

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ERICSSON INC.
Petitioner,

v.

DALI WIRELESS, INC.,
Patent Owner.

U.S. Patent No. 9,820,171

Title: REMOTELY RECONFIGURABLE DISTRIBUTED ANTENNA
SYSTEM AND METHODS

Inter Partes Review No.: IPR2023-00700

**PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 9,820,171
UNDER 35 U.S.C. §§ 311-319 and 37 C.F.R. §§ 42.1-.80, 42.100-.107**

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Petitioner’s Exhibit List

<i>Exhibit #</i>	<i>Description</i>
1001	U.S. Patent No. 9,820,171 (the “’171 Patent”)
1002	Selected Portions of the Prosecution History of the ’171 Patent (“File History”)
1003	Declaration of Petitioner’s Expert Dr. Henry H. Houh (“Dr. Houh”)
1004	International Application Publication WO 2009/021359 A1 published on February 19, 2009 (“Leng”)
1005	Certified English Translation of Leng (EX-1004)
1006	U.S. Patent No. 8,270,387 (“Cannon”)
1007	Institution Decision of IPR2020-01432 for the 171 Patent, <i>John Mezzalingua Associates, LLC v. Dali Wireless, Inc.</i> , Paper 16 (P.T.A.B., Feb. 9, 2021)
1008	U.S. Patent Application Publication US2008/0045254A1 (“Gupta”)
1009	U.S. Patent Application Publication US2010/0128676 (“Wu”)
1010	U.S. Pat. No. 8,588,614 (“Larsen”)
1011	Related Patents
1012	U.S. Provisional Patent Application No. 61/374,593
1013	Prosecution History of U.S. Patent No. 8,682,338 (“the ’338 Patent”)
1014	Institution Decision of IPR2022-01212 for the ’338 Patent, <i>Ericsson Inc. v. Dali Wireless Inc.</i> , Paper 17 (P.T.A.B., Feb. 1, 2023).
1015	Claim Construction Order (including for terms in the ’338 Patent) in <i>Dali Wireless, Inc. v. Cellco Partnership D/B/A Verizon Wireless, et al.</i> , Case No. 6:22-cv-01313-ADA, Dkt. 31 (W.D. Texas, Feb. 2, 2023)
1016	Claim Construction Order (for terms in the ’338 Patent) in <i>Dali Wireless, Inc. v. CommScopeTechnologies LLC, et al.</i> , Case No. 19-952 (MN), Dkt. 321 (D. Del., March 3, 2022).
1017	Claim Construction Order (including for terms in the ’338 Patent) in <i>Dali Wireless, Inc. v. CommScopeTechnologies LLC, et al.</i> , Case No. 19-952 (MN), Dkt. 122 (D. Del., Jan. 4, 2021).

<i>Exhibit #</i>	<i>Description</i>
1018	Joint Claim Construction Statement (including for terms in the '338 Patent) in <i>Dali Wireless, Inc. v. AT&T Corp., et al.</i> , Case No. 2:22-cv-00012-RWS-RSP, Dkt. 109 (E.D. Texas, Feb. 13, 2023).
1019	Patent Owner's (Dali Wireless, Inc.'s) Opening Claim Construction Brief in <i>Dali Wireless, Inc. v. AT&T Corp., et al.</i> , Case No. 2:22-cv-00012-RWS-RSP, Dkt. 113 (E.D. Texas, Mar. 2, 2023)

I. INTRODUCTION

Pursuant to 35 U.S.C. §§311 et seq. and 37 C.F.R. §§42.1 et seq., Ericsson Inc. (“Petitioner”) hereby petitions for an *inter partes* review of U.S. Patent No. 9,820,171 (the “’171 Patent”). Petitioner respectfully submits that Claims 1-20 (the “Challenged Claims”) of the ’171 Patent are unpatentable under 35 U.S.C. §103. 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.

II. OVERVIEW

The Challenged Claims are directed to prior art systems and combinations of conventional components of a distributed antenna system (“DAS”) that reconfigures remote radio units (“RRUs”) based on loading. Specifically, the ’171 Patent reconfigures an RRU by increasing or decreasing the number of frequency carriers used by the RRU. In some embodiments, the RRUs are reconfigured based on a load by determining which carriers are active for each RRU.

However, at the time the ’171 Patent was filed, Leng (EX-1005) disclosed the same structure and method for managing resources in a DAS, including a DAS that reconfigures remote radios based on the load of the radios by increasing or decreasing the number of frequency carriers used by the radios. Cannon (EX-1006) discloses the specific details of reconfiguring a remote radio in a DAS.

The systems described in Leng, Cannon, and the '171 Patent with common elements highlighted by color are illustrated below:

Leng

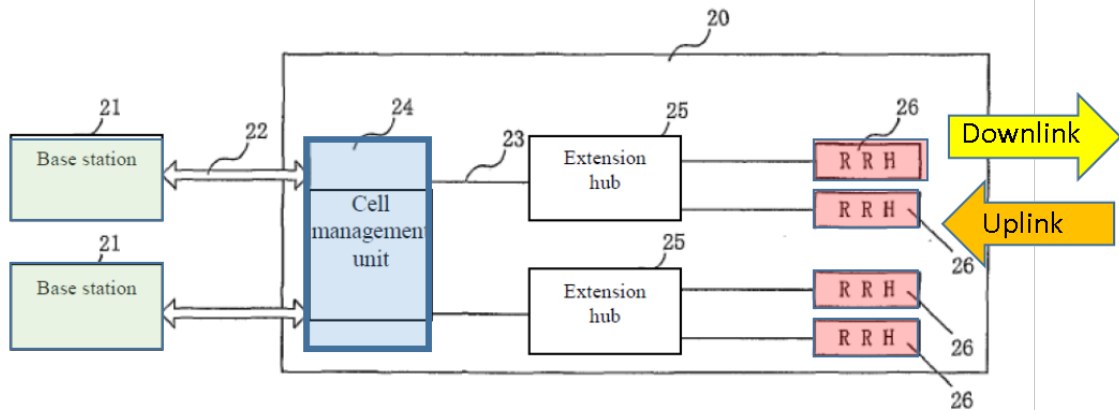


Fig. 2

EX-1005 FIG. 2 (annotated); EX-1003 ¶¶32, 33 and 34.

Cannon

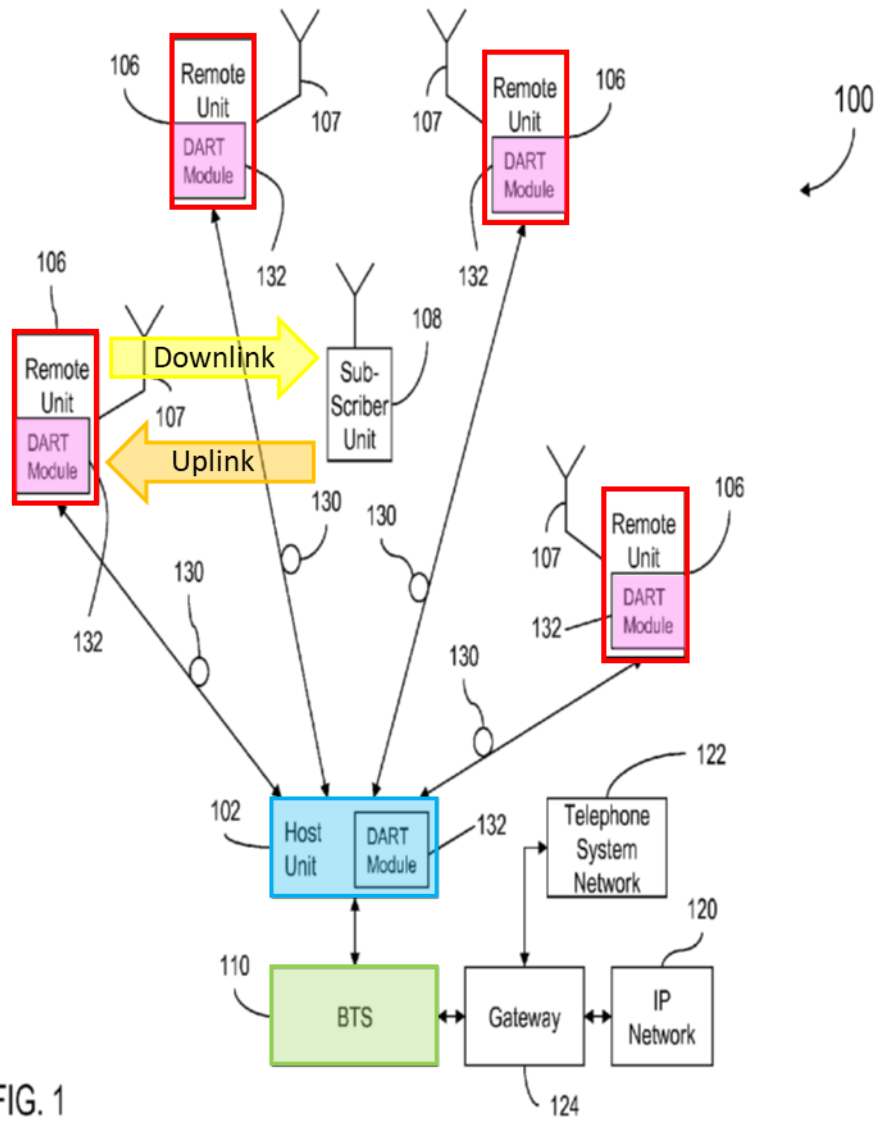


FIG. 1

EX-1006 FIG. 1 (annotated); EX-1003 ¶¶33, 34.

'171 Patent

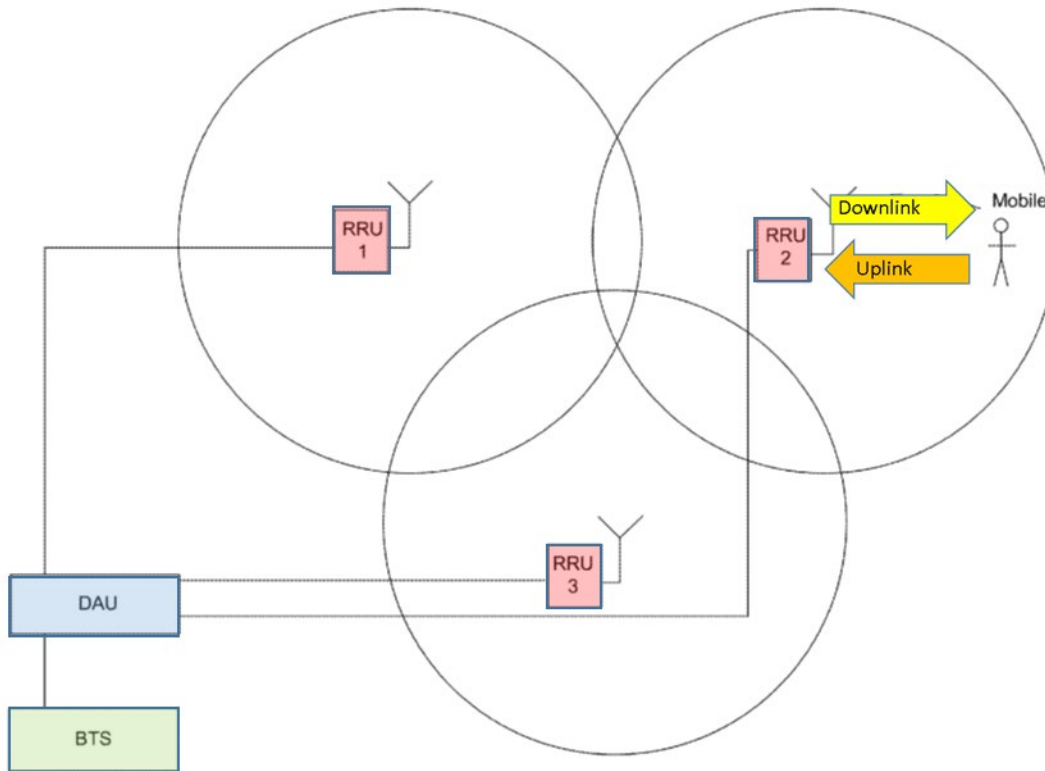


Figure 4 Indoor Localization System of GSM and LTE

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

The terminology used in each reference to describe common elements is shown in the table below:

Leng	Cannon	171 Patent
Remote Radio Head (RRH)	Remote Unit	Remote Radio Unit (RRU)
Cell Management Unit (CMU)	Host Unit	Digital Access Unit (DAU)
Base Station	Base Station (BTS)	Base Station (BTS)
Downlink		

Leng discloses reconfiguring remote radios by switching active carriers, and Cannon discloses specific details for reconfiguring a remote software-defined radio by reprogramming the carrier frequencies that are used by the remote radio.

