

Paper No. ____

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

COMMSCOPE TECHNOLOGIES LLC.
Petitioner

v.

DALI WIRELESS, INC.
Patent Owner

Case IPR _____
U.S. Patent No. 10,750,382
Issued: August 18, 2020
Filed: October 23, 2019

PETITION FOR *INTER PARTES* REVIEW OF U.S. PAT. NO. 10,750,382
UNDER 35 U.S.C. §§ 311-319 AND 37 C.F.R. § 41.100 ET SEQ.

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MANDATORY NOTICES

A. Real Parties-in-Interest

CommScope Technologies LLC, CommScope, Inc. of North Carolina, CommScope, Inc, and CommScope Holding Company, Inc. are the real parties-in-interest.

Based on current law and information available at this time, it is not clear to Petitioner that there are any other real parties-in-interest. Petitioner notes the following. Customer T-Mobile USA, Inc. and T-Mobile US, Inc. are named defendants in the Related Matters identified below. No entity, however, other than CommScope (the listed real-parties-in-interest) is funding, controlling, or otherwise had an opportunity to provide input regarding this Petition; no entity other than CommScope will fund, control, or otherwise have an opportunity to provide input regarding any resulting IPR trial; no entity other than CommScope has reviewed this Petition.

B. Related Matters

The challenged patent was asserted against Petitioner and others in a complaint in *Dali Wireless, Inc. v. T-Mobile US, Inc. et al*, Case No. 2:22-cv-00414 (E.D. Texas), which was served on Petitioner on October 25, 2022. A petition for IPR was filed by a third party against the challenged patent in *Ericsson Inc. v. Dali Wireless, Inc.*, IPR2023-00795 (PTAB).

C. Lead and Back-Up Counsel

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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 '382 Patent; Petitioner is not barred or estopped.

B. Identification of Challenge

Petitioner requests invalidation of claims 1-19.

	claims	Basis for Unpatentability
Ground 1	1-19	Anticipation (102) based on Stapleton
Ground 2	1-19	Obvious (103) based on Stapleton alone or in combination with Kummetz-464
Ground 3	1-2, 4-6, 8-17 and 19	Anticipation (102) based on Kummetz-464
Ground 4	1-19	Obvious (103) based on Kummetz-464 alone or in combination with Wu
Ground 5	7	Obvious (103) based on Kummetz-464 alone or in combination with Kummetz-579

C. Supporting Declaration

Petitioner submits a declaration from Dr. Acampora (EX1003)

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

Patent No. 10,750,382 (“the ‘382 patent”) discloses a digital distributed antenna system that assigns radio resources to remote antenna units of the DAS based on analysis of metrics called key performance indicators (KPIs). But the Stapleton and Kummets-464 references already disclosed that concept and anticipate the claims of the ‘382 patent.

Patent Owner (“PO”) did not act to have the highly material Stapleton reference properly considered during prosecution. PO only belatedly listed Stapleton on a non-compliant IDS after the claims were already allowed. The examiner stated on the record that he would not consider any of the belated references. Rather than file a request for continued examination to allow the examiner time to consider the references, PO allowed the claims to issue without consideration of any of the late-filed references, including Stapleton.

Kummets-464 references was also not considered during prosecution. Moreover, in an IPR of a parent patent (10,506,454), the Board granted institution on very similar claims based on Kummets-464, but ultimately did not find those claims unpatentable because they required reconfiguring the system based on not only KPIs, but also based on QoS. Here, however, PO broadened the ‘382 patent claim to make QoS optional. Independent claims 1 and 10 only require reconfiguring the system based on KPIs “and/or” QoS. Thus, PO removed the

only limitation that prevented a finding of invalidity. Therefore, this petition presents a compelling case of invalidity.

THE '382 PATENT

A. Overview

The '382 patent, titled “Optimization of Traffic Load in a Distributed Antenna System,” describes a system for routing radio resources in a Distributed Antenna System (DAS). EX1001, page 1, 1:21-25, 1:49-51. The system uses the conventional components of a DAS, specifically, a host unit (called a “DAU”) that distributes signals from base stations (BTSs) to remote antenna units (called “DRUs”) throughout the desired coverage areas. See, e.g., Fig. 1.

The '382 patent addresses the problem of using a DAS in venues in which the wireless subscribers move and congregate in different areas at different times. EX1003, ¶¶44-55; EX1001 at 1:31-48. To solve this problem, the disclosed system reconfigures the capacity by allocating different radio resources (e.g., carriers) for use at different remote antenna units based on measurements of key performance indicators such as traffic loads within the system. EX1001, 4:47-61; 5:58-65; EX1003, ¶¶50-55. The disclosed system includes a traffic monitoring unit that “tracks the traffic load at each DAU in the network” and an optimization unit that “calculates the overall DAS network performance and determines the optimum reconfigured network to improve or maximize performance” by

reallocating radio resources to different sets of DRUs. EX1001, 7:15-27; 4:47-61; 10:62-11:25; EX1003, ¶¶47-55.

B. The Claims

The two independent claims (1, 10) recite substantially the same limitations, except that claim 10 adds a limitation that the traffic monitoring unit be “external to” at least one of the DAUs which is not required for claim 1. EX1003, ¶56. The Claims Appendix lists the text of each of the claims and labels each element (1A, 1B, 1C, etc.) for ease of reference.

C. Prosecution History

Neither Stapleton nor Kummetz-464 were considered during prosecution. EX1002. After the examiner had allowed the claims, the PO listed Stapleton on a non-compliant IDS. EX-1002, 163-167. The examiner stated that he would not consider the references filed after allowance because the applicant did not comply with 37 CFR 1.97(e) that requires a specific statement about how or when the applicant became aware of the references. EX1002, 338. Instead of requesting continued prosecution to have the references considered, the PO let the claims issue without having these references considered.

Stapleton is not cumulative of any considered reference. Although portions of Stapleton overlap with the Lee reference (US2013/0128810), importantly, the Stapleton reference has a much earlier publication date (Feb. 2012) which predates

the provisional application date to which the '382 patent claims priority.

Therefore, the Stapleton reference asserted herein is prior art not only under 102(e) but also under 102(a) as a printed publication before the date of invention. Thus, Stapleton can be used in obviousness rejections. This is important because the PO responded to rejections based on Lee during prosecution of the parent '454 patent by asserting that Lee could not be used to render the claims obvious due to the carve out in 103(c)(1) for references that are only prior art under 102(e). EX1022, 457-458. The examiner relied on this argument when allowing the '454 patent claims. EX1022, 406 (withdrawing rejection based on argument), 159 (reasons for allowance citing response made on 7/5/2016). That is not true for Stapleton. Stapleton is prior art also under 102(a) and, therefore, can be used in obviousness grounds.

D. Prior IPR on parent '454 patent

The parent to the '382 patent, U.S. Patent No. 10,506,454 (the '454 patent), was the subject of IPR2021-00408. EX1014 (Institution Decision), EX1015 (Final Written Decision). The claims of the '454 patent are very similar to the claims of the '382 patent (see EX1003, ¶62). Two differences are notable. First, PO replaced the term "sector" with the phrase "radio resource." Id. Second, the '454 patent claim 1 requires the traffic monitoring unit to reconfigure the system based on *both* of two recited characteristics of network traffic, i.e., (1) key performance

indicator (KPI) “**and**” (2) quality of service (QoS). Id. By contrast, the ‘382 patent claim 1 requires reconfiguring based on only one of the two recited characteristics, i.e., based on (1) a key performance indicator (KPI) “and/**or**” (2) a quality of service (QoS).¹ EX1001, 18:22, 19:6; EX1003, ¶¶62-67.

That the ‘454 patent requires determination of both a KPI and a QoS was important to the PTAB’s final written decision (FWD) in the IPR on ‘454 patent. In the ‘454 IPR, the PTAB found that, although Kummetz-464 did disclose determining a KPI, the Petitioner had failed to establish that Kummetz-464 also disclosed determining a “QoS”. That was the sole basis for the PTAB’s decision not to invalidate the ‘454 claims in light of Kummetz-464. EX1015, 25. However, that “QoS” limitation is not a requirement of the claims of the ‘382 patent.

PRIOR ART

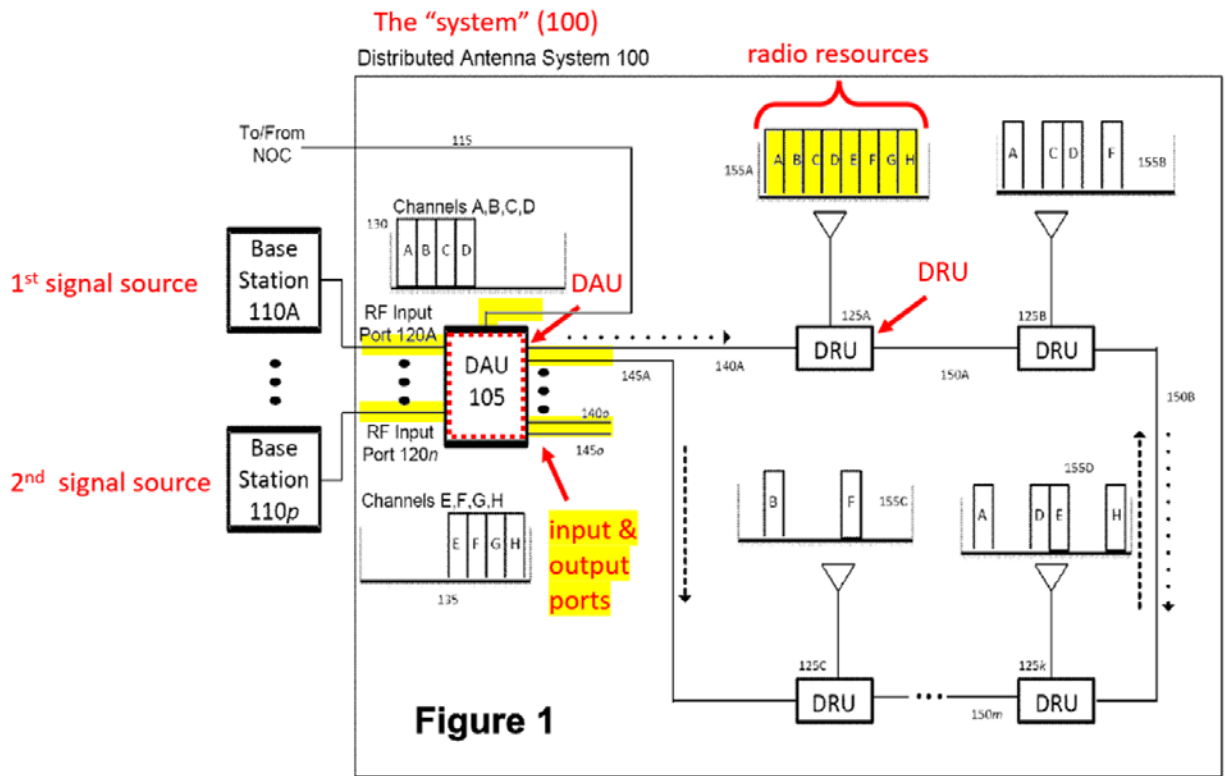
A. Primary References

1. “Stapleton”: U.S. Patent App. Pub. No. 2012/0039254

Stapleton (EX1001) is a printed publication published February 16, 2012 from a patent application filed August 16, 2011, and is prior art to the ‘382 patent at least under both 102(a) and 102(e).

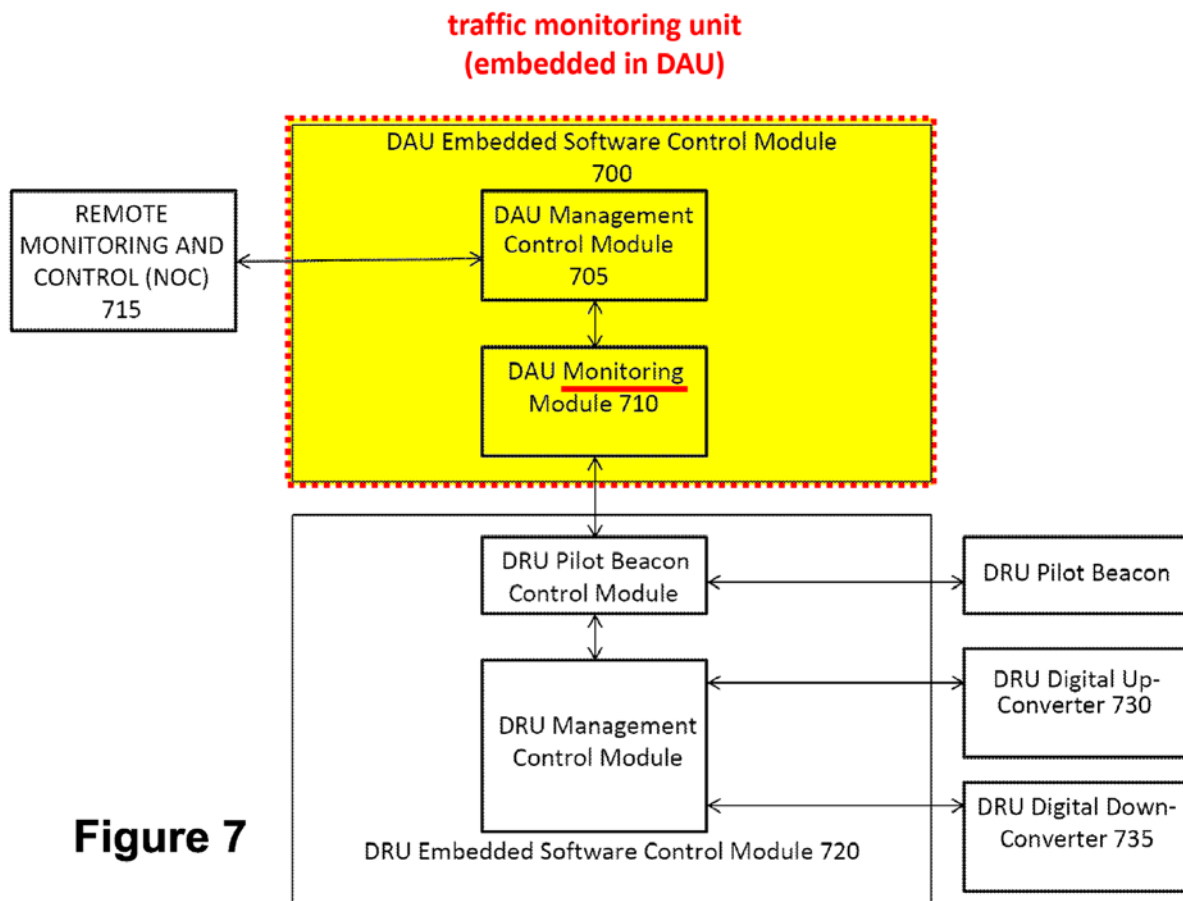
Stapleton discloses a reconfigurable distributed antenna system (DAS). EX1006, ¶28, Fig. 1 (below).

¹ All annotations, emphasis, and highlighting added unless otherwise noted.



The Stapleton DAS (100) comprises a digital access unit (DAU) (105) and digital remote units (DRUs) (125). In the Stapleton DAS, a “key function is determining and/or setting the appropriate amount of *radio resources* (such as RF carriers, CDMA codes or TDMA time slots) assigned to a *particular DRU or group of DRUs* to meet desired capacity and throughput objectives.” EX1006, ¶0054; see also EX1006, ¶0058 (“certain *radio resources* (such as RF carriers, CDMA codes or TDMA time slots) for use by a *particular DRU*”); EX1003, ¶¶68-70.

Stapleton includes a “DAU Embedded Software Control Module”:



EX1006, Fig. 7, ¶58 (explains how the software control modules operates to reconfigure the plurality of radio resources).

Stapleton explains that an “algorithm operating within the DAU Monitoring module ... detects which carriers and corresponding time slots for each carrier are active for each DRU.” *Id.* That information is provided to “the DAU Management Control module to help identify when, e.g., a particular downlink carrier is loaded by a percentage greater than a predetermined threshold.” *Id.* “If that occurs, the DAU Management Control module can adaptively modify the system configuration to begin to deploy ... additional radio resources ... for use by a

particular DRU which need those radio resources within its coverage area.” *Id.* At the same time, the DAU Management Control module can “*remove ... certain radio resources*” used by a particular DRU “where that DRU no longer needs those radio resources within its coverage area.” *Id.*

2. “Kummetz-464”: U.S. Patent No. 9,398,464

Kummetz-464 (EX1005) is patent filed July 11, 2012 and is prior art at least under 102(e). Further, all of the claims of Kummetz-464 are supported by an earlier provisional application (as is all the disclosure relied on in this petition). EX1003, ¶¶74-75.

Kummetz-464 is directed to a “base station router” for use in a distributed antenna system (“DAS”). EX1005, Title; 1:16-17, Abstract. The Kummetz-464 DAS includes a router 14 coupled to a plurality of coverage areas or zones where each zone is served by one or more distributed remote antenna units. EX1005, Fig. 1, Fig. 2, 2:54-59; 3:7-8; 7:4-5; EX1003, ¶¶76-82. Kummetz-464 DAS with the router adaptively redistributes radio resources to address load balancing problems.

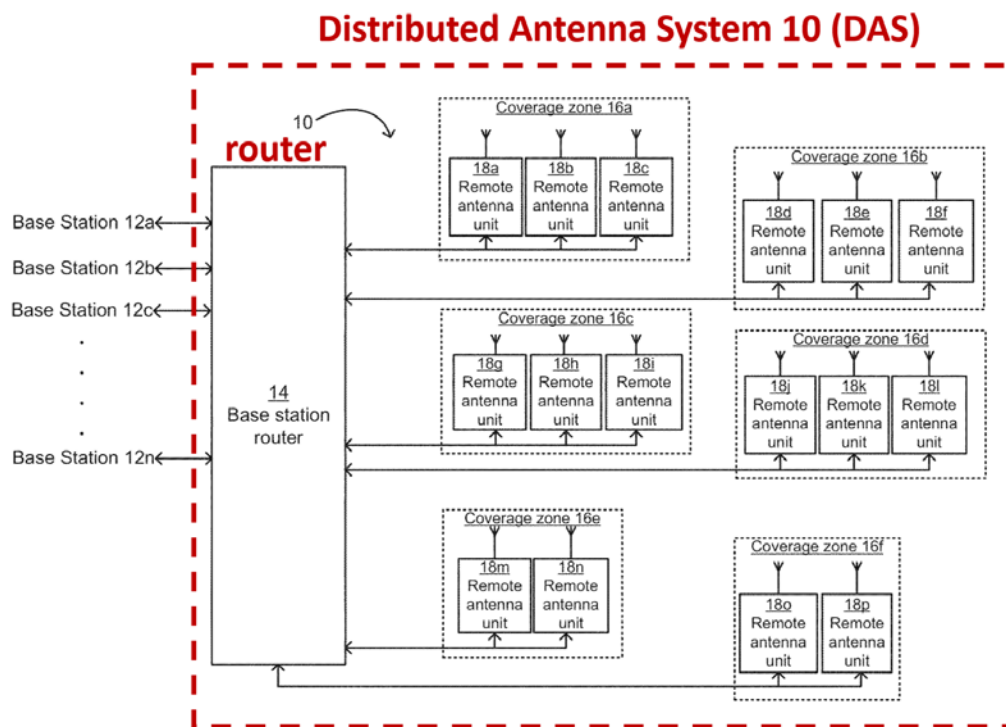


FIG. 1

The Kummetz-464 system includes a controller (a traffic monitoring unit). EX1005 at 2:19–20, 8:54–58, 8:63–67, 9:22–25, Fig. 2 (controller 108), Figs. 2 and 3 (below); EX1003, ¶¶83–86. The controller of the Kummetz-464 system can detect traffic and determine the number of mobile devices in each coverage zone (the Kummetz-464 refers to these measures as traffic indicators). EX1005, 9:44–47 (“A traffic indicator can include data describing or otherwise corresponding to a number of mobile devices in each coverage zone”); 9:52–54; 9:40–65.

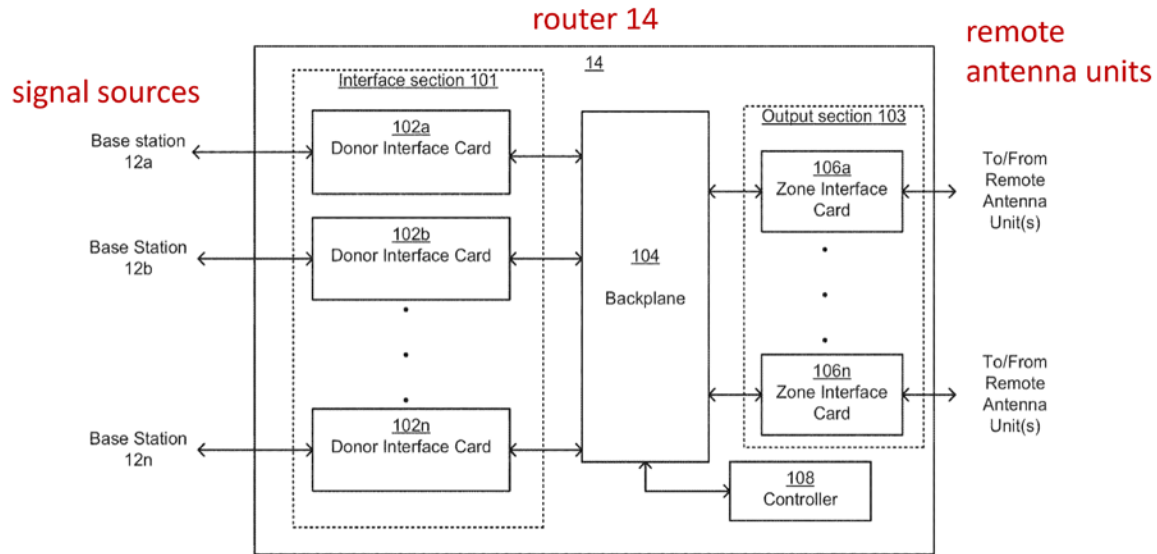
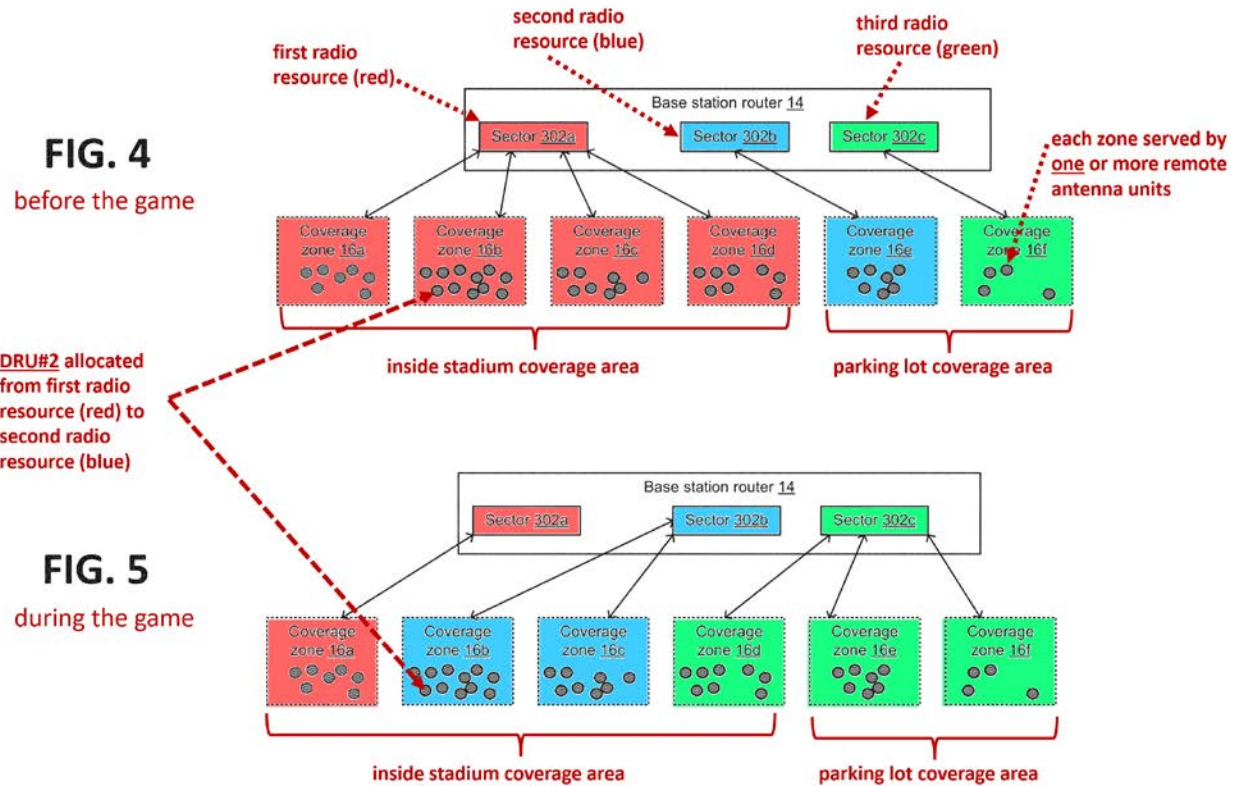


FIG. 2

Based on detected traffic indicators, the Kummetz-464 router reconfigures the distribution of radio resources to the remote antenna units by allocating at least one remote antenna unit from a first radio resource to a second radio resource. Figs. 4 and 5 (below, annotated) illustrate how the system may adaptively distribute capacity before (Fig. 4) and during a sporting event (Fig. 5) hosted a venue with coverage areas that include: (a) inside a stadium, and (b) the parking lots surrounding the stadium. EX1005, 10:64 - 11:28; EX1003, ¶¶87-90.



B. Secondary References

“Wu” (U.S. Patent Application Pub. No. 2010/0128676) is 102(b) prior art. EX1007; EX1003, ¶¶91-103 (overview of Wu). “Kummetz-579” (U.S. Patent Application Pub. No. 2011/0281579) is prior art at least under 102(e). EX1008.

