

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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AT&T CORP., AT&T COMMUNICATIONS LLC, AT&T SERVICES, INC.,  
AT&T MOBILITY LLC, AND AT&T MOBILITY II LLC  
Petitioners,

v.

DALI WIRELESS INC.,  
Patent Owner.

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U.S. Patent No. 8,682,338

Title: REMOTELY RECONFIGURABLE DISTRIBUTED ANTENNA  
SYSTEM AND METHODS

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*Inter Partes* Review No.: IPR2023-00646

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**PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 8,682,338  
UNDER 35 U.S.C. §§ 311-319 and 37 C.F.R. §§ 42.1-.80, 42.100-.106**

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**Petitioner's Exhibit List**

| <b><i>Exhibit #</i></b> | <b><i>Description</i></b>   |
|-------------------------|---|
| <b>1001</b>             | U.S. Patent No. 8,682,338 (“the ’338 Patent”)   |
| <b>1002</b>             | Prosecution history of the ’338 Patent (“File History”)   |
| <b>1003</b>             | Declaration of Petitioner’s Expert Dr. Henry H. Houh (“Dr. Houh”)                               |
| <b>1004</b>             | International Application Publication WO 2009/021359 A1 published on February 19, 2009 (“Leng”) |
| <b>1005</b>             | Certified English Translation of Leng (EX-1004)   |
| <b>1006</b>             | U.S. Patent No. 8,270,387 (“Cannon”)  |
| <b>1007</b>             | Institution Decision of IPR2020-01466 for Patent 8,682,338, Paper 16                            |
| <b>1008</b>             | U.S. Patent Application Publication US2008/0045254A1 (“Gupta”)                                  |
| <b>1009</b>             | U.S. Patent Application Publication US2010/0128676 (“Wu”)                                       |
| <b>1010</b>             | U.S. Pat. No. 8,588,614 (“Larsen”)  |
| <b>1011</b>             | Related Patents   |
| <b>1012</b>             | US Provisional Application 61/374593  |

## **I. INTRODUCTION**

Pursuant to 35 U.S.C. §§ 311 et seq. and 37 C.F.R. §§ 42.1 et seq., AT&T entity, Inc. (“Petitioner”) hereby petitions for an *inter partes* review of U.S. Patent No. 8,682,338 (the “’338 Patent”). Petitioner respectfully submits that Claims 1-12 (the “Challenged Claims”) of the ’338 Patent are unpatentable under 35 U.S.C. §103 in view of the prior art references discussed herein. This Petition demonstrates by a preponderance of the evidence that there is a reasonable likelihood that Petitioner will prevail with respect to at least one of these claims. Accordingly, it is respectfully requested that the Board institute an *inter partes* review of the ’338 Patent pursuant to 37 C.F.R. § 42.108.

## **II. OVERVIEW**

The Challenged Claims are unpatentable as obvious over the prior art. The claims are directed to prior art systems and combinations of conventional components of a distributed antenna system (DAS) that reconfigure remote radio units based on loading. Specifically, the ’338 Patent reconfigures a remote radio unit (RRU) by determining a load percentage for the RRU and increasing or decreasing the number of frequency carriers used by the radio based on the load percentage.

However, at the time the '338 Patent was filed, the Leng reference disclosed the same structure and method for managing resources, including a DAS that reconfigures remote radios based on the load of the radios, and the Cannon reference discloses the specific details of reconfiguring an RRU in a DAS.

A comparison of the DASs described in Leng, Cannon and the '338 Patent with common elements highlighted in the same color is illustrated below:

Leng

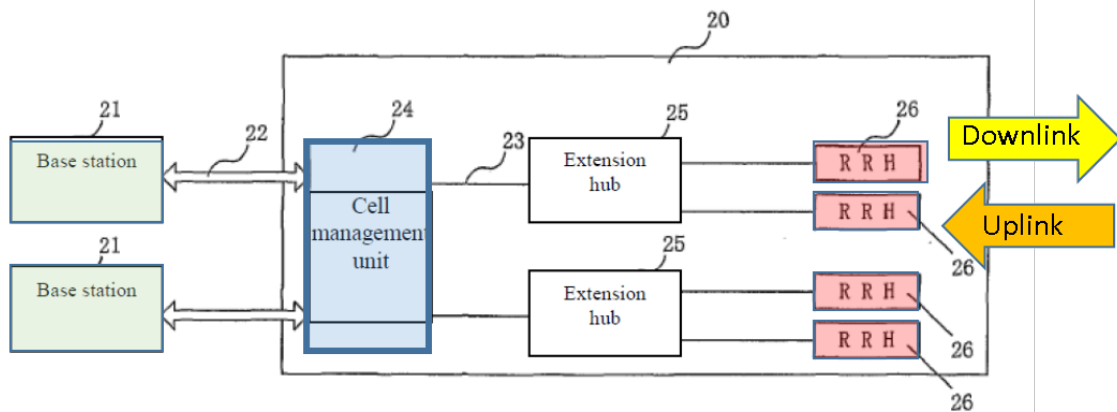
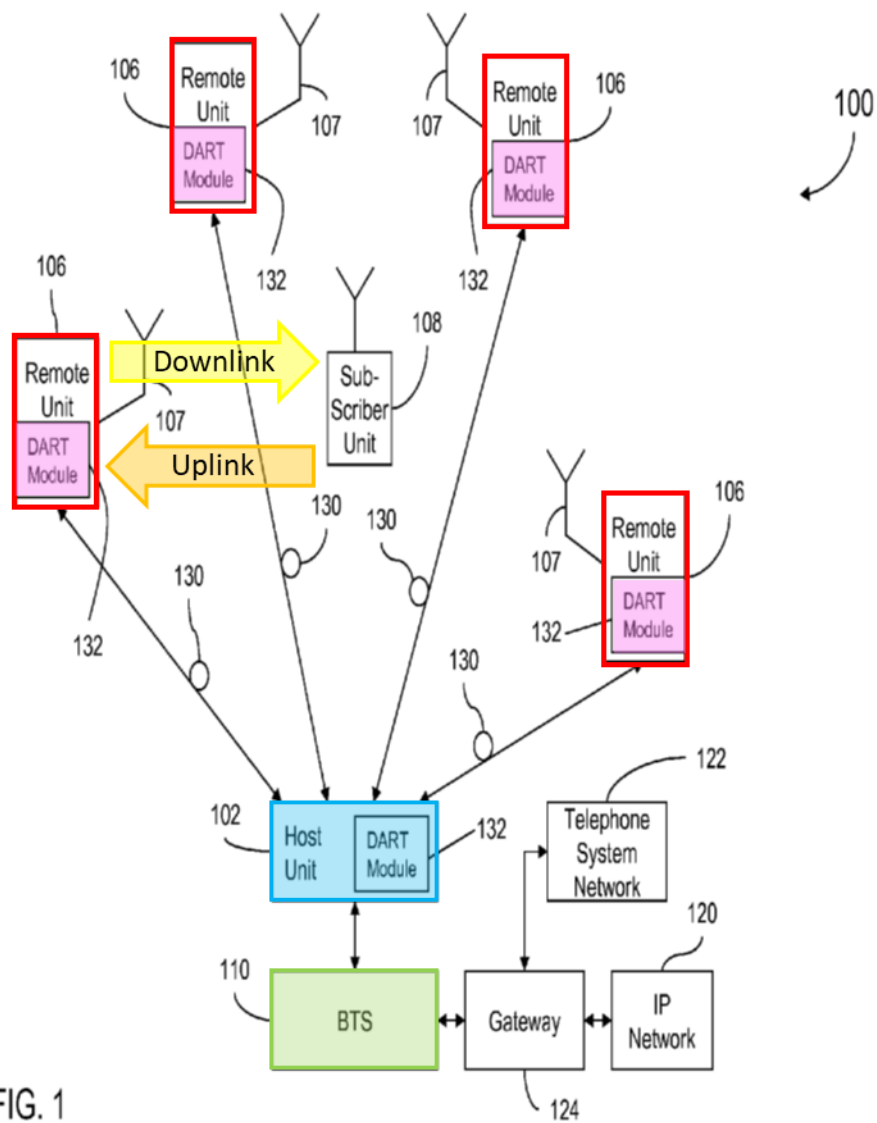


Fig. 2

EX-1005 FIG. 2 (annotated); EX-1003 ¶¶55, 80, and 81.

Cannon



EX-1006 FIG. 1 (annotated); EX-1003 ¶¶65, 85



'338 Patent

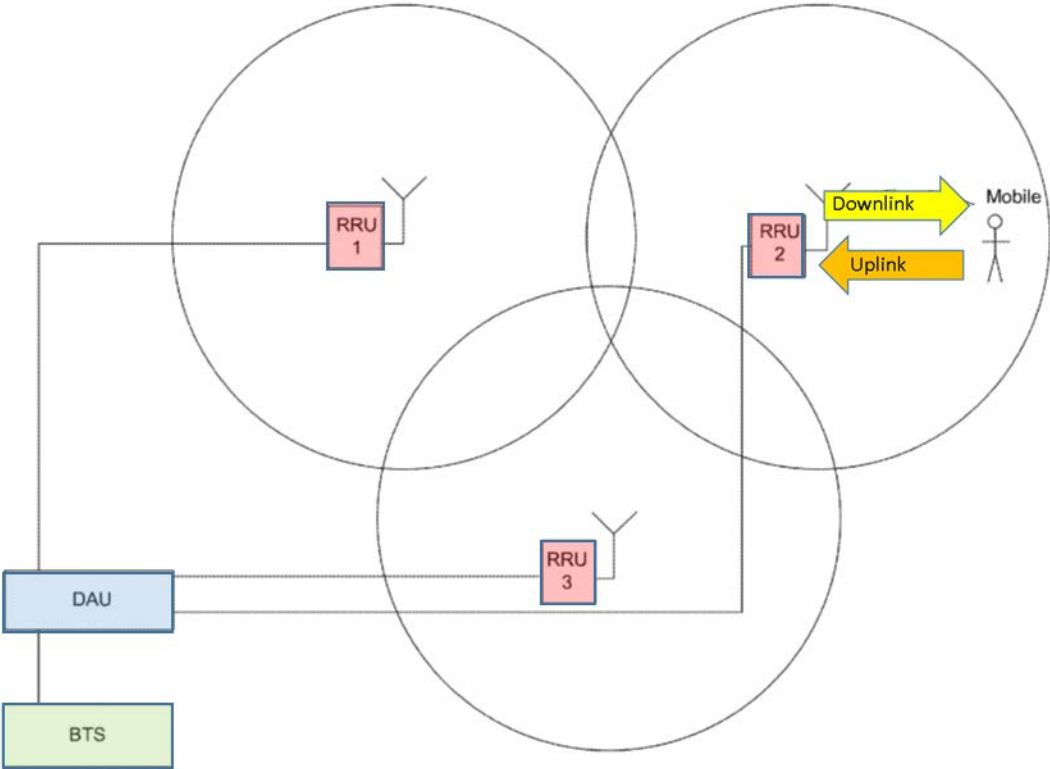


Figure 4 Indoor Localization System of GSM and LTE

EX-1001 FIG. 4 (annotated); EX-1003 ¶55.

|                            |                    |                           |
|----------------------------|--------------------|---------------------------|
| Leng                       | Cannon             | 338 Patent elements       |
| Remote Radio Head (RRH)    | Remote Unit        | Remote radio units (RRU)  |
| Cell Management Unit (CMU) | Host Unit          | Digital access unit (DAU) |
| Base Station               | Base Station (BTS) | Base Station (BTS)        |
| Downlink                   |                    |                           |
| Uplink                     |                    |                           |
| Baseband                   |                    |                           |

Leng discloses that the reconfiguration includes the RRHs switching carriers upon receiving a notification and the Cannon reference includes the specific details for reconfiguring a software defined radio by reprogramming the carrier frequencies that are used by the remote radio. Further, a POSA would be motivated to modify the teaching of Leng to use the reconfiguration technique of Cannon because Cannon expressly teaches that by allowing a user to reprogram the carrier frequency of the remote radio “it can be adjusted to meet changing needs of the end user.” Thus, each of the independent claims are unpatentable over the combination of Leng and Cannon, if not Leng alone. The balance of the dependent claims is directed to various architectures of DASs, *e.g.*, number of digital access units, base stations and remote radio units, which were well-known as demonstrated by Gupta.

### **III. GROUNDS FOR STANDING (37 C.F.R. § 42.104(a))**

Petitioner certifies that the '343 Patent for which review is sought is available for *inter partes* review and that Petitioner is not barred or estopped from requesting an *inter partes* review of the Challenged Claims on the grounds identified herein. 37 C.F.R. § 42.104(a). This Petition is filed pursuant to 37 C.F.R. § 42.106(a).

#### **IV. REASONS FOR THE REQUESTED RELIEF**

As explained in §§ II and VI-VIII of this Petition and in the attached Declaration of Petitioner's Expert, Petitioners Expert, *EX-1003*, the systems and methods reconfiguring an RRU based on load of the radio, as described and claimed in the '338 Patent, were obvious over the prior art to a person of ordinary skill in the art ("POSA") at the time of the invention.

##### **A. Summary of the '338 Patent**

The '338 Patent is generally directed to wireless communication systems employing Distributed Antenna Systems (DAS) as part of a distributed wireless network in which a base station communicates to mobile devices through an interface, called a Digital Access Unit ("DAU") and remote radio units ("RRU"). *EX-1001* 1:15-17. The '338 Patent describes several problems associated with prior art DAS implementation. One problem is associated with the deployment of many low-power high-capacity base stations throughout a facility. The quantity of base stations is determined based on the coverage of each base station and the total space to be covered. Each base station is provisioned with enough radio resources, i.e., capacity and broadband data throughput, to accommodate the maximum subscriber loading which occurs during the course of the workday and work week. Although this approach typically yields a high quality of service, the notable disadvantage of this approach is that during major periods of time the capacity of

many base stations is wasted. Since a typical indoor wireless network deployment involves capital and operational costs which are assessed on a per-subscriber basis for each base station, the typically high total life cycle cost for a given enterprise facility is far from optimal. EX-1001 1:47-61; EX-1003 ¶29.

Another problem identified with prior art DAS implementations is associated with a DAS having a centralized group of base stations dedicated to the DAS. If the DAS is a “fixed” system, the system configuration does not change based on time of day or other information about usage. The remote units associated with the DAS are configured during the design process so that a particular block of base station radio resources is predetermined to be enough to serve each small group of DAS remote units. A notable disadvantage of this approach is that most enterprises undergo frequent re-arrangements and re-organizations of various groups over time. Therefore, it’s highly likely that the initial setup will need to be changed from time to time, requiring deployment of additional staff and contract resources with appropriate levels of expertise regarding wireless networks. EX-1001 1:62-2:10; EX-1003 ¶30.

The ’338 Patent further explains that manually changing the location of quantity of DAS remote units associated with any particular centralized base station requires additional staff and it is difficult or impractical to monitor the subscriber loading on each base station. EX-1001 2:11-2:26; EX-1003 ¶31.

The '338 Patent describes that a solution to these problems include the capability to reconfigure the amount of radio resources (such as RF carriers, CDMA codes or TDMA time slots) assigned to a particular RRU or group of RRUs via software control. Specifically, the '338 Patent describes the use of software-programmable frequency selective Digital Up-Converters (DUCs) and Digital Down-Converters (DDCs). EX-1001 4:2-11; EX-1003 ¶32.

As illustrated in FIG. 1, a Digital Access Unit (“DAU”) serves as an interface to the base station (BTS). The DAU is (at one end) connected to the BTS, and on the other side connected to multiple Remote Radio Units (“RRU”):

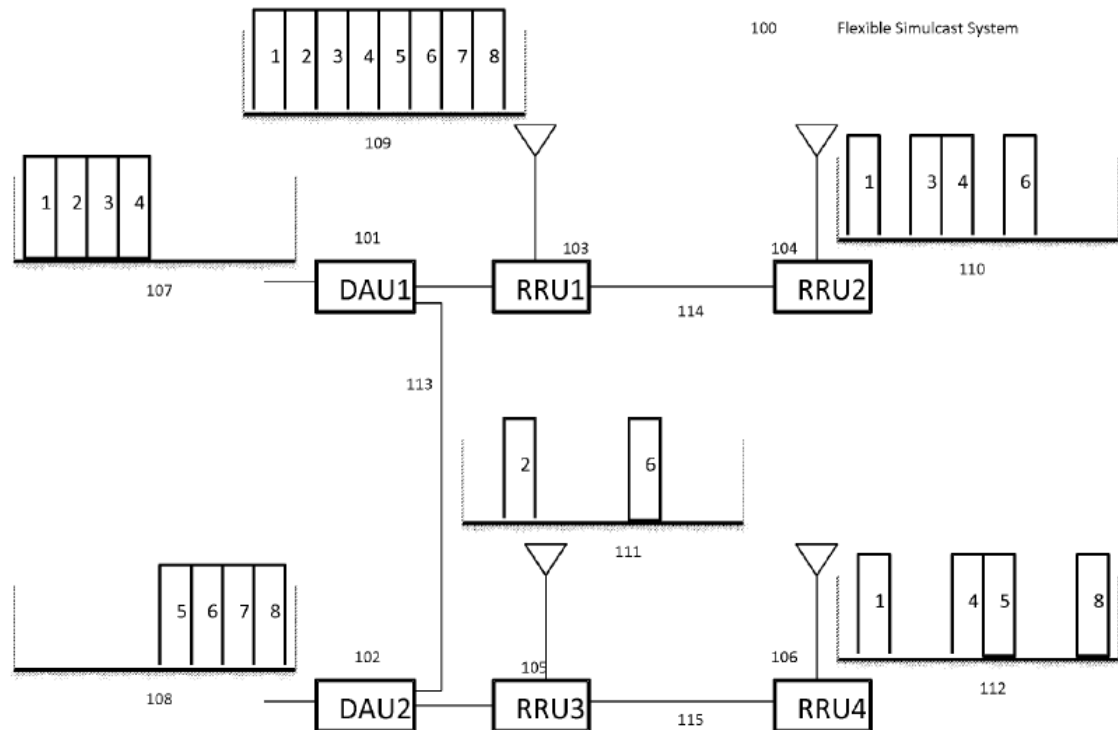


Figure 1: Flexible Simulcast Downlink Example

EX-1001 Fig. 1; EX-1003 ¶33.