Further, a POSA would be motivated to modify the teachings 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, independent Claims 1 (method) and 15 (system) are unpatentable over Leng and Cannon, if not Leng alone. The dependent claims are directed to various architectures of DASs, *e.g.*, a number of DAUs, BTSs and RRUs, which were well-known as demonstrated, for example, by Gupta. EX-1003 ¶35.

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

Petitioner certifies that the '171 Patent for which review is sought is available for IPR and that Petitioner is not barred or estopped from requesting an IPR 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 this Petition and in the attached Declaration of Petitioner's Expert (EX-1003), the systems and methods for reconfiguring a remote radio by increasing or decreasing the number of carriers used by the remote radio, including based on the load of the radio, as described and claimed in the '171 Patent, were obvious over the prior art to a person of ordinary skill in the art ("POSA") at the time of the invention.

V. BACKGROUND

A. Summary of the '171 Patent

The '171 Patent is titled "Remotely Reconfigurable Distributed Antenna System and Methods" and is generally directed to a DAS as part of a distributed wireless network. EX-1001 1:1-4, 19-21. In one embodiment, a DAS includes a base station that communicates to mobile devices through an interface, called a Digital Access Unit ("DAU"), and remote radio units ("RRUs"). EX-1001 1:15-17. The '171 Patent describes "[o]ne of the most difficult challenges faced by network operators is caused by the physical movements of subscribers from one location to another, and particularly when wireless subscribers congregate in large numbers at one location." EX-1001 1:33-37. The '171 Patent identifies "one notable example is a business enterprise facility during lunchtime, when a large number of wireless subscribers visit a cafeteria location in the building." EX-1001 1:37-39; EX-1003 ¶36.

The '171 Patent describes a solution to this challenge by reconfiguring 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 '171 Patent describes the use of software-programmable frequency selective Digital Up-Converters (“DUCs”) and Digital Down-Converters (“DDCs”). EX-1001 4:9-19; EX-1003 ¶37.

As illustrated in FIG. 1, a 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 RRUs:

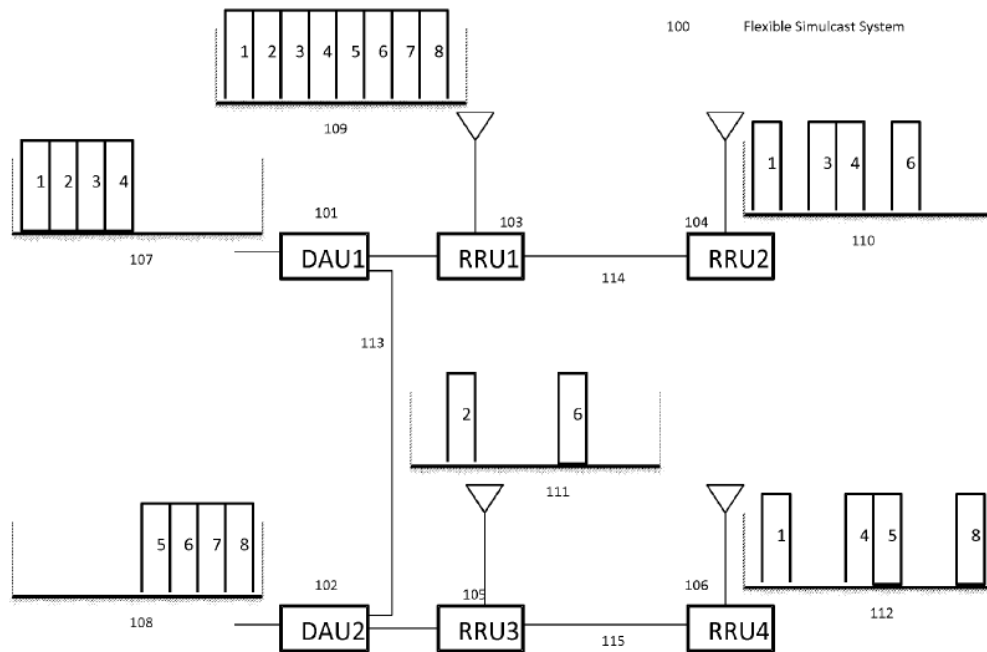


Figure 1: Flexible Simulcast Downlink Example

EX-1001 FIG. 1; EX-1003 ¶38.

The DAU serves as an interface between the BTS and multiple RRUs. EX-1001 6:6-8. For the downlink path, RF signals received from the BTS are separately down-converted, digitized, and converted to baseband (using a DDC). 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 RRUs over optical fiber cable. EX-1001 6:9-17; EX-1003 ¶39.

In the embodiment of FIG. 1, a composite downlink input signal 107 (comprised of Carriers 1-4) from a BTS belonging to one wireless operator enters DAU1 101 at the DAU1 RF input port; and a second composite downlink input signal 108 (comprised of Carriers 5-8) from a second BTS belonging to the same wireless operator enters DAU2 at the DAU2 RF input port. EX-1001 6:22-32. Bidirectional optical cable 113 connects DAU1 and DAU2 and facilitates networking of DAU1 and DAU2 such that all of Carriers 1-8 are available within DAU1 and DAU2 to transport to RRU1, RRU2, RRU3 and RRU4. EX-1001 6:38-42. Software settings within each RRU1, RRU2, RRU3, and RRU4 are configurable to enable particular carriers to be present in each respective downlink output signal 109, 110, 111, and 112 at the antenna ports of the RRUs. EX-1001 6:37-65; EX-1003 ¶40.

For example, with respect to the embodiment of FIG. 1, 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 '171 Patent explains that one possible application for RRU1 is a cafeteria in an enterprise building during lunch hour where a large number of wireless subscribers are gathered. EX-1001 6:50-53. 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/off the individual carriers via gain control parameters. EX-1001 6:37-65; EX-1003 ¶41.

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 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 the RRUs. EX-1001 6:66-7:18; EX-1003 ¶42. The reciprocal operations in the uplink direction (RRUs to DAUs to BTSs) is shown and described in Figure 2. EX-1001 FIG. 2, 6:17-22, 8:49-9:49; EX-1003 ¶42.

In an embodiment, the '171 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 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 needs those radio resources within its coverage area. EX-1001 11:64-12:10; EX-1003 ¶45.

The '171 Patent discloses the use of software-programmable frequency selective DUCs and DDCs and that the individual RF parameters of the DUCs and DDCs can be changed to enable or disable specific carriers, but does not describe

how this is accomplished. Instead, the '171 Patent states that the functionality of the DAUs and RRUs, including the programmability of the DUCs and DDCs, is “explained in detail” in the '593 Provisional Application. (EX-1012) attached as an appendix to the '171 Patent. EX-1001 6:32-37; EX-1003 ¶46.

As disclosed in U.S. Provisional Application Ser. No. 61/374,593, entitled “Neutral Host Architecture for a Distributed Antenna System” filed Aug. 17, 2010 and also referring to FIG. 1 of the instant patent application, the Digital Up Converters present in the RRU can be programmed to process various signal formats and modulation types including FDMA, CDMA, TDMA, OFDMA and others. Also, the Digital Up Converters present in the respective RRUs **can be programmed to operate with signals to be transmitted within various frequency bands** subject to the capabilities and limitations of the system architecture disclosed in U.S. Provisional Application Ser. No. 61/374,593, entitled “Neutral Host Architecture for a Distributed Antenna System, filed Aug. 17, 2010.

EX-1001 8:3-16, 8:49-9:5, 9:31-35; EX-1003 ¶46.

Each embodiment of the '593 Provisional Application discloses the use of an FPGA having a DUC and DDC. For example, FIG. 6 illustrates an RRU that is described as “field reconfigurable”. EX-1012 15, 18, 26; EX-1003 ¶47.

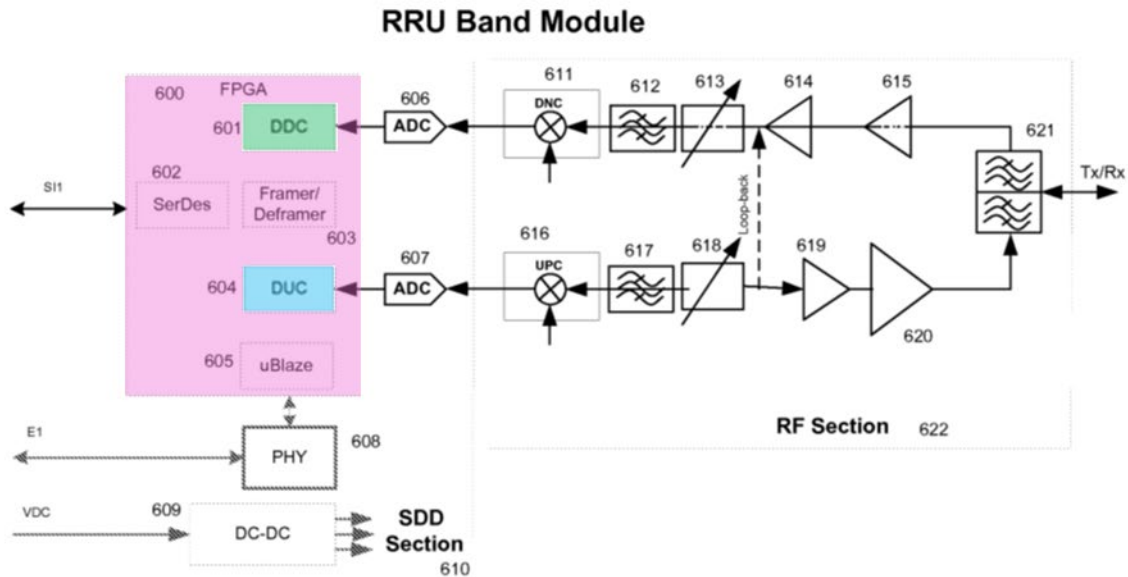


Figure 6. Remote Radio Head Unit Band Module

As illustrated above, the software-programmable frequency selective DDC 601(**green**) and DUC 604 (**blue**) are implemented in FPGA 600 (**pink**).

The '171 Patent includes twenty claims. Independent Claim 1 (and Claims 2-14 dependent therefrom) are directed to a method of reconfiguring at least one of a plurality of RRUs by increasing or decreasing the number of carriers in the respective subset of carriers received or transmitted by this RRU. Independent Claim 15 (and Claims 16-20 dependent therefrom) are directed to a system.

