

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. 10,750,382
Issue Date: Aug. 18, 2020
Title: OPTIMIZATION OF TRAFFIC LOAD IN A DISTRIBUTED ANTENNA
SYSTEM

Inter Partes Review No.: Unassigned

DECLARATION OF HENRY HOUH, PH.D. IN SUPPORT OF
PETITION FOR INTER PARTES REVIEW OF
U.S. PATENT NO 10,750,382

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Patent Trial and Appeal Board
U.S. Patent and Trademark Office
P.O. Box 1450
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I. INTRODUCTION

1. I am over the age of eighteen (18) and otherwise competent to make this Declaration.

2. I have been retained by Ericsson Inc. (Petitioner) as an independent, technical expert consultant in this proceeding before the United States Patent and Trademark Office (USPTO). I am being compensated at my rate of \$680 per hour for my services. No part of my compensation is dependent on my opinions or on the outcome of this proceeding. I have no financial interest in any of the parties to this proceeding.

3. This Declaration is in support of the Petition for *inter partes* review involving U.S. Patent 10,750,382 (the “’382 Patent” or the “Patent”) (EX-1001), entitled “OPTIMIZATION OF TRAFFIC LOAD IN A DISTRIBUTED ANTENNA SYSTEM” and listing Shawn Patrick Stapleton and Seyed Amin Hejazi as the inventors.

4. For the purposes of this *inter partes* review as I discuss later, I have been instructed to assume that the effective filing date of the claims of the ’382 Patent challenged by the Petitioner in this *inter partes* review is no earlier than July 31, 2012.

5. I understand that, according to USPTO records, the '382 Patent is currently assigned to Dali Wireless, Inc. ("Dali Wireless" or "Patent Owner"). I assume for purposes of this proceeding that Dali Wireless is the patent owner.

6. The '382 Patent is generally directed to wireless communication systems employing Distributed Antenna Systems (DASs). I am familiar with the technology described in the '382 Patent as of the earliest possible priority date of July 31, 2012, the filing date of Provisional Application No. 61/678,016.

7. In preparing this Declaration, I have reviewed the '382 Patent (EX-1001) and its prosecution history (EX-1002), as well as the patents and documents cited herein, and I have considered these documents in light of the general knowledge in the art as of July 31, 2012. In formulating my opinions, I have relied upon my experience in the relevant art. I have also considered the viewpoint of a person of ordinary skill in the art ("POSA") in the relevant field, as of July 31, 2012, who I describe below (§ IV.D). For convenience, the materials I considered in arriving at my opinions are listed in Appendix A.

8. I have been asked to provide my technical expertise, analysis, insights and opinions regarding the '382 Patent and relevant references

that form the basis of the arguments set forth in the accompanying Petition for *inter partes* review of the '382 Patent. As described in detail below, I offer the following opinions in this Declaration:

9. 1) A POSA would have found Claims 1-8, 10-19 of the '382 Patent to be obvious over *Kummetz*.

10. 2) A POSA would have found Claims 1-19 of the '382 Patent to be obvious over *Leng*.

11. Unless otherwise indicated, the emphasis in quotations has been added.

II. QUALIFICATIONS

12. My qualifications for forming the opinions set forth in this declaration are summarized here and explained in more detail in my *curriculum vitae*, which is included as Appendix B. Appendix B also includes a list of my publications and patents.

13. I received a Ph.D. in Electrical Engineering and Computer Science from the Massachusetts Institute of Technology ("MIT") in 1998. I also received a Master of Science degree in Electrical Engineering and Computer Science in 1991, a Bachelor of Science degree in Electrical Engineering and Computer Science in 1989, and a Bachelor of Science Degree in Physics in 1990, all from MIT.

14. For the last thirteen years I have been self-employed as an independent technical consultant which specializes in, among other things, Web Site Development, Data Networking, Optical Networking, Telecommunications, and Media Streaming. My clients include almost every major law firm in the country.

15. My career in the area of telecommunications began in 1987 when I worked at AT&T Bell Laboratories as part of a five-year dual degree program at MIT. Later, as part of my doctoral research at MIT from 1991-1998, I was a research assistant in the Telemedia Network Systems (“TNS”) group at the Laboratory for Computer Science. The TNS group built a high-speed gigabit network and created applications that ran over the network. Example applications included ones for remote video capture, processing, and display of video on computer terminals. In addition to working on the design of core network components, designing and building the high speed links, and designing and writing the device drivers for the interface cards, I also set up the group’s web server. Furthermore, because our group focused on real-time software processing of live streamed data, some members of our group focused on research in software radios, which was thus commonly discussed in meetings and casual conversations. One of my labmates,

Vanu Bose, went on to found Vanu, Inc., a software radio company focused on low cost base stations for rural cell carriers. Several members of our group joined Vanu's company and I continued to meet with Vanu and members of his company. Thus, I became aware of the architectures around software radios starting in the late 1990's.

16. I defended and submitted my Ph.D. thesis, titled "Designing Networks for Tomorrow's Traffic," in January 1998. As part of my thesis research, I analyzed local-area and wide-area flows to show a more efficient method for routing packets in a network, based on traffic patterns at the time.

17. From 1997 to 1999, I was a Senior Scientist and Engineer at NBX Corporation, a start-up that made business telephone systems for streaming packetized audio over data networks instead of using traditional telephone lines. NBX was later acquired by 3Com Corporation, and the phone system is still used today by numerous businesses. As part of my work at NBX, I designed the core audio reconstruction algorithms for the telephones, as well as the packet transmission algorithms. I also designed and validated the core packet transport protocol used by the phone system. The protocol was used for all signaling in the phone system. The NBX system also featured a

computer interface for initiating phone calls, which could also initiate conference calls. The NBX system also supported TAPI, the Telephony Application Programming Interface, thus allowing other computer programs to integrate with our system telephony features. We obtained U.S. Patent No. 6,967,963, entitled “Telecommunication method for ensuring on-time delivery of packets containing time-sensitive data,” as a result of part of this work.

18. From 1999-2004, I was employed by Empirix or its predecessor company, Teradyne. Empirix was a leader in test tools for telecommunications protocols and systems, providing functional testing tools as well as load testing tools. From 2000-2001, I conceived and built a test platform for testing Voice-over-IP (VoIP). The first application on this new test platform was a cloud emulator for simulating the effects of transmitting VoIP over a busy network.

19. In 2006, as part of my role at BBN Technologies, I helped found PodZinger Inc., now known as RAMP Inc. PodZinger utilized BBN’s speech recognition algorithms to search through the spoken words in audio and video segments. While I was Vice President of Operations and Technology, PodZinger followed its initial prototype with a full streaming audio and video search solution.

20. Furthermore, I have served as expert witness in over one-hundred forty patent-related cases where I wrote expert reports and testified in over eighty depositions on topics such as network communications and telecommunications, including Internet protocols, streaming media, and mobile wireless technologies. I have testified in Federal courts, the PTAB, and the ITC on behalf of leading companies such as Amazon, AT&T, Cisco Systems, Google, Microsoft, Comcast, Time Warner Cable, Samsung, and Apple.

21. I have been awarded several United States patents, including the following examples:

• U.S. Pat. No.	• Title
• 7,975,296	• Automated security threat testing of web pages
• 7,877,736	• Computer language interpretation and optimization for server testing
• 7,801,910	• Method and apparatus for timed tagging of media content
• 7,590,542	• Method of Generating Test Scripts Using a Voice-Capable Markup Language
• 7,860,999	• Distributed computation in network devices

• 6,967,963	• Telecommunication method for ensuring on-time delivery of packets containing time-sensitive data
• 7,359,993	• Method and apparatus for interfacing external resources with a network element

22. Based on my above-described over three decades of experience in network usage and resource allocation and the acceptance of my publications and professional recognition by societies in my field, I believe that I am qualified to be an expert in the field of wireless technology.

23. Based on my experience described above, and as indicated in my *curriculum vitae*, I am qualified to provide the following opinions with respect the patent in this proceeding. Additionally, I am at least a person having ordinary skill in the art, as I have set forth in §IV.D below, as of the priority date of the '382 Patent.

III. RELEVANT LEGAL STANDARDS

24. I do not provide any legal opinions in this Declaration. I have been informed and understand that certain legal standards are to be applied by technical experts in forming opinions regarding the meaning and validity of patent claims. I have been asked to provide my opinions regarding whether the claims of the '382 Patent would have been obvious

to a person having ordinary skill in the art at the time of the alleged invention, in light of the prior art.

25. Further, I have been informed and understand that a patent claim is not patentable as obvious (a requirement I understand to be governed by a statute, 35 U.S.C. § 103) if the differences between the patent claim and the prior art are such that the claimed subject matter as a whole would have been obvious at the time the claimed invention was made to a person having ordinary skill in the relevant art. Obviousness, as I have been informed and understand, is based on the scope and content of the prior art, the differences between the prior art and the claim, the level of ordinary skill in the art, and, to the extent that they exist, certain objective indicia of non-obviousness.

26. I understand that objective indicia can be important evidence regarding whether a patent is obvious or nonobvious, if it has an appropriate nexus to the claimed invention, i.e., is a result of the merits of a claimed invention (rather than the result of design needs or market-pressure advertising or similar activities). Such indicia include: commercial success of products covered by the patent claims; a long-felt need for the invention; failed attempts by others to make the invention; copying of the invention by others in the field; unexpected results

achieved by the invention as compared to the closest prior art; praise of the invention by the infringer or others in the field; the taking of licenses under the patent by others; expressions of surprise by experts and those skilled in the art at the making of the invention; the patentee proceeded contrary to the accepted wisdom of the prior art, and, the contemporaneous development of the subject matter claimed by others.

27. I have been informed that whether there are any relevant differences between the prior art and the claimed invention is to be analyzed from the view of a person of ordinary skill in the relevant art at the time of the invention. As such, my opinions below as to a person of ordinary skill in the art are as of the time of the invention, even if not expressly stated as such; for example, even if stated in the present tense.

28. In analyzing the relevance of the differences between the claimed invention and the prior art, I have been informed that I must consider the impact, if any, of such differences on the obviousness or non-obviousness of the invention as a whole, not merely some portion of it. The person of ordinary skill faced with a problem is able to apply his or her experience and ability to solve the problem and also look to any available prior art to help solve the problem.

29. I have been informed that a precise teaching in the prior art directed to the subject matter of the claimed invention is not needed. I have been informed that one may take into account the inferences and creative steps that a person of ordinary skill in the art would have employed in reviewing the prior art at the time of the invention. For example, if the claimed invention combined elements known in the prior art and the combination yielded results that were predictable to a person of ordinary skill in the art at the time of the invention, then this evidence would make it more likely that the claim was obvious. On the other hand, if the combination of known elements yielded unexpected or unpredictable results, or if the prior art teaches away from combining the known elements, then this evidence would make it more likely that the claim that successfully combined those elements was not obvious.

30. I have been informed and understand that there are recognized, exemplary, rationales for combining or modifying references to show obviousness of claimed subject matter. Some of the rationales include the following: combining prior art elements according to known methods to yield predictable results; simple substitution of one known element for another to yield predictable results; use of a known technique to improve a similar device (method or product) in the same way;

applying a known technique to a known device (method or product) ready for improvement to yield predictable results; choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success; known work in one field of endeavor may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations are predictable to one of ordinary skill in the art; and some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art teachings to arrive at the claimed invention.

IV. OVERVIEW

31. The Challenged Claims are unpatentable as obvious over the prior art. The claims are directed to a distributed antenna system (DAS) that reconfigures the carrier channels allocated to remote antenna units based on key performance indicators (KPIs) of the DAS network. The KPIs are described as traffic measurements which are typically a function of the number of users on the network, and are measured and analyzed by a traffic monitoring unit which triggers reconfiguration of the carrier channels.

32. Both *Kummetz* (EX-1006) and *Leng* (EX-1005 (English Translation)) are directed to the same problem and provide the same solution as that provided by the '382 Patent. Both *Kummetz* and *Leng* disclose substantially the same DAS as the '382 Patent for reconfiguring the carrier channels of the remote antenna units based on a determination of KPIs by a traffic monitoring unit. In *Kummetz*, the KPI is the number of users in a coverage zone, and in *Leng* the KPI is load information, which includes the number of registered users.

33. A comparison of the DASs described in the '382 Patent, *Kummetz*, and *Leng* is illustrated below with common elements highlighted in the same color:¹

34. '382 Patent

¹ All annotation of figures and text by color, bolding, or italicizing is added by Petitioner unless identified as original.

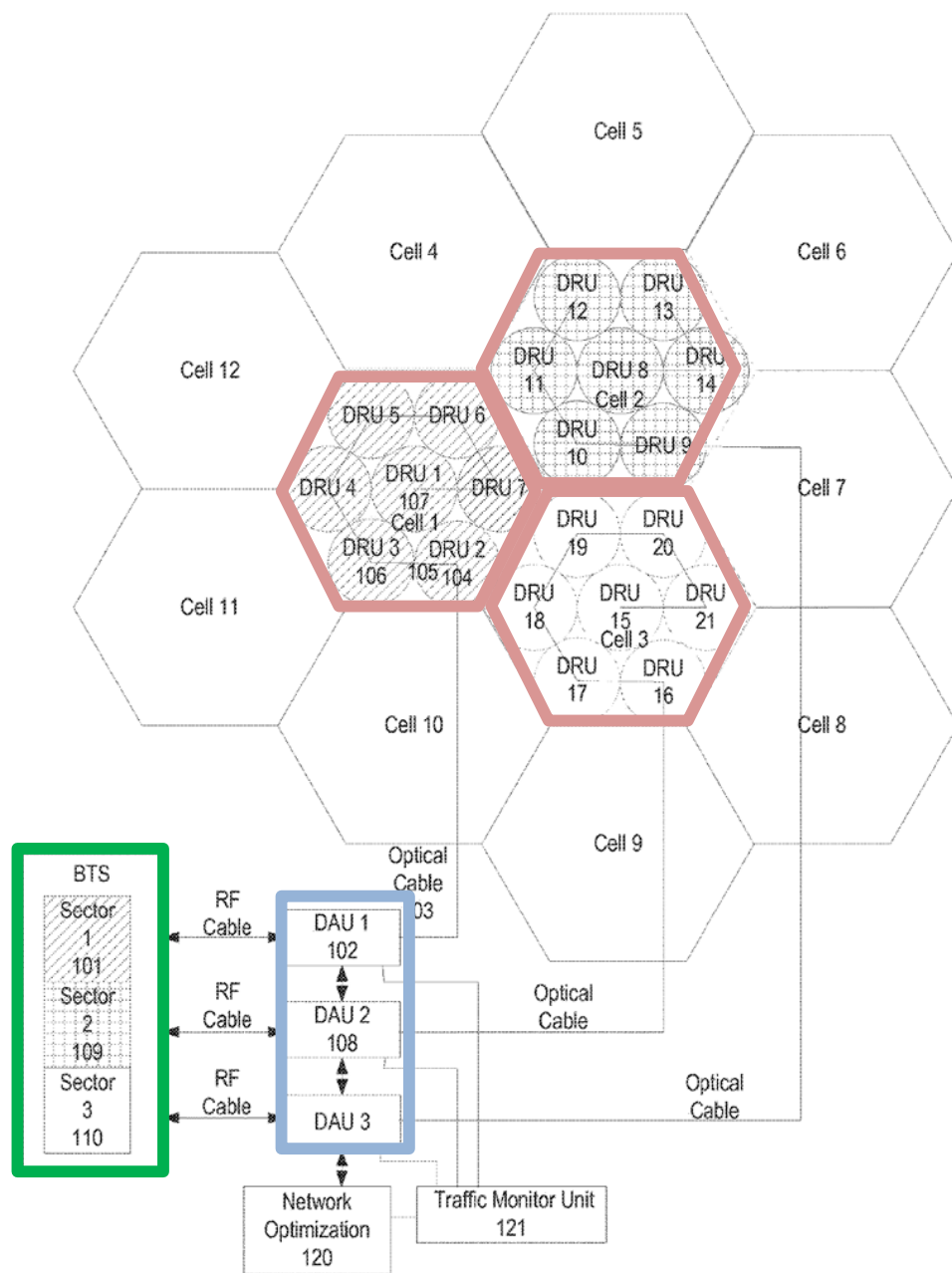


FIG. 1

EX-1001 FIG. 1.

35. *Kummetz*

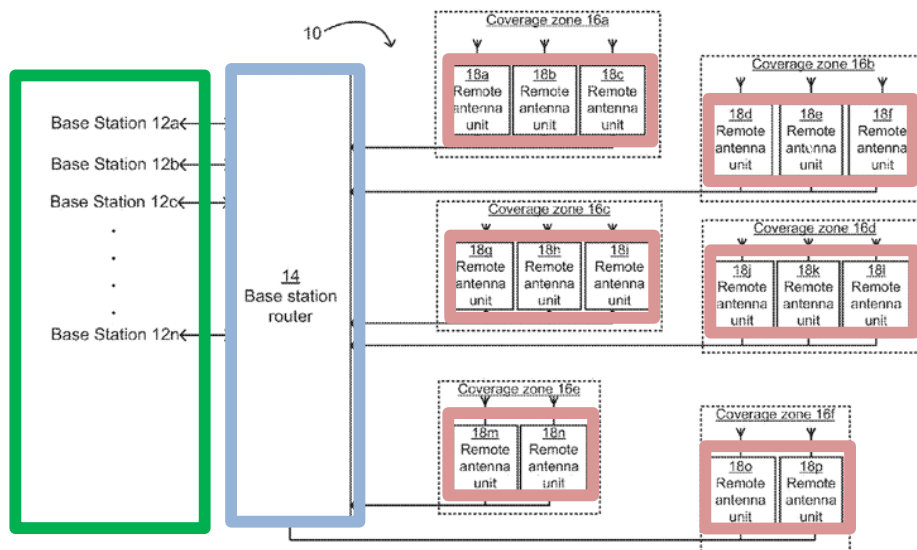


FIG. 1

EX-1006 FIG. 1.

36. Leng

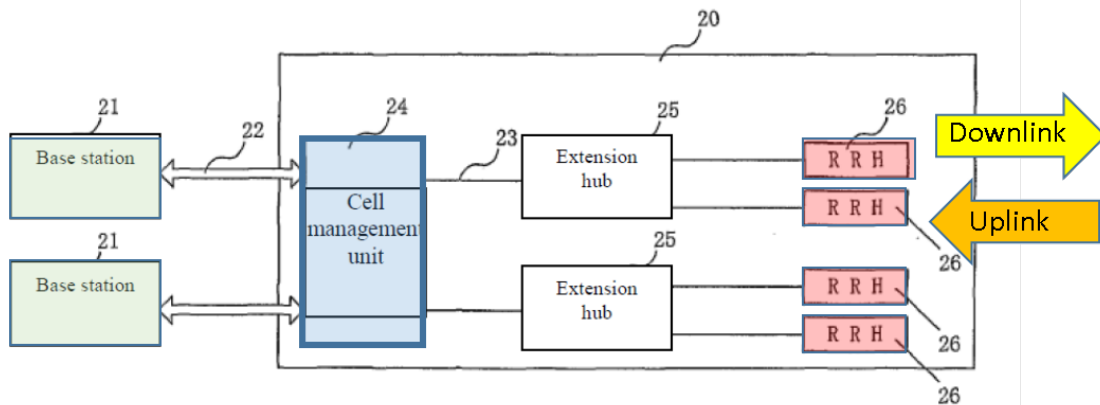


Fig. 2

EX-1005 FIG. 2.

'382 Patent	<i>Kummetz</i>	<i>Leng</i>
Remote Radio Unit (RRU)	Remote Antenna Unit	Remote Radio Head (RRH)
Digital Access Unit (DAU)	Base Station Router	Cell Management Unit (CMU)
Base Station (BTS)	Base Station	Base Station

V. BACKGROUND

A. Summary of the '382 Patent

37. The '382 Patent is directed to systems for dynamically routing signals in a DAS as part of a distributed wireless network. EX-1001 1:49-50. The '382 Patent describes a traffic monitoring unit to

provide flexibility to manage, control, enhance, and facilitate radio resource efficiency and usage, and the overall performance of the distributed wireless network. EX-1001 1:21-25, 4:19-23. One example of a DAS is provided in FIG. 1, reproduced below:

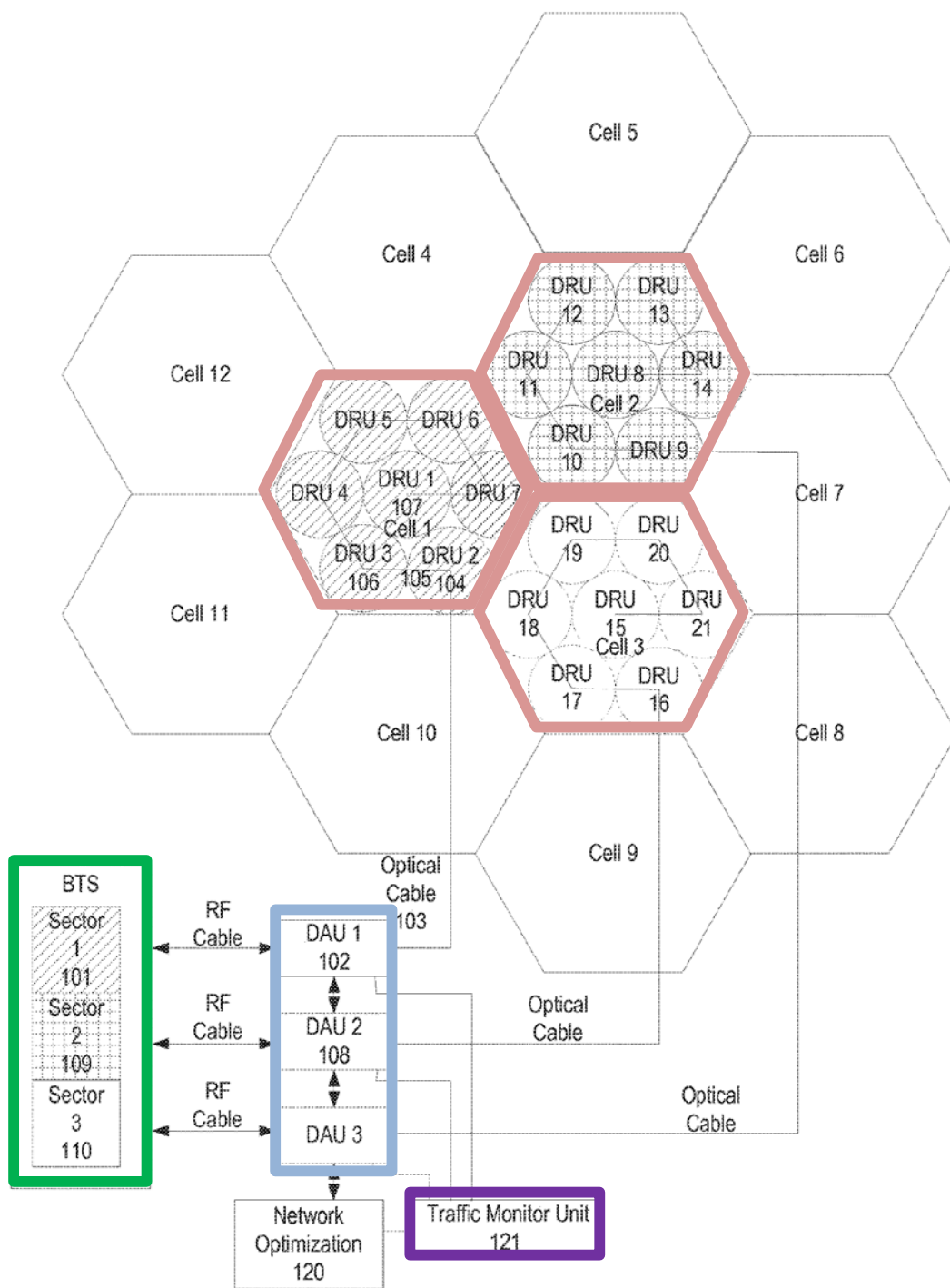


FIG. 1

EX-1001 FIG. 1.

38. FIG. 1 is a block diagram showing a DAS employing multiple Digital Access Units (DAUs) (blue) and Digital Remote Units (DRUs) arranged in cells (red). In this example, a three-sector base station (BTS) (green) including sectors 101, 109, and 110, provides downlink signals to DAU 1 (102), DAU 2 (108) and DAU 3, respectively, with each sector using a different radio resource, e.g., “[a] typical base station comprises 3 independent radio resources, commonly known as sectors.” EX-1001 2:26-30, 5:8-13; 5:60–6:1. The DAUs “function as the interface between the base stations and digital remote units (DRUs).” EX-1001 4:66-5:2. DAU 1 is connected to and transports signals to DAU 2 , and DAU 2 is connected to DAU 3. EX-1001 6:29-32; 7:8-10. The radio resources from the BTS sectors are transported to a daisy-chained network of DRUs to provide coverage to a geographical area. EX-1001 6:60-66. For example, DRUs 1-7 are daisy-chained to provide coverage to the geographical area of Cell 1. EX-1001 7:1-10. EX-1001 6:4-7; 6:60-67.

39. Traffic Monitoring Unit 121 (purple) tracks and collects traffic load at each DAU in the network, and stores this information in the network optimization unit 120. EX-1001 7:14-19, FIG. 9 (element 910). Network performance may be expressed by Key Performance Indicators (KPIs) collected from different parts of the network. EX-1001

5:58-62. For example, the '382 Patent describes that KPIs may comprise information such as number of blocked calls, number of active calls, average power of uplink channels, average power of downlink ports, External Ports and PEER Ports, traffic on each sector, failed calls, number of satisfied users, number of unsatisfied users, number of users through a given DRU, and the like. EX-1001 10:37-45.

