UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

COMMSCOPE TECHNOLOGIES LLC.
Petitioner

v.

DALI WIRELESS, INC.
Patent Owner

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

DECLARATION OF DR. ANTHONY ACAMPORA

In Support of Inter Partes Review of U.S. Patent No. 10,750,382

Table of Contents

I. INTRODUCTION 1
II. SUMMARY OF OPINIONS 2
III. QUALIFICATIONS 2
IV. MATERIALS CONSIDERED 8
V. RELEVANT LEGAL PRINCIPLES 11
A. Effective Filing Date 11
B. Person of Ordinary Skill in the Art 11
C. Claim Construction Standard 12
D. Construing Terms of '382 Patent 13
E. Anticipation and Obviousness Law 14
1. Anticipation 14
2. Obviousness 14
VI. The '382 Patent 18
A. Overview 18
B. Claims 26
C. The '382 Prosecution History 28
D. Prior IPR proceedings on the '454 patent 33
VII. Summary of the Asserted Prior Art 36
A. Stapleton U.S. Patent App. Pub. No. 2012/00339254 36
B. Kummetz-464 37
1. Kummetz-464 is prior art 37
2. Overview of Kummetz-464 81
C. Wu: U.S. Patent Application Pub. No. 2010/0128676 94
D. Prior art topologies commonly used to connect remote antenna units in a DAS 100

VIII. GROUNDS 103
A. Ground 1: Stapleton anticipates all claims 103
1. Independent Claim 1 103
2. Independent Claim 10 172
3. Dependent Claim 2 181
4. Dependent Claim 3 184
5. Dependent Claim 4 188
6. Dependent Claim 5 189
7. Dependent Claim 6 190
8. Dependent Claim 7 193
9. Dependent Claim 8 199
10. Dependent Claim 9 201
11. Dependent Claim 11 202
12. Dependent Claim 12 206
13. Dependent Claim 13 212
14. Dependent Claim 14 213
15. Dependent Claim 15 214
16. Dependent Claim 16 216
17. Dependent Claim 17 218
18. Dependent Claim 18 219
19. Dependent Claim 19 223
B. Ground 2: Stapleton alone or in combination with Kummetz-464 renders all claims (1-19) obvious 225
1. Independent Claims 1 and 10 225
2. Dependent Claim 3 244
3. Dependent Claim 17 256
C. Ground 3: Kummetz-464 anticipates claims 1-2, 4-6, 8-17 and 19 (all claims except dependent claims 3, 7 and 18) 264

1. Claim 1 264
2. Claim 2 295
3. Claim 4 298
4. Claim 5 298
5. Claim 6 299
6. Claim 8 299
7. Claim 9 300
8. Claim 10 302
9. Claim 11 304
10. Claim 12 305
11. Claim 13 306
12. Claim 14 308
13. Claim 15 308
14. Claim 16 309
15. Claim 17 311
16. Claim 19 312

D. Ground 4: Kummetz-464 alone or in view of Wu renders claims 1-19 obvious. 312

1. Independent claims 1 and 10 312
2. Claim 3 317
3. Claim 7 323
4. Claim 9 327
5. Claim 18 331
6. Claims 2, 4-6, 8, 11-17 and 19 332

E. Ground 5: Kummetz-464 in combination with Kummetz-579 renders claim 7 obvious 333

APPENDIX - LISTING OF CHALLENGED CLAIMS 338

I. INTRODUCTION

1. I have been retained by Petitioner, CommScope Technologies LLC, ("CommScope" or "Petitioner") to provide expert opinions in connection with a petition for inter partes review before the United States Patent and Trademark Office. I understand that this declaration involves my expert opinions and expert knowledge related to U.S. Patent No. 10,750,382 ("the '382 Patent"), titled "Optimization of Traffic Load in a Distributed Antenna System," and its field of endeavor.

2. I have been asked to provide my independent technical review, analysis, insights, and opinions regarding the '382 Patent and the references that form the basis for the grounds of unpatentability set forth in the Petition for Inter Partes Review of the '382 Patent. The statements made herein are based on my own knowledge and opinions.

II. SUMMARY OF OPINIONS

3. To summarize the opinions stated herein, it is my opinion that the claims of the '382 patent are invalid based on the following grounds:

Grounds	claims 1-19
Ground 1: Stapleton (EX. 1006) anticipates:	1-19
Ground 2: Stapleton alone or in combination with Kummetz-464 (EX1005) renders obvious:	1-19
Ground 3: Kummetz-464 anticipates:	1-2, 4-6, 8-17 and 19
Ground 4: Kummetz-464 alone or in combination with Wu (EX1007) renders obvious:	1-19
Ground 5: Kummetz-464 in combination with Kummetz-579 (EX1008) renders obvious:	7

III. QUALIFICATIONS

4. I received my Bachelor of Science, Master of Science, and Doctor of Philosophy degrees, all in Electrical Engineering, from the Polytechnic Institute of Brooklyn in 1968, 1970, and 1973, respectively. Both my Master's thesis and my Ph.D. dissertation involved theoretical aspects of electromagnetic wave propagation in plasma and gaseous media. From June 1968 through September 1988, I was employed at AT&T Bell Laboratories in various engineering, research, and managerial positions, all in the general area of telecommunications.

5. My initial work at Bell Laboratories (1968-1974) involved high power radar design and development, and signal design and processing for extraction of pertinent information from radar target returns, both focused on anti-ballistic missile defense applications. A modern radar system operates by transmitting carefully designed radio signals toward a target, and processing the reflected radio signals arriving back at the radar, to determine target location, velocity, and key features. For ballistic missile defense applications, it is also important to distinguish real warheads from decoys.

6. My next assignment at Bell Laboratories (1974-1981) was in the Radio Research Laboratory, an organization responsible for basic research, where I was involved in new discovery and proposals involving novel approaches for communication satellite systems. Communication satellites are radio systems, often world-wide in scope, intended to enable wireless communications among terrestrial users from a platform of one or more Earth-orbiting satellites. My contributions to the communication satellite state-of-the-art included (1) strategies to efficiently encode and recover digital information sent to and from the satellites via high capacity radio beams; (2) novel systems and on-board satellite switching approaches that use multiple radio beams (so-called spot beams), each focused on a small portion of Earth, to vastly increase the capacity of a communication satellite by enabling the radio spectrum to be re-used among the spot beams; (3) strategies

to acquire and maintain synchronization of radio signals sent to and from a satellite; and (4) a novel approach to overcome the effects of rain-induced attenuation of the radio beams that dynamically assigns available radio resources to those spots on Earth where rain attenuation is instantaneously most severe.

7. I was promoted to Supervisor of the Data Theory Group at Bell Laboratories in 1981, with responsibility for exploratory development of local area data networks. These are packet-switching networks intended to enable very high speed computer, voice, and video communications via on-demand capture of a shared transmission channel. Several new approaches were suggested and studied.

8. In 1984, I was promoted to Head of the Network Systems Research Department (one of several departments within the Radio Research Laboratory, later to become the Communications Systems Research Laboratory, at Bell Laboratories) with responsibility for new architectures for packet switching and multiwavelength optical networks, wireless networks for broadband local access, and integrated voice/data wireless networks. Contributions included (1) a system architecture for using a raster of focused radio beams to deliver broadband service to a large number of buildings from a central location within a city; (2) a novel packet switching architecture for Internet-like wide area packet networks; and (3) a wide area multimedia networking strategy to enable access to the enormous information-bearing capacity potential of optical fiber cabling.

9. I was promoted to Director of the Transmission Technology Laboratory in 1987, a group of approximately 80 people with broad charter for exploratory development of (1) transmission and switching systems for next-generation Internet-like packet-based networks and (2) applications for digital signal processing in telecommunications.

10. I left AT&T Bell Laboratories in September 1988 to become Professor of Electrical Engineering and Director of the Center for Telecommunications Research at Columbia University. Here, my responsibilities were three-fold: (1) education of students in the field of telecommunications, (2) pursuit of a program of independent research in the area of telecommunications, and (3) management of a National Science Foundation Engineering Research Center devoted to many aspects of telecommunications and founded for the express purpose of improving American economic competitiveness through research, education, and transfer of relevant technical findings from academia to the telecommunications industry. Research programs at the Center for Telecommunications Research were focused on multiwavelength fiber optical networks, wireless communications, image and video communications, network management and control, and underlying photonic and electronic devices and materials. Contributions included (1) laboratory implementation and feasibility demonstration of the world's first multiwavelength packet switched optical

network; (2) new approaches for randomly accessing a shared radio channel; (3) strategies for enabling rapid handoff among radio cells in a high capacity cellular network; (4) a rigorous understanding of multiwavelength optical network capabilities and limitations; and (5) algorithms for the efficient resource management and control of packet based multimedia networks.