The DAU serves as an interface between the BTS and multiple RRUs. For the downlink (DL) path, RF signals received from the BTS are separately down-converted, digitized, and converted to baseband (using a Digital Down-Converter). Data streams are then I/Q mapped and framed. Specific parallel data streams are then independently serialized and translated to optical signals and delivered to different RRUs over optical fiber cable. EX-1003 ¶34

In one embodiment shown in FIG. 1, a composite downlink input signal 107 (comprised of Carriers 1-4) from a base station belonging to one wireless operator enters DAU1 101 at the DAU1 RF input port. A second composite downlink input signal 108 (comprised of Carriers 5-8) from a second base station belonging to the same wireless operator enters DAU2 at the DAU2 RF input port. One optical output of DAU1 is fed to RRU1. A second optical output of DAU1 is fed to DAU2. This connection facilitates networking of DAU1 and DAU2, which means that all of Carriers 1-8 are available within DAU1 and DAU2 to transport to RRU1, RRU2, RRU3 and RRU4 depending on software settings within the networked DAU system comprised of DAU1 and DAU2. The software settings within RRU1 are configured such that Carriers 1-8 are present in the downlink output signal 109 at the antenna port of RRU1. The presence of all 8 carriers means that RRU1 is potentially able to access the full capacity of both base stations feeding DAU1 and DAU2. The '338 Patent explains that one possible

application for RRU1 is in a wireless distribution system is a cafeteria in an enterprise building during lunch hour where a large number of wireless subscribers are gathered. RRU2 is fed by a second optical port of RRU1 to RRU2. The software settings within RRU2 are configured such that Carriers 1, 3, 4 and 6 are present in downlink output signal 110 at the antenna port of RRU2. The capacity of RRU2 is set to a much lower value than RRU1 by virtue of its specific DUC settings. The individual RRUs have integrated frequency selective DUCs and DDCs with gain control for each carrier. The DAUs can remotely turn on and off the individual carriers via the gain control parameters. EX-1001 6:13-51; EX-1003 ¶35.

Likewise, the software settings within RRU3 are configured such that Carriers 2 and 6 are present in downlink output signal 111 at the antenna port of RRU3. Compared to the downlink signal 110 at the antenna port of RRU2, the capacity of RRU3 which is configured via the software settings of RRU3 is much less than the capacity of RRU2. RRU4 is fed by a second optical port of RRU3 to RRU4. The software settings within RRU4 are configured such that Carriers 1, 4, 5 and 8 are present in downlink output signal 112 at the antenna port of RRU4. The capacity of RRU4 is set to a much lower value than RRU1. The relative capacity settings of RRU1, RRU2, RRU3 and RRU4 and can be adjusted dynamically as discussed in connection with FIG. 7 to meet the capacity needs within the coverage

zones determined by the physical positions of antennas connected to RRU1, RRU2, RRU3 and RRU4 respectively. EX-1001 6:52-7:4; EX-1003 ¶36.

Referring to FIG. 7, the DAU embedded software control module and RRU embedded software control module determine and/or set the appropriate amount of radio resources (such as RF carriers, CDMA codes or TDMA time slots) assigned to a particular RRU or group of RRUs to meet desired capacity and throughput objectives. The DAU embedded software control module comprises a DAU Monitoring module that detects which carriers and corresponding time slots are active for each RRU. The DAU embedded software control module also comprises a DAU Management Control module which communicates with the RRU over a fiber optic link control channel via a control protocol with the RRU Management Control module. In turn, the RRU Management Control module sets the individual parameters of all the RRU DUCs to enable or disable specific radio resources from being transmitted by a particular RRU or group of RRUs, and also sets the individual parameters of all the RRU Digital Down-Converters to enable or disable specific uplink radio resources from being processed by a particular RRU or group of RRUs. EX-1001 11:18-11:39; EX-1003 ¶37.

In an embodiment, the '338 Patent describes an algorithm operating within the DAU Monitoring module, that detects which carriers and corresponding time slots for each carrier are active for each RRU, provides information to the DAU



Management Control module to help identify when, e.g., a particular downlink carrier is loaded by a percentage greater than a predetermined threshold whose value is communicated to the DAU Management Control module by the DAU's Remote Monitoring and Control function. If that occurs, the DAU Management Control module adaptively modifies the system configuration to slowly deploy additional radio resources (such as RF carriers, CDMA codes or TDMA time slots) for use by a particular RRU which need those radio resources within its coverage area. Concurrently, in at least some embodiments the DAU Management Control module adaptively modifies the system configuration to slowly remove certain radio resources (such as RF carriers, CDMA codes or TDMA time slots) for use by a particular RRU which no longer needs those radio resources within its coverage area. EX-1001 11:40-58; EX-1003 ¶38.

The original application issued with 12 claims. Independent Claim 1 is directed to the embodiment of reconfiguring a remote radio unit based on the loading of the remote radio unit.

Claim 1 recites:

1. A method for routing and switching RF signals comprising:

providing one or more remote radio units, each remote radio unit configured to transmit one or more downlink RF signals and to receive one or more uplink RF signals;

providing at least one digital access unit configured to communicate with the one or more remote radio units; translating the uplink and downlink signals between RF and base band as appropriate;

packetizing the uplink and downlink base band signals, wherein the packetized signals correspond to a plurality of carriers;

configuring each remote radio unit to receive or transmit a respective subset of the plurality of carriers, each respective subset of the plurality of carriers including a number of carriers;

reconfiguring each remote radio unit by:

determining a load percentage for each remote radio unit; and

increasing or decreasing the number of carriers in the respective subset of the plurality of carriers based on the load percentage; and

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

## B. Prosecution History

The '338 Patent issued on March 25, 2014 from Application No. 13/211,243 filed on August 16, 2011.

In the first Office Action during prosecution, Claims 1-3 were rejected as anticipated by Kilfoyle. In response, the Patent Owner ("PO") amended independent Claim 1 as follows:

1. (Currently Amended) A method for routing and switching ~~operator~~ RF signals comprising:

- providing one or more remote radio units, each remote radio unit configured to ~~receive~~ transmit one or more downlink ~~radio frequencies~~ RF signals and to ~~transmit~~ receive one or more uplink ~~radio frequencies~~ RF signals[[,]];
- providing at least one digital access unit configured to communicate with ~~at least some the one or more~~ remote radio units[[,]];
- translating the uplink and downlink signals between RF and base band as appropriate[[,]];
- packetizing the uplink and downlink base band signals, wherein the packetized signals correspond to a plurality of carriers; [[and]]
- configuring each remote radio unit to receive or transmit a respective subset of the plurality of carriers, each respective subset of the plurality of carriers including a number of carriers;
- reconfiguring each remote radio unit by:
  - determining a load percentage for each remote radio unit; and
  - increasing or decreasing the number of carriers in the respective subset of the plurality of carriers based on the load percentage; and
- routing and switching the packetized signals among the one or more remote radio units [[and]] via the at least one digital access ~~units~~ unit according to a result of the reconfiguring.

EX-1002 90.

In arguing for allowability over Kilfoyle, the PO argued:

Thus, Kilfoyle’s system contrasts with the system recited in amended claim 1, which recites, in part, “configuring each remote radio unit ***to receive or transmit*** a respective subset of the plurality of carriers.” (Emphasis Added). Furthermore, Kilfoyle does not disclose or suggest “reconfiguring each remote radio unit by: determining a load percentage of each remote radio unit; and increasing or decreasing the number of carriers in the respective subset of the plurality of carriers based on the load percentage,” as recited in amended claim 1.

EX-1002 94.

The examiner allowed all claims “based on amended claim, updated search and Applicant’s remarks filed on 8/29/2013.” EX-1002 87.

### **C. Previous IPR Proceeding**

On August 13, 2020, Commscope, Inc. filed a request for *inter partes* review of all claims of the ’338 Patent (“IPR2020-01466”) on the following grounds:

*D. Grounds Asserted*

Petitioner challenges the patentability of claims 1–12 on the following grounds:

| <b>Claim(s) Challenged</b> | <b>35 U.S.C. §</b> | <b>Reference(s)/Basis</b>                           |
|----------------------------|--------------------|---|
| 1–3                        | 102(e)             | Hettstedt   |
| 1–3                        | 103(a)             | Hettstedt   |
| 1–12                       | 103(a)             | Hettstedt, Sabat '552                               |
| 1–12                       | 103(a)             | Hettstedt, Sabat '552, UMTS Standard                |
| 1, 2                       | 103(a)             | Oh, Scheinert                                       |
| 3                          | 103(a)             | Oh, Scheinert, Hettstedt                            |
| 1, 2, 4–12                 | 103(a)             | Oh, Scheinert, Sabat '552                           |
| 1–12                       | 103(a)             | Oh, Scheinert, Hettstedt, Sabat '552, UMTS Standard |
| 1–3                        | 102(e)             | Wu  |
| 1–3                        | 103(a)             | Wu, UMTS Standard                                   |
| 1–12                       | 103(a)             | Wu, UMTS Standard, Sabat '552                       |
| 1–12                       | 103(a)             | Wu, Sabat '552, UMTS Standard, Sabat '426           |

EX-1007 7.

On February 9, 2021, the Board denied institution of all grounds. The Board construed the term “reconfiguring each remote radio unit” to be “changing the configuration of each remote unit,” consistent with the district court’s construction (cite?). The Board further found that the claim term requires that “it is the remote radio unit itself that is changed because the “remote radio unit” is the direct object of the verb “reconfiguring.” EX-1007 9.

Based on this construction, the Board denied institution finding that none of the primary references (Hettstedt, Oh, and Wu) disclose changing the configuration of each remote unit. EX-1007 15, 19, 22.

This Petition does not rely upon Hettstedt, Oh, or Wu for the “reconfiguring each remote radio unit” limitation, but rather bases unpatentability upon Leng and Cannon, each of which discloses the reconfiguring of the remote radio units as previously construed by the Board. EX-1003 ¶¶74-76, 94-103.

**D. Claim Construction**

The claims should be given “their ordinary and customary meaning” as understood by a person of ordinary skill at the time of the claimed invention.

*Phillips v. AWH Corp.*, 415 F.3d 1303, 1312, 1327 (Fed. Cir. 2005).

Petitioner proposes that each claim term in the Challenged Claims be given its plain and ordinary meaning in this proceeding, and that no specific construction of any claim term is required because the prior art relied on in this Petition meets each of the claim terms under any reasonable construction.

As discussed above, the Board in IPR2020-01466 construed the term “reconfiguring each remote radio unit” to be “changing the configuration of each remote unit,” which Petitioner believes is consistent with the plain and ordinary meaning of the term.

**E. Priority Date of the Challenged Claims**

The '338 Patent claims the benefit of U.S. Patent Application Ser. No. 61/382,836, filed on September 14, 2010. Solely for the purposes of this IPR, Petitioner assumes the priority date is September 14, 2010.

**F. Person of Ordinary Skill in the Art**

With respect to the '338 Patent, a POSA in September 2010 would have been familiar with reconfiguring remote radio units in a DAS. EX-1003 ¶44. A POSA would have gained knowledge of these concepts through a mixture of training and work experience, such as by having a Bachelor's degree in electrical engineering and four years of experience; or by obtaining a Master's degree in electrical engineering, but having only one to two years of experience; or by having no formal education but experience in cellular communications of at least eight years. EX-1003 ¶44.

**G. State of the Art**

The following section describes the state of the art for power control for cellular systems as of September 2010. EX-1003 ¶45. The prior art references, and the discussions of what was known to a POSA, provide the factual support for the general description of the state of the art at the time of the invention, and provide additional motivation to modify or combine the references. Accordingly, these references should be considered by the Board.

**1. Prior Art DAS**

A DAS is a network of spatially separated antenna nodes connected to a common node via a transport medium that provides wireless service within a geographic area or structure. Common wireless communication system configurations employ a host unit as the common node, which is located at a centralized location (for example, at a facility that is controlled by a wireless service provider). The antenna nodes and related broadcasting and receiving equipment, located at a location that is remote from the host unit (for example, at a facility or site that is not controlled by the wireless service provider), are also referred to as “remote units.” Radio frequency (RF) signals are communicated between the host unit and one or more remote units. In such a DAS, the host unit is typically communicatively coupled to one or more base stations (for example, via wired connection or via wireless connection) which allow bidirectional communications between wireless subscriber units within the DAS service area and communication networks such as, but not limited to, cellular phone networks, the public switch telephone network (PSTN) and the Internet. A DAS can provide, by its nature, an infrastructure within a community that can scatter remote units across a geographic area for providing wireless services across that area. EX-1006 1:14-36; EX-1003 ¶46.



## 2. Reconfiguring remote radio units based on loading

One such prior art DAS systems that reconfigures the carrier frequencies of the remote radio units based on loading is shown below in FIG. 1.

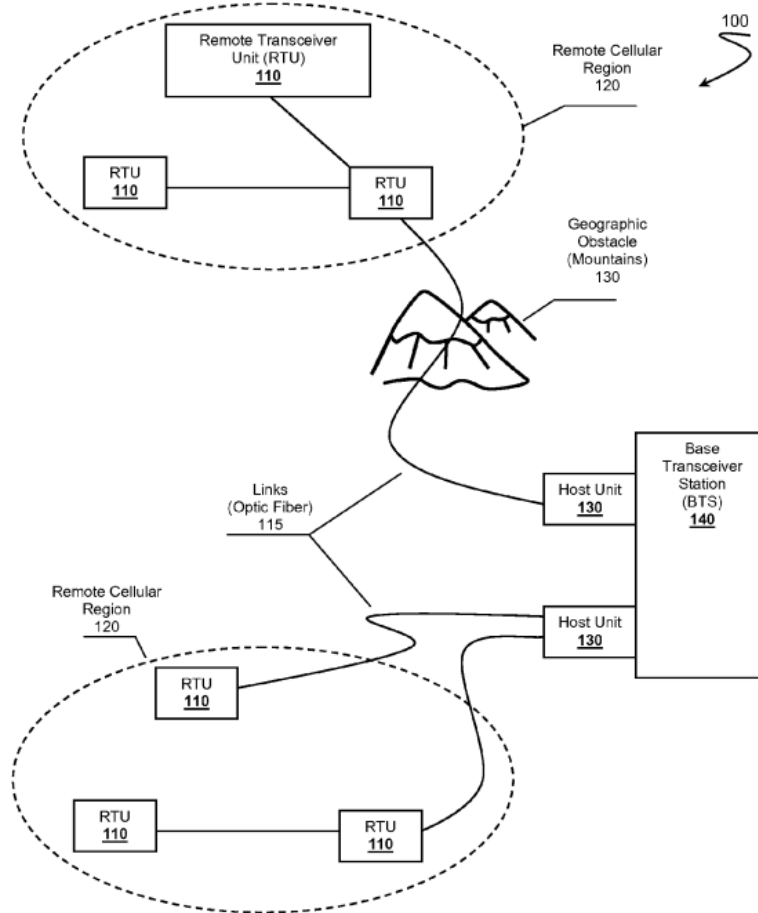


Figure 1

EX-1009 Fig. 1; EX-1003 ¶47.

Base transceiver stations (BTSs) communicate signals to remote transceiver units (RTUs) via one or more host units. EX-1009, Title, ¶0030. The system provides control over the communication by splitting carrier channels from their bands and routing only selected channels to RTUs according to a routing policy. EX-1009, ¶0009. The carrier channels may be routed “individually, collectively as

shown, or in arbitrary groups” to RTUs as desired using a matrix switch according to a routing policy, where the routing policy could be updated or reconfigured as desired. EX-1009 ¶ 0049, 0009, 0011, 0038-39, 0047. One example is that “more channels” could be allocated when needed to increase the bandwidth available in a particular region. EX-1009 ¶ 0046; ¶0039-45. Multiple hosts could serve a base station and transmissions between host units and RTUs were preferably occurring according to suitable standards such as the CPRI Standard. EX-1009, ¶31, 49; EX-1003 ¶48.