CLAIM CONSTRUCTION

In view of the art applied, terms are not expected to be disputed for this proceeding.

LEVEL OF ORDINARY SKILL

A person of ordinary skill in the art (POSA) would have had a bachelor’s degree in electrical engineering or equivalent field, with 2-3 years of work experience in the field of wireless communications. EX1003, ¶¶23-25.

DISCRETIONARY ISSUES

The Board should not deny institution under 35 U.S.C. §314(a) for two reasons. First, the *Fintiv* factors favor institution: the parties have not yet invested significantly in the district court (no claim construction, no depositions, no written discovery); and trial will not commence before July of 2024.

Second, this Petition presents “compelling” evidence of unpatentability because it presents multiple anticipatory prior art references not considered during prosecution (Stapleton, Kummetz-464). Stapleton, the PO’s own reference, anticipates all the claims. The examiner even told the PO that the Stapleton reference would not be considered, but PO chose to let the claims issue anyway without consideration. EX1002, 338. Further, the record from the prior IPR for the narrower claims of the parent ‘454 patent shows that the broader claims of the child ’382 patent are likely invalid because the sole basis for the parent claims not being invalid (QoS) is only an optional feature in the broader claims of the child ’382 patent. EX1015, 25. Therefore, it is highly likely the petitioner will prevail for at least one of these broader claims (e.g., claim 1).

The *Fintiv* factors favor institution.

Factor 1: Petitioner has moved for a stay of the related litigation. EX1025.

Factors 2 & 5: One week before this petition, the district court set trial for July 15, 2024. EX1026. Petitioner was diligent in bringing this IPR petition six

months before the deadline; thus, this factor is neutral and should not heavily weigh against a diligent Petitioner.

Factor 3 weighs against discretionary denial. No written discovery, claim construction briefing, motion hearings or rulings, or depositions have occurred.

As to Factor 4, Petitioner stipulates not to raise in district court any of the grounds raised in this Petition if IPR is instituted. Thus, Factor 4 weighs against discretionary denial.

Factor 6 weighs against discretionary denial because, as explained above, the petition presents compelling evidence of unpatentability for at least one claim (e.g., claim 1).

ARGUMENT

Ground 1: Stapleton anticipates claims 1-19

A. Claim 1

1. Element 1A/10A

“A system comprising”

Stapleton discloses a reconfigurable distributed antenna *system* (DAS).

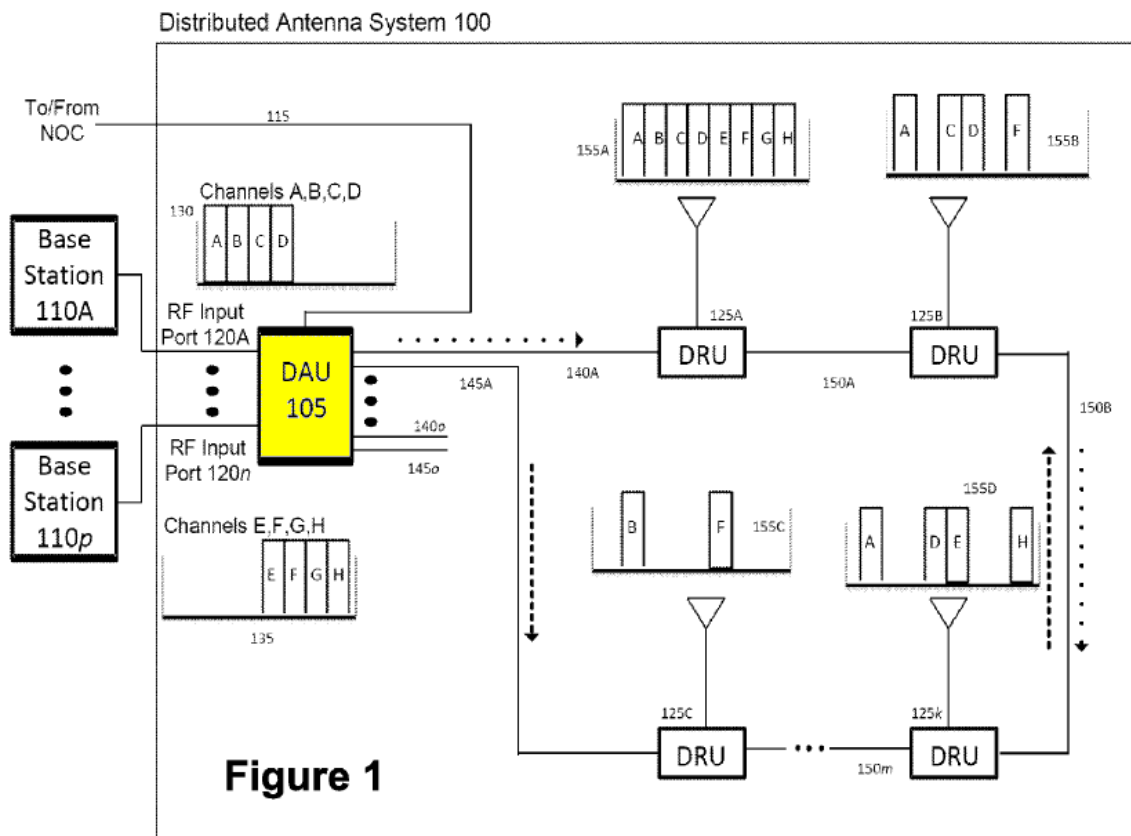
EX1006, ¶0028, Fig. 1; EX1003, ¶107.

2. Element 1B/10B

“one or more Digital Access Units (DAUs) operable to receive at least one signal from at least one of a first signal source and a second signal source from one or more of a plurality of signal sources, each DAU of the one of more DAUs including an input port configured as an

uplink/downlink port and an output port configured as an uplink/downlink port

First, Stapleton expressly teaches its system employs “Digital Access Unit functionality 105.” EX1006, ¶0028. Figure 1 shows DAU (105):



Stapleton Figs. 4 and 8 also disclose more than one DAU:

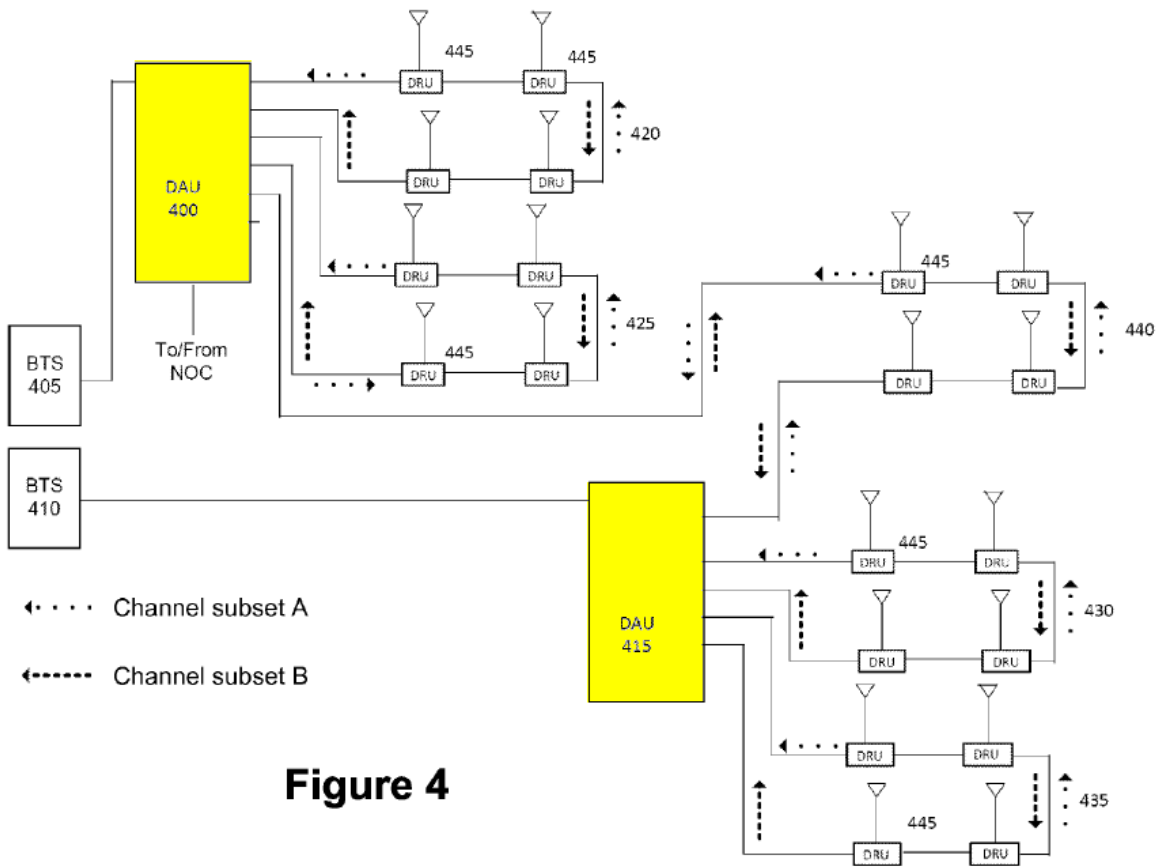


Figure 4

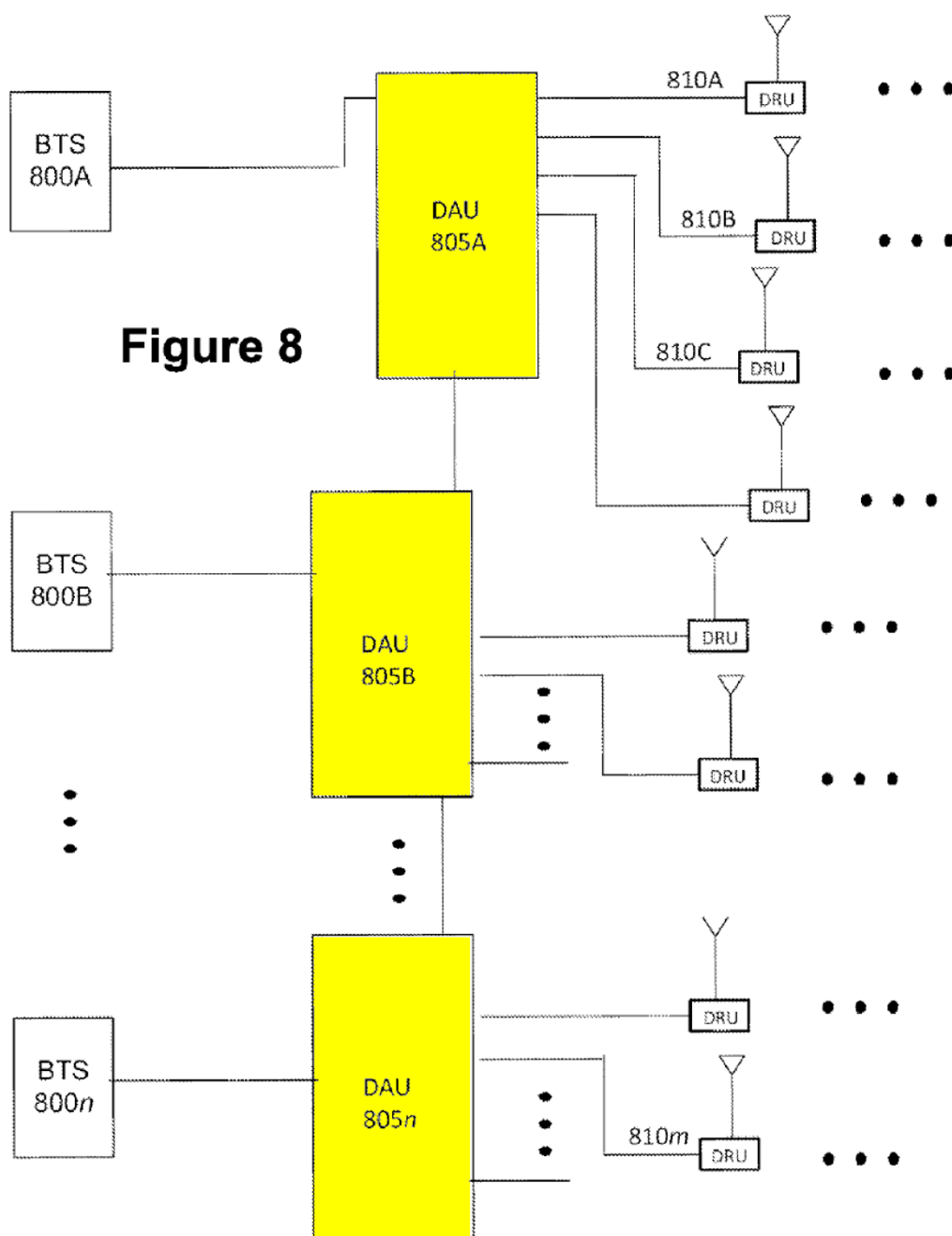
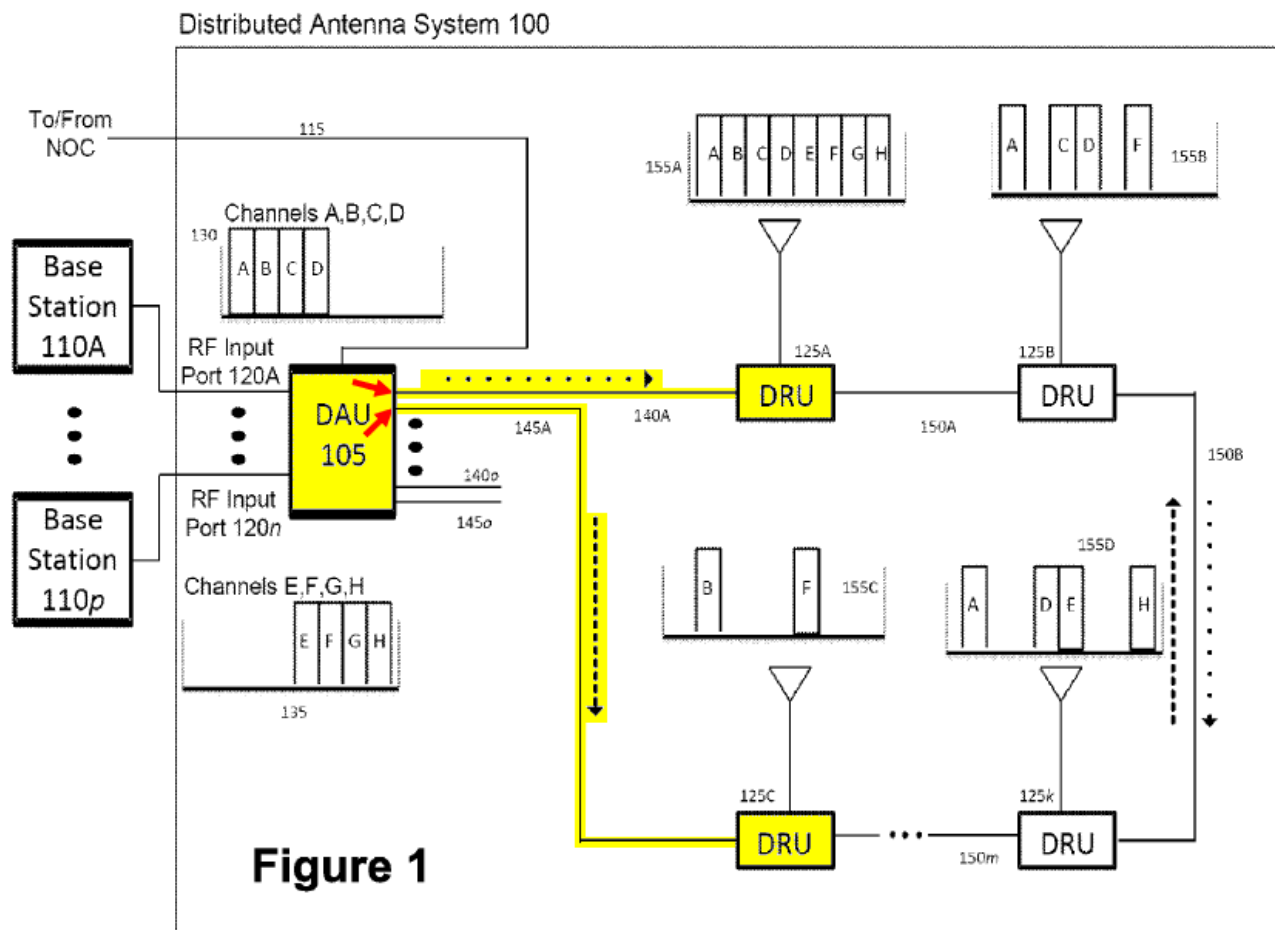


Figure 8

EX1006, ¶0023, Fig. 8, ¶0027; EX1003, ¶¶108-109.

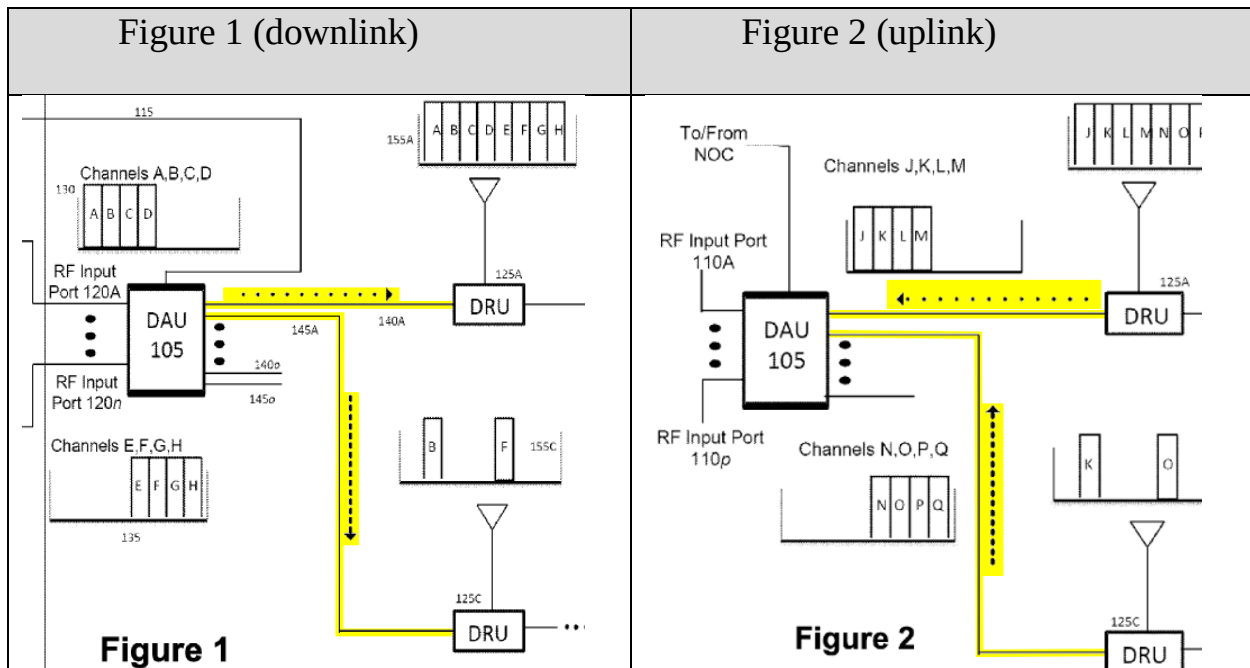
Second, Stapleton teaches its DAUs receive “RF signals” (at least one signal) from one or more base station units (BTS) (a first signal source and a second signal source). EX1006, ¶¶0028-0029; EX1003, ¶¶110-114.

Third, Stapleton’s DAU includes an “output” port that is *configured as an uplink/downlink port* (i.e., bidirectional). EX1003 ¶¶114-131. Stapleton teaches: “One optical output of DAU 105 is fed to DRU 125A, via bidirectional optical cable 140A. A second optical output of DAU 105 is fed via bidirectional optical cable 145A to DRU3.” EX1006, ¶0033. Figure 1 shows these outputs:



Stapleton’s DAU has “pluggable SFP modules” for the optical cables, which are each an example of an *output port*. EX1006, ¶0029; EX1003, ¶¶114-115. Further, Stapleton’s DAU’s inherently must include a port to connect the optical

cable; otherwise, the cable would be disconnected. EX1003 ¶¶114-115. Each of Stapleton’s DAU-DRU connections uses a single “bidirectional” cable; thus, the underlying port for each cable must be bidirectional (otherwise, one direction would not work). EX1006, ¶0033; EX1003 ¶¶114-117, 123-125. Stapleton illustrates uplink/downlink over the same connection.



See also Fig. 4.

The relevant industry standard for the DAU-to-DRU output (“CPRI”) confirms each of these links involves a bidirectional port. EX1006, ¶0048 (“DAU...using the Common Public Interface Standard (CPRI).”)

Link:

The term “link” is used to indicate the **bidirectional interface in between two directly connected ports**, either between REC and RE, or between two nodes, using one transmission line per direction. A working link consists of a master port, a bidirectional cable, and a slave port.

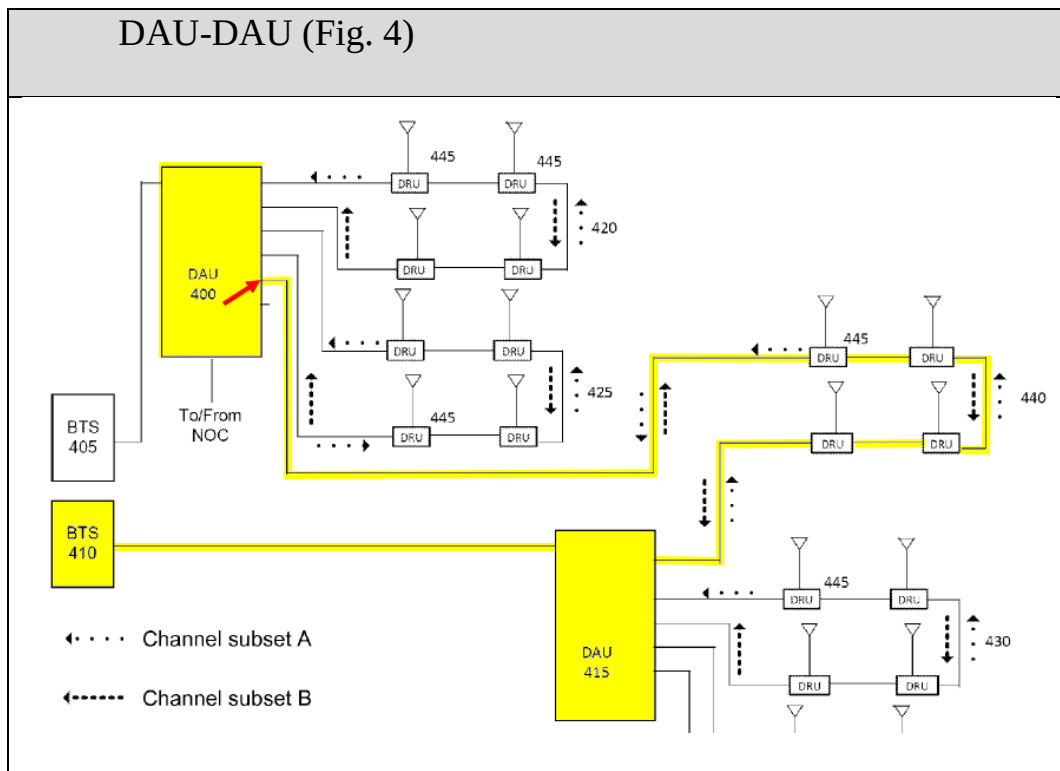
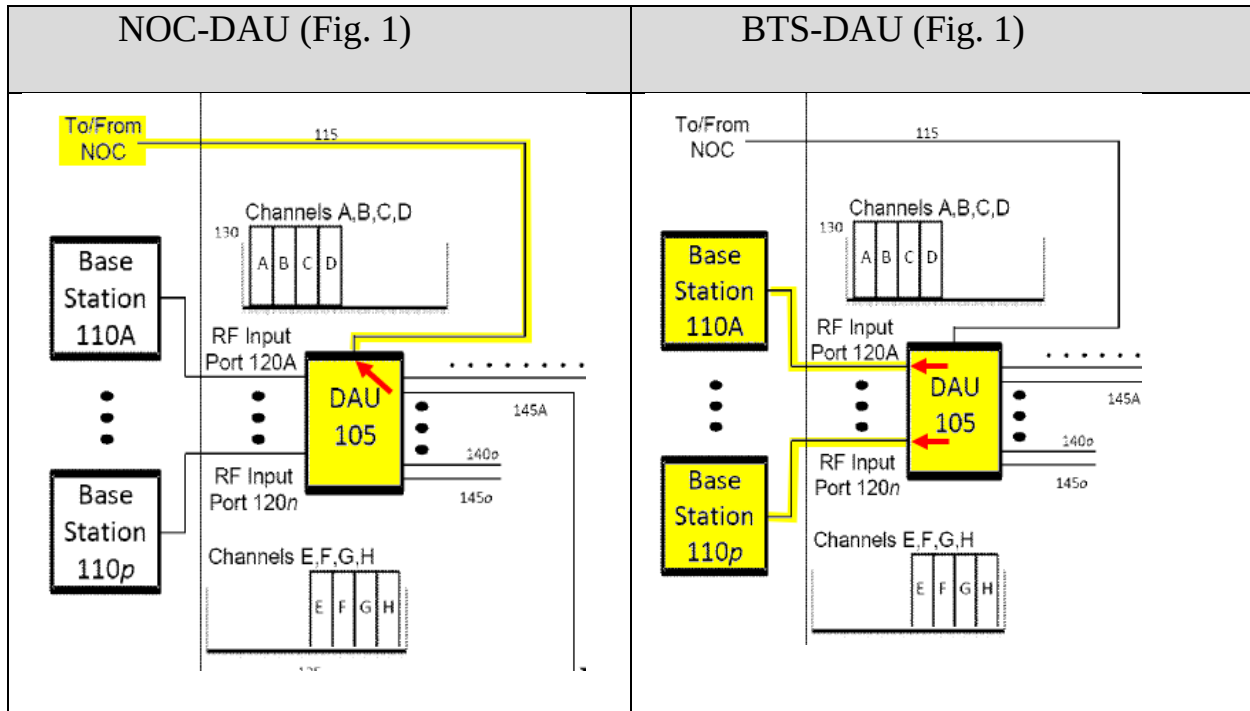
Master/master and slave/slave links are not covered by this specification (for the definition of master and slave see below).