11. In August 1995, I left Columbia University to become Professor of Electrical and Computer Engineering and Director of the Center for Wireless Communications at the University of California, San Diego (UCSD). Again, my responsibilities were threefold: (1) education of students in the field of wireless communications, (2) pursuit of a program of independent research in the area of wireless communications, and (3) management of an industrially funded research center devoted exclusively to wireless communications. Contributions included (1) strategies for allowing the use of so-called “smart” antennas in cellular-based packet radio networks; (2) a proposal for a new city-wide network based on a wireless mesh-based approach using either focused wireless beams of light or focused radio beams, intended to deliver broadband services to buildings and/or to connect wireless radio cells with the world-wide fiber-optic backbone network; and (3) mobility management strategies for high speed packet-based wireless networks. The second of these contributions has served as the technical foundation

for at least two new venture-backed telecommunications equipment companies, one of which I co-founded.

12. In December 1999, I resigned as Director of the Center for Wireless Communications to pursue full-time research and education as a Professor of Electrical and Computer Engineering at UCSD, and on January 1, 2008, I became Professor of Electrical and Computer Engineering, Emeritus, Recalled to Research, maintaining an active research program.

13. At UCSD, I have taught courses on (1) probability, (2) random processes, and (3) wireless networks. My current research is focused on (1) broadband wireless networks for local access to homes, schools, and businesses; (2) wireless spaces to enable ubiquitous voice, data, and video wireless communications within buildings, and (3) so-called ad-hoc (self-organizing) networks of wireless sensor nodes for business and homeland security applications.

14. Over the course of my career, I have published (individually or with collaborators) over 170 original papers in scholarly journals and professional conference proceedings, and I am the named inventor or co-inventor on 40 U.S. patents.

15. I wrote one of the world's first textbooks devoted to broadband telecommunications, entitled An Introduction to Broadband Networks. I have lectured extensively on telecommunications in general and wireless

communications in particular, and I have regularly attended, and continue to attend, numerous world-wide professional conferences. I have chaired several major telecommunications conferences, and I have chaired numerous professional conference technical sessions. I read the technical literature extensively, and subscribe to several leading journals in the field of telecommunications in general and wireless communications in particular. Over the years, I have delivered many 3 to 5 day intensive short courses on telecommunications and wireless communications to professional audiences of practicing engineers and others. In 1988, I was elected to the grade of Fellow of the Institute of Electrical and Electronics Engineers, cited for contributions to high capacity digital satellite systems and broadband local communication networks.

16. I am being compensated for my time at the rate of $725 per hour for time spent on this matter. I have no interest in the outcome of this proceeding.

IV. MATERIALS CONSIDERED

17. My technical review, analysis, insights, and opinions are based on my experience and other qualifications discussed above, as well as my study of relevant materials.

18. I have reviewed and am familiar with the ‘382 patent specification, claims, and prosecution history.

19. I have also reviewed and am familiar with each exhibit cited herein. I confirm that to the best of my knowledge the accompanying exhibits are true and accurate copies of what they purport to be, and that an expert in the field would reasonably rely on them to formulate opinions such as those set forth in this declaration.

Exhibit No.	Exhibit Description
1001	U.S. Patent No. 10,750,382
1002	Prosecution History of U.S. Patent No. 9,197,382
1003	[Present] Declaration of Dr. Anthony Acampora
1004	*Curriculum Vitae* of Dr. Anthony Acampora
1005	U.S. Patent No. 9,398,464 ("Kummetz-464")
1006	U.S. Publication No. 2012/0039254A1 (Stapleton)
1007	U.S. Patent Application Publication No. 2010/0128676 A1 to Wu et al. ("Wu")
1008	U.S. Publication No. 2011/0281579 ("Kummetz-579")
1009	Common Public Radio Interface (CPRI); Interface Specification V4.0 (2008-06-30)
1010	U.S. Publication No. 2012/0057572 ("Evans")
1011	Provisional Application No. 61/506,363 (related to Kummetz-464 patent)

1012	U.S. Patent No. 9,735,999 ("Kummetz-999")
1013	Requirements for Open Radio equipment Interface (ORI) (Release 1), ETSI GS ORI 001 V1.1.1 (2011-10)
1014	PTAB-IPR2021-00408-7 (paper 7, Institution Decision in IPR on Patent Owner's '454 patent, the parent to the '382 patent)
1015	PTAB-IPR2021-00408-30 (paper 30, Final Written Decision in IPR on Patent Owner's '454 patent, the parent to the '382 patent)
1016	PTAB-IPR2018-00571-53 (paper 53, Final Written Decision in IPR on Patent Owner's '473 patent)
1017	U.S. Provisional Application Ser. No. 61/382,836, entitled 'Remotely Reconfigurable Distributed Antenna System and Methods,' filed Sep. 14, 2010, (incorporated by prior art Stapleton of EX1006)
1018	U.S. Patent Application Publication No. 2009/0180426 A1 ("Sabat").
1019	U.S. Patent U.S. Patent No. 9,531,473 ("the '473 patent")
1020	Exhibit C (Claim Chart for '454 Patent) to Dali Wireless, Inc.'s Disclosure of Asserted Claims and Infringement Contentions in *Dali Wireless, Inc. v. Corning Optical Communications LLC*, No. 3:20-cv-06469-EMC (N.D. Cal.)
1021	U.S. Provisional Application Ser. No. 61/374593, entitled 'Remotely Reconfigurable Distributed Antenna System and Methods,' filed Sep. 14, 2010, (incorporated by prior art Stapleton of EX1006)
1022	U.S. Patent No. 10,506,454 (parent to '382 patent at issue in this IPR)
1023	*Network Design Basics for Cabling Professionals*, BICSI, McGraw-Hill (2002)(excerpts).

V. RELEVANT LEGAL PRINCIPLES

A. Effective Filing Date

20. I understand that claims of a patent have an "effective filing date" and that obviousness is considered based on the prior art as of that date.

21. The utility application for the '382 patent (application No. 16 / 661,368) was filed on October 23, 2019 ("Utility Application"). The Utility Application claims priority to a Provisional Application No. 61/678,016 filed on July 31, 2012.

22. For the purpose of this proceeding, I have been asked to use July 31, 2012 as the effective filing date for challenged claims 1-19.

B. Person of Ordinary Skill in the Art

23. I have been informed that a person of ordinary skill in the art ("POSA") is a person who is presumed to have complete knowledge of the relevant prior art and who would think along the lines of conventional wisdom in that art. The person of ordinary skill in the art has ordinary creativity and does not have extraordinary skill, e.g., is not an expert. I have been informed that factors to consider in determining the level of ordinary skill in the art include the educational level of workers in the field, the types of problems addressed in the art, prior-art solutions to such problems, how quickly innovations are made, and the complexity of the technology.

24. The ‘382 patent relates to wireless communication systems. Generally speaking, the ‘382 patent is directed to wireless communication systems employing distributed antenna systems. *See* EX-1001 (‘382 Patent). In wireless communications, a distributed antenna system is used by a wireless service provider to distribute communication signals to or from mobile devices such as cell phones into coverage areas that are difficult to reach using conventional base station antennas. For example, conventional base stations often have difficulty sending wireless signals into buildings. In view of the factors mentioned above and the discussion of the technical background herein, it is my opinion that a person of ordinary skill in the art of the ‘382 patent would have a Bachelor’s Degree in Electrical Engineering or equivalent field of study, with 2-3 years of work experience in the field of wireless communications.

25. Throughout my declaration, even if I discuss my analysis in the present tense, I am always making my determinations based on what a POSA would have known at the time of the invention.

C. Claim Construction Standard

26. I have been instructed by counsel on the law regarding claim construction and patent claims, and understand that a patent may include two types of claims—independent claims and dependent claims. An independent claim stands alone and includes only the features it recites. A dependent claim can

depend from an independent claim or another dependent claim. I understand that a dependent claim includes all the features that it recites in addition to all of the features recited in the claim from which it depends.

