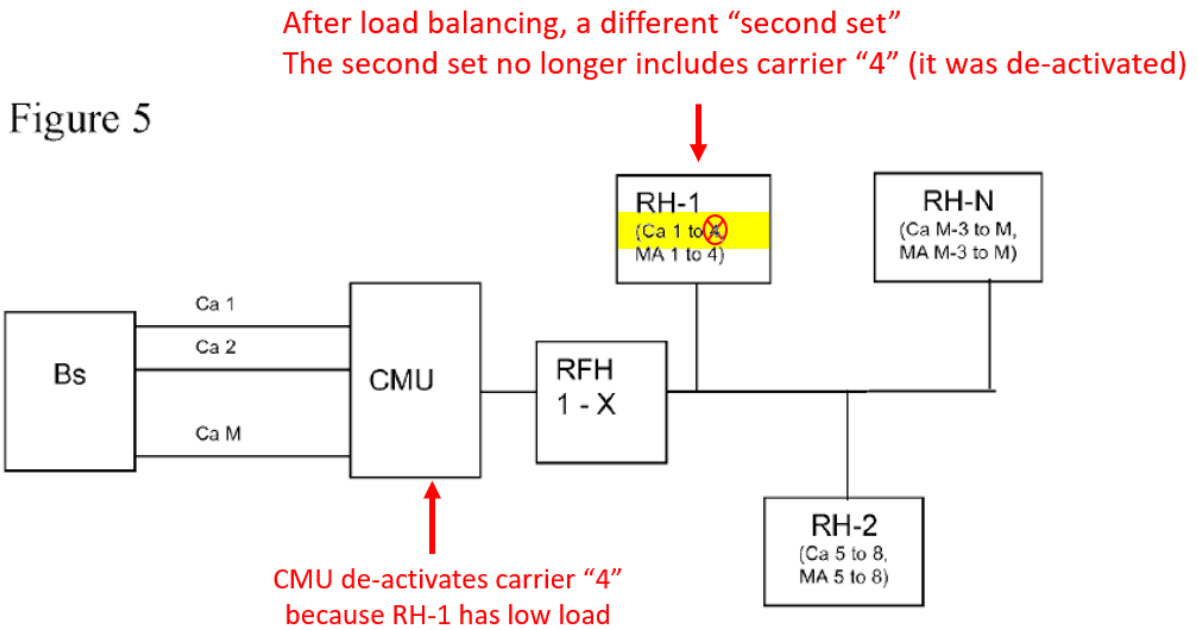
CMU is configured to perform load balancing comprising (1) “de-activation” of un-used carriers, (2) “shifting” these carriers “from radio where these carriers are not used for radio heads with high load on their active carriers,” and (3) “activation of the shifted carriers” at radio heads of “high loading.” EX-1006 ¶0044, ¶0029, claims 2-3. The actions of de-activating, shifting, and activating carrier changes the set of carriers at the radio heads and results in the recited “second set.” EX-1003 ¶218. After de-activating, shifting, and activating the carriers during load balancing, the CMU is now configured to send the second set of carriers to the radio head. EX-1003 ¶222. The “point in time” after each instance of load balancing at the same radio head can be considered the recited

“second” point in time. EX-1003 ¶221. Correspondingly, the sets of carriers at that radio head before and after the load balancing can be considered the recited “first” and “second” set of radio resources. *Id.*

Consider the example in Fig. 5. The starting configuration at RH-1 is a “first set”



Now apply Hettstedt’s teachings about load balancing. When the load is low on a carrier at RH-1, Hettstedt teaches to de-activate the carrier (e.g., carrier 4), which results in a *second set* (Carriers 1-3 compared to the first set of Carriers 1-4). EX-1006 ¶0029, ¶0044.



EX-1003 ¶219.

Hettstedt’s parallels the ‘499 patent disclosure. EX-1003 ¶224. The ‘499 patent teaches to change the assignment of radio resources (the *sets*) in response to the load. EX-1001 at 12:50-64. Hettstedt likewise teaches to shift the carriers for “load balancing.” EX-1006 ¶0044.

9. Element 1I

“wherein a number of radio resources in the first set of radio resources is different from a number of radio resources in the second set of radio resources”

When a carrier is de-activated or activated at a radio head during load balancing as explained in the prior limitation, the “number” of radio carriers in the set before the load balancing (the *first set*) becomes different from the number in

the set after the load balancing (the *second set*)—deactivating reduces the number and activating increase the number. EX-1003 ¶¶225-226.

The fact that each radio head is illustrated as having four carriers active in Figure 5 is merely an “example.” EX-1006 ¶0053; EX-1003 ¶228. The number of carriers at radio heads necessarily change when carriers are activated or de-activated. EX-1003 ¶¶226-227. The section for prior limitation, for example, illustrates that the number in the first set (four carrier) is different from the number in the second set (three carriers) after the de-activation. EX-1003 ¶227, ¶228 (other examples), ¶¶219-222.

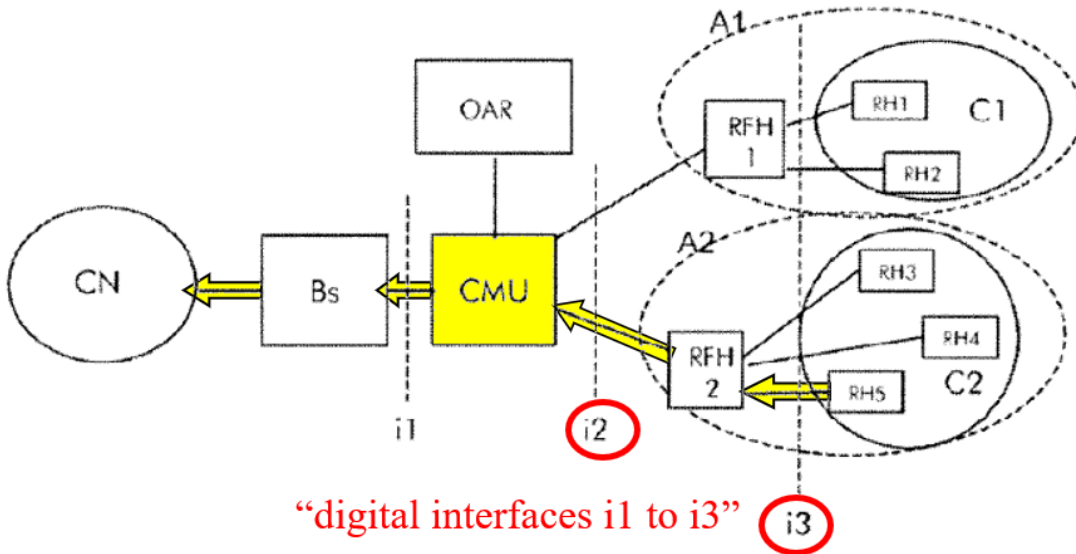
10. Element 1J

“wherein the baseband unit is configured to receive digital signals from each of the plurality of remote units.”