EX1009, 7-10; EX1003 ¶¶118, 128.

Fourth, Stapleton’s DAU discloses an “*input*” port that is *configured as an uplink/downlink port* (i.e., bidirectional). EX1003 ¶¶114, 119-131. Similar to the above, Stapleton’s DAU has input ports for three cable connections (any of which is sufficient to invalidate):

- (1) DAU’s cable connection (115) to the network operations center (NOC)
- (2) DAU’s cable connections (120) to BTSs 110A-110p
- (3) DAU’s cable connection (440) to another DAU (interconnected DAUs such as shown in Figs. 4 and 8 to enable a DAU to access radio resources from other base stations). EX1003 ¶¶114, 119-131.

Figures 1 and 4 illustrates these:



Stapleton's DAU inherently must have a matching port for each cable to connect to; otherwise, the cable would be disconnected. EX1003 ¶¶114, 120. Stapleton teaches that an optical cable has a matching optical port and RF cable has a matching RF input port. EX1006, ¶0036 ("RF carriers... respective RF input port"), ("optical port...via bidirectional optical cable"). The red arrows indicate where the DAU must have a port for each cable connection. The patent describes each cable connection in the singular (e.g., "bidirectional link 115"), which means the matching port for the bidirectional cable must be *configured as an uplink/downlink port* to support both directions of that cable. EX1003 ¶¶114, 125.

First example: Stapleton's DAU connects to the NOC via a "bidirectional link (115)" such as an "Ethernet" connection. EX1006, ¶0028, ¶0017. Thus, the DAU has a matching Ethernet port. EX1003, ¶¶114, 122. The port must be bidirectional because the DAU can receive commands (*downlink*) from the NOC and provide information back to the NOC (*uplink*) via cable 115. EX1006, ¶0036, ¶0054, ¶0029; EX1003, ¶¶122, 125.

Second example: Stapleton's DAU connects to the other DAU via "fiber optic cable" (440). EX1006, ¶0044; ¶0034. Stapleton teaches the optical fibers are "bidirectional;" thus, the matching port must be bidirectional (i.e., configured as an

uplink/downlink port). EX1006, ¶¶0013²; EX1003, ¶¶114, 120, 125-126. Figure 4 shows that DAU receives signals from the other BTS via this DAU-DAU connections, i.e., *inputs*:

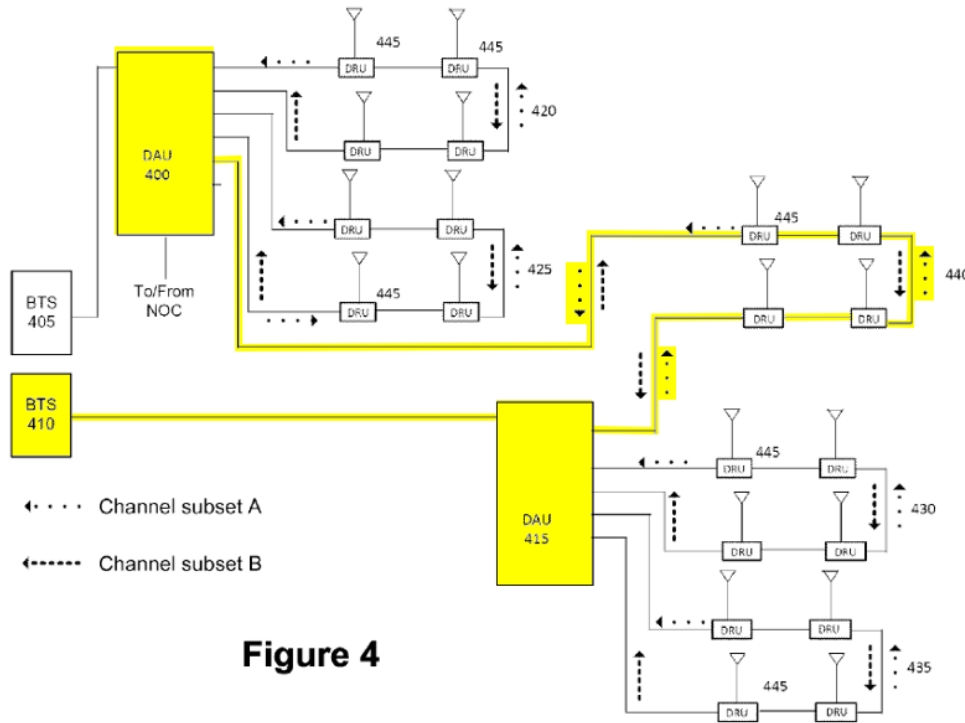


Figure 4

Third example: Stapleton’s DAU has an “RF input port” (120A, 120n) for the BTS-DAU cable connection. EX1006 ¶0032, Fig. 1; EX1003 ¶121. The DAU receives RF signals “from” this connection, i.e., *inputs*. EX1006, ¶0029. A POSA

² Stapleton incorporates the ‘836 provisional application that confirms the cable is bidirectional. EX1017, ¶0030 (“A second optical output of DAU 1 is fed via bidirectional optical cable 113 to DAU2”); EX1006 ¶0001, ¶ 0012, ¶0036 (incorporating by reference)

knows this input port is configured as an uplink/downlink port because the DAU communicates both uplink and downlink signal via this port. Stapleton ¶¶0041 (“The *downlink* channels ... The *uplink* channels ... The *DAU in turn communicates with one or more BTS's via RF Ports...*”);³ EX1003 ¶¶114, 129.

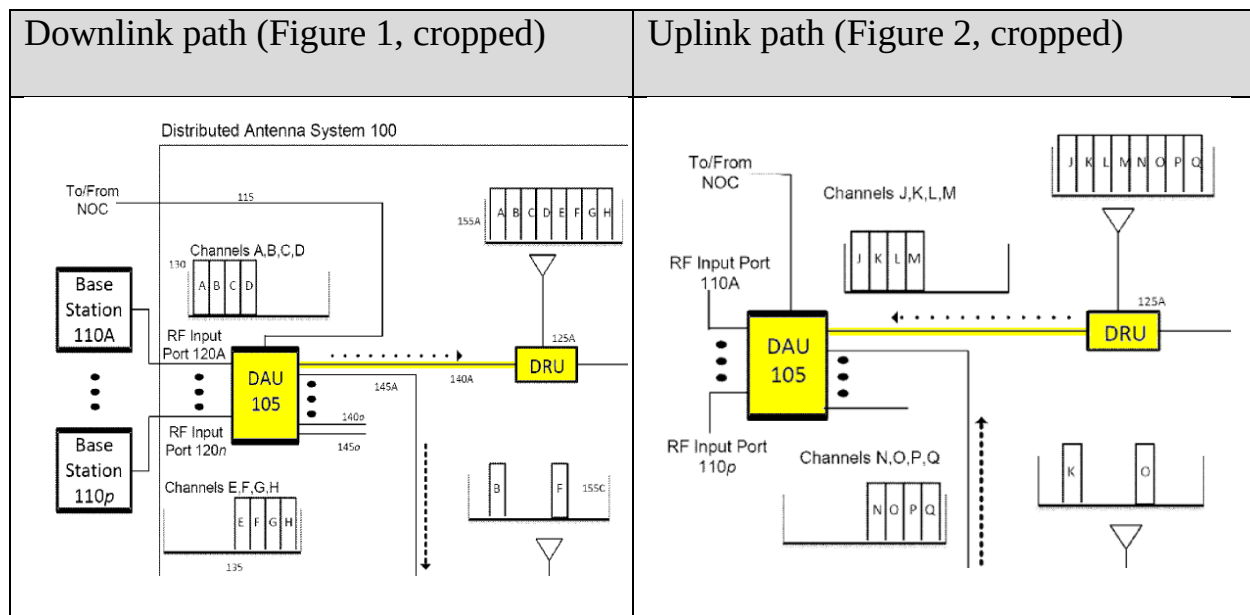
3. Element 1C/10C

“one or more Digital Remote Units (DRUs) connectable to the one or more DAUs and operable to transport signals between one or more of the one or more DRUs and the one or more DAUs”

Stapleton’s DAS comprises a “a plurality of digital remote units (DRU).” EX1006, ¶¶0028; EX1003, ¶¶132-133. The back arrows in Figures 1-2, below, show exemplary DRU (125A) is operable to transport signals (digitized RF signals) between the DRU and DAU via fiber optic cables (140A):

³ Even if PO disputed all three examples, that would not distinguish Stapleton.

Recall the DAU has a pluggable SFP modules (*port*) for each of multiple DAU-to-DRU connections that both transmit outputs (Fig. 1) and receive inputs (Fig. 2)—one of these multiple port could alternatively be the recited input port. EX1003 ¶123.



EX1006, ¶0029, ¶0031, ¶0033 (explaining RF signal transport).

4. Element 1D/10D

“a plurality of radio resources formed from the one or more DRUs comprising a first radio resource and a second radio resource different from the first radio resource, each radio resource comprising a subset of the plurality of DRUs”

Stapleton teaches that a plurality of radio resources are formed from Stapleton’s remote antenna units (DRUs) according to how the radio resources were distributed to the to the remote units to provide wireless RF coverage via antenna elements. EX1003 ¶¶134-142. The DRUs include frequency selective digital up/down converter (DUCs/DDCs) that are “integrated” in DRUs and have gain control for “each carrier” (*radio resources*). EX1006 ¶0034. Stapleton’s carriers are its radio resources. EX1006, ¶0058 (“radio resources...such as RF carriers”). Thus, using the DUCs, the DRU’s “enable or disable specific radio

resources from being transmitted by a particular DRU or group of DRUs.”

EX1006, ¶0056; EX1003, ¶137. Figure 7 illustrates the DUCs (730):

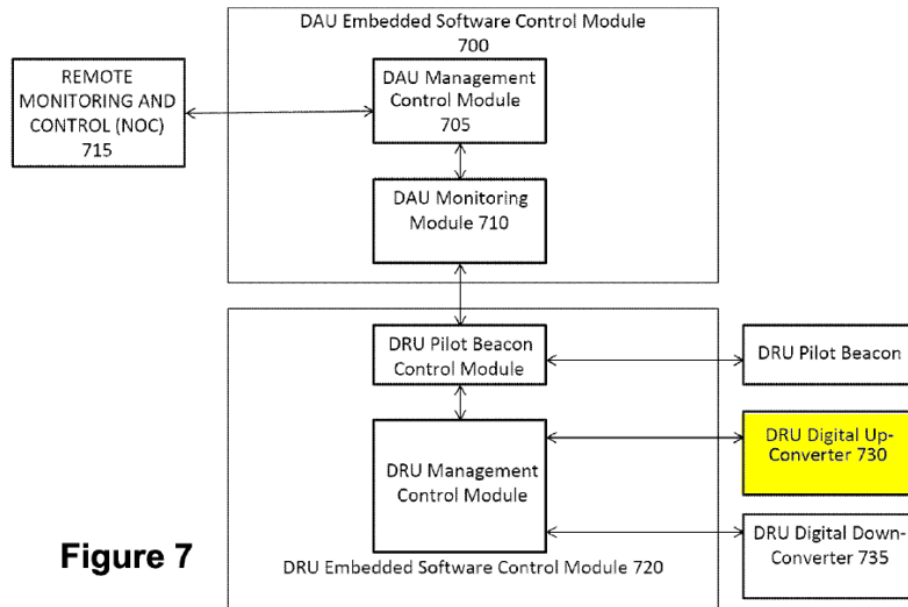


Figure 7

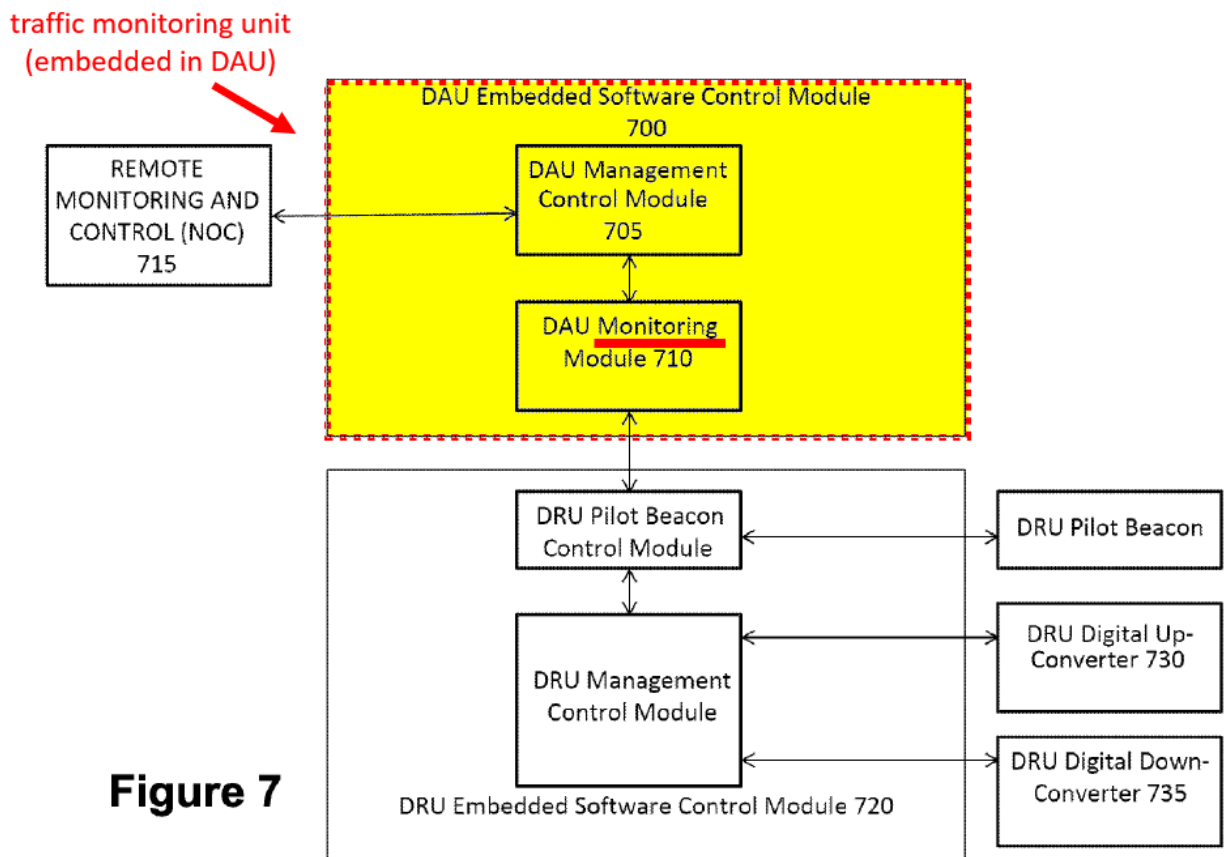
Based on software settings (the gain control parameter) within the DRU, the DUCs forms an output signal containing the correct radio resources. EX1006, ¶0033, ¶¶0034-¶0035. The DAU can remotely turn on or off the RF carriers via the gain control parameter (the software setting). EX1006, ¶0034.

The radio resources formed from the DUCs integrated in the DRUs are different and each correspond to a subset of the DRUs. EX1003 ¶138. Figure 1, for example, shows 8 radio resources (A...H) distributed throughout the DRUs:

5. Element 1E

“a traffic monitoring unit coupled to at least one of the DAUs”

Stapleton’s DAU contains an “embedded software control module” (700), which is a “*traffic monitoring unit*.” EX1003 ¶143-146. Figure 7 shows module (700):



EX1006, Fig. 7, ¶0054. Numeral 700 contains a “monitoring module” (710). This module runs an algorithm to monitor “which carriers and corresponding time slots for each carrier are active for each DRU” to “help identify when, e.g., a particular downlink carrier is loaded by a percentage greater than a predetermined threshold.”

EX1006, ¶0058, ¶0037 (“The carriers and time slots are monitored by the DAU...”). The traffic load is higher when a higher number of carriers/time slots are active. EX1003, ¶145.

Stapleton also identifies alternative traffic monitoring units (e.g., both in the DRU and in the remote monitoring and control NOC), which are discussed for claim 10 incorporated here by reference. EX1003, ¶¶147-151.

6. Element 1F/10F

**“wherein the traffic monitoring unit is configured to:
determine one or more of: one or more key performance
indicators (KPIs) and/or a quality of service (QoS) of a
network traffic for the one or more DAUs, wherein the QoS
is a function of the one or more KPIs”**

Stapleton’s software module in the DAU determines three examples of KPIs and/or QoSs: (1) which carriers and time slots are active (each a *KPI*), (2) the load percentage on a carrier (a *QoS*), and (3) whether the percentage is greater than a threshold (a *QoS*). EX1003 ¶¶152-162. Stapleton explains that an “algorithm operating within the DAU Monitoring module ... ***detects*** which ***carriers and corresponding time slots for each carrier are active for each DRU.***” EX1006, ¶58. That information is provided to “the DAU Management Control module to help identify when ... a particular downlink carrier is ***loaded by a percentage*** greater than a predetermined threshold” *Id.* “If that occurs, the DAU Management Control module can adaptively modify the system configuration to”

allocate additional radio resources to a DRU or remove radio resources from a DRU. *Id.*

First example: Which carriers and time slots are active is a *KPI* because it is the indicator used to “identify” traffic on a carrier to determine if a carrier is overloaded. *Id.*; EX1003 ¶¶153-155. Stapleton determines which carriers and corresponding time slots are active by “power detection.” EX1006, ¶¶0037, ¶¶0028.

Second example: The load percentage identified by the software is an example of *quality of service (QoS) of a network traffic*. EX1003 ¶¶156-158. It is calculated from the KPI. The higher the load percentage the higher the network traffic on that carrier. Where the load percentage for a network’s radio resource is very high, there are increased occurrences of dropped calls or inability to handle call requests due to lack of available resources (e.g., time slots on the carrier), i.e., the quality of performance is lower. *Id.* The load percentage is a function of which time slots are active (a *KPI*), e.g., the load percentage is 100% if 8 of 8 total time slots are active. *Id.*

Third example: Whether the load percentage is “greater than a predetermined threshold” is a *quality of service (QoS) of a network traffic*. EX1003 ¶¶159-161. The result (above vs. below the threshold) describes the quality of service on the network for that carrier. *Id.* Whether the load percentage

is above the threshold is a function of the detected activity on carriers/time slots (a KPI). Id.

7. Element 1G/10G

“wherein the traffic monitoring unit is configured to: ... reconfigure the plurality of radio resources based on one or more of the one or more KPIs and/or the QoS by allocating at least one DRU from the first radio resource to the second radio resource”

Stapleton expressly teaches its system can “re-configure” the radio resources. EX1006, ¶0028 (*“Reconfigurable Distributed Antenna System”*). Stapleton discloses a specific example of how the disclosed system can reconfigure based on the KPIs/QoS discussed in the prior element. If the DAU Management Control Module determines that “a downlink carrier is loaded by a percentage greater than a predetermined threshold” then:

the DAU Management Control module can adaptively modify the system configuration ... to deploy ... additional radio resources ... for use by a particular DRU which need those radio resources within its coverage area. At the same time, ... the DAU Management Control module adaptively modifies the system configuration ... to remove ... certain radio resources ... for use by a particular DRU where that DRU no longer needs those radio resources within its coverage area.

EX1006, ¶0058. Allocating a “particular DRU” from the overloaded RF carrier (the first radio resource) to the “additional radio resource” (the second radio resource) is an example of allocating at least one DRU from the first radio resource

to the second radio resource. EX1003 ¶¶163-171 (see, e.g., ¶167 and ¶169 discussing and illustrating examples using Fig. 1). If the claim requires removing the *first radio resource*, that does not distinguish Stapleton. Paragraph 58, quoted above, also teaches to “remove” radio resources at the same time as adding the additional radio resources. EX1006, ¶0058; EX1003 ¶¶166-169.

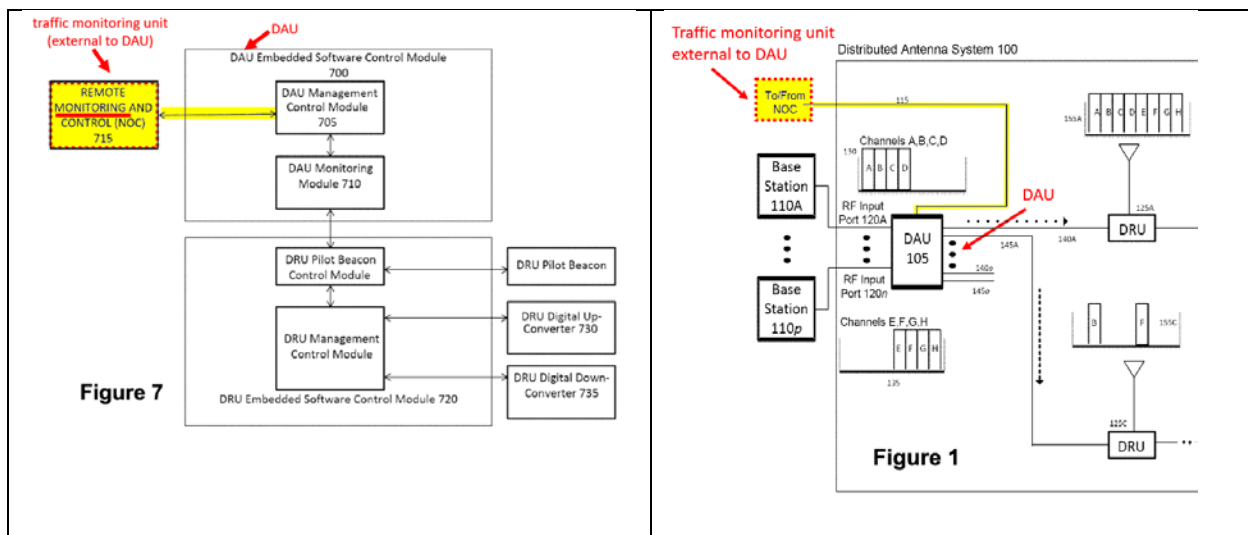
B. Claim 10

Claim 10 is nearly identical to claim 1 except it adds the limitation in element 10E that the traffic monitoring unit is “external” to “at least one” DAU. Stapleton discloses this limitation. EX1003, ¶¶173-175.

First, if there are “more than one DAU present,” Stapleton teaches one DAU is “designated a Master DAU” and “the Management Control module located in the Master DAU makes decisions to optimize the overall transport capacity.” EX1006, ¶0040 (“Referring again to FIG. 1...”), see also Figs. 4, 8. The Master DAU’s management control module is an example of “*a traffic monitoring unit external to and couplable to at least one of the DAUs.*” EX1003 ¶176. It is external to all DAUs other than the Master DAU. Paragraph 58 explains that the “management control module” is the specific part of the embedded software module that reconfigures the radio resources (by deploying/removing radio resources). EX1006, ¶0058. Further, although the management module does not monitor which carriers and time slots are active, it is the module with the

“threshold” that identifies whether a carrier is overloaded (a QoS). EX1006, ¶0058 (“to help identify when ... a particular downlink carrier is loaded by a percentage greater than a predetermined threshold whose value is communicated to the DAU Management Control module by the DAU's Remote Monitoring and Control function 715. If that occurs, the DAU Management Control module can adaptively modify...”). The claim only requires the traffic monitoring unit determine “one” of a KPI “and/or” QoS; thus, this satisfies the claim. EX1003 ¶176.

Second, alternatively, Stapleton includes a remote network operations center (NOC) that performs “remote monitoring and control” and is an example of an external traffic monitoring unit. EX1006, ¶0028; EX1003 ¶¶177-182. Figs. 1 and 7 (cropped) shows the NOC is external to and couplable to at least one of the DAUs:



See also EX1006, ¶0054. Stapleton expressly teaches that the NOC “monitors” the DAS. EX1006, ¶0054 (“NOC 715 monitors the DAS operation”), ¶0026. The NOC can request the same information the DAU uses to monitor the traffic (which carriers are time slots are active). EX1006, ¶0037.

The NOC is “*configured to: determine one or more of one or more key performance indicators (KPIs) and/or a quality of service (QoS)*” The NOC sets the “threshold” value for the traffic monitoring algorithm. EX1006, ¶0058. The threshold is at least one of a *key performance indicators (KPIs)* or a *quality of service (QoS)*. EX1003 ¶181. It is a key value used by the DAU’s software to decide when to trigger additional radio resource and indicates the limit for when performance is acceptable (i.e., when the performance is below the threshold). EX1006, ¶0058. The threshold value can also be considered a *quality of service (QoS) of a network traffic*. EX1003 ¶181. It sets the goal the DAU is attempting to achieve for network traffic on the downlink carriers. By setting the load percentage threshold higher/lower, the NOC can determine how quickly the system will deploy additional radio resources, which affects the quality of the service at the DRUs using the radio resources. EX1003 ¶181. The threshold value is also a *function of one more KPIs* because it is compared to the load percentage which is calculated from which carriers and time slots are active (the *KPIs*). EX1003 ¶181.

The NOC is configured to perform the claimed reconfiguring because the NOC sends “commands” through the DAU that reconfigure that digital upconverter within the DRUs, which in turn changes which radio resources the DRUs form at their outputs. EX1006, ¶0036 (“Digital Up Converters located within the DRU can be dynamically reconfigured as the result of commands from the NOC.”); ¶0028, ¶0054; ¶0037; EX1003 ¶182.

Third, the section on dependent claim 7 explains that Stapleton also teaches the DRU has its own embedded software, which is another example of a traffic monitoring unit which is “*external to and couplable to at least one of the DAU.*” EX1003 ¶183.