27. In an *inter partes* review proceeding such as this, I understand the claim of a patent shall be construed using the same claim construction standard that would be used to construe the claim in a civil action. I understand this includes construing the claim in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent. For completeness, I understand this standard is different from the prior "broadest reasonable interpretation" standard that was used in certain earlier inter partes review proceedings.

28. I understand an appropriate dictionary definition may provide evidence explaining the ordinary and customary meaning as would be understood by a person of ordinary skill in the art.

29. I understand that if there are specific statements in the specification that define the invention with respect to a term, those statements are strong evidence of a definition for the term.

D. Construing Terms of '382 Patent

30. In view of the prior art applied in my analysis, I do not expect the meaning of any of the claim terms will be in dispute in this proceeding.

E. Anticipation and Obviousness Law

31. In this declaration I have been instructed by counsel on the law regarding anticipation and obviousness. I understand that a claim is invalid if it is anticipated or obvious. My opinions here relate to both anticipation and obviousness as detailed below.

1. Anticipation

32. I understand that anticipation of a claim requires that every element of a claim is expressly or inherently disclosed in a single prior art reference. I understand that an anticipating reference need not use the exact terms of the claims, but must describe the patented subject matter with sufficient clarity and detail to establish that the claimed subject matter existed in the prior art and that such existence would be recognized by persons of ordinary skill in the field of the purported invention. I also understand that an anticipating reference must enable one of ordinary skill in the art to reduce the purported invention to practice without undue experimentation.

2. Obviousness

33. I understand that a patent claim is also invalid if the claims would have been obvious to a POSA at the time of the invention. I understand that the

obviousness inquiry should not be done in hindsight but rather from the perspective of a POSA as of the time of the invention.

34. I understand that to obtain a patent, the claims must have been, as of the time of the invention, nonobvious in view of the prior art. I understand that an obviousness analysis involves comparing a claim to the prior art to determine whether the claimed invention would have been obvious to a POSA at the time of the invention in view of the prior art and in light of the general knowledge in the art as a whole. I also understand that obviousness is ultimately a legal conclusion based on underlying facts of four general types, all of which must be considered:

(1) the scope and content of the prior art;

(2) the level of ordinary skill in the art;

(3) the differences between the claimed invention and the prior art; and

(4) any objective indicia of nonobviousness.

35. I understand that a claim is obvious when the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious to a POSA at the time of the invention.

36. I understand that certain objective indicia can be important evidence regarding whether a patent is obvious. Such indicia include: industry acceptance; commercial success of products covered by the patent claims; 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; taking of licenses under the patent by others; expressions of surprise by experts and those skilled in the art at making the invention; and the patentee proceeded contrary to the accepted wisdom of the prior art. I understand that such evidence must have a nexus, or causal relationship to the elements of the claim. I am unaware of any such objective considerations having a nexus to the claims at issue in this proceeding.

37. I understand that obviousness can be established by combining multiple prior art references to meet each and every claim element, or by modifying a single prior art reference.

38. I understand that a showing of obviousness requires that, as of the patent's effective filing date, (1) a POSA would have been motivated to combine prior art references to arrive at the claimed subject matter and (2) there would have been a reasonable expectation of success in achieving the claimed invention from such combination.

39. I also understand that to support a combination of multiple prior art references or a modification of a single reference, there must be a rationale explaining why a skilled artisan would combine or modify the references in the

manner claimed and how the proposed combination or modification meets each and every claim element. But I also understand that a proposed combination or modification of references can be susceptible to hindsight bias. When it appears hindsight bias is being used, I understand the modification or combination is not considered obvious.

40. I understand that exemplary rationales that may support a conclusion of obviousness include: combining or modifying prior art elements according to known methods to yield predictable results; simple substitutions of one known element for another to obtain predictable results; using a known technique to improve similar devices in the same way; applying a known technique to a known device ready for improvement to yield predicable results; choosing from a finite number of identified, predicable 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 predicable 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.

41. I understand that teaching away, e.g., discouragement from making the proposed modification, is strong evidence that the references are not

combinable. I also understand that a disclosure of more than one alternative does not necessarily constitute a teaching away.

42. I understand that the combination does not need to result in the most desirable embodiment, but if the proposed combination does not have a reasonable expectation of success at the time of the invention, a POSA would not have had an adequate teaching, suggestion, or motivation to combine the references.

43. I understand that the test for obviousness is not whether the features of a secondary reference may be bodily incorporated or physically combined into the structure of the primary reference, but whether the claimed invention is rendered obvious by the teachings of the references as a whole.

VI. The '382 Patent

A. Overview

44. The '382 patent, titled "Optimization of Traffic Load in a Distributed Antenna System," describes a system for dynamically routing radio resources in a Distributed Antenna System (DAS). EX1001, Abstract, 1:21-25, 1:49-51 ("a system for dynamically routing signals in a Distributed Antenna System is provided"). The '382 patent generally relates to a DAS that employs traffic monitoring and load balancing. EX1001, Abstract, 1:21-25.

45. Problem addressed. The '382 patent addresses the problem of load balancing in a distributed wireless network and, in particular, for venues in which the wireless subscribers frequently move and congregate in areas within the venue.

> One of the most difficult challenges faced by network operators is caused by the physical movement of subscribers from one location to another, and particularly when wireless subscribers congregate in large numbers at one location. A notable example is a business enterprise facility during lunchtime, when a large number of wireless subscribers visit a lunch room or cafeteria location in the building. At that time, a large number of subscribers have moved away from their offices and usual work areas. … . [I]t is very likely that the lunchtime scenario will present some unexpected challenges with regard to available wireless capacity and data throughput.

EX1001 at 1:31-48.

46. A preferred embodiment of the DAS of the '382 patent is shown in Fig. 1 (below, annotated). The system of Fig. 1 includes a single three-sector base transceiver station (BTS) coupled to three digital access units (DAUs). The DAUs are coupled to digital remote units (DRUs) located in cells or coverage areas. Each cell includes seven DRUs. EX1001, 2:26-30. As claimed, the system of the '382 patent may include "one or more" BTSs (e.g., claim 2) and "one or more" DAUs (e.g., claim 1). EX1001 at 1:49–2:15, 2:26-30, 4:56–67, Fig. 1, claim 1 ("one or more DAUs").