40. The '382 Patent describes using the KPIs from the network traffic to load balance the DRUs. In one example, the '382 Patent describes that system performance may be improved allocating a DRU from a first sector to a second sector thereby shifting traffic from the first sector to the second sector. EX-1001 11:6-12.

41. The Petition Challenges independent Claims 1 and 10 and dependent Claims 2–9 and 11–19. Claim 1 illustrates the Challenged Claims at issue:

1. [i]. *A system comprising:*

[ii]. *one or more Digital Access Units (DAUs) operable to receive at least one signal from at least one of a first signal source and a second signal source from one or more of a plurality of signal sources,*

[iii]. *each DAU of the one or more DAUs including an input port configured as an uplink/downlink port and an output port configured as an uplink/downlink port;*

[iv]. *one or more Digital Remote Units (DRUs) connectable to the one or more DAUs and operable to transport signals between one or more of the one or more DRUs and the one or more DAUs;*

[v]. *a plurality of radio resources formed from the one or more DRUs comprising a first radio resource and a second radio resource different from the first radio resource,*

[vi]. *each radio resource comprising a subset of the plurality of DRUs; and;*

[vii]. *a traffic monitoring unit coupled to at least one of the DAUs, wherein the traffic monitoring unit is configured to:*

[a] determine one or more of: one or more key performance indicators (KPIs) and/or a quality of service (QoS) of a network traffic for the one or more DAUs, wherein the QoS is a function of the one or more KPIs; and

[b] reconfigure the plurality of radio resources based on one or more of the one or more KPIs and/or the QoS by allocating at least one DRU from the first radio resource to the second radio resource.

B. Claim Construction

42. I understand that 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.

43. I understand the term “radio resources” has previously been construed by the Board in IPRs related to Dali Wireless’s other patents directed to DAS, most recently in IPR2022-01419, and in litigation, most recently in *Dali Wireless, Inc. v. Cellco Partnership d/b/a Verizon Wireless, et al.* U.S.D.C. WDTX Case No. 6:22-cv- 01313-ADA.

44. These constructions of “radio resources” are consistent with the plain and ordinary meaning of the term that I applied herein.

C. Priority Date of the Challenged Claims

45. The application for the ’382 Patent was filed on October 23, 2019, as a continuation of the ’454 Patent and claims priority of provisional application No. 61/678,016 filed on July 31, 2012. I have been instructed to assume the priority date is July 31, 2012.

D. Person of Ordinary Skill in the Art

46. A POSA in July 2012 would have been familiar with managing and configuring radio resources in a DAS. . A POSA would have gained knowledge of these concepts through a mixture of training and work experience, such as by having a Bachelor’s degree in electrical engineering and four years of experience; or by obtaining a Master’s

degree in electrical engineering, but having only one to two years of experience; or by having no formal education but experience in cellular communications of at least eight years.

E. State of the Art

47. The following section describes the state of the art for DAS networks and reconfiguring the use of radio resources by the DAS as of July 2012. . 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, assist in understanding how a POSA understood the disclosures of the prior art, and provide the motivation to modify or combine the teachings of references.

1. Prior Art DAS

48. A DAS is a network of spatially separated antenna nodes connected to a common node via a transport medium that provides wireless service within a geographic area or structure. Common wireless communication system configurations employ a host unit as the common node, which is located at a centralized location (for example, at a facility that is controlled by a wireless service provider). The antenna nodes and related broadcasting and receiving equipment, located remote from the host unit (for example, at a facility or site that is not controlled by the

wireless service provider), are also referred to as “remote units.” Radio frequency (RF) signals are communicated between the host unit and one or more remote units. In such a DAS, the host unit is typically communicatively coupled to one or more base stations (for example, via wired connection or via wireless connection) which allow bidirectional communications between wireless subscriber units within the DAS service area and communication networks such as, but not limited to, cellular phone networks, the public switch telephone network (PSTN) and the Internet. A DAS can provide an infrastructure within a community that can scatter remote units across a geographic area for providing wireless services across that area. EX-1009 1:14-36.

2. Reconfiguring remote radio units based on performance metrics

49. It was known to reconfigure the radio resources of a DAS based on KPIs of the DAS network. One such prior art DAS that reconfigures the carrier frequencies of the remote radio units based on loading is shown below in FIG. 1.

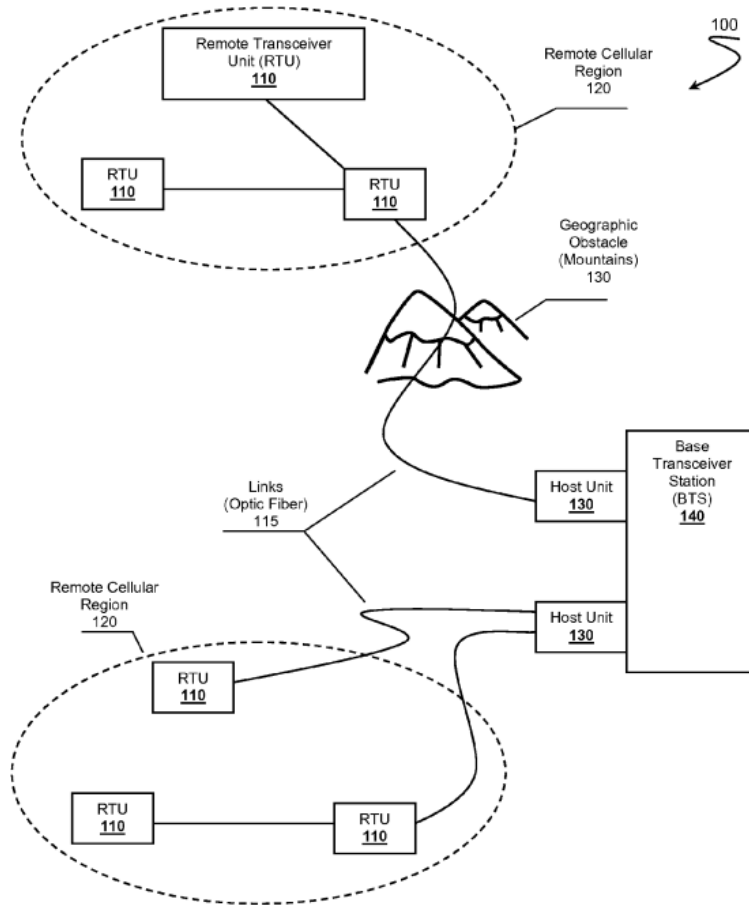


Figure 1

EX-1010 FIG. 1.

50. Base transceiver stations (BTSs) communicate signals to remote transceiver units (RTUs) via one or more host units. EX-1010 Title, ¶0030. The system provides control over the communication by splitting carrier channels from their bands and routing only selected channels to RTUs according to a routing policy. EX-1010 ¶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-1010 ¶¶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-1010 ¶¶0046; 0039-45.

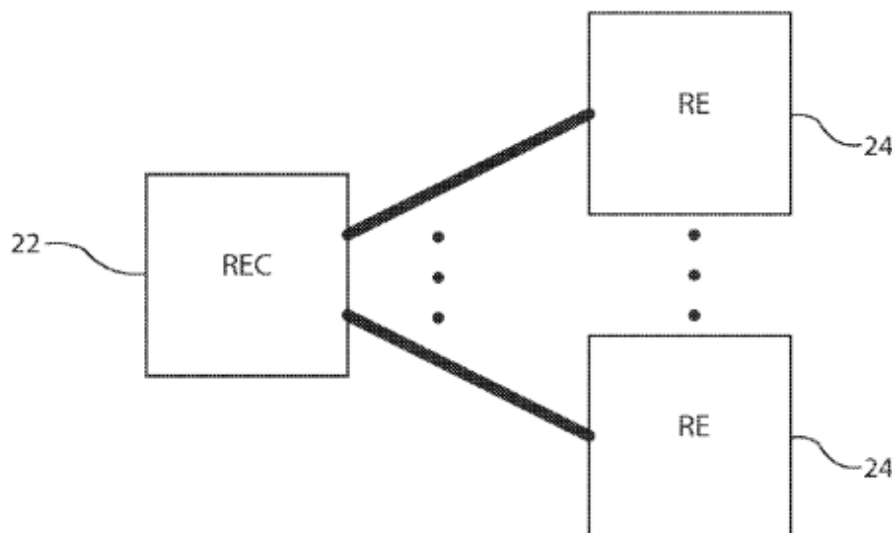
51. A processor can be used to analyze traffic metrics *e.g.*, data rate, call rate, consumed bandwidth, etc.) in order to reconfigure channels to increase efficiency and optimization of the DAS such as through load balancing. EX-1010 0044.

3. Prior art DAS topographies

52. By July 2012, multiple hosts could serve a base station and transmissions between host units and remote units were preferably occurring according to suitable standards such as the Common Public Radio Interface (CPRI) Standard. EX-1010 ¶¶0031, 0049. Many different topologies for DASs were available to connect the remote transceivers to the host and to each other. The CPRI Standard defines “a publicly available specification for the data transfer interfaces between the radio equipment (RE) and radio equipment controllers (REC) of transceiver systems, including base stations and distributed antenna systems (DAS).” EX-1011 [0005].

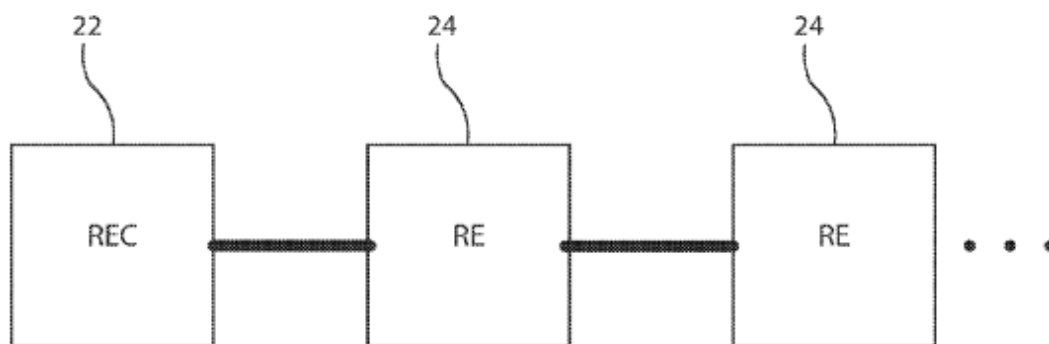
53. Using CPRI, the REC (host unit) is responsible for processing baseband signals and communicating with the core telecommunication network, whereas each RE (remote unit performs) performs the radio frequency (RF) processing for transmission of signals over the antenna to mobile devices. EX-1011 [0005]; EX-1012 9, 13. Well-known topographies for a DAS included “point-to-point, multiple point-to-point, chain, star, tree, ring and combinations thereof” (EX-1011 [0005]), “daisy-chained” (EX-1013 [0086]), and “bus type, a star type or a hybrid type” (EX-1014 [0033]). Several of these basic topologies are illustrated below:

54. Star Type



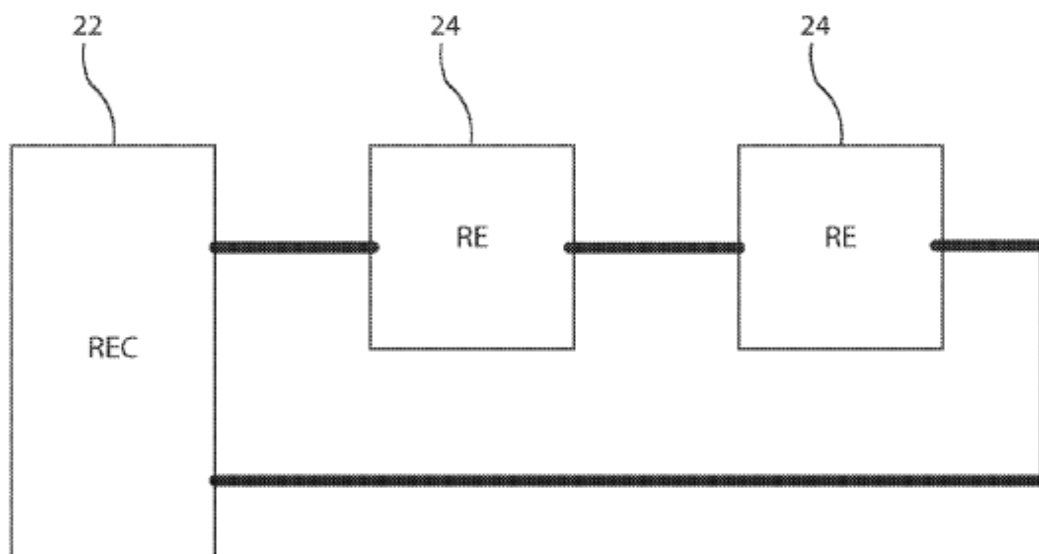
EX-1011 [0005], FIG. 3; EX-1012 FIG. 5.

55. Chain or Daisy Chain Type



EX-1011 FIG. 4; EX-1012 FIG. 5A.

56. Ring or Loop Type



EX-1011 FIG. 6; EX-1012 FIG. 5C.

57. It was also known to couple components of a DAS, for example coupling multiple host units, coupling host to remote units etc., via optical fiber. EX-1015 FIG. 6, [0029].

VI. IDENTIFICATION OF CHALLENGES

A. Challenged Claims

58. Claims 1-19 of the '382 Patent are challenged in this Petition.

B. Statutory Grounds for Challenges

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

Ground	Claims	Basis	Reference
1	1-8, 10-19	§ 103	<i>Kummetz</i>
2	1-19	§ 103	<i>Leng</i>

C. Prior Art

60. I have been informed that U.S. Patent 9,398,464 (“*Kummetz*”) and International Published Application WO 2009/090414 (“*Leng*”) each qualify as prior art under § 102 for purposes of this IPR.

VII. IDENTIFICATION OF HOW THE CHALLENGED CLAIMS ARE UNPATENTABLE

A. Ground 1: Claims 1-8, 10-19 are unpatentable over *Kummetz*

1. The *Kummetz* Reference

61. *Kummetz* describes a method for load balancing in a DAS.

EX-1006 Abstract, 1:40–2:4. Like the '382 Patent, *Kummetz* disclosed techniques for monitoring traffic in the DAS and reallocating network resources based on predefined criteria. EX-1006 1:40–2:4, 2:40–48.

Also like the '382 Patent, *Kummetz* describes a mechanism to “execute the configuration management function in response to the detection of a traffic indicator” and to “redistribute signal capacity among coverage zones.” EX-1006 9:40-65.

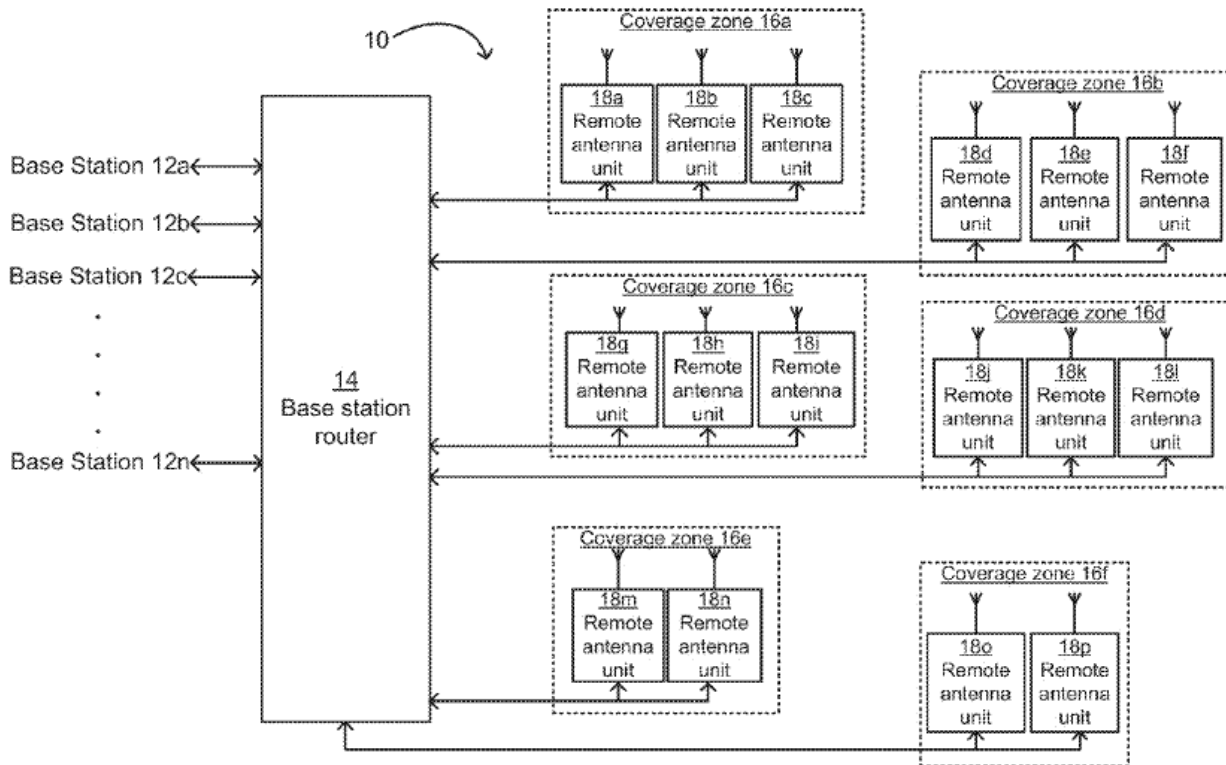


FIG. 1

EX-1006 FIG. 1.

62. FIG. 1 above illustrates a DAS embodiment of *Kummetz*. A base station router 14 communicates with a plurality of base stations 12a–n and a plurality of remote antenna units 18a–p that are distributed into different coverage zones (e.g., in stadiums, office buildings, or other confined environments). EX-1006 5:14–16. “Different base stations 12a–n can be associated with different sectors of one telecommunication system operator and/or be associated with different sectors of different telecommunication system operators.” EX-1006 5:19–23. The DAS can

also be configured to have a plurality of interconnected base station routers to expand coverage. EX-1006 FIG., 6, 11:39–52.

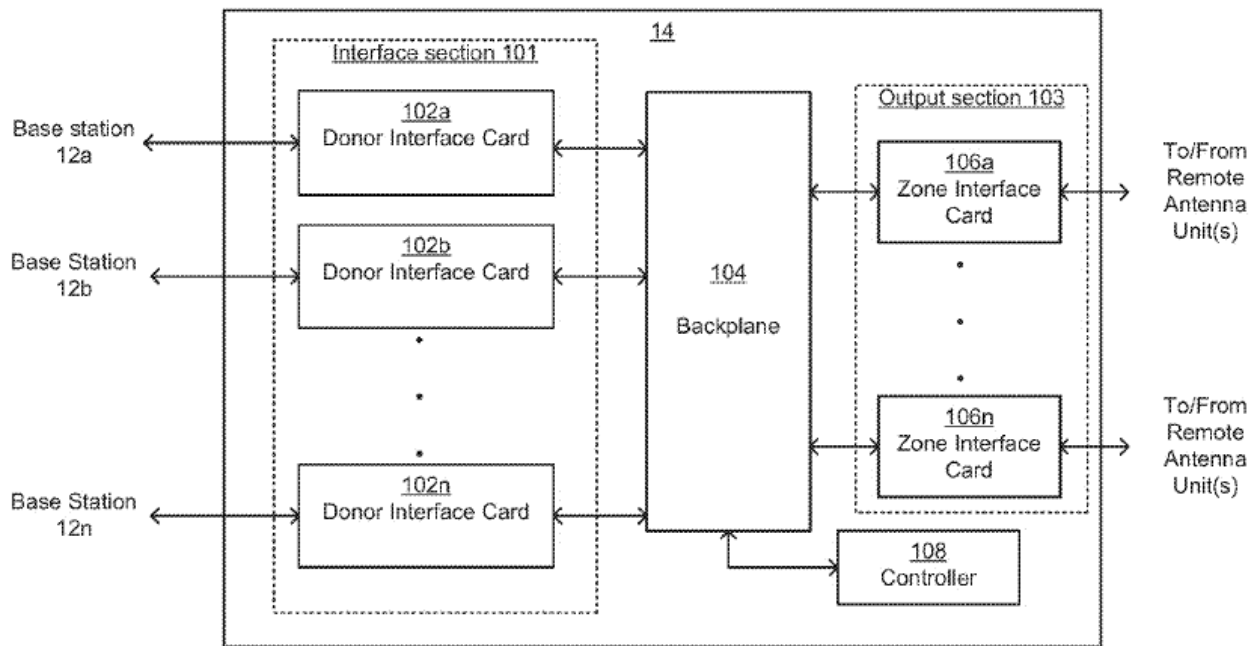


FIG. 2

EX-1006 FIG. 2.

63. FIG. 2 above is one example of a base station router 14, which includes an interface section 101 for bidirectional connections to the base stations and an output section 103 for bidirectional connections to the remote antenna units. EX-1006 7:45–8:53. The router 14 is coupled to a controller 108, which can be disposed in the router or in a separate device external to and in communication with the router. EX-

1006 8:54–62. Controller 108 is responsible for reconfiguring the digital signal processing circuitry to change the routing of signals between the base stations and remote antenna units. EX-1006 8:54-62. Controller 108 comprises a configuration engine 210 that causes controller 108 to redistribute capacity in the DAS based on the detection of a “traffic indicator.” EX-1006 9:22–30, 9:40–44.

A traffic indicator can include data describing or otherwise corresponding to a number of mobile devices in each coverage zone. Examples of a traffic indicator can include a scheduled event of a game, concert, or other type of event, a scheduled sequence of events with pre-game, game, and post-game configurations, traffic measurements passing low or high thresholds, base transceiver station failure events, and loss of capacity due to high inter-sector interference. In some aspects, the controller 108 can detect traffic and perform measurements independent of a wireless network standard and protocol.

EX-1006 9:44–54.

64. *Kummetz* further describes that controller 108 can implement any process for measuring uplink signals for traffic and other types of information. EX-1006 9:55–65.

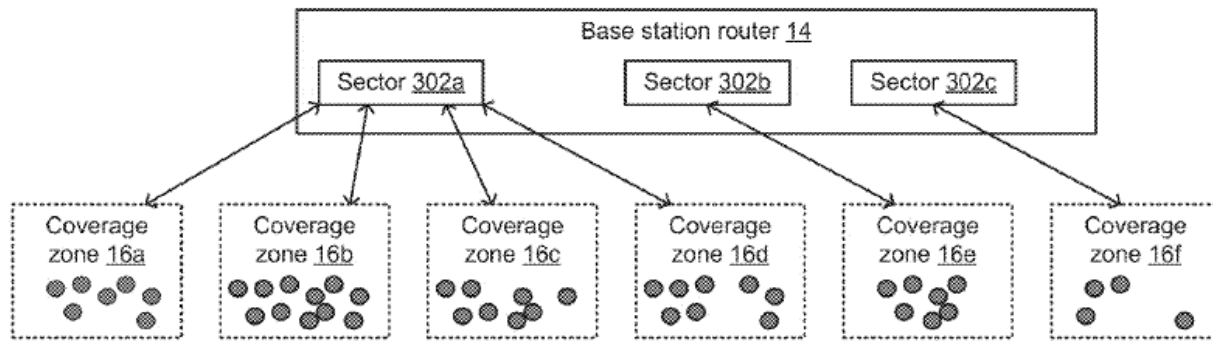


FIG. 4

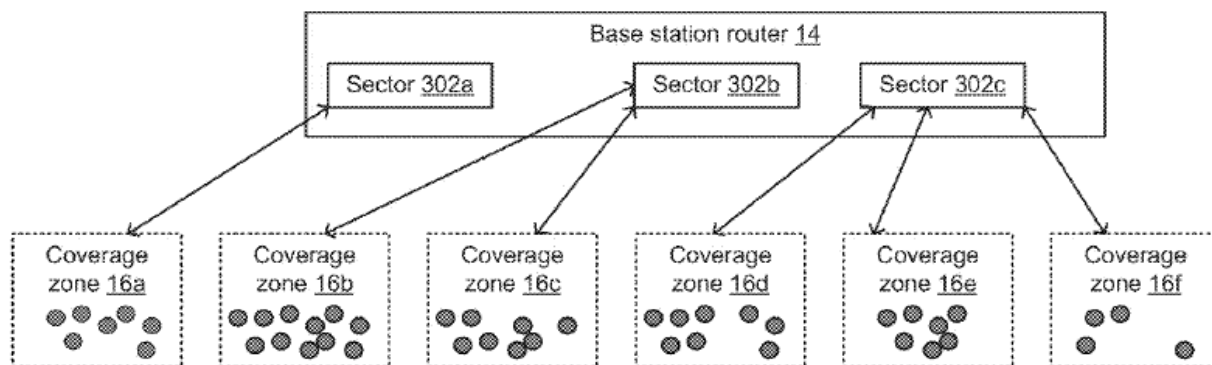


FIG. 5

EX-1006 FIG. 5.

65. For instance, in response to a traffic indicator, the controller can cause the base station router 14 to redistribute capacity by changing which sectors are provided to which coverage zones. EX-1006 9:40-54, 10:30-43. *Kummetz* illustrates this in FIGs. 4 and 5, which include three sectors 302a-c distributing radio resources to the remote antenna units in coverage zones 16a-f. EX-1006 10:30-63.