Claim 1 recites:

1. [pre] *A method for routing and switching signals comprising:*

[1.a] *providing a plurality of radio units, each remote radio unit configured to transmit one or more downlink signals and to receive one or more uplink signals;*

[1.b] *providing at least one digital access unit configured to communicate with the plurality of remote radio units;*

[1.c] *translating the uplink and downlink signals between RF and base band;*

[1.d] *packetizing the uplink and downlink base band signals, wherein the packetized signals correspond to a plurality of carriers, each remote radio unit configured to receive or transmit a respective subset of the plurality of carriers;*

[1.e] *routing and switching the packetized signals among the one or more remote radio units via the at least one digital access unit;*

[1.f] *reconfiguring at least one of the plurality of remote radio units by increasing or decreasing the number of carriers in the respective subset of the plurality of carriers; and thereafter*

[1.g] *routing and switching the packetized signals among the plurality of remote radio units via the at least one digital access unit according to a result of the reconfiguring.*

B. Prosecution History

The '171 Patent issued November 14, 2017 from Application No. 15/205,820 filed July 8, 2016, a divisional of Application No. 14/169,719, which is a continuation of Application No. 13/211,243 (now Patent No. 8,628,338 ("the '338 Patent")).

In a first Office Action, the then-pending Challenged Claims were rejected solely based on non-statutory double patenting over the '338 Patent claims. EX-1002 10-16. Subsequent to the submission of a Terminal Disclaimer by Patent Owner ("PO"), the Challenged Claims were allowed "for the same reasons presented in the Patented Application No. 13/211,243, Patent No. 8,682,338 and updated search report." EX-1002 1-7.

During prosecution of the '338 Patent, the claims were rejected as anticipated by Kilfoyle. In response, PO amended 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 unit according to a result of the reconfiguring.

EX-1013 90.

PO argued:

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-1013 94.

The examiner allowed all claims “based on amended claim, updated search and Applicant’s remarks filed on 8/29/2013.” EX-1013 87.

C. Previous IPR Proceeding

John Mezzalingua Associates, LLC (“JMA”) filed a petition for IPR of all claims (Claims 1-20) of the ’171 Patent (“IPR2020-01432”) based on the following grounds:

Reference(s)	Basis	Claims Challenged
Oh ¹	§ 102	1, 2, 14–16
Oh, Cannon ²	§ 103	1, 2, 14, 16
Oh, Fischer ³	§ 103	5–13, 19, 20

Reference(s)	Basis	Claims Challenged
Oh, Wu ⁴	§ 103	3, 4, 17, 18

EX-1007 6.

The Board denied institution. *See* EX-1007. In that Decision, the Board agreed with the district court’s analysis in construing the term “*reconfiguring each remote radio unit*” to be “changing the configuration of each remote unit” in *Dali Wireless Inc. v. CommScope Technologies LLC*, Case No. 1:19-cv-00952 (D. Del.) involving the parent ’338 Patent. EX-1007 10. In view of the district court’s analysis, the Board construed the term “*reconfiguring at least one of the plurality of [remote] radio units*” in Claim 1 to be “changing the configuration of at least one of the plurality of radio units” and in Claim 15 construed the term “*wherein ...*

at least one remote radio unit of the plurality of remote radio units is reconfigured” to be “wherein the configuration of at least one remote radio unit of the plurality of remote radio units is changed.” EX-1007 11.

Based on this construction, the Board denied institution finding that the primary reference Oh did not disclose changing the configuration of at least one RRU, and that JMA failed to sufficiently show that a POSA would combine the primary reference Oh with Cannon. EX-1007 16, 20-21.

This Petition does not rely upon Oh or the combination of Oh and Cannon for the “*reconfiguring*” limitation, but rather bases unpatentability upon Leng and Cannon, each of which discloses the “*reconfiguring*” limitation as previously construed by the Board in IPR2020-01432. EX-1003 ¶¶52, 66-88, 93-126.

D. Claim Construction

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.¹

With respect to the “reconfiguring limitation” (Element [1.f]), Petitioner agrees that the Board’s construction in IPR2020-01432, as discussed above, is consistent with the plain and ordinary meaning of the term.²

E. Priority Date of the Challenged Claims

The ’171 Patent claims the priority benefit of, through a series of parent applications, Provisional Application No. 61/382,836, filed on September 14, 2010. Solely for the purposes of this IPR, Petitioner assumes the priority date of the Challenged Claims is September 14, 2010.

F. Person of Ordinary Skill in the Art

With respect to the ’171 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

¹ Claim terms in the parent ’338 Patent have been construed by the Board (*see* n.2), and district courts in Delaware and W.D. Texas (EXs-1015-1017), and will be construed in E.D. Texas (EXs-1018-1019).

² In IPR2022-01212 for the ’338 Patent, the parties proposed, and the Board adopted this same construction in the Institution Decision. EX-1014 18-19.

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 reconfigurable DAS 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. Reconfiguring remote radio units of a DAS based on loading

A DAS is a network of spatially separated antenna nodes (*e.g.*, remote transceiver unit (RTU)) connected to a common node (*e.g.*, host unit) via a transport medium that provides wireless service within a geographic area or structure. EX-1006 1:14-36; EX-1009 FIG. 1. One such prior art DAS that reconfigures the carrier frequencies of the remote radios based on loading is shown below in FIG. 1:

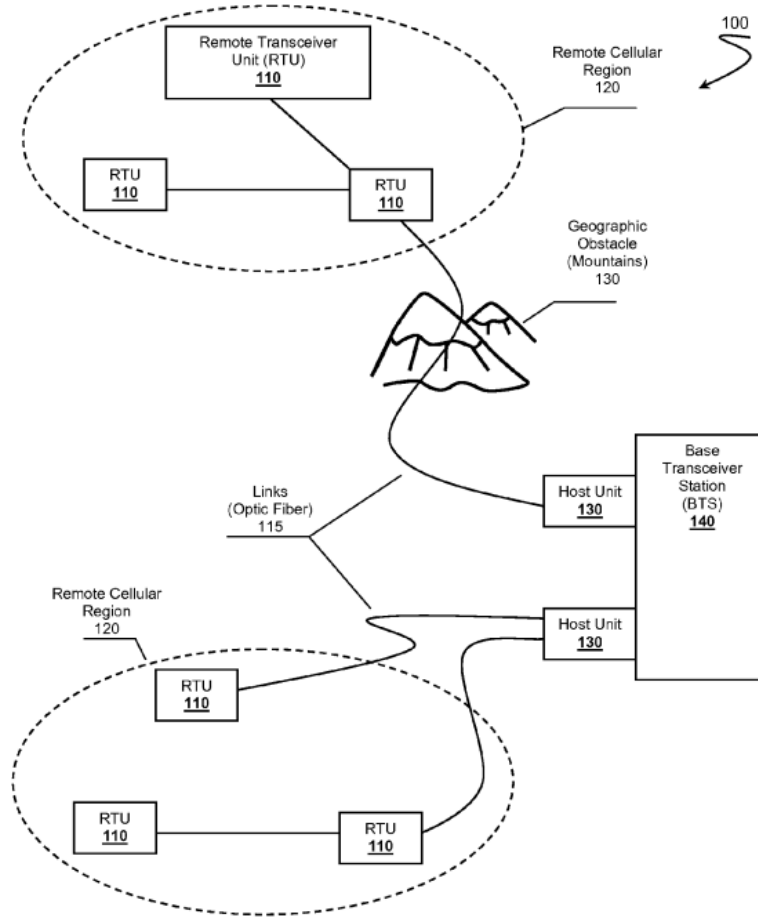


Figure 1

EX-1009 Fig. 1; EX-1003 ¶59.

Base transceiver stations (BTSs) communicate signals to, and receive signals from, remote transceiver units (RTUs) via one or more host units. EX-1009, Title, ¶0030. The system provides control over the communications 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 ¶ 60.

2. Prior art DAS 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).

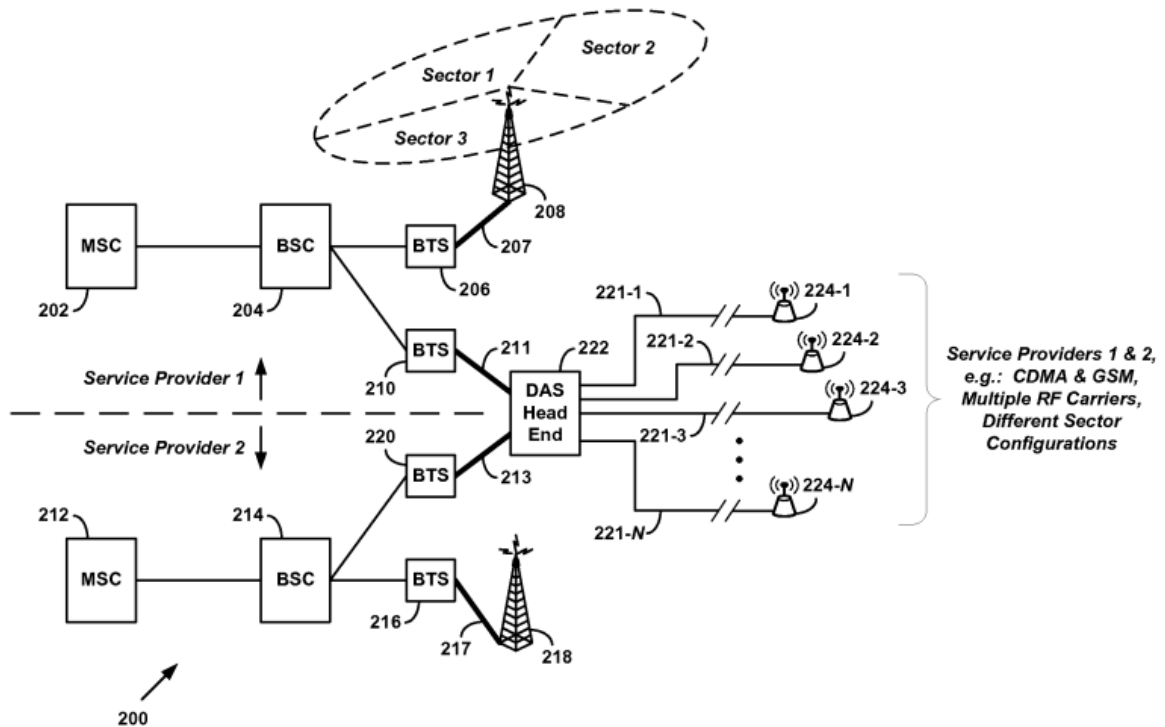


FIG. 2

EX-1010 FIG. 2; EX-1003 ¶61.

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 ¶61.

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 ¶62.

VI. IDENTIFICATION OF CHALLENGES

A. Challenged Claims

Claims 1-20 of the '171 Patent are challenged in this Petition.

B. Statutory Grounds for Challenges

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

Ground	Claims	Basis	Reference
1	1-4, 14-18	§ 103	Leng alone or in view of Cannon
2	5-13, 19-20	§ 103	Leng in view of Cannon and Gupta

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)³. 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 IPR2020-01432.

³ 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, but as discussed in Section V.C above, the Board determined that the petitioner (JMA) in IPR2020-01432 failed to sufficiently show that a POSA would combine Cannon with the asserted primary reference Oh.

US Patent Publication 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 IPR2020-01432.

VII. IDENTIFICATION OF HOW THE CHALLENGED CLAIMS ARE UNPATENTABLE

A. Challenge 1: Claims 1-4 and 14-18 Are Obvious Over Leng Alone or in Combination With Cannon

1. Leng

Leng relates to DAS technology, and more particularly to a cell management apparatus, a DAS, 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 ¶66.

Leng's FIG. 2 illustrates the basic structure of one embodiment of the DAS 20.