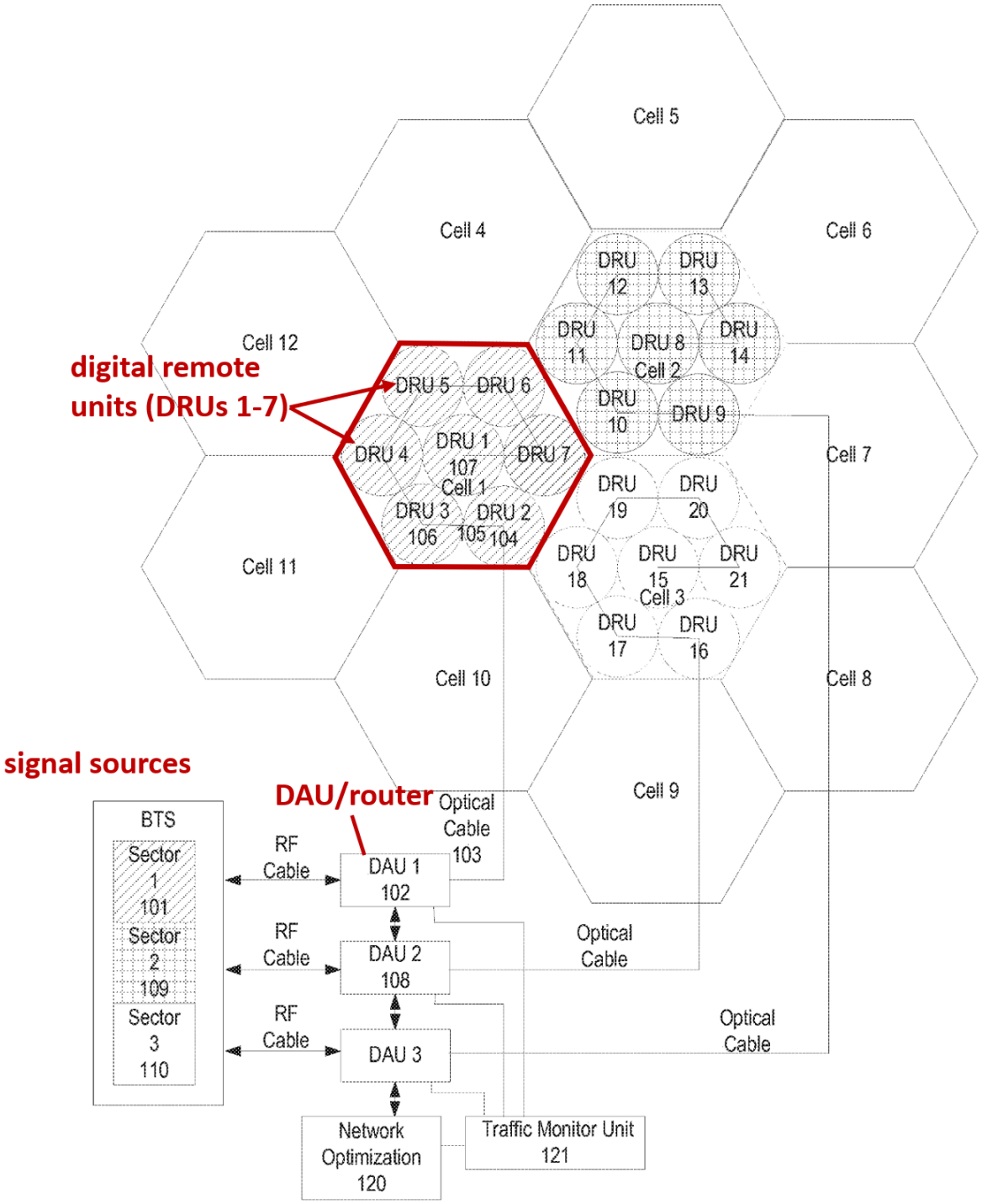


FIG. 1

EX1001, Fig. 1.

47. Sectors/radio resources received from the BTS. In Fig. 1 of the '382 patent, the BTS comprises "3 independent radio resources, commonly known as sectors." EX1001, 5:8-10. While the radio resources of each sector are received by a different DAU (i.e., DAU-1 receives sector-1, DAU-2 receives sector-2, and DAU-3 receives sector-3), the DAUs are interconnected and thus the radio resources of each sector are available to each of the DAUs. EX1001, 7:8-13 (e.g., "DAU1 … is networked with DAU2 … to allow the downlink signals from Sector-2 … and Sector-3 … to be transported to all the DRUs in Cell 1.") "The system's switching and routing functions enable the selection of which sectors' signals are transmitted and received by each DRU." EX1001, 7:10-13.

48. Traffic monitoring unit. The system of the '382 patent further comprises a traffic monitoring unit 121 and network optimization unit 120. EX1001, 7:15-27. The traffic monitoring unit 121 "tracks the traffic load at each DAU in the network," collects that information, and stores it in the network optimization unit 121, which in turn "calculates the overall DAS network performance and determines the optimum reconfigured network to improve or maximize performance." *Id.* Optimization is achieved by "communicating with the DAUs and shifting traffic between sectors." *Id.*, 7:37-39. It should be noted that '382 patent defines "optimization" to include performance improvements, even if complete optimization is not achieved:

> Although embodiments are discussed in terms of optimization of DAS networks, the term optimization is properly understood to include performance improvements in comparison to conventional systems, even if complete optimization is not achieved. Thus, optimization does not require the maximum values for traffic management metrics, but also includes distribution of traffic that improves system performance while remaining short of maximum performance.

EX1001, 6:7-15

49. The network optimization unit 120 can implement a network optimization goal (*e.g.*, number of users) based on traffic information in the form of key performance indicators (KPIs):

> KPI may comprise information such as: number of blocked calls, number of active calls, average power of uplink channels, average power of downlink channels, traffic on each sector, failed calls, number of satisfied users, number of unsatisfied users, number of users operating through a given DRU, and the like.

EX1001, 10:38-45. See also EX1001, 7:51-53, 11:33-38.

50. Redistributing radio resource capacity based on KPI and/or QoS. Based on KPIs and predefined Quality of Service (QoS) threshold, a DRU can be reallocated from one BTS sector (*e.g.*, a high traffic sector) to another BTS sector (*e.g.*, a low traffic sector). EX1001, 11:5-25. The '382 patent describes an example of load balancing based on a detected KPIs such as the traffic load for respective DRUs.

> As an example of optimizing network performance, a base station typically has three sectors. The DRU can be allocated to different sectors in order to improve performance by shifting traffic from a first sector (e.g., a high traffic sector) to a second sector (e.g., a low traffic sector) by shifting a DRU allocated to the first sector to the second sector. Although some embodiments of the present invention will not optimize performance of the system, the system performance can be improved using the techniques described herein, for example, by measuring the traffic load on the DRUs, performing load balancing of the traffic on the DRUs, to reduce the load on a first DRU characterized by a first traffic load by shifting the load to a second DRU characterized by a second traffic load less than the first traffic load.

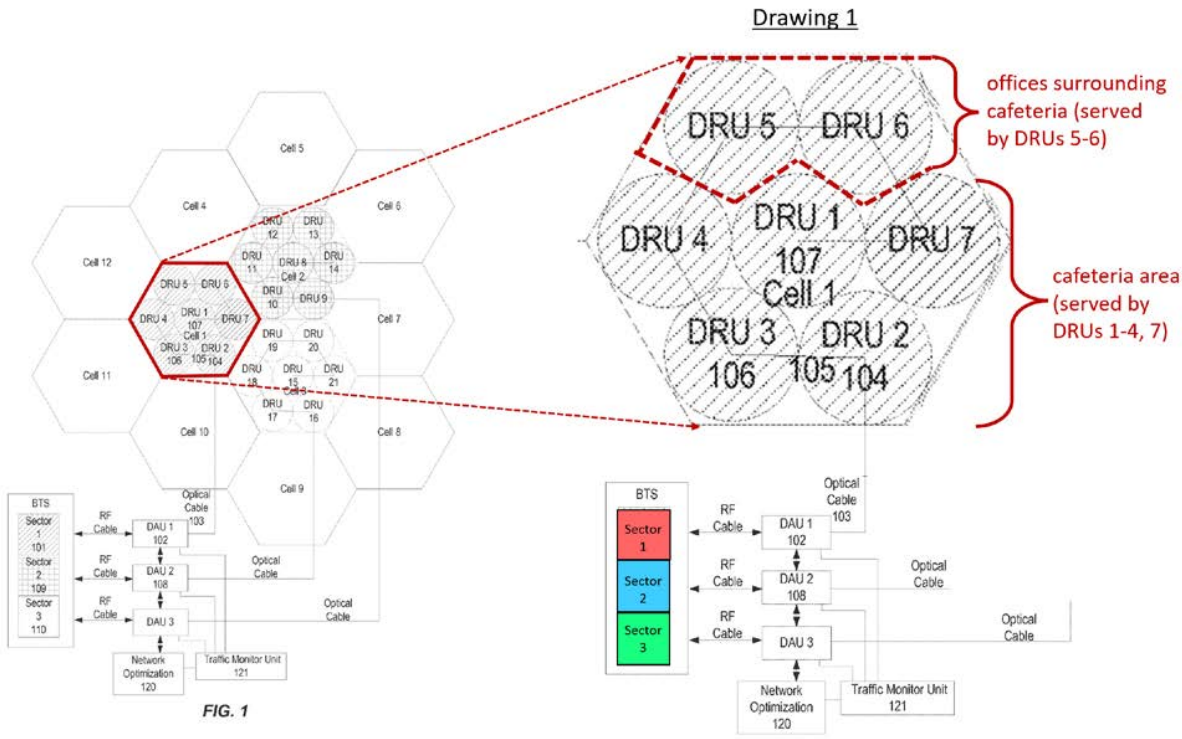
EX1001, 11:6-20. The '382 patent further states that in "the optimization process, system performance can be measured against a predetermined threshold [a QoS], with the optimization process terminating one the predetermined threshold has been reached." EX1001, 11:20-25 and 11:61-62 ("QoS metrics could be defined and mapped to a set of KPIs").