66. *Kummetz* uses the example of a stadium (coverage zones 16a-d) and the surrounding parking lot (coverage zones 16e-f), wherein

before an event begins, the radio resources provided by a single sector 302a may sufficiently cover the entire stadium. EX-1006 10:64–11:12. When there are more wireless devices concentrated within the stadium than in the parking lot, the base station router can redistribute capacity such that the remote antenna units in coverage zones 16b–d can be reallocated to different sectors 302b–c. EX-1006 11:13–28.

2. Detailed Application of *Kummetz* to the Challenged Claims

a. Claim 1

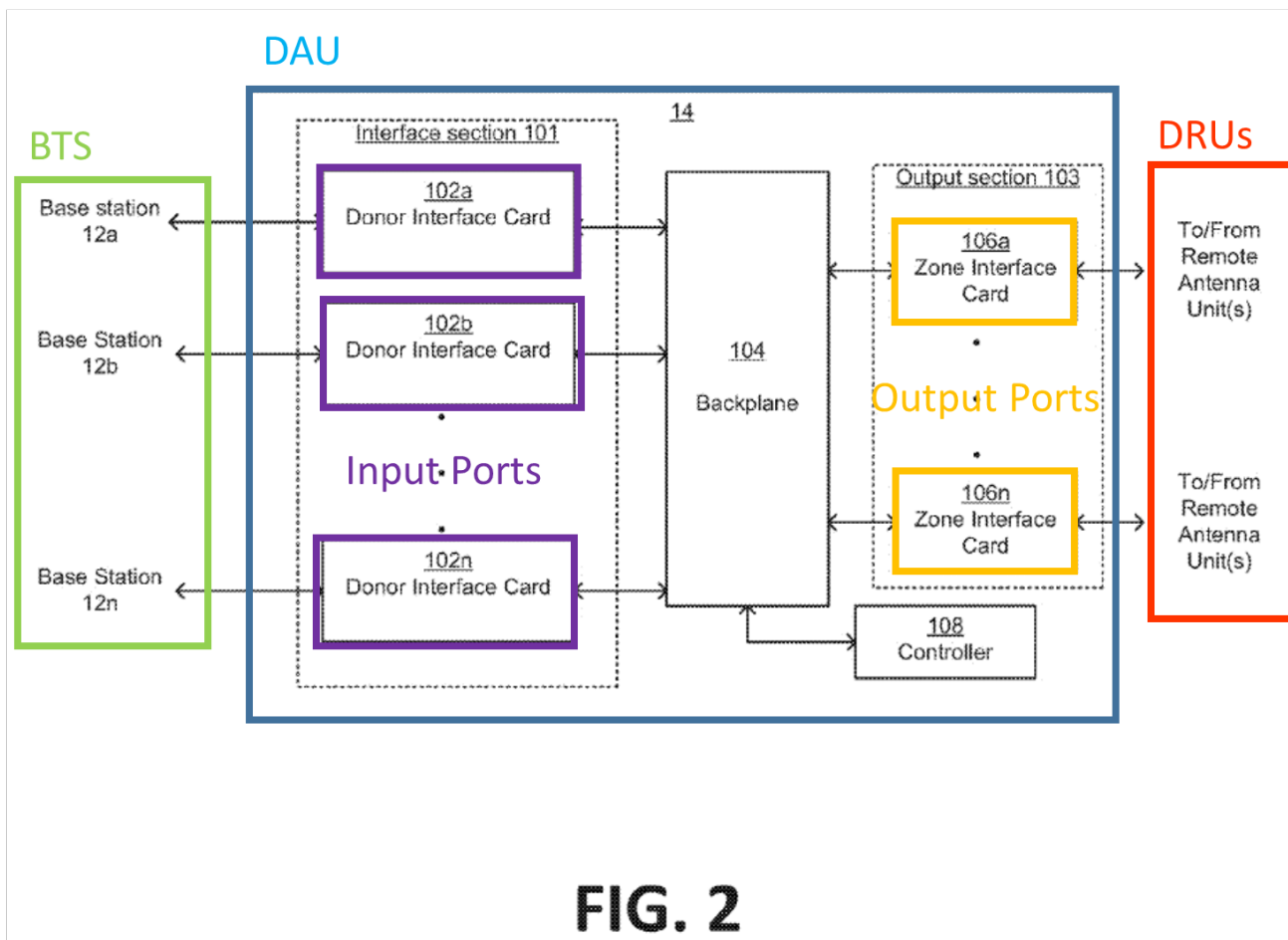
i. A system comprising:

67. *Kummetz* discloses a reconfigurable DAS. EX-1006 Abstract.

ii. one or more Digital Access Units (DAUs) operable to receive at least one signal from at least one of a first signal source and a second signal source from one or more of a plurality of signal sources,

68. *Kummetz* discloses a DAU in the form of a base station router 14 shown in FIG. 2 that includes an interface section 101, an output section 103, and a backplane 104. Interface section 101 includes donor interface cards 102a–n. In the downlink direction, donor interface cards 102a–n transform RF signals received from base stations 12a–n into one or more digital data streams (*operable to receive at least one signal from*

at least one of a first signal source and a second signal source from one or more of a plurality of signal sources). EX-1006 7:45-53.



EX-1006 FIG. 2.

- iii. *each DAU of the one of more DAUs including an input port configured as an uplink/downlink port and an output port configured as an uplink/downlink port;*

69. *Kummetz* discloses that base station router (DAU) includes donor interface cards (purple) (input port configured as an uplink/downlink port) that transform RF signals received from base

stations 12a–n into one or more digital data streams in the downlink direction and transform digital data streams into uplink signals to be provided to base stations 12a–n in the uplink direction. EX-1006 7:50–8:1.

70. *Kummetz* further discloses base station router 14 (*DAU*) includes zone interface cards 106a–n (green) (*output port configured as an uplink/downlink port*) that can transform the combined data streams into downlink signals to be provided to the remote antenna units of one or more coverage zones and can receive uplink signals from one or more remote antenna units. EX-1006 8:23–54.

***iv. one or more Digital Remote Units (DRUs)
connectable to the one or more DAUs and
operable to transport signals between one or
more of the one or more DRUs and the one or
more DAUs;***

71. *Kummetz* discloses one or more remote antenna units (*DRUs*) (blue) connectable to the one or more base station routers (*DAUs*) (red) operable to transport signals between the *DRUs* and *DAUs*. EX-1006 7:50-8:53. *Kummetz* discloses that each base station router (*DAU*) comprises zone interface cards 106a–n and that each card “can transform the combined data streams into downlink signals to be provided to the remote antenna units [*DRUs*] of one or more coverage zones ... [and] can

receive one or more uplink signals from the one or more remote antenna units [DRUs].” EX-1006 8:27-42.

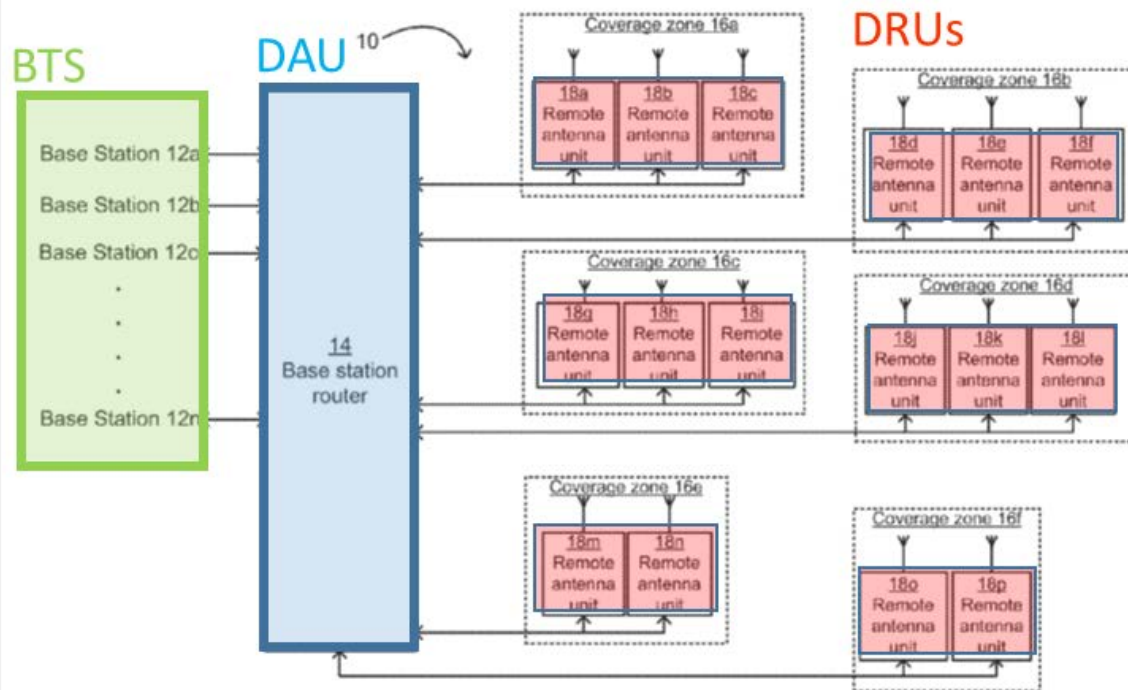


FIG. 1

EX-1006 FIG. 1.

- v. *a plurality of radio resources formed from the one or more DRUs comprising a first radio resource and a second radio resource different from the first radio resource,*

72. *Kummetz* discloses that a sector can include an RF channel to be distributed to all of the remote antenna units (DRUs) in a coverage zone. EX-1006 2:48-52; 3:20-24. As shown below in annotated FIG. 4,

Kummetz discloses that the channels associated with Sector 302a (green), 302b (blue) and 302c (gold) (*a plurality of radio resources*) formed from one or more remote antenna units (*DRUs*) comprising a first channel (green) (*a first radio resource*) and a second channel (blue) (*a second radio resource different from the first radio resource*). EX-1006 10:56-63, FIG 4.

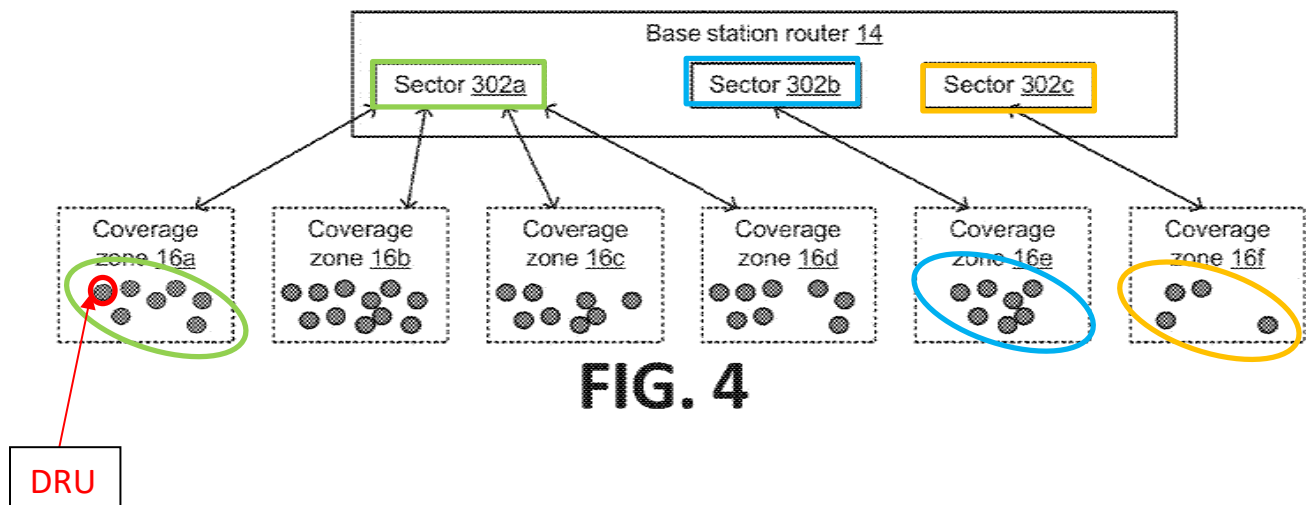


FIG. 4

73. *Kummetz* is consistent with the disclosure in the '382

Patent that: “A typical base station comprises 3 independent radio resources, commonly known as sectors. These 3 sectors are typically used to cover 3 separate geographical areas without creating co-channel interference between users in the 3 distinct sectors.” EX-1001 5:8-13.

This is illustrated in annotated FIG. 1 of the '382 Patent:

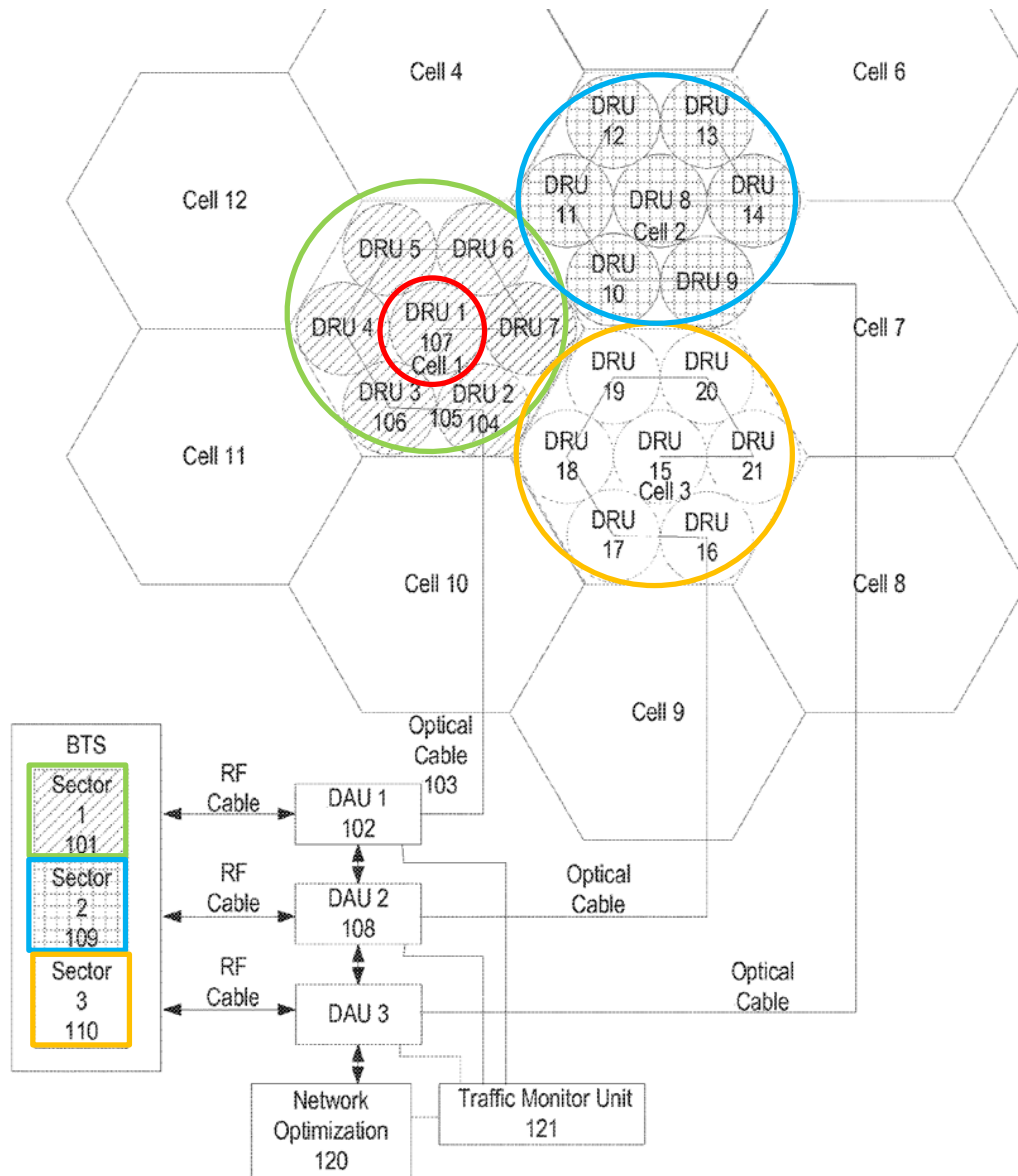


FIG. 1

EX-1001 FIG. 1

vi. each radio resource comprising a subset of the plurality of DRUs;

74. *Kummetz* discloses that the RF channels (*each radio resource*) of a sector are assigned to a coverage zone comprising a subset

of the plurality of remote antenna units (*DRUs*) as illustrated in annotated FIG 4, above. .

vii. and a traffic monitoring unit coupled to at least one of the DAUs,

75. *Kummetz discloses that controller 108 (dark green) (traffic monitoring unit) coupled to the backplane of the base station router (DAU) can detect traffic and perform measurements independent of a wireless network standard and protocol. EX-1006 9:53-54, 9:57-61.*

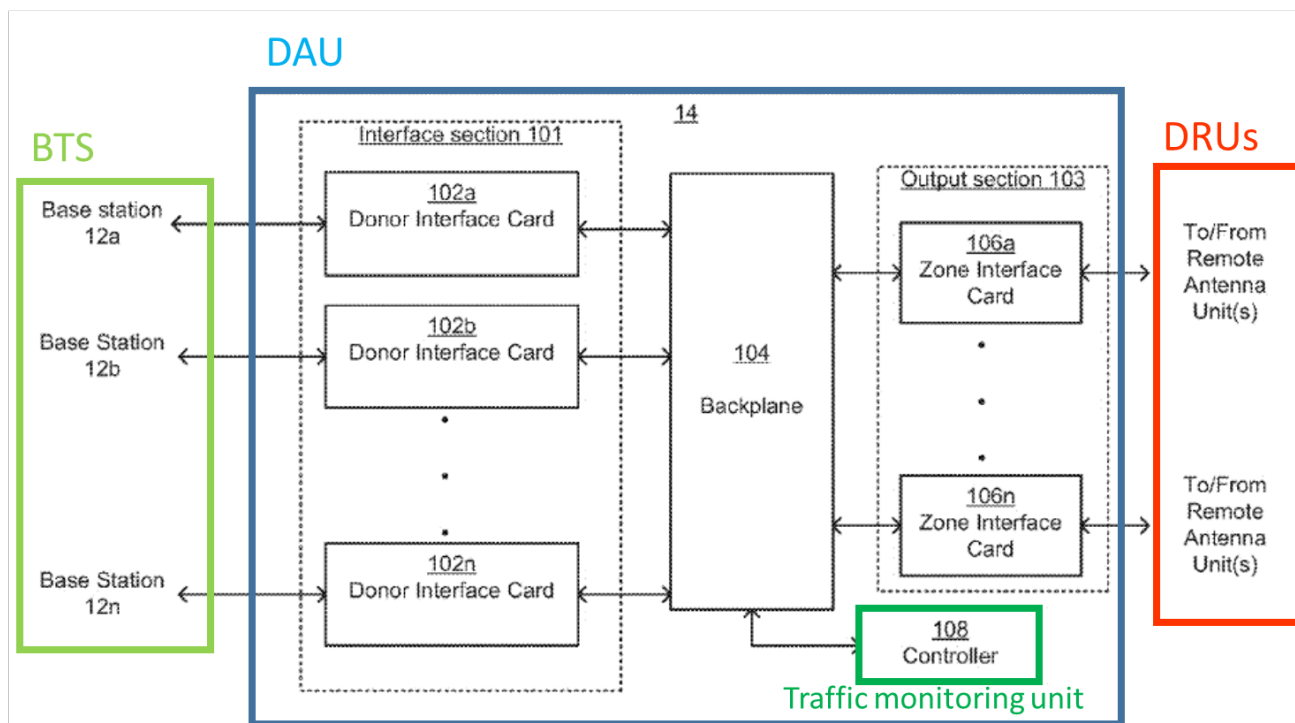


FIG. 2

EX-1006 FIG. 2.

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

76. *Kummetz* discloses that controller 108 (*traffic monitoring unit*) determines one or more KPIs, such as the number of mobile devices in each coverage zone, traffic measurements passing low or high thresholds, base transceiver station failure events, and loss of capacity due to high inter-sector interference. EX-1006 9:40-54. *Kummetz* further describes that capacity provided by a coverage area can be increased by decreasing the number of coverage zones assigned to a sector. Thus as the number of users in a coverage area goes up the density requirement of a sector increases the number of sectors:

The base station router can redistribute capacity such that the capacity requirements or capacity density match the provided capacity.

EX-1006 3:32-34.

Increasing the number of coverage zones to which a sector is distributed can decrease the capacity density of each coverage zone. Decreasing the number of coverage zones to which a sector is distributed can increase the capacity density of each zone. The level of the capacity

density can determine how many mobile devices can use telecommunication services and capacity in a given coverage zone. In some aspects, a maximum capacity density can be achieved by distributing the sector to a minimum size coverage zone. A non-limiting example of a minimum size coverage zone is a single remote unit or a single antenna unit.

EX-1006 3:43-53.

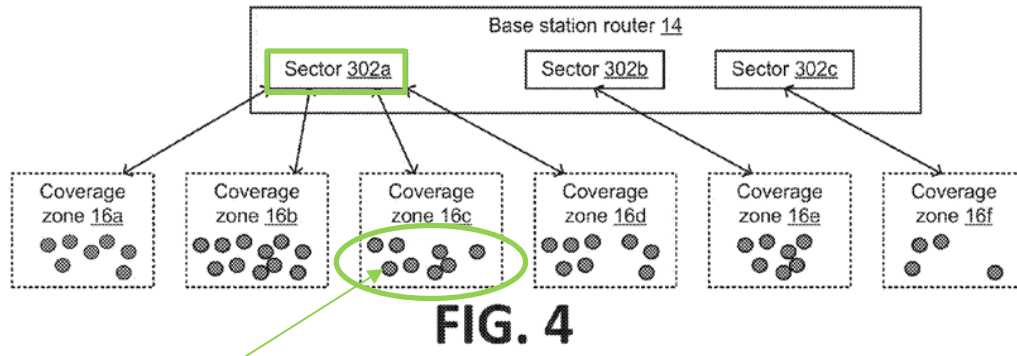
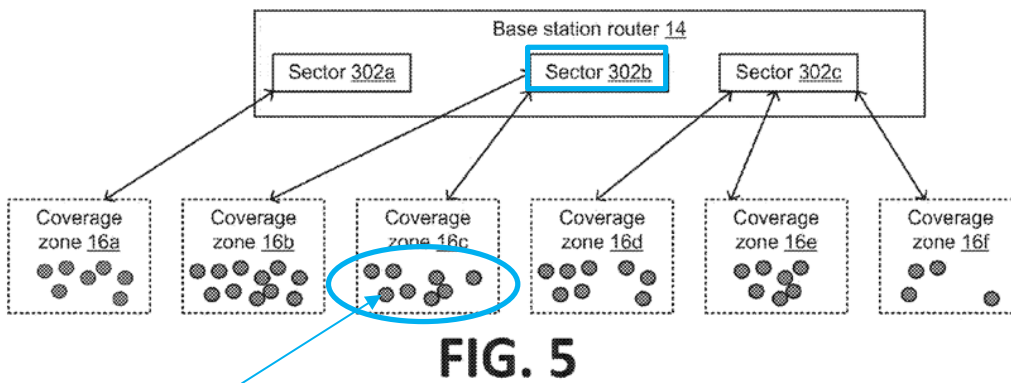
(b) and reconfigure the plurality of radio resources based on one or more of the one or more KPIs and/or the QoS by allocating at least one DRU from the first radio resource to the second radio resource.

77. *Kummetz* discloses that controller 108 (*traffic monitoring unit*) includes a configuration engine 210 that causes the controller to redistribute capacity in the DAS by reconfiguring the RF channels assigned to a remote antenna unit (*allocating at least one DRU from the first radio resource to the second radio resource*). EX-1006 9:22-25.

Specifically, the configuration engine can include a configuration management function for determining how to redistribute signal capacity among coverage zones in response to the detection of a traffic indicator. EX-1006 9:40-44.

78. FIGs. 4 and 5 of *Kummetz* disclose an example of the traffic monitoring unit reconfiguring the channels assigned to the remote

antenna units (depicted as darkened circles) based on the number of wireless devices (*KPI*) in a coverage zone. .



EX-1006 10:30-37, FIGs.4, 5.

79. FIG. 4 depicts the base station router (*DAU*), according to an initial configuration, providing the channels of sectors 302a-c to the remote antenna units (*DRUs*) in coverage zones 16a-f. Initially, the channels of sector 302a can be configured for the remote antenna units in zones 16a-d, such that the carrier signals of the remote antenna units in zone 16c are provided by sector 302a (green circle). *Kummetz* describes that this initial configuration can be used for a football stadium where

zones 16a-d correspond to different sections of the stadium and zones 16e-f correspond to the parking lot. Before an event hosted at the stadium begins, fewer wireless devices are in the stadium than the parking lot and therefore zones 16a-d require less capacity, thus sector 302a can provide sufficient capacity density for zones 16a-d. On the other hand, many wireless devices may be concentrated in the parking lot before the stadium event begins, and therefore zones 16e-f require more capacity than zones 16a-d and thus sector 302b is assigned to zone 16e and sector 302c is assigned to zone 16f. EX-1006 10:64-11:12.