**3. Prior art DAS systems allowed for efficient use of infrastructure**

One prior art system shown below allowed multiple service providers each to provide signals to a BTS which is in turn sent to a common DAS Head End (DAU).

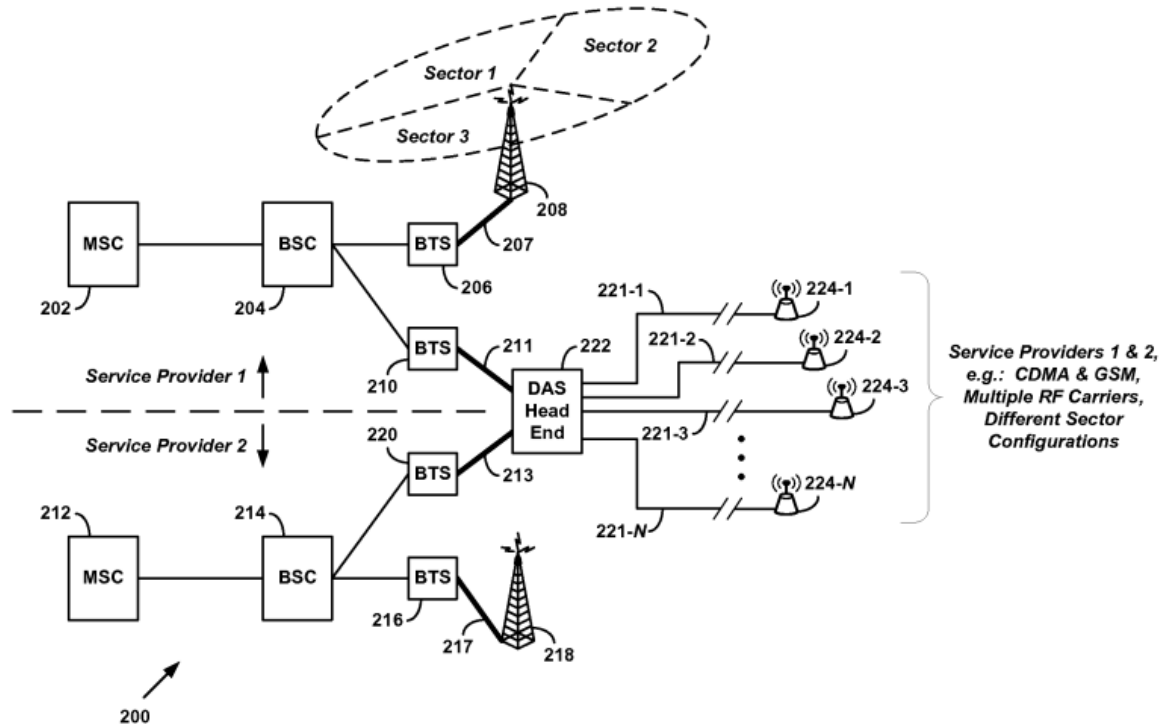


FIG. 2

EX-1010 Fig. 2; EX-1003 ¶49.

The interface between the RF module and the DAS head end is same as that between the RF modulation Subsystem and the radio/antenna Subsystem of a traditional BTS. **As such, multiple BTSs from multiple service providers can be connected to single DAS head end, thus allowing them to share a common access infrastructure.**

EX-1010 2:24-29 (emphasis added); EX-1003 ¶49.

As illustrated in FIG. 2, multiple service providers or operators using different communications protocols (e.g., CDMA, GSM, etc.) could share common

infrastructure resources and thus avoid the cost and complexity of each provider proving its own infrastructure. EX-1003 ¶50.

## **V. IDENTIFICATION OF CHALLENGES**

### **A. Challenged Claims**

Claims 1-12 of the '338 Patent are challenged in this Petition.

### **B. Statutory Grounds for Challenges**

The Challenges are set forth in detail below and summarized as follows:

| <b>Ground</b> | <b>Claims</b> | <b>Basis</b> | <b>Reference</b>                                    |
|---------------|---------------|--------------|---|
| 1             | 1-3           | § 103        | Leng alone or in view of Cannon                     |
| 2             | 4-12          | § 103        | Leng in view of Cannon and further in view of Gupta |

#### Leng

International Published Application WO 2009/090414 (“Leng”) is titled CELL MANAGEMENT SET, DISTRIBUTED ANTENNAE AND RECONFIGURATION THEREOF and it published on February 19, 2009 from an application filed on August 14, 2007. (EX-1004)<sup>1</sup>. Leng qualifies as prior art under §102(e). Leng was not cited or applied by the examiner during prosecution, nor was it considered by the Board in IPR2020-01466.

#### Cannon

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<sup>1</sup> Citations to Leng are to the English Translation (EX-1005).

U.S. Patent 8,270,387 (“Cannon”) is titled SYSTEMS AND METHODS FOR IMPROVED DIGITAL RF TRANSPORT IN DISTRIBUTED ANTENNA SYSTEMS and it issued on September 18, 2012 from an application filed on January 13, 2010 (EX-1008). Cannon qualifies as prior art under §102(e). Cannon was not cited or applied by the examiner during prosecution, nor was it considered by the Board in IPR2020-01466.

Gupta

Patent Publication US 2008/0045254 A1 (“Gupta”) is titled METHOD AND APPARATUS FOR MAXIMIZING RESOURCE UTILIZATION OF BASE STATIONS IN A COMMUNICATION NETWORK and it published on February 21, 2008 from an application filed on August 15, 2006 (EX-1006). Gupta qualifies as prior art under §102(b). Gupta was not cited or applied by the examiner during prosecution, nor was it considered by the Board in IPR2020-01466.

**VI. IDENTIFICATION OF HOW THE CHALLENGED CLAIMS ARE UNPATENTABLE**

**A. Challenge 1: Claims 1-3 Are Obvious Over Leng Alone or in Combination With Cannon**

**1. The Leng Reference**

Leng relates to a DAS technology, and more particularly to a cell management apparatus, a distributed antenna system, and a reconfiguration method thereof, which are capable of reallocating a carrier in time to effectively adapt to a

load change when a communication traffic of a region varies greatly. EX-1005

abstract; EX-1003 ¶54

Fig. 2 of Leng illustrates the basic structure of one embodiment of the DAS antenna system 20. The Remote Radio Head (RRH) 26 is placed around the building. A cell management device (CMU) 24 is connected to the base station 21 and is configured to distribute a downlink wireless signal to the radio remote unit 26, collect an uplink wireless signal, and transmit the uplink radio signal to the base station 21. CMU 24 also collects load information of the DAS 20 and reconfigures the DAS based on the load information. The RRH corresponds to the RRU of the '338 Patent, and the CMU corresponds to the DAU of the '338 Patent. EX-1005 3:20-25; EX-1003 ¶55

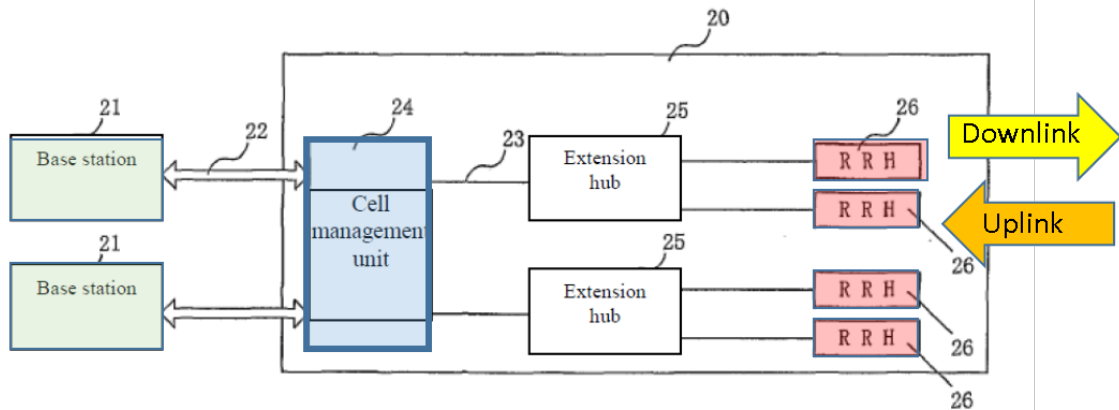


Fig. 2

EX-1005 FIG. 2 (annotated); EX-1003 ¶55.

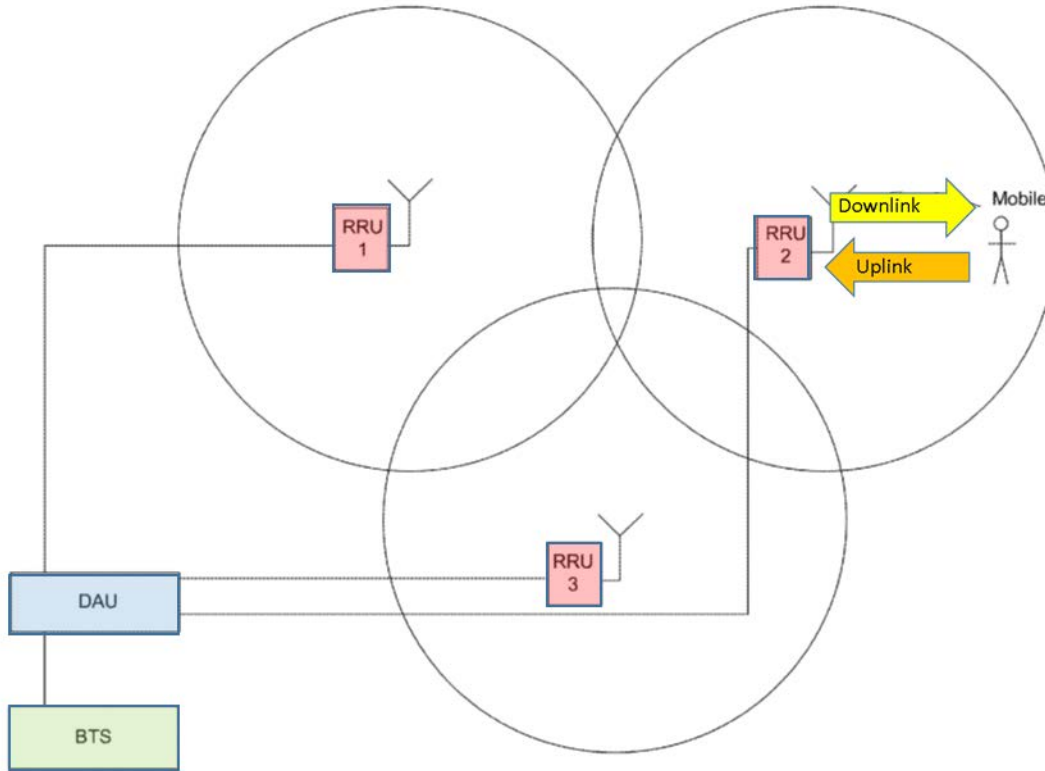


Figure 4 Indoor Localization System of GSM and LTE

EX-1001, FIG. 4 (annotated); EX-1003 ¶55.

Like the '338 Patent, Leng describes several problems with prior art DAS implementation. First, once the DAS has been installed, the allocation of the RF spectrum is fixed. Such systems are not suitable for areas where communication traffic varies greatly, such as auditoriums, conference halls, and the like. If too much spectrum is allocated to such areas, spectrum resources are wasted when these areas are idle. However, if only a small amount of spectrum resources are allocated to these areas, when these areas become crowded, spectrum resources may be insufficient. EX-1005 1:19-23; EX-1003 ¶56.

Second, Leng explains the disadvantages of most existing DASs include the inability to dynamically reassign carriers to effectively adapt to load changes when necessary. Some DASs include manual offline reconfiguration, which requires the administrator to manually reconfigure based on the expected load distribution and to stop the service during reconfiguration. This manual approach does not dynamically reconfigure in a timely and efficient manner based on real-time traffic distribution, and interrupts continuity during reconfiguration. EX-1005 1:24-30; EX-1003 ¶57.

Leng describes that its solution to these problems is a dynamically reconfigurable DAS which is capable of reallocating carriers in a timely and efficient manner to meet the communication traffic needs of a region. The DAS adapts to load changes by collecting load information and reconfiguring the system based on the load information. EX-1005 1:33-36; EX-1003 ¶58. As part of the reconfiguration, Leng describes the RRHs switch their carriers upon notification from the carrier reconfiguration module. EX-1005 9:1-10; EX-1003 ¶58.

FIGS 4 and 5 of Leng illustrate an embodiment of the reconfigurable DAS. Figure 4 shows the initial configuration of the DAS 20. RRH A and RRH B use carrier 1 (annotated in red), RRH C and RRH D use carrier 2 (annotated in blue),



and RRH E and RRH F use carrier 3 (annotated in green). EX-1005 4:18-22; EX-1003 ¶59.

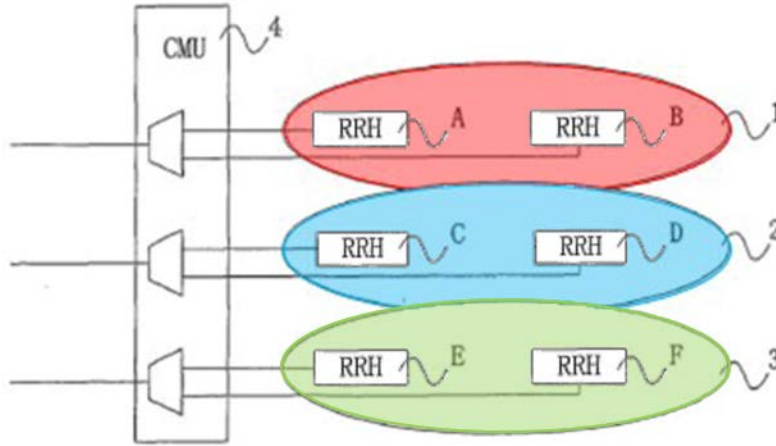


图 4

EX-1005 FIG. 4 (annotated); EX-1003 ¶59.

When CMU 24 detects that RRH A and RRH B become areas of high load, DAS 20 is reconfigured as shown in FIG. 5. After reconfiguration, RRH B is reconfigured to use carrier 2 (annotated in blue), and RRH C and D are reconfigured to use carrier 3, along with RRH E and F (annotated in green). As a result, RRH A uses carrier 1 and RRH B uses carrier 2. Thus DAS 20 is reconfigured to split the heavy load which was previously only on carrier 1 between carriers 1 and 2. Carrier 3 which was being used before configuration only by RH E and RRH F, is now shared with RRH C and RRH D since it is sufficient to carry the load of all four RRHs. EX-1005 4:18-27; EX-1003 ¶60

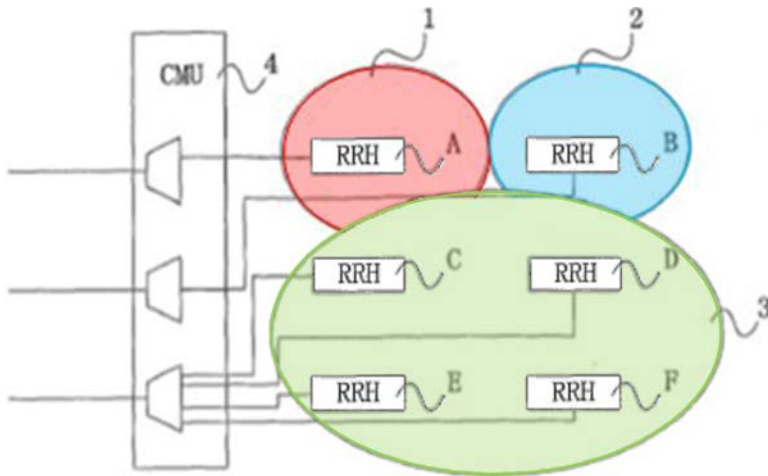


图 5

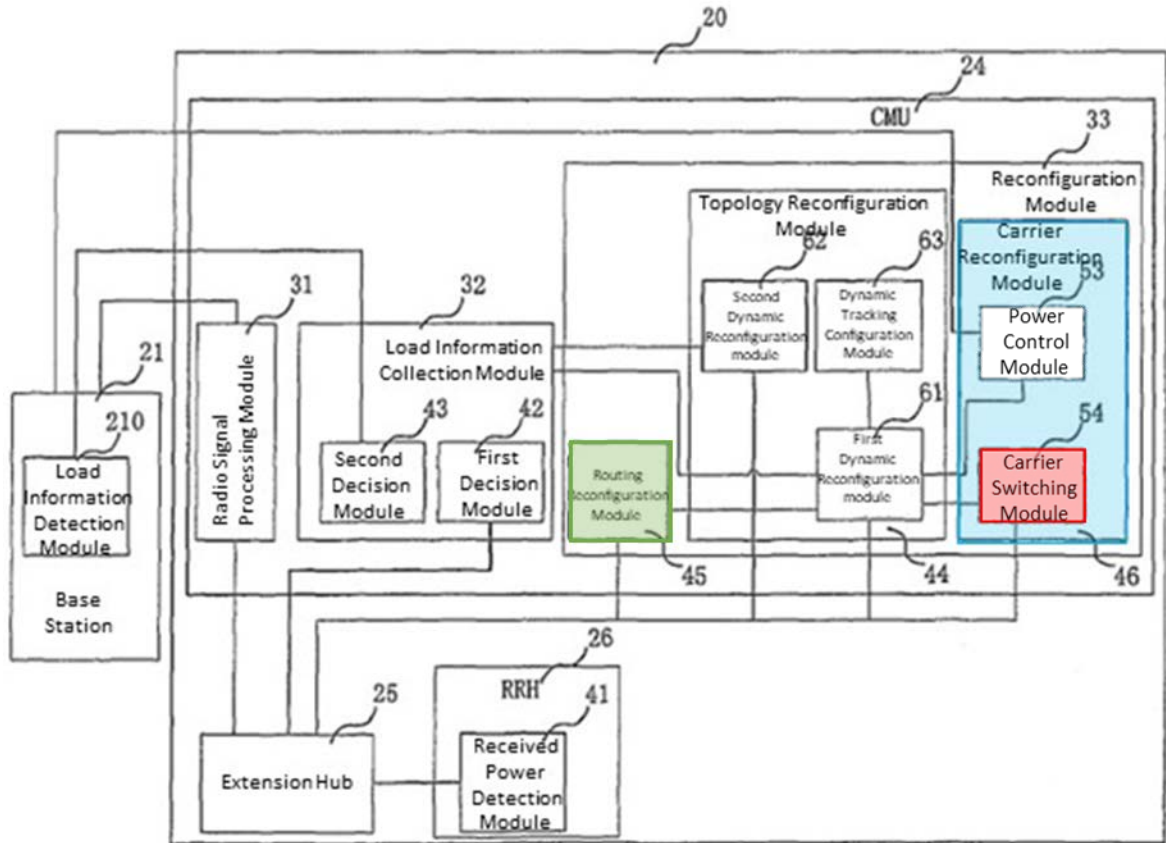
EX-1005 FIG. 5 (annotated); EX-1003 ¶60.