51. Drawing 1 (below, right) corresponds to Fig. 1 of the '382 patent but focuses only on the coverage area of cell 1. Drawing 1 is provided to illustrate how the '382 system operates to address the capacity problem "when wireless subscribers congregate in large numbers at one location." EX1001, 1:31-35.

> A notable example is a business enterprise facility during lunchtime, when a large number of wireless subscribers visit a … cafeteria location in the building. At that time, a large number of subscribers have moved away from their offices and usual work areas. … . [I]t is very likely that the

> lunchtime scenario will present some unexpected challenges with regard to available wireless capacity and data throughput.

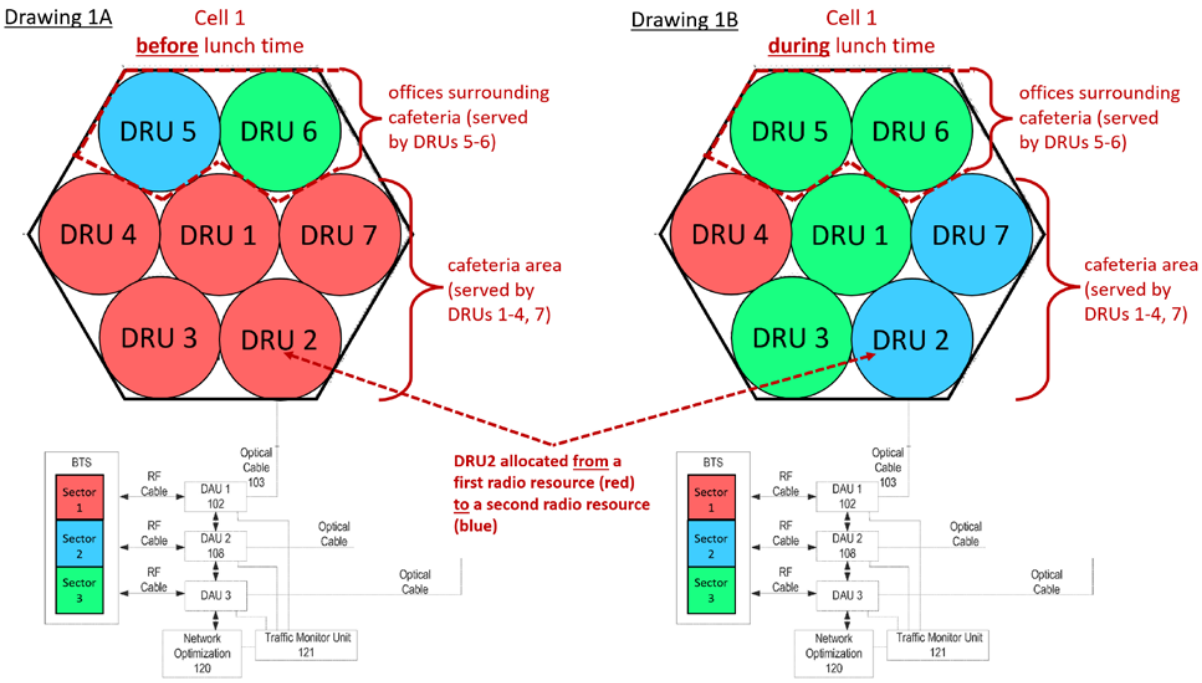
EX1001, 1:31-48.



52. As illustrated in the '382 patent system of Drawing 1: (a) the venue's coverage area includes two locations including the cafeteria area and the office area, each served by a different subset of DRUs (DRUs 1-4, 7 serve the cafeteria and DRUs 5, 6 serve the office area); (b) the DAS receives "a plurality of radio resources" from the BTS, including a first, second, and third radio resource, red, blue and green, respectively; and (c) each of the red, blue and green radio resources are available to the router for distribution to all, or any subset, of DRUs

1-7 serving the coverage area. While each of the red, blue, and green radio resources are received by a different DAU, the DAUs are interconnected and thus each of the red, blue and green radio resources are available to DAU1 for distribution to DRUs 1-7 serving the coverage area. EX1001, 7:8-13.

53. I created Drawings 1A and 1B below (derived from Fig. 1 of the '382 patent) to illustrate an example of how the system of the '382 patent would operate to address the problem discussed at column 1, lines 35-42, i.e., the movement of wireless subscribers within a "business enterprise facility" in which the coverage areas include (a) the cafeteria and (b) the offices surrounding the cafeteria.



54. Before lunch time (Drawing 1A), most of the wireless subscribers are located in the offices surrounding the cafeteria, not in the cafeteria. During that

time, the system of the ‘382 patent would allocate more radio resources (sectors) to the office areas. Thus, in the example of Drawing 1A, DRU 5 and DRU 6 serving the office areas are allocated the radio resources of sectors 2 (blue) and sector 3 (green), respectively. DRUs 1-4, 7 would be allocated less capacity, each being allocated the radio resource of sector 1 (red).

55. During lunch time (Drawing 1B), most of the wireless subscribers congregate in the cafeteria and the system of the ‘382 patent would detect this through KPI measurements and respond by allocating more radio resources to the DRUs serving the cafeteria area (DRUs 1-4, 7). Thus, in the example of Drawing B, the DRUs serving the cafeteria (DRUs 1-4, 7) are allocated most of the capacity: the radio resource of sector 1 (red) is dedicated to DRU 4, the radio resource of sector 2 (blue) is dedicated to DRUs 2 and 7, and the radio resource of sector 3 (green) is allocated to DRUs 1 and 3 and shared with the DRUs serving the office area (DRUs 5-6).

B. Claims

56. The ‘382 patent includes two independent claims, claims 1 and 10. The table below, showing claims 1 and 10 side by side, indicates that claims 1 and 10 are nearly identical in scope. I have highlighted one difference between claims 1 and 10 – claim 10 requires that the “traffic monitoring unit” be “external to” at least one of the DAUs.

Claim 1 (‘382 patent)	Claim 10 (‘382 patent)
1. A system comprising:	10. A system comprising:
one or more Digital Access Units (DAUs) operable to receive at least one signal from at least one of a first signal source and a second signal source from one or more of a plurality of signal sources, each DAU of the one of more DAUs including an input port configured as an uplink/downlink port and an output port configured as an uplink/downlink port;	one or more Digital Access Units (DAUs) operable to receive at least one signal from at least one of a first signal source and a second signal source from one or more of a plurality of signal sources, each DAU of the one or more DAUs including an input port configured as an uplink/downlink port and an output port configured as an uplink/downlink port;
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;	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;
a plurality of radio resources formed from the one or more DRUs comprising a first radio resource and a second radio resource different from the first radio resource, each radio resource comprising a subset of the plurality of DRUs; and	a plurality of radio resources formed from the one or more DRUs comprising a first radio resource and a second radio resource different from the first radio resource, each radio resource comprising a subset of the one or more DRUs; and
a traffic monitoring unit coupled to at least one of the DAUs, wherein the traffic monitoring unit is configured to:	a traffic monitoring unit **external to** and couplable to at least one of the DAUs, 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	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,
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.	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.

C. The '382 Prosecution History

57. Utility application number 16/661,368 that eventually issued as the '382 patent was originally filed on October 23, 2019. The application as filed included one claim shown below:

> 1. A system for dynamically routing signals in a Distributed Antenna System, the system comprising:
>
> a plurality of Digital Access Units (DAUs), wherein the plurality of DAUs are coupled and operable to route signals between the plurality of DAUs;
>
> a plurality of Digital Remote Units (DRUs) coupled to the plurality of DAUs and operable to transport signals between DRUs and DAUs;
>
> a plurality of Base Transceiver Stations (BTS);
>
> a plurality of traffic monitoring modules; and
>
> a network optimization goal and optimization algorithm.

EX-1002, 28.

58. In an office action dated February 13, 2020, the examiner rejected the sole claim (a) based on double patenting in light of claims 1 and 2 of the related parent patent (10,506,454) and (b) for anticipation by patent application no. 2013/0128810 to Lee. The examiner explained that the Lee reference disclosed the claimed network optimization goal and optimization algorithm in an algorithm operating within the DAU Monitoring module described in paragraph 0069 of the reference. EX-1002, 83-89, 87.