80. FIG. 5 depicts reconfiguration after the event in the stadium begins and the number of mobile devices in the stadium (zones 16a-d) increases and the number in the parking lot (zones 16e-f) decreases. The base station router (*DAU*) is reconfigured by the controller (*traffic monitoring unit*) in response to the concentration of mobile devices (*KPIs*) in the coverage zones. Specifically, channels of sector 302a are provided to zone 16a, channels of sector 302b are provided to zones 16b-c, and channels of sector 302c are provided to zones 16d-f. The reconfiguration results in increasing the density capacity of zones 16a-d where the concentration of the number of mobile devices has increased. EX-1006 11:13-28. As a result, the remote antenna units in zone 16c

which were originally provided with the channels assigned to sector 302a (green circle in FIG. 4), have been reconfigured such that the channels assigned to sector 302b are provided to the remote antenna units in the coverage zone 16c (blue circle in FIG. 5).

81. Thus, *Kummetz* discloses that the controller (*traffic monitoring unit*) reconfigures channels assigned to sectors (*the plurality of radio resources*) based on the number of mobile devices in a coverage zone (*KPIs*) by allocating at least one DRU from the first radio resource (green circle in FIG. 4) to the second radio resource (blue circle in FIG. 5).

b. Claim 2

The system of claim 1, further comprising a one or more Base Transceiver Stations (BTSs) coupled to the one or more DAUs, wherein each BTS comprises the plurality of radio resources.

82. *Kummetz* discloses a system comprising a plurality of base transceiver stations 12a–n (*one or more BTSs*) (green) coupled to the one or more DAUs, wherein each BTS comprises the plurality of RF channels assigned to sectors as illustrated in annotated FIG. 2. EX-1006 5:14–23, 7:45–8:7.

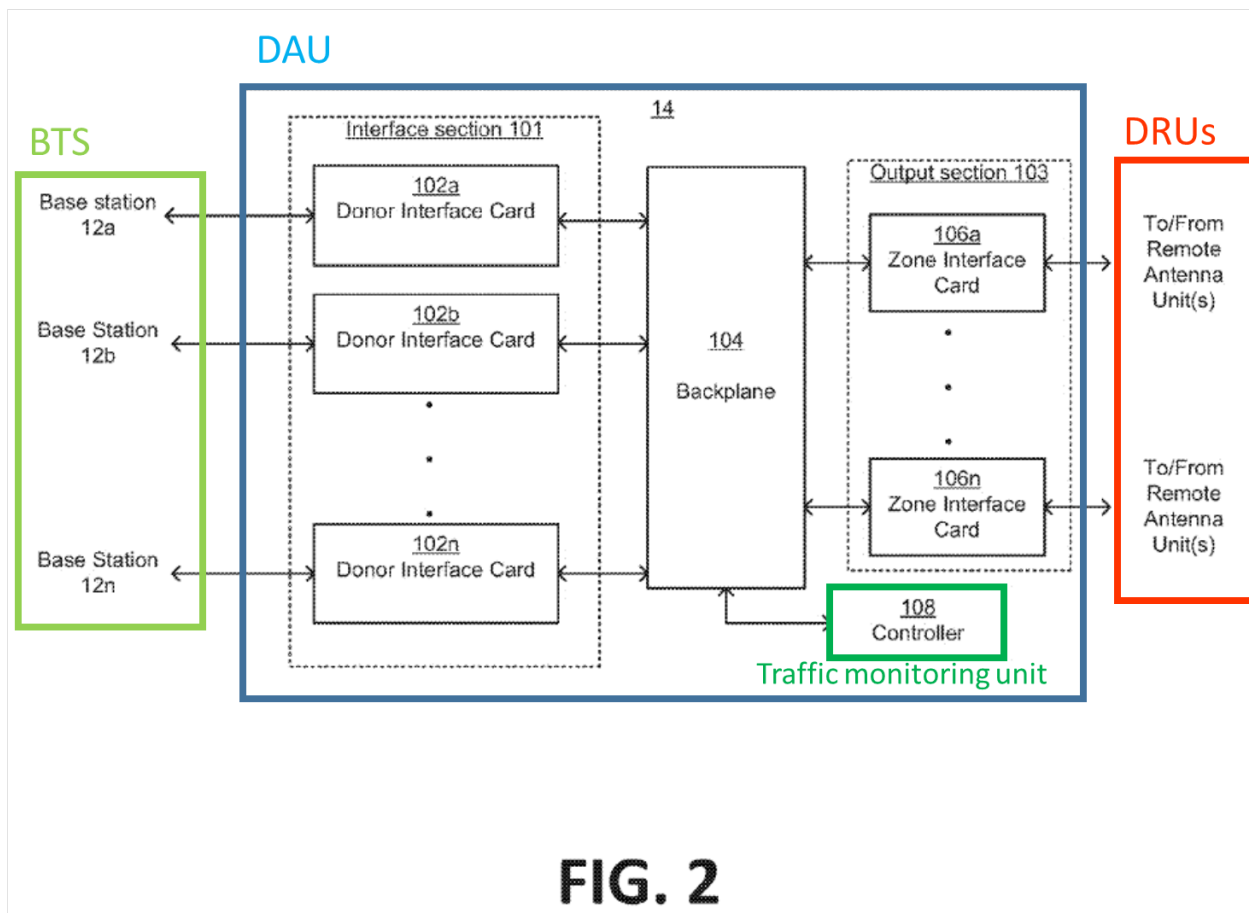


FIG. 2

EX-1006 FIG. 2.

83. *Kummetz* further discloses that each base station 12a–n can comprise one or more sectors. EX-1006 5:50–54 (“Routing the signals can include combining the signals of the sectors from one or more base stations 12a–n.”); 4:5-19; 5:19-22. Further, a POSA understood that a base station could comprise multiple sectors, as acknowledged by the ’382 Patent. EX-1001, 5:8-13. Base station router 14 (*DAU*) can combine signals from multiple sectors from the one or more base stations 12a–n. EX-1006 5:54–58. Base station router 14 then distributes the one

or more sectors of each base station 12a–n to the coverage zones. EX-1006 3:15–30, 10:30–43.

c. **Claim 3**

The system of claim 2, further comprising a network optimization goal comprising a percentage of users associated with each of the plurality of radio resources.

84. *Kummetz* further discloses a network optimization goal comprising a percentage of users associated with each of the plurality of sectors. For example, as discussed above for Claim [1.vii], *Kummetz* discloses reconfiguring the capacity of base station sectors to different groups of remote antenna units in coverage zones 16a–f based on the number of mobile devices in the coverage zones.

85. A POSA understood that the number of mobile devices represents the number of users in a coverage zone. *Kummetz* further discloses that “[t]he base station router can redistribute capacity such that the capacity requirements or capacity density match the provided capacity,” where the “capacity density” is the capacity per physical area (i.e., coverage zone) and the “provided capacity” is the capacity provided by each of the sectors. EX-1006 1:43–46, 1:66–67, 3:32–34, 3:55–58. This can be achieved by “changing which sectors are provided to which coverage zones.” EX-1006, 3:15–16. A POSA understood that

redistributing capacity by matching “capacity density” and “provided capacity” discloses a network optimization goal, i.e., “[t]he level of the capacity density can determine how many mobile devices can use telecommunication services and capacity in a given coverage zone.” EX-1006 3:47–49. Thus, increasing the number of coverage zones to which the provided capacity of a sector is distributed decreases the capacity density of the coverage zones and increases the number of mobile devices or users that are using the provided capacity across the coverage zones. EX-1006 3:43–53. In contrast, decreasing the number of coverage zones to which the provided capacity of a sector is distributed increases the capacity density of the coverage zones and decreases the number of mobile devices or users that are using the provided capacity across the coverage zones. EX-1006, 3:54–61.

86. Thus, *Kummetz* discloses redistributing capacity such that capacity density matches provided capacity, which shifts the percentage of mobile devices (i.e., users) associated with each of the plurality of sectors (i.e., network optimization goal). To the extent that Dali Wireless argues that *Kummetz* does not expressly recite that the optimization goal is based on a percentage of users using the channels assigned to the

sectors, a POSA would be motivated to modify *Kummetz* to use the percentages of users based on the express teachings of *Kummetz* that:

Capacity can be redistributed in whole or in part from the first coverage zone to the second coverage zone based on the second coverage zone having a greater capacity requirement (i.e., a larger number of mobile devices).

EX-1006 3:39–42.

87. Further, *Kummetz* discloses that “[t]he base station router can distribute capacity to sub-divide a larger cell into smaller cells.” EX-1006 3:36–37. When the larger cell is sub-divided into smaller cells, the mobile devices or users associated with the larger cell are split among the smaller cells, which increases or decreases the number of users per cell. . Further, *Kummetz* discloses “[i]ncreasing the bandwidth associated with a sector can increase the capacity represented by the sector.” EX-1006 3:19–20. A POSA understood that when the capacity represented by a sector is increased, more mobile devices or users can use the additional capacity of the sector associated with their coverage zone(s) or cell(s), and this results in adjusting the percentage of users per cell. Thus, a POSA would be motivated to implement an optimization plan that uses a percentage of users in a coverage zone that can be supported by the available bandwidth. The disclosure of *Kummetz* is consistent with the

teachings of the '382 Patent of a network optimization goal based on the number of users on the system which utilizes a base station having three sectors serving multiple DRUs. EX-1001 4:50-54, 5:66-6:15.

d. **Claim 4**

The system of claim 1, wherein the traffic monitoring unit is external to the one or more DAUs.

88. Kummetz discloses that controller 108 (*traffic monitoring unit*) “can be disposed in a separate device external to and in communication with the base station router 14” (*DAU*). EX-1006 8:59-62.

e. **Claim 5**

The system of claim 1, wherein the traffic monitoring unit is provided as a component of each of the one or more DAUs.

89. Kummetz discloses that controller 108 (*traffic monitoring unit*) can be provided as a component of a base station router (*DAU*) as shown in FIG. 2. EX-1006 8:58-59.

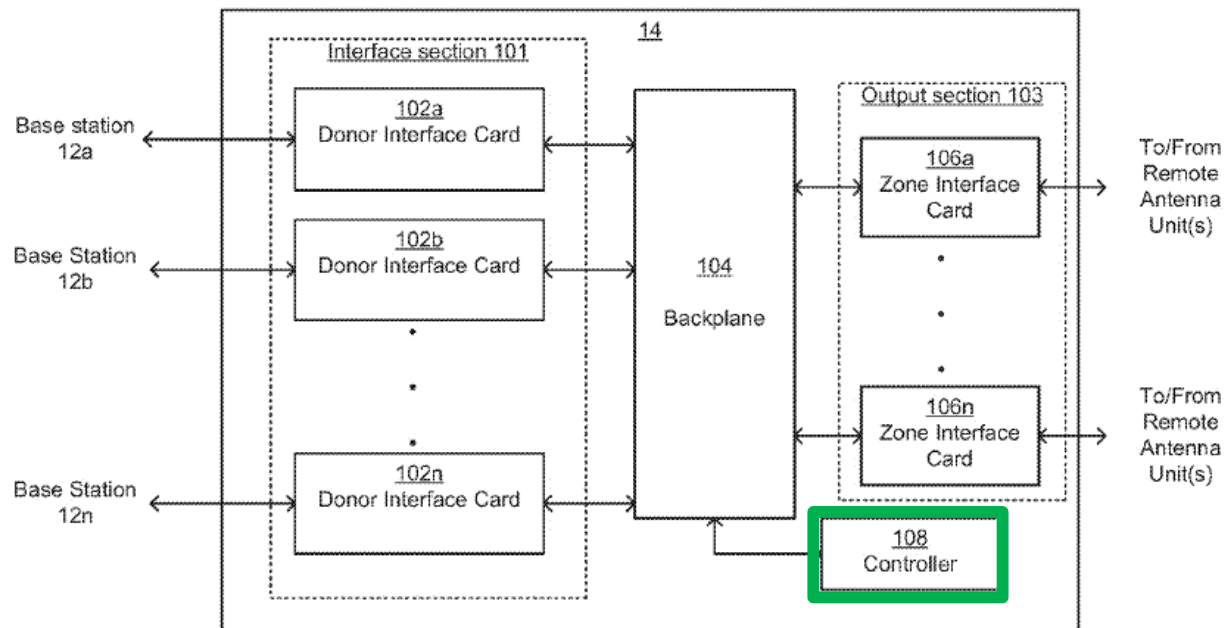


FIG. 2

EX-1006 FIG. 2.

f. Claim 6

The system of claim 1, wherein the traffic monitoring unit is external to the one or more DRUs.

90. *Kummetz* discloses this limitation for the same reason as discussed regarding claim limitation [1.vii] and Claim 5 showing the controller external to the remote antenna unit. EX-1006 5:14–16, 8:54–62; FIGS. 1-2.

g. Claim 7

The system of claim 1, wherein the traffic monitoring unit is provided as a component of each of the one or more DRUs.

91. *Kummetz* discloses that KPIs include traffic measurements and that a POSA understood one such measurement to be uplink power. EX-1006 9:40-54; EX-1001 10:37-45. *Kummetz* further discloses that each remote antenna unit measures the RSSI of uplink signals from mobiles. EX-1006 4:48-54. Thus, *Kummetz* discloses a traffic monitoring unit in the form of a component located in the remote antenna unit (*DRU*) that determines the uplink power.

h. Claim 8

The system of claim 1, wherein the traffic monitoring unit is configured to analyze Key Performance Indicators (KPIs) of the DAS.

92. *Kummetz* discloses the traffic monitoring unit is configured to analyze KPIs. In one example, *Kummetz* discloses that controller 108 (*traffic monitoring unit*) includes a configuration engine 210 for determining how to redistribute signal capacity among coverage zones in response to the detection of a traffic indicator (*analyze Key Performance Indicators (KPIs) of the DAS*). EX-1006 9:40-54.

i. Claim 10

93. See Claim [1.i- vii(b)] above

i. A system comprising:

See Claim [1.i].

- ii. *one or more Digital Access Units (DAUs) operable to receive at least one signal from at least one of a first signal source and a second signal source from one or more of a plurality of signal sources,*

See Claim [1.ii].

- iii. *each DAU of the one or more DAUs including an input port configured as an uplink/downlink port and an output port configured as an uplink/downlink port;*

See Claim [1.iii].

- iv. *one or more Digital Remote Units (DRUs) couplable to the one or more DAUs and operable to transport signals between the one or more DRUs and the one or more DAUs;*

See Claim [1.iv].

- v. *a plurality of radio resources formed from the one or more DRUs comprising a first radio resource and a second radio resource different from the first radio resource,*

See Claim [1.v].

- vi. *each radio resource comprising a subset of the one or more DRUs; and*

See Claim [1.vi].

- vii. *a traffic monitoring unit external to and couplable to at least one of the DAUs*

See Claim [1.vii].

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

See Claim [1.vii(a)].

- (b) *reconfigure the plurality of radio resources based on one or more of the one or more KPIs and/or the QoS by allocating at least one DRU from the first radio resource to the second radio resource.*

See Claim [1.vii(b)].

j. **Claim 11**

The system of claim 10, wherein the traffic monitoring unit is external to one or more Base Transceiver Stations (BTSS) and coupled to each of the one or more BTSSs.

94. Kummetz discloses that controller 108 (*traffic monitoring unit*) may be provided as a component of a base station router 14 (*DAU*) and router 14 is external and coupled to each of base stations 12a–n (*BTSSs*). EX-1006 5:14–16, 7:50–8:7, 8:54–62, FIGS. 1-2.

k. **Claim 12**

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

95. *Kummetz* further discloses a network optimization processor coupled to the traffic monitoring unit. For example, *Kummetz* discloses that controller 108 (*traffic monitoring unit*) includes a configuration engine 210 (*network optimization processor*) that, when executed by the processor 202, “can cause the controller 108 to redistribute capacity in the DAS 100” including “in response to changes [in] concentration of wireless devices in the respective coverage zones.” EX-1006 9:22-25; 9:55-61; 11:13-15, FIG. 3. Thus, configuration engine 210 executed by processor 202 is an optimization processor coupled to the controller (*traffic monitoring unit*) for optimizing the DAS as described with respect to Claim 3.

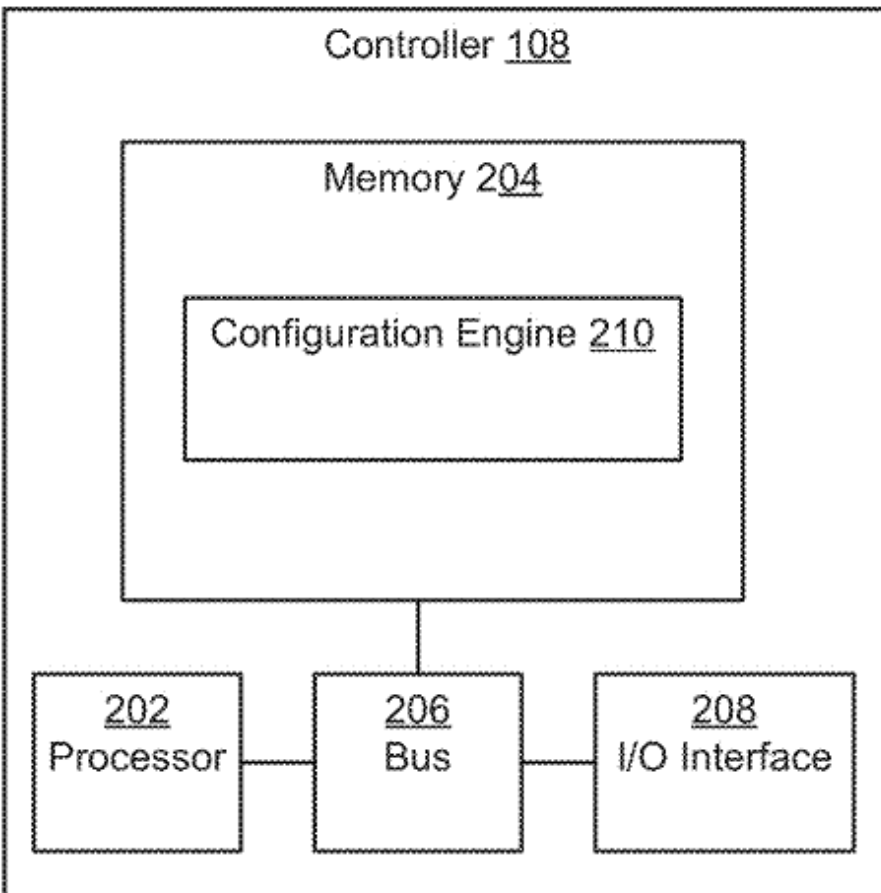


FIG. 3

EX-1006 FIG. 3, 8:64–9:5.

I. Claim 13

The system of claim 10, wherein the one or more DAUs are coupled via at least one of an ethernet cable, optical fiber, microwave line of sight link, wireless link, and/or satellite link.

96. *Kummetz* discloses an embodiment of the system comprising a plurality of base station routers 14a-c (*DAUs*)(red) as illustrated in FIG. 6 below:

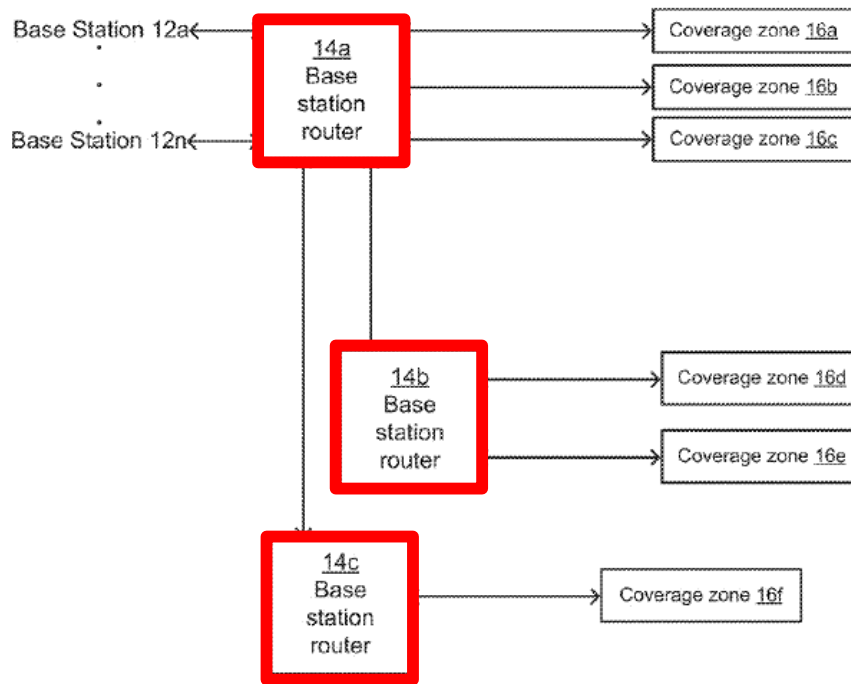


FIG. 6

EX-1006 FIG. 6.

97. *Kummetz* further states that the one or more base station routers (*DAUs*) are coupled via at least one of an ethernet cable, optical fiber, microwave line of sight link, wireless link, and/or satellite link:

The interconnections between multiple base station routers can use different media. Examples of interconnections between base station routers can include (but are not limited to) wired connections, optical connections, free-air paths, etc. Examples of wired connections can

include (but are not limited to) coaxial cables and twisted pair cables. Examples of optical connections can include optical fiber or other optical guides. Examples of free-air paths can include using radiated RF signals or radiated optical signals.

EX-1006 4:61-5:4.

m. Claim 14

The system of claim 10, wherein the one or more DAUs are coupled to the one or more DRUs via at least one of an ethernet cable, optical fiber, microwave line of sight link, wireless link, and/or satellite link.

98. *Kummetz* discloses that the one or more base station routers (DAUs) are coupled to the one or more remote antenna units (DRUs) via at least one of an ethernet cable, optical fiber, microwave line of sight link, wireless link, and/or satellite link:

The remote antenna units 18a–p can communicate with the base station router 14 via any communication medium capable of carrying signals between the base station router 14 and the remote antenna units 18a–p. Examples of a suitable communication medium include copper wire (such as a coaxial cable), optical fiber, and microwave or optical link. The link can transport the signals in analog or in digitized form.

EX-1006 7:12-19.

n. Claim 15

The system of claim 10, wherein the one or more DRUs are connected in a daisy chain configuration.

99. *Kummetz* discloses several functional schematic examples of multiple DRU's connected to a DAU, and DRUs connected to one another, but does not provide details of the physical connections between one or more DRUs and with the DAU. However, as discussed in the State of the Art section, a POSA understood that there were many different topology configurations used in DASs to connect DRU's including "point-to-point, multiple point-to-point, chain, star, tree, ring and combinations thereof" (EX-1011 0005), "daisy-chained" (EX-1013 0086), and "bus type, a star type or a hybrid type" (EX-1014 0033). *Kummetz* does not disclose any preference or any restriction for any topology, and thus a POSA understood that *Kummetz*'s teachings include using a daisy chain configuration. .

100. To the extent that Dali Wireless argues that *Kummetz* does not expressly teach a daisy chain configuration, a POSA would be motivated to use a daisy chain as there is a finite number of choices, and a daisy chain is a well-known implementation. Specifically, *Kummetz* explicitly references the CPRI specification as a preferred protocol for use with the DAS embodiments (EX-1006) and as discussed in the State

of the Art section, the CPRI standard as well as prior art DAS systems using CPRI have identified a daisy chain as a suitable topography. EX-1011 0005, FIG. 4; EX-1012 FIG. 5A. A POSA understood that different topologies of remote antenna units provide different coverage areas and those topologies can provide the necessary or desired coverage for particular venues, such as stadiums and office buildings. A POSA would have reasonably expected to succeed with the different topologies because the arrangement of the remote antenna units would provide predictable coverage areas for the particular venues or location. Thus, based on the advanced state of the art, implementing such topologies would have been routine, and would have led to predictable results.

o. Claim 16

The system of claim 10, wherein the one or more DRUs are connected to the one or more DAUs in a star configuration.

101. This limitation is disclosed for the same reasons as discussed with respect to Claim 15. Specifically, the use of a star configuration was well known in the art and implementing such topologies would have been routine, and would have led to predictable results. EX-1011 [0005] FIG. 3; EX-1012 FIG. 5; EX-1014 0033.

p. Claim 17

The system of Claim 10, wherein the one or more DAUs are connected to one or more BTSs via at least one of an ethernet cable, optical fiber, microwave line of sight link, wireless link and/or satellite link.

102. Kummetz discloses that the base station router 14 “can receive signals from the base station 12a–n via a wired or wireless communication medium.” EX-1006 5:24–25. A POSA understood that such connection medium included at least one of an ethernet cable, optical fiber, microwave line of sight link, wireless link and/or satellite link.

103. Additionally, as discussed with respect to Claims 13 and 14, Kummetz describes examples of such wired and wireless communication mediums in the context of other connections to the base station router 14 such as coaxial cables, twisted pair cables, optical fiber, microwave link, optical link, radiated RF signals, and radiated optical signals. EX-1006 4:66–5:4; 7:16–20.

q. Claim 18

The system of claim 10, wherein the one or more DRUs are connected in a loop to one or more of the one or more DAUs.

104. This limitation is disclosed for the same reason as discussed with respect to Claim 15. Specifically, the use of a loop

configuration was well known in the art and implementing such topologies would have been routine, and would have led to predictable results. EX-1011, FIG. 6; EX-1012 FIG. 5C.

r. Claim 19

The system of claim 10, wherein a single DAU port is connected to one or more BTSs.