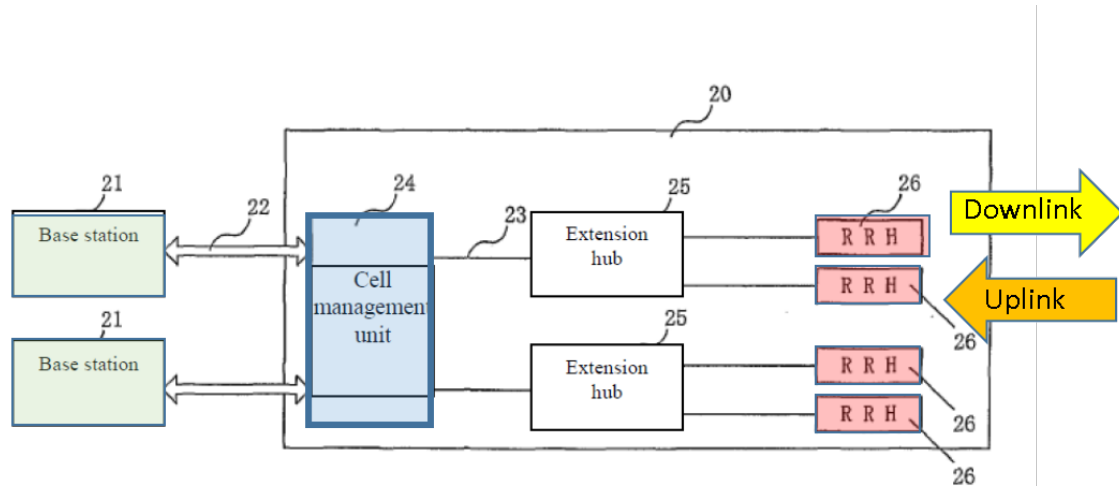


Fig. 2

EX-1005 FIG. 2 (annotated); EX-1003 ¶67.

Remote Radio Heads (RRHs) 26 are placed around the building. A cell management device (CMU) 24 is connected to the base station(s) 21 and is configured to collect downlink radio signals from the base station(s) 21 and distribute them to the RRHs 26, and to collect uplink radio signals from the RRHs 26 and transmit them to the base station(s) 21. CMU 24 also collects load information of the DAS 20 and reconfigures the DAS based on the load

information. The RRHs correspond to the RRUs of the '171 Patent, and the CMU corresponds to the DAU of the '171 Patent. EX-1005 3:20-25; EX-1003 ¶68

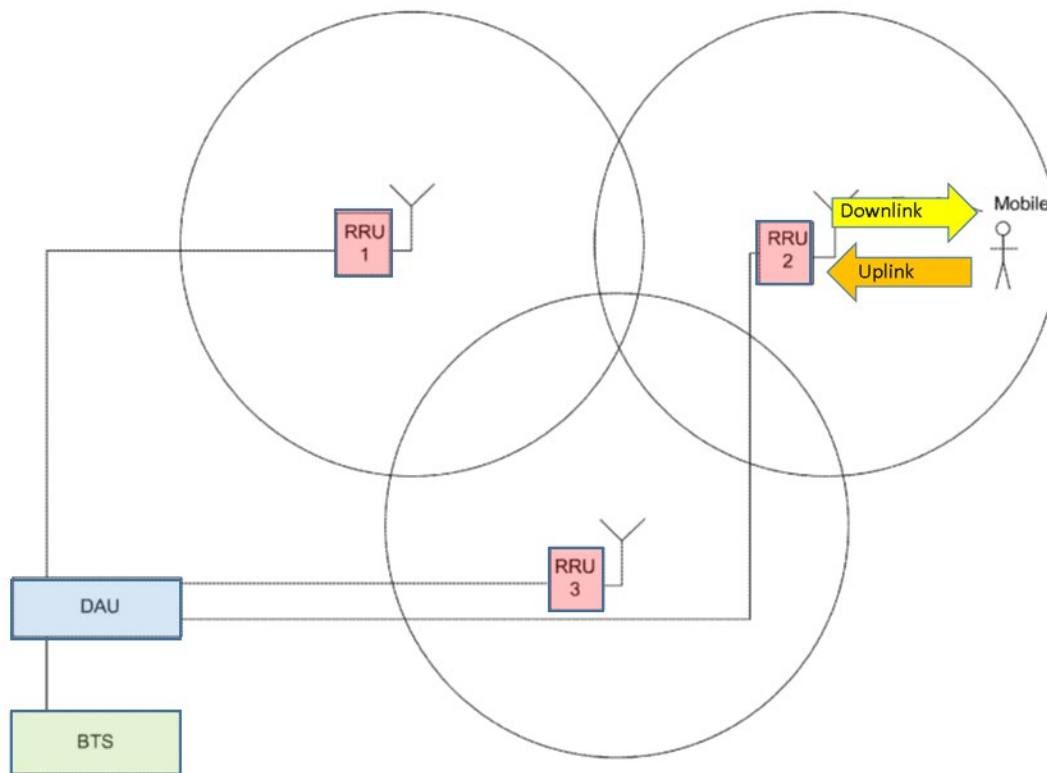


Figure 4 Indoor Localization System of GSM and LTE

EX-1001, FIG. 4 (annotated); EX-1003 ¶68.

Like the '171 Patent, Leng describes several problems with prior art DAS implementations. First, once the DAS were installed, the allocation of the RF spectrum was fixed. Such systems were not suitable for areas where communication traffic varies greatly, such as auditoriums, conference halls, and the like. If too much spectrum was allocated to such areas, spectrum resources

were wasted when these areas are idle. However, if only a small amount of spectrum resources were allocated to these areas, spectrum resources may be insufficient when these areas became crowded. EX-1005 1:19-23; EX-1003 ¶¶69.

Second, Leng explains that the disadvantages of most existing DASs included the inability to dynamically reassign carriers to effectively adapt to load changes when necessary. Some DASs included manual offline reconfiguration, which required the administrator to manually reconfigure based on the expected load distribution and to stop the service during reconfiguration. This manual approach did not dynamically reconfigure in a timely and efficient manner based on real-time traffic distribution, and interrupted continuity during reconfiguration. EX-1005 1:24-30; EX-1003 ¶¶70.

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. Leng's 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 ¶¶71.

FIGS. 4 and 5 of Leng illustrate an embodiment of the reconfigurable DAS. FIG. 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 ¶72.

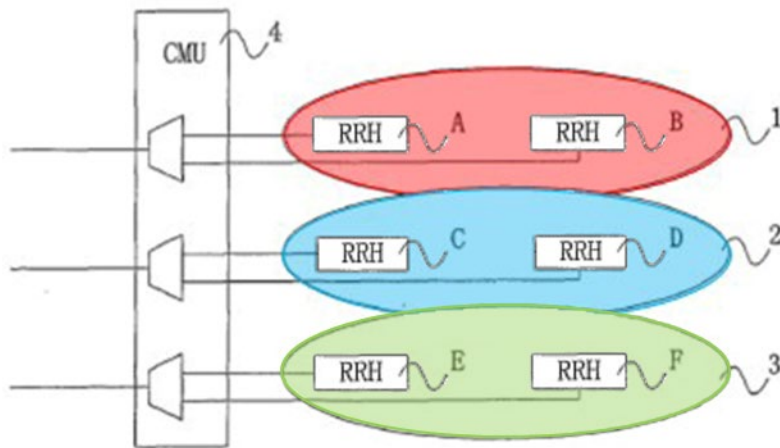


图 4

EX-1005 FIG. 4 (annotated); EX-1003 ¶72.

When CMU 4 detects that RRH A and RRH B become areas of high load, DAS 20 is reconfigured as shown in FIG. 5.

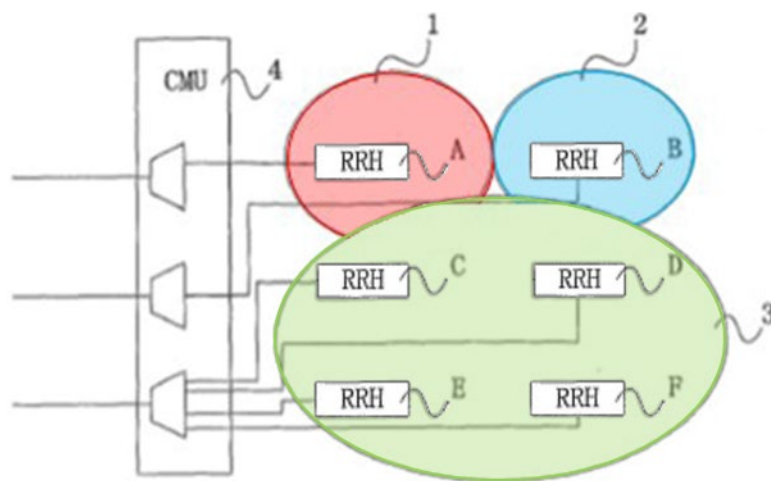


图 5

EX-1005 FIG. 5 (annotated); EX-1003 ¶73.

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 reconfiguration only by RRH E and RRH F, is now shared with RRH C and RRH D since it is sufficient to carry the load of these four RRHs. EX-1005 4:18-27; EX-1003 ¶74.

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 3:39-43, 1:15-18. Similar to the disclosure in the ’171 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 ¶75. For example, RRH A and RRH B may be located in the same cafeteria in a building and the reconfiguration of the carrier used by RRH B from FIG. 4 to FIG. 5 may occur at lunchtime when users congregate in the cafeteria. *Id.*

The reconfiguration of the wireless signal routing is performed by routing 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 ¶78. Leng discloses that carrier switching module 54 (red) in carrier reconfiguration 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 ¶78.

Leng further discloses that each RRH may support multiple carriers. EX-1005 1:15-18, 3:39-43; EX-1003 ¶79.

2. Cannon

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

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 ¶81.

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 ¶82.

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 ¶83.

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

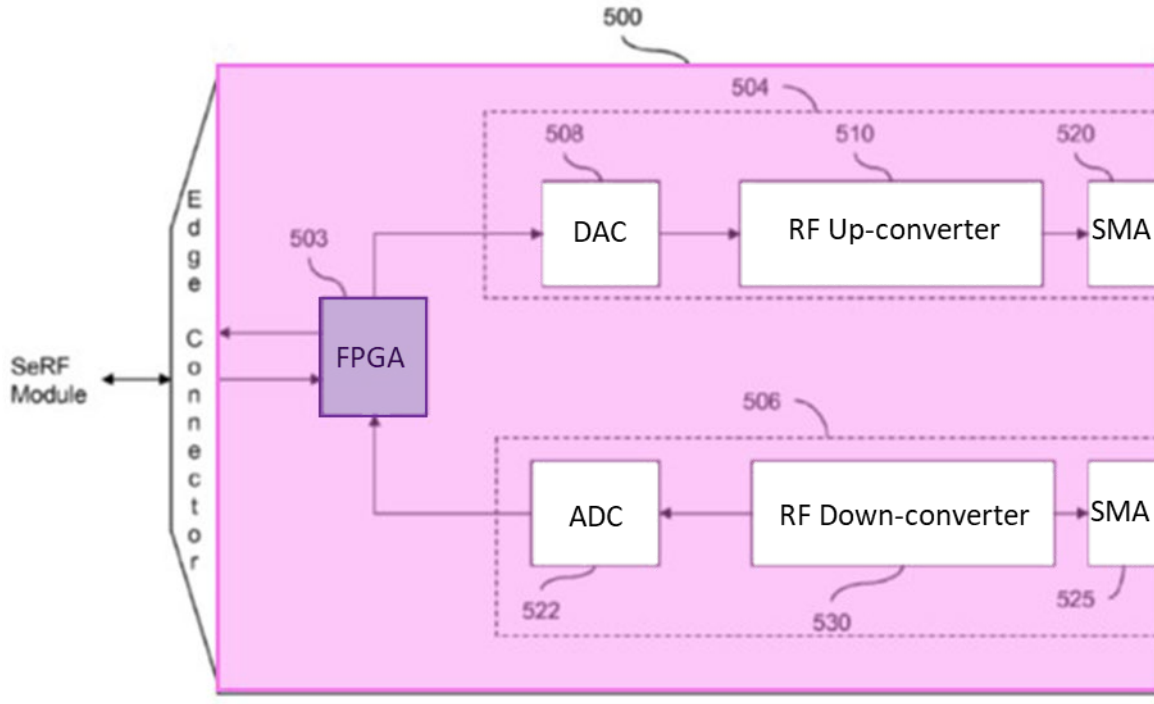


Fig. 5

EX-1006 Fig. 5 (annotated); EX-1003 ¶84.