59. In an amendment dated March 30, 2020, the patent owner filed a terminal disclaimer[1] to overcome the double-patenting rejection, amended claim 1 as shown below, and filed new claims 2-19:

[1] I understand that a terminal disclaimer is a statement made by the applicant agreeing to limit or shorten the term during which the claims under examination would be enforceable if issued and that the shorter term is typically the same term given to an already-issued patent that already included claims of similar scope.

1. (Currently Amended) A system ~~for dynamically routing signals in a Distributed Antenna System, the system comprising:~~

~~a plurality of Digital Access Units (DAUs), wherein the plurality of DAUs are coupled and operable to route signals between the plurality of DAUs;~~

~~a plurality of Digital Remote Units (DRUs) coupled to the plurality of DAUs and operable to transport signals between DRUs and DAUs;~~

~~a plurality of Base Transceiver Stations (BTS);~~

~~a plurality of traffic monitoring modules; and~~

~~a network optimization goal and optimization algorithm.~~

comprising:

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

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;

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

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

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.

EX-1002, 101-106, 102-103.

60. In response, on April 9, 2020, the examiner issued a notice of allowability. The examiner's reasons for allowance discussed what the examiner believed to be the closest prior arts of record as follows:

> The closest prior arts of record are:
>
> Lee et al. (US-2013/0128810) which differs from the claimed invention by not explicitly reciting 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 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.
>
> Trigui et al. (US-8,498,207) discloses the ability to provide dynamic load balancing in a cellular network, but differs from the claimed invention by not explicitly reciting 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.
>
> Kummetz et al. (US-2010/0278530) provides for a distributed antenna system for wireless network systems (Abstract) that includes DAUs [0031] "Master Units" and DRUs

> [0031] "Remote Units", but differs from the claimed invention by not explicitly reciting 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 and that 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 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.
>
> Applicant's claims recite a particular combination that is neither taught nor suggested by the prior art and are allowed for these reasons and the reasons stated by the Applicant in the response dated 3/30/2020.

EX-1002, 120-124, 122-123.

61. After allowance, on July 6, 2020, the applicant submitted another information disclosure statement that listed multiple prior art references for the examiner to review. EX-1002, 163-167. The form listed 57 references or other materials, including US 2012/0039254 to Stapleton. EX-1002, 163-167. However, the examiner refused to consider any of the 57 references because the information disclosure statement did not include a required statement:

NOTICE OF NON-COMPLIANT INFORMATION DISCLOSURE STATEMENT

An Information Disclosure Statement (IDS) filed 7.06.2020 in the above-identified application fails to meet the requirements of 37 CFR 1.97(d) for the reason(s) specified below. Accordingly, the IDS will be placed in the file, but the information referred to therein has not been considered.

The IDS is not compliant with 37 CFR 1.97(d) because:

☑ The IDS lacks a statement as specified in 37 CFR 1.97(e).

☐ The IDS lacks the fee set forth in 37 CFR 1.17(p).

☐ The IDS was filed after the issue fee was paid. Applicant may wish to consider filing a petition to withdraw the application from issue under 37 CFR 1.313(c) to have the IDS considered. See MPEP 1308.

EX-1002, 338.

D. Prior IPR proceedings on the '454 patent

62. The parent patent to the '382 patent, U.S. Patent No. 10,506,454 (the '454 patent), was the subject of IPR2021-00408. EX1014 (Institution Decision), EX1015 (Final Written Decision). The table below shows claim 1 '382 next to claim 1 of the '454 patent.

Designation	Claim 1 ('382 patent) (EX1001, 17:64 – 18:24)	Claim 1 (parent '454 patent) (EX1022, 17:50 – 18:12)
Element 1A	1. A system comprising:	1. A system for dynamically routing signals in a Distributed Antenna System (DAS) operable to communicate with a plurality of signal sources, the system comprising:
Element 1B	one or more Digital Access Units (DAUs) operable to receive at least one signal from at least one of a first signal source and a second signal source from one or more of a plurality of signal	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

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

63. I note two differences between the two claims.

64. First, the term "sector" as used in claim 1 of the '454 patent is replaced with the term "radio resources" in claim 1 of '382 patent.

65. Second, the '454 patent claim 1 requires the traffic monitoring unit to determine both recited characteristics of network traffic, i.e., the system must determine (a) key performance indicator (KPI) **and** (b) quality of service (QoS). By contrast, the '382 patent claim 1 requires the traffic monitoring unit to determine only one of the two recited characteristics, i.e., the system must determine (a) a key performance indicator (KPI) **or** (b) a quality of service (QoS).

66. Likewise, the '454 patent claim 1 requires the traffic monitoring unit to reconfigure the sectors based on both recited characteristics of network traffic, i.e., based on (a) key performance indicator (KPI) **and** (b) quality of service (QoS). By contrast, the '382 patent claim 1 requires the traffic monitoring unit to reconfigure the radio resources based on only one of the two recited characteristics, i.e., based on (a) a key performance indicator (KPI) **or** (b) a quality of service (QoS).

67. That the '454 patent requires determination of both a KPI and a QoS was important to the PTAB's final written decision (FWD) in the IPR on '454 patent. In the '454 IPR, the PTAB found that, although Kummetz-464 discloses determining a KPI, the Petitioner had failed to establish that Kummetz-464

discloses determining a quality of service (QoS) of network traffic. The PTAB also found that the Petitioner in the '454 IPR failed to establish that Kummetz-464 reconfigured sectors based on a quality of service (QoS) of network traffic.

VII. Summary of the Asserted Prior Art

A. Stapleton U.S. Patent App. Pub. No. 2012/00339254

68. Stapleton discloses a distributed antenna *system* (DAS). Figure 1, for example, shows distributed antenna system (100):

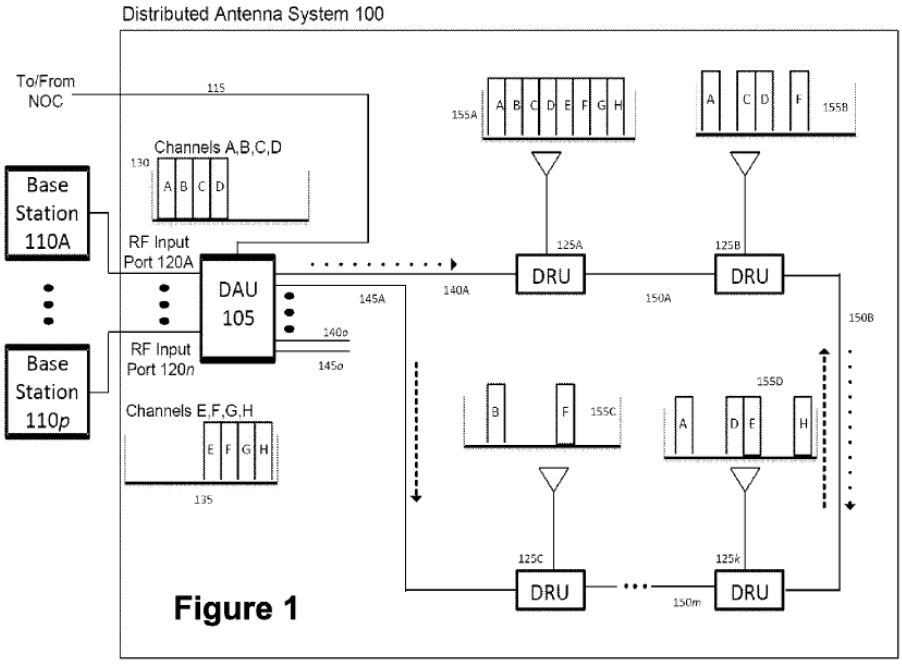


Figure 1

69. EX1006, Fig. 2. As shown, DAS (100) comprises a digital access unit (DAU) (105) and a plurality of digital remote units (DRUs) (125). In the Stapleton DAS, a "key function is determining and/or setting the appropriate amount of *radio resources* (such as RF carriers, CDMA codes or TDMA time slots) assigned to a

particular DRU or group of DRUs to meet desired capacity and throughput objectives." EX1006, ¶0054; *see also* EX1006, ¶0058 ("certain *radio resources* (such as RF carriers, CDMA codes or TDMA time slots) for *use by a particular DRU*").