C. Claim 2

Stapleton’s system includes “base stations” (BTS) coupled to the DAU. EX1006, ¶0028; EX1003 ¶¶184-186. Figure 1 is representative:

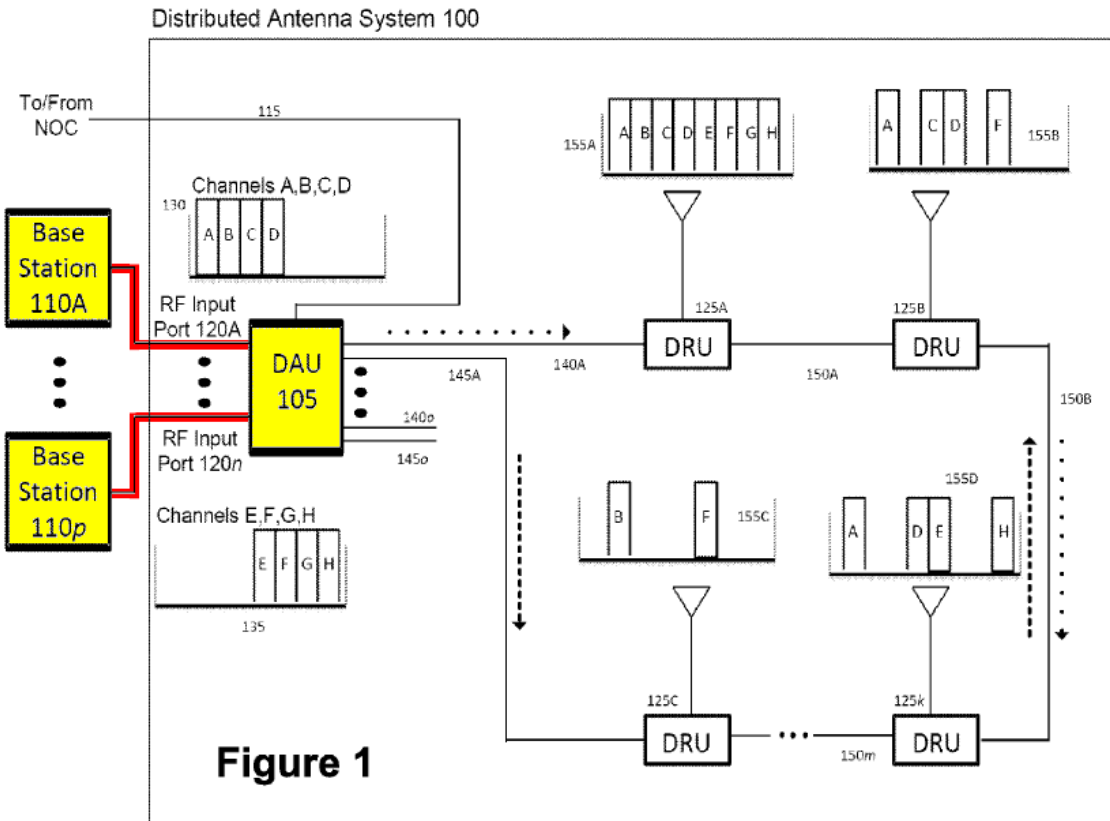
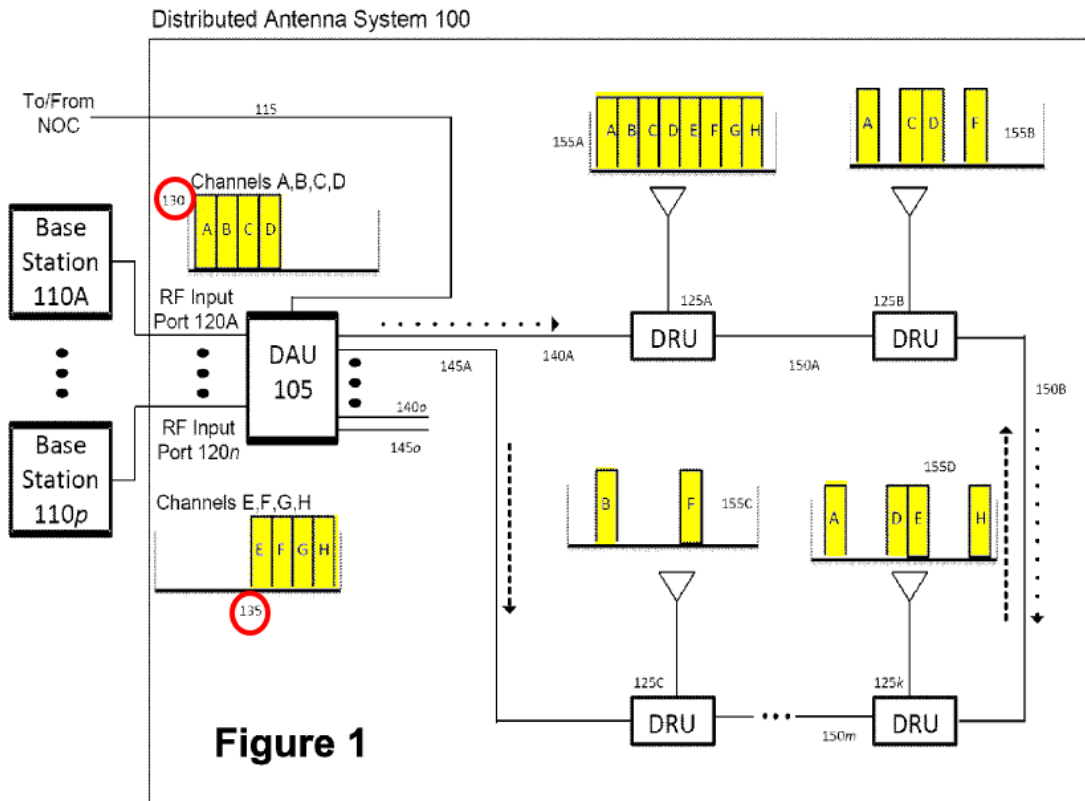


Figure 1 shows the BTS radio resources (A...H) correspond to the radio resources later formed by the DRUs:



Numerals 130/135 are output signal from the BTSs that comprise the carriers A...H (radio resources). EX1005, ¶0032.

D. Claim 3

First, Stapleton’s system comprises a “*network optimization goal*.” EX1003, ¶187. Stapleton’s DAU comprises software that checks whether “a particular downlink carrier is loaded by a percentage greater than a predetermined *threshold*.” EX1006, ¶0058. The ‘382 patent confirms that an embodiment of a “network optimization goal” is to compare a metric “against a *threshold*.” ‘382 patent at 11:20-23. Stapleton’s “*goal*” is to have the particular downlink carrier loaded by a percentage less than the threshold; otherwise, Stapleton determines it

needs to deploy additional radio resources. EX1003, ¶187. Stapleton expressly teaches the DAU's software operates "to optimize" the capacity. EX1006, ¶0040. Deploying additional radio resources based on the threshold is an example of optimizing the network. See EX1006 ¶0058 ("*If that occurs*, the DAU Management Control module can adaptively modify the system configuration"), ¶0010 ("The present invention enables ... *network and radio resource optimization*").

Second, Stapleton's goal comprises "a percentage of users associated with each of the plurality of radio resources." EX1003, ¶187 ("Second..."). Stapleton expressly teaches its goal comprises "a percentage." EX1006, ¶0058 ("a particular downlink carrier is loaded by a percentage greater than a predetermined threshold.") Stapleton's percentage relates to the number of users associated with each particular downlink carrier (Stapleton's *radio resources*) and relates to the number of active time slots. EX1006, ¶0058; EX1003, ¶187 ("Second..."). *The number of active time slots relates to the number of users*. EX1003, ¶¶187-188. In GSM systems, for example, each active time slot represents a voice conversation of a user. If 8 of 8 time slots on a carrier are active, there are eight active users. EX1003, ¶¶187-188.

To be clear, Stapleton includes GSM systems. Stapleton, for example, teaches to consult the '593 provisional application (which it incorporates)

regarding processing “various signal formats and modulation types.” ¶0045 (“As disclosed in U.S. Provisional Application Ser. No. 61/374,593... programmed to *process various signal formats and modulation types...*”); see also EX1006 ¶0032, ¶¶0046-0047, ¶0001 (incorporating the ‘593 application); EX1003, ¶188. In turn, the incorporated provisional teaches this includes GSM:

[0025] Moreover, the NHDAS system is flexible with regard to being able to support various modulation schemes such as QPSK, QAM, OFDM, etc. in CDMA, TD-SCDMA, GSM, WCDMA, CDMA2000, LTE and wireless LAN systems. This means that the NHDAS system is capable of supporting multi-modulation schemes, multi-bands and multi-operators.

EX1021, ¶0025; *see also* ¶0001.⁴

Stapleton’s disclosure further confirms that its resource allocations relate to the number of users, which Stapleton calls “subscribers.” EX1003, ¶189.

Stapleton, for example, teaches to allocate additional radio resources to DRU 125A in Figure 1 because that is where there are “a large number of wireless

⁴ Stapleton also incorporates the ‘836 provisional application (EX1017) that covers GSM networks. EX-1006 ¶0001, ¶0012, ¶0036 (incorporating and discussing the ‘836 provisional application) *with* ‘836 provisional application noting that an “object of the present invention to enhance GSM and LTE 10 indoor location accuracy...”. EX1017, ¶0019.

subscribers” (i.e., *users*). EX1006, ¶0033. Stapleton also teaches to perform the reconfiguration based on “subscriber needs” in order to address the needs of subscribers in “specific locations” (e.g., particular DRUs). EX1006, ¶0004. Further, Stapleton incorporates Application No. 61/382,836 (“the ’836 provisional application”). EX1006, ¶0012. The ’836 provisional application specifically teaches that the DAU can (1) “track” users and (2) “record a running data base” about the information. EX1017, ¶0019. Finally, Stapleton monitors the plural active “carriers”; thus, it checks the percentage of users associated with each carrier (*radio resource*). EX1006, ¶0058; EX1003, ¶190.

E. Claim 4

See the discussion of claim 10 above and claim 7 below. The alternative examples of a traffic monitoring unit discussed for Claim 10 – the NOC and management control module in the Master DAU– meet this claim for the reasons discussed for Claim 10. EX1003, ¶191. The alternative example discussed for claim 7 (the DRU’s embedded software) also meets this claim. *Id.*

F. Claim 5

The traffic monitoring unit discussed for Claim 1 – the DAU’s embedded software module – meets this claim. The software control module is “embedded” within each DAU, which means it is “*provided as a component of each of the one or more DAUs.*” ¶0054. EX1003, ¶¶192-193.

G. Claim 6

The traffic monitoring unit discussed for Claim 1 – the DAU’s embedded software module – meets this claim. EX1003, ¶¶194-197. The DAU is external to the DRUs. See EX1006, Fig. 1.

H. Claim 7

Like the DAU discussed for Claim 1, Stapleton’s DRUs contain an embedded software module (720):

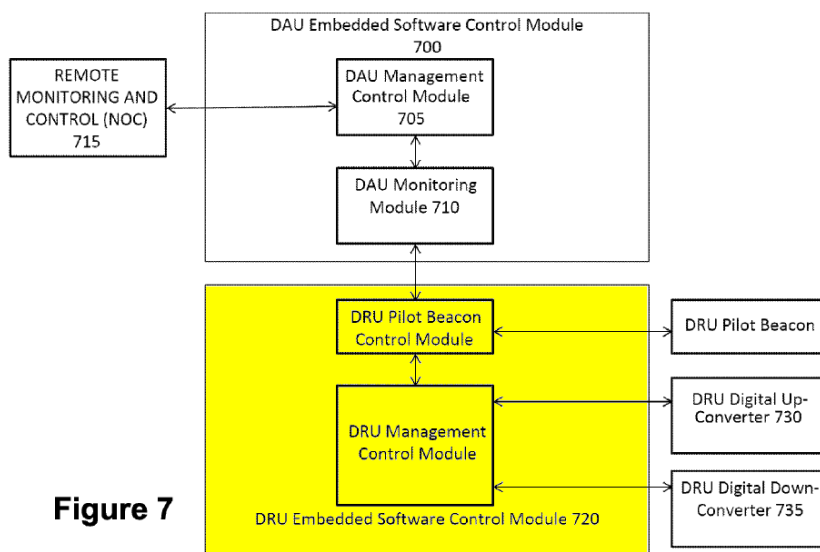


Figure 7

EX1006, ¶0054; EX1003, ¶198. The DRU’s embedded software module (720) is also a *traffic monitoring unit*. EX1003, ¶¶198-200. It participates in the same traffic monitoring process described for Claim 1. The section for Claim 1 explains that the DAU monitors which time slots are active, which involves “power detection.” EX1006, ¶0037. The DRU has functionality for “measuring uplink and downlink power,” which it reports to the DAU. EX1006, ¶0055 (“DRU

functions or features ... *measuring uplink and downlink power*, measuring gain of uplink and downlink, and monitoring alarms in the DRU.”), ¶0028. The DRU has similar functionality for measuring which carriers are active. The DRU has functionality for “measuring gain of uplink and downlink” and reporting back “active carriers.” EX1006, ¶0028, ¶0055. Thus, the DRU’s software is also a *traffic monitoring unit* because it measures and reports the information used in the traffic monitoring process.

The DRU embedded software module is configured to “*determine one or more of one or more key performance indicators (KPIs)....*” for the reasons just discussed. EX1003, ¶¶201-202. Stapleton’s DRU is configured for “measuring” three KPIs: (1) “downlink power,” (2) “uplink power,” and (3) “gain” / “active carriers.” EX1006, ¶0055, ¶0028. The ‘382 patent specifically teaches that a KPI can comprise information about “*power*.” EX1001, 10:40-45. Here, power is a key indicator of which time slots or carriers are active (which is done by “power detection”). Which carriers and time slots are active is the key information used to help identify if the carrier is overloaded, i.e., network traffic is too high. EX1006, ¶0058.

The DRU embedded software module is configured to perform the reconfiguring function of this claim. EX1003, ¶¶203-207. The DRUs’ embedded software is configured to participate in the same reconfiguration process described

for claim 1. In response to commands from the DAU, the DRU's software module “sets the individual parameters of all the DRU Digital Up-Converters 730 to *enable or disable specific radio resources from being transmitted by a particular DRU.*” EX1006, ¶0056. This corresponds to the teaching that “if” the load percentage exceeds the threshold, then the traffic monitoring algorithm can “deploy....additional radio resources ...for use by a *particular DRU* which need those radio resources within its coverage area. At the same time.... Remove...certain radio resources...for use by a *particular DRU.*” By setting the parameter of the DUCs to “to enable or disable specific radio resources from being transmitted by a particular DRU, the DRU’s software module performs the reconfiguring claimed. EX1003, ¶¶205-207.

I. Claim 8

As discussed for claim 1, Stapleton’s embedded software module in the DAU (the *traffic monitoring unit*) is configured to monitor which carriers/time slots are active (*KPIs*) for each DRU in its DAS and uses that information “to help identify” when a particular downlink carrier is loaded by a percentage greater than a threshold. EX1006, ¶0058. This identification process is an example of analyzing plural KPIs (e.g., time slots and carriers). EX1003, ¶¶208-209. Further, the software is configured to do this for “each” DRU, which involves plural KPIs

(the carriers/time slots active for a first DRU, second DRU, etc.). See EX1006, Fig. 1 (showing 4 DRUs and 8 carrier A...H).

J. Claim 9

As discussed for claim 1, Stapleton's embedded software module in the DAU (the *traffic monitoring unit*) is configured to identify whether the load percentage on a particular carrier is "greater than" a threshold. EX1006, ¶0058.

This process is an example of analyzing plural QoS values (the calculated load percentages, the threshold, and the result of the comparison are all QoS values used to determine when to reconfigure the system). EX1003, ¶210. Further, the software is configured to do this for any particular carrier, which covers plural analyses because there are plural carriers (A...H) (e.g., the load percentage on A compared to the threshold, the load percentage on B compared to the threshold, etc.). *Id.*

K. Claim 11

The alternative examples of a traffic monitoring unit discussed for Claim 10 – the NOC and the management control module in the Master DAU– meet this claim. EX1003, ¶¶211-214. As shown in annotated Figures 4, below, an exemplary Master DAU is external to the BTSs and coupled to the BTSs:

Exemplary Master DAU (400)
(traffic monitoring unit)

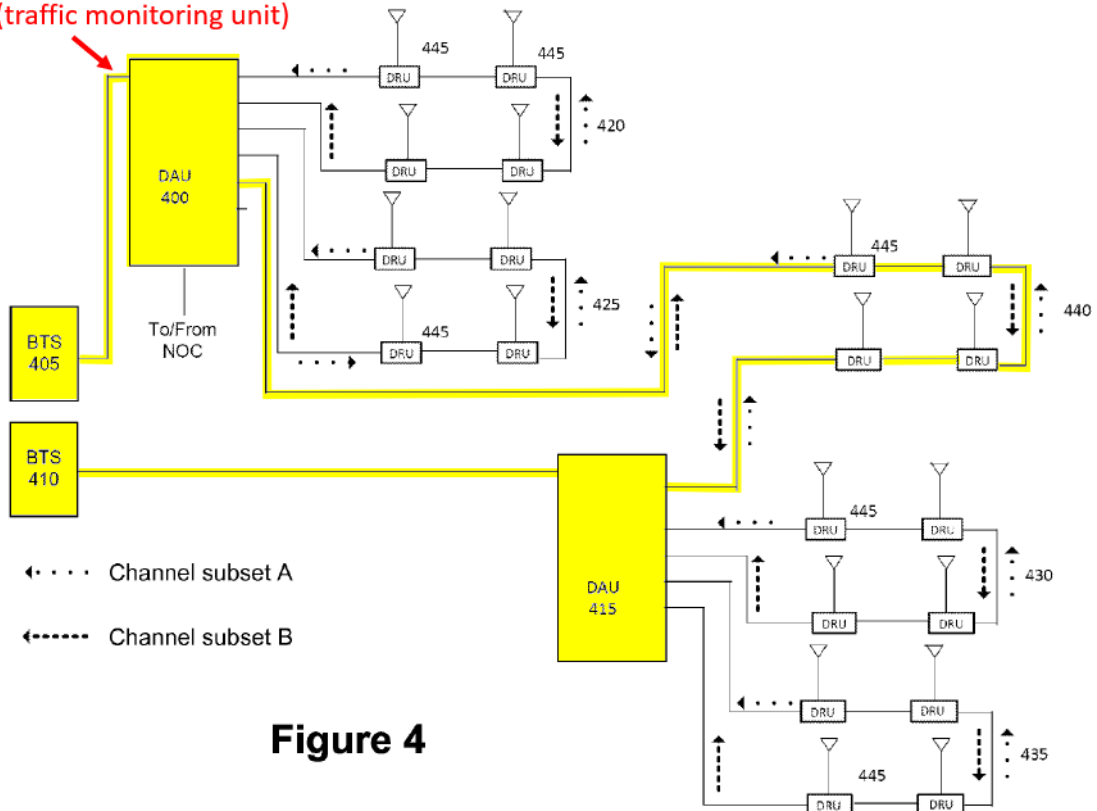
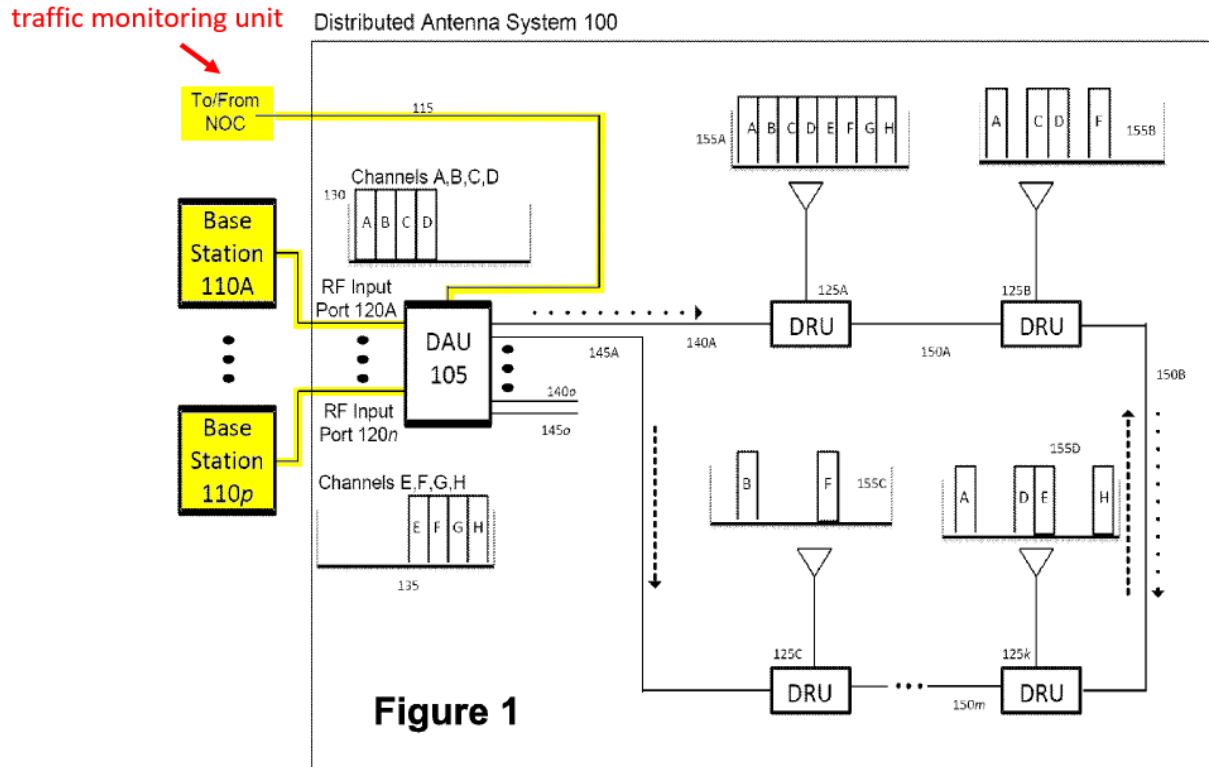
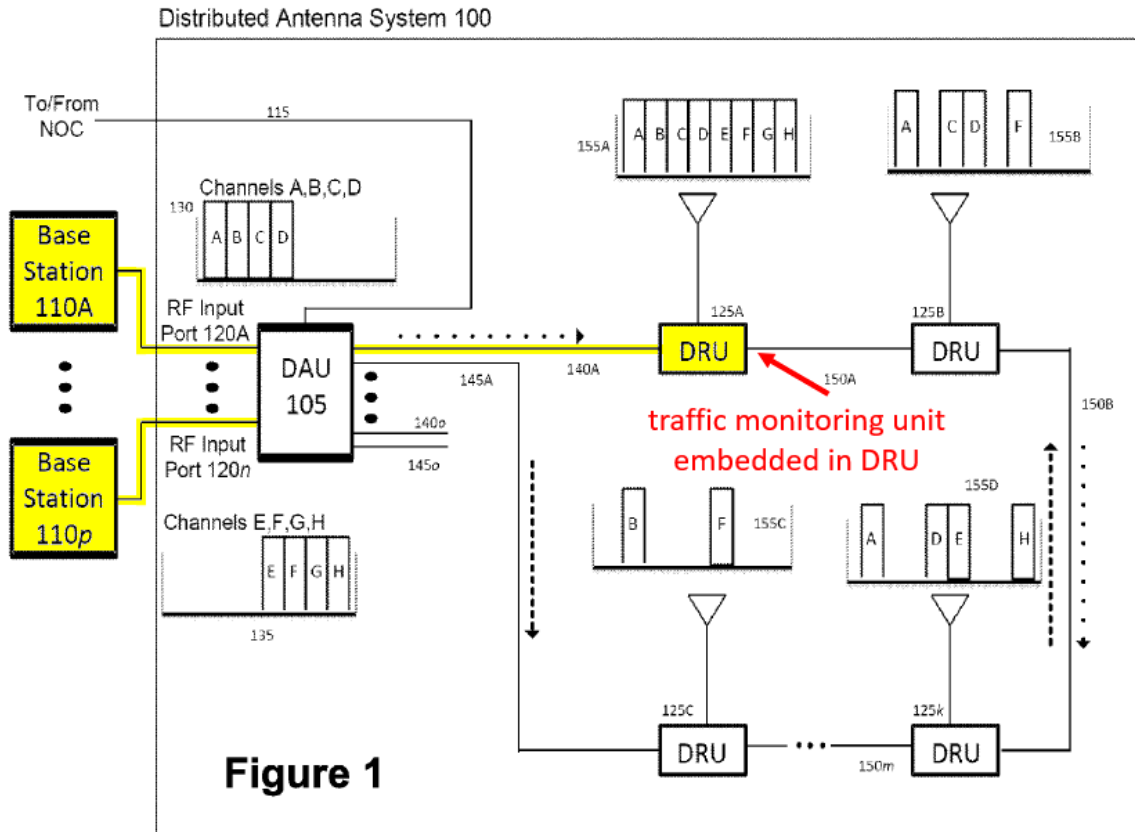


Figure 4

See also Figs. 1, 8. annotated Figure 1 shows a NOC (715) that is external to the BTSs and also coupled to the BTSs (via a DAU):



The alternative example discussed for claim 7 (the DRU's embedded software) also meets this claim. Figure 1 shows this:



EX1006, ¶0029, ¶0031.