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. EX-1006 7:10-33; EX-1003 ¶85.

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

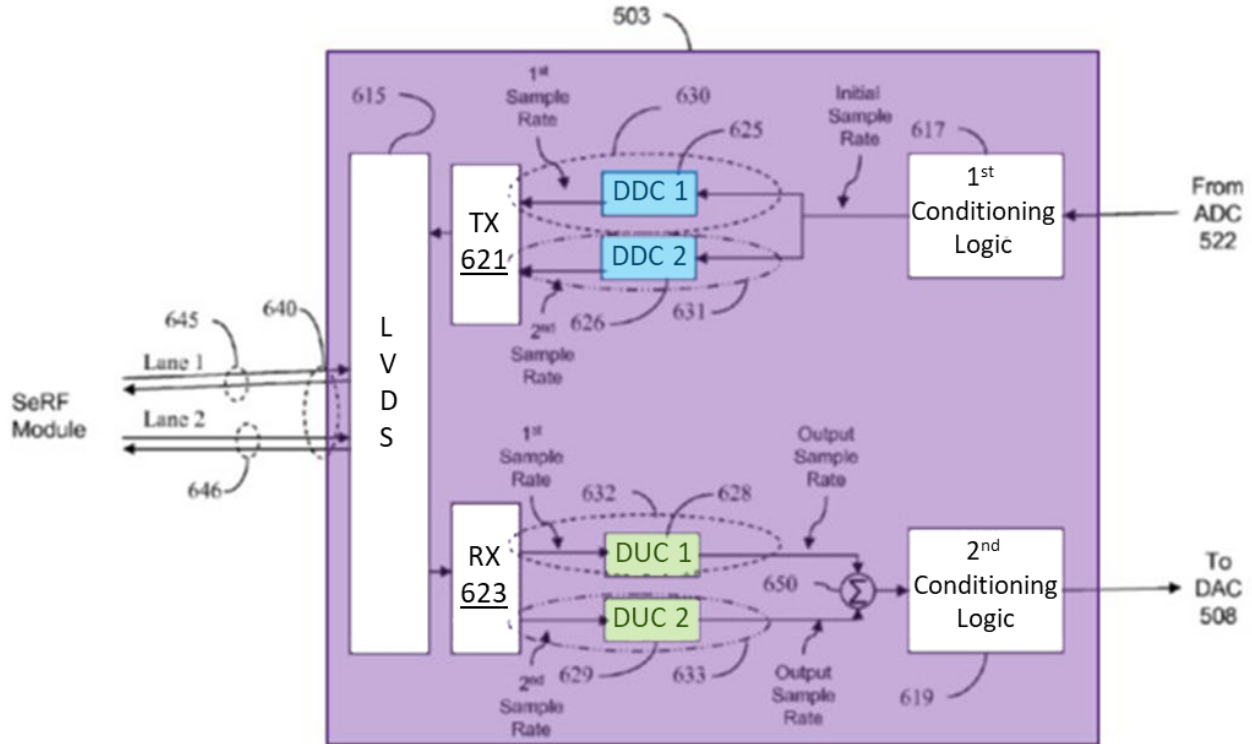


Fig. 6

EX-1006 Fig. 6 (annotated); EX-1003 ¶86.

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 ¶87. Thus, a POSA understood that Cannon teaches

that each FPGA could be programmed with a set of carrier frequencies. EX-1003 ¶87.

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 unit. EX-1006 FIG. 6; 8:45-9:10; EX-1003 ¶88. Cannon describes that the use of a FPGA in a remote unit is beneficial because the remote unit can be adjusted to meet the changing needs of the end user very simply using programming. EX-1006 9:45-47; EX-1003 ¶88.

3. Motivation to Combine Leng and Cannon

The '171 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 ¶89.

The '171 Patent describes reconfiguring each RRU based on determining which carriers are active for each unit. EX-1001 11:64-12:17; EX-1003 ¶74. The '171 Patent describes that RRUs are reconfigured by the use of software-programmable frequency selective DUCs and DDCs. EX-1001 4:9-28; EX-1003 ¶89. Leng likewise describes reconfiguring each RRH based on the relative loading of each RRH in the system. EX-1005 FIGs. 4, 5; EX-1003 ¶89. 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 using a FPGA that 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 ¶89.

Cannon's use of a FPGA in an RRH to allow software reconfiguration of the RRH's carrier is consistent with the disclosure of the '171 Patent that discloses the use of FPGA with software-programmable frequency selective DUCs and DDCs so that the individual RF parameters of the DUCs and DDCs can be changed to enable or disable specific radio resources. EX-1003 ¶90.

A POSA would be motivated to modify the teachings of Leng to include a FPGA in the RRH as taught by Cannon because Cannon expressly teaches that the

use of a FPGA allows each RRH 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 RRHs. Specifically, a POSA understood that Leng teaches to reconfigure a RRH in a DAS by changing the carriers of the RRH based on the relative load of the RRH, 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 RRH is the use of a FPGA and requires only a programming change. EX-1003 ¶91. The '171 Patent's disclosure of the use of an FPGA to reconfigure the carrier frequency of the remote radios demonstrates the suitability of combining Cannon's teaching of an FPGA with Leng's teaching of reconfiguring the RRHs based on the loading of the radios. EX-1003 ¶91.

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 ¶92.

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 an FPGA having software-programmable frequency selective DUCs and DDCs was identified as a known benefit in the '171 Patent. EX-1003 ¶92.

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 ¶92.

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 ¶92.

4. Detailed Application of Leng and Cannon to Claims 1-4 and 14-18

a. Claim 1

i. [pre] *A method for routing and switching signals comprising:*

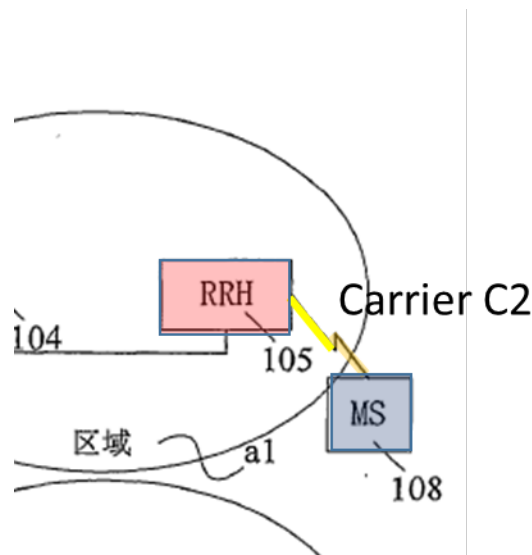
To the extent the preamble is limiting, Leng discloses a method for routing and switching signals, including RF signals. As shown below, Leng discloses distributing (*routing and switching*) downlink radio signals (*signals*) to the RRHs, and collecting (*routing and switching*) uplink radio signals (*signals*) from the RRHs, 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), 4:11-17, FIG. 2; EX-1003 ¶93.

- ii. [1.a] *providing a plurality of remote radio units, each remote radio unit configured to transmit one or more downlink signals and to receive one or more uplink signals;*

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



EX-1005 FIG. 10 (annotated); EX-1003 ¶94.

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 ¶94.

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 ¶¶94.

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 ¶¶95.

iii. [1.b] providing at least one digital access unit configured to communicate with the plurality of remote radio units;

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

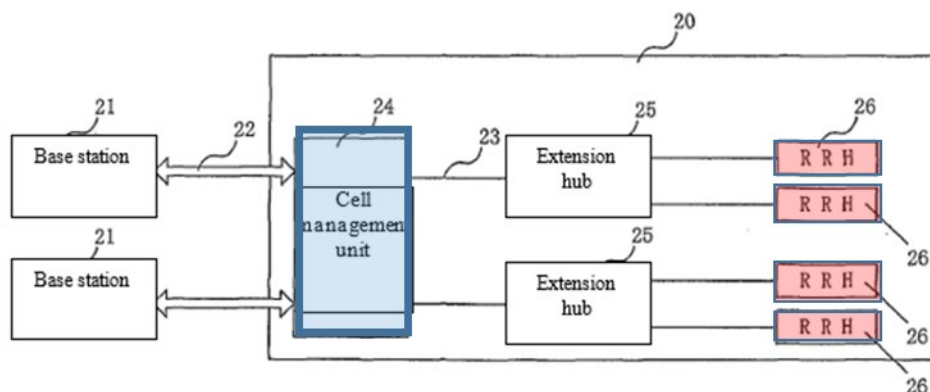


Fig. 2

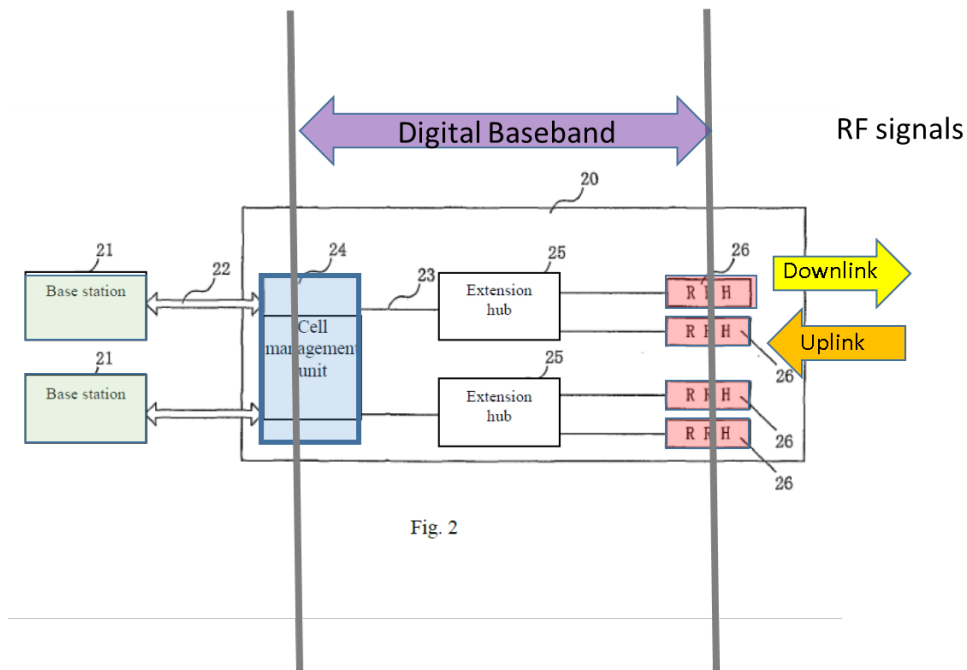
EX-1005 FIG. 2 (annotated); EX-1005 3:26-28; EX-1003 ¶¶96.

iv. [1.c] *translating the uplink and downlink signals between RF and base band;*

Leng discloses the RRHs each convert downlink digital baseband signals from the transmission medium to RF signals and the uplink RF signals from mobile stations to digital baseband signals 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 ¶97.



EX-1005 FIG. 2 (annotated); EX-1003 ¶97.

On the other end, Leng discloses the CMU, via an interface, supplies downlink signals from the base station 21 to the appropriate RRH as digital baseband signals over medium 23. The uplink signals received by the CMU as digital baseband signals 23 are 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 ¶98.