70. Stapleton provides an overview of the system in Paragraph 28:

> The present invention is a novel Reconfigurable Distributed Antenna System that provides a high degree of flexibility to manage, control, re-configure, enhance and facilitate the radio resource efficiency, usage and overall performance of the distributed wireless network. FIG. 1 illustrates an embodiment of the Distributed Antenna System 100 in accordance with the present invention. The system employs a Digital Access Unit functionality 105 (hereinafter "DAU"). The DAU 105 serves as an interface between associated base stations (BTS) 110A-B and a plurality of digital remote units (DRU) 125A-n, although only four DRU's are shown in FIG. 1. … In addition, those skilled in the art will recognize that a DAU is monitored and controlled by a remote network operations center ("NOC"), as indicated at bidirectional link 115 in FIG. 1. Such links are typically Ethernet connections or external modems, but can be any form of link suitable for remote monitoring and control. The NOC has the capability to remotely configure the DAU parameter settings which in turn configures the DRU's parameter settings. The NOC can request information from the DAUs. The DAUs can subsequently request information from the DRUs. The information requested includes but is not limited to uplink power, downlink power, optical error rate, gain settings, active carriers, etc.

EX1006, ¶0028. Stapleton also illustrates its system in Figs. 2-4, 7, 8.

B. Kummetz-464

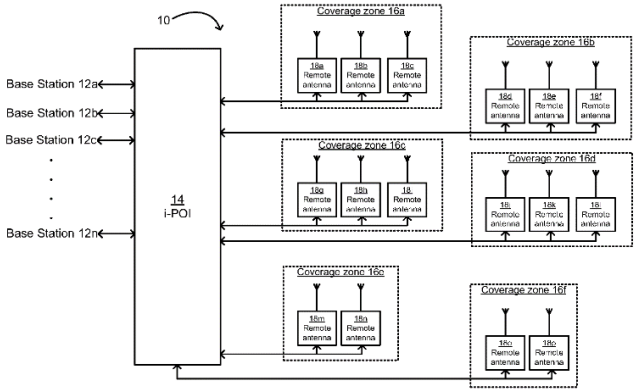
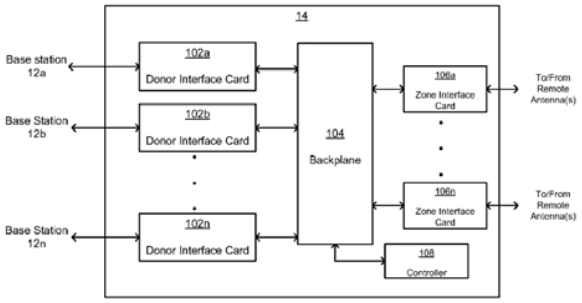
1. Kummetz-464 is prior art

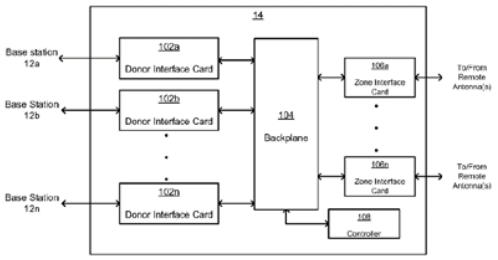
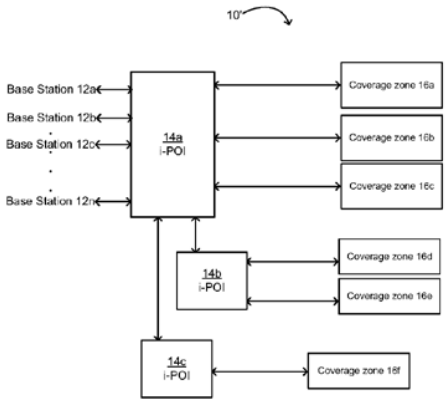
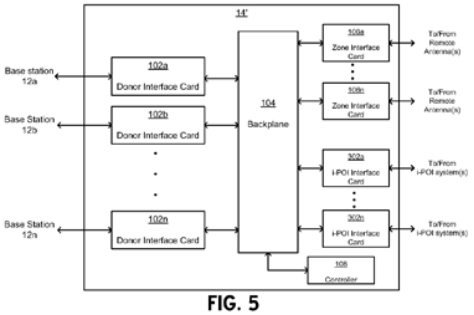
71. The application for the Kummetz-464 patent was filed on July 12, 2012. EX-1005.

72. I have been advised that Kummetz-464 (EX1005) is prior art to the '382 patent (EX1001) because the application for the Kummetz-464 was filed before the earliest effective filing date of the '382 patent.

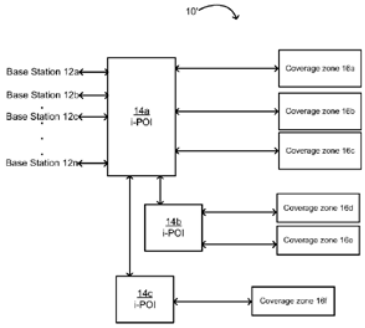
73. I have also been advised that the application for the Kummetz-464 claims the benefit of US provisional application no. 61/506,363 ("Kummetz-363 provisional application," (EX1011) which was filed on July 11, 2011. I have also been advised that the application for the Kummetz-464 may be entitled to the priority date of its provisional application (*i.e.*, July 11, 2011) if the provisional application provides support for (a) the claims of Kummetz-464 and (b) the disclosures relied upon in the Petition.

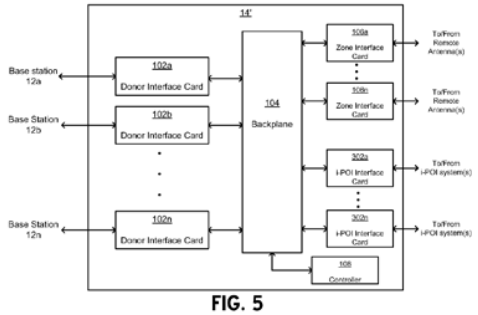
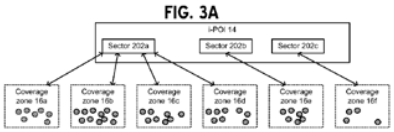
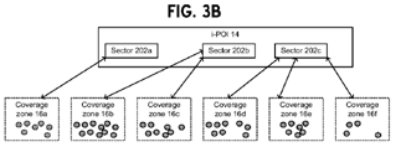
74. It is my opinion that the Kummetz-363 provisional application provides support for (a) claims of Kummetz-464, and (b) the disclosures relied upon in the Petition. See the tables below.

Claim 1 of Kummetz-464 (EX1005)	Support found in Kummetz-363 provisional application filed July 11, 2011 (EX1011)
1. A base station router configured for being disposed in a distributed antenna system, the base station router comprising:	*See e.g.,* EX1011, ¶¶ 6, 12-14, 16, 30, 50, 51, and Figs. 1, 2, 4, 5. For example, and without limitation: EX1011, ¶ 6: "Certain aspects and embodiments are directed to an intelligent point of interface ("i-POI") system that can be disposed in a distributed antenna system (DAS) and that can redistribute capacity among coverage zones serviced by the DAS. A DAS can include a unit, such as an i-POI system, in communication with carrier systems, such as base stations of cellular service providers. The i-POI system can provide one or more signals, such as analog RF signals or digitized RF signals, over a serial link to the remote antennas in the coverage zone. **An example of an i-POI system is an intelligent base transceiver station ("BTS") router."**  FIG. 1  FIG. 2
a first interface device configured for receiving sectors from a base station,	*See* EX1011, ¶¶ 7-9, 11-14, 17-20, 27-28, 33-30, 36, 38-39, 46, 50-51 and Figs. 1, 2, 4 and 5. EX1011, ¶2: "Figure 2 is a block diagram of an i-POI system with an interface section, an output section, and a backplane according to one embodiment."

each sector comprising a plurality of communication channels to be radiated to mobile devices in coverage zones managed by the base station router and representing an amount of telecommunication capacity for communicating information between the mobile devices and the base station; digital signal processing circuitry configured for managing an availability of the sectors for the coverage zones; a second interface device configured for communicating with a remote base station router configured for managing an additional availability of additional sectors for remote coverage zones; and	EX1011, ¶4: "Figure 4 is a block diagram of **interconnected i-POI systems [i.e., a first router interconnected to second router]** according to one embodiment." See also, EX1011, ¶6 stating that "An example of an i-POI system is an intelligent **base transceiver station ("BTS") router.**"  FIG. 2  FIG. 4  FIG. 5 For example, and without limitation: EX1011, ¶2: "Figure 2 is a block diagram of an i-POI system with **an interface section, an output section, and a backplane** according to one embodiment."