Although the examples in FIGs. 4 and 5 show each RRH using one carrier, Leng discloses that “the RRHs can also support multiple carriers.” EX-1005 3:31-32. Similar to the disclosure in the ’338 Patent, Leng discloses a DAS which may be dynamically reconfigured to accommodate areas with large changes in communication traffic, such as auditoriums, conference halls, etc., by dynamically allocating RF resources according to the current traffic state to balance the traffic load and improve system efficiency. EX-1005 2:14-17; EX-1003 ¶61.

Leng discloses several different embodiments of a CMU 24, all of which include a load information collecting module 32 and a reconfiguration module 33. EX-1005 FIGS. 6, 8, 15. Module 32 is configured to collect load information and the reconfiguration module 33 is configured to collect the load information from collecting module 32 and determine the new topology, re-allocate the carrier in the

corresponding RRH, and reconfigure the routing of the wireless signal. EX-1005 4:15-17; EX-1003 ¶62.

Leng further describes an embodiment of FIG. 15 that can be used to reconfigure RRHs as illustrated in FIGS 4 and 5. EX-1005 10:1-3; EX-1003 ¶63.



EX-1005 FIG. 15 (annotated).

The reconfiguration of the wireless signal routing is performed by route reconfiguration module 45 (green), and the reallocation of the carrier in the corresponding RRH is performed by carrier reconfiguration module 46 (blue). EX-1005 10:21-27; EX-1003 ¶64. Leng discloses that switching module 54 (red) in module 46 (blue) is configured to notify the high-load RRH 26 to switch the

carrier to the carrier of the corresponding low-load RRH according to the new topology determined by module 44. EX-1005 11:17-21; EX-1003 ¶64.

Leng further discloses that each RRH may support multiple carriers. EX-1005 1:15-18, 3:39-43; EX-1003 ¶65.

## **2. The Cannon Reference**

Cannon is directed to a DAS for receiving and distributing RF signals within a coverage area. FIG. 1 of Cannon illustrates one embodiment:

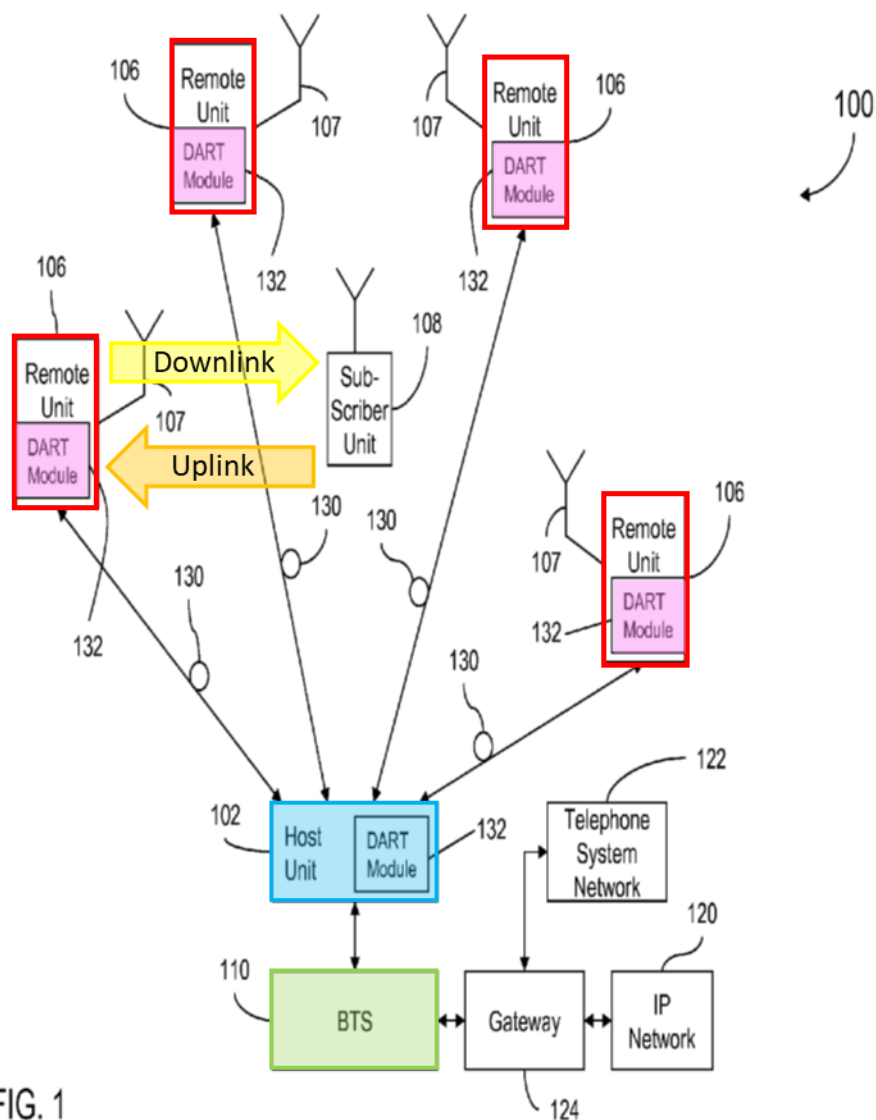


FIG. 1

EX-1006 FIG. 1 (annotated); EX-1003 ¶65.

DAS 100 includes a host unit 102 (blue) and a plurality of remote units 106 (red). Remote units 106 each house electronic devices and systems used for wirelessly transmitting (yellow) and receiving (orange) modulated RF communications via antenna 107 with one or more mobile subscriber units 108.

Host unit 102 is coupled to at least one base station BTS 110 (green). BTS 110 communicates voice and other data signals between the respective host unit 102 and a larger communication network via a gateway 124 coupled to a telephone system network 122 (for example, the public switched telephone network and/or wireless service provider networks) and an internet protocol (IP) network 120, such as the Internet. EX-1006 2:59-3:23; EX-1003 ¶66.

In the embodiment of FIG. 1, each remote unit 106 and host unit 102 comprises a digital to analog radio frequency transceiver (DART) module 132 (pink) configured to conserve the available bandwidth of the communication links 130 by separating and individually processing spectral regions of interest from a larger RF spectrum. Ex-1006 4:6-11; EX-1003 ¶67.

Cannon describes that the DART modules are realized using field programmable gate arrays (FPGAs), application specific integrated circuits (ASICs), digital signal processing (DSP) boards, or similar devices. EX-1006 4:20-23; EX-1003 ¶68.

FIG. 5 is a block diagram illustrating a DART Module 500 of one embodiment.

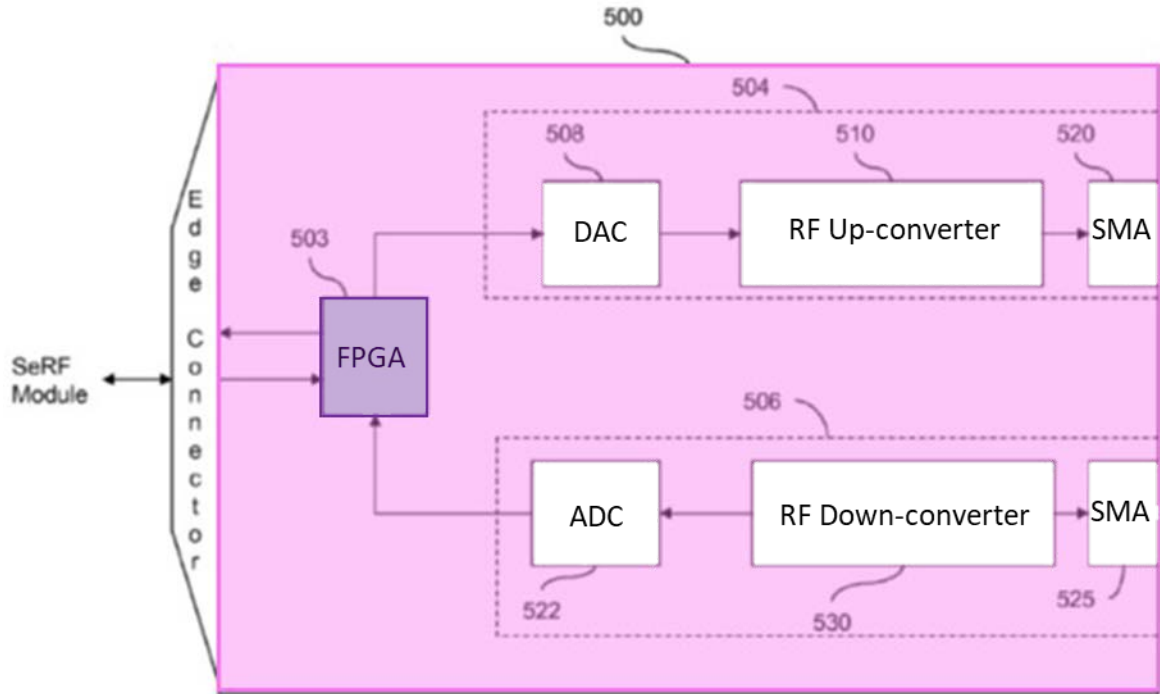


Fig. 5

EX-1006 Fig. 5 (annotated): EX-1003 ¶69.

DART module 500 (pink) has two main signal paths: a transmission path 504 and a reception path 506. For signals received from a SeRF module, DART module 500 forms parallel digital RF data from the incoming data stream. In this embodiment, FPGA 503(purple) is a logic device that is programmed to convert serial digital data into RF sampled data and programmed to convert RF sampled data into serial digital data. DART module 500 then converts the digital RF data to an analog signal with digital to analog converter (DAC) 508. Transmission path 504 continues with RF transmission interface 510 which filters, amplifies, and up-converts the analog signal for RF transmission. Cannon describes that RF

transmission interface 510 will typically include an assortment of filters, amplifiers, oscillators and attenuators known to a POSA. In one embodiment, the transmission path exits DART module 500 at a subminiature version A RF coaxial connector (SMA) connector 520. EX-1006 7:10-33: EX-1003 ¶70.

FIG. 6 is a block diagram providing further details for FPGA 503 (purple) for one embodiment.

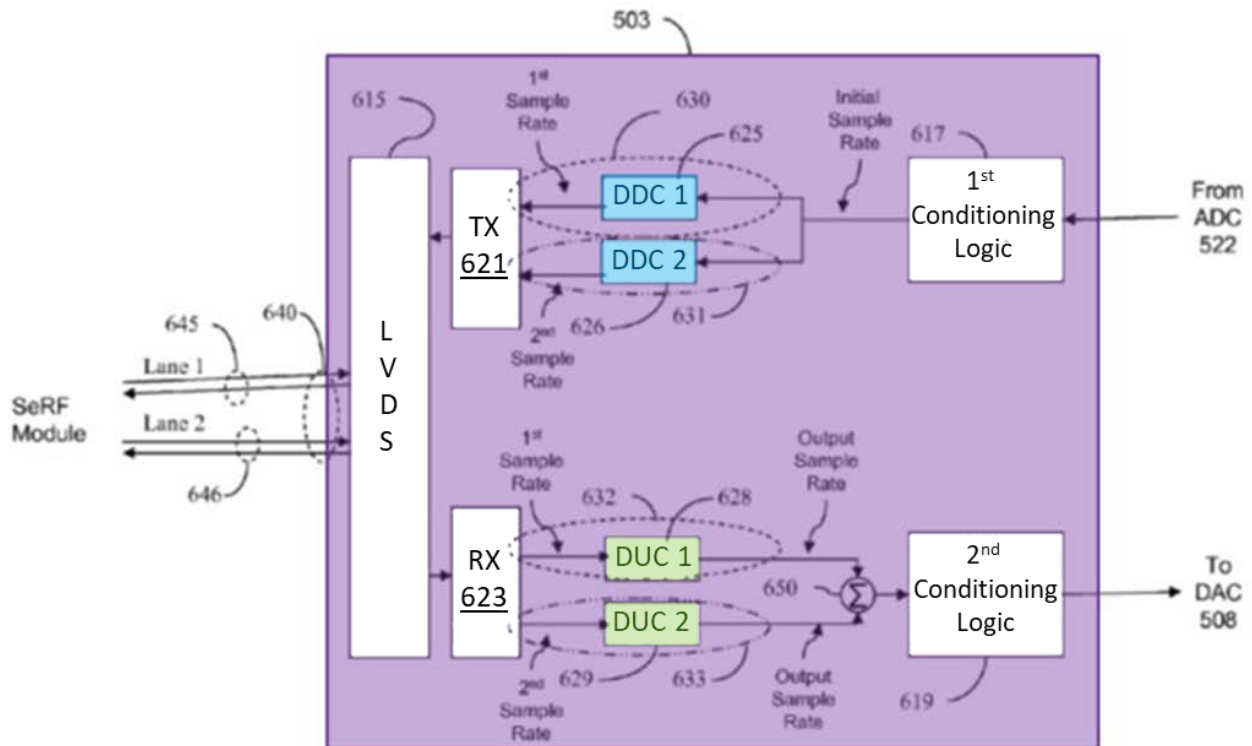


Fig. 6

EX-1006 Fig. 6 (annotated); EX-1003 ¶71.

FPGA 503, for both the upstream and downstream directions, provides separate signal processing paths for each discrete spectral region of a digitized RF spectrum (such as 400 or 460 from FIG. 4) that is to be mapped onto timeslots of



the transport frame 460. Cannon discloses that the number of carriers is not limited to only two, and that the DART can be programmed to handle three or more carriers, limited only by the limits of the implementing hardware. EX-1006 6:47:55; 7:47-64; EX-1003 ¶72. Thus, a POSA understood that Cannon teaches that each FPGA could be programmed with a set of carrier frequencies.

Cannon describes that using a FPGA includes DUCs (green) and DDCs (blue) that can be programmed with a center frequency and bandwidth to reconfigure the carrier of the remote radio unit. EX-1006 FIG. 6; 8:45-9:10; EX-1003 ¶73. Cannon describes that the use of a FPGA in a remote radio unit is beneficial because the remote radio unit can be adjusted to meet the changing needs of the end user very simply using programming. EX-1006 9:45-47; EX-1003 ¶73.

### **3. Motivation to Combine Leng and Cannon**

The '338 Patent, Leng and Cannon are all directed to dynamically allocating frequency spectrum in a DAS. All three provide examples of mobile subscribers communicating with a remote radio unit of a DAS. EX-1001 FIG. 1, EX-1005 FIG. 2; EX-1006 FIG. 1; EX-1003 ¶74. The '338 Patent describes reconfiguring each RRU based on load percentage of each unit. EX-1001 13:2-24; EX-1003 ¶74. The '338 Patent describes that RRUs are reconfigured by the use of software-programmable frequency selective DUCs and DDCs. EX-1001 4:1-15; EX-1003

¶74. Leng likewise describes reconfiguring each RRH based on load percentage of each unit. EX-1005 FIGs. 4, 5; EX-1003 ¶74. Leng describes that the carrier of an RRH may be changed at the RRH in response to a notification by a carrier reconfiguration module based on the load of the radio, but does not provide the details of how the frequency of the RRH is changed. Specifically, as described above, in one embodiment, Leng discloses that the switching module 54 in carrier reconfiguration module 46 is configured to notify the high-load radio RRH to switch the carrier to the carrier of the corresponding low-load RRH according to the new topology determined by the topology reconfiguration module. Cannon describes that the RRH can use a DART in the form of a field programmable gate array (FPGA). Cannon describes that using a FPGA includes DUCs and DDCs that can be programmed with a center frequency and bandwidth to reconfigure the carrier of the RRH. EX-1006 FIG. 6; 8:45-9:10; EX-1003 ¶74. Cannon describes that the use of a FPGA in an RRH is beneficial because the unit can be simply adjusted to meet the changing needs of the end user using programming. EX-1006 9:45-47; EX-1003 ¶74.