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 ¶98.

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 ¶99.

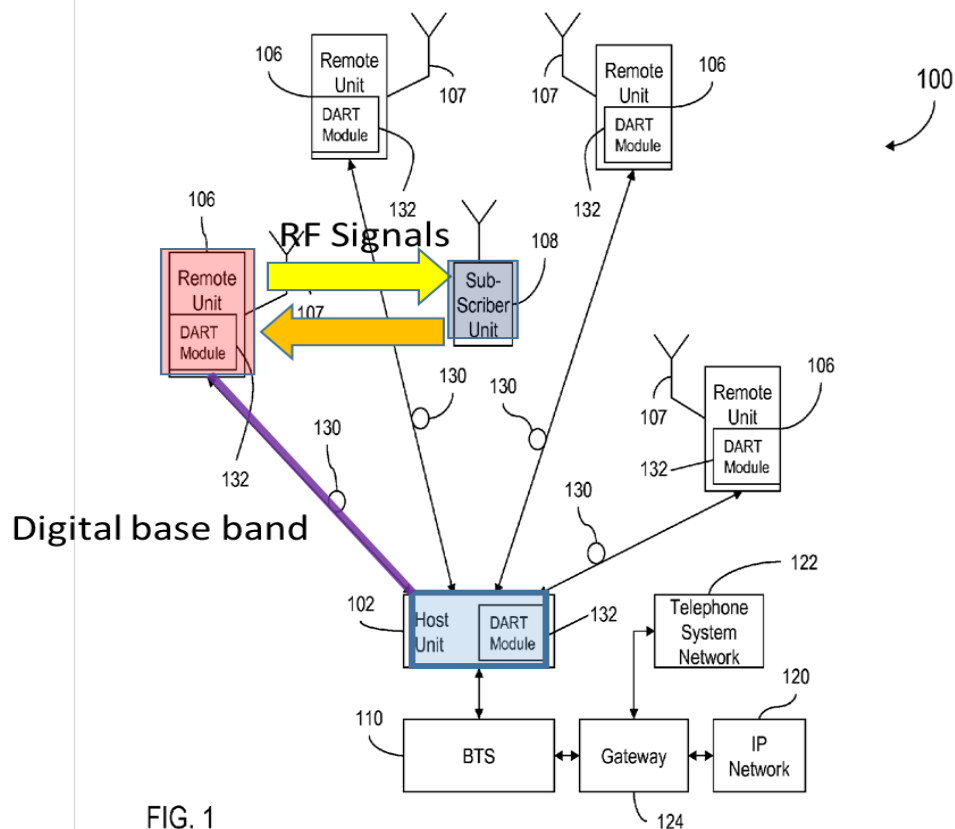
To the extent PO argues that Leng does not expressly disclose translating the uplink and downlink signals between an RF band and a baseband, Cannon does. Cannon discloses translating between the RF signal and the digital baseband. Cannon describes that the uplink RF signals received by the remote unit 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 also describes that downlink RF signals received by host unit 102 from BTS 110 are converted from analog RF signals to digital baseband signals. EX-1006 3:27-30, 3:58-63. 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 ¶100.

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 ¶101.



EX-1006 FIG. 1 (annotated); EX-1003 ¶101.

As described above in the Motivation to Combine section, it would have been obvious to combine the teachings of Cannon to the method and system of Leng. EX-1003 ¶102. 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 ¶102.

To the extent PO argues that this is required and not disclosed in Leng, a POSA would also recognize that it is simply a design choice to have Leng's radio signal interface between the CMU and base station use RF bands in addition to baseband, as expressly taught by Cannon and was well-known to POSAs, because doing so would involve nothing more than selecting from a finite number of well-known communication techniques and applying it to a known system to yield predictable results of increased compatibility with existing base stations. EX-1005, 3:26-33, 8:29-35; EX-1006 3:27-30, 3:58-63; EX-1003 ¶103.

v. ***[1.d] packetizing the uplink and downlink base band signals, wherein the packetized signals correspond to a plurality of carriers,***

As set forth above for limitation [1.c], 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 ¶104.

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 ¶105.

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 ¶106.

A POSA understood that a WiMax network utilizes packetized data, and that an Ethernet link also utilizes packetized data. EX-1003 ¶107.

- vi. [1.e] *each remote radio unit configured to receive or transmit a respective subset of the plurality of carriers;*

Leng discloses each RRH is configured to receive or transmit using one or more carriers of the available carriers (*subset of the 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 the plurality of carriers (e.g., 1, 2, and 3).

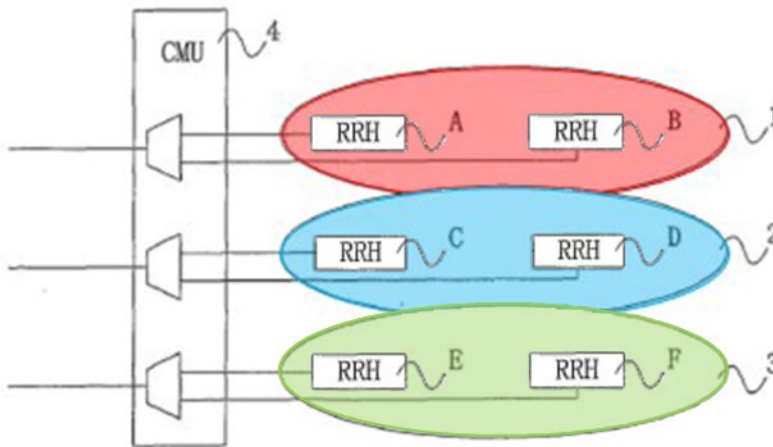


图 4

EX-1005 FIG. 4 (annotated); EX-1003 ¶108.

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 ¶108.

Although the example in FIG. 4 shows each RRH using one carrier, Leng discloses that “the RRHs can also support multiple carriers.” EX-1005 3:39-43, 1:15-18. 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 ¶109.

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 in the Motivation to Combine section. EX-1003 ¶110.

vii. [1.f] *routing and switching the packetized signals among the plurality of remote radio units via the at least one digital access unit;*

Leng discloses that the CMU and extension hub distribute downlink radio signals in the form of I/Q data addressed to the remote radio units to an extended coverage area (*routing and switching the packetized signals among the plurality of remote radio units via the at least one digital access unit*). EX-1005 3:25-35; [1d] above. Leng describes the details of how the system routes and switches the packetized downlink signals to, and the packetized uplink signals from, the remote radio units and via the CMU using reconfiguration as an example. 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 recited in Claim 1, element [1.h] below.

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 and from 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.

A POSA understood that Leng teaches that the system routes and switches the packetized signals among the RRHs and via the CMU according to the present configuration of the system, and further the system routes and switches the packetized signals among the RRHs and via the CMU after reconfiguration using the same method. *Id.*, EX-1003 ¶113.

viii. [1.g] reconfiguring at least one of the plurality of remote radio units by increasing or decreasing the number of carriers in the respective subset of the plurality of carriers;

Leng discloses reconfiguring the DAS, the network topology of at least one of the plurality of the RRHs and their respective carriers (*reconfiguring at least one of the plurality of remote radio units*).

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 ¶114.

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 ¶115.

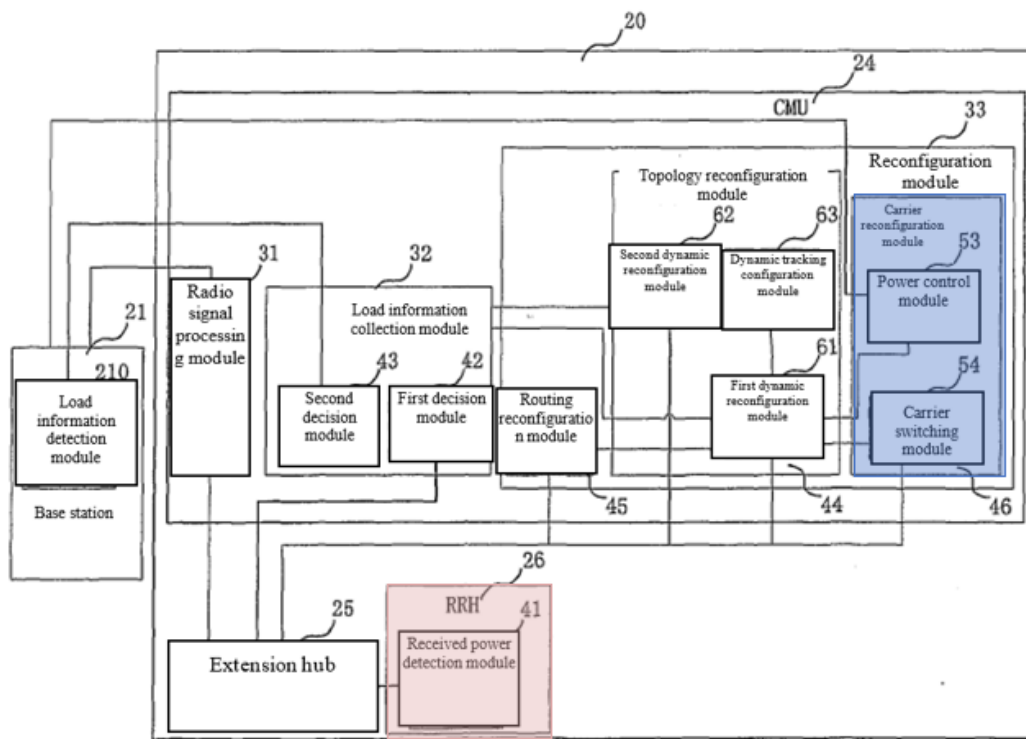
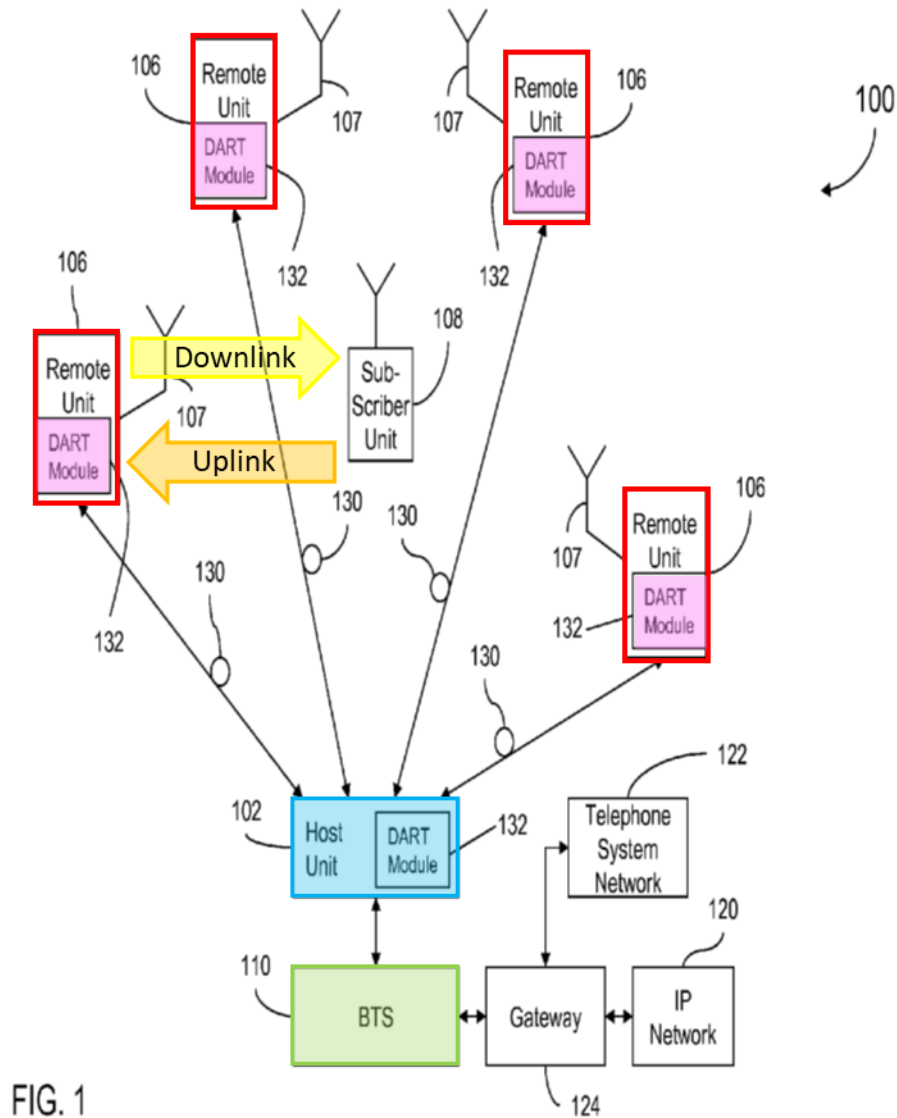


Fig. 15

EX 1005 FIG. 15 (annotated); EX-1003 ¶115.