105. This limitation is disclosed for the same reason as discussed with respect to Claim [10.iii] because a single port of the donor interface card 102a is connected to base station 12a as illustrated in FIG 2.

B. Ground 2: Claims 1-19 are Unpatentable Over *Leng*

1. The *Leng* Reference

106. *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 to effectively adapt to load changes when communication traffic of a region varies greatly. EX-1005 Abstract.

107. FIG. 2 of *Leng* illustrates one embodiment of DAS 20. Remote Radio Heads (RRHs) 26 are placed around the building. Cell management device (CMU) 24 is connected to base station 21 and is configured to distribute a downlink wireless signal to RRH 26, collect an

uplink wireless signal, and transmit the uplink signal to base station 21. CMU 24 also collects load information of DAS 20 and reconfigures the DAS based on the load information. The RRH corresponds to the RRU of the '382 Patent, and the CMU corresponds to the DAU of the '382 Patent. EX-1005 3:20-25.

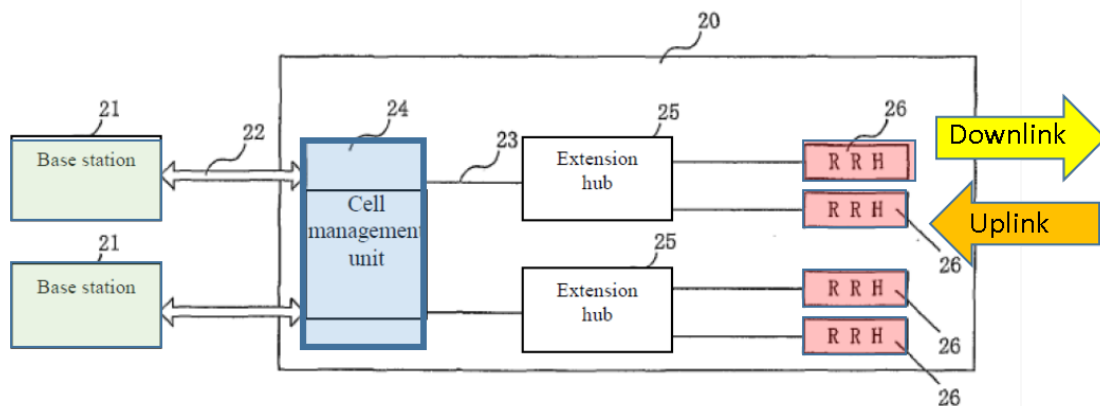


Fig. 2

EX-1005 FIG. 2.

108. *Leng* describes several problems with prior art DAS implementations. First, once the DAS has been installed, the allocation of the RF spectrum is fixed. Such systems are not suitable for areas where communication traffic varies greatly, such as auditoriums, conference halls, and the like. If too much spectrum is allocated to such areas, spectrum resources are wasted when these areas are idle.

However, if only a small amount of spectrum resources are allocated to these areas, when these areas become crowded, spectrum resources may be insufficient. EX-1005 1:19-23.

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

110. *Leng* describes that its solution to these problems is dynamically reconfiguring a DAS that is capable of reallocating carriers in a timely and efficient manner to meet the changing communication traffic needs of a region. The DAS collects load information and reconfigures the system based on the load information. EX-1005 1:33-36. As part of the reconfiguration, *Leng* describes that the RRHs switch their carriers upon notification from the carrier reconfiguration module. EX-1005 9:1-10.

111. FIGs. 4 and 5 of *Leng* illustrate an embodiment of the reconfigurable DAS. FIG. 4 shows the initial configuration of DAS 20. RRH A and RRH B use carrier 1 (red), RRH C and RRH D use carrier 2 (blue), and RRH E and RRH F use carrier 3 (green). EX-1005 4:18-22.

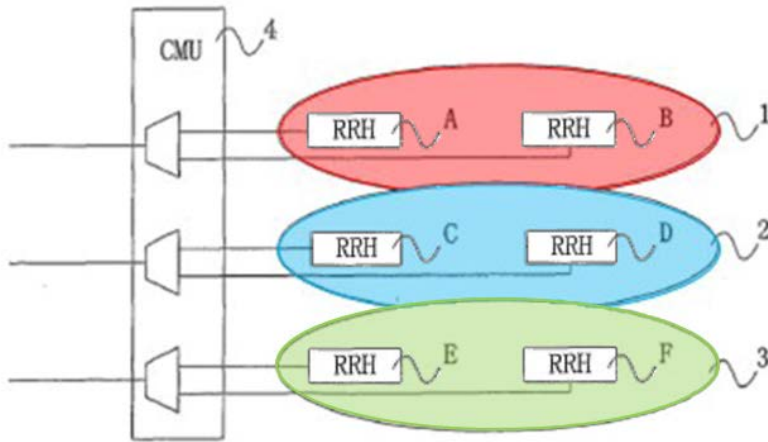


图 4

EX-1005 FIG. 4.

112. When CMU 24 detects that RRH A and RRH B become areas of high load, DAS 20 is reconfigured as shown in FIG. 5. After reconfiguration, RRH B is reconfigured to use carrier 2 (blue), and RRHs C and D are reconfigured to use carrier 3, along with RRHs E and F (green). As a result, RRH A uses carrier 1 and RRH B uses carrier 2. Thus DAS 20 is reconfigured to split the heavy load which was previously only on carrier 1 between carriers 1 and 2. Carrier 3 which was being used before configuration only by RRH E and RRH F, is now

shared with RRH C and RRH D since it is sufficient to carry the load of all four RRHs. EX-1005 4:18-27.

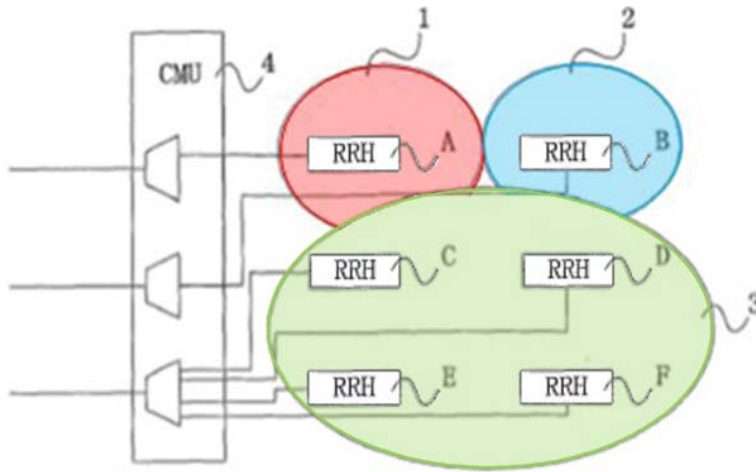


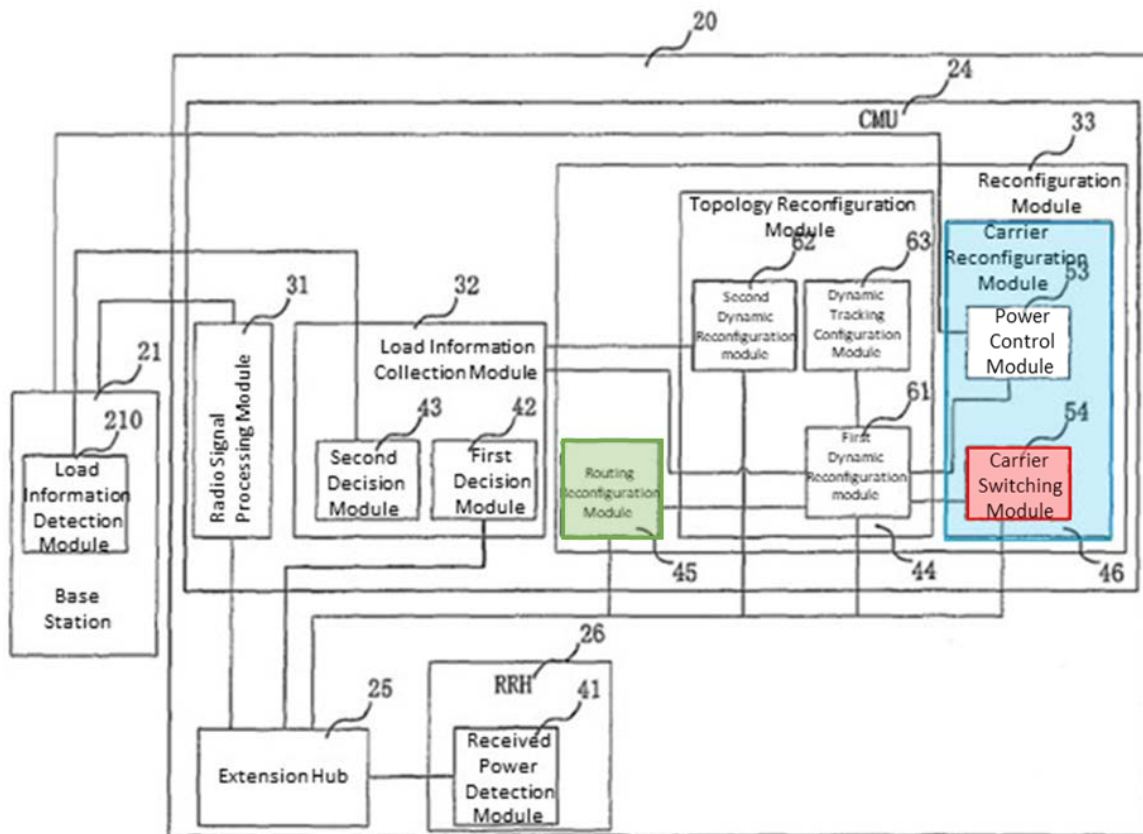
图 5

EX-1005 FIG. 5.

113. Although the examples in FIGs. 4 and 5 show each RRH using one carrier, *Leng* discloses that “the RRHs can also support multiple carriers.” EX-1005 3:31-32. Similar to the disclosure in the ’382 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.

114. *Leng* discloses several different embodiments of a CMU 24, all of which include load information collecting module 32 and reconfiguration module 33. EX-1005 FIGS. 6, 8, 15. Module 32 is configured to collect load information and reconfiguration module 33 is configured to collect the load information from module 32 and determine the new topology, re-allocate the carrier in the corresponding RRH, and reconfigure the routing of the wireless signals. EX-1005 4:15-17.

115. *Leng* further describes an embodiment of FIG. 15 that can be used to reconfigure RRHs as illustrated in FIGs. 4 and 5. EX-1005 10:1-3.



EX-1005 FIG. 15.

116. 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. *Leng* discloses that switching module 54 (red) 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.

117. *Leng* further discloses that each RRH may support multiple carriers. EX-1005 1:15-18, 3:39-43.

2. Detailed Application of *Leng* to the Challenged Claims

a. Claim 1

i. *A system comprising:*

118. *Leng* discloses a reconfigurable DAS. EX-1005 Abstract.

ii. *one or more Digital Access Units (DAUs) operable to receive at least one signal from at least one of a first signal source and a second signal source from one or more of a plurality of signal sources,*

119. *Leng* discloses CMU 24 (blue) (DAU) operable to receive at least one signal from base stations 21 (green) (at least one of a first signal source and a second signal source from one or more of a plurality of signal sources):

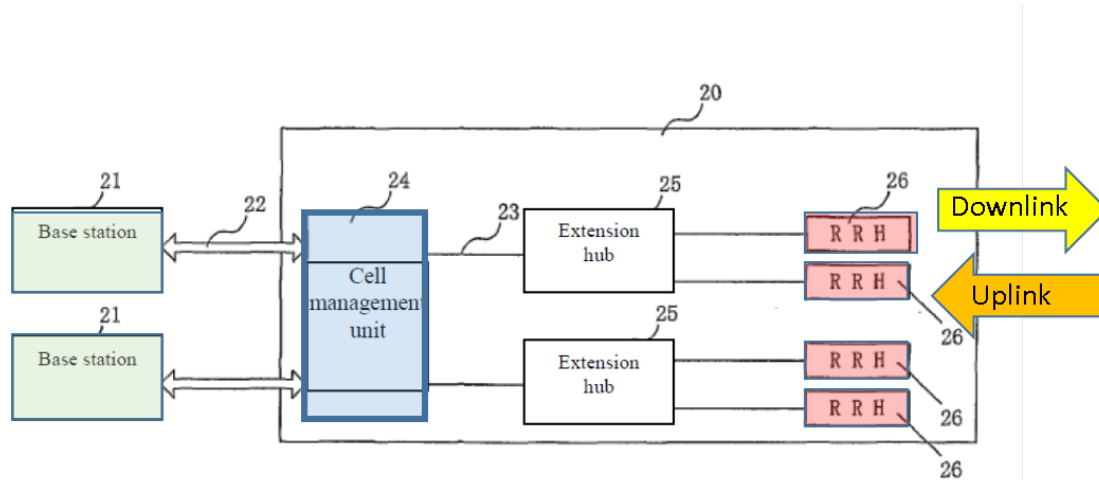


Fig. 2

EX-1005 FIG. 2.

120. CMU 24 is connected to base station 21 and is configured to distribute a downlink wireless signal to RRHs 26, collect an uplink wireless signal, and transmit the uplink signal to base station 21. CMU 24 also collects load information of DAS 20 and reconfigures the DAS based on the load information. The RRH corresponds to the DRU of the '382 Patent, and the CMU corresponds to the DAU of the '382 Patent. EX-1005 3:20-25.

iii. each DAU of the one of more DAUs including an input port configured as an uplink/downlink port and an output port configured as an uplink/downlink port;

121. *Leng* describes that CMU 24 is connected to base station 21 using an interface 22 (yellow), and is connected to the extension hub 25 through transmission medium 23(light blue):

The interface 22 between the CMU 24 and the base station 21 can be the standard Open Base Station Architecture Initiative interface (OBSAI), the Common Public Radio Interface (CPRI), or a special local communication interface.

EX-1005 3:31-33.

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 3:36-38.

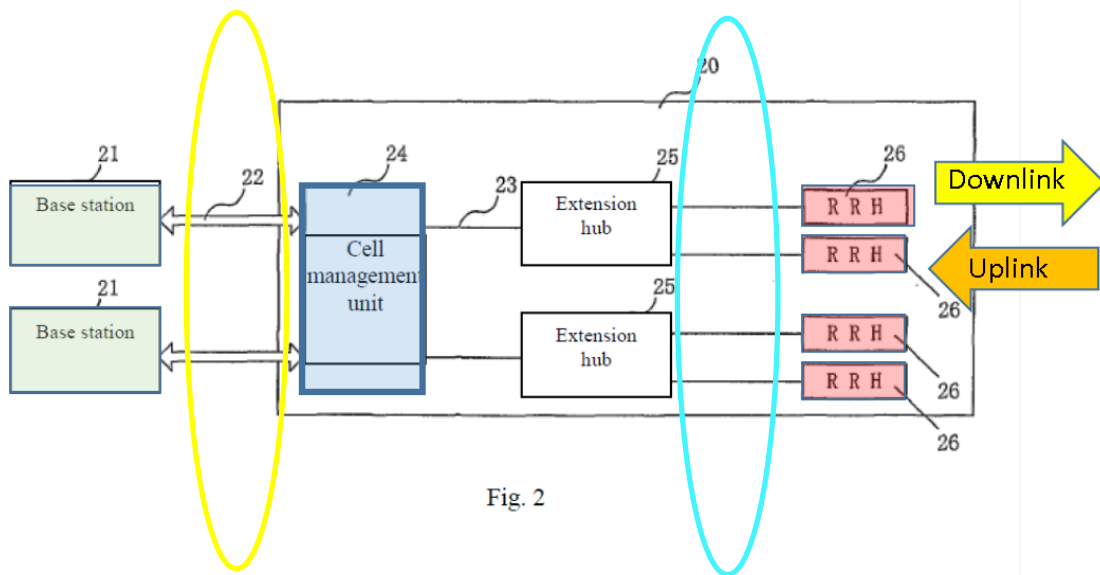


Fig. 2

EX-1005 FIG. 2.

122. A POSA understood that interface 22 (yellow) would be connected to the CMU unit through an input port which is configured to receive downlink signals from base station 21, and configured to send uplink signals to base station 21. Further, a POSA understood that transmission medium 23 (light blue) would be connected to connected to the CMU through an output port which is configured to receive uplink signals from extension hub 25, and configured to send downlink signals to the extension hub. This disclosure is consistent with the disclosure of the '382 Patent which shows that RF cable (yellow) is connected to the input port of the DAU and optical cable (light blue) is connected to the output port of the DAU:

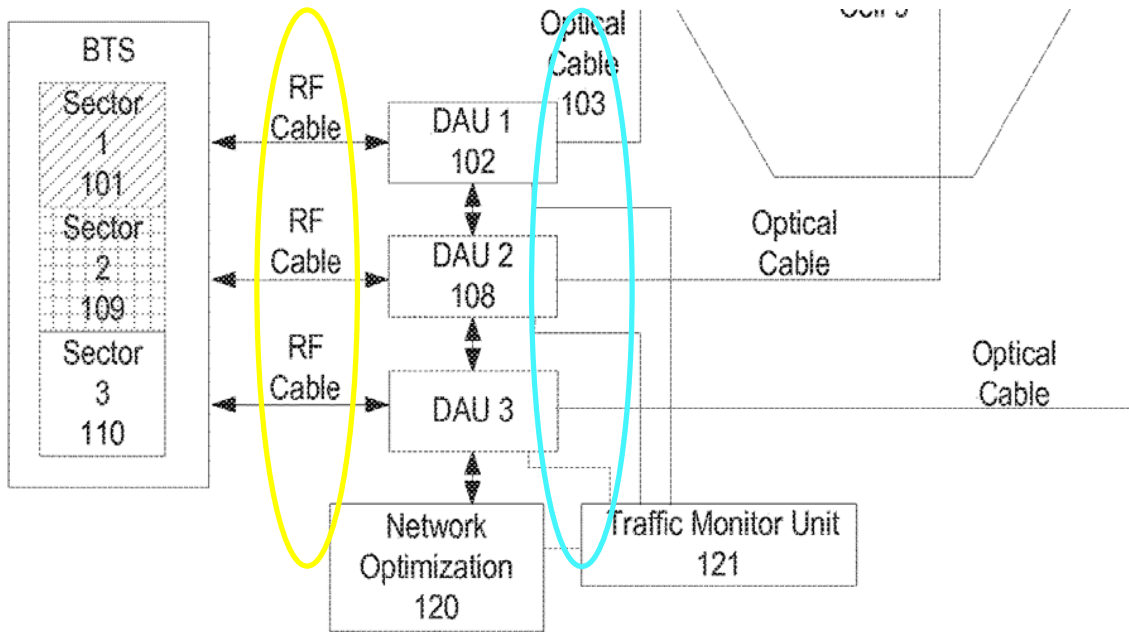


FIG. 1

EX-1001 FIG. 1.

- iv. *one or more Digital Remote Units (DRUs) connectable to the one or more DAUs and operable to transport signals between one or more of the one or more DRUs and the one or more DAUs;*

123. *Leng discloses that RRH 26 (red) (DRU) is connectable to CMU 24 (blue) (DAU) and operable to transmit signals between one or more of the DRUs and DAUs:*

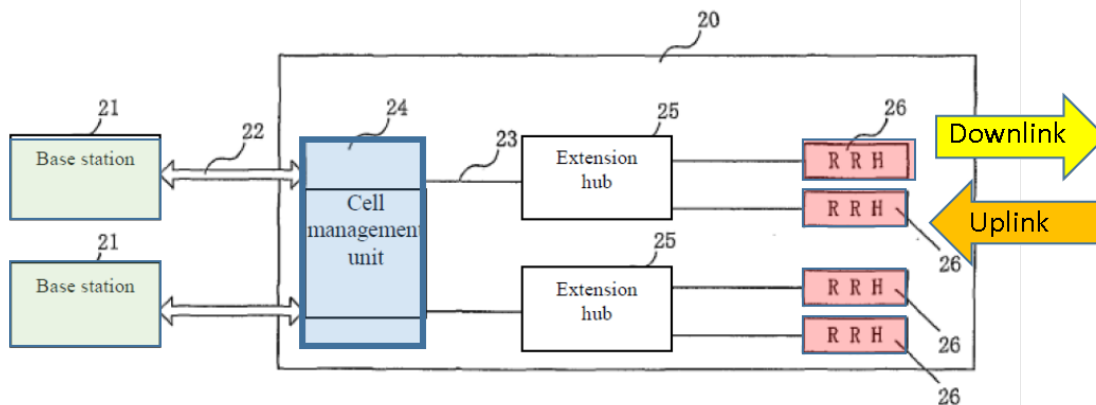
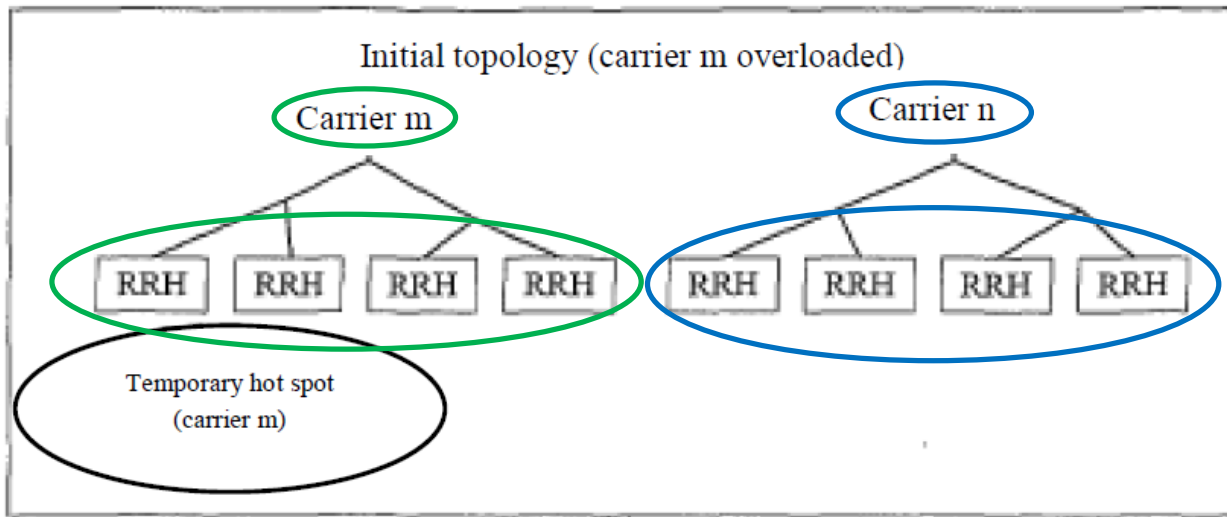


Fig. 2

EX-1005 FIG. 2.