A POSA would be motivated to modify the teachings of Leng to include a FPGA in the remote radio unit as taught by Cannon because Cannon expressly teaches that the use of a FPGA allows each remote radio unit to be adjusted to meet the changing needs of the end user, and Leng teaches that the needs of the

end user can be determined by the load of the remote radios. Specifically, a POSA understood that Leng teaches to reconfigure a remote radio unit in a DAS by changing the carriers of the remote radio unit based on the relative load of the remote radio unit, and that there are only a few finite ways to reconfigure a radio by changing its carrier frequency. Cannon discloses one such suitable way to reconfigure the carrier frequency of the remote radio is the use of a FPGA and requires only a programming change. EX-1003 ¶75.

In view of this section (and discussed further below in the claims analysis) Petitioner has demonstrated at least:

- i. Leng and Cannon themselves provided teaching, suggestion, or motivation that would have led a POSA to modify Leng's teaching of reconfiguring a remote radio unit in a DAS based on the relative loading of the remote radio unit, with the use of an FPGA in the remote radio unit as taught by Cannon because an FPGA is adjustable to meet the changing needs of the end user. EX-1003 ¶76.

- ii. The general knowledge in the art was that Cannon's use of FPGA was an accepted, known and predictable mechanism to adjust the carrier frequencies of DUCs and DDCs in remote radio units in a DAS by using programming, and the use of software-programmable frequency

selective DUCs and DDCs was identified as a known benefit in the '338 Patent. EX-1003 ¶76.

iii. The beneficial aspects of Leng's technique for dynamic reassignment of the DAS based on a real-time load distributing condition, improving the efficiency of the system, and achieving reassignment on line without interrupting the service, would be accomplished by using an FPGA with predictable results. EX-1003 ¶76.

iv. A POSA would also be confident the modification would have a high likelihood of success given the predictable nature of FPGA and radio transceivers. EX-1003 ¶76.

#### **4. Detailed Application of Leng and Cannon to Claims 1-3**

##### **a. Claim 1**

##### ***i. A method for routing and switching RF signals comprising:***

To the extent the preamble is limiting, Leng discloses a method for routing and switching RF signals. As shown below, Leng discloses distributing (*routing and switching*) the downlink radio signals (*RF signals*) to the remote radio units and reconfiguring a DAS in accordance with load information.

[T]he cell management unit 24 is connected to the base station 21 and connected to the remote radio heads 26 via the extension hub 25 **for distributing downlink radio signals to the remote radio heads 26, collecting uplink radio signals and transmitting them to the base**

**station 21**, and collecting the load information of the distributed antenna system 20 **and reconfiguring the distributed antenna system 20 according to the load information.**

EX-1005 3:22-25 (emphasis added); EX-1003 ¶77.

- ii. providing one or more remote radio units, each remote radio unit configured to transmit one or more downlink RF signals and to receive one or more uplink RF signals.*

Leng discloses providing one or more RRHs (*remote radio units*). Each of the RRHs is configured to distribute (*transmit*) downlink radio signals (*downlink RF signals*) and collect (*receive*) uplink radio signals (*uplink RF signals*).

Fig. 2, an embodiment of the present disclosure provides a **distributed antenna system 20 comprising at least one remote radio head (RRH) 26.**

EX-1005 3:20-21 (emphasis added); EX-1003 ¶78.

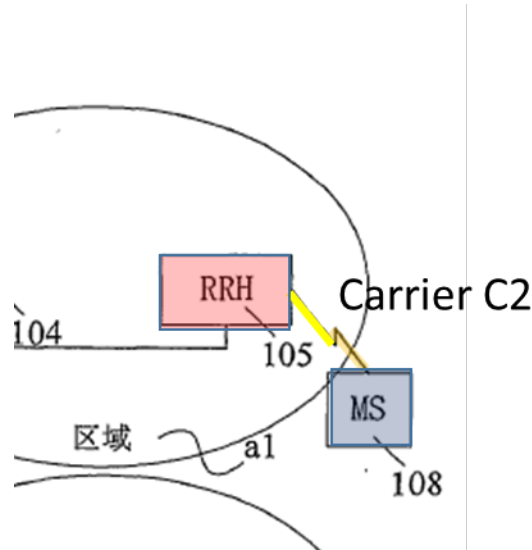
The cell management unit 24 is connected to the base station 21, and is configured to **distribute downlink radio signals to the remote radio head 26, collect uplink radio signals and transmit them to the base station 21.**

EX-1005 3:22-24 (emphasis added); EX-1003 ¶78.

**The base station 101 transmits carriers C1 and C2, and assigns them to RRH 104 and RRH 105.** The base station 102 transmits

carriers C3 and C4, and assigns them to RRH 106 and RRH 107. **The mobile station (MS) 108 is in the area a1 and uses carrier C2.**

EX-1005 9:11-14 (emphasis added); EX-1003 ¶78.



EX-1005 FIG. 10 (annotated); EX-1003 ¶78.

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

- iii. *providing at least one digital access unit configured to communicate with the one or more remote radio units.*

Leng discloses a cell management unit (CMU) (blue) (*digital access unit*) which is configured to communicate with one or more RRHs (red) (*remote radio units*).

According to an embodiment of the present disclosure, the cell management unit (CMU) 24 is the control center of the distributed antenna system 20, and **the cell management unit 24 is connected to the base station 21 and connected to the remote radio heads 26 via the extension hub 25.**

EX-1005 3:26-28 (emphasis added); EX-1003 ¶80.

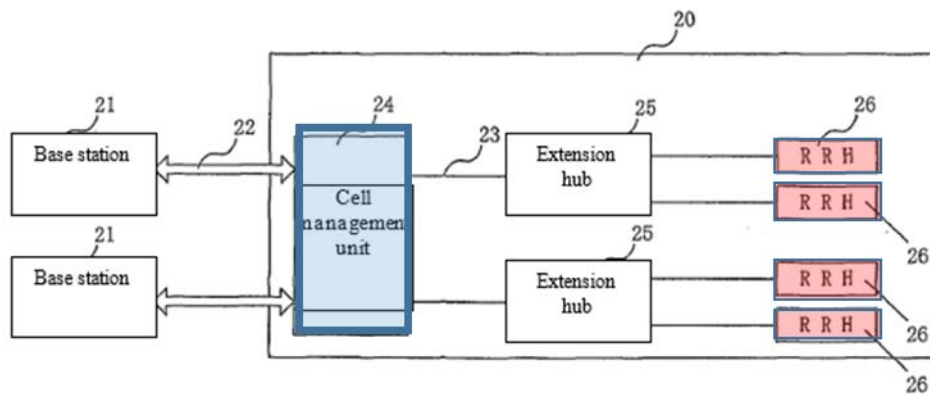


Fig. 2

EX-1005 FIG. 2 (annotated); EX-1003 ¶80.

*iv. translating the uplink and downlink signals between RF and base band as appropriate.*

Leng discloses the RRH converts the downlink digital baseband signals from the transmission medium to an RF signal and the uplink from an RF signal to a digital baseband signal on the transmission medium.

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

EX-1005 3:34-38 (emphasis added); EX-1003 ¶81.

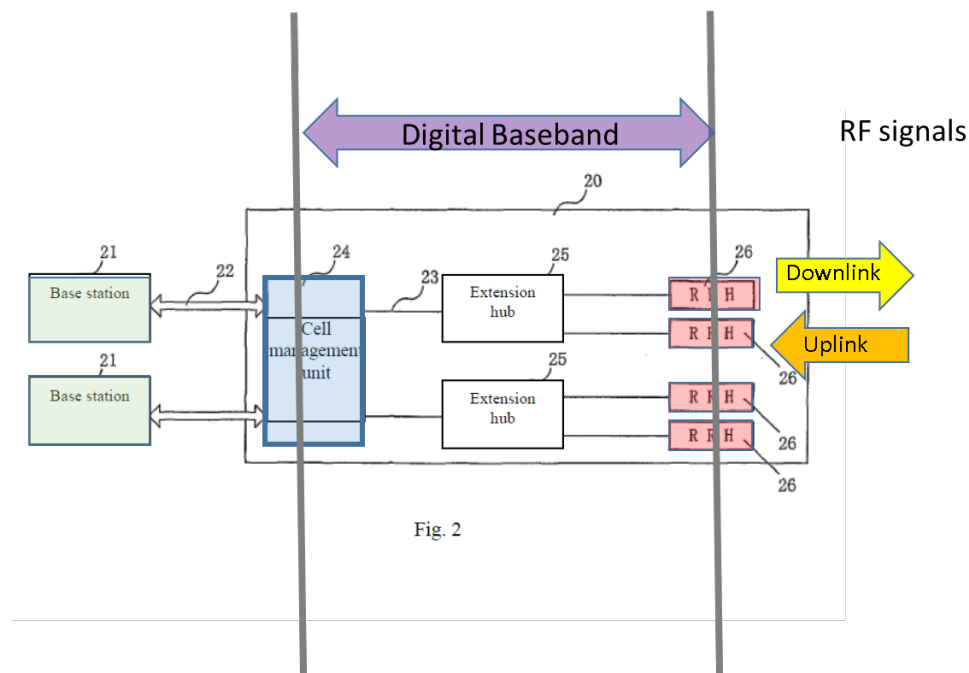


Fig. 2

EX-1005 FIG. 2 (annotated); EX-1003 ¶81.

On the other end, Leng discloses the CMU via an interface supplies signals from the base station 21 to the appropriate RRH as digital baseband signals over medium 23. The uplink signal received by the CMU as a digital baseband signal 23 is also transmitted to the base station via interface 22.



The number of carriers supported depends on the wireless technology used and its operating bandwidth. For example, for 5 MHz WiMAX technology, **the digital baseband signal traffic is 137 Mbps.**

Considering an overhead of 25%, the traffic would be 171.25 Mbps, so a Gigabit Ethernet link can support five carriers.

EX-1005 3:40-43 (emphasis added); EX-1003 ¶82.

The current trend in distributed antenna systems is to use fiber optic or unshielded twisted pair/shielded twisted pair (UTP/STP) cables to **transmit digital radio signals, which are primarily digital baseband signals.**

EX-1005 1:12-14 (emphasis added); EX-1003 ¶82.

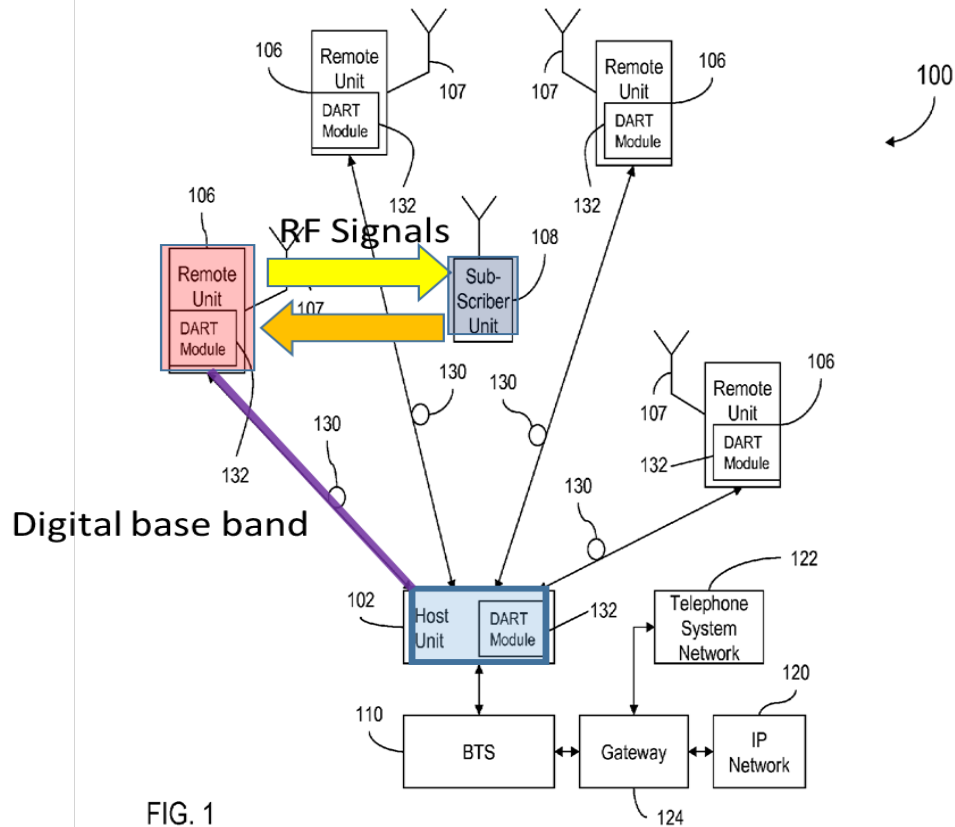
A POSA understood that before transmission of an RF signal, the baseband signal would be upconverted to RF for transmission and after receipt, the RF signal would be downconverted to a baseband signal. EX-1003 ¶83

To the extent PO argues that Leng does not expressly disclose translating between an RF band and a baseband as appropriate, Cannon does. Cannon discloses translating between the RF signal and the digital baseband. Cannon describes that the RF signals received by the remote unit are sent to the DART module 500 and downconverted to provide a data stream of digitally sampled RF. EX-1006 7:37-46, 8:3-6. Cannon describes that a digitally sampled RF signal is a baseband version of the received signal:

DAS 100 comprises a digital DAS transport meaning that the **downlink and uplink transport signals transmitted between host unit 102 and remote units 106 over communication links 130 are generated by digitizing the downlink and uplink RF signals,** respectively. In other words, the downlink and uplink transport signals are not analog RF signals but instead are digital data signals representing digital RF samples of a modulated RF signal. **These digital data signals, which may be alternately referred to herein as “digital RF”, “digitally sampled RF” and “digital baseband”, may comprise digital representations of an RF, IF or baseband version of the original RF signal.**

EX-1006 3:45-56 (emphasis added); EX-1003 ¶84.

For processing the downlink signal, the FPGA includes a DUC to convert the digital baseband signal to an RF signal for transmission. EX-1006 8:6-16; EX-1003 ¶85.



EX-1006 FIG. 1 (annotated); EX-1003 ¶85.

As described above, (section V.A.3), it would have been obvious to combine the teachings of Cannon to the method and system of Leng. EX-1003 ¶86.

Specifically, a POSA would have been motivated to transport the signals between the RRH and the CMU in a baseband format as taught by Cannon to conform with conventional practice that favors transport of digital baseband signals in order to minimize the sampling rate needed to digitize the full band signal compared to the original upconverted RF signal. EX-1003 ¶86.

- v. ***packetizing the uplink and downlink base band signals, wherein the packetized signals correspond to a plurality of carriers.***

As mentioned above, (section V.A.4.a.iv), Leng discloses utilizing uplink and downlink signals that are packetized for transport between the CMU and the RRHs. Leng discloses these uplink and downlink signals support multiple carriers (*corresponding to a plurality of carriers*).

**According to an embodiment of the present disclosure, the distributed antenna system 20 can support multiple carriers** and multiple base stations, of which the RRHs can also support multiple carriers.

EX-1005 3:39-43 (emphasis added); EX-1003 ¶87.

Each of these digital baseband signals corresponds to one of the multiple carrier (*plurality of carriers*) signals and are transported between the CMU and the RRH in packets via a packet address (*packetized uplink and downlink signals*).

**The cell management unit 24 updates the radio signal route by reconfiguring the I/Q packet addresses and updating the routing table** stored in the cell management unit 24 and the extension hub 25 according to the new topology determined.

EX-1005 6:19-21 (emphasis added); EX-1003 ¶88.

An example of the transport of the radio signals provided by Leng is that of a 5 MHz WiMax.

The number of carriers supported depends on the wireless technology used and its operating bandwidth. For example, for 5 MHz WiMAX technology, the digital baseband signal traffic is 137 Mbps.

Considering an overhead of 25%, the traffic would be 171.25 Mbps, so a Gigabit Ethernet link can support five carriers.

EX-1005 3:40-43; EX-1003 ¶89.

A POSA understood that a WiMax network utilizes packetized data, and that an Ethernet link also utilizes packetized data. EX-1003 ¶90.