L. Claim 12

12. The system of claim 10, further comprising a network optimization processor coupled to the traffic monitoring unit.

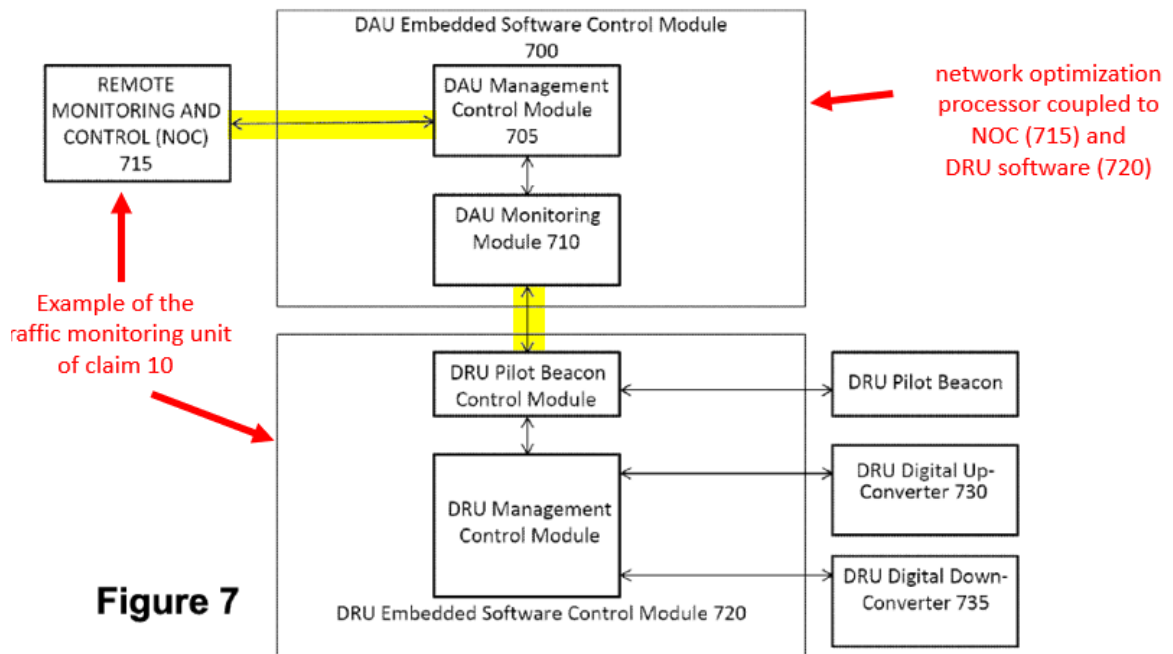
Stapleton teaches that the Master DAU's software management control module (the *traffic monitoring unit*) makes decisions "to optimize" the capacity.

EX1006, ¶0040. Specifically, it optimizes the radio resources by

deploying/removing them based on detected load. EX1006, ¶0058, ¶0010

(“network and radio resource optimization”). The software runs on a processor. EX1006, ¶0051 (“software in the digital processor”), ¶¶0036-0037 (“FPGA,” which is a processor). Thus, the Master DAU also comprises a “*network optimization processor.*” EX1003, EX1006, 221-222. It is *coupled to the traffic monitoring unit* because it is part of the same unit. *Cp.* EX1001, 7:29-36 (“the network optimization unit 120, which can be the *same* server including the traffic monitor unit or a different server.”)

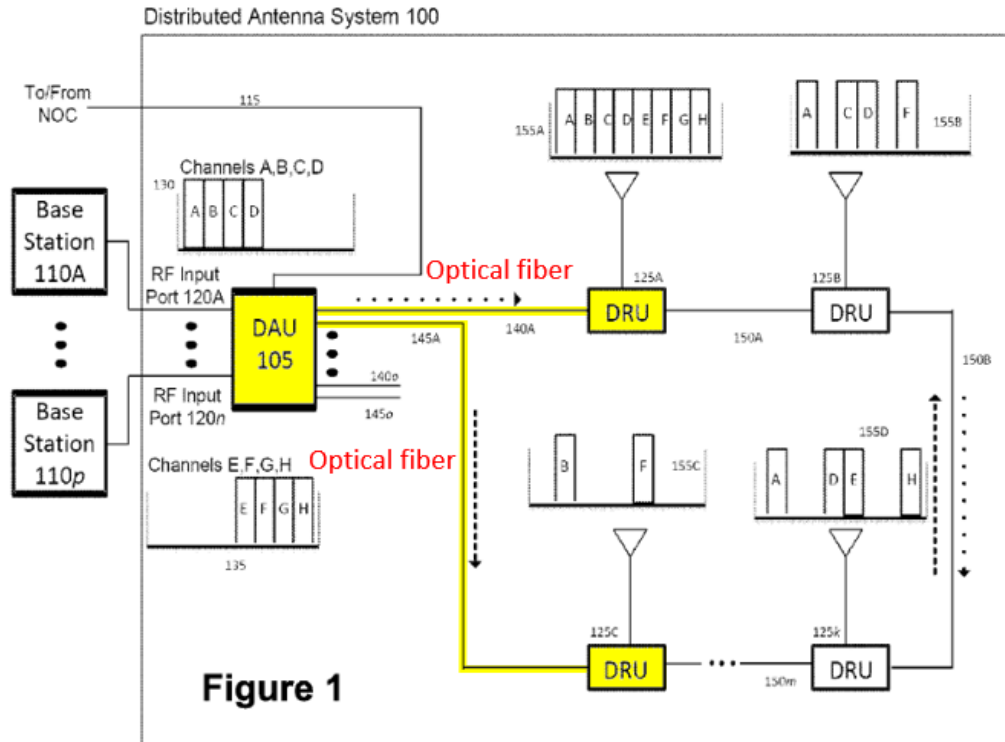
Alternatively, either (a) the NOC or (b) the DRU’s embedded software (see claim 10) can be considered the traffic monitoring unit. EX1003, ¶¶215-222. Both of these are coupled to the DAU processor running the DAU embedded control software as shown in Figure 7:



The NOC itself is a network optimization processor coupled to the DAU's embedded software control module which is a traffic monitoring unit. EX1003, ¶216, ¶219. The NOC optimizes the radio resources by setting the "threshold" to trigger re-allocating the radio resources and issuing "commands." EX1006, ¶0058, ¶¶0036-0037, ¶0028, ¶0054; EX1003, ¶¶216-220. The NOC comprises a computer, i.e., a processor. EX1006, ¶0017 ("a remote computing center"). EX1003, ¶¶216-220. It also inherently must have a processor to issue its software commands.

M. Claims 13 and 14

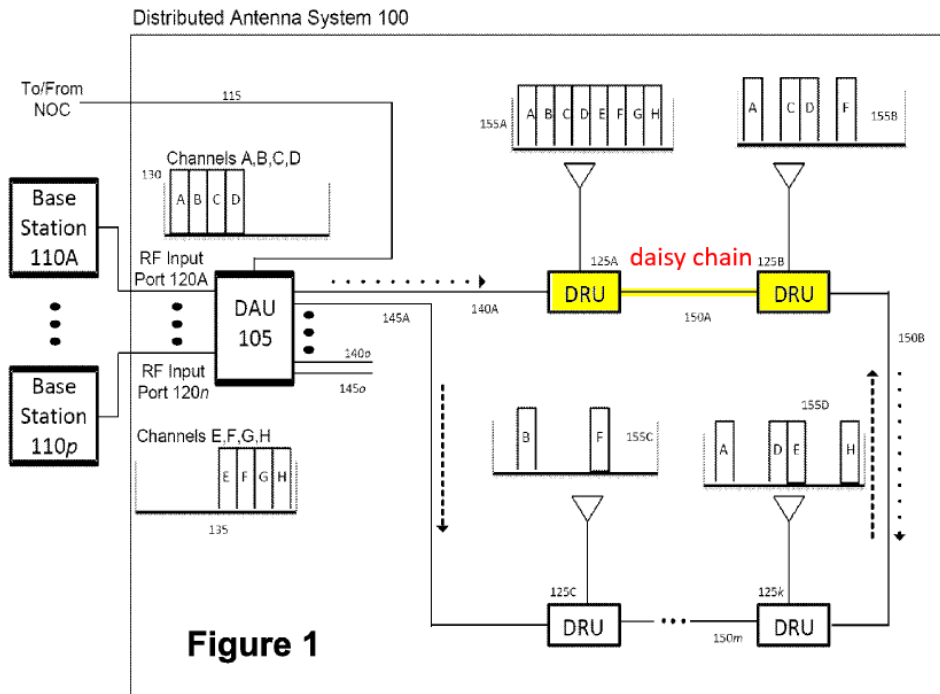
Stapleton's DAUs are coupled to the DRUs via "optical fibers," which meets both these claims. EX1006, ¶0029 ("received at the DAU 105....then delivered to different DRU's 125A-125k, typically over optical fiber cable"); EX1003, ¶¶223-225. Numerals 140A/145A, for example, are optical fibers:



EX1006, ¶0033 (“optical cables”), ¶0013 (“optical fibers”), ¶0036 (“optical fiber transport”).

N. Claim 15

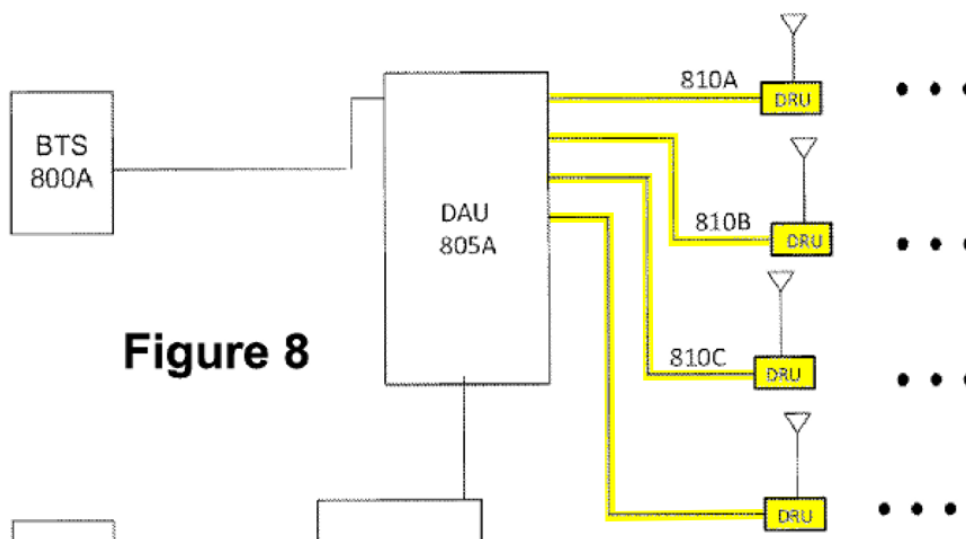
Stapleton discloses the DRUs can be connected in a “daisy chain configuration.” EX1006, ¶0029 (“daisy chain configuration.”), EX1006, ¶0057; ¶0007; ¶0041; ¶0044; ¶0053; Figs. 1, 3-4, 6, 8; EX1003, ¶¶226-229. Figures 1 and 8 show this:



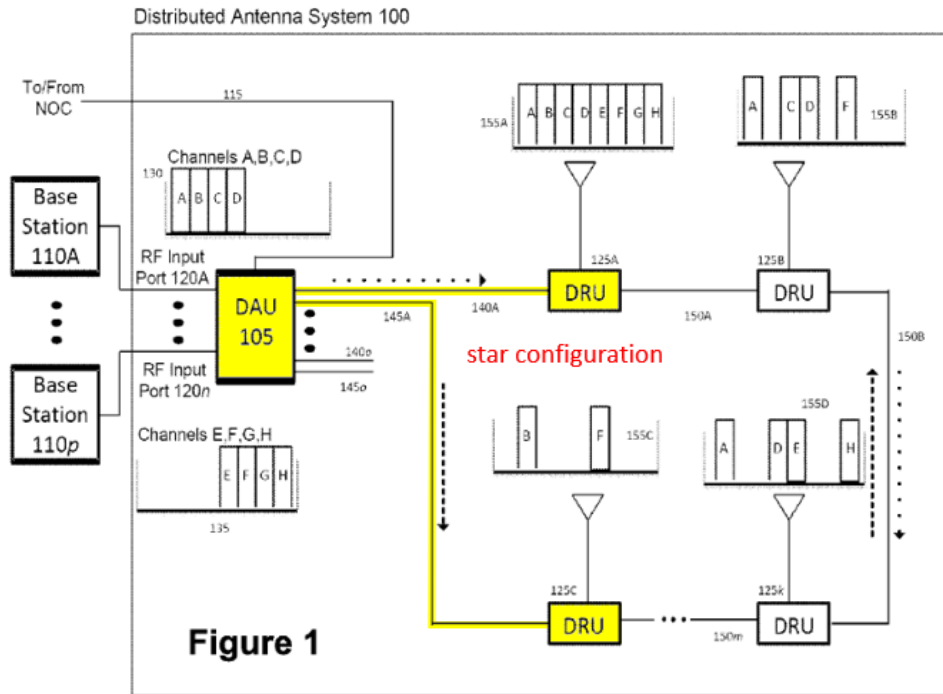
O. Claim 16

Stapleton discloses that the DRUs can be arranged in a star configuration.

EX1003, ¶¶230-232. See, e.g., Figure 8:



EX1006, Fig. 8 (cropped). Figure 1 also illustrates at least two DRUs in a star:



P. Claim 17

Stapleton teaches its DAUs can be indirectly connected to one or more BTSs (through another DAU) via an optical fiber. EX1003, ¶¶233-234. Figure 4, for example, shows that DAU 415 is indirectly coupled to BTS 405 via “optical cable 440” (red):

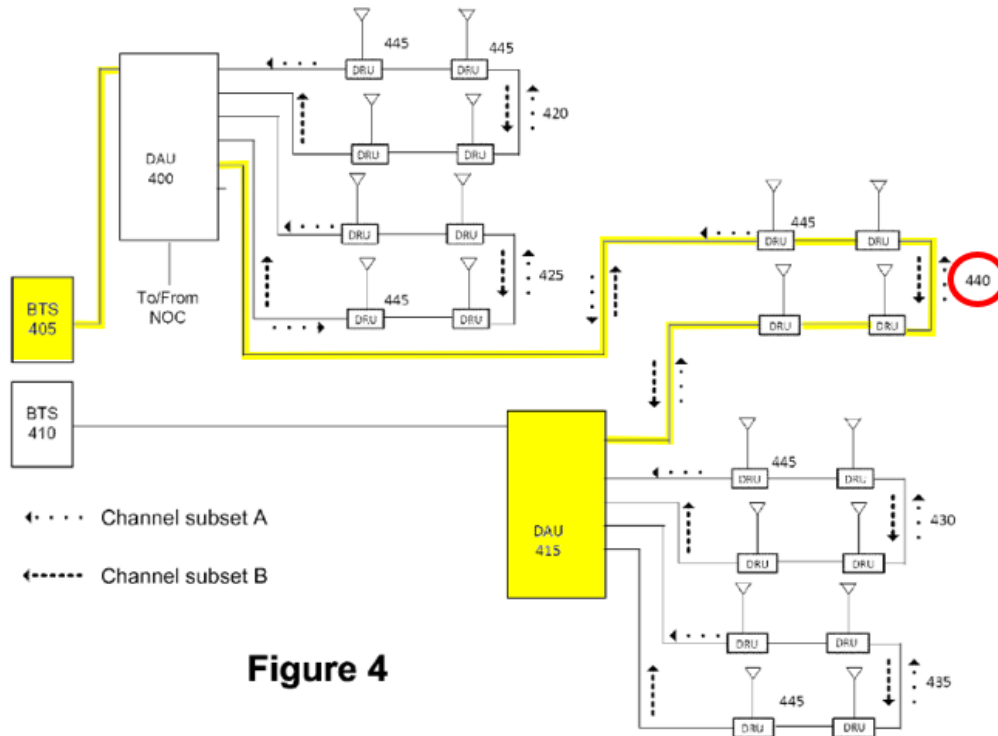


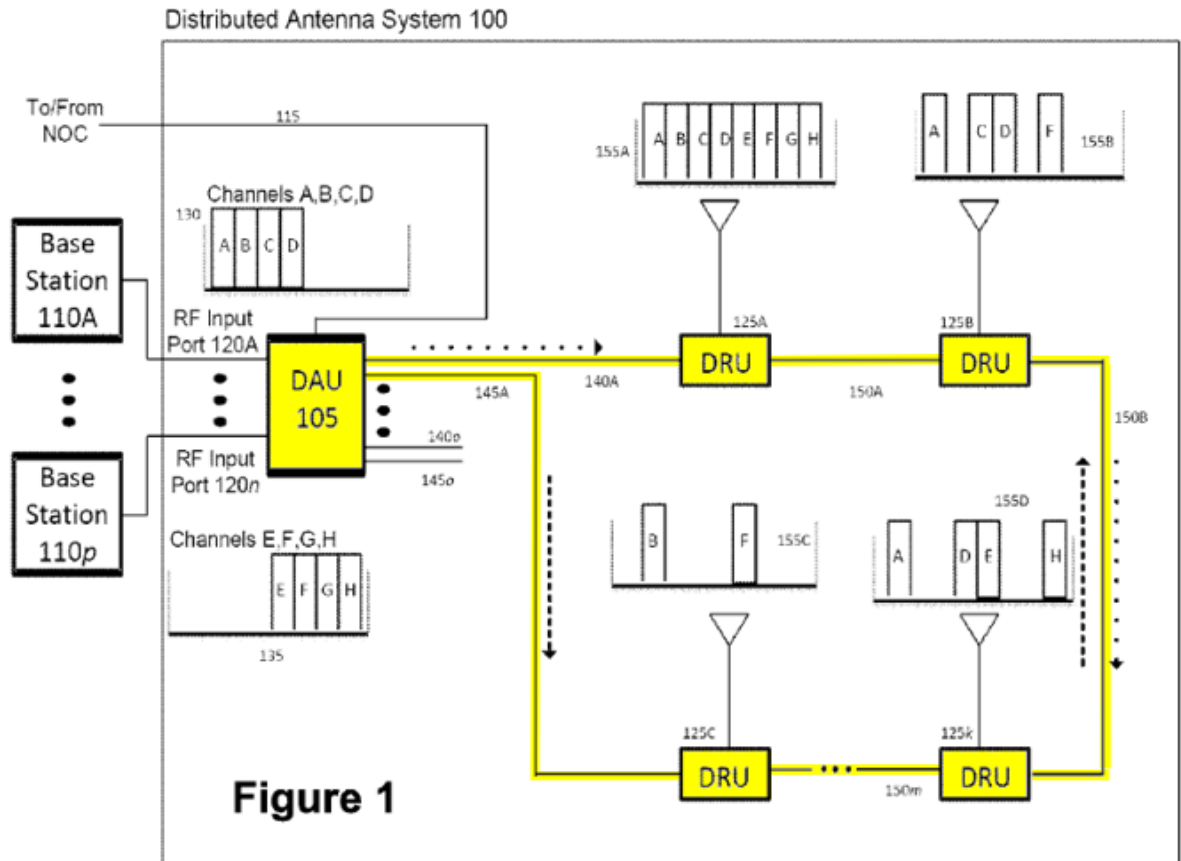
Figure 4

EX1006, ¶0036 (“The present invention ...allows more efficient use of the available optical fiber transport”), ¶0006 (“transport media e.g., optical fiber”).

The incorporated ‘836 provisional explains such optical cables provides access to the carriers from the other base station. EX1017, ¶0030. EX1006, ¶0001, ¶ 0012, ¶0036 (incorporating EX1017); EX1003, ¶234.

Q. Claim 18

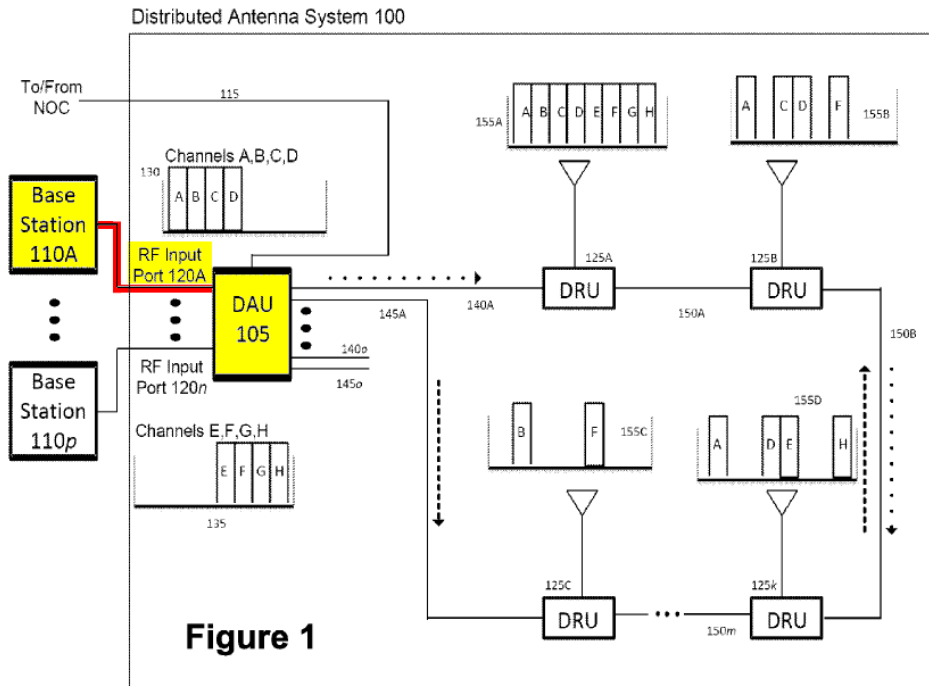
Stapleton discloses the DRUs can be connected in a “ring configuration,” which is an example of a “loop.” EX1006, ¶0007 (“DRU’s associated with a given DAU can be configured in either a linear or ring Daisy chain configuration.”), ¶0009, ¶0013, ¶0057; EX1003, ¶¶235-238. Figure 1 shows this:



See also EX1006, ¶0020 (“FIG. 1... ring scenario”), ¶0030 (“propagated around the ring”), ¶0029, ¶0033, ¶¶0039-0040, ¶¶0021-0023.

R. Claim 19

Figure 1 of Stapleton shows that the DAU has a single “RF input port” that is connected to one base station 110A:



EX1006, ¶0032 (“downlink input signal 130 from, e.g., a first base station 110A belonging to one wireless operator, enters the DAU 105 at the RF input port 120A”), ¶0036, ¶0044, ¶0028, Fig. 3; EX1003, ¶¶239-240.

Ground 2: Stapleton alone or in view of Kummetz-464 render claims 1-19 obvious

A. Claims 1 and 10

1. Element 1B/10B: “...configured as an uplink/downlink port”

Obvious in view of Stapleton itself

In addition to the express teachings in Stapleton, a POSA would find it obvious for Stapleton’s DAU to include bidirectional ports (i.e., uplink/downlink) for each of the cable connections. EX1003, ¶¶242-253.

First, where there are a finite number of predictable options, the subject matter is obvious. There are only two main options for a port: (1) a bi-directional duplex port (downlink/uplink), which would match Stapleton’s bi-directional cables or (2) a unidirectional simplex port (only downlink or uplink), which would not match Stapleton’s bidirectional cables. EX1003, ¶¶246-251. The option is taught in basic industry textbooks and only requires selecting from two alternatives. *Id.*; EX1023, 4.

Second, there are strong motivations to use bidirectional ports. EX1003, ¶¶247-253. Each bidirectional port *halves* the number of ports/cables compare to two unidirectional ports/cables, which saves money and space and makes installation easier. EX1003, ¶247. Further, a POSA would have been specifically motivated to enable the DAU to communicate with a digital base stations that follow the industry “CPRI” standard. EX1003, ¶¶252-253. As explained above for claim 1, CPRI requires the use of bidirectional ports. EX1009, 7. (CPRI defining “link” to be “the bidirectional interface in between two directly connected ports”). Background references corroborate this. EX1018, ¶0014, Fig. 3 (bidirectional arrows to 302), ¶0019. Stapleton incorporates the ‘593 provisional (EX1021) that already contemplates BTSs that use CPRI (and a bidirectional link to the BTS). EX1021, ¶0002, Fig. 4. There are many benefits for a DAS that communicates with a digital base station: improved resistance to noise/errors,

increased range, and the ability to remove costly analog-to-digital converter component at the DAU. EX1003, ¶¶252.

Third, a POSA would have a reasonable expectation of success. EX1003, ¶¶253, ¶246. Bidirectional duplex ports are off-the-shelf components. EX1003, ¶246.

Obvious in view of Stapleton in combination with Kummertz-464

Ground 3, below, explains that Kummertz-464 teaches to use bidirectional ports in a DAS. A POSA reading Stapleton would naturally look to Kummertz-464. EX1003, ¶¶254-258. (1) They both disclose distributed antenna systems. *Compare* EX1006, ¶0028 with EX1005, 2:40-53. (2) They both address a similar goal (adjusting/redistributing capacity). *Compare* EX1006, ¶0035, ¶0054 with EX1005, 2:40-53. (3) They both address a similar problem (users gathering in one place, e.g., a cafeteria/stadium). *Compare* EX1006, ¶0033, ¶0004 with EX1005, 11:17-21. The same motivations and rationale discussed above—finite number of choices, half the number of ports/cables, etc.—equally apply to a combination with Kummertz-464. EX1003, ¶256. Further, Kummertz-464 supports the motivation to include a bidirectional port to connect to a CPRI base station—Kummertz suggests this very option of receiving CPRI signals from a base station. EX1005, 7:50-65; EX1003, ¶257.

Consider the example: the DAU deploys an additional radio resource (e.g., C) to DRU 125k because “A” is overloaded. If A is *not* removed at the same time from DRU 125k, A would likely remain highly loaded because it is still being used by three DRUs. EX1003, ¶267. In contrast, it improves the load balancing to remove A from the DRU 125k at the same time C is added. *Id.* This reduces the overall load on A for the other two DRUs (125A/125B) because there are only two, not three, DRUs using this radio resource. *Id.*; EX1003, ¶268; see also example at ¶¶266-267.

Second, Stapleton itself suggests this implementation because it teaches to “remove” radio resources and enable “load balancing.” Stapleton ¶0058, ¶0010 (“automatic traffic load-balancing”); EX1003, ¶269.

Third, a POSA would have a reasonable expectation of success. EX1003, ¶270. Removing a radio resource only requires sending a command to the DRU’s DUC component to disable the radio resource. Stapleton ¶0034, ¶¶0036-0037, ¶0054; EX1003, ¶270. The DUCs can “enable or disable” (i.e., add or remove) each specific radio resource. Stapleton ¶0056.