- v. *a plurality of radio resources formed from the one or more DRUs comprising a first radio resource and a second radio resource different from the first radio resource,*

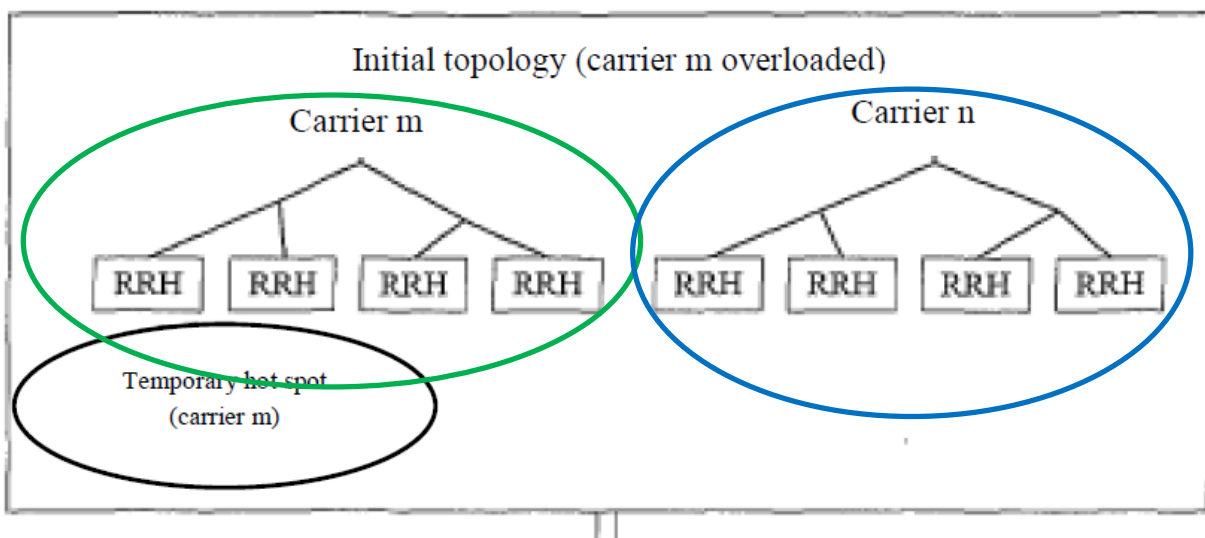
124. *Leng discloses that carriers m and n (a plurality of radio resources) formed from one or more RRHs (DRUs) comprising carrier m (green) (a first radio resource) and carrier n (blue) (a second radio resource different from the first radio resource):*



EX-1005 FIG 17

vi. *each radio resource comprising a subset of the plurality of DRUs; and*

125. *Leng* discloses that each carrier (*each radio resource*) comprises a subset of the one or more RRHs (*DRUs*). For example, as illustrated below, carrier m comprises a subset of RRHs circled in green and carrier n comprises a subset of RRHs circled in blue:



vii. *a traffic monitoring unit coupled to at least one of the DAUs;*

126. *Leng* discloses a traffic monitoring unit in the form of load information detection module 210, a received power detection module 41, load information collection module 32, and reconfiguration module 33 (outlined in red). Each of these modules 210, 41, 32 and 33 is coupled to the CMU (DAU) (blue):

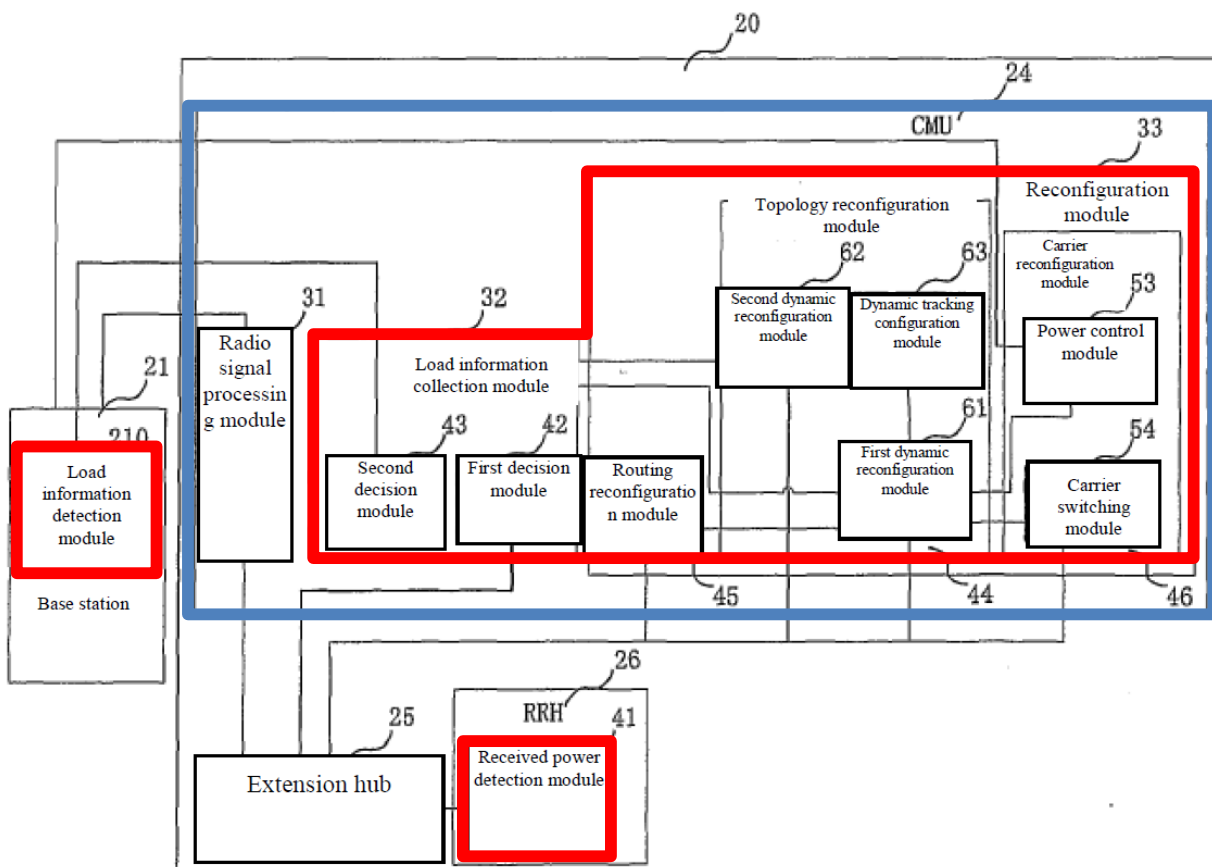


Fig. 15

127. Because Claim 4 recites the traffic monitoring unit is “external” to the one or more DAUs, a POSA understood that the present limitation of a *traffic monitoring unit coupled to at least one of the DAUs* is broad enough to encompass a traffic monitoring unit that is internal or external to the DAU.

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

128. *Leng* discloses that load information detection module 210 (component of the *traffic monitoring unit*) determines one or more of KPIs such as throughput, number of connections, number of registered users, QoS, etc.:

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 6:1-5.

However, if the CMU wants to know more detailed load information, such as the traffic load for different QoS, the number

of users, etc., it must turn to the base station or the base station control center.

EX-1005 5:27-32.

129. *Leng* also discloses that the RRHs comprise received power detection module 41 (component of the *traffic monitoring unit*) configured to detect the total broadband power received by the RRHs and transmit the detected power value to load information collection module 32. EX-1005 5:13-15.

130. *Leng's* disclosure that load information collection module 32 collects KPIs determined by load information detection module 210 and received power detection module 41 is consistent with the disclosure of the '382 Patent that network performance may be expressed by KPIs collected from different parts of the network. EX-1001 5:58-62. For example, the '382 Patent describes that KPIs may comprise information such number of blocked calls, number of active calls, average power of uplink channels, average power of downlink ports, External Ports and PEER Ports, traffic on each sector, failed calls, number of satisfied users, number of unsatisfied users, number of users through a given DRU, and the like. EX-1001 10:37-45.

(b) *and reconfigure the plurality of radio resources based on one or more of the*

one or more KPIs and/or the QoS by allocating at least one DRU from the first radio resource to the second radio resource.

131. *Leng* discloses that reconfiguration module 33 (component of the *traffic monitoring unit*) reconfigures the carriers assigned to DRUs (*reconfigure the plurality of radio resources*) based on the load information collected by load information collection module 32 and/or the detected power value determined by received power detection module 41 (*based on one or more KPIs*):

... 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.

... and notify the reconfiguration module 33 to reconfigure the distributed antenna system according to the power value when the power value exceeds a threshold value.

EX-1005 4:11-17, 5:17-19.

132. In one example, *Leng* reconfigures the plurality of resources by allocating a RRH from an area of high load to an area of low load to thereby reduce the load on the carrier in the high load area:

As shown in Fig. 17, in the initial topology of the distributed antenna system, the carrier m in the temporary hot spot determined according to the load information has a high load. In the intermediate topology state, after switching the carriers of half of the RRHs in the temporary hot spot to carrier n, the carrier m is still found to have a high load according to the load information. Therefore, half of the remaining RRHs with unswitched carriers in the temporary hot spot continue to be switched to carrier n, and load balance is achieved in this final topology state.

EX-1005 13:16-19

133. As illustrated in annotated FIG. 17, *Leng* discloses allocating a RRH (*DRU*) (outlined in red) from the first carrier m (shaded in green) to the second carrier n (shaded in blue) (*allocating at least one DRU from the first radio resource to the second radio resource*).

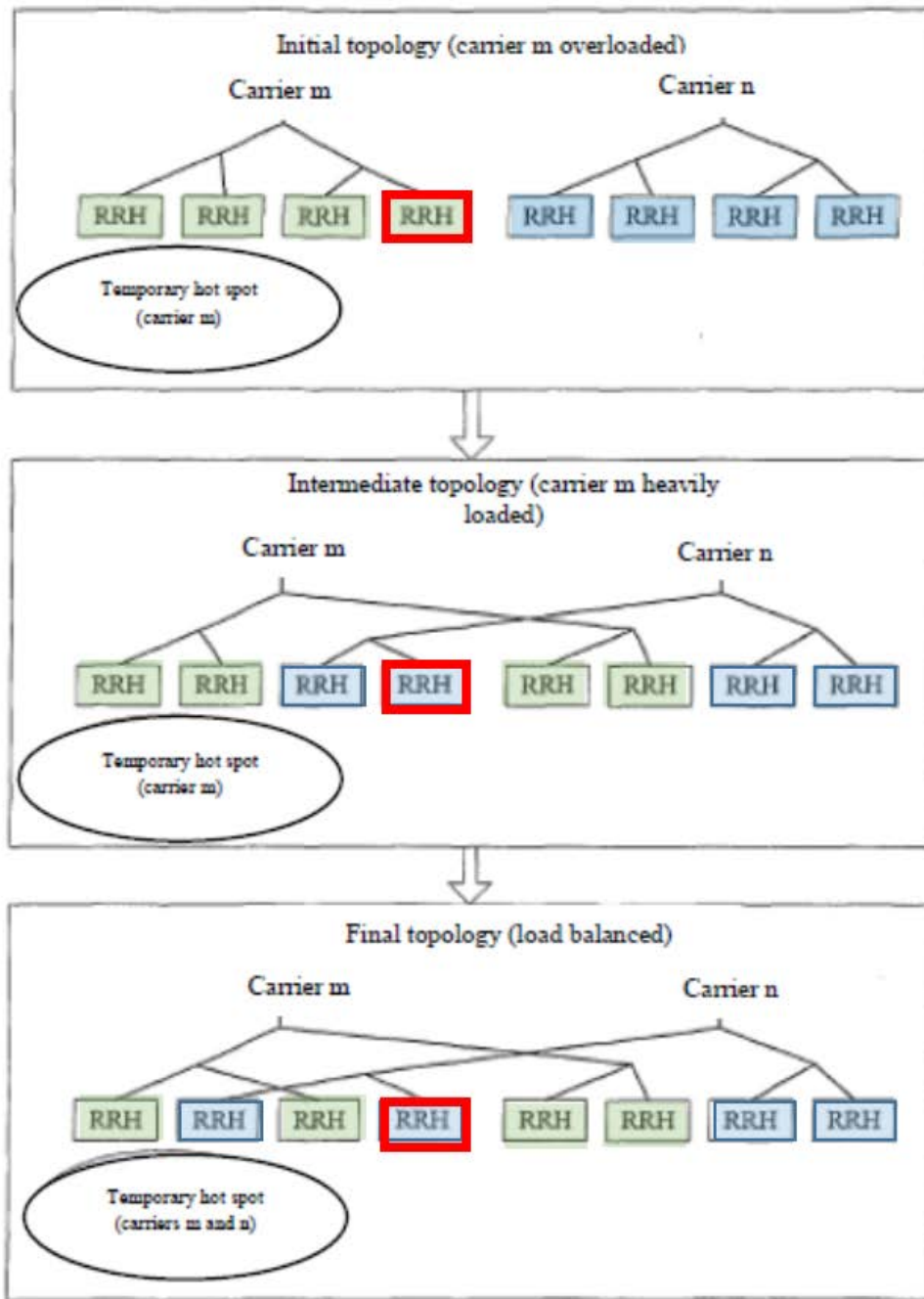


Fig. 17

EX-1005 FIG. 17

b. Claim 2

The system of claim 1, further comprising a one or more Base Transceiver Stations (BTSs) coupled to the one or more DAUs, wherein each BTS comprises the plurality of radio resources.

134. As described with respect to Claim 1, *Leng* discloses that base stations 21 are coupled to the CMU 24 (*DAU*). *Leng* further discloses that the base stations transmit the carriers (*radio resources*) that are assigned to the RRHs. EX-1005 9:11-15.

c. **Claim 3**

The system of claim 2, further comprising a network optimization goal comprising a percentage of users associated with each of the plurality of radio resources.

135. *Leng* discloses that one of the goals of its system is “balancing the load and improving the system efficiency in a timely manner.” EX-1005 2:15-16. *Leng* provides as an example, an optimization goal based on a percentage of remote radio heads associated with the plurality of radio resources, *i.e.*, “exchanging the assigned carriers of a predetermined percentage of remote radio heads in the high-load areas with those of a corresponding number of remote radio heads in low-load areas to determine a new topology.” EX-1005 12:5-10. While this example discusses an optimization goal of load balancing in terms of a predetermined number of remote radio heads associated with the radio

resources, a POSA understood that *Leng*'s optimization goal could be based on a percentage of users associated with the radio resources. . *Leng* expressly discloses that load information includes the number of users. EX-1005 5:30-32. *Leng* expressly describes that prior art DAS cannot "be reassigned in time to effectively adapt to load changes when the communication traffic in an area varies greatly" (1:26-27), and a POSA understood that one way *Leng*'s teachings solved this problem was to measure load changes by monitoring the amount of users for each remote radio head, and load balancing based on the number of users. . Thus, a POSA understood that *Leng* discloses an optimization goal of load balancing based on a percentage of users associated with the radio resources.

d. **Claim 4**

The system of claim 1, wherein the traffic monitoring unit is external to the one or more DAUs.

136. *Leng* discloses this limitation for the same reasons as discussed with respect to Claim 1 because load information detection module 210 and received power detection module 41 (components of the *traffic monitoring unit*) are external to the CMU (*DAU*).

137. To the extent that Dali Wireless argues that the traffic monitoring unit needs to be completely external to the DAU, *Leng*

discloses this limitation for the same reasons as discussed with respect to Claim 10.

e. **Claim 5**

The system of claim 1, wherein the traffic monitoring unit is provided as a component of each of the one or more DAUs.

138. For the same reasons as discussed with Claim 1, *Leng* discloses that load information collection module 32 and reconfiguration module 33 (components of the *traffic monitoring unit*) are a component of the CMU (*DAU*).

f. **Claim 6**

The system of claim 1, wherein the traffic monitoring unit is external to the one or more DRUs.

139. For the same reasons as discussed with Claim 1, *Leng* discloses that load information detection module 210, load information collection module 32, and reconfiguration module 33 (components of the *traffic monitoring unit*) are external to one or more RRHs 26 (*DRUs*).

g. **Claim 7**

The system of claim 1, wherein the traffic monitoring unit is provided as a component of each of the one or more DRUs.

140. As discussed with respect to limitation [1.vii], *Leng* discloses that load information in the form of received power can be

determined in received power detection module 41 (component of the *traffic monitoring unit*) in RRH 26 and sent to load information collection module 32. EX-1005 10:14-16. This is consistent with the '382 Patent's disclosure that uplink power and downlink power are KPIs. EX-1001 10:37-45. Thus, as illustrated in annotated FIG. 15 for limitation [1.vii], *Leng* discloses a traffic monitoring unit in the form of load information detection module 210, received power detection module 41, load information collection module 32, and reconfiguration module 33 (collectively highlighted in red), where received power detection module 41 is a component of RRH 26 (*DRU*).

h. Claim 8

The system of claim 1, wherein the traffic monitoring unit is configured to analyze Key Performance Indicators (KPIs) of the DAS.

141. *Leng* discloses several examples of the traffic monitoring unit configured to analyze KPIs. In one example, *Leng* discloses that load information collection module 32 (component of the *traffic monitoring unit*) is configured to receive the load information (*KPIs*) and notify reconfiguration module 33 to reconfigure DAS 20 according to the load information when the load information meets the reconfiguration conditions (*analyze KPIs*). EX-1005 5:33-37.

142. In another example, *Leng* discloses that load information collection module 32 (component of the *traffic monitoring unit*) is configured to receive the power value (*KPIs*) transmitted by received power detection module 41 and notify reconfiguration module 33 to reconfigure the DAS according to the power value when the power value exceeds a threshold value (*analyze KPIs*). EX-1005 5:16-19.

i. **Claim 9**

The system of claim 1, wherein the traffic monitoring unit is configured to analyze Quality of Service (QoS) values of the DAS.

143. *Leng* discloses that QoS is load information, e.g., “traffic load for different QoS” that can be received from the base station and used by load information collection module 32 (component of the *traffic monitoring unit*) in order to decide whether to reconfigure the intelligent DAS (*analyze QoS values*). EX-1005 5:27-32. A POSA understood that the QoS would change as a function of the traffic load and thus it would be useful to analyze the traffic load for different QoS in determining whether to reconfigure the radio resources of the DAS.

j. **Claim 10**

144. Claim 10 is substantially similar to Claim 1 with the exception that the recited *traffic monitoring unit* is “external” to at least

one of the DAUs. In Claim 1, there is no restriction on whether the *traffic monitoring unit* is “external” or “internal” to the DAU, only that it be coupled to the DAU. Thus, the analysis of Claim 1 illustrates four modules making up the *traffic monitoring unit*, two of which are internal to the CMU (DAU), *e.g.*, load information collection module 32, and reconfiguration module 33, and two modules which are external to the CMU (DAU), *e.g.*, load information detection module 210, received power detection module 41. Thus, Claim 10 is obvious over *Leng* for the same reasons as discussed with respect to Claim 1 because the *traffic monitoring unit* includes two modules that are external to the CMU, *e.g.*, unit load information detection module 210, received power detection module 41.

145. To the extent that Dali Wireless argues that “external” means that the traffic monitoring unit uses a separate server from the DAU, a POSA understood that the various software modules of *Leng* identified as the traffic monitoring unit could be running on a server(s) separate from the processor/server in the CMU, as it was known to distribute hardware and software and *Leng* contemplates doing so. EX-1005 14:25-26.

146. Further, to the extent that Dali Wireless asserts that Claim 10 requires all components of the *traffic monitoring unit* to be external to the DAU, Petitioner has provided an alternative analysis below where the DAU includes only certain portions of the CMU, the radio signaling processing module 31. In addition, in this alternative analysis, the *traffic monitoring unit* comprise three modules, all external to the radio signaling processing module (DAU). Thus, under this alternative analysis, Claim 10 is obvious in view of *Leng* even if all components of the *traffic monitoring unit* are required to be completely external to the DAU.

i. A system comprising:

See Claim [1.i]

ii. one or more Digital Access Units (DAUs) operable to receive at least one signal from at least one of a first signal source and a second signal source from one or more of a plurality of signal sources,

147. *Leng* discloses this limitation for the same reasons as recited with respect to Claim [1.ii].

148. In the alternative, *Leng* discloses a DAU in the form of radio signaling processing module 31. *Leng* describes that radio signaling processing module 31 (blue) is configured to distribute

downlink signals from base stations 21 (green) (*at least one of a first signal source and a second signal source from one or more of a plurality of signal sources*) to the remote radio heads 26, collect uplink radio signals and transmit them to the base stations. EX-1005 7:1-3.

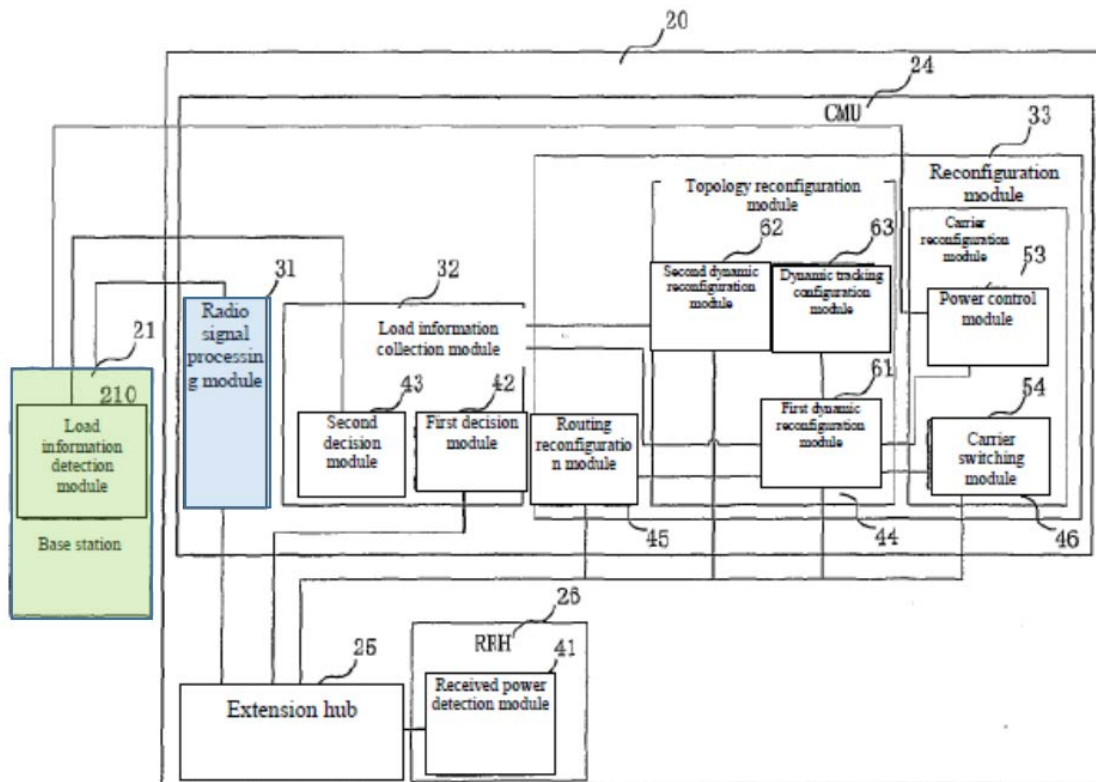


Fig. 15

EX-1005 FIG. 15.

iii. each DAU of the one or more DAUs including an input port configured as an uplink/downlink port and an output port configured as an uplink/downlink port;

149. *Leng* discloses this limitation for the same reasons as recited with respect to Claim [1.iii].

150. Alternatively, a POSA understood that an interface would be connected to an input port on radio signal processing module 31 which is configured to receive downlink signals from base station 21, and configured to send uplink signals to base station 21 and that a transmission medium would be connected to an output port of radio signal processing module 31 which is configured to receive uplink signals from RRH 26, and configured to send downlink signals to RRH 26.

iv. one or more Digital Remote Units (DRUs) couplable to the one or more DAUs and operable to transport signals between the one or more DRUs and the one or more DAUs;

151. *Leng* discloses this limitation for the same reasons as recited with respect to Claim [1.iv].

152. Alternatively, as shown in FIG. 15 above, *Leng* discloses that RRH 26 (green) (*DRU*) is couplable to radio signal processing module 31 (blue) (*DAU*) and operable to transmit signals between one or more of the DRUs and DAUs. EX-1005 FIG. 15.

v. a plurality of radio resources formed from the one or more DRUs comprising a first radio

resource and a second radio resource different from the first radio resource,

153. *Leng* discloses this limitation for the same reasons as discussed with respect to Claim [1.v].

vi. each radio resource comprising a subset of the one or more DRUs; and

154. *Leng* discloses this limitation for the same reasons as discussed with respect to Claim [1.vi].

vii. a traffic monitoring unit external to and couplable to at least one of the DAUs,

155. *Leng* discloses this limitation for the same reasons as recited with respect to Claim [1.vii].

156. Alternatively, *Leng* discloses an embodiment of the traffic monitoring unit in the form of load information collection module 32, reconfiguration module 33 and received power detection module 41 (red) and is completely external to and couplable to the DAU (blue):

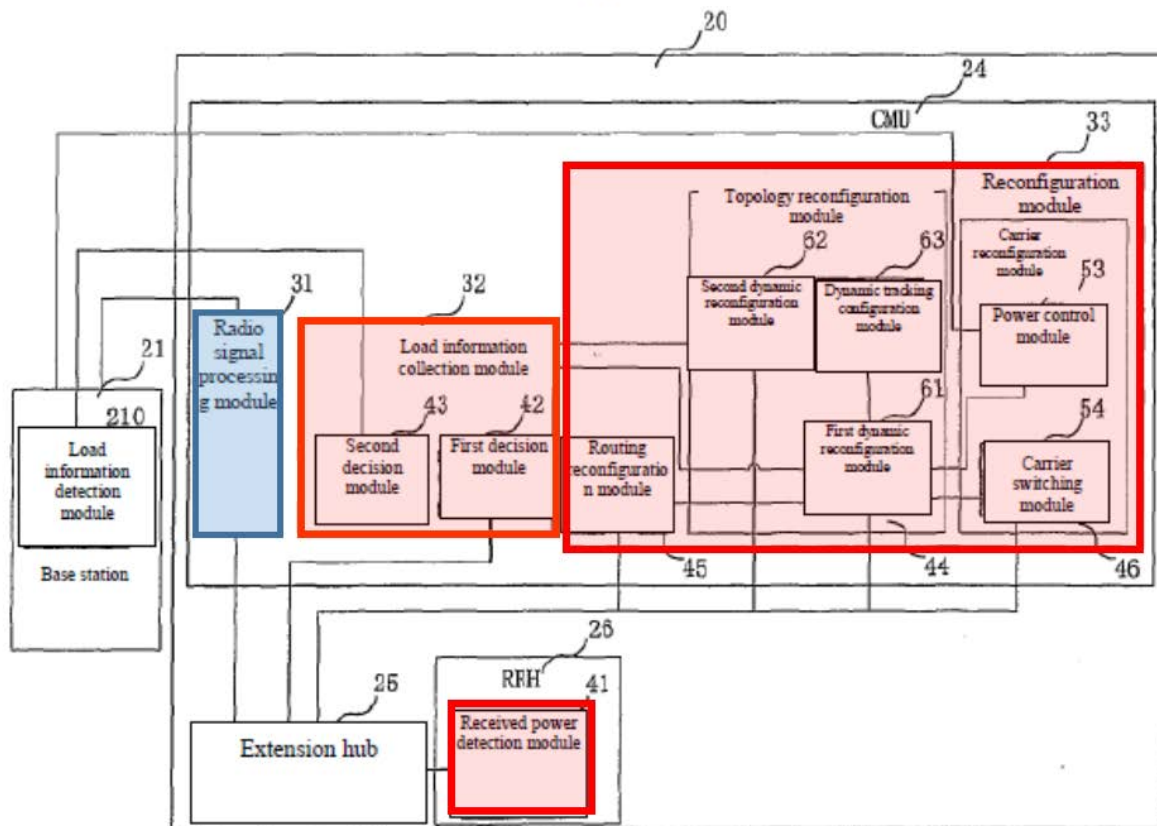


Fig. 15

EX-1005 FIG. 15.