Thus, Leng discloses reconfiguration of the carrier signal at an RRH which meets the claim limitation *reconfiguring at least one of the plurality of remote radio units*. EX-1003 ¶116.

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 architecture and method described in the '171 Patent. EX-1003 ¶117.



EX 1006 FIG. 1 (annotated); EX-1003 ¶117.

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 ¶9118

Further, Cannon discloses using a FPGA 503 that 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 ¶119.

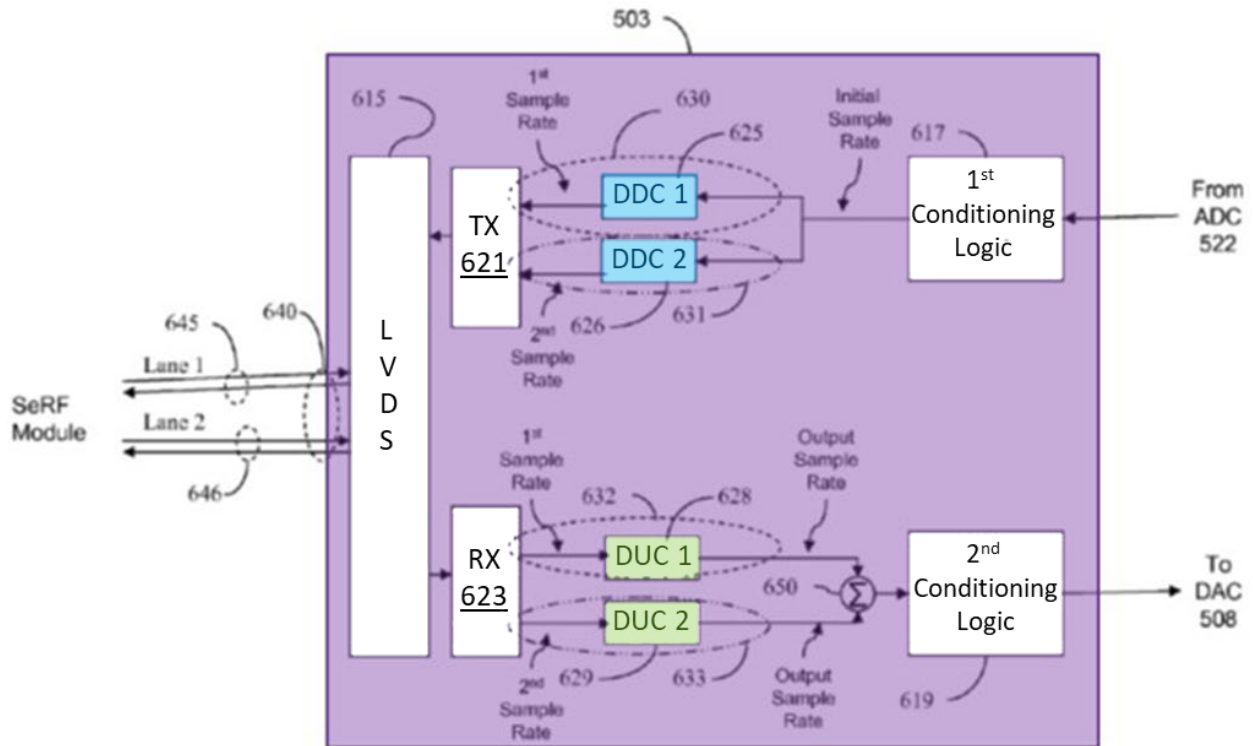


Fig. 6

EX 1006 FIG. 6 (annotated); EX-1003 ¶119.

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).

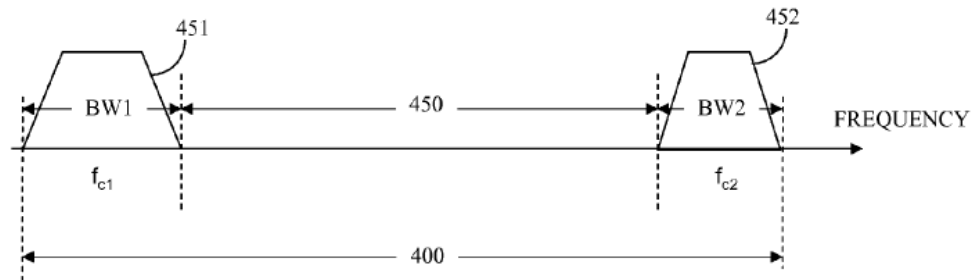


Fig. 4A

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 ¶120.

Cannon's description of changing the carrier frequencies of the remote radio unit DUCs and DDCs is consistent with the disclosure in the '171 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 ¶121.

As described above in the Motivation to Combine section, it would have been obvious to combine the teachings of Cannon to the method and system of Leng. EX-1003 ¶122.

Leng discloses reconfiguring the number of carriers each RRH (*increasing or decreasing the number of carriers*) is currently using (*in the respective subset of the plurality of carriers*).

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 ¶123.

Leng gives an example of switching carriers between each RRH in FIGS. 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 3:39-43. 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 ¶124.

To the extent PO 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 ¶125. 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. EX-1003 ¶125.

ix. [1.h] routing and switching the packetized signals among the plurality of remote radio units via the at least one digital access unit according to a result of the reconfiguring.

This limitation is disclosed by Leng for the same reasons discussed regarding element [1.f].

b. **Claim 2**

The method of claim 1, 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 ¶127.

A POSA understood that each carrier used by an RRH utilized its own RF band to prevent interference between the carriers. EX-1003 ¶128.

c. **Claim 3**

The method of claim 1 wherein reconfiguring each remote radio unit further comprises determining a load 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, wherein determining the load comprises detecting which carriers are active for each remote radio unit.

Leng discloses determining a load for each RRH (*determining a load for each 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 ¶129.

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 ¶129.

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 ¶129.

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 ¶129.

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 ¶129.

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 ¶129.

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 ¶129.

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 ¶129.

A POSA understood Leng discloses load balancing to determine a new network topology to most efficiently distribute network resources using the combination of load information of the RRHs. EX-1003 ¶130. A POSA understood determining a load for each RRH 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 one disclosed purpose of Leng. EX-1003 ¶131.

Leng discloses determining a load for each RRH comprises detecting which carriers are active for each RRH in several ways. In one example, 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 ¶132.

In another example, Leng can determine a carrier is active by the load on the carrier. Leng discloses collecting various types of load 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 ¶133.

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 ¶133.

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 ¶133.

[T]he 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 ¶133.

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 ¶133.

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 ¶134.

d. **Claim 4**

The method of claim 1, wherein reconfiguring each remote radio unit further comprises detecting which carriers are active 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 active carriers.

This limitation is disclosed by Leng and Cannon for the same reasons as discussed regarding element [1.g] and Claim 3.

e. **Claim 14**

The method of claim 1, wherein each remote radio unit is configured to transmit one or more downlink RF signals and to receive one or more uplink RF signals.

See element [1.a].

f. **Claim 15**

i. *A system for transmitting signals, comprising:*

See element [1.pre].

ii. *a plurality of remote radio units; and*

See element [1.a].

iii. *at least one digital access unit configured to communicate with the plurality of remote radio units,*

See element [1.b].

iv. *wherein the plurality of remote radio units are each configured to packetize uplink signals for transmission to the at least one digital access unit, and*

See elements [1.a] and [1.d].

- v. *the at least one digital access unit is configured to packetize downlink signals for transmission to the plurality of remote radio units,*

See elements [1.b] and [1.d].

- vi. *wherein the packetized signals correspond to a plurality of carriers,*

See element [1.d].

- vii. *and each of the plurality of remote radio units is configured to receive or transmit a respective subset of the plurality of carriers,*

See element [1.e].

- viii. *wherein during a first time period, each of the plurality of remote radio units is configured to receive or transmit the respective subset of the plurality of carriers,*

See elements [1.e] and [1.f].

- ix. *wherein during a second time period, at least one remote radio unit of the plurality of remote radio units is reconfigured to increase or decrease the number of carriers in a first subset of the plurality of carriers,*

See element [1.g].

- x. *and the at least one remote radio unit is configured to receive or transmit the first subset of the plurality of carriers according to the reconfiguration.*

See element [1.h].

g. Claim 16

The system of claim 15, wherein each carrier corresponds to a respective RF band.

See Claim 2.

h. Claim 17

The system of claim 15, wherein the at least one remote radio unit is reconfigured to increase or decrease the number of carriers in the first subset of the plurality of carriers based on a load on the at least one remote radio unit.

See Claim 3.

i. Claim 18

The system of Claim 15, wherein the at least one remote radio unit is reconfigured to increase or decrease the number of carriers in the first subset of the plurality of carriers based on a number of active carriers for the at least one remote unit.

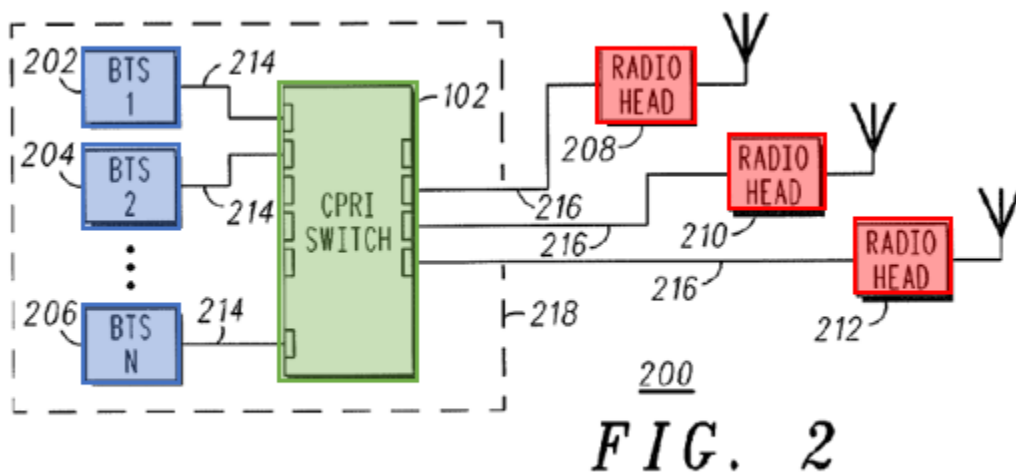
See Claim 4.

B. Challenge 2: Claims 5-13 and 19-20 Are Obvious Over Leng Alone or in Combination with Cannon and Gupta

1. Gupta

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 ¶150.