Hettstedt’s systems also operates in the “uplink” direction. EX-1006 ¶0041. In the uplink direction, the CMU (the *baseband unit*) is configured to receive signals from the radio heads for transport to the core network:

Figure 3

“In the uplink direction, radio signals ...are received by the remote radio heads RH1 to RH5 and sent to the core network CN”



EX-1006 ¶¶0041; EX-1003 ¶¶229-231. Specifically, over the i2 digital interface, the CMU is configured to receive digital packets containing radio signals received by the radio heads. EX-1006 ¶¶0040-0041 (explaining uplink operates “Similarly” to downlink where the downlink uses “digital packets”); ¶0039; EX-1003 ¶¶230-231. Digital packets containing radio signals received by the radio heads are “digital signals.” EX-1003 ¶230.

B. Independent Claim 8

Claim 8 tracks the language of claim 1 but with a different preamble that recites a “baseband controller,” which Ground 1 explains does appear to be a limitation because the body never refers to it. If it is a limitation, Hettstedt’s discloses it. EX-1003 ¶¶233-238. Hettstedt’s CMU not only comprises a

baseband unit for transporting wireless communication (see Ground 5), but also is the “controller” for the cell configuration, distribution of carriers, load balancing, and numerous other functions. EX-1006 ¶¶0043-0048, ¶0029; EX-1003 ¶236.

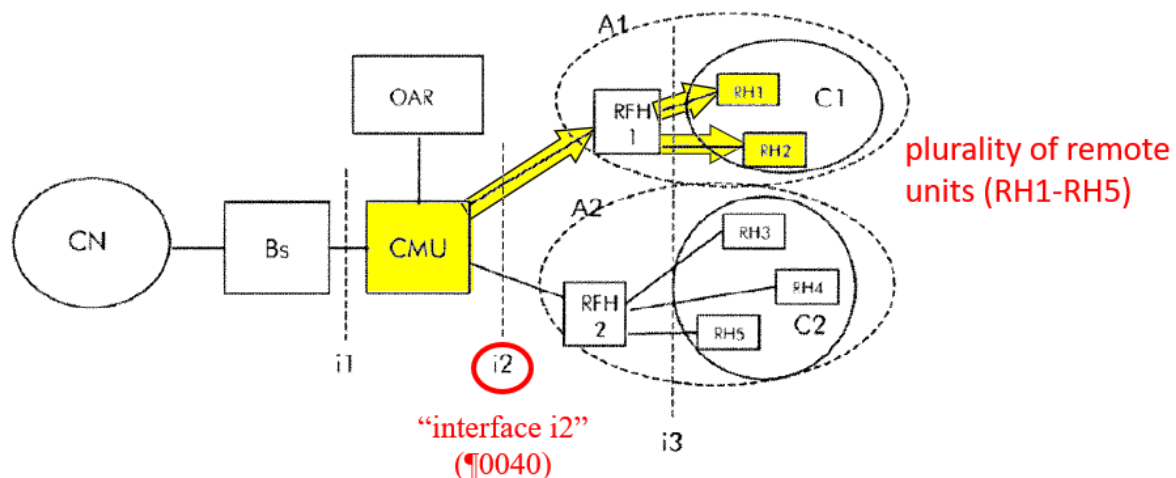
Element 8B is taught for the same reasons as Element 1E.

Element 8C recites: “at least one interface to communicatively couple the baseband unit to a plurality of remote units, including at least a first remote unit.”

Hettstedt teaches that the CMU comprises “interface i2” to indirectly couple the CMU (the *baseband unit*) to multiple remote radio heads, which discloses this.

EX-1006 ¶0040 (“second digital connection interface i2, e.g. an electrical or optical connection using Ethernet protocol”), ¶0039. Figure 3 is exemplary:

Figure 3



EX-1006 Fig. 3-6; EX-1003 ¶241.

Element 8D is taught for the same reasons as Element 1F.

Element 8E is taught for the same reasons as Element 1G.

Element 8F is taught for the same reasons as Element 1H.

Element 8G is taught for the same reasons as Element 1I.

Therefore, claim 8 is unpatentable for the same reasons as claim 1. EX-1003 ¶¶239-246.

C. Independent Claim 14

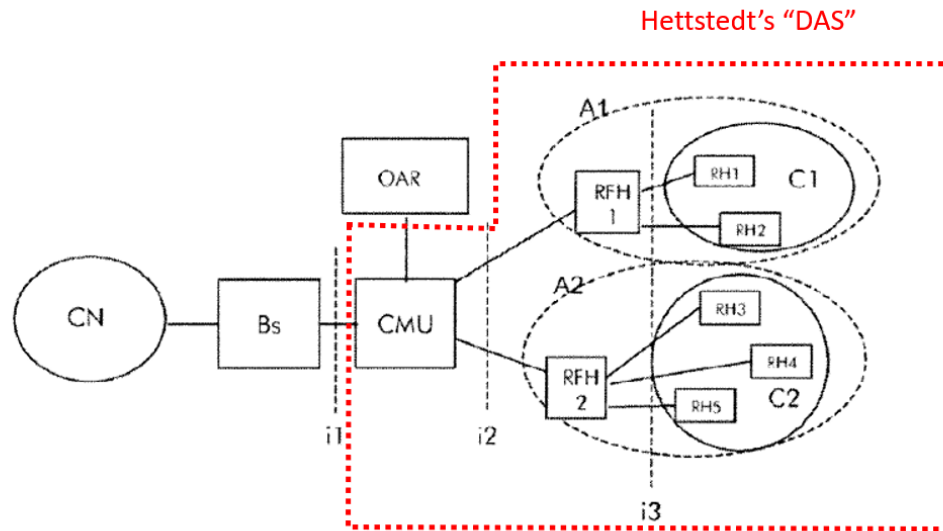
Claim 14 track claim 1 except written as a method. Using Hettstedt's systems results in performing the method of claim 14. Claim 14 does not include any limitation not already present in claim 1.