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

157. *Leng* discloses this limitation for the same reasons as recited with respect to Claim [1.vii(a)].

158. Alternatively, *Leng* discloses that the RRHs comprise received power detection module 41 (component of the *traffic monitoring unit*) configured to detect the total broadband power received by the RRHs and transmit the detected power value to load information collection module 32. EX-1005 5:13-15.

159. *Leng*'s disclosure that load information collection module 32 collects KPIs determined by received power detection module 41 is consistent with the disclosure of the '382 Patent that uplink power and downlink power are KPIs and that network performance may be expressed by KPIs collected from different parts of the network. EX-1001 5:58-62, 10:37-45. For example, the '382 Patent describes that KPIs may comprise average power of uplink channels and average power of downlink ports. EX-1001 10:37-45.

(b) reconfigure the plurality of radio resources based on one or more of the one or more KPIs and/or the QoS by allocating at least one DRU from the first radio resource to the second radio resource.

160. *Leng* discloses this limitation for the same reasons as recited with respect to Claim [1.vii(b)].

161. Alternatively, in one embodiment, *Leng* discloses that reconfiguration module 33 (component of the *traffic monitoring unit*)

reconfigures the carriers assigned to DRUs (*reconfigure the plurality of radio resources*) based on the detected power value determined by received power detection module 41 (*based on one or more KPIs*):

The load information collection module comprises a first decision module configured to receive the power value transmitted by the received power detection module and notify the reconfiguration module 33 to reconfigure the distributed antenna system according to the power value when the power value exceeds a threshold value.

EX-1005 4:11-17, 5:16-19; EX-1003 ¶94.

162. In one example, *Leng* reconfigures the plurality of resources by allocating a RRH from an area of high load to an area of low load to thereby reduce the load on the carrier in the high load area.

EX-1005 13:16-19.

k. **Claim 11**

The system of claim 10, wherein the traffic monitoring unit is external to one or more Base Transceiver Stations (BTSs) and coupled to each of the one or more BTSs.

163. *Leng* discloses an embodiment of the *traffic monitoring unit* in the form of load information collection module 32, reconfiguration module 33 and received power detection module 41

(outlined in red) and is completely external to and couplable to the BTS 21 (green).

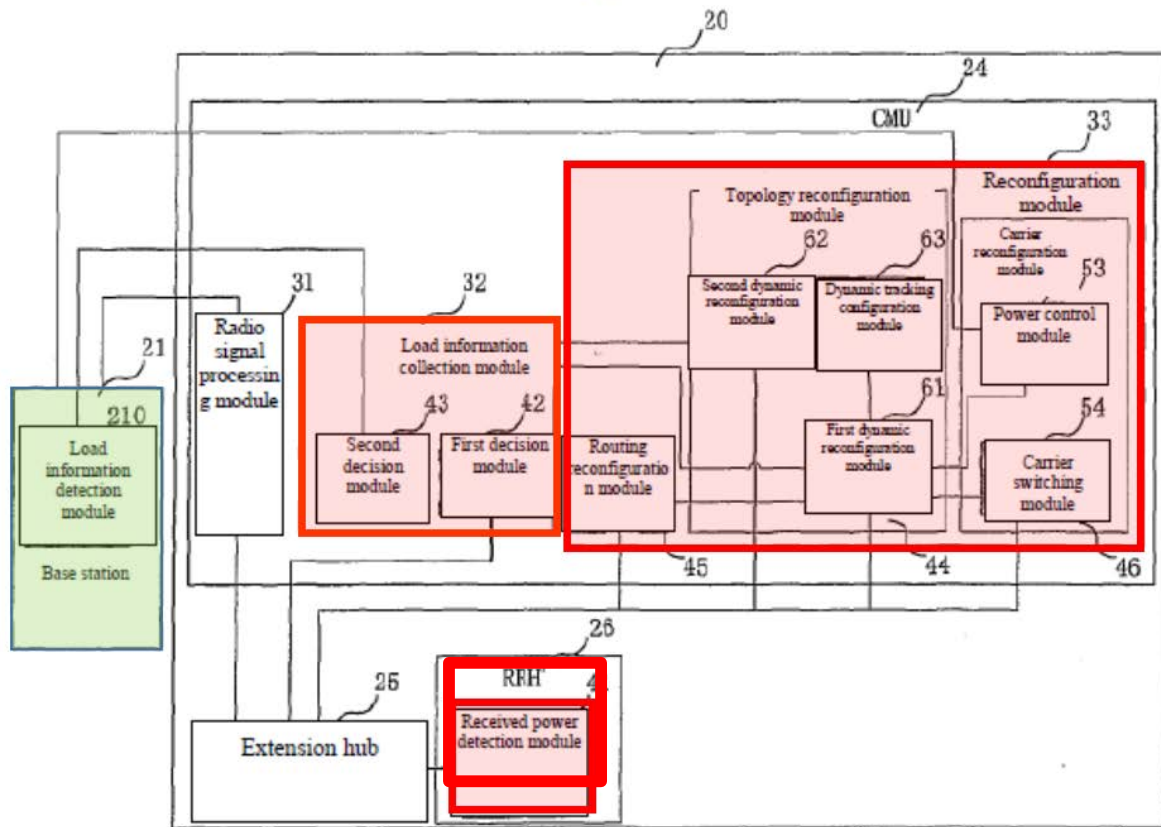


Fig. 15

EX-1005 FIG. 15.

I. Claim 12

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

164. *Leng* discloses network optimization as discussed with respect to Claim 3. With reference to FIG. 15, *Leng* discloses that the

traffic monitoring unit comprises topology reconfiguration module 44 (*optimization processor*) which optimizes topology reconfiguration based on the load information to balance the load between the high and low load areas:

The topology reconfiguration module 44 comprises: a first dynamic reconfiguration module 61, configured such that when the total received broadband power transmitted by the remote radio heads 26 is received, it determines the high-load remote radio heads based on the power value and the predetermined threshold value, and determines the new topology by exchanging the assigned carriers of high-load remote radio heads with those of low-load remote radio heads (for example, in Figs. 4 and 5, RRH B is switched from carrier 1 to carrier 2, and RRH C and RRH D are 5 switched from carrier 2 to carrier 3); a second dynamic reconfiguration module 62, configured such that when the cell management unit 24 receives the load information transmitted by the base station 21, it determines the high-load areas based on the load information transmitted by the base station 21, and determines the new topology by exchanging the assigned carriers of a predetermined percentage (e.g. 50%) of remote radio heads in the high-load areas with those of a corresponding number of remote radio heads in low-load areas; a dynamic tracking configuration module 63, configured such that after the distributed antenna system 20 is reconfigured according to the new topology determined by the second dynamic reconfiguration module 62, if the high-load areas are still detected

with a high load according to the received load information, it obtains a new topology by exchanging the assigned carriers of a predetermined percentage of remote radio heads in high-load areas that have yet to be switched with those of a corresponding number of remote radio heads in low-load areas, and repeats the steps for determining a new topology until the high-load areas are no longer detected with a high load according to the received load information.

EX-1005 11:1-16.

m. Claims 13, 14 and 17

[13]. The system of claim 10, wherein the one or more DAUs are coupled via at least one of an ethernet cable, optical fiber, microwave line of sight link, wireless link, and/or satellite link.

[14]. The system of claim 10, wherein the one or more DAUs are coupled to the one or more DRUs via at least one of an ethernet cable, optical fiber, microwave line of sight link, wireless link, and/or satellite link.

[17] The system of Claim 10, wherein the one or more DAUs are connected to one or more BTSs via at least one of an ethernet cable, optical fiber, microwave line of sight link, wireless link and/or satellite link.

165. As discussed with respect to Claim [1.iii], *Leng* discloses that the transmission medium coupling the one of more DAUs to the BTS or between the one or more DRUs may be ethernet or optical fiber. EX-1005 3:31-38. *Leng* discloses the use of the Open Base Station

Architecture Initiative interface (OBSAI), or Common Public Radio Interface, each of which may use Ethernet cable or optical fiber. EX-1005 3:31-33. A POSA also understood DAUs as well as other components where known to be coupled via Ethernet or optical fiber. *See* State of the Art.

a. **Claim 15**

The system of claim 10, wherein the one or more DRUs are connected in a daisy chain configuration.

166. *Leng* discloses several functional schematic examples of multiple DRU's connected to a DAU, but does not provide details of the physical connections between one or more DRUs and the DAU.

However, as discussed in the State of the Art section, a POSA understood that there were many different topology configurations used in DASs to connect DRU's including "point-to-point, multiple point-to-point, chain, star, tree, ring and combinations thereof" (EX-1011 0005), "daisy-chained" (EX-1013 0086), and "bus type, a star type or a hybrid type" (EX-1014 0033). . *Leng* does not disclose any preference or any restriction for any topology, and thus a POSA understood that *Leng*'s teaching including using a daisy chain configuration.

167. To the extent that Dali Wireless argues that *Leng* does not expressly teach a daisy chain configuration, a POSA would be

motivated to use a daisy chain as there is a finite number of choices, and a daisy chain is a well-known implementation. Specifically, *Leng* explicitly references the CPRI specification as a suitable protocol for use with the DAS embodiments (EX-1005 6:11-15), and as discussed in the State of the Art section, the CPRI standard as well as prior art DAS systems using CPRI have identified a daisy chain as a suitable topography. EX-1011 0005, FIG. 4; EX-1012 FIG. 5A. A POSA understood that different topologies of remote antenna units provide different coverage areas and those topologies can provide the necessary or desired coverage for particular venues, such as stadiums and office buildings. A POSA reasonably expected to succeed with the different topologies because the arrangement of the remote antenna units would provide predictable coverage areas for the particular venues or locations. Thus, based on the advanced state of the art, implementing such topologies would have been routine, and would have led to predictable results.

b. Claim 16

The system of claim 10, wherein the one or more DRUs are connected to the one or more DAUs in a star configuration.

168. This limitation is disclosed for the same reasons as with respect to Claim 15. Specifically, the use of a star configuration was well known in the art implementing such topologies would have been routine, and would have led to predictable results. EX-1011 [0005], FIG. 3; EX-1012 FIG. 5; EX-1014 [0033].

c. **Claim 18**

The system of claim 10, wherein the one or more DRUs are connected in a loop to one or more of the one or more DAUs.

169. This limitation is disclosed for the same reasons as discussed with respect to Claim 15. Specifically, the use of a loop configuration was well known in the art implementing such topologies would have been routine, and would have led to predictable results. EX-1011 FIG. 6; EX-1012 FIG. 5C.

d. **Claim 19**

The system of claim 10, wherein a single DAU port is connected to one or more BTSs.

170. This limitation is disclosed for the same reasons as discussed with respect to Claim [10.iii] because a single port of radio signal processing module 31 is connected to base station 21 as illustrated in FIG 15.

CONCLUSION AND DECLARATION

My findings and opinions set forth in this Declaration are based on my work and examination to date. I may continue my examinations in view of additional documents or other factual evidence over the course of this proceeding that may necessitate supplementing and/or refining my opinions. I reserve the right to add to, alter, or delete my opinions and my Declaration upon discovery of additional information. I reserve the right to make such changes as necessary.

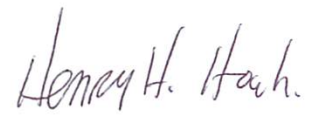
In signing this Declaration, I understand that the Declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I acknowledge that I may be subject to cross-examination in this case and that cross-examination will take place within the United States. If cross-examination is required of me, I will appear for cross-examination within the United States during the time allotted for cross-examination.

I declare that all statements made herein of my knowledge are true, and that all statements made on information and belief are believed to be true, and that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001, of Title 18 of the United States Code.

[SIGNATURE ON FOLLOWING PAGE]

Date: April 4, 2023

By:

A handwritten signature in dark ink, appearing to read "Henry H. Houh". The signature is written in a cursive, slightly slanted style.

Henry H. Houh

APPENDIX A – MATERIALS RELIED UPON

<i>Exhibit #</i>	<i>Description</i>
1001	U.S. Patent No. 10,750,382 (the “’382 Patent”)
1002	Prosecution history of the ’382 Patent (“File History”)
1004	International Application Publication WO 2009/021359 A1 published on February 19, 2009 (“ <i>Leng</i> ”)
1005	Certified English Translation of <i>Leng</i> (EX-1004)
1006	U.S. Pat No. 9,398,464 (“ <i>Kummetz</i> ”)
1007	<i>Ericsson Inc. v. Dali Wireless, Inc.</i> , IPR2022-01419, Paper 11, March 9, 2023
1008	<i>Dali Wireless, Inc. v. Cellco Partnership d/b/a Verizon Wireless, et al.</i> U.S.D.C. WDTX Case No. 6:22-cv- 01313-ADA, Docket No. XX (March XX, 2023)
1009	U.S. Patent No. 8,270,387 (“Cannon”)
1010	U.S. Patent Application Publication US2010/0128676 (“Wu”)
1011	U.S. Publication No. 2012/0057572 (“Evans”)
1012	Common Public Radio Interface: Interface Specification v4.1 (“CPRI v4.1”) February 18, 2009
1013	U.S. Publication No. 2012/0177026 (“Uyehara”)
1014	U.S. Publication No. 2012/0057572 (“Kobayshi”)
1015	U.S. Patent Application Publication US2008/0045254A1 (“Gupta”)

APPENDIX B – Curriculum vitae

Henry H. Houh

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cell: 781-325-8273

Education

Massachusetts Institute of Technology, Cambridge, MA

- PhD in Electrical Engineering and Computer Science, February 1998. “Designing Networks for Tomorrow's Traffic,” thesis supervised by Professor David Tennenhouse and Professor John Guttag. GPA 4.7/5.0
- Master of Science in Electrical Engineering and Computer Science, February 1991. “Demonstration of a laser repetition rate multiplier,” thesis. GPA 4.5/5.0
- Bachelor of Science in Electrical Engineering and Computer Science, June 1989. “Boundary element analysis of arbitrarily shaped dielectric structures,” thesis. GPA 4.7/5.0
- Bachelor of Science in Physics, February 1990. GPA 4.7/5.0

MITx, Cambridge, MA

- September 2020 – present: Enrolled in Statistics and Data Science MicroMasters program, a sequence of five MIT-offered graduate-level courses in statistics and machine learning, culminating in a MicroMasters certificate. Have completed four of five required courses.

Experience

BlocksCAD Inc. (H3XL spin-out)

- 2014 - present: Founder and member of Board of Directors. BlocksCAD is a visual Computer-Aided Design (CAD) program, designed to teach children mathematics and geometric visualization. BlocksCAD is being used in U.S. schools and worldwide in maker spaces, with 350,000+ users. BlocksCAD was selected to be part of the LearnLaunch 2017 Boost Accelerator, the MIT Play Labs 2018 Summer Accelerator, and the MassChalLenge 2018 Boston Cohort. Recipient of DARPA DSO grant in 2014, and SBIR grant from the USDA in 2019.

H3XL Inc. d/b/a Einstein's Workshop (formerly Lexington Robotics)

- 2009 - 2022: Founder and President. Started local league providing science and engineering education programs based on LEGO Mindstorms, LEGO WeDo, and FIRST LEGO League. In 2012, grew program into a full science, technology, engineering and math enrichment program and creative/maker space, in 7,000 square feet of space. Serve 2,000+ kids and families annually. As of end of 2021, have delivered an estimated 220,000 student-instruction-hours of STEM courses. Principle Investigator for 2-year DARPA grant to improve 3D Computer Aided Design tool developed in-house for the purposes of teaching 8 year olds and up 3D CAD.

Houh Consulting Inc. / Independent Consultant

- 2009 - present: Technical consultant specializing in Social Networking, Web 2.0, Web Site Development, Data Networking, Optical Networking, Telecommunications, Media Streaming and Voice Over IP. Clients include: Akin Gump Strauss Hauer & Feld LLP, Arnold & Porter Kaye Scholer LLP, BBN, Baker Botts LLP, Barnes & Thornburg LLP, BBN Technologies, Beus Gilbert McGroder PLLC, Bracewell LLP, Christensen O'Connor Johnson Kindness PLLC, Cooley LLP, Covington & Burling LLP, Cozen O'Connor P.C., DLA Piper, Davis Polk & Wardwell LLP, Desmarais LLP, Duane Morris LLP, Erise IP, P.A., Faegre Baker Daniels LLP, Finnegan, Henderson, Farabow, Garrett & Dunner, LLP, Fish & Richardson P.C., Goldman Ismail Tomaselli Brennan & Baum LLP, Haynes and Boone, LLP, Kaye Scholer, Kellogg Huber Hanson Todd Evans & Figel PLLC, Kirkland & Ellis LLP, Klarquist Sparkman, LLP, McCarthy Tetrault LLP, McGuireWoods LLP, Morgan, Lewis & Bockius LLP, Munger Tolles & Olson LLP, Orrick, Herrington & Sutcliffe LLP, O'Melveny & Myers LLP, Orrick, Herrington & Sutcliffe LLP, Paul Hastings LLP, Paul, Weiss, Rifkind, Wharton & Garrison LLP, Perkins Coie LLP, Quinn Emanuel Urquhart & Sullivan, LLP, Sidley Austin LLP, Smith Baluch LLP, Sterne, Kessler, Goldstein & Fox PLLC, Troutman Sanders LLP, Venable LLP, Weil, Gotshal & Manges LLP, Wiley Rein LLP, Wilmer Cutler Pickering Hale and Dorr LLP, and Winston & Strawn LLP.

Eons

- 2008 - 2009: Chief Technology Officer. Created product that Eons acquired from BBN Technologies. Integrated BBN product with Eons social networking platform and significantly increased the Eons group creation rate. Helped evaluate advertisement platform offerings and rolled out the "Boom Network" advertising network. Eons raised \$32 million from General Catalyst Partners, Charles River Ventures, Sequoia Capital, and Intel Capital.

BBN Technologies

- 2007 - 2008: Delta Division, Vice President of Technology. Grew "Boomerang" counter-sniper project engineering team and significantly de-risked \$10 million worth of product deliveries. Boomerang was a significant asset leading to the acquisition of BBN by Raytheon in 2009. Created new business plan and grew team; launched new fully-featured social networking web site in 5 months. Served as lead expert witness in patent

infringement lawsuit, resulting in \$58 million jury award to client; verdict for patents I testified on were upheld on appeal which resulted in a \$120 million settlement.

- 2004 - 2007: Delta Division, Director of Technology, responsible for commercializing IP and creating new businesses. Hired and grew division's initial engineering team. Wrote three business plans, two of which are funded and active. For call center business plan, acted as general manager, hiring and managing engineering team, inside sales team, and identifying and recruiting a new general manager. Identified and recruited other key employees to Delta Division, including senior members of team leading to successful internal sales growth and spin-outs of projects. Contracted by BBN to BBN spin-out PodZinger as VP of Operations and Technology. Identified sales team for counter-sniper system, leading to \$10 million dollars of new sales within 6 months and \$100+ million in additional orders in the following two years.

PodZinger Inc. (BBN spin-out, also known as EveryZing and now RAMP)

- 2006: Vice President of Operations and Technology. Significantly upgraded capability of consumer-facing search site and redeployed web site from company to co-location facility. Identified key portions of infrastructure for upgrading and cost reduction. Helped write business plan, evaluating advertisement models of revenue. Hired in operations replacement and phased back to BBN.

Commonwealth Capital

- 2004: Entrepreneur-in-residence (informally), performed technical due diligence on business plans, brainstormed ideas for new businesses with venture partner. With venture partner, left for portfolio company BBN to form core of commercialization team.

Empirix, Inc./Teradyne, Inc.

- 2001 - 2004: Chief Technologist, Engineering Manager, Web Application Test Group. Researched potential new product areas; developed product plan and prototype. Responsible for three new and existing products. Managed off-shore development team. Chief architect for all web testing products. Re-architected core testing product, helped write javascript interpreter. Provided technical vision for core product.
- 2000 - 2001: Chief Technologist, Communication Infrastructure Test Group. Responsible for incorporating new technology internally, tracking new technologies, technical evaluation of partnerships and potential acquisitions. Helped develop division strategy. Developed plans which formed core capabilities for successful new products introduced in 2004-5.
- 2000 - 2001: Engineering Manager, Communications Infrastructure Test Group. Execution of new product plan developed in prior role. Grew team from four existing engineers to team of over 30 on immediate team and over 40 on project. Delivered new platform in one year. Platform and derivatives accounted for large portion of booked products for the division within 2 years and is currently (2008) a key portion of new product offerings.

- 2000: Empirix was formed as a spin-out of Teradyne in January 2000. Reported to CEO in carve-out of Empirix from Teradyne.
- 1999: (Teradyne) Director of Business Development, Software Test Units. Reported directly to Chairman of the Board/Founder and then to general manager of software test unit (6 divisions of Teradyne). Evaluated and researched acquisition and partnership candidates. Internally assessed technology position in market and gaps in product lines. Worked with senior division staff to develop new product strategies. Attended internal Teradyne divisional board meetings. Chairman served as my mentor.

3Com Corporation/NBX Corporation

- 1999: Software Engineer 5. Continued work after 3Com acquisition of NBX. Built cross-division relationships for new products and research directions. NBX was acquired by 3Com in March 1999.
- 1997 - 1999: (NBX) Senior Scientist and Engineer. Work in IP Telephony. Architected next-generation product. Protocol design and validation for core protocol now used tens of millions of times daily. Led team in integration of IP protocols into current product. Designed audio reconstruction algorithms. Developed applications for bug analysis and diagnosis of system problems. Implementation of network simulator. Work on collaborative projects with external partners. Worked to identify gaps in product. Representative at numerous trade shows. Innovated novel methods of using product.

MIT Department of Electrical Engineering and Computer Science, Cambridge, MA

- 1991 - 1998: Research assistant, Telemedia Network Systems Group. Design, development, and implementation of Gigabit ATM network for distributed multimedia system. Studied host interface design issues. ATM network simulation.
- Spring 1989, Fall 1990, Spring 1995: Teaching assistant, Computation Structures digital systems course. (Spring 1995 Head TA)
- 1988 - 1989: Head laboratory teaching assistant for Computation Structures. Responsibilities included writing and revising lab assignments, and maintaining the lab.
- 1987: Laboratory teaching assistant for Computation Structures.
- 1987: Design, construction, and programming of 16-bit computer.

Agora Technology Group, Incorporated

- 1994 - 1996: Founder and CEO. Conceived and oversaw development of targeted advertising-supported Web sites. Responsible for company's vision and direction. Attended the first two WWW Conferences, presenting a workshop and paper at the first, and appearing on the "Commercialization and Economics of the Web" panel and chairing the "Where Commercial Services and the Web Are Headed" panel at the second. Sold company intact; is currently an operating stand-alone company.

AT&T Bell Laboratories, Holmdel, NJ

- 1989 - 1990: Implementation of cascable all-optical fiber logic gate. Modelocking of all-fiber erbium laser. Construction of modelocked laser repetition rate booster. Strong optics laboratory and fiber optic experience.
- Summer 1988, 1987: Research in integrated optics. Analysis of rectangular waveguides using microwave modeling. Fabrication of integrated optical components.

Honors

- MIT Alumni Association Great Dome Award, 2010, Baker 60th Anniversary Reunion Co-Chair (highest group award given by MIT Alumni Association)
- MIT Alumni Association Presidential Citation Award (now known as Great Dome), 2008, Member of MIT Chairman's Salon committee
- MIT Alumni Association Bronze Beaver Award, 2007 (highest individual award given by MIT Alumni Association)
- MIT Alumni Association Volunteer Honor Roll, February 2004
- MIT Alumni Association Lobdell Award, 1999
- Boston Museum of Science Gold Pin for 1000 hours of Volunteer Service, April 1999
- MIT Alumni Association Presidential Citation Award (now known as Great Dome), 1997, Member of Alumni Online Communications Committee

Patents and Patent Publications

- U.S. Patent #9,697,231, H. Houh, J. Stern, R. Spina, M. Meter, "Methods and apparatus for providing virtual media channels based on media search," July 4, 2017.
- U.S. Patent #9,697,230, H. Houh, J. Stern, "Methods and apparatus for dynamic presentation of advertising, factual, and informational content using enhanced metadata in search-driven media applications," July 4, 2017. See also WO2007056485.
- U.S. Patent #7,975,296, L. Apfelbaum, H. Houh, T. Mayberry and G. Friedman, "Automated security threat testing of web pages," July 5, 2011. See also US20030159063, WO2003067405.
- U.S. Patent #7,877,736, H. Houh and J. N. Stern, "Computer language interpretation and optimization for server testing," January 25, 2011. See also US20050138104, WO2005043300.
- U.S. Patent #7,801,910, H. Houh and J. N. Stern, "Method and apparatus for timed tagging of media content," September 21, 2010. See also US20070112837, US20090222442, WO2007056535.
- U.S. Patent #7,590,542, D. C. Williams, W. C. Hand, H. Houh, A. R. Seeley, "Method of Generating Test Scripts Using a Voice-Capable Markup Language," September 15, 2009. See also EP1530869, US20030212561, WO2003096663.
- U.S. Patent #6,967,963, H. H. Houh, P. Anderson, C. Gadda, "Telecommunication method for ensuring on-time delivery of packets containing time-sensitive data," November 22, 2005. See also EP1060400, WO2000033092, CA2318774.