Obvious in view of Stapleton combined with Kummetz-464.

Ground 3, below, explains that Kummetz-464 teaches to shift DRUs from one radio resource to another by removing the first radio resource and adding the second radio resource. As already explained, a POSA would have naturally looked

to Kummetz-464 because they are similar systems that address similar problems. EX1003, ¶¶271-275. The combination only calls for using a known technique (adding/removing radio resources) to improve similar devices (another DAS) in the same way (reallocating radio resources when users gather in one place and increase the load). EX1003, ¶274-275. The same motivations and expectation of success described listed above for obviousness based on Stapleton itself also apply to the combination of Kummetz-464 with Stapleton. EX1003, ¶273.

B. Claim 3

Obvious in view of Stapleton itself

As discussed in Ground 1, Stapleton already discloses the recited “*network optimization goal*.” Stapleton’s goal is to have the particular downlink carrier loaded by a percentage less than the threshold; otherwise, Stapleton determines it needs to deploy additional radio resources. Further, as discussed in Ground 1, Stapleton expressly teaches the goal comprises a “*percentage*.” If Stapleton teaching is not sufficiently express that the percentage is the percentage of “users associated with each of the plurality of radio resources,” a POSA would find this obvious in view of Stapleton’s disclosure. EX1003, ¶¶279-285.

First, this is a predicable variation of Stapleton’s disclosure. EX1003, ¶280. The number of users associated with each radio resource describes the load on the radio resources. *Id.* Stapleton’s disclosure already covers “load.” EX-1006,

¶0058 (“a particular downlink carrier is loaded by a percentage greater than a predetermined threshold”). Further, Stapleton already expressly teaches to consider the “number of wireless subscribers” (i.e., *users*) when allocating radio resources. Stapleton, for example, teaches to allocate additional radio resources to DRU125A in Figure 1 because that is where there are “a large number of wireless subscribers.” EX1006, ¶0033. Stapleton already expressly teaches to perform the reconfiguration based on “subscriber needs” (the subscriber are the *users* as recited in the claim). EX1006, ¶0004. Further, Stapleton discloses a way to determine the number of users occupying each radio resource by detecting how many timeslots are active. EX1006, ¶0058. That subscribers are counted based on detecting active slots/carriers means the subscribers are actual “users.”

Said another way, a POSA would find this claim particularly obvious because Stapleton’s existing technique already reflects the percentage of *users* associated with each of the plurality of radio resources. EX1003, ¶281. The number active time slots for a carrier (*radio resources*) reflects the number of users associated with the carrier (*radio resources*) because in well-known wireless standards (e.g., GSM) each active time slot represent is voice conversation for a user. *Id.*

Second, a POSA would have been motivated to implement Stapleton’s optimization process so that its percentage is the percentage of users associated

with each radio resource for multiple reasons: (1) to improve Stapleton's ability to *meet the needs of network subscribers when they gather in specific locations*.

EX1003, ¶¶282-283. Stapleton itself already recognizes the need to provide sufficient capacity (*radio resources*) to meet the needs of subscribers (i.e., *users*) when they gather in specific locations (e.g., a cafeteria at lunch time). EX1006, ¶¶0004, ¶¶0033. Implementing Stapleton's optimization process so that it relates to the number of users associated with each radio resource directly addresses this issue of subscribers (i.e., *users*) when they gather in specific locations; (2) *Second*, a POSA would have been motivated to implement Stapleton's optimization process so that it accounts for the number of users associated with each radio resource to *reduce the number of blocked/dropped calls and ensure balance coverage throughout the DAS*. EX1003, ¶284. (3) *Third*, redistributing capacity based on a percentage of users is a way to more equitably allocate resources to users (i.e., not allowing heavy users to consume unfair portion of capacity). EX1003, ¶290. (4) *Fourth* calculating the load percentage as a percentage of users can allow the system to predict where demand on radio resources are likely to increase. EX1003, ¶289.

A POSA would have a reasonable expectation of success because calculating a percentage of users is a basic division operation (number of users on this radio resources / total users). EX1003, heavy 285. Further, the provisional

'836 application incorporated in Stapleton already teaches a feature to determine the number of users (“track the radio signatures of all the active users within its network and record a running data base”). EX1017, ¶0019.

Obvious in view of Stapleton combined with Kummetz-464

As discussed in Ground 1, as discussed in Ground 1, Stapleton expressly teaches the optimization goal comprises a “percentage.” If Stapleton’s teaching is not sufficiently express that the percentage is the percentage of “users associated with each of the plurality of radio resources,” a POSA would find this obvious in view of Kummetz-464’s disclosure. EX1003, ¶¶286-292.

Kummetz-464 teaches a distributed antenna system can redistribute capacity (e.g., radio resources such as carriers) based in part on detecting traffic indicators such as the number of mobile devices in a coverage zone. EX1005, 9:40-47, 11:13-15. The location of mobile devices in Kummetz-464 is the location of *users*. This is evident from the way Kummetz-464 determines the location of the mobile devices. EX1003, ¶288. The location of the mobile devices in Kummetz-464 is based on the mobile device’s detected *use* of an allocated carrier or time slot. EX1005, 9:66-10:21, 12:40-55 (“The base station router **14** can communicate with the detection device **604** to identify which remote antenna unit receives the uplink signal at the strongest RSSI.”); EX1003, ¶288.

A POSA would be motivated to and have a reasonable expectation of success in calculating Stapleton's load percentage based on the number of users as taught by Kummetz-464 for the same reasons provided in the discussion above regarding Stapleton by itself. EX1003, ¶¶289-291, 283-285

C. Claim 17

Obviousness in view of Stapleton itself

If claim 17 is limited to direct connections (which it does not say), a POSA would have found this obvious. EX1003, ¶¶293-304.

First, Stapleton already teaches the direct connection between the DAU and DRU is an optical fiber. EX1006, ¶0029 (“DAU delivered to different DRU's...over optical fiber cable”), ¶0033, ¶0013, Fig. 1. Thus, the subject matter of this claim if narrowly construed only requires extending Stapleton's existing teaching from the DAU-DRU connection to the DAU-BTS connection, which is a predictable variation. EX1003, ¶295. Stapleton itself suggests this. Stapleton incorporates by reference a provisional that teaches to use optical fiber for a cable connection to a base station. EX1003, ¶¶295-297; EX1021, ¶0032; EX1021, ¶0002 (“BTS communicates...via optical fiber), ¶0016 (“communicate with the BTS using different optical wavelengths over one fiber”).

Second, there are only a finite number of options for cabled connection in a DAS: optical fiber or one of coaxial, twisted pair, or ethernet cable. EX1003,

¶298. The challenged ‘382 patent does not teach there is anything unpredictable about selecting optical fiber. It is an off-the-shelf cable type. *Id.*

Third, a POSA would have been motivated to choose an optical fiber over other cables because optical fiber *enables higher data rates and decreases signal loss*. EX1003, ¶¶300-301. A POSA would also have been motivated to choose optical fiber to gain the benefit (discussed above) of *communicating with digital base stations that follow the industry “CPRI” standard*. EX1003, ¶302. The CPRI standard teaches to use an “optical interface” for the connection between the base station and a remote node (here the DAU). EX1009, 4-5, 27, 29 (explaining the optical interface is a “fiber”).

Fourth, a POSA would have a reasonable expectation of success. EX1003, ¶303. Optical fiber is a standard, predictable, off-the-shelf component. *Id.*

Obviousness of Stapleton combined with Kummetz-464

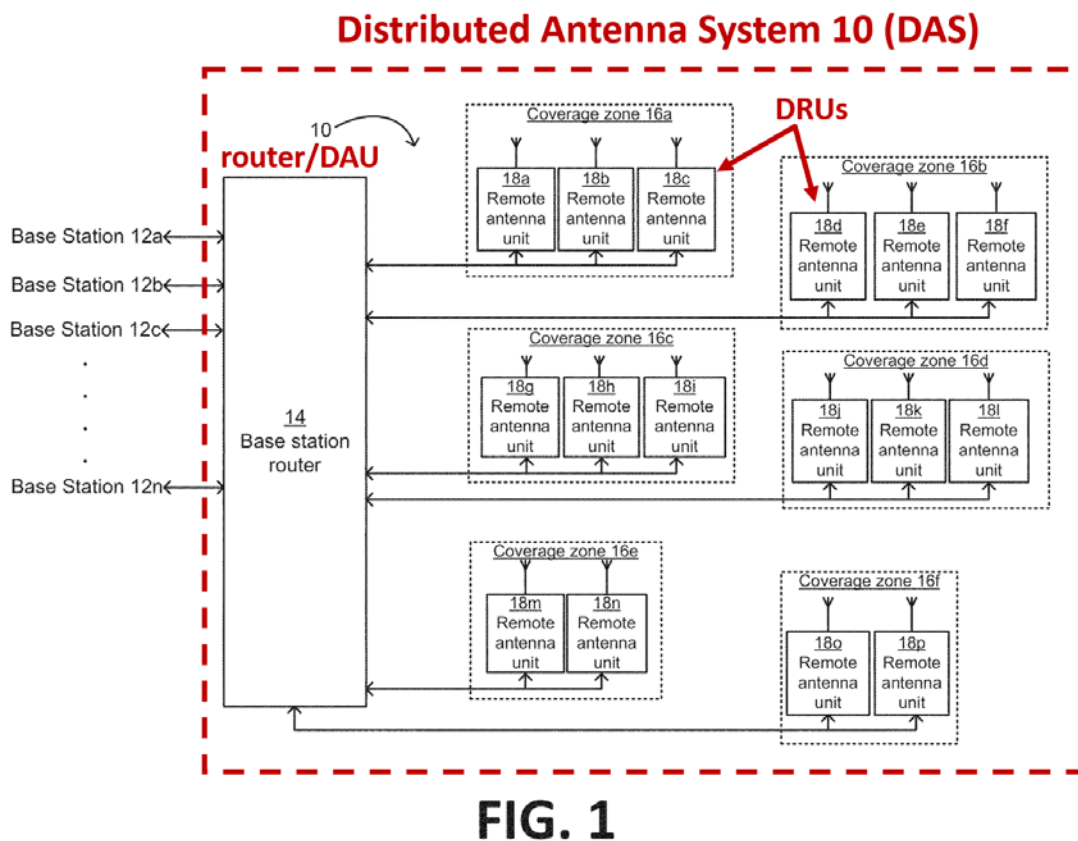
Ground 3, below, explains that Kummetz-464 teaches its DAU (the router) can connect to the base station via optical fiber. A POSA would have been motivated to incorporate this feature from Kummetz-464 into Stapleton for the same reason just discussed (*optical fiber enables higher data rates, decreases signal loss, longer distances*). EX1003, ¶305-310. Further, as already discussed, a POSA would naturally look to Kummetz-464 because it is a similar system that addresses a similar problem. EX1003, ¶310.

Ground 3: Kummetz-464 anticipates claims 1-2, 4-6, 8-17 and 19 (all claims except 3, 7, and 18)

A. Claim 1

1. Element 1A

Kummetz-464 discloses “a system” because it discloses a “distributed antenna system” (DAS). EX1005, 1:16-16, 1:20-25, codes (54) (57), Fig. 1 (below); Fig. 2, 2:54-59, 3:7-8; 4:27; EX1003, ¶311.



2. Element 1B

First, the Kummetz-464 DAS includes a “base station router 14” (a *DAU*). EX1005, Fig.1; EX1003, ¶¶312-313. The router is operable to receive at least one signal from at least one of a *first signal source* (BTS 12a of Fig. 1) and a *second*

signal source (BTS 12b of Fig. 1). EX1005, Fig. 1, 14:14-16, and Fig. 2 (below, annotated); EX1003, ¶313.

Second, Kummetz-464 router includes “an input port” and “an output port,” identified in Fig. 2 below by the left and right arrows. EX1003, ¶314. Each input port and the output port of the Kummetz-464 system is configured as an “uplink/downlink port”. EX1005, Fig. 2; EX1003, ¶¶314-315.

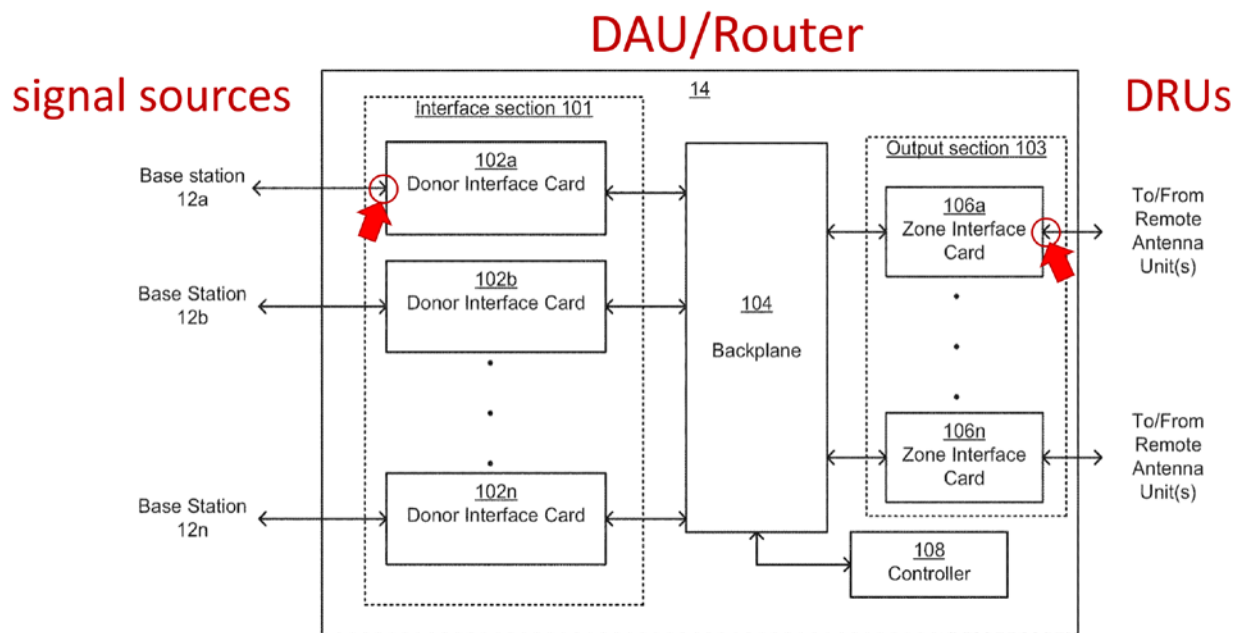


FIG. 2

The bi-directional input port: The router (DAU) includes an input interface 101 (interface section 101) that receives signals from and provides signals to the base stations 12a–12n, supporting uplink and downlink functionality. EX1005 at 6:11-15, 7:45–48, 7:50–52, 7:66–8:1, 8:8–10, Fig. 2 (Fig. 2 shows a bi-directional link between a base station and a donor interface card); EX1003, ¶315, 317-318.

The bi-directional output port: Base station router 14 also includes an output section that receives signals from and provides signals to the remote antenna units, similarly, allowing uplink and downlink functionality. EX1005 at Fig. 2 (showing bi-directional link “To/From Remote Antenna Units”); 7:60-65 (link to/from remote antenna units may also use “common digital formats”), 6:11-15 (listing CPRI and ORI as examples of common digital formats), 7:45–49, 8:23–24, 8:27–32, 8:41–42. EX1013, Fig. 2.3.1, section 3.1 (“ORI link: bidirectional interface in between two directly-connected ORI ports, on two ORI nodes”); EX1003, ¶¶316-318.

3. Element 1C

Kummetz-464’s system includes one or more “remote antenna units” (*DRUs*), each coupled to the router (*DAU*). EX1003, ¶¶319-321. Each remote antenna unit is operable to transport signals to/from the router. EX1005, 8:23–54, Fig. 6, 11:39–52, Fig. 1 (below, annotated); EX1003, ¶¶319-321.

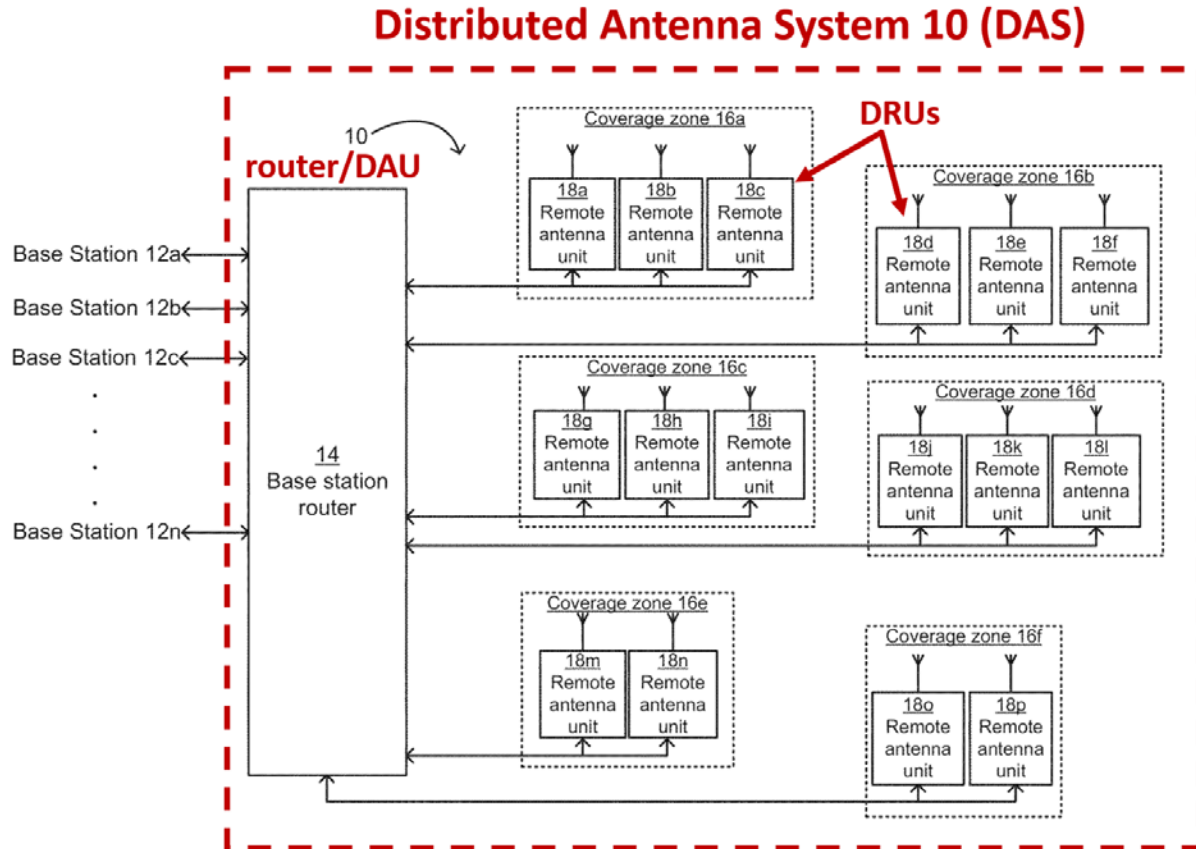


FIG. 1

4. Element 1D

The sectors in Kummetz-464 are a plurality of radio resources that are formed from the remote antenna units (*DRUs*) by being radiated from the remote antenna units into coverage zones according to how the radio resources were distributed by the router. EX1005, 3:16-19, 10:56-63 (sectors include multiple RF channels), Fig. 4, 5:24-42; EX1003, ¶¶322-332. As shown, e.g., in Figure 4 there are multiple different sectors (302a-302c) that are each radiated into different coverage zones by different subsets of remote antenna units (*DRUs*). EX1005, Fig. 4, 5:24-42; EX1003, ¶¶328-332. A POSA would understand element 1D to

cover the '382 patent's disclosed operation of how radio resources are "formed from the DRUs" by being radiated wirelessly within a coverage area. Kummets-464 discloses the same operation. EX1003 ¶¶322-332.

5. Element 1E

Kummets-464 discloses element 1E because the system includes a "controller 108" (*a traffic monitoring unit*) coupled to the backplane of router 14 (*DAU*). EX1005 at 8:54–58, 8:63-9:25, 9:34-65, Figs 2, 3; EX1003, ¶¶333-339. The controller can "detect traffic and perform measurements independent of a wireless network standard and protocol." EX1005, 9:44–54. Kummets discloses that a detected "traffic indicator" can include, data describing or otherwise corresponding to traffic measurements, usage, a number of mobile devices in each coverage zone, spurious signals, failure events, loss of capacity due to interference. EX1005, 9:40-61; EX1003, ¶¶337-338.

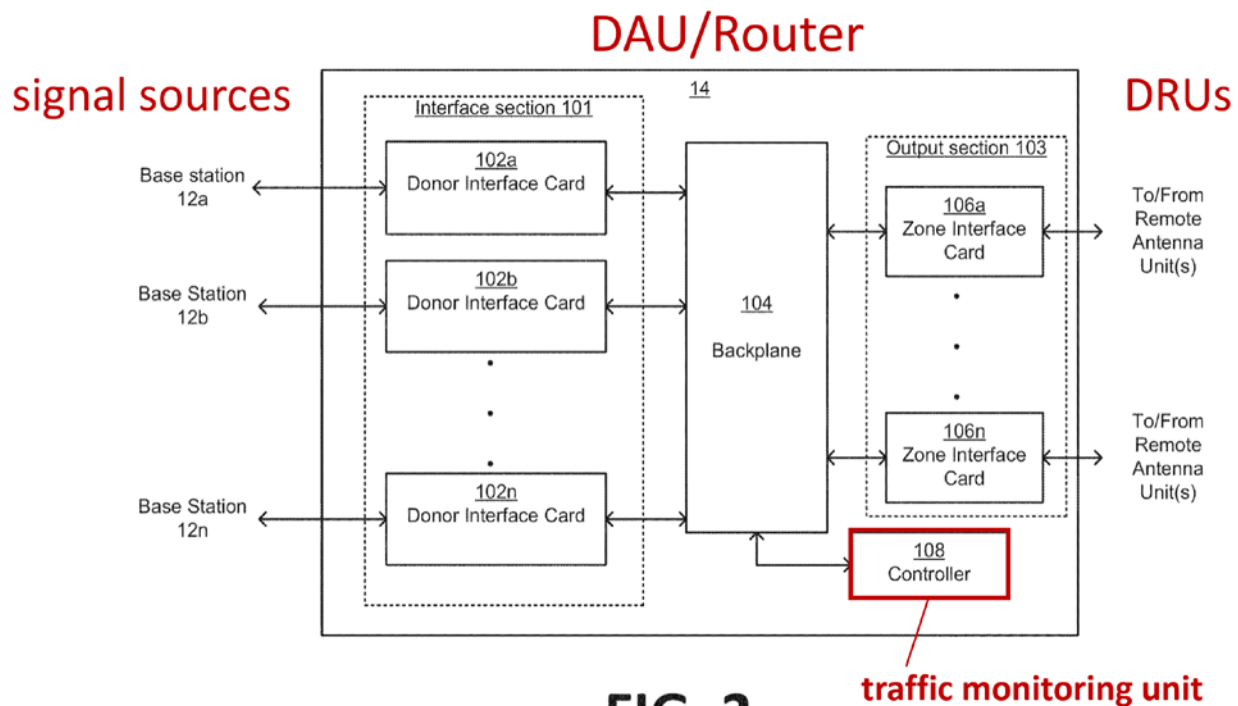


FIG. 2

6. Element 1F

By contrast to the parent ‘454 patent, element 1F of the ‘382 patent requires the traffic monitoring unit to determine only one of two alternatives: (a) *determining a key performance indicator (KPI) **or*** (b) *determining a quality of service (QoS)*. Thus, prior art disclosing a traffic monitoring unit that determines only one of the two alternatives satisfies element 1F. *See Brown v. 3M*, 265 F.3d 1349, 1352 (Fed. Cir. 2001) (finding claim anticipated where prior art disclosed one of two alternatives claimed); *In re Theresa*, 720 F.App’x 634, 637 (Fed. Circ. 2018)(same).

Kummetz-464 discloses a controller 108 (*traffic monitoring unit*) that determines at least one or more traffic indicators (*KPIs*), such as the detected

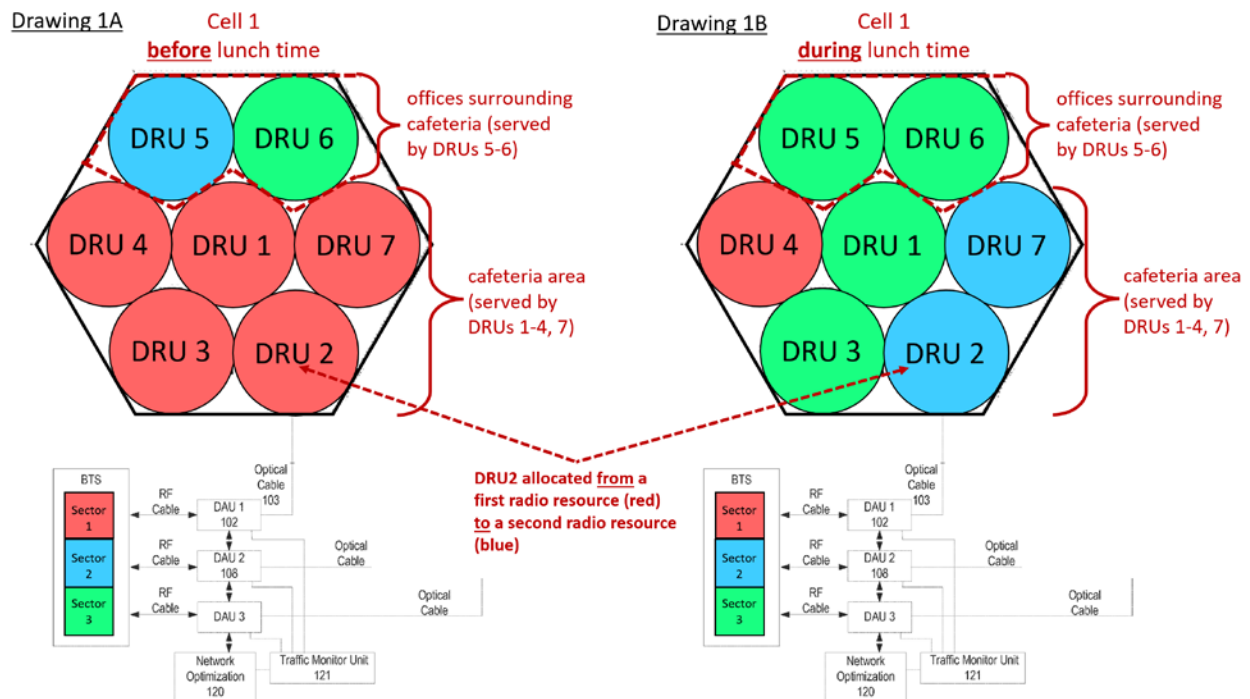
traffic, usage, number of users in each coverage zone, failure events, interference. EX1005, 9:40–61; EX1003, ¶¶341-347. In addition, Kummetz-464 determines QoS based on KPIs. For example, Kummetz compares the traffic measurements to low or high thresholds. EX1005, 9:50-51. The result of this comparison (passing or not passing) as well as the threshold itself are determinations of QoS of network traffic. EX1003, ¶¶342, 370. They describe and evaluate the quality of the performance of the network. *Id.*

7. Element 1G

The discussion under elements 1D-1F are incorporated by reference. The controller 108 in Kummetz-464 reconfigures the distribution of radio resources (sectors) based on detected traffic indicators. EX1005, 9:34–35, 9:44–54, 9:55–65, 11:13–15, Figs. 4–5, 10:30–11:28; EX1003, ¶¶349-357.