If the preamble recites a limitation (Element 14A), Hettstedt discloses it. EX-1003 ¶¶248-252. Hettstedt discloses a method that provides *digital signals* (Hettstedt's digital packets) in a *DAS* (Hettstedt's system of the CMU and RRHs).

EX-1006 ¶0008 ("a method"), ¶¶0039-0040 ("digital"); EX-1003 ¶251.

Hettstedt's system is a DAS because it includes a central unit (CMU) that transport base station signals from base station(s) to distributed remote units (RRHs) that extend the RF coverage of the base station by broadcasting "RF" signals into the desired areas (A1-A2):

Figure 3



EX-1006 at Fig. 3; EX-1003 ¶252.

Element 14B is taught for the same reasons as Element 1F.

Element 14C is taught for the same reasons as Element 1G.

Element 14D is taught for the same reasons as Element 1H.

Element 14E is taught for the same reasons as Element 1I.

Therefore, claim 14 is unpatentable for the same reasons as claim 1. EX-1003 ¶¶253-258.

D. Dependent Claims

1. Claims 2, 9, 19

“2. The system of claim 1 wherein the baseband unit is configured to packetize each digital representation of a radio resource.”

Hettstedt’s CMU (the *baseband unit*) is configured to package the carriers into “digital packets” such as “Ethernet packets.” EX-1006 ¶0040, ¶0053; EX-

1003 ¶¶260-263. “Packaging” carriers into “digital packets” is *packetizing*, i.e., forming packets. *Id.* ¶0028, ¶0040; EX-1003 ¶261. Hettstedt’s “digital” packets contain the carriers in “digital form,” which is an example of packetizing a “*digital representation of a radio resource*.” EX-1006 ¶0040; EX-1003 ¶¶262-263.

2. Claims 3, 10 and 15⁷

“3. The system of claim 1 wherein the digital representation of the first set of radio resources includes destination information identifying the first remote unit and the digital representation of the second set of radio resources includes destination information identifying the first remote unit.”

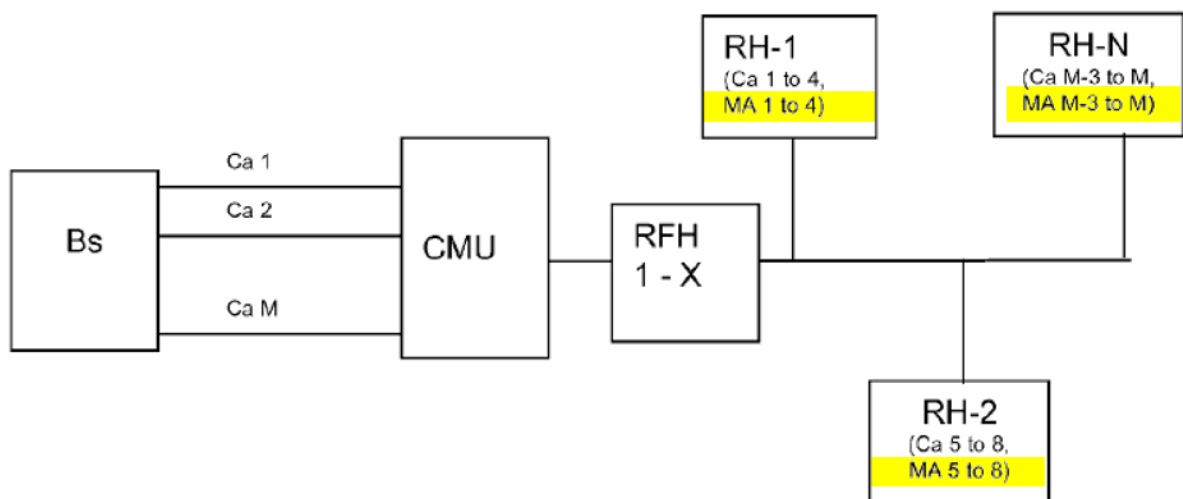
As already explained, Hettstedt’s distributes the sets of carriers (e.g., *first set*) by packaging the carriers into digital form into digital Ethernet packets.

Hettstedt teaches the digital Ethernet packets include “MAC addresses” that are “in” the packets, which discloses these claims. EX-1006 ¶0053, ¶0028, ¶¶0043-0045; EX-1003 ¶¶264-268. Hettstedt’s MAC addresses are “*destination*

⁷ See footnote 5. Resolving antecedent basis for “the second remote” is unnecessary: Hettstedt discloses it under any interpretation. Hettstedt identifies each “individual RRH” “through their MAC addresses” (which covers a first/second remote and first/second destination information). EX-1006 ¶0045, ¶0053, Fig. 5. A first/second remote may have the same set (e.g., when in the same cell). EX-1006 ¶0052.

information” for “*identifying*” each remote unit. EX-1003 ¶¶265-267. Hettstedt’s expressly teaches that they are the means through which the “individual radio heads” (the destinations) are “identified.” EX-1006 ¶0045. The CMU maps which carriers go to which radio heads using the MAC addresses. *Id.* Figure 5 is exemplary:

Figure 5



EX-1006. “MA” refers to “MAC address.” EX-1006 ¶0053. Patent Owner has acknowledged that Ethernet packets have “destination information.” EX-1024 at 48 (“*ethernet and IP protocols have destination information.*”).⁸

⁸ Ethernet uses a standard format defined by the IEEE 802.3 standard. EX-1003 ¶267. Per the standard, the format includes a “destination address” field. EX-1003 ¶267; EX-1043 at 30-31, 47-49; EX-1044 at 4.