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 communicate with a plurality of radio heads (red). EX-1008 [0017-0018]. EX-1003 ¶151.



EX-1008 FIG. 2 (annotated); EX-1003 ¶151.

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 ¶152.

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 ¶153.

2. Detailed Application of Leng, Cannon and Gupta to Claims 5-13 and 19-20

a. Claim 5

The method of claim 1, wherein the at least one digital access unit comprises a first digital access unit and a second digital access unit configured to communicate with each other via a first optical cable.

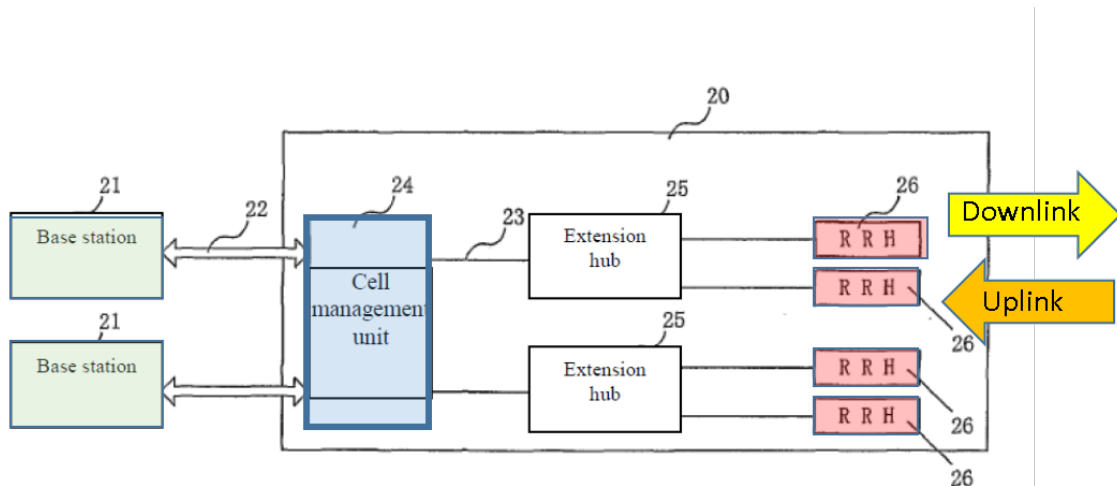


Fig. 2

Leng discloses having two extension hubs, each with two RRHs attached. The extension hubs 25 are connected 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 ¶154.

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 ¶154.

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 ¶155.

For example, FIG. 6 of Gupta (EX-1008) 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 switch 102 (*a first digital access unit*) and second CPRI switch 602 (*a second digital access unit*) configured to communicate with each other via *a first optical cable* 610. EX-1003 ¶156.

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. EX-1008 [0031]. Thus, a POSA implementing the teachings of Gupta for their intended purpose would expect the combination to be successful. EX-1003 ¶157.

b. Claim 6

- i. The method of claim 5, wherein the plurality of 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 regarding Claim 5, Gupta discloses a second CPRI switch 602 (*digital access unit*) 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 ¶158.

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 ¶159.

As described regarding Claim 5, it was obvious to modify the combination of Leng and Cannon with the teachings of Gupta, for the same reasons. EX-1003 ¶160.

c. **Claim 7**

The method of claim 6, 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 regarding Claim 5, 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 ¶161.

For the same reasons described above regarding Claim 5, it was obvious to modify the combination of Leng and Cannon with the teachings of Gupta. EX-1003 ¶162.

d. **Claim 10**

The method of claim 7, 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 ¶163.

As discussed regarding Claim 1, element [1.c], Leng alone, and/or in view of Cannon, also discloses that the CMU receives radio signals (*RF signals*) from the base stations. EX-1003 ¶164. 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 ¶165.

e. **Claim 11**

The method of claim 10, 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 ¶166.

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 ¶166.

A POSA understood that, in a system with multiple base stations and multiple carriers, 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 ¶167.

f. **Claim 12**

The method of claim 10, 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 ¶168.

A POSA understood that, in Leng's disclosed system with multiple base stations and multiple carriers and where each carrier is dynamically allocated as necessary to any RRH, that each carrier from each base station would be available

to be allocated for use by each RRU. Accordingly, a POSA understood Leng discloses the first RRH (*remote radio unit*) being configured to receive or transmit RF signals corresponding to one of the carriers of the second base station (*one of the second number of carriers*), and also the second RRH (*remote radio unit*) being configured to receive or transmit RF signals corresponding to one of the carriers of the first base station (*one of the first number of carriers*). EX-1003 ¶169.

g. **Claim 13**

The method of claim 10, wherein the second remote radio unit is configured to receive or transmit RF signals corresponding to one of the first number of carriers.

See Claim 12. EX-1003 ¶¶170, 171.

h. **Claim 8**

The method of claim 7, 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 ¶172.

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 ¶173.

To the extent PO argues that Leng does not expressly disclose a second base station is associated with a different wireless operator than the first base station, a POSA understood that it was common to utilize common DAS infrastructures among different carriers. As discussed in section V.G.2 above, a POSA understood that the multiple service providers using different communications protocols (*e.g.*, CDMA, GSM, etc.) may 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. *See* V.G.2; EX-1003 ¶174.

i. **Claim 9**

The method of claim 7, wherein the first base station and the second base station are associated with a common wireless operator.

Leng discloses using multiple carriers and multiple base stations. EX-1005 1:15-18 (reproduced for claim 8); EX-1003 ¶175.

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 ¶176.

VIII. THE BOARD SHOULD NOT EXERCISE ITS DISCRETION AND DENY INSTITUTION

A. The Board Should Not Deny Institution under 35 U.S.C. § 325(d)

As discussed above in Section V.C, the '171 Patent was challenged in IPR2020-01432. The primary reference Leng, as set forth in Grounds 1 and 2 of this Petition, was not considered by the Board, and neither was the Gupta reference of Ground 2. The Cannon reference was asserted in the prior IPR, but only in combination with a different primary reference (Oh), and the Board denied institution of the combination only on the basis that the petitioner in that proceeding failed to establish that a POSA would combine Oh with Cannon. Here, Cannon is being used because it discloses the use of an FPGA with software-

programmable frequency selective DUCs and DDCs and that the individual RF parameters of the DUCs and DDCs can be changed to enable or disable specific carriers, just like the '171 Patent. EX-1001 8:3-16; EX-1012 426-27. The Board did not consider this disclosure in IPR2020-01432. Therefore, the combination of art in the present grounds, and the arguments related thereto, were not previously presented to the Office.

B. The Board Should Not Deny Institution Under 35 U.S.C. § 314(a)

The PTAB has discretion to deny institution under 35 U.S.C. § 314(a). Related to the Director's June 2022 interim guidance regarding application of the *Finitv* factors⁴, (1) the Petition is particularly strong in the underlying merits, and (2) the Petitioner adopts the identical stipulation from *Sotera*, namely, that if the IPR is instituted, the Petitioner will not pursue in the District Court Litigation any ground raised or that could have been reasonably raised in an IPR for the challenged patent. Thus, under the Interim Guidance, the Board should not deny institution.

⁴ Interim Procedure For Discretionary Denials In AIA Post Grant Proceedings With Parallel District Court Litigation, PTO Director's Memorandum (June 21, 2022).

Nevertheless, the Board's decision in *Sotera Wireless, Inc. v. Masimo Corp.*, IPR2020-01019, Paper 12 (Dec. 1, 2020) (precedential as to § II.A) and the Director's decision in *CommScope Techs. LLC v. Dali Wireless, Inc.*, IPR2022-01242, Paper 23 (Feb. 27, 2023) (precedential) instruct that a holistic view of the remaining *Fintiv* factors also weighs in favor of institution.

Factor 1 is neutral because no request for stay has been filed. *Sand Revolution II LLC v. Continental Intermodal Group – Trucking LLC*, IPR2019-01393, Paper 24 at 7 (June 16, 2020) (informative).

Under factor 2, the trial date has not been set. According to the most recent statistics on median time-to-trial for civil actions (https://www.uscourts.gov/sites/default/files/data_tables/fcms_na_distprofile0930.2022.pdf), the median time from filing to trial is 21 months in the Eastern District of Texas. The Related Litigation was filed on October 21, 2022 and thus would be expected to go to trial shortly after July 21, 2024 according to the median time to trial statistics. A Final Written Decision is expected in the present matter in September 2024. Considering the inherent uncertainties of litigation scheduling, particularly where multiple defendants are involved, this factor weighs against discretionary denial.

Factor 3 favors institution. The co-pending litigation is in its early stages, and the investment in it has been minimal. The initial scheduling conference is scheduled for April 24, 2023.

Under factor 4, in addition to the *Sotera* stipulation that Petitioner issued to PO, PO has only identified in the Complaint a subset of the claims that are being challenged in the present Petition. Thus, it is unlikely the district court will be addressing the validity of all of the claims challenged by this Petition.

Under factor 5, Petitioner is a defendant in the Related Litigation. While some cases favor institution where petitioner is not a defendant, nothing within *Fintiv* suggests that the same party between the proceedings weighs in favor of discretionary denial. See *HP Inc. v. Slingshot Printing LLC*, IPR2020-01084, Paper 13 at 9 (having the “same parties as parallel proceeding” makes factor 5 “neutral”).

Under factor 6, other circumstances weigh in favor of institution. Here, the merits of the Petition are particularly strong. For example, Ground 1 discloses the limitation that the Board found was missing in the references in IPR2020-01432 (i.e., “*reconfiguring at least one of the plurality of remote radio units....*”) (See V.C above).

When viewed holistically, the timing of the present Petition is reasonable, there has been relatively limited investment in the related litigation, and there is minimal overlap between the present IPR and the Related Litigation. Further,

coupling these *Fintiv* considerations with compelling evidence of unpatentability presented in the Petition, the efficiency and integrity of the IPR process is best served by instituting review.

IX. MANDATORY NOTICES UNDER 37 C.F.R. §42.8

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

The real party-in-interest in this Petition is Ericsson Inc. and corporate parent Telefonaktiebolaget LM Ericsson. No other parties have directed, funded, or controlled the filing of this IPR, and this IPR was not filed at the behest of any other party.

B. Related Matters (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 '171 Patent is involved in the following litigations ("Related Litigation"):

Dali Wireless, Inc. v. T-Mobile US, Inc., et al., E.D. Texas (Case No. 2:22-cv-00414-RWS-RSP)

2. Administrative Matters:

As of the filing date of this Petition and to the best knowledge of Petitioner, the '171 Patent was subject to the following *inter partes* review proceeding, which was not instituted:

John Mezzalingua Associates, LLC v. Dali Wireless, Inc. (IPR2020-01432).

3. Related Patents

See Exhibit 1011.

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

Lead Counsel:

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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.

X. CONCLUSION

Petitioner has established a reasonable likelihood of prevailing with respect to all Challenged Claims of the '171 Patent and requests the Board institute *inter partes* review and then cancel all claims as unpatentable.

Respectfully submitted,

DUANE MORRIS LLP

BY: /Patrick D. McPherson/

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Dated: March 15, 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 15, 2023, a complete and entire copy of this Petition for *Inter Partes* Review of U.S. Patent No. 9,820,171 and all supporting exhibits were served via Federal Express, postage prepaid, to Patent Owner by serving the correspondence address of record for the '171 Patent:

Artegis Law Group, LLP

John Carey
7710 Cherry Park Drive Suite T #104
Houston TX 77095

and upon counsel of record for the Patent Owner in the litigation before the United States District Court for the Eastern District of Texas via electronic mail at the following addresses:

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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 13,930 words as calculated by the “Word Count” feature of Microsoft Word 2010, the word processing program used to create it.

Dated: March 15, 2023

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