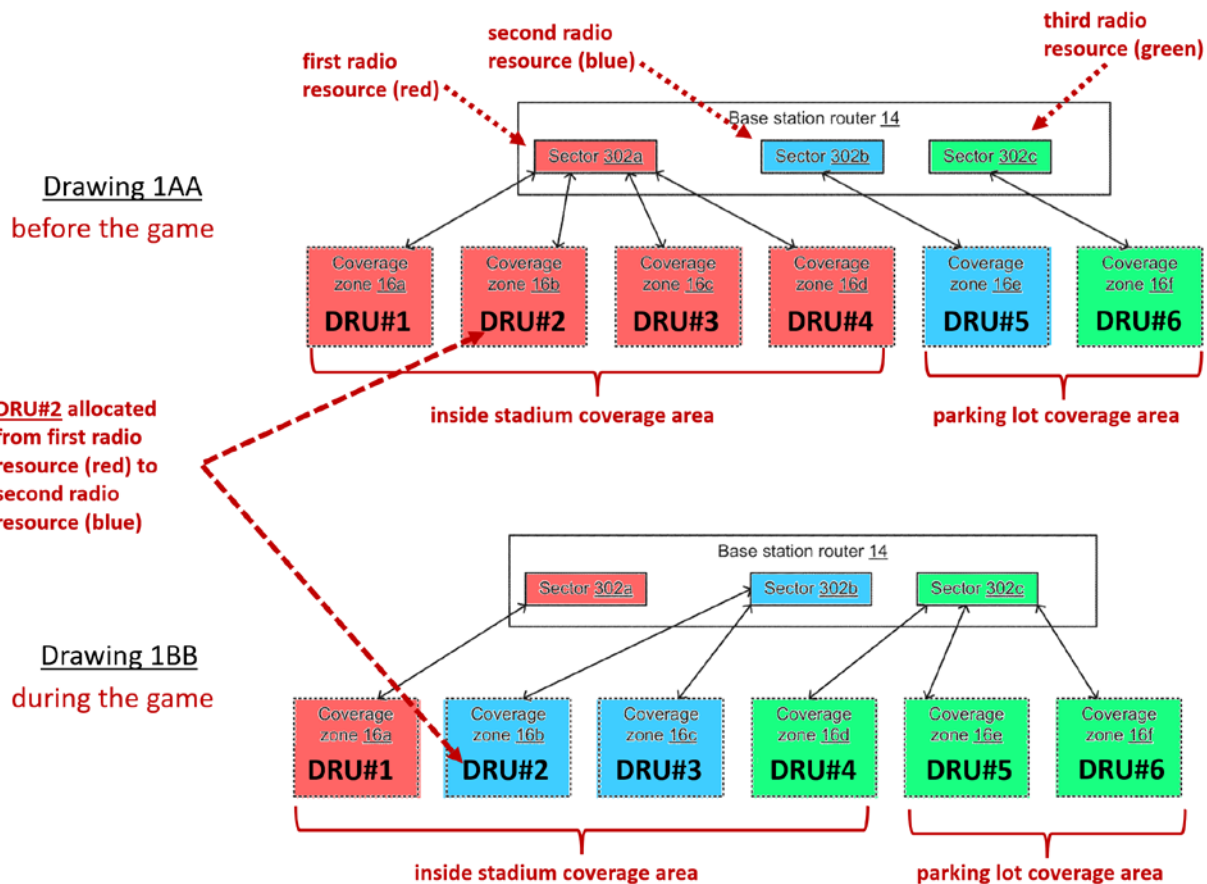
The operation of the ‘382 patent system. With reference to the example discussed in the ‘382 patent at 1:31-48, Drawing 1A (below) illustrates how DAU1 allocates and distributes the red, blue and green radio resources to DRUs 1-7 before lunch time. EX1003, ¶355. Consistent with the ‘382 patent’s disclosure, before lunch time, the DAU 1 distributes less capacity to the cafeteria (e.g., only the red radio resource is distributed to DRUs 1-4, 7 that serve the cafeteria). By contrast, Drawing 1B (below) illustrates how DAU1, after detecting a KPI showing that most of the wireless subscribers have moved to the cafeteria, allocates and

redistributes the red, blue and green radio resources during lunch time. EX1003, ¶355. Consistent with the ‘382 patent’s disclosure, during lunch time, more capacity is shifted to the cafeteria. Further, to satisfy the operation of element 1F, the reconfiguring includes “*allocating at least one DRU [e.g., DRU#2, below] from the first radio resource [e.g., from red] to the second radio resource [e.g., blue]*”



The operation of the Kummetz-464 system is the same. EX1003, ¶¶356-357. With reference to the example discussed in the Kummetz-464 patent (EX1005, 10:64 - 11:28, Figs. 4,5), Drawing 1AA (below) illustrates how the router allocates and distributes the red, blue and green radio resources to DRUs 1-6 before the game. EX1003, ¶356. Before the game, the router distributes less

capacity to the stadium (e.g., only the red radio resource is distributed to DRUs 1-4 that serve the stadium). By contrast, Drawing 1BB (below) illustrates how the router, after detecting a traffic indicator (*KPI*) (e.g., such as the number of users in each coverage zone) showing the wireless users have moved to the stadium, allocates and redistributes the red, blue and green radio resources during the game. EX1003, ¶356. Consistent with the '382 patent's disclosure, during the game, more capacity is shifted to the stadium. Further, to satisfy the operation of element 1G, the reconfiguring includes "*allocating at least one DRU [e.g., DRU#2, below] from the first radio resource [e.g., from red] to the second radio resource [e.g., blue]*."



Kummetz-464 discloses element 1F because it discloses the same operation as discussed for the ‘382 patent for satisfying element 1G. EX1003, ¶¶348-357.

B. Claim 10

See analysis of claim 1. Claim 10 is nearly identical to claim 1 except it adds the limitation in element 10E that the traffic monitoring unit is “external” to “at least one” DAU. Kummetz-464 teaches that the controller (a *traffic monitoring unit*) “can be disposed in a separate device external to and in communication with” the router (a DAU). EX1005, 8:60-62, Fig. 9. EX1003, ¶376, ¶363.

C. Claim 2

Each of Kummets-464 Figs. 1, 2 and 6 disclose a base station router (DAU) that is coupled to *one or more base transceiver stations* 12a–n. EX1005, Fig. 1, 5:14-23; EX1003, ¶¶358-362. Kummets-464 further discloses that *each base station 12a–n can comprise one or more sectors* (each sector representing a different set of radio sources, e.g., one or more frequency channels or RF bands). EX1005, 5:50–54; 4:5–19, 5:14–23, 5:54–58; EX1003, ¶361.

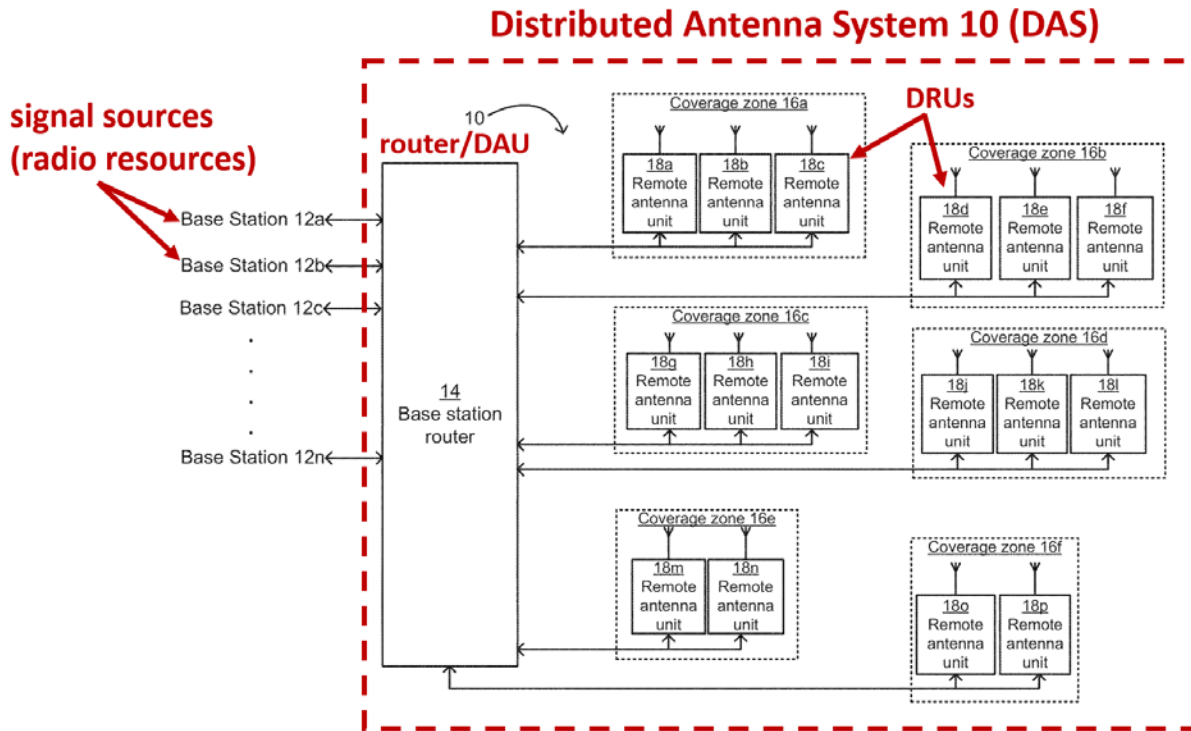


FIG. 1

D. Claim 4

Kummetz-464 teaches that the controller (*a traffic monitoring unit*) “can be disposed in a separate device external to and in communication with” the router (a DAU). EX1005, 8:60-62, Fig. 9; EX1003, ¶363.

E. Claim 5

Kummetz-464 teaches that the controller (*traffic monitoring unit*) “can be disposed in the base station router” (a DAU). EX1005, 8:58-59, Fig. 2; EX1003, ¶364.

F. Claim 6

Kummetz-464 discloses that the “controller 108” (*a traffic monitoring unit*) is provided as a component of a “base station router” (DAU) which is external to “remote antenna units 18a–p” (the DRUs). EX1005, Figs. 1–2, 5:14–16, 8:54–62; EX1003, ¶365.

G. Claim 8

See ground 3 under elements 1F and 1G. Kummetz-464 discloses that the “controller” (*traffic monitoring unit*) can analyze one or more “traffic indicators” [KPIs] for the system’s router. EX1005, 9:44–54. Kummetz-464 states:

A traffic indicator can include data describing or otherwise corresponding to a number of mobile devices in each coverage zone. Examples of a traffic indicator can include ... traffic measurements passing low or high thresholds

EX1005, 9:44–52. Comparing traffic measurements to low or high thresholds is an example of analyzing a key performance indicator. EX1003, ¶366. Further, the controller can “communicate data describing the routing of signals by the base station router” and “implement any process for measuring uplink signals for traffic and other types of information.” EX1005, 9:34–35, 9:55–65.

H. Claim 9

Kummetz-464 teaches that a traffic indicator can also be compared to a “low” threshold value or a “high” threshold value. EX1005, 9:47-52. This is an example of analyzing QoS values of the DAS. EX1003, ¶¶367-370. The result of the comparison (passing threshold / not passing threshold) is a QoS value of network traffic, is a function of the KPIs, and is used to trigger adding or removing radio resource sectors to and from remote antenna units. EX1005, 8:54-62; 9:22-25; 9:40-61; 11:13-28; EX1003, ¶370. In addition, the high and low threshold values themselves are examples of QoS values of network traffic. EX1003, ¶370. The threshold values are a function of one more traffic indicators (KPIs) because the thresholds are chosen in light of and are compared to the measured traffic indicators and are used to decide whether to trigger adding or removing radio resources. EX1003, ¶370.

I. Claim 11

See ground 3 under element 1E. Kummets-464 discloses that the controller (*a traffic monitoring unit*) may be provided as a component of a “base station router 14,” and the “base station router 14” is external and coupled to each of “base stations 12*a–n*.” EX1005, Figs. 1–2, 5:14–16, 7:50–8:7, 8:54–62; EX1003, ¶379.

J. Claim 12

Kummets-464 discloses a processor 202 (*a network optimization processor*) coupled to the controller (*a traffic monitoring unit*). EX1005, 8:64–9:5; EX1003, ¶¶380–382.

The Kummets-464 controller includes a configuration engine 210 that, when executed by the processor 202, can optimize the network, e.g., redistribute capacity in response to changes in traffic indicators. EX1005, 9:22–25, 9:55–61, Fig. 3, 11:13–15; Ex 1003, ¶¶381–382.

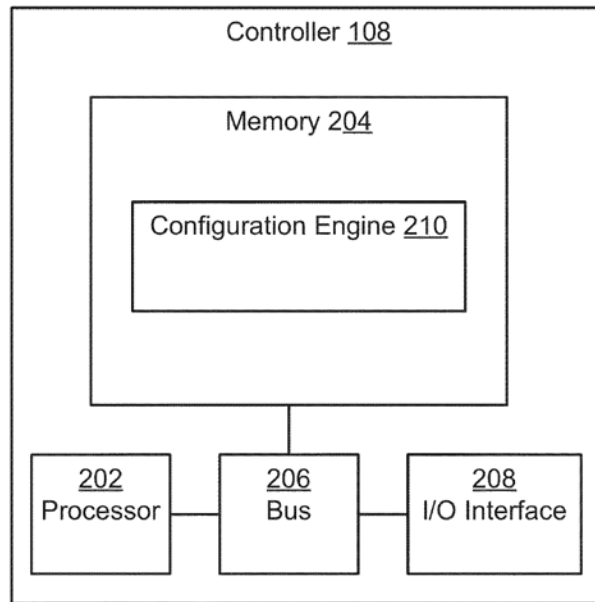


FIG. 3

K. Claim 13

Kummetz-464 discloses that a plurality of base station routers 14a–c (*DAUs*) can be coupled to each other (other *DAUs*) and to remote antenna units (*DRUs*). EX1005, Fig. 1, 2:54-59, 11:39–52, Fig. 6 (below). Kummetz-464 also teaches that the links between the *DAUs* can be wired, optical (i.e. optical fiber) or free air paths (i.e., wireless). EX1005, 4:61–5:4. EX1003, ¶383-385.

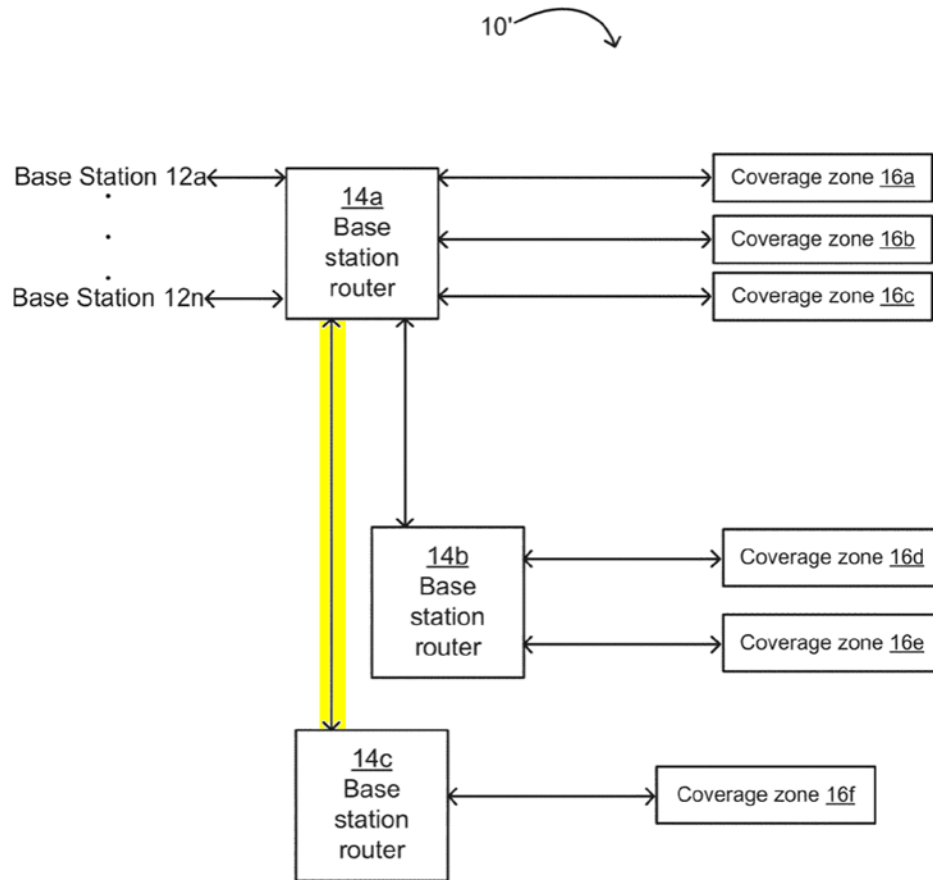


FIG. 6

L. Claim 14

Kummetz-464 discloses that the base station routers (DAUs) are coupled to remote antenna units (DRUs) via optical fiber and microwave link (wireless).

EX1005, Fig. 1, 7:12-21; EX1003, ¶¶386-387.

M. Claim 15

Kummetz-464 discloses a system in which the one or more remote antenna units (DRUs) are connected in a *daisy chain configuration*. Figure 1 of Kummetz-

464 illustrates an embodiment in which a base station router 14 is directly connected to multiple remote antenna units 18a-c (a *daisy-chain*) which is described as using a “serial link”. EX1005, Fig. 1 (below), 2:54–58, 3:7-14, 5:14-16, 7:12-19, 7:45–49, 8:23–33; EX1003, ¶388.

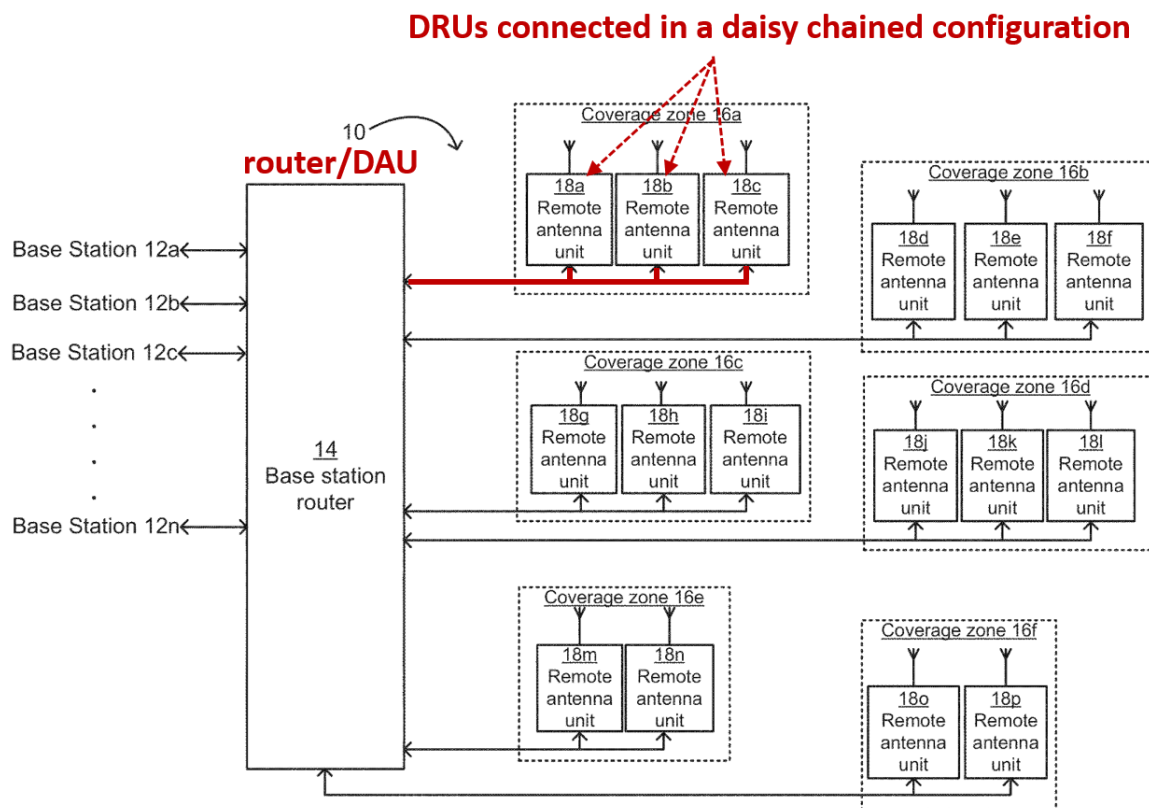


FIG. 1

N. Claim 16

A POSA would understand that a “star configuration” refers to a point-to-multipoint topology in which a central node is directly connected to a plurality of peripheral nodes—also called a “hub-and-spoke” configuration. See EX1009,

Section 2.3 and Figs. 5 (showing “star topology” supported by CPRI); EX1003, ¶389. Fig. 1 (below) of Kummetz-464 shows that DRUs 18a, 18d, 18g, 18j, 18m, and 18o are connected to router 14 (a DAU) in a star configuration. EX1005, Fig. 1, 2:54–58, 3:7–14, 5:14–16, 7:12–19, 7:45–49, 8:23–33; EX1003, ¶390.

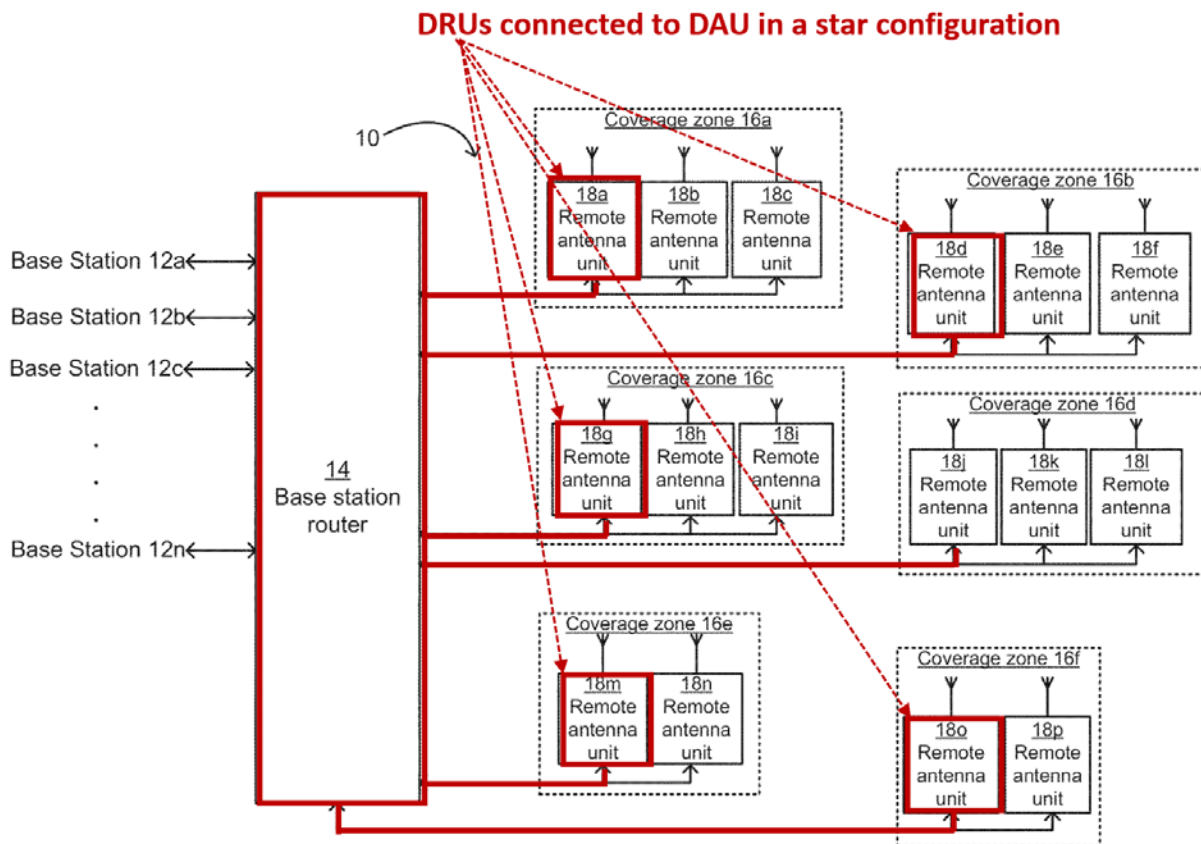


FIG. 1

O. Claim 17

Kummetz-464 states that the base station router 14 (DAU) “can receive signals from the base station 12a–n via a ... wireless communication medium” (a *wireless link*) EX1005, 5:24–25. EX1003, ¶¶391-393.