3. Claims 4, 11, and 16:

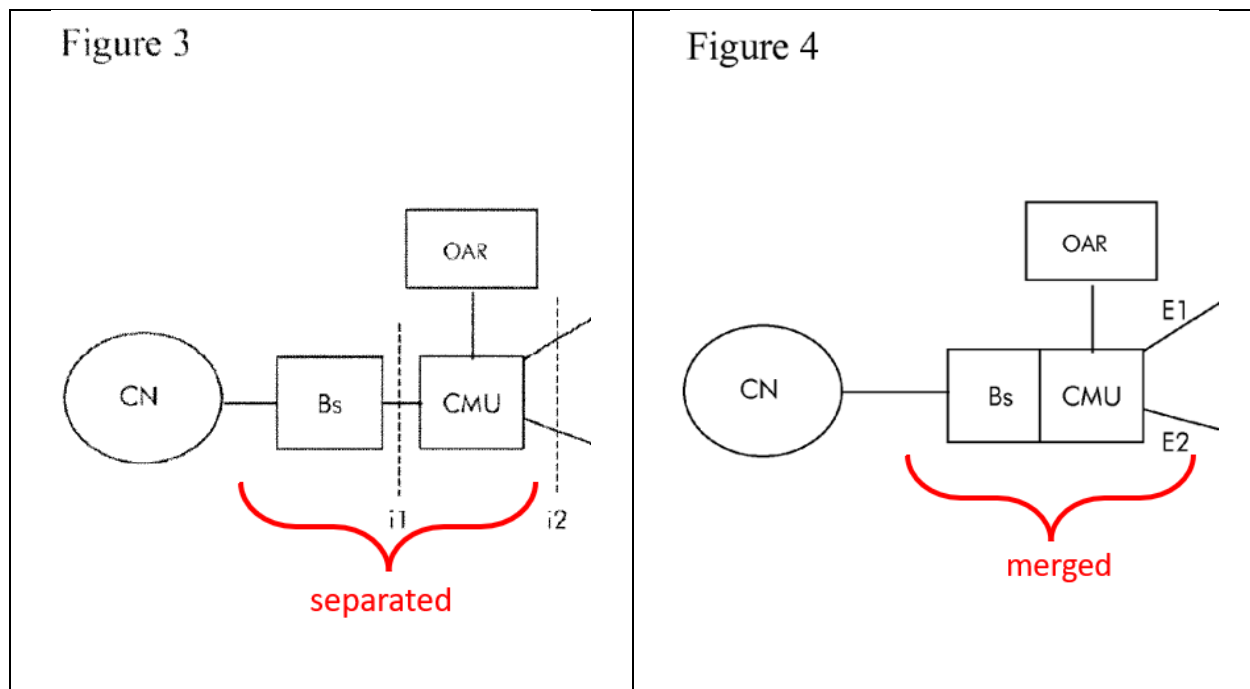
“4. The system of claim 1 wherein the first set of radio resources is a subset of the plurality of radio resources and includes at least some radio resources from the first signal source and at least some radio resources from the second signal source.

Hettstedt teaches that CMU has the functionality to “combine different base stations” with the RF hubs that distribute the packets to the radio heads, which discloses the limitations in these claims. EX-1006 ¶0042; EX-1003 ¶¶269-275. Ground 5, Element 1C explains that a base station is a “*signal source*.” When signals from any two base stations are combined as taught by Hettstedt, the resulting set of carriers has at least some carriers from the first base station (*first signal source*) and at least some carriers from the second base station (*second signal source*). EX-1003 ¶271, ¶¶274-275.

4. Claim 5:

“5. The system of claim 1 wherein the baseband unit and at least one of the plurality of signal sources are part of a baseband controller.”

Hettstedt teaches that CMU (the *baseband unit*) and base station (*signal source*) can be separated or merged, which discloses this claim. Compare Figure 3 and 4:



EX-1006 Figs. 3 and 4. The merged combination is a *baseband controller* for essentially the same reasons discussed above for the preamble of Claim (“A baseband controller....”). The merged combination, through the CMU, distributes the carriers at *baseband* (EX-1006 ¶0030) and *controls* the distribution of carriers, load balancing, and cell configuration. EX-1006 ¶0029, ¶¶0043-0045; EX-1003 ¶276.

5. Claims 13 and 18

“13. The baseband controller of claim 8 wherein the plurality of radio resources include a first composite signal from the first signal source and a second composite signal from the second signal source, and the baseband unit is configured to form the digital representation of the first set of radio resources from a first subset of the first composite signal and a second subset of the second composite signal.”

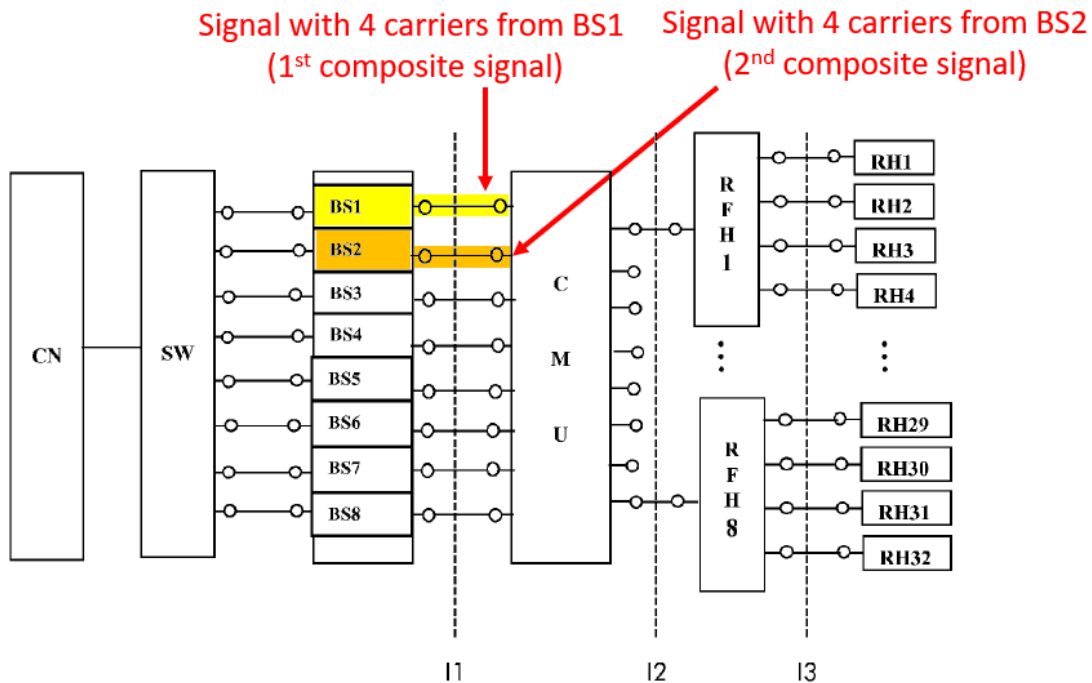
First, Hettstedt teaches the recited composite signals. EX-1003 ¶¶278-281.

The ‘499 patent specification explains that a “composite signal” refers to, inter alia, when a base station provides “more than one” carrier. EX-1001 at 5:53-59.

The disclosed example is where the DAU receives (1) “carriers A-D” from a first base station and (2) “carriers E-H” from a different base station—i.e., four carriers from each base station. EX-1001 at 5:59-6:2.