- U.S. Patent #5,144,375, M. C. Gabriel, H. H. Houh, N. A. Whitaker, “Sagnac Optical Logic Gate,” September 1, 1992. Also issued as European Patent # EP0456422, July 23, 1997, German Patent #DE69126913, August 28, 1997
- U.S. Patent Application Publication No. 20020015387, “Voice Traffic Packet Capture and Analysis Tool for a Data Network” (Abandoned in 2007)
- U.S. Patent Application Publication No. 20020016708, “Method and Apparatus for Utilizing a Network Processor as Part of a Test System” (Abandoned in 2007)
- U.S. Patent Application Publication No. 20020016937, “Method and Apparatus for Utilizing a Network Processor as Part of a Test System.” (Abandoned in 2007) See also WO2002011413.
- U.S. Patent Application Publication No. 20070106646, “User-directed navigation of multimedia search results” (Abandoned in 2009)
- U.S. Patent Application Publication No. 20070106660, “Method and apparatus for using confidence scores of enhanced metadata in search-driven media applications” (Abandoned in 2009)
- U.S. Patent Application Publication No. 20070106685, “Method and apparatus for updating speech recognition databases and reindexing audio and video content using the same” (Abandoned in 2015)
- U.S. Patent Application Publication No. 20070118873, “Methods and apparatus for merging media content” (Abandoned in 2015)
- U.S. Patent Application Publication No. 20090222442, “User-directed navigation of multimedia search results” (Abandoned in 2016)
- U.S. Patent Application 11/395,732, “Search snippet creation for audio and video data” (Abandoned in 2009)
- U.S. Patent Application 11/774,931, “Methods and apparatus for managing a social networking web site”
- U.S. Patent Application 11/774,947, “Methods and apparatus for organizing media files”
- U.S. Patent Application 11/774,956, “Methods and apparatus for managing an online event”
- U.S. Provisional Patent Application 61/086,909, “Measuring and ranking relationship activity”
- U.S. Provisional Patent Application 61/086,914, “Detecting media object commonality”
- U.S. Provisional Patent Application 61/086,904, “Message categorization based on message characteristics”
- U.S. Provisional Patent Application 61/086,905, “Photo tagging to request action”

Trials, Testimony and Depositions

- Case No. 1:06CV682 (CMH/BRP), Verizon vs. Vonage, U.S. District Court for the Eastern District of Virginia, filed expert report, was deposed and testified at trial.
- Case No. 1:08CV157 (CMH/TRJ), Verizon vs. Cox, U.S. District Court for the Eastern District of Virginia, was deposed and testified at trial.
- Case No. 5:09-cv-476, Two-Way Media vs. AT&T, U.S. District Court for the Western District of Texas, filed expert report, testified at trial.

- Case No. 2:10-cv-248 (RAJ/FBS), ActiveVideo Networks vs. Verizon, U.S. District Court for the Eastern District of Virginia, filed expert report and was deposed as an expert witness.
- Case No. 1:11-cv-00880-TSE-JFA, Bear Creek Technologies, Inc. vs. Verizon Services Corp., et al, U.S. District Court for the Eastern District of Virginia, was deposed as an expert witness.
- Case No. 3:10-CV-298-BBC, AlmondNet, Inc. vs. Microsoft Corp., U.S. District Court for the Western District of Wisconsin, filed expert report.
- Case No. 6:10-cv-00597, Guardian Media Technologies, Ltd. Vs. AT&T Operations, Inc. et al., U.S. District Court for the Eastern District of Texas, Tyler Division, filed expert report.
- Case No. ESCV2010-02282C, The Octopus Solution LLC v. Gary Brown et al., Essex, MA Superior Court, testified at trial.
- Investigation No. 337-TA-882, In the matter of Certain digital media devices, including televisions, Blu-ray disc players, home theater systems, tablets and mobile phones, components thereof and associated software, U.S. International Trade Commission, filed expert reports, was deposed and testified at hearing.
- Investigation No. 337-TA-995, In the matter of Certain communications or computing devices, and components thereof, U.S. International Trade Commission, filed expert reports, and was deposed.
- Case No. 8:12-cv-122-LES-TDT, Prism Technologies LLC v. AT&T Mobility LLC, U.S. District Court for the District of Nebraska, filed expert report, was deposed and testified at trial.
- Case No. 11-2684 (JWL), Sprint Communications Co., L.P., v. Comcast Cable Communications, LLC, et al., U.S. District Court for the District of Kansas, filed expert report and was deposed.
- Case No. 11-2686 (JWL), Sprint Communications Co., L.P., v. Time Warner Cable, Inc., et. al., LLC, et al., U.S. District Court for the District of Kansas, filed expert report, was deposed, and testified at trial.
- Case No. 12-487 (SLR), Cox Communications, Inc., et al., v. Sprint Communications Company L.P., et al., U.S. District Court for the District of Delaware, filed expert report and was deposed.
- Case IPR 2014-00039, Microsoft Corporation v. B.E. Technology LLC, U.S. Patent No. 6,628,314. Submitted declaration and cross-examined in deposition.
- Case IPR 2014-00086, Apple, Inc. v. Evolutionary Intelligence, LLC, U.S. Patent No. 7,010,536. Submitted declaration and cross-examined in deposition.
- Case No. 6:11-CV-421, Stragent, LLC v. Intel Corporation, U.S. District Court for the Eastern District of Texas, Tyler Division, deposed and testified at trial as a fact witness.
- IPR2014-01366, IPR2014-01367, IPR2014-01368, Samsung et al. v. Straight Path, submitted IPR declarations and was deposed.
- IPR2015-1006, IPR2015-1007, Cisco v. Straight Path, submitted IPR declarations.
- IPR2014-01457, IPR2014-01459, Microsoft v. Biscotti, submitted IPR declaration and was deposed.
- IPR2016-00302, Apple v. Nonend, submitted IPR declaration.
- IPR2014-00812, Yelp and Twitter v. Evolutionary Intelligence, submitted IPR declaration.

- IPR2015-00307, Cisco v. AIP, submitted IPR declaration.
- Microsoft v. Acacia, submitted IPR declaration.
- IPR2015-00342, AT&T Mobility LLC and Cellco Partnership d/b/a Verizon Wireless v. Solocron, submitted IPR declaration.
- Mediatube v. Bell Canada, Canadian Federal Court, submitted expert report and testified at trial.
- CBM2016-00036, Google v. At Home Bondholder's Liquidating Trust, submitted CBM declaration.
- IPR2016-01198, IPR2016-01201, Apple, Inc. v. VoIP-Pal.com, Inc., submitted IPR declaration and was deposed.
- Case No. 3:14-cv-2824-VC, Trend Micro Incorporated v. Rpost Holdings, Inc., et al, submitted expert report and was deposed
- Akamai v. Limelight Networks, IPR2016-01631, IPR2016-03821, IPR2017-00249, IPR2017-00349, submitted IPR declarations and was deposed
- Hyperlinc Technologies v. Verizon Sourcing, No. 650151/2015 New York Supreme Court, submitted declaration and was deposed
- Cascades Streaming Technologies v. Big Ten Networks, submitted expert reports and was deposed
- Klaustech, Inc. v. Google LLC., Case No. 4:10-CV-05899-JSW (N.D. Cal.), submitted expert report and was deposed
- Cisco v. Uniloc, IPR2017-00198, IPR2017-00058, submitted IPR declarations and was deposed.
- Cisco v. Uniloc, IPR2017-00597, submitted IPR declaration and was deposed
- Twitter v. Youtoo Technologies, LLC, IPR2017-01133, IPR2017-01131, submitted IPR declarations and was deposed
- Taser International Inc. (now Axon Enterprise, Inc.) v. Digital Ally Inc., IPR2017-00375, submitted IPR declaration and was deposed
- Taser International Inc. (now Axon Enterprise, Inc.) v. Digital Ally Inc., IPR2017-00376, IPR2017-00515, IPR2017-00775, submitted IPR declarations
- HTC Corporation v. IPA Technologies, IPR2018-00306, IPR2018-00307, submitted IPR declaration
- Hulu v. Soundview, IPR2018-00864, IPR2018-01023, submitted IPR declarations and was deposed
- XpertUniverse v. Cisco, 3:17-cv-3848, U.S. District Court for Northern District of California, submitted declaration in support of claim construction and was deposed
- Improved Search v. Microsoft, C.A. No. 16-cv-650-JFB-SRF (Del.), submitted declaration in support of claim construction
- Apple v. Uniloc, IPR2018-00361, IPR2018-00394, IPR2018-00395, IPR2019-00700, IPR2019-00701, IPR2019-01667, submitted IPR declarations
- LG Electronics v. Uniloc, submitted IPR declaration
- SRC Labs and Saint Regis Mohawk Tribe v. Microsoft, 2:18-cv-00321-JLR, U.S. District Court for Western District of Washington at Seattle, submitted declaration in support of claim construction and was deposed
- Verizon Wireless v. Barkan Wireless IP Holdings LP, submitted IPR declarations

- Verizon Wireless and Samsung Electronics America Inc. v. Barkan Wireless IP Holdings LP, IPR2019-199, IPR2019-200, IPR2019-234, IPR2019-631, IPR2019-632, submitted IPR declarations
- Samsung Electronics America Inc. v. Barkan Wireless IP Holdings LP, IPR2019-100, submitted IPR declaration
- Cisco Systems Inc. v. Meetrix IP LLC, IPR2019-539, IPR2019-540, IPR2019-541, IPR2019-542, IPR2019-543, IPR2019-544, submitted IPR declarations
- GMG Products LLC v. Traeger Pellet Grills LLC, PGR2019-24, PGR2019-34, PGR2019-35, PGR2019-36, submitted PGR declaration and was deposed
- Uniloc 2017 LLC v. Google LLC, 2:18-cv-00502-JRG-RSP, U.S. District Court for the Eastern District of Texas, Marshall Division, submitted declaration in support of claim construction
- Microsoft Corporation v. Uniloc 2017 LLC, IPR2020-00102, IPR2020-00103, submitted IPR declarations
- Microsoft Corporation and HP Inc. v. Syncloud Technologies, LLC, IPR2020-00316, IPR2020-01031, IPR2020-01032, IPR2020-01269, IPR2020-01270, IPR2020-01271, submitted IPR declarations
- Seven Networks, LLC v. Apple Inc, 2:19-cv-115-JRG, U.S. District Court for the Eastern District of Texas, Marshall Division, submitted declaration in support of claim construction
- Unified Patents Inc. v. Ortiz & Associates Consulting, LLC, IPR2019-00743, submitted IPR declaration
- Uniloc 2017 LLC v. Apple Inc., 3:19-cv-01905-JD, U.S. District Court for the Northern District of California, San Francisco Division, submitted declaration in support of claim construction and was deposed
- ClearPlay Inc. v. Dish Network LLC et al.; 2:14-cv-00191, U.S. District Court for the District of Utah, Central Division, submitted expert report and re-examination declarations
- AMC Networks, Inc. et al v. Sound View Innovations, LLC, IPR2020-00482, submitted IPR declaration
- Case No. 1:17-cv-01734-RGA, Sprint Communications Co., L.P., v. Charter Communications, Inc., et al., U.S. District Court for the District of Delaware, filed expert report and was deposed.
- CommScope Technologies LLC et al. v. Barkan Wireless IP Holdings LP et al., IPR2020-00827, IPR2020-00829, IPR2020-00831, IPR2020-00833, IPR2020-00835, IPR2020-00838, submitted IPR declarations
- Cisco Systems Inc. v. Monarch Networking Solutions LLC, IPR2020-01226, submitted IPR declaration
- CoolTV Network.com v. Blackboard, Inc., Facebook, Inc., International Business Machines Corporation, Kaltura, Inc., Limelight Networks, Inc., Microsoft Corporation, Ooyala, Inc., Snap, Inc., and Trapelo Corp., submitted declaration in support of claim construction and was deposed
- Facebook, Inc. v. Onstream Media Corporation, IPR2020-01507, IPR2020-01508, IPR2020-01525, IPR2020-01527, IPR2020-01528, submitted IPR declarations
- Hisense Co LTD. v. Maxell, LTD, IPR2020-01598, IPR2020-01600, submitted IPR declarations

- Microsoft Corp. v. O'Brien, IPR2021-00015, submitted IPR declaration and was deposed
- Sable Networks Inc. v. Cisco Systems, Inc., WA:20-CV-00288-ADA, U.S. District Court for the Western District of Texas, Waco Division, submitted declaration in support of claim construction
- Peloton Interactive, Inc. v. Icon Health and Fitness Inc et al., IPR2021-00342, submitted IPR declaration
- Hulu, LLC v. SITO Mobile R&D IP, LLC et al., CBM2020-00028, IPR2020-00158, IPR2020-00206 , IPR2020-00219 , IPR2020-00265 , IPR2020-00298 , IPR2020-00304 , IPR2020-00308 , submitted CMB and IPR declarations and was deposed
- Twitter, Inc. and Google LLC v. B.E. Technology, LLC, IPR2021-00482, IPR2021-00483, IPR2021-00484, IPR2021-00485, submitted IPR declarations
- MG Freesites LTP v. ScorpCast, LLC, IPR2021-00511, submitted IPR declaration
- Avionte, LLC v. Sandeep Acharya, Samar Basnet, and Aqore LLC, Arbitration, Hon. Jeffrey Keyes (Ret.)
- Microsoft Corporation v. WSOU Investments, LLC d/b/a Brazos Licensing and Development, IPR2021-00751, submitted IPR declaration
- SAP America, Inc. v. Express Mobile, Inc., IPR2021-01144, IPR2021-01145, IPR2021-01146, submitted IPR declarations
- StratosAudio Inc. v. Hyundai Motor America, 6:20-cv-01125-ADA, U.S. District Court for the Western District of Texas, Waco Division, submitted claim construction declaration and was deposed Peloton Interactive, Inc. v. Ifit Health and Fitness Inc, IPR2022-00029, IPR2022-00030, submitted IPR declarations and was deposed
- Investigation No. 337-TA-1263, In the matter of Certain televisions, remote controls, and components thereof, U.S. International Trade Commission, filed expert reports, was deposed, and testified at hearing
- Alexander Stross v. Netease, Inc., et al., U.S. District Court (Central District of California), Case 2:20-cv-00861-AB(JC), filed expert reports, and was deposed
- Ralph Ledergerber v. Netease, Inc., et al., U.S. District Court (Central District of California), Case 2:20-cv-00862-AB(JC), filed expert reports and was deposed
- John Walmsley v. Netease, Inc., et al., U.S. District Court (Central District of California), Case 2:20-cv-00863-AB(JC), filed expert reports and was deposed
- Bernhard Kuhmstedt v. Netease, Inc., et al., U.S. District Court (Central District of California), Case 2:20-cv-02044-AB(JC), filed expert reports and was deposed
- Netflix, Inc. v. CA, Inc., IPR2021-01319, submitted IPR declaration and was deposed
- F45 Training Pty Ltd. v. Body Fit Training USA Inc., C.A. No. 20-1194 (LPS) (D. Del.), filed expert report
- Apple v. Fintiv, submitted IPR declarations
- Estech Systems, Inc. v. Howard Midstream Energy Partners d/b/a Howard Energy Partners, C.A. No. 6:20-cv-777-ADA (Western District of Texas, Waco Division), filed expert reports and was deposed
- Echelon Fitness Multimedia, LLC. v. Peloton Interactive, Inc., IPR2020-01187, submitted IPR declaration and was deposed
- Microsoft Corporation v. SurfCast, Inc., submitted IPR declarations
- MemoryWeb, LLC v. Samsung Electronics Co., LTD. and Samsung Electronics America, Inc., Case No. 6:21-cv-00411-ADA (Western District of Texas, Waco Division), filed declaration and was deposed

Publications

- “IP switching: server driven flow classification,” H. H. Houh, *Proceedings of the Washington University Workshop on Integration of IP and ATM*, November 1996.
- “Aurora at MIT,” D. D. Clark, H. H. Houh, and D. L. Tennenhouse, Editors, *MIT Laboratory for Computer Science Technical Report 673*, December 1995.
- “ViewStation Applications: Implications for Network Traffic,” C. J. Lindblad, D. Wetherall, W. Stasior, J. F. Adam, H. H. Houh, M. Ismert, D. Bacher, B. Phillips, and D. L. Tennenhouse, *IEEE Journal of Selected Areas in Communications*, 1995.
- “The VuNet Desk Area Network: Architecture, Implementation, and Experience,” H. H. Houh, J. F. Adam, M. Ismert, C. J. Lindblad, and D. L. Tennenhouse, *IEEE Journal of Selected Areas in Communications*, 13 (4), May, 1995.
- “Reducing the Complexity of ATM Host Interfaces,” H. H. Houh and D. L. Tennenhouse, Hot Interconnects II Symposium Proceedings, Stanford, August 11-12, 1994.
- “Media-intensive data communications in a ‘desk-area’ network,” J. F. Adam, H. H. Houh, M. Ismert, and D. L. Tennenhouse, *IEEE Communications*, August 1994.
- “ViewStation Applications: Intelligent Video Processing Over A Broadband Local Area Network,” C. J. Lindblad, D. J. Wetherall, W. Stasior, B. Phillips, D. Bacher, J. Adam, H. Houh, M. Ismert, and D. L. Tennenhouse, Proceedings of the 1994 USENIX Symposium on High-Speed Networking, Oakland, CA, August 1994.
- “The Media Gateway: Live Video on the World Wide Web,” H. H. Houh, C. J. Lindblad, J. Soo, D. L. Tennenhouse, and D. J. Wetherall, Workshop at the 1994 World Wide Web Conference, Geneva, Switzerland, May 1994.
- “Active Pages: Intelligent Nodes on the World Wide Web,” H. H. Houh, C. J. Lindblad, and D. J. Wetherall, Proceedings of the 1994 World Wide Web Conference, Geneva, Switzerland, May 1994.
- “WaveLength Division vs. Code Division Access Methods for Optical Networks,” H. H. Houh, Area Exam Paper, May 1993.
- “Experience with the VuNet: A Network Architecture for a Distributed Multimedia System,” J. F. Adam, H. H. Houh, D. L. Tennenhouse, Proceedings of the 18th Conference on Local Computer Networks, pp. 70-76, September 1993
- “The VudBoard: A Simple DMA Interface,” H. H. Houh, Proceedings of the 4th Gigabit Minijam, January 1994.
- “A Software-Oriented Approach to the Design of Media Processing Environments,” D. L. Tennenhouse, J. Adam, D. Carver, H. Houh, M. Ismert, C. Lindblad, W. Stasior, D. Weatherall, D. Bacher, and T. Chang., submitted to the International Conference on Multimedia Computing and Systems, May 1994.
- “A Network Architecture for Distributed Multimedia Systems,” J. F. Adam, H. H. Houh, M. Ismert, and D. L. Tennenhouse, submitted to the International Conference on Multimedia Computing and Systems, May 1994.
- “The Viewstation Collected Papers,” D. L. Tennenhouse, J. Adam, C. Compton, A. Duda, D. Gifford, H. Houh, M. Ismert, C. Lindblad, W. Stasior, R. Weiss, D. Wetherall, D. Bacher, D. Carver, and T. Chang, MIT Laboratory for Computer Science Technical Report, MIT/LCS/TR-590, November 1993.

- “The Viewstation Collected Papers II,” W. F. Stasior, D. L. Tennenhouse, J. F. Adam, D. R. Bacher, H. H. Houh, M. Ismert, C. J. Lindblad, B. M. Phillips, D. J. Wetherall, MIT Laboratory for Computer Science Technical Report, MIT/LCS/TR-696, April 1996.
- “A System's Perspective of the Sagnac Fiber Logic Gates and Their Possible Applications,” A. Huang, N. Whitaker, C. Gabriel, H. Avramopoulos, P. M. W. French, H. H. Houh, and I. Chuang, Applied Optics, September 10, 1994
- “Complete Switching in a Three-Terminal Sagnac Switch,” H. Avramopoulos, P. M. W. French, M. C. Gabriel, H. H. Houh, N. A. Whitaker, T. Morse, IEEE Phot. Tech. Lett. **3** (3), 235
- “Complete Switching in a Three-Terminal Sagnac Switch,” H. Avramopoulos, P. M. W. French, M. C. Gabriel, H. H. Houh, N. A. Whitaker, IEEE/LEOS Annual Meeting, Paper PDP-13, November 1990
- “All-optical phase-locked oscillator,” N. A. Whitaker, Jr., H. H. Houh, H. Avramopoulos, T. F. Morse, IEEE/LEOS Annual Meeting, Paper ELT2.4/MOO3, November 1990
- “Passive modelocking of an all-fiber erbium laser,” H. Avramopoulos, H. H. Houh, N. A. Whitaker, M. C. Gabriel, T. F. Morse, IEEE/LEOS Conference on Optical Amplifiers and their Applications, Paper PDP-8, August 1990
- “Transverse modes, waveguide dispersion, and 30ps recovery in submicron GaAs/AlAs microresonators,” J. L. Jewell, S. L. McCall, A. Scherer, H. H. Houh, N. A. Whitaker, A. C. Gossard, and J. H. English, Appl. Phys. Lett. **55** (1), July 3, 1989

Leadership, Activities and Interests

- Leadership
 - Reading Symphony Orchestra
 - Board of Directors (Treasurer), 2022 - present
 - Discovery Museums (Acton, MA)
 - Science and Technology Advisory Council, 2012 - present
 - MIT Alumni Association Board of Directors
 - National Selection Committee, 3 year term, 2020 – 2023
 - K-12 STEM Initiatives Co-chair, 2013 – 2017
 - Awards Committee Chair, 2012 – 2014
 - Awards Committee, 3 year term, 2011 – 2014
 - Vice President, 2 year term, 2004 – 2006
 - Alumni Ad-Hoc Committee, Chair, 2005-2006
 - Board Member, 2 year term, 1997 – 1999
 - MIT Club of Boston
 - Board of Directors, 2006 - 2011
 - K-12 Initiatives Chair, 2009 - 2012
 - VP of Communications, MIT Club of Boston, 2003 - 2006
 - Past-President, MIT Club of Boston, 2002 - 2003
 - President, MIT Club of Boston, 2001 - 2002
 - President-Elect, MIT Club of Boston, 2000 - 2001
 - VP of Programs, MIT Club of Boston, 1999 - 2000
 - Activities Super-Chair, MIT Club of Boston, 1998 - 1999
 - MIT Enterprise Forum of Cambridge, Inc.

- Past Chair, 2009 – 2011
 - In-NOW-vation Co-chair, 2010
 - Chair, 2007 - 2009
 - Vice Chair, 2005 - 2007
 - Executive Board Member, 2002 - 2011
 - Winter Workshop Co-Chair, February 2007 - conceived idea for conference, which sold-out and produced largest attendance numbers in recent memory
 - Spring Workshop Co-Chair, Spring 2004
 - Membership Committee Chair, Fall 2003 - 2006
 - 25th Anniversary Dinner Chair, Fall 2003
 - As Membership Chair and Board Member, started Special Interest Groups in 2004; a SIG won the MIT Presidential Citation award, the MIT Alumni Association's highest award for organizations, in 2006
- Estabrook Elementary School PTA
 - Advisory committee to the superintendent on PCB issue, 2010-2011
 - 4th Grade after-school science program co-organizer, 2010-2012
 - 4th and 5th Grade before-school Math Olympiad co-organizer, 2009-2013
 - 5th Grade BBQ and Yearbook Committee, 2011, 2013
 - Family Math Night volunteer, 2008-2012
- Tau Beta Pi National Engineering Honor Society
 - Advisor, MA B Chapter at MIT, 2003 - present
 - District Director (National Officer), Tau Beta Pi, New England Area, 1991 - 2003
 - President, MA B Chapter at MIT, Fall 1988 - Spring 1989
 - Laureate award, 1989
- MIT Class of 1989
 - Secretary, five consecutive 5 year terms, 1989 - 2014
 - 30-year Reunion Committee, 2019
 - 25-year Reunion Committee, 2014
 - 20-year Reunion Committee and Gift Committee, 2009
 - 15-year Reunion Committee and Gift Committee, 2004
 - 10-year Reunion Committee and Gift Committee, 1999
 - 5-year Reunion Committee, 1994
 - Interim Treasurer, 1993 - 1994
 - Instituted annual senior class career fair, now raising over \$100,000 annually for senior class activities, Fall 1988
- Strong, consistent record of leadership dating to high school
- Acting
 - ‘21’ (Sony Pictures), credited as “Chinatown Dealer,” 2007, Kevin Spacey's movie about the MIT Blackjack Team inspired by “Bringing Down the House” by Ben Mezrich, opened nationwide on March 28, 2008. 21 was the number one movie in US for two weeks and number one globally for one week. 21 also topped the DVD sales, Blu-ray sales and DVD rental charts.
 - Spring Lake Theater Company, first New York-area off-broadway production of “A Chorus Line,” played role of Mark, Summer 1990

- Former member of the MIT Blackjack team
- Producer for 10,000 Maniacs' 2013 album "Music from the Motion Picture"
- Executive Producer for 10,000 Maniacs' 2015 album "Twice Told Tales"
- Violist, violist, harpist, guitarist, singer, actor: played in many amateur/semi-professional groups including Firebird Pops Orchestra, Reading Symphony Orchestra, MIT Summer Philharmonic Orchestra, Freisinger Chamber Orchestra, Merrimack Valley Philharmonic, Longwood Symphony, MIT Symphony, and Somerville Community Chorus
- Violist, "Coming Home" album by Karen Phillips, 2014
- Google Scholar citations: 1914, h-index: 21, i10-index: 26 (since 2016: 649/13/13)
- Erdos-Bacon number of 7
- Erdos-Bacon-Sabbath number of 11