P. Claim 19

See ground 3 under element 1B.

Ground 4: Kummetz-464 alone or in view of Wu render claims 1-19 obvious

A. Claims 1 and 10, element 1B/10B: “...configured as an uplink/downlink port”

See ground 3 above. The last clause of element 1B/10B requires “an input port” and “an output port” both “configured as an uplink/downlink port”.

Obvious based on Kummetz-464 alone. Fig. 2 *shows* a bidirectional link between the router and the remote antenna unit, but does not use the term bidirectional in its description of that link. To extent it is argued that Kummetz-464 does not provide a disclosure describing the port for supporting the link between the router and a remote antenna unit can be bi-directional, then, based on Kummetz-464 alone it would have been obvious to a POSA to employ a bi-directional port between the router and the remote antenna units of Kummetz-464. EX1003, ¶¶396-400, 402.

Kummetz-464 Fig. 2 specifically *shows* the use of bi-directional link for transporting signals “**To/From Remote Antenna Units**”); EX1005, Fig. 2. That Kummetz-464 states that the link “to/from remote antenna units” may also use “common digital formats” (EX1005 at 7:60-65) also would have suggested to a POSA to use CPRI or ORI digital formats both of which use bi-directional links. EX1005 at 6:11-15 (listing CPRI and ORI as examples of common digital

formats), 7:45–49, 8:23–24, 8:27–32, 8:41–42. EX1003, ¶400. As discussed above, the CPRI interface protocol defines its links to be bidirectional between two directly connected ports. EX1009, 7; see also EX1013 at Fig. 2.3.1 and section 3.1 (“**ORI link:** bidirectional interface in between two directly-connected ORI ports, on two ORI nodes”).

Obvious on Kummetz-464 in view of Wu. Wu also discloses a distributed antenna system and is directed to the same problem: load balancing in a DAS when conditions in the coverage area changes. EX1003, ¶401. Wu also discloses a DAS that can dynamically route radio resources to address the problem. EX1007, ¶0039, ¶0047, ¶0040–46. For efficiency reasons, Wu teaches to use a bidirectional link using CPRI for the links to the remotes, a common digital format that employs bidirectional links. EX1007, ¶0031 (fiber links 115 to RTUs 110 (examples of DRUs) from host units 130 (part of DAUs) use CPRI); ¶0056 (system is “bidirectional”). The CPRI interface protocol defines its links to be bidirectional between two directly connected ports. EX1009, 7. Thus, based on Wu’s disclosure of a DAS that addresses the same problem as addressed by Kummetz-464 and ‘the 382 patent, a POSA would have been motivated to use a bi-directional link between the Kummetz-464 router output port and the remote antenna port. One would be motivated to use bidirectional ports to reduce the components, cost,

and size of the system. Fewer ports and fewer cables would be necessary where bidirectional ports are employed. EX1003, ¶401 .

Reasonable expectation of success. A POSA would have known that CPRI is a common digital format and thus would have had an expectation that such a link could be successfully employed in the Kummetz-464. EX1003, ¶402.

B. Claim 3

If the PO argues that Kummetz-464 does not anticipate the claim 3, then, alternatively, Kummetz-464 alone renders claim 3 obvious. EX1003, ¶¶403-414. It should be noted that ‘382 patent defines “optimization” to include performance improvements, even if complete optimization is not achieved. EX1001, 6:7-15.

Obvious in view of Kummetz-464 itself

As discussed in Ground 3, Kummetz-464 teaches to use the disclosed system to redistribute capacity with the target or goal of matching required capacity with provided capacity (*a network optimization goal*). EX1005, 3:32-34 (the router redistributes capacity “such that [a] the capacity requirements or capacity density match [b] the provided capacity.”); EX1003, ¶¶406-407.

To trigger the redistribution and achieve the network optimization goal, the Kummetz-464 system measures or detects a traffic indicator such as “data describing or otherwise corresponding to a number of mobile devices in each

coverage zone” or “traffic measurements passing low or high thresholds.” EX1005, 9:34-54; EX1003, ¶408.

A POSA would also understand that, due to the nature of sporting events: (a) before game time, a very large percentage of users are in the parking lot and a low percentage of users, if any, are in the stadium; and (b) during the game, a very low percentage of users, if any, are in the parking lot and a very high percentage of users are in the stadium. EX1003, ¶409. Thus, for the sporting event example, a POSA would also understand that the measured traffic indicator would be an indication that a very large percentage of users have moved to inside the stadium, thus triggering the redistribution of more capacity to the remote antenna units inside the stadium. *Id.*

PO may argue that to satisfy claim 3, the system must use an indicator that represents a percentage, e.g., more than 50% of the total number of users have moved to inside the stadium. If PO argues that it is not enough that the traffic indicators be used as an indication that a large percentage of the users have moved to inside the stadium, then it would have been obvious to POSA to use a traffic indicator expressed as a percentage of the total number of users that have moved inside the stadium to use the sector resources inside the stadium. EX1003, ¶410.

Under the Kummetz-464 teachings, the system would already have (a) the total number of users; (b) the number of users using the resources in the parking

lot, and (c) the number of users using the resources in the stadium. Having a system that already provides the information of (a) – (c), using a traffic indicator expressed as a percentage is a predictable variation of the measured traffic indicators used in the Kummetz-464 system.

A POSA would be motivated to state Kummetz-464 traffic threshold as a percentage for multiple reasons: (1) Calculating load as a percentage of users is a predictable variant of Kummetz-464 that would assist Kummetz-464 in matching the capacity requirements to the provided capacity; (2) Calculating the load percentage as a percentage of users can allow the system to predict where demand on radio resources are likely to increase; and (3) Redistributing capacity based on a percentage of users is a way to more equitably allocate resources to users (i.e., not allowing heavy users to consume unfair portion of capacity). EX1003, ¶¶411-413.

A POSA would have a reasonable expectation of success to calculate the traffic load as a percentage of users because it is a simple mathematical calculation easily performed by the processors present in Kummetz-464. EX1003, ¶414.

C. Claim 7

Kummetz-464 alone renders the limitation added by claim 7 obvious. EX1003, ¶¶415-420. Kummetz-464 discloses the controller (a traffic monitoring unit) “can be disposed in a separate device external to and in communication with the base station router 14.” EX1005, 8:58–62. A POSA would understand that

each of the remote antenna units of Kummetz-464 is an example of “a separate device” (i.e., external to the router) external to the router that the traffic monitoring unit could be disposed in as by Kummetz-464. EX1003, ¶415. Therefore, the teaching of Kummetz-464 (i.e., including the controller in a “separate device external to” the router) would have at least motivated a POSA to include a traffic monitoring unit within each of the “one or more” remote antenna units, one of the already-existing components of the system, that already have access to the signals to be monitored for activity, e.g., via RSSI measurements on received traffic signals. EX1003, ¶415.

A POSA would have understood which external unit incorporated the controller was a matter of design choice (there are only a limited number of existing components external to the router in Kummetz-464’s system). EX1003, ¶416. Implementing such a design in the remote antenna units (DRUs) would have been routine (e.g., power or signal strength detectors) and would have led to predictable results (measurements of traffic activity received from user devices at the remote antenna units). EX1003, ¶¶417-420.

Therefore, it would have been obvious to a POSA, based on Kummetz-464 to provide the traffic monitoring functions of the controller within a remote antenna unit where the upstream and downstream traffic signals pass and can be monitored via measurements.

D. Claim 9

To the extent that PO contends that Kummetz-464's teaching to compare a measured traffic indicator to a "low" threshold value or a "high" threshold value is not an example of analyzing QoS values, then it would have been obvious to configure the Kummetz-464 DAS to analyze Quality of Service (QoS) values based on Kummetz-464 alone. EX1003, ¶¶421-423.

A POSA would have found it obvious that the high and low threshold values could also be applied to analyze metrics that are calculated from the KPIs (i.e. to analyze QoS values of network traffic), not merely to KPIs themselves. EX1003, ¶423. Combining or deriving a QoS value as a function of the traffic indicators disclosed in Kummetz-464 and then analyzing those QoS values by comparing to a high or low threshold is predictable variant of Kummetz-464. *Id.* Using raw data to calculate a separate QoS value such as a sum, a rate (e.g., count per unit time), a percentage (count per total), or a density are well-known, simple mathematical functions that can be used to describe the performance of the network using KPI data as inputs. *Id.* A POSA would be motivated, for example, to derive or combine raw KPI data in Kummetz-464 into a QoS value for analysis (e.g., by comparison to a threshold) for a number of reasons, including: (1) to simplify into a single decision analysis the inputs from multiple KPI measures; and (2) to genericize the values so that the analysis criteria (threshold) can be the same across

multiple different air interface protocols (i.e., stating threshold as a percentage of a capacity total allows the same threshold to be applied whether the traffic is counted in time slots, carriers, resource blocks or some other measure). EX1003, ¶423. A POSA would have a reasonable expectation of success because these type of simple mathematical functions are easy to program and execute by the processors already present in the Kummetz-464 system. *Id.*

Obvious based on Kummetz-464 in view of Wu

In addition, Wu explains that the routing policy 255 “can comprise one or more rules” that will control how the switch distributes channels to the RTUs. EX1007, ¶0040. The rules of policy 255 can operate as functions of one or more metrics available to switch 250. EX1007, ¶0041. Wu explains that “metrics” can include observed or measured metrics (*KPIs*), as well as calculated or derived metrics that indicate the quality of the wireless service (*QoS values*). EX1007, ¶0042 (“Example observed metrics include a time (e.g., absolute, relative, date, etc.), a rate, a threshold, a quantity, a count, or other type of data that is measurable.”); ¶0042 (“A calculated metric is ...derived from a function operating on other metrics. Example, calculated metrics can include a traffic rate, a consumed bandwidth, an aggregated count, or other derived metrics.”).

The Wu system includes a processor 253 that “can be configured to analyze traffic metrics (e.g., data rate, call rate, consumed bandwidth, etc.) and correlate

various metrics with a signature of potential traffic issues, load balancing for example.” EX1007 at ¶0044.

Motivation to combine. A POSA reading Kummetz-464 would have naturally looked to Wu for its disclosure regarding analyzing calculated and derived metrics (examples of QoS) for the reasons discussed above and because they both disclose distributed antenna systems, they both disclose a system with the similar goal of adjusting or redistributing the capacity throughout the coverage zones of the DAS as needed, and they both address the same problem of load balancing in a DAS when conditions in the coverage area change. EX1003, ¶¶424-428. For further understanding of the network’s performance and how to optimize, a POSA would have been motivated by Wu’s teaching to employ the processor provided in the Kummetz-464 system to calculate and “analyze traffic metrics (e.g., data rate, call rate, consumed bandwidth, etc.)” to assess the network’s performance and identify potential balancing issues. EX1003, ¶428.

Reasonable expectation of success. A POSA would have a reasonable expectation that Wu’s calculated metrics could successfully be combined with the Kummetz-464 system. As in the Wu system, the Kummetz-464 system employs a processor and it would be a matter of routine implementation to calculate and analyze the traffic metrics (e.g., data rate, call rate, consumed bandwidth, etc.) as taught by Wu. EX1003, ¶429.

E. Claim 18

Before the effective date of the '382 patent, each of the (a) star, (b) daisy chain, and (c) loop topologies for connecting remote antenna units in a DAS were well known. EX1003, ¶¶104-106, 430-431. Each of Kummetz-464, Evans, and Wu teach that the common digital format of CPRI may be used on the transport links to and from the remote antenna units. EX1005, 7:60-65, 6:11-15, EX1010, ¶5; EX1007, ¶31; EX1003, ¶430. Example topologies disclosed in and supported by CPRI include, for example, (a) star, (b) daisy chain, (c) ring or loop. EX1009, Section 2.3 and Figs. 3, 4, 5, 5A, 5B, 5C, 5D, 5E; EX1003, ¶105; see also EX1005, Fig. 1 (disclosing combination of star and daisy chain); EX1010, Fig. 3 (star), Fig. 4 (daisy chain), Fig. 6 (ring or loop); EX1007, Fig. 1 (star and daisy chain).

Thus, in designing and deploying a DAS, a POSA would have understood that the topology used for connecting remote antenna units (e.g., loop) was a matter of design choice. EX1003, ¶431. For example, rings/loops are known to be more resilient by providing redundant paths to each node. Implementing any of such topologies in a DAS would have been routine and would have led to predictable results. EX1003, ¶431.

F. Claims 2, 4-6, 8, 11-17 and 19

See Ground 3. EX1003, ¶432.

Ground 5: Kummetz-464 in view of Kummetz-579 renders claim 7 obvious

Kummetz-464 in combination with Kummetz-579 (EX1008) renders obvious providing the traffic monitoring unit as a component of the DRUs as recited in claim 7. EX1003, ¶433-439. The Kummetz-464 reference specifically refers a POSA to the disclosure of Kummetz-579 as teaching systems and processes for measuring uplink signals for traffic and other types of information. EX-1001, 9:57-65; EX1003, ¶436. Application No. 12/778,312 published as US 2011/0281579 (“Kummetz-579”). EX1008. Fig. 4 of Kummetz-579 discloses and shows a remote antenna unit of a DAS may include a measurement receiver (a *traffic monitor unit*) capable of measuring network traffic, which is one of the “traffic indicators” (*i.e.*, KPIs) identified in Kummetz-464. EX1008, Fig. 4 (“measurement receiver” 101), ¶0038; ¶0039, ¶¶0035-0038 (“a suitable measurement receiver 101 is utilized to capture signals in the uplink path and to provide RSSI values reflective of the received power of such signals.”):

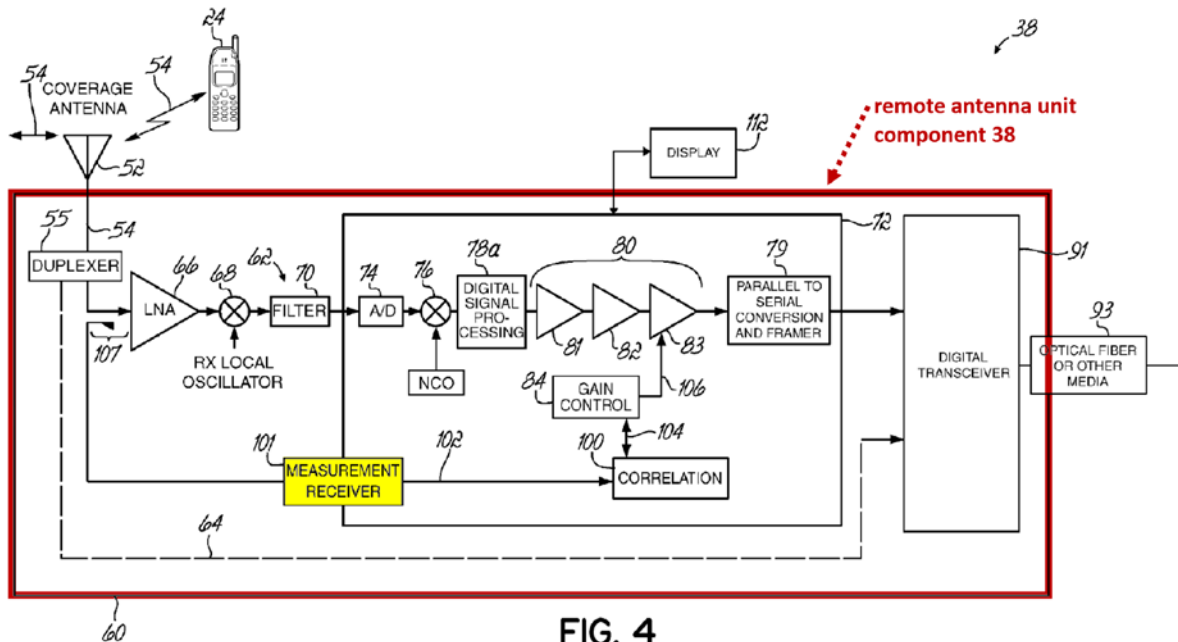


FIG. 4

EX1008, Fig. 4 (annotations added); EX1003, ¶¶436-437.

A POSA would have understood the remote antenna unit of the Kummetz-579 DAS to be analogous to the “remote antenna unit” of Kummetz-464 system. Compare EX1005, Figs. 1–2, 3:7–14, 3:28–30, 4:45–58, 5:14–16 to EX1008, Figs. 2, 4, 4a, ¶¶20-38. EX1003, ¶437.

One would have been motivated to position the traffic monitoring functions of the controller of Kummetz-464 in the remote antenna unit as taught by the placement of the measurement receiver in Kummetz-579 because (i) Kummetz-464 specifically teaches a POSA to look to the Kummetz-579 patent for systems to implement a controller as for measuring uplink signal traffic, (ii) the remote antenna unit is an already-existing component external to Kummetz-464’s base station router (i.e., is a location external to the base station router taught by

Kummetz-464), (iii) the remote antenna units already have access to both the uplink and downlink signals to be monitored, (iv) placing a measurement receiver of the controller in already-existing remote antenna unit avoids additional cost and complexity of building, installing, and housing another component for the system. EX1003, ¶438. It would have been an obvious design choice to position the traffic monitoring unit (controller) in the remote antenna units as taught by Kummetz-579 which Kummetz-464 specifically references as teaching systems for measuring for traffic in a distributed antenna system. *Id.*

CONCLUSION

There is a “reasonable likelihood” of invalidity of claims 1-19 of the ‘382 patent.

Respectfully submitted,

Dated: April 27, 2023

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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 13,986 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 27, 2023

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CERTIFICATE OF SERVICE

Pursuant to 37 CFR §§ 42.6(e)(4)(i) *et seq.* and 42.105(b), the undersigned certifies that on April 27, 2023 a complete and entire copy of this PETITION FOR INTER PARTES REVIEW OF UNITED STATES PATENT NO. 10,750,382 PURSUANT TO 35 U.S.C. §§ 311–319, 37 C.F.R. § 42 and all supporting exhibits were provided by Federal Express, to the Patent Owner by serving the correspondence address of record as follows:

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Appendix A: Listing of Claims

Designation	Independent Claim 1
Element 1A	1. A system comprising:
Element 1B	one or more Digital Access Units (DAUs) operable to receive at least one signal from at least one of a first signal source and a second signal source from one or more of a plurality of signal sources, each DAU of the one or more DAUs including an input port configured as an uplink/downlink port and an output port configured as an uplink/downlink port;
Element 1C	one or more Digital Remote Units (DRUs) connectable to the one or more DAUs and operable to transport signals between one or more of the one or more DRUs and the one or more DAUs;
Element 1D	a plurality of radio resources formed from the one or more DRUs comprising a first radio resource and a second radio resource different from the first radio resource, each radio resource comprising a subset of the plurality of DRUs; and
Element 1E	a traffic monitoring unit coupled to at least one of the DAUs,
Element 1F	wherein the traffic monitoring unit is configured to: determine one or more of: one or more key performance indicators (KPIs) and/or a quality of service (QoS) of a network traffic for the one or more DAUs, wherein the QoS is a function of the one or more KPIs; and
Element 1G	reconfigure the plurality of radio resources based on one or more of the one or more KPIs and/or the QoS by allocating at least one DRU from the first radio resource to the second radio resource.

Designation	Claims that depend from claim 1
Claim 2	2. The system of claim 1, further comprising a one or more Base Transceiver Stations (BTSs) coupled to the one or more DAUs, wherein each BTS comprises the plurality of radio resources.
Claim 3	3. The system of claim 2, further comprising a network optimization goal comprising a percentage of users associated with each of the plurality of radio resources.
Claim 4	4. The system of claim 1 wherein the traffic monitoring unit is external to the one or more DAUs.
Claim 5	5. The system of claim 1 wherein the traffic monitoring unit is provided as a component of each of the one or more DAUs.
Claim 6	6. The system of claim 1 wherein the traffic monitoring unit is external to the plurality of DRUs.
Claim 7	7. The system of claim 1 wherein the traffic monitoring unit is provided as a component of each of the plurality of DRUs.
Claim 8	8. The system of claim 1 wherein the traffic monitoring unit is configured to analyze Key Performance Indicators (KPIs) of the DAS.
Claim 9	9. The system of claim 1 wherein the traffic monitoring unit is configured to analyze Quality of Service (QoS) values of the DAS.
Designation	Independent claim 10
Element 10A	10. A system comprising:
Element 10B	one or more Digital Access Units (DAUs) operable to receive at least one signal from at least one of a first signal source and a second signal source from one or more of a plurality of signal sources, each DAU of the one or more DAUs including an input

	port configured as an uplink/downlink port and an output port configured as an uplink/downlink port;
Element 10C	one or more Digital Remote Units (DRUs) couplable to the one or more DAUs and operable to transport signals between the one or more DRUs and the one or more DAUs;
Element 10D	a plurality of radio resources formed from the one or more DRUs comprising a first radio resource and a second radio resource different from the first radio resource, each radio resource comprising a subset of the one or more DRUs; and
Element 10E	a traffic monitoring unit external to and couplable to at least one of the DAUs, wherein the traffic monitoring unit is configured to:
Element 10F	determine one or more of one or more key performance indicators (KPIs) and/or a quality of service (QoS) of a network traffic for the one or more DAUs,
Element 10G	reconfigure the plurality of radio resources based on one or more of the one or more KPIs and/or the QoS by allocating at least one DRU from the first radio resource to the second radio resource.
Designation	Claims that depend from claim 10
Claim 11	11. The system of claim 10, wherein the traffic monitoring unit is external to one or more Base Transceiver Stations (BTSS) and coupled to each of the one or more BTSSs.
Claim 12	12. The system of claim 10, further comprising a network optimization processor coupled to the traffic monitoring unit.
Claim 13	13. The system of claim 10, wherein the one or more DAUs are coupled via at least one of an ethernet cable, optical fiber, microwave line of sight link, wireless link, and/or satellite link.
Claim 14	14. The system of claim 10, wherein the one or more DAUs are coupled to the one or more DRUs via at least one of an ethernet

	cable, optical fiber, microwave line of sight link, wireless link, and/or satellite link.
Claim 15	15. The system of claim 10, wherein the one or more DRUs are connected in a daisy chain configuration.
Claim 16	16. The system of claim 10, wherein the one or more DRUs are connected to the one or more DAUs in a star configuration.
Claim 17	17. The system of claim 10, wherein the one or more DAUs are connected to one or more BTSs via at least one of an ethernet cable, optical fiber, microwave line of sight link, wireless link, and/or satellite link.
Claim 18	18. The system of claim 10, wherein the one or more DRUs are connected in a loop to one or more of the one or more DAUs.
Claim 19	19. The system of claim 10, wherein a single DAU port is connected to one or more BTSs.

Appendix B: Petitioner's Exhibit List

Exhibit No.	Exhibit Description
1001	U.S. Patent No. 10,750,382
1002	Prosecution History of U.S. Patent No. 9,197,382
1003	Declaration of Dr. Anthony Acampora
1004	<i>Curriculum Vitae</i> of Dr. Anthony Acampora
1005	U.S. Patent No. 9,398,464 (“Kummetz-464”)
1006	U.S. Publication No. 2012/0039254A1 (Stapleton)
1007	U.S. Patent Application Publication No. 2010/0128676 A1 to Wu et al. (“Wu”)
1008	U.S. Publication No. 2011/0281579 (“Kummetz-579”)
1009	Common Public Radio Interface (CPRI); Interface Specification V4.0 (2008-06-30)
1010	U.S. Publication No. 2012/0057572 (“Evans”)
1011	Provisional Application No. 61/506,363 (related to Kummetz-464 patent)
1012	U.S. Patent No. 9,735,999 (“Kummetz-999”)
1013	Requirements for Open Radio equipment Interface (ORI) (Release 1), ETSI GS ORI 001 V1.1.1 (2011-10)
1014	PTAB-IPR2021-00408-7 (paper 7, Institution Decision in IPR on Patent Owner’s ‘454 patent, the parent to the ‘382 patent)
1015	PTAB-IPR2021-00408-30 (paper 30, Final Written Decision in IPR on Patent Owner’s ‘454 patent, the parent to the ‘382 patent)

1016	PTAB-IPR2018-00571-53 (paper 53, Final Written Decision in IPR on Patent Owner's '473 patent)
1017	U.S. Provisional Application Ser. No. 61/382,836, entitled 'Remotely Reconfigurable Distributed Antenna System and Methods,' filed Sep. 14, 2010, (incorporated by prior art Stapleton of EX1006)
1018	U.S. Patent Application Publication No. 2009/0180426 A1 ("Sabat").
1019	U.S. Patent U.S. Patent No. 9,531,473 ("the '473 patent")
1020	Exhibit C (Claim Chart for '454 Patent) to Dali Wireless, Inc.'s Disclosure of Asserted Claims and Infringement Contentions in <i>Dali Wireless, Inc. v. Corning Optical Communications LLC</i> , No. 3:20-cv-06469-EMC (N.D. Cal.)
1021	U.S. Provisional Application Ser. No. 61/374593, entitled 'Remotely Reconfigurable Distributed Antenna System and Methods,' filed Sep. 14, 2010, (incorporated by prior art Stapleton of EX1006)
1022	U.S. Patent No. 10,506,454 (parent to '382 patent at issue in this IPR)
1023	<i>Network Design Basics for Cabling Professionals</i> , BICSI, McGraw-Hill (2002)(excerpts).
1024	Prosecution History of U.S. Patent No. 10,506,454 (parent to '382 patent at issue in this IPR)
1025	Defendants' Opposed Motion to Stay Pending Inter Partes Review, Case 2:22-cv-00414, ECF#57 (Apr. 17, 2023)
1026	Proposed Docket Control Order, Dali Wireless, Inc. v. T-Mobile US, Inc., et al., No. 2:22-cv-0414.