***vi. configuring each remote radio unit to receive or transmit a respective subset of the plurality of carriers, each respective subset of the plurality of carriers including a number of carriers.***

Leng discloses each RRH is configured to receive or transmit using one or more carriers of the available carriers (*subset of a plurality of carriers*). For example, Fig. 4 shows, a configuration where each RRH (A,B,C,D,E,F) has a single carrier (e.g. 1), which is a subset of a plurality of carriers (e.g., 1, 2, and 3).

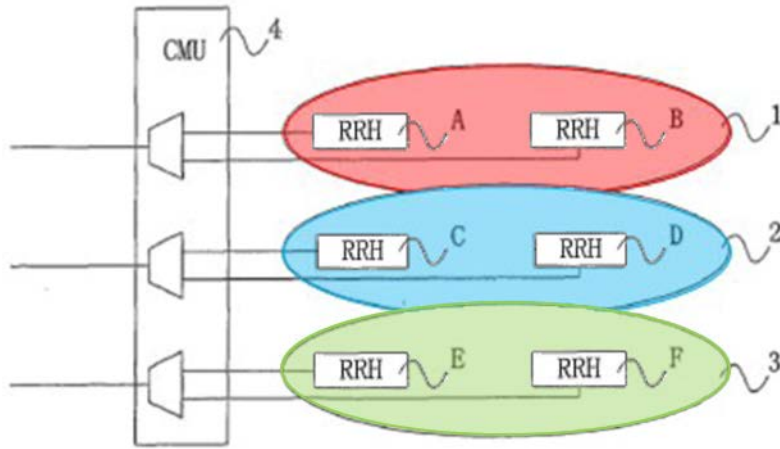


图 4

EX-1005 Fig. 4 (annotated); EX-1003 ¶91.

Fig. 4 shows the initial configuration of the distributed antenna system 20, with **RRH A and RRH B using carrier 1, RRH C and RRH D using carrier 2, and RRH E and RRH F using carrier 3.**

EX-1005 3:19-20 (emphasis added); EX-1003 ¶91.

Although the example in FIG 4 shows each RRH using one carrier, Leng discloses that “the RRHs can also support multiple carriers.” EX-1005 3:39-40. Thus, a POSA understood that each RRH can be configured with a subset of the plurality of carriers 1-3, where the subset includes a number of carriers, e.g., carriers 1-2. EX-1003 ¶92.

To the extent that PO argues that Leng does not expressly disclose this limitation, Cannon expressly discloses that each FPGA in a DART module could be programmed to handle multiple carriers which would include the limitation of a

subset of the plurality of carriers. EX-1006 6:47:55; 7:47-64; EX-1003 ¶93. A POSA would be motivated to combine the teachings of Leng with the teachings of Cannon as discussed above. EX-1003 ¶93

***vii. reconfiguring each remote radio unit by:***

Leng discloses reconfiguring the DAS, the network topology of the RRHs and their respective carriers (*reconfiguring each remote radio unit*).

As shown in FIG. 3, ... **a reconfiguration module 33, configured to determine a new topology, reassign carriers among the corresponding remote radio heads, and reconfigure the routing of radio signals according to the load information collected by the load information collection module 32.**

EX-1005 4:11-17 (emphasis added); EX-1003 ¶94.

Leng discloses the RRHs are notified to switch carrier frequencies and the RRHs switch their carriers quicker than the base station reassigns the mobile stations to the switched carriers.

The carriers of the corresponding low-load remote radio heads may be a neighboring available carrier. If there is no neighboring available carrier, the base station switches the mobile station to a specific target carrier after a predetermined delay time, with the target carrier being a low-load target carrier to which the RRH corresponding to the mobile station should be switched according to the determined new topology. Obviously, the delay time should be greater than the time for the RRH

to switch carriers in order to switch the mobile station to the target carrier after the RRH has switched to the target carrier.

EX-1005 9:6-10; EX-1003 ¶¶95.

Leng discloses reconfiguring each RRH using carrier reconfiguration module 46 to change the carrier frequency of the RRH. Specifically, Leng discloses that switching module 54 in carrier reconfiguration module 46 (blue) is configured to notify the high-load RRH 26 (pink) to switch the carrier to the carrier of the corresponding low-load RRH according to the new topology determined by the topology reconfiguration module. EX-1005 10:21-27; EX-1003 ¶¶96.

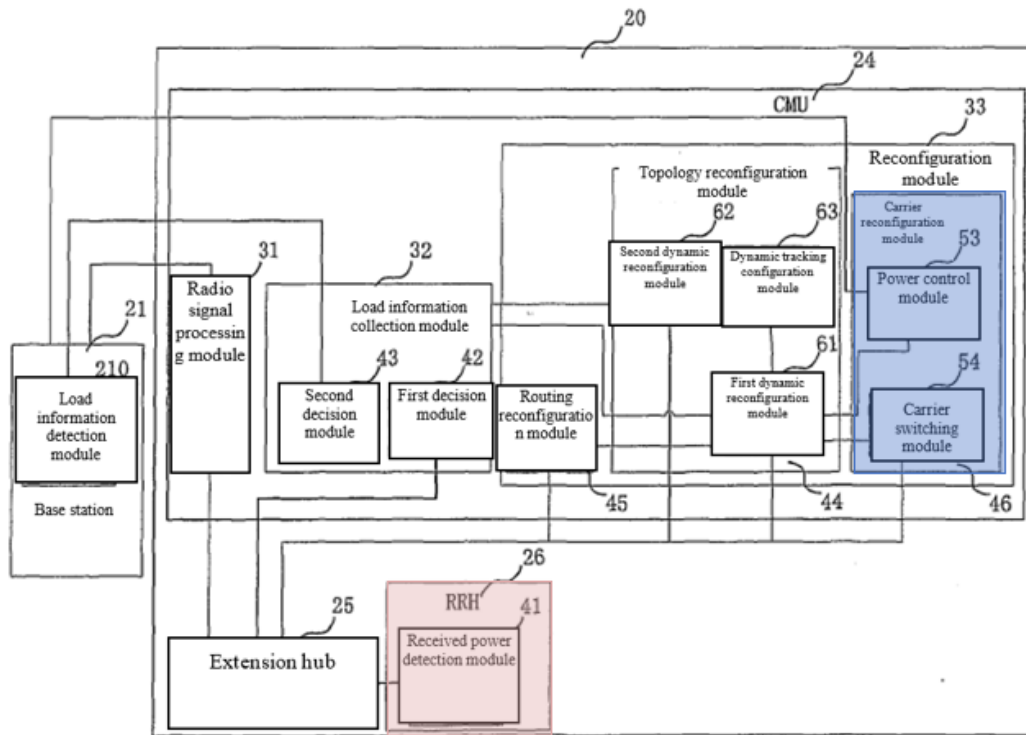


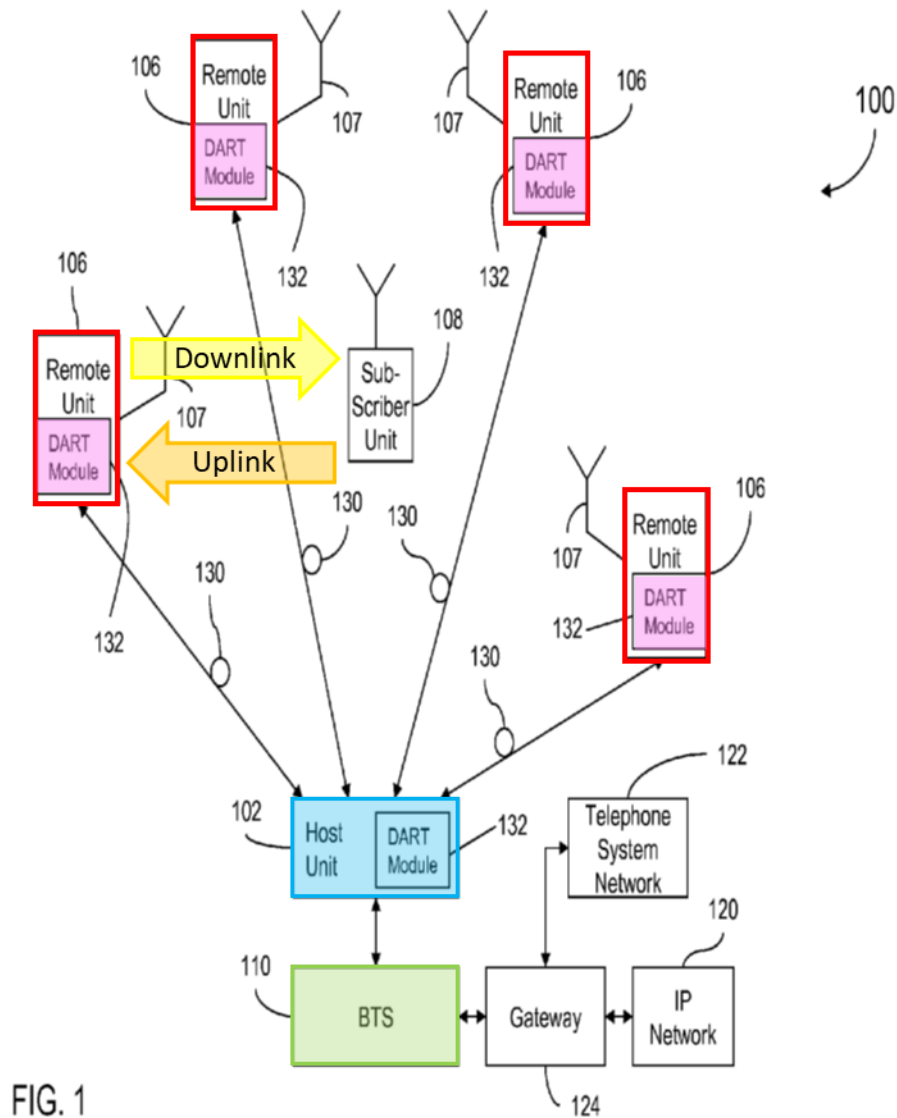
Fig. 15

EX 1005 Fig. 15 (annotated); EX-1003 ¶¶96.



Thus, Leng discloses reconfiguration of the carrier signal at an RRH which meets the claim limitation *reconfiguring each remote radio unit*. EX-1003 ¶97.

To the extent PO argues that Leng does not expressly disclose how the carrier frequency is reconfigured at an RRH, Cannon discloses reconfiguring the carrier frequency of a remote radio unit using the same method described in the '338 Patent. EX-1003 ¶98.



EX 1006 Fig. 1 (annotated); EX-1003 ¶98.

Cannon discloses a DART module that separates spectral regions of interest of the overall spectrum.

In the embodiment shown in FIG. 1, **each remote unit 106 and host unit 102 comprises a digital to analog radio frequency transceiver (DART) module 132 configured to conserve the available**

**bandwidth** of the communication links 130 by **separating and individually processing spectral regions of interest from a larger RF spectrum**.

EX-1006 4:4-11 (emphasis added); EX-1003 ¶¶99.

Further, Canon discloses that using a FPGA 503 includes DUCs 632 and DDCs 630 that can be programmed with a center frequency and bandwidth to reconfigure the carrier of the remote radio unit. EX-1006 FIG. 6; 8:45-9:10; EX-1003 ¶100.

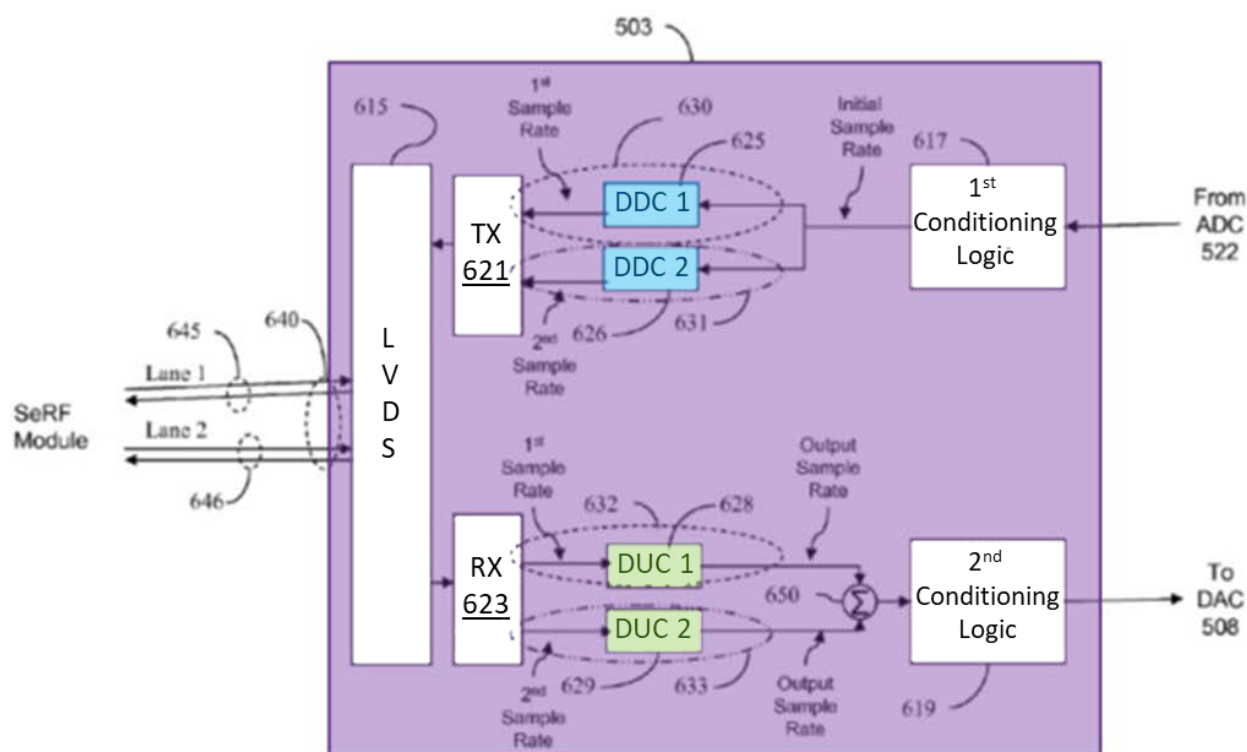


Fig. 6

EX 1006 Fig. 6 (annotated); EX-1003 ¶100.

As illustrated in FIG. 4A, each FPGA is programmable to adjust (*reconfigure*) the remote unit (*remote radio unit*) itself to alter both the bandwidths and the frequencies (*carrier*) of the DUCs and DDCs of the remote unit (*remote radio unit*).

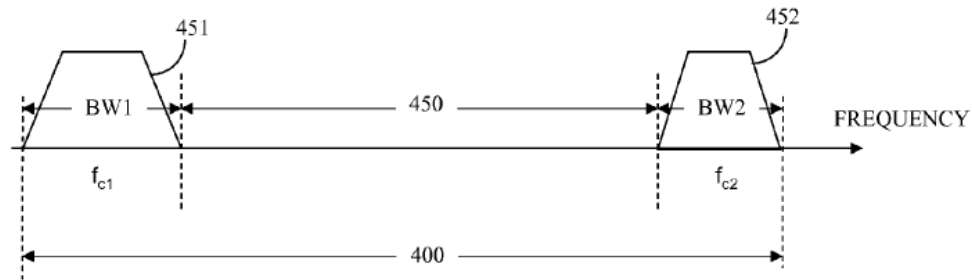


Fig. 4A

EX-1006 FIG. 4A; EX-1003 ¶101.

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

configuration builds are stored in a memory, for example within a SeRF Module. In such an embodiment, a DART Module's FPGA can be reconfigured by pushing a new build image onto the FPGA.

EX-1006 9:45-67 (emphasis added); EX-1003 ¶101.

Cannon's description of changing the carrier frequencies of the DUCs and DDCs is consistent with the disclosure in the '338 Patent that the RRU Management Control module sets the individual parameters of all the RRU Digital Up-Converters to enable or disable specific radio resources from being transmitted by a particular RRU or group of RRUs, and also sets the individual parameters of all the RRU Digital Down-Converters to enable or disable specific uplink radio resources from being processed by a particular RRU or group of RRUs. EX-1001 11:18-11:39; EX-1003 ¶102.

As described above, (section V.A.3), it would have been obvious to combine the teachings of Cannon to the method and system of Leng. EX-1003 ¶103.

**(a) *determining a load percentage for each remote radio unit; and***

Leng discloses determining the load distribution (*load percentage*) for each RRH (*remote radio unit*).

The distributed antenna system 20 is reconfigured the CMU 24 based on the collected load information, instead of via manual configuration during service interruption by the administrator based on the expected

situation as based on the prior art. This thus allows the distributed antenna system 20 to be **dynamically reconfigured in a timely and efficient manner based on the real-time load distribution, balancing the load and improving the system efficiency in a timely manner**, while greatly improving the convenience, real-time nature and accuracy of the configuration, and without service interruption, ensuring the continuity of services.

EX-1005 4:5-10 (emphasis added); EX-1003 ¶104.

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

EX-1005 4:24-27 (emphasis added); EX-1003 ¶104.

The remote radio heads 26 comprise a received **power detection module 41 configured to detect the total broadband power received by the remote radio heads 26** and transmit the detected power value to the load information collection module 32.

EX-1005 5:13-15 (emphasis added); EX-1003 ¶104.