Hettstedt teaches that same example: “*Each* base station can provide *four carriers* at individual services.” EX-1006 ¶0054. Hettstedt gives the example of eight different base stations each providing four carriers for a total of 32 carriers. *Id.* Thus, Hettstedt teaches that the *plurality of radio resources* (e.g., the 32 carriers) include *a first composite signal from the first signal source* (the signal with four carriers from any of the eight base stations) and *a second composite signal from the second signal source* (the signal with four carriers from any of the other base stations). EX-1003 ¶280.

Figure 6



EX-1003 ¶280. Recall the i1 interface can use “CPRI.” EX-1006 ¶0040. When there are multiple carriers as in Hettstedt, CPRI explains that the carriers are multiplexed into a composite signal. EX-1003 ¶281.

Second, Hettstedt teaches to form the recited digital representation from the first and second composite signal. EX-1003 ¶¶282-285. The CMU (the *baseband unit*) packages the carriers in digital form into digital packets (i.e., *form the digital representation of the first set of radio sources*). See Ground 5, Element 1G; EX-1003 ¶283. As explained for Claim 4, the CMU has the functionality to “combine different base stations” when forming the packets. EX-1003 ¶¶284-285, ¶¶269-275. When the CMU combines different base stations, the carriers from the first base station are a *first subset of the first composite signal*, and the carriers from the

other different base station are a *second subset of the second composite signal*.

EX-1003 ¶285, ¶¶270-275.

Ground 6: Hettstedt plus Wu renders obvious claims 1-5, 8-11, 13-16, 18-19

A. Claims 1, 8, 14

If Patent Owner argues Hettstedt’s disclosure that the CMU activates/de-activates carriers when sending the digital packets of carriers to the radio heads is not sufficient to disclose that the CMU send different sets of carriers at different times where the sets have different number of carriers, then the combination of Hettstedt and Wu render this obvious (Elements 1G-1I, 8E-8G, 14C-14E). EX-1003 ¶¶294-298.

As explained in Ground 1, Wu discloses a baseband unit that sends the radio resources to the remote units in groups according to a routing policy that allocates more or fewer radio resources as desired. *See* Ground 1, Elements G-I; EX-1005 ¶0049, ¶0046. Wu implements the policy using standard memory and a standard processor. EX-1005 ¶0040. The routing policy comprises instruction stored in memory that can be executed by the processor to configure a switch to route the channels. *Id.*

A POSITA would have found it obvious to combine Hettstedt with Wu’s routing policy. EX-1003 ¶295. Hettstedt already teaches that the CMU may comprise any “mapping means” to map the carriers to the radio heads. EX-1006

¶0045. Wu’s routing policy is an example of mapping means. EX-1003 ¶295. It maps the radio resources to the remote units according to the rules/triggers defined in the policy. EX-1005 ¶¶0041-0047.

Motivation. A POSITA would have been motivated to make this modification to obtain “fine grained” control over the carriers, to preserve bandwidth over the links, and to make the system able to respond efficiently to changing conditions. EX-1005 ¶0005, ¶0009, ¶0011, ¶¶0041-0047; EX-1006 ¶0028; EX-1003 ¶295. This modification improves Hettstedt’s goal of “efficient load balancing” because, as taught by Wu, the routing policy can use link bandwidth more efficiently (i.e., delivering more or fewer resources only as needed) when executing automatic load balancing, which Hettstedt recognized as desirable. EX-1005 ¶¶0044-0045; EX-1006 Abstract, ¶0044, ¶0028; EX-1003 ¶296.

Reasonable expectation of success. A POSITA would have a reasonable expectation of success because this modification involves conventional components: a processor and memory. EX-1005 ¶0040; EX-1003 ¶297. Wu’s routing policy is merely programmatic instructions stored in conventional memory that cause a conventional processor to configure the switch. EX-1005 ¶0040. Hettstedt already discloses an intelligent switch. EX-1006 ¶0042. A POSITA

knows how program rules/triggers for a routing policy using well-known IF/THEN statements. EX-1003 ¶297.

On a second point, as mentioned above, Hettstedt CMU meets Patent Owner’s own representation of the meaning of “baseband unit.” EX-1029 at 25-28 (Section D); EX-1020 at 10. If Patent Owner were to change positions and argues the term “baseband unit” *further* requires the functionality to *convert* analog RF signals to baseband format, the same combination of Hettstedt and Wu also renders that obvious. EX-1003 ¶287.

Wu teaches to include conversion circuitry (downconverters and analog-to-digital converters) in unit 230 when communicating with an analog RF base station to convert the analog RF base station signals to baseband format before distribution at baseband. See Ground 1, Element 1B; EX-1003 ¶103. A POSITA would have found it obvious to modify Hettstedt’s CMU to include conversion circuitry. EX-1003 ¶289.

Motivation. A POSITA would have been motivated to make this modification to make Hettstedt’s system *compatible with an analog RF base station*. EX-1003 ¶290, ¶¶288-289. Relatedly, a POSITA would have been motivated to make Hettstedt’s system compatible to (1) *maximize deployment flexibility and (2) decrease cost*. EX-1003 ¶290. Without this modification, Hettstedt’s could only be narrowly deployed with digital base stations. *Id.* With

this modification, Hettstedt's system could be deployed with digital or analog base stations. *Id.* This is important because "current" solutions are "based on an analog RF connection to the base station.," i.e., there are many existing analog base stations. EX-1010 ¶¶0008; *see also* EX-1033 ¶¶0005. The modification also saves cost. EX-1003 ¶290. Without this modification, the installer would need to incur the cost of installing new digital base stations to replace the existing conventional analog RF base stations before Hettstedt's system can be deployed. *Id.* With this modification, no such costs are necessary because the CMU would be compatible with existing analog RF base stations. *Id.* Hettstedt and the background art corroborate these motivations. EX-1003 ¶¶291-292.

Reasonable expectation of success. A POSITA would have a reasonable expectation of success because this modification involves well-known standard components, e.g., an analog-to-digital converter (ADC).⁹ EX-1003 ¶293. The background art corroborates this. EX-1003 ¶293; EX-1026 at 5:10-14, 10:37-44.

⁹ Downconverters to shift analog signals to baseband are also well known, standard components. EX-1034 at 3:22-40.

B. Dependent Claims 4, 11, 16

These claims recite a limitation about the subset sent to remote units including “*at least some radio resources from the first signal source and at least some radio resources from the second signal source.*”

Hettstedt teaches to “combine different base stations.” EX-1006 ¶0042. If this is insufficient, a POSITA would have found this limitation obvious in view of Wu. EX-1003 ¶301. Wu teaches that the routing policy allow the radio resources to be routed “individually, collectively as shown, or in arbitrary groups”—arbitrary groups covers where the groups comprise some radio resources from the first and second signal source. EX-1005 ¶0049; EX-1003 ¶301.

Motivation. A POSITA would have been motivated to make this modification to enable base stations *to share radio heads* by having the CMU send both their carriers to the same radio head, which *saves cost and avoid installing duplicate radio heads for each base station*. EX-1003 ¶302. The background art corroborates that it was advantageous to share infrastructure equipment. EX-1003 ¶303. The need to share arises, for example, where the same operator has multiple base stations, and the operator desires the efficiency of re-using radio heads for its base stations. EX-1003 ¶302. Hettstedt example where there are eight base stations naturally implicates that scenario. *Id.*

Reasonable expectation of success. A POSITA would have a reasonable expectation of success for the same reasons discussed for Wu’s routing policy in the independent claims. EX-1003 ¶297.

Hettstedt supports this modification by teaching the CMU should provide for “a *broad scope of complex scenarios of operation*” with “*multi-carrier, multi-service and multi-operator function.*” EX-1006 ¶0027. This broad scope covers allocating signals from multiple signals sources to the same radio head. EX-1003 ¶304.

C. Dependent Claim 5

This claim recites: “*wherein the baseband unit and at least one of the plurality of signal sources are part of a baseband controller.*” Hettstedt illustrates merging the CMU (*baseband unit*) and base station (*signal source*). See Ground 5, Claim 5. If Patent Owner argues that is insufficient, Wu expressly teaches the baseband unit and signal source can be part of the same unit. See Ground 1 at Claim 5. A POSITA would have found it obvious that Hettstedt CMU and base station can be part of the same unit. EX-1003 ¶¶306-308.

Motivation & reasonable expectation of success. The petition already discusses the well-known motivations, reasonable expectation of success, and supporting case law for placing components with the same unit. See Ground 2; EX-1003 ¶307, ¶¶166-168. That same reasoning applies here.

D. Dependent Claims 13 and 18

These claims recite two limitations (a) the signals sources providing first and second “composite signals” and (b) the baseband unit forms the first set from subsets from these composite signals.

As explained in Ground 5, Hettstedt discloses that (a) plural base stations (*first and second signal source*) each provide a signal comprising four carriers (*first and second composite signals*) and the (b) CMU packages the carriers into digital packets (*form the digital representation of the first set of radio sources*) and can combine the carriers (the *recited first and second subset*) from the different base station signals (the recited *first and second composite signals*).

If Patent Owner argues that is insufficient, Wu provides further disclosure.

As to the first limitation, Wu teaches base stations provide multiple carrier channels in the form of a composite signal. See Ground 1 at claims 13, 18. A POSITA would have found it obvious that Hettstedt’s base stations would provide their four carriers in the form of a composite signal. EX-1003 ¶311.

Motivation. A POSITA would have been motivated to make this combination to reduce the numbers of cables/connectors needed for each base stations, which reduces costs and makes installation easier. EX-1003 ¶312. When carriers are multiplexed together in a composite signal, the base station only

requires one cable/connection to deliver the carriers compared to a separate cable/connection for each carrier. *Id.*

Reasonable expectation of success. A POSITA would have reasonable expectation of success because it was well-known how to combine carriers together for transport over a cable (e.g., multiplexing). EX-1003 ¶313; EX-1007 at 34 (explaining how multiplex multiple CPRI carriers into a frame); EX-1034 at 5:66-6:46 (explaining a method that “multiplexes or combines the separate bandwidth segments (A, B, C, D)...”).

As to the second limitation, Wu teaches that its routing policy allow the radio resources to be routed “in arbitrary groups,” which covers the recited subsets from the first and second composite signal. EX-1005 ¶0049. Ground 6, Section A already discusses the motivation and reasonable expectation of success for adding this feature to Hettstedt.

E. Dependent Claims 2-3, 9-10, 15, 19

Ground 5 shows Hettstedt discloses the limitations; no further combination is needed beyond the independent claims already discussed.

Ground 7: Hettstedt plus Sabat-552 renders obvious claims 6-7, 12, 17

For the same reasons, motivations, and expectation of success addressed above with respect to Ground 3, it would have been obvious to provide a cable interface from one of Hettstedt’s CMUs (*baseband unit*) to additional CMUs

(*additional baseband units*) both by direct connection and by indirect connection as taught by Sabat-552 (EX-1011) to enable different base stations coupled to different CMUs to deliver their radio resources to additional radio heads, reducing the need to duplicate radio heads and cabling as well as reducing costs by facilitating sharing radio heads among different operators. Ex-1003 ¶316, ¶¶171-176.

Conclusion

There is at least a reasonable likelihood claims 1-19 are invalid.

Respectfully submitted,

Dated: April 10, 2023

By: /Samuel A. Hamer/
Samuel A. Hamer, Reg. No. 46,754
Capella Tower, Suite 4200
225 South Sixth Street
Minneapolis, MN 55402
shamer@carlsoncaspers.com
Phone: 612.436.9615
Fax: 612.436.9605

Claims Listing Appendix

U.S. Patent No. 10,334,499

Claims 1-19

Designation	Claim 1
Element 1A	1. A system for transporting wireless communications, comprising:
Element 1B	a baseband unit;
Element 1C	a plurality of signal sources, including at least a first signal source and a second signal source;
Element 1D	a plurality of remote units, including at least a first remote unit and a second remote unit;
Element 1E	wherein the baseband unit comprises a plurality of interfaces to communicatively couple the baseband unit to the plurality of signal sources;
Element 1F	wherein the baseband unit is configured to receive a plurality of radio resources from the first signal source and the second signal source;
Element 1G	wherein the baseband unit is configured to send a digital representation of a first set of radio resources to the first remote unit at a first point in time, the first set of radio resources for transmission at an antenna of the first remote unit;
Element 1H	wherein the baseband unit is configured to send a digital representation of a second set of radio resources to the first remote unit at a second point in time, the second set of radio resources for transmission at the antenna of the first remote unit;
Element 1I	wherein a number of radio resources in the first set of radio resources is different from a number of radio resources in the second set of radio resources;
Element 1J	and wherein the baseband unit is configured to receive digital signals from each of the plurality of remote units.