According to the above configuration, **the cell management unit 24 receives the power information detected and transmitted by the RRH 26, compares it with a predetermined threshold, and then decides whether to reconfigure the intelligent distributed antenna**

**system.** This embodiment does not require any changes to the base station and allows fine-grained load information (**specific to each RRH**) to be obtained.

EX-1005 5:27-30 (emphasis added); EX-1003 ¶104.

The load information detection module 210 is provided in each base station 21, and it is configured to collect various load information (for example, throughput, **number of connections, number of registered users**, etc.) and transmit the collected load information to the CMU through the OBSAI/CPRI interface or a local management interface.

EX-1005 6:1-4 (emphasis added); EX-1003 ¶104.

It should be understood by those skilled in the art that the **structure and method of the foregoing two methods for obtaining load information may be flexibly selected according to the needs of the actual application scenario**, or a combination thereof may be applied.

EX-1005 6:23-25 (emphasis added); EX-1003 ¶104.

The topology reconfiguration module 44 comprises: a storage module 51, configured to store a predefined topology, wherein the predefined topology **corresponds to load information or a combination of load information.**

EX-1005 7:26-27 (emphasis added); EX-1003 ¶104.

The distributed antenna system can be dynamically reconfigured in a **timely and effective manner according to the real-time load distribution.**

EX-1005 14:13-14 (emphasis added); EX-1003 ¶104.

A POSA understood Leng discloses load balancing, the use of a load percentage (i.e. the amount of load used by RRH compared to the total load on the network) to determine a new network topology to most efficiently distribute network resources using the combination of load information of the RRHs. EX-1003 ¶105.

A POSA understood using a load percentage (i.e. the amount of load used by RRH compared to the total load on the network) to determine a new network topology to most efficiently distribute network resources for load balancing using the combination of load information of the RRHs as is one disclosed purpose of Leng. EX-1003 ¶106.

***(b) increasing or decreasing the number of carriers in the respective subset of the plurality of carriers based on the load percentage; and***

Leng discloses reconfiguring the number of carriers each RRH (*increase or decreasing the number of carriers*) is currently using (*the subset of the plurality of carrier*) based on load information (*load percentage*).



As shown in FIG. 3, ... **a reconfiguration module 33, configured to determine a new topology, reassign carriers among the corresponding remote radio heads, and reconfigure the routing of radio signals according to the load information collected by the load information collection module 32.**

EX-1005 4:11-17 (emphasis added); EX-1003 ¶107.

Leng gives an example of switching carriers between each RRH in Figures 4 and 5 based on the load information. EX-1005 3:18-22; EX-1003 ¶109. Although the examples in FIGS 4 and 5 show each RRH using one carrier, Leng discloses that “the RRHs can also support multiple carriers.” EX-1005 3:31-32. Thus, a POSA understood that each RRH can be configured to use more than one carrier and thus the number of carriers in the subset assigned to each RRH may be decreased or increased as appropriate based upon load. EX-1003 ¶108.

To the extent Patent Owner argues Leng does not disclose this limitation, Cannon expressly discloses that each FPGA in a DART module could be programmed to handle multiple carriers which would include a subset of the plurality of carriers that can either be increased or decreased. EX-1006 6:47:55; 7:47-64; EX-1003 ¶110. A POSA would be motivated to combine the teachings of Leng with the teachings of Cannon as discussed above to increase or decrease number of carriers used by a remote radio unit based on the load percentage. EX-1003 ¶110.

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

Leng discloses the reconfiguration module 33 of the CMU (*digital access unit*) reconfigures the network topology based on the load information and then re-allocates the carriers to their appropriate RRH (*remote radio units*) based on the new topology (*routing and switching the packetized signals according to a result of the reconfiguring*).

As shown in Fig. 3, according to another embodiment of the present disclosure, in the above distributed antenna system 20, the cell management unit 24 may comprise: ... a reconfiguration module 33, configured to determine a new topology, reassign carriers among the corresponding remote radio heads, and reconfigure the routing of radio signals according to the load information collected by the load information collection module 32.

EX-1005 4:11-17; EX-1003 ¶111.

The reconfiguration module of the CMU (*DAU*) 33, discussed above, updates the signal packet address to route the packetized digital base carrier signal to the appropriate RRH (*routing and switching the packetized signals*). EX-1003 ¶112.

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

EX-1005 5:20-23 (emphasis added); EX-1003 ¶112.

b. **Claim 2**

*i. The method of claim 1*

*ii. wherein each carrier corresponds to a respective RF band.*

Leng discloses that each carrier corresponds to an RF band:

According to an embodiment of the present disclosure, the distributed antenna system 20 can support multiple carriers and multiple base stations, of which **the RRHs can also support multiple carriers.**

**The number of carriers supported depends on the wireless technology used and its operating bandwidth.** For example, for 5 MHz WiMAX technology, the digital baseband signal traffic is 137 Mbps. Considering an overhead of 25%, the traffic would be 171.25 Mbps, so a Gigabit Ethernet link can support five carriers.

EX-1005 3:39-43 (emphasis added); EX-1003 ¶113.

A POSA understood that each carrier used by an RRH utilized its own RF band to prevent interference between the carriers. EX-1003 ¶114.

c. **Claim 3**

- i. *The method of claim 1*
- ii. *wherein determining the load percentage comprises detecting which carriers are active for each remote radio unit.*

Leng discloses receiving the total power of each RRH (*remote radio unit*).

The remote radio heads 26 comprise a received power detection module 41 configured to **detect the total broadband power received by the remote radio heads 26 and transmit the detected power value to the load information collection module 32.**

EX-1005 5:13-15 (emphasis added); EX-1003 ¶115.

Leng also discloses collecting various other types of information and data and using it to dynamically determine if the carriers need to be reallocated to other RRHs to balance load and to increase the availability of resources where there are “hot spots.” EX-1005 11:22-26 (emphasis added); EX-1003 ¶116.

The load information detection module 210 is provided in each base station 21 for collecting **various load information** (e.g., throughput, **number of connections**, number of registered users, **etc.**).

EX-1005 6:1-4 (emphasis added); EX-1003 ¶116.

With the present disclosure, a distributed antenna system can be **dynamically reconfigured in a timely and effective manner**

**according to the real-time load distribution**, balancing the load and improving the system efficiency in a timely manner.

EX-1005 2:14-16 (emphasis added); EX-1003 ¶116.

the cell management unit 24 receives the **load information transmitted by the base station 21, and when the load information meets the reconfiguration conditions**, the need to reconfigure the distributed antenna system 20 according to the load information (step 71) is determined.

EX-1005 6:12-15 (emphasis added); EX-1003 ¶116.

Fig. 4 and Fig. 5 are schematic diagrams showing the principle of reconfiguration of the distributed antenna system in the embodiment. Fig. 4 shows the initial configuration of the distributed antenna system 20, with RRH A and RRH B using carrier 1, RRH C and RRH D using carrier 2, and RRH E and RRH F using carrier 3. When the load of carrier 2 and carrier 3 is transferred to the area of carrier 1, that is, when the CMU 4 detects that RRH A and RRH B have become temporary hot spots of high load, the distributed antenna system 20 is reconfigured. **Fig. 5 shows the reconfigured state of the distributed antenna system 20, with RRH A using carrier 1, RRH B using carrier 2, and RRH C, RRH D, RRH E, and RRH F using carrier 3. Clearly, by using the distributed antenna system provided by this embodiment, for areas where communication traffic varies greatly, such as auditoriums, conference halls, etc., it is possible to dynamically allocate radio frequency resources according to the**

**current traffic condition, and greatly balance the traffic load** and improve system efficiency.

EX-1005 4:18-27 (emphasis added); EX-1003 ¶116.

A POSA understood that to properly redistribute resources to balance loading you would need to know which of the multiple carriers on each of the RRHs are being used. If this was not done, a carrier which was in use may be transferred to augment a “hot spot” overloading the carrier causing an unexpected disconnection of the user(s) using the carrier that was transferred. EX-1003 ¶117.

To the extent PO argues that Leng does not disclose determining a load percentage for each remote radio unit, a POSA understood that Leng’s disclosure of the relative loading of each RRH can be converted to a load percentage using well-known simple mathematical conversions. EX-1003 ¶118.

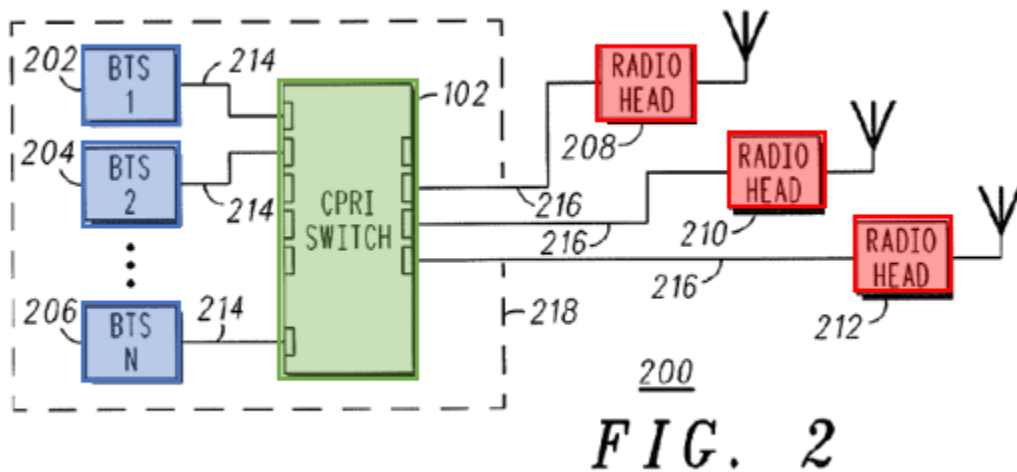
It would have been obvious and routine to perform the conversion into a load percentage as known to a POSA as a matter of preference in the method and system of Leng. EX-1003 ¶119.

**B. Challenge 2, Claims 4-12 Are Obvious Over Leng Alone or in Combination with Cannon and Gupta**

**1. The Gupta Reference**

Gupta is directed to providing a device and connection methodology for connecting resources of a system of BTSs to maximize the use of capacity resources in a communication network. EX-1003 ¶120.

Gupta discloses that radio resources are provided in a distributed fashion by connecting a set of base stations (blue) to one or more Common Public Radio Interfaces (green) that communicates with a plurality of radio heads (red). EX-1008 [0017-0018]. EX-1003 ¶121.



EX-1008 Fig. 2 (annotated); EX-1003 ¶121.

Gupta discloses that the CPRI switch can be used for allocating resources of one or more base stations to allow high-traffic sites to become capable of utilizing the resources of under-utilized sites. The CPRI switch uses the CPRI protocol to provide aggregation, switching and distribution of baseband signals between one or more radio resources. EX-1008 [0019]; EX-1003 ¶122.

Gupta describes that its architecture reduces the infrastructure costs and needs, while increasing the overall capacity of a set of base stations by increasing

the effective utilization of the resources. EX-1008 [0031]. In addition, Gupta describes that the architecture allows for integration of different types of base stations using the CPRI switches. EX-1008 [0031]; EX-1003 ¶123.

**2. Detailed Application of Leng, Cannon and Gupta to Claims 4-12**

**a. Claim 4**

*i. The method of claim 1*

*ii. wherein the at least one digital access unit comprises a first digital access unit and a second digital access unit configured to communicate with each other via a first optical cable.*

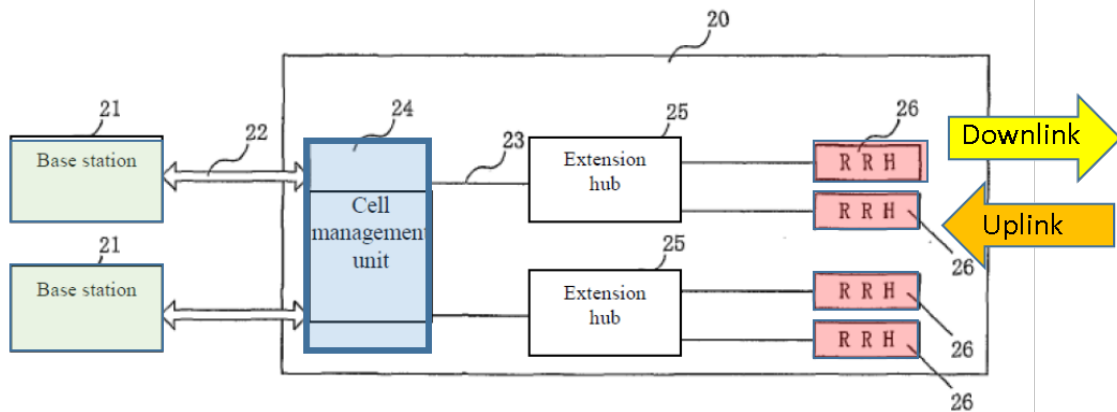


Fig. 2



Leng discloses having two expansion slots, each with two RRHs attached.

The expansion slots 25 are connect through an optical fiber, 23 and the CMU.

**An extension hub 25 is used to aggregate and distribute I/Q data to an extended coverage area.** The remote radio heads (RRHs) 26 are used for digital filtering, analog/digital-to-analog conversion, and analog front-end functions. **The transmission medium 23 of the distributed antenna system 20 may be an optical fiber or a UTP/STP cable, etc.**

EX-1005 3:34-37 (emphasis added); EX-1003 ¶124.

As shown in Fig. 2, an embodiment of the present disclosure provides a distributed antenna system 20 comprising **at least one remote radio head (RRH) 26 and a cell management unit (CMU) 24 connected to the remote radio heads 26 via at least one extension hub 25.** The cell management unit 24 is connected to the base station 21, and is configured to distribute downlink radio signals to the remote radio head 26, collect uplink radio signals and transmit them to the base station 21, and collect the load information of the distributed antenna system 20 and reconfigure the distributed antenna system 20 based on the load information.

EX-1005 3:20-25 (emphasis added); EX-1003 ¶124.

A POSA understood that, akin to the multiple extension hubs, 25, the method and system of Leng would accommodate a second CMU (*DAU*) connected

via an optical fiber similar to transmission line 23 to attach additional RRHs (*remote radio units*) and extend the coverage. EX-1003 ¶125.

For example, FIG. 6 of Gupta describes an architecture that provides for two CPRI switches in communication with each other and a plurality of radio heads via optical cables. The CPRI switches are the functional equivalent of the CMU taught by Leng. Thus Gupta discloses a *digital access unit* that includes a first CPRI 102 (*a first digital access unit*) and CPRI 602 (*a second digital access unit*) configured to communicate with each other via *a first optical cable* 610. EX-1003 ¶126.

A POSA would be motivated to combine the teachings of Gupta to add a second CMU (*a second digital access unit*) and additional radio heads to the first CMU (*a first digital access unit*) of Leng in order to extend the geographical footprint of the network to achieve the benefits described by Gupta, *e.g.*, reduce the infrastructure costs and needs, while increasing the overall capacity of a set of base stations by increasing the effective utilization of the resources. Thus, a POSA implementing the teachings of Gupta for their intended purpose and would expect the combination to be successful. EX-1003 ¶127.

b. **Claim 5**

- i. *The method of claim 4*
- ii. *wherein the one or more remote radio units comprise a first remote radio unit and a second*

*remote radio unit, the first remote radio unit configured to communicate with the first digital access unit via a second optical cable, and the second remote radio unit configured to communicate with the second digital access unit via a third optical cable.*

As discussed with respect to Claim 4, Gupta discloses a second CPRI switch (*digital access unit*) 602 that is in communication with the first CPRI switch 102 that allows for an increase in the number of radio heads (*remote radio units*) by adding radio heads 604 and 606.

**The CPRI switch 102 can also be connected through an electrical or fiber optic cable 610 to a remote CPRI switch 602. Further, the remote CPRI switch 602 can be connected through the plurality of electrical or fiber optic cables 608 to a fourth RH 604 and a fifth RH 606. The first base station 202, the second base station 204, and the third base station 206 can then distribute the communication network data to the forth [sic] RH 604 and a fifth RH 606. The fourth RH 604 and the fifth RH 606 can then radiate and receive the communication network data and can behave like another base station**

EX-1008 [0029] (emphasis added); EX-1003 ¶128.

A POSA understood that CPRI switch 102 would also have been connected to its RHs using optical fiber cables just as CPRI switch 602 is connected via optical fiber cables to RH 604 and RH 606. EX-1003 ¶129.

As described above with respect to Claim 4, it was obvious to modify the combination of Leng and Cannon with the teachings of Gupta, for the same reasons. EX-1003 ¶130.

c. **Claim 6**

- i. *The method of claim 5*
- ii. *wherein the first digital access unit is configured to communicate with a first base station, and the second digital access unit is configured to communicate with a second base station.*

As discussed with respect to Claim 4, Gupta discloses each CPRI switch (*digital access unit*) is configured to communicate via optical line 214, to the base stations.

FIG. 2 illustrates an exemplary way of connecting a set of base stations and a set of RHs to a CPRI switch 102 in a communication network 200, in accordance with various embodiments of the present invention. The communication network 200 includes a first base station 202, a second base station 204, and a third base station 206.

**The first base station 202, the second base station 204, and the third base station 206 can be connected to the CPRI switch 102 through a plurality of electrical or fiber optic cables 214.**

EX-1008 [0029] (emphasis added); EX-1003 ¶131.

For the same reasons as described above with respect to Claim 4, it was obvious to modify the combination of Leng and Cannon with the teachings of Gupta. EX-1003 ¶132.

d. **Claim 7**

- i. *The method of claim 6*
- ii. *wherein the first base station transmits or receives RF signals corresponding to a first number of carriers, and the second base station transmits or receives RF signals corresponding to a second number of carriers.*

Leng discloses multiple base stations and multiple carriers.

Fig. 1 shows the basic structure of an existing digital distributed antenna system 10. Remote radio heads (RRHs) 17 are placed around the building. The primary hub 14 and the extension hubs 16 distribute downlink radio signals to the remote radio heads 17 and collect uplink radio signals for the base station 11. **Since the transmitted signals are digital radio signals, it is easy to support multiple carriers and multiple base stations at the same time.**

EX-1005 1:15-18 (emphasis added); EX-1003 ¶133.

Leng also discloses that the CMU receives radio signals (*RF signals*) from the base stations.

In order to avoid service interruption to mobile stations (MS) caused by the carrier switching of the RRH and ensure service continuity, the

embodiment of the present disclosure provides a manner of implementation for carrier reconfiguration and the corresponding structure. By gradually reducing the transmit power of the carriers to be switched, a situation in which mobile stations leave the cell is simulated, and this makes the mobile stations actively **send a request to the base station to switch carriers, thus enabling the base station to be informed of the specific mobile stations that need a switch of carriers and switch these mobile stations to the target carriers through the base station.**

EX-1005 8:29-35 (emphasis added); EX-1003 ¶134.

A POSA understood a first base station transmitting a carrier corresponds to transmitting a first number of carriers and the second base station transmitting a carrier corresponds to transmitting a second number of carriers. EX-1003 ¶135.

e. **Claim 8**

- i. The method of claim 7*
- ii. wherein the first number of carriers and the second number of carriers correspond to different RF bands.*

Leng discloses that each carrier has an operating bandwidth within the overall bandwidth and therefore only a fixed number of carriers can be supported.

According to an embodiment of the present disclosure, the distributed antenna system 20 can support multiple carriers and multiple base stations, of which **the RRHs can also support multiple carriers.**

**The number of carriers supported depends on the wireless technology used and its operating bandwidth.** For example, for 5 MHz WiMAX technology, the digital baseband signal traffic is 137 Mbps. Considering an overhead of 25%, the traffic would be 171.25 Mbps, so a Gigabit Ethernet link can support five carriers.

EX-1005 3:39-43 (emphasis added); EX-1003 ¶136.

Fig. 1 shows the basic structure of an existing digital distributed antenna system 10. Remote radio heads (RRHs) 17 are placed around the building. The primary hub 14 and the extension hubs 16 distribute downlink radio signals to the remote radio heads 17 and collect uplink radio signals for the base station 11. **Since the transmitted signals are digital radio signals, it is easy to support multiple carriers and multiple base stations at the same time.**

EX-1005 1:15-18 (emphasis added); EX-1003 ¶136.

A POSA understood that in a system with multiple base stations and multiple carriers, that each base station with its own number of carriers would utilize different RF bands for their carriers than the RF Bands of carriers of adjacent base stations, in order to minimize interference. EX-1003 ¶137.

f. **Claim 9**

- i. The method of claim 7*
- ii. wherein the first remote radio unit is configured to receive or transmit RF signals corresponding to one of the second number of carriers.*

Leng discloses that its system can be reconfigured such that each RRH (*remote radio unit*) can utilize any carrier to dynamically allocate resources as needed based on load distribution.

Fig. 4 and Fig. 5 are schematic diagrams showing the principle of reconfiguration of the distributed antenna system in the embodiment. Fig. 4 shows the initial configuration of the distributed antenna system 20, with RRH A and RRH B using carrier 1, RRH C and RRH D using carrier 2, and RRH E and RRH F using carrier 3. **When the load of carrier 2 and carrier 3 is transferred to the area of carrier 1, that is, when the CMU 4 detects that RRHA and RRH B have become temporary hot spots of high load, the distributed antenna system 20 is reconfigured.** Fig. 5 shows the reconfigured state of the distributed antenna system 20, with RRH A using carrier 1, RRH B using carrier 2, and RRH C, RRH D, RRH E, and RRH F using carrier 3. **Clearly, by using the distributed antenna system provided by this embodiment, for areas where communication traffic varies greatly, such as auditoriums, conference halls, etc., it is possible to dynamically allocate radio frequency resources according to the current traffic condition, and greatly balance the traffic load and improve system efficiency.**

EX-1005 4:18-27 (emphasis added); EX-1003 ¶138.

A POSA understood that in a system with multiple base stations and multiple carriers, wherein each carrier is dynamically allocated (*configured to receive*) as necessary to an RRH (*remote radio unit*), that each carrier (*one of the*



*second number of carriers*) from each base station would be one of the RF bands corresponding to those used by that base station. EX-1003 ¶139.

g. **Claim 10**

- i. *The method of claim 7*
- ii. *wherein the second remote radio unit is configured to receive or transmit RF signals corresponding to one of the first number of carriers.*

Leng discloses that its system can be reconfigured such that each RRH (*remote radio unit*) can utilize any carrier to dynamically allocate resources as needed based on load distribution.

Fig. 4 and Fig. 5 are schematic diagrams showing the principle of reconfiguration of the distributed antenna system in the embodiment. Fig. 4 shows the initial configuration of the distributed antenna system 20, with RRH A and RRH B using carrier 1, RRH C and RRH D using carrier 2, and RRH E and RRH F using carrier 3. **When the load of carrier 2 and carrier 3 is transferred to the area of carrier 1, that is, when the CMU 4 detects that RRH A and RRH B have become temporary hot spots of high load, the distributed antenna system 20 is reconfigured.** Fig. 5 shows the reconfigured state of the distributed antenna system 20, with RRH A using carrier 1, RRH B using carrier 2, and RRH C, RRH D, RRH E, and RRH F using carrier 3. Clearly, **by using the distributed antenna system provided by this embodiment, for areas where communication traffic varies**

**greatly, such as auditoriums, conference halls, etc., it is possible to dynamically allocate radio frequency resources according to the current traffic condition,** and greatly balance the traffic load and improve system efficiency.

EX-1005 4:18-27 (emphasis added); EX-1003 ¶140.

A POSA understood that in a system with multiple base stations and multiple carriers, wherein each carrier is dynamically allocated (*configured to receive*) as necessary to an RRH (*remote radio unit*), that each carrier (*one of the first number of carriers*) from each base station would be one of the RF bands corresponding to those used by that base station. EX-1003 ¶141.

h. **Claim 11**

- i. *The method of claim 6*
- ii. *wherein the first base station and the second base station are associated with different wireless operators.*

Leng discloses using multiple carriers and multiple base stations.

Fig. 1 shows the basic structure of an existing digital distributed antenna system 10. Remote radio heads (RRHs) 17 are placed around the building. The primary hub 14 and the extension hubs 16 distribute downlink radio signals to the remote radio heads 17 and collect uplink radio signals for the base station 11. **Since the transmitted signals are digital radio signals, it is easy to support multiple carriers and multiple base stations at the same time.**

EX-1005 1:15-18 (emphasis added); EX-1003 ¶142.

A POSA understood different carriers are associated with different base stations and different carriers are typically associated with different wireless operators, therefore it is not uncommon that base stations are associated with different operators. EX-1003 ¶143.

To the extent PO argues that Leng does not expressly disclose a second base station is associated with a different wireless operator, a POSA understood that it was common to utilize common DAS infrastructures among different carriers. *See* section III.G.3. As discussed in the state of the art section above, a POSA understood that the multiple service providers using different communications protocols (e.g., CDMA, GSM, etc.) could share common infrastructure resources and thus avoid the cost and complexity of each provider providing its own infrastructure. EX-1010 2:24-29. In addition, Gupta expressly discloses integration of different types of base stations within the same network. Thus, a POSA was motivated to modify the teachings of Leng to include base stations associated with different wireless operators to achieve the benefits of reduced infrastructure costs, with an expectation that such modification would be successful. EX-1003 ¶144.

i. **Claim 12**

i. *The method of claim 6*

- ii. wherein the first base station and the second base station are associated with a common wireless operator.*

Leng discloses using multiple carriers and multiple bases stations.

Fig. 1 shows the basic structure of an existing digital distributed antenna system 10. Remote radio heads (RRHs) 17 are placed around the building. The primary hub 14 and the extension hubs 16 distribute downlink radio signals to the remote radio heads 17 and collect uplink radio signals for the base station 11. **Since the transmitted signals are digital radio signals, it is easy to support multiple carriers and multiple base stations at the same time.**

EX-1005 1:15-18 (emphasis added); EX-1003 ¶145.

A POSA understood that a single wireless operator would have multiple base stations to provide coverage to a large area. A POSA also understood that the coverage areas would have varying amount of load demand such that it would be advantageous to reallocate resources between a first and a second base station having a common carrier. EX-1003 ¶146.

## **VII. THE BOARD SHOULD NOT EXERCISE ITS DISCRETION AND DENY INSTITUTION**

### **A. The Board Should Not Exercise Its Discretion under 35 U.S.C. § 325(d) and Deny Institution**

As discussed above, the '338 Patent was challenged in IPR2020-01466. The references, individually and in combination, as set forth in Grounds 1 and 2 of this

Petition have not previously been considered by the Board. Therefore, the combination of art in the present grounds, and the arguments related thereto were not previously presented to the Office. Following the precedential decision in *Advanced Bionics LLC*, Petitioner respectfully submits that the Board should not exercise its discretion under 35 U.S.C. § 325(d) to deny this Petition

**B. The Board Should Exercise Its Discretion under 35 U.S.C. § 314(a) and Deny Institution**

The PTAB has discretion to deny *inter partes review* under 35 U.S.C. § 314(a). In *Apple Inc. v. Fintiv, Inc.* On June 21, 2022, the Director issued interim procedure regarding application of the *Fintiv* factors (Interim Guidance). The Interim Guidance stated that “the PTAB will not deny institution of an IPR or PGR under *Fintiv* (i) when a petition presents compelling evidence of unpatentability..... or (iii) where a petitioner stipulates not to pursue in a parallel district court proceeding the same grounds as in the petition or any grounds that could have reasonably been raised in the petition.” First, the Petition is particularly strong in the underlying merits. Second, the Petitioner adopts the identical stipulation from *Sotera*, Thus, under the Interim Guidance, the Board should not deny institution.

Nevertheless, a holistic view of the remaining *Fintiv* factors also weighs in favor of institution.

Under factor 1, *Sotera* found the factor neutral because the district court has not been requested to issue a stay. Here, no stay has yet been requested and thus this factor is speculative at best and neither weighs for or against institution.

Under factor 2, *Sotera* determined that “[i]f the court’s trial date is at or around the same time as the projected statutory deadline or even significantly after the projected statutory deadline, the decision whether to institute will likely implicate other factors discussed herein.” *Sotera* p. 15. Accordingly, although the trial in *Sotera* was slated to begin around the same time as the final written decision date, the Board refused to exercise discretionary denial. Here, the litigations are at an initial stage. Specifically, the trial date has been set for all defendants in the related litigation for October 16, 2023, which is in line with the most recent statistics. A Final Written Decision is expected in the present matter February 1, 2024. Considering the inherent uncertainties of litigation scheduling, particularly where multiple trials are scheduled for the same date this factor weighs against discretionary denial.

Under factor 3, *Sotera* noted that infringement and invalidity contentions had been exchanged, but that “fact discovery is ongoing, expert reports are not due yet, and substantive motion practice is yet to come” and found that “although the parties and the District Court have invested some effort in the parallel proceedings to date, further effort remains to be expended in this case before trial.” *Sotera* p.

16. Similarly, expert discovery and Markman have not been concluded. Thus, following *Sotera*, this factor weighs against discretionary denial.

Under factor 4, Petitioner makes a *Sotera* stipulation that if the IPR is instituted, it will not pursue any ground raised or that could have been reasonably raised with the IPR in the district court litigation. In addition, PO has only identified a subset of the claims that are being challenged in the present Petition. . Patent Owner has only identified Claims 1 and 2 of the '338 Patent in its infringement contentions served. Thus, it is likely that the district court will not be addressing the validity of all of the Challenged Claims.

Under factor 5, Petitioner is a defendant in the District Court Litigation.

Under factor 6, other circumstances weigh in favor of institution. Here, the merits of the Petition are especially strong given the Board granted institution in IPR2022-01212, which shares the identical grounds with the present petition. In the previous proceeding, the Board found that not only were the respective claims of Ground 1 obvious over Leng in view of Cannon, but where obvious over Leng alone ( “Accordingly, we determine that Petitioner shows a reasonable likelihood that it would prevail with respect to its contention that claim 1 would have been obvious over Leng alone or the combined teachings of Leng and Cannon”). IPR2022-01212, DI. 54. The Petition explains how the references disclose each of the limitations added during prosecution to gain allowability (see IV.B above), and

that they discloses the method of reconfiguring a remote radio that the Board found was missing in the 446 IPR proceeding (see IV.C above). When viewed holistically, just like in *Sotera*, the timing of the present Petition was reasonable, there has been relatively limited investment in the related litigation, and there is minimal overlap between the present IPR and the Related Parallel Litigation. Thus, the efficiency and integrity of the IPR process is best served by instituting review.

#### **VIII. Mandatory Notices Under 37 C.F.R. §42.8**

##### **A. Real Party-in-Interest (37 C.F.R. § 42.8(b)(1))**

AT&T Corp., AT&T Communications LLC AT&T Services, Inc., AT&T Mobility LLC, and AT&T Mobility II LLC are the real parties-in-interest. In addition, AT&T Inc. is identified as a real party-in-interest only to the extent that Patent Owners contend it needs to be named as such. AT&T Inc. is and always has been a holding company that is a legally and factually distinct entity from its subsidiaries. Each of AT&T Inc.'s subsidiaries, including AT&T Corp, AT&T Mobility LLC, AT&T Mobility LLC II, and AT&T Services, Inc., maintains its own independent own independent status, identity, and structure. AT&T Inc. does not provide any of the products and services at issue in the underlying patent infringement lawsuit.



**B. Related Matters (37 C.F.R. § 42.8(b)(2))**

**1. Judicial Matters**

As of the filing date of this Petition and to the best knowledge of Petitioner, the '338 Patent is involved in the following litigations ("Related Litigations"):

*Dali Wireless, Inc. v. AT&T Corp., et al.*, E.D. Texas (Case No. 2:22-cv-12)

*Dali Wireless, Inc. v. Cellco Partnership, et al.* (W.D. Texas (Case No. 6:22-cv-00104)).

*Dali Wireless, Inc. v. CommScope Techs.*, No. 19-952 (Del.), on appeal *Dali Wireless Inc. v. CommScope Techs LLC*, No. 22-1699 (Fed. Cir.).

**2. Administrative Matters:**

As of the filing date of this Petition and to the best knowledge of Petitioner, the '338 Patent was subject to the following *inter partes* reviews:

**IPR2020-01466-** *Commscope, Inc. v. Dali Wireless, Inc.* (Institution denied)

**IPR2022-01212-** *Ericsson, Inc. v Dali Wireless, Inc.* (Instituted 2/1/2023)

**3. Related Patents**

See Exhibit 1011.

**C. Lead/Back-up Counsel (37 C.F.R. § 42.8(b)(3)):**

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**D. Notice of Service Information (37 C.F.R. § 42.8(b)(4)):**

Please direct all correspondence to lead and back-up counsel at the above addresses. Petitioner consents to electronic service at the email addresses above.

## **IX. CONCLUSION**

For the reasons set forth above, Petitioner has established a reasonable likelihood of prevailing with respect to all Challenged Claims of the '338 Patent and requests the Board institute *inter partes* review and then cancel all claims as unpatentable.

Respectfully submitted,

BY: s/Patrick Craig Muldoon/  
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Dated: March 1, 2023

**CERTIFICATION OF SERVICE ON PATENT OWNER**

Pursuant to 37 C.F.R. §§ 42.6(e), 42.8(b)(4) and 42.105, the undersigned certifies that on March 1, 2023, a complete and entire copy of this Corrected Petition for *Inter partes* Review of U.S. Patent No. 8,682,338 and all supporting exhibits were served via email, to the Patent Owner via their service address. :

Artegis Law Group, LLP

John Carey  
7710 Cherry Park Drive Suite T #104  
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A courtesy copy was also sent via electronic mail to Patent Owner's counsel listed below.

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**CERTIFICATE OF COMPLIANCE**

Pursuant to 37 C.F.R. § 42.24 *et seq.*, the undersigned certifies that this document complies with the type-volume limitations. This document contains 13,995 words as calculated by the “Word Count” feature of Microsoft Word 2010, the word processing program used to create it.

Dated: March 1, 2023

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