Claim 2	2. The system of claim 1 wherein the baseband unit is configured to packetize each digital representation of a radio resource.
Claim 3	3. The system of claim 1 wherein the digital representation of the first set of radio resources includes destination information identifying the first remote unit and the digital representation of the second set of radio resources includes destination information identifying the first remote unit.
Claim 4	4. The system of claim 1 wherein the first set of radio resources is a subset of the plurality of radio resources and includes at least some radio resources from the first signal source and at least some radio resources from the second signal source.
Claim 5	5. The system of claim 1 wherein the baseband unit and at least one of the plurality of signal sources are part of a baseband controller.
Claim 6	6. The system of claim 1 wherein the baseband unit further comprises at least one interface to communicatively couple the baseband unit to one or more additional baseband units.
Claim 7	7. The system of claim 6 wherein the one or more additional baseband units includes a plurality of additional baseband units, and the baseband unit is connected to at least a first one of the plurality of additional baseband units through a direct connection and at least a second one of the plurality of additional baseband units through an indirect connection.

Designation	Claim 8
Element 8A	8. A baseband controller for use in the transport of wireless communications, comprising:
Element 8B	a plurality of interfaces to communicatively couple a baseband unit to a plurality of signal sources, including at least a first signal source and a second signal source;
Element 8C	at least one interface to communicatively couple the baseband unit to a plurality of remote units, including at least a first remote unit;

Element 8D	wherein the baseband unit is configured to receive a plurality of radio resources from the first signal source and the second signal source;
Element 8E	wherein the baseband unit is configured to send digital representations of a first set of radio resources to the first remote unit at a first point in time, the first set of radio resources for transmission at an antenna of the first remote unit;
Element 8F	wherein the baseband unit is configured to send digital representations of a second set of radio resources to the first remote unit at a second point in time, the second set of radio resources for transmission at the antenna of the first remote unit; and
Element 8G	wherein a number of radio resources in the first set of radio resources is different from a number of radio resources in the second set of radio resources.
Claim 9	9. The baseband controller of claim 8 wherein the baseband unit is configured to packetize each digital representation of a radio resource.
Claim 10	10. The baseband controller of claim 8 wherein the digital representation of the first set of radio resources includes destination information identifying the first remote unit and the digital representation of the second set of radio resources includes destination information identifying the first remote unit.
Claim 11	11. The baseband controller of claim 8 wherein the first set of radio resources is a subset of the plurality of radio resources and includes at least some radio resources from the first signal source and at least some radio resources from the second signal source.
Claim 12	12. The baseband controller of claim 8 wherein the baseband unit further comprises at least one interface to communicatively couple the baseband unit to one or more additional baseband units.
Claim 13	13. The baseband controller of claim 8 wherein the plurality of radio resources include a first composite signal from the first signal source and a second composite signal from the second signal source, and the

	baseband unit is configured to form the digital representation of the first set of radio resources from a first subset of the first composite signal and a second subset of the second composite signal.
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Designation	Claim 14
Element 14A	14. A method for providing digital signals in a Distributed Antenna System (DAS), comprising:
Element 14B	receiving at a baseband unit, from a plurality of signal sources including at least a first signal source and a second signal source, a plurality of radio resources;
Element 14C	transmitting from the baseband unit, at a first point in time, a digital representation of a first set of radio resources to a first remote unit, the first set of radio resources for transmission at an antenna of the first remote unit;
Element 14D	transmitting from the baseband unit, at a second point in time, a digital representation of a second set of radio resources to the first remote unit, the second set of radio resources for transmission at the antenna of the first remote unit;
Element 14E	wherein a number of radio resources in the first set of radio resources is different from a number of radio resources in the second set of radio resources.
Claim 15	15. The method of claim 14 wherein the digital representation of the first set of radio resources includes destination information identifying the first remote unit and the digital representation of the second set of radio resources includes destination information identifying the second remote unit.
Claim 16	16. The method of claim 14 wherein the first set of radio resources is a subset of the plurality of radio resources and includes at least some radio resources from the first signal source and at least some radio resources from the second signal source.

Claim 17	17. The method of claim 14 further comprising receiving at the baseband unit, from at least one additional baseband unit, a second plurality of radio resources.
Claim 18	18. The method of claim 14 wherein the plurality of radio resources include a first composite signal from the first signal source and a second composite signal from the second signal source, the method further comprising forming, at the baseband unit, the digital representation of the first set of radio resources from a first subset of the first composite signal and a second subset of the second composite signal.
Claim 19	19. The method of claim 14 further comprising packetizing, at the baseband unit, at least a subset of the plurality of radio resources.

Exhibit List Appendix

Exhibit No.	Exhibit Description
1001	U.S. Patent No. 10,334,499
1002	Prosecution History of U.S. Patent No. 10,334,499
1003	Declaration of Dr. Anthony Acampora as filed originally in IPR2022-01293
1004	<i>Curriculum Vitae</i> of Dr. Anthony Acampora as filed originally in IPR2022-01293
1005	U.S. Patent Application Publication No. 2010/0128676 A1 to Wu (“Wu”)
1006	U.S. Patent Application Publication No. 2008/0119198 A1 to Hettstedt (“Hettstedt”)
1007	Common Public Radio Interface (CPRI) Specification version 4.0 (2008-06-30)
1008	OBSAI “Reference Point 3 Specification Version 3.1” (November 13, 2006)
1009	OBSAI “BTS System Reference Document Version 2.0” (April 27, 2006)
1010	U.S. Patent Application Pub. No. 2009/0180426 A1 to Sabat et al. (“Sabat-426”)
1011	U.S. Patent No. 6,963,552 B2 to Sabat et al. (“Sabat-552”)
1012	U.S. Patent No. 10,080,178 (“the ‘178 patent”)
1013	IPR2020-01473 Institution Decision (‘178 patent IPR)
1014	IPR2020-01473 Judgment (‘178 patent IPR)
1015	IPR2020-01473 Petition (‘178 patent IPR)
1016	U.S. Patent No. 9,531,473 (“the ‘473 patent”)
1017	IPR2018-00571 Final Written Decision (‘473 patent IPR)
1018	Declaration of Dr. Peter Kenington as originally filed in IPR2022-01293
1019	Interim Procedure for Discretionary Denials in AIA Postgrant Proceedings with Parallel District Court Litigation
1020	Memorandum Opinion re Claim Construction, <i>Dali Wireless, Inc. v. Johm Mezzalingua Associates LLC</i> , No. 19-2367-RGA (D. Del., Mar. 11, 2021).
1021	Provisional patent application number 61/439,940
1022	U.S. Patent Application Pub. No. 2006/0094470 (“Wake”)
1023	Complaint in Civil Action No. 2:22-cv-00012-RWS-RSP (E.D. Tex.)

1024	Preliminary infringement contentions by Patent Owner (Dali) in Civil Action No. 6:22-CV-00104-ADA (W.D. Tex.)
1025	Intentionally Blank
1026	U.S. Patent No. 7,286,507 (“Oh”)
1027	Patent Owner’s preliminary response in IPR2020-01466
1028	Memorandum Opinion re Claim Construction, <i>Dali Wireless, Inc. v. Johm Mezzalingua Associates LLC</i> , No. 19-2367-RGA (D. Del., Mar. 11, 2021).
1029	Patent Owner’s Preliminary response in IPR2020-01430
1030	U.S. Patent Number 6,785,558 (“Stratford”)
1031	U.S. Patent Number 8,737,454 (“Wala”)
1032	U.S. Patent Number 8,346,091 (“Kummetz”)
1033	U.S. Patent Publication No. 2010/0296816 (“Larsen”).
1034	U.S. Patent Number 7,848,747 (“Wala-747”)
1035	U.S. Patent Number 8,204,544 (“Beaudin”)
1036	U.S. Patent Publication No. 2005/0157675 (“Feder”)
1037	Prosecution History of U.S. Patent No. 10,080,178
1038	Patent Owner’s preliminary response in IPR2020-01473
1039	Patent Owner’s power of attorney in IPR2020-01473
1040	ECF 174 in <i>Dali Wireless, Inc. v. CommScope Technologies LLC, et al.</i> , Case No. 1:19-cv-00952-MN (Attachment to Stipulation of dismissal of Certain Claims)
1041	Final Written Decision in IPR2018-01178
1042	U.S. Patent Application Publication No. 2007/0177552 A1
1043	<i>Ethernet The Definitive Guide</i> , Spurgeon, (O'Reilly & Associates, Inc. 2000), Chapters 1-6.
1044	<i>Hargraves Communications Dictionary</i> , Hargrave, F., IEEE Press p. 169
1045	Intentionally Blank
1046	Complaint in <i>Dali Wireless, Inc. v. T-Mobile US, Inc., et al.</i> , Case No. 2:22-cv-414-RWS-RSP (E.D. Tex.)
1047	Complaint in <i>Dali Wireless, Inc. v. AT&T Corp., et al.</i> , Case No. 2:22-cv-00012-RWS-RSP (E.D. Tex.)
1048	PACER Docket in Civil Action No. 2:22-cv-414 (E.D. Tex.) as of Jan. 20, 2023
1049	Complaint in <i>Dali Wireless, Inc. v. Cellco P’ship, et al.</i> , Case No. 6:22-cv-104-ADA (W.D. Tex.)
1050	U.S. District Courts Statistics as of June 30, 2022
1051	Notice of ECF Case Transfer to E.D. Tex. of Civil Action No. 6:22-cv-104-ADA

1052	ECF 95 in <i>Dali Wireless, Inc. v. Cellco P'ship, et al.</i> , Case No. 6:22-cv-104-ADA (Order Severing Cases and Transferring Case Against CommScope and Verizon to the Eastern District of Texas)
1053	ECF 92 in <i>Dali Wireless, Inc. v. Cellco P'ship, et al.</i> , Case No. 6:22-cv-104-ADA (Agreed Joint Motion to Transfer Severed Action to the Eastern District of Texas)
1054	ECF 79 in <i>Dali Wireless, Inc. v. AT&T Corp., et al.</i> . Case No. 2:22-cv-00012-RWS-RSP (Stipulation Regarding Narrowing of Issues)
1055	ECF 94 in <i>Dali Wireless, Inc. v. AT&T Corp., et al.</i> . Case No. 2:22-cv-00012-RWS-RSP (Order)
1056	ECF 22 in <i>Dali Wireless, Inc. v. Cellco P'ship, et al.</i> , Case No. 6:22-cv-1314-ADA (W.D. Tex.) (Joint Stipulation of Dismissal with Prejudice)
1057	Standing Order Governing Proceedings (OGP) 1.2—Patent Cases (W.D. Tex. Waco)
1058	Correspondence Re: <i>Dali Wireless, Inc. v. Cellco P'ship, et al.</i> , Case No. 2:23-cv-0002 (E.D. Tex.)
1059	Claim Construction Order in <i>Dali Wireless, Inc. v. Cellco P'ship, et al.</i> , Case No. 6:22-cv-1313-ADA (W.D. Tex.)

CERTIFICATION UNDER 37 CFR § 42.24(d)

Under the provisions of 37 CFR § 42.24(d), the undersigned hereby certifies that the word count for the foregoing Petition for *Inter Partes* Review totals 13,430 words per Microsoft Word word count tool, which complies with requirement of 14,000 words allowed under 37 CFR § 42.24(a)(i).

Dated: April 10, 2023

By: /Samuel A. Hamer/
Samuel A. Hamer, Reg. No. 46,754
Capella Tower, Suite 4200
225 South Sixth Street
Minneapolis, MN 55402
shamer@carlsoncaspers.com
Phone: 612.436.9615
Fax: 612.436.9605

CERTIFICATE OF SERVICE

Pursuant to 37 CFR §§ 42.6(e)(4)(i) *et seq.* and 42.105(b), the undersigned certifies that on April 10, 2023 a complete and entire copy of this PETITION FOR INTER PARTES REVIEW OF UNITED STATES PATENT NO. 10,334,499 PURSUANT TO 35 U.S.C. §§ 311–319, 37 C.F.R. § 42, Motion for Joinder, Power of Attorney, and all supporting exhibits were provided by Federal Express, to the Patent Owner by serving the correspondence address of record as follows:

Artegis Law Group, LLP
John Carey
7710 Cherry Park Drive Suite T #104
Houston TX 77095

Dated: April 10, 2023

By: /Samuel A. Hamer/
Samuel A. Hamer, Reg. No. 46,754
Capella Tower, Suite 4200
225 South Sixth Street
Minneapolis, MN 55402
shamer@carlsoncaspers.com
Phone: 612.436.9615
Fax: 612.436.9605