	EX1011, ¶7: "A coverage zone can include one or more remote antennas that provide signal coverage to an area. The remote antennas in a coverage zone can communicate with the i-POI system over a serial link. **The remote antennas can wirelessly communicate the signals from the i-POI system to wireless devices positioned in a coverage zone**." EX1011, ¶ 8: "The i-POI system can redistribute capacity by changing which sectors are provided to which coverage zones. **A sector can represent an amount of telecommunication capacity that can be allocated to wireless devices in one or more coverage zones**. Increasing the bandwidth associated with a sector can increase the capacity represented by the sector. **A sector can include one or more analog RF channels or digital signals representing RF channels**, signals in one or more analog or digital RF bands, and/or one or more multiple-input and multiple-output ('MIMO') data streams." EX1011, ¶ 12: "An i-POI system can include donor interface cards, a backplane, and zone interface cards. A donor interface card interfaces with a base station and can provide **digital data streams representing the signals of a sector to the backplane**." EX1011, ¶ 19: "The i-POI system 14 can include **circuitry for processing the signals communicated between the base stations 12a-n and the coverage zones 16a-f.** Processing the signals can include **transforming the signals received from the base stations 12a-n into a digital format**. Processing the signals can also include filtering downlink signals from the base stations 12a-n." EX1011, ¶ 20: "The i-POI system 14 can also include **circuitry for routing signals from the base stations 12a-n to the remote antennas 16a-f**. Routing the signals can include combining the signals of the sectors from one or more base stations 12a-n. In some embodiments, the i-POI system 14 can combine signals from multiple sectors associated with a common telecommunication system operator if the signals are associated with different frequency bands or different non-overlapping segments of the same RF band." EX1011. ¶ 27: "The **remote antennas in the coverage zone can radiate the group of signals, such as a sector, received from the i-POI system 14 to the coverage zone**." EX1011, ¶ 33: "In the downlink direction, the digital data streams from the donor interface cards 102a-n can be provided to the backplane 104. The backplane 104 can include configurable **digital signal processing circuitry for processing signals from the donor interface cards 102a-**n. An example

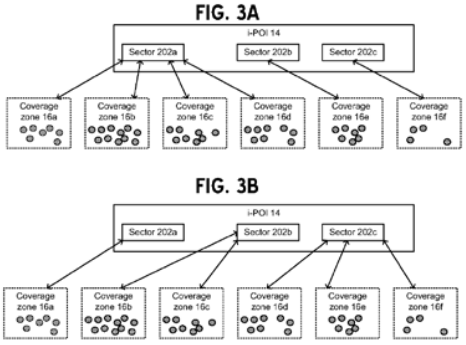
	of the configurable **digital processing circuitry is a field-programmable Gate Array ('FPGA')**." EX1011, ¶ 50: **Figure 4 depicts an embodiment of a DAS 10' that includes an i-POI systems 14a [i.e., a first router] in communication with other i-POI systems 14b, 14c [i.e., a second router].** The interconnected i-POI systems can communicate via any suitable communication medium, such as copper cable or optical link. An i-POI system 14a can provide the sectors received by the i-POI system 14a to the i-POI systems 14b, 14c. The sectors can be provided as digital data streams. By providing digital data streams to the i-POI systems 14b, 14c representing the sectors received by the i-POI system 14a, the DAS 1 O' can be expanded to provide coverage to a larger environment without requiring additional connections between the base stations 12a-n and the i-POI systems 14b, 14c. EX1011, ¶ 51: "Figure 5 depicts an embodiment of an i-POI system 14' with an output section of iPOI system 14' that includes one or more i-POI interface cards 302a-n. **The i-POI system 14' can communicate with other i-POI systems** via the i-POI interface cards 302a-n. The i-POI system 14' **can either provide sectors to coverage zones via the zone interface cards** 106a-n **or provide sectors to other i-POI systems via one or more i-POI interface cards 302a-n.**
a controller configured for: redistributing the availability of at least one sector from a first coverage zone of the coverage zones managed by the base station router to a second coverage zone of the coverage zones managed by the base station router, and redistributing, via the second interface device, the availability of at least one additional sector from the received sectors between at least one of	*See* EX1011, ¶¶ 7-9, 11-14, 17-20, 27-28, 33-30, 36, 38-39, 44-48, 50-51 and Figs. 1, 2, 3A, 3B, 4 and 5. EX1011, ¶2: "Figure 2 is a block diagram of an i-POI system with an interface section, an output section, and a backplane according to one embodiment." EX1011, ¶4: "Figure 4 is a block diagram of **interconnected i-POI systems [i.e., a first router interconnected to second router]** according to one embodiment." See also, EX1011, ¶6 stating that "An example of an i-POI system is an intelligent **base transceiver station ("BTS") router.**"  FIG. 4

the coverage zones managed by the base station router and at least one of the remote coverage zones managed by the remote base station router, wherein redistributing the availability of the at least one additional sector decreases a capacity density of at least one coverage zone managed by the base station router and increases a capacity density of at least one remote coverage zone managed by the remote base station router.	 FIG. 5  FIG. 3A  FIG. 3B For example, and without limitation: EX1011, ¶ 6: "Certain aspects and embodiments are directed to an intelligent point of interface ("i-POI") system that can be disposed in a distributed antenna system (DAS) and that can redistribute capacity among coverage zones serviced by the DAS. A DAS can include a unit, such as an i-POI system, in communication with carrier systems, such as base stations of cellular service providers. The i-POI system can provide one or more signals, such as analog RF signals or digitized RF signals, over a serial link to the remote antennas in the coverage zone. An example of an i-POI system is an intelligent base transceiver station ("BTS") router." EX1011, ¶ 8: "The i-POI system can redistribute capacity by changing which sectors are provided to which coverage zones. A sector can represent an amount of telecommunication capacity that can be allocated to wireless devices in one or more coverage zones. Increasing the bandwidth associated with a sector can increase the capacity represented by the sector. A sector can include one or more analog RF channels or digital signals representing RF channels, signals in one or more analog or digital RF bands, and/or one or more multiple-input and multiple-output ("MIMO") data streams." EX1011, ¶ 36: "The i-POI system 14 can also include a controller 108. The controller 108 can re-configure the configurable digital signal processing circuitry of the backplane 104 to change the routing of signals from the

	base stations 12a-n to the coverage zone 16a-f. The controller 108 can receive input representing changes to the routing of signals by the i-POI system 14. The input can be received via a graphical user interface or from an automation algorithm for determining the demand on each of the coverage zones. In some embodiments, as depicted in Figure 2, the controller 108 can be disposed in the i-POI system 14. In other embodiments, the controller 108 can be disposed in a separate device external to and in communication with the i-POI system 14." EX1011, ¶45: "Figure 3A depicts the i-POI system 14, according to an initial configuration, providing sectors 202a-c to the coverage zones 16a-f. The i-POI system 14 can be configured to communicate the signals of sector 202a to the coverage zones 16a-d, the signals of sector 202b to the coverage zone 16e, and the signals of sector 202c to the coverage zone 16f. The capacity of sector 202a is divided among the coverage zones 16a-d, while the entire capacity of sector 202b is provided to coverage zone 16e and the entire capacity of sector 202c is provided to coverage zone 16f. Accordingly, the capacity density of each of the coverage zones 16a-d is less than the capacity density of each of the coverage zones 16e-f." EX1011, ¶46: "The signals of a sector can be divided among the coverage zones. For example, a first wireless device in the coverage zone 16a may communicate using a first RF channel of sector 202a and a second wireless device in the coverage zone 16a may communicate using a second RF channel of sector 202a. The first and second RF channels of the sector 202a may be included in a common frequency band but be distributed to different coverage areas." EX1011, ¶47: "For example, a DAS 10 may service a stadium and a parking lot surrounding the stadium, with the coverage zones 16a-d corresponding to different sections of the stadium and the coverage zones 16e-f corresponding to the parking lot. Before an event hosted in the stadium begins, fewer wireless devices will be concentrated in the stadium than in the parking lot. The coverage zones 16a-d may therefore require less capacity than the coverage zones 16e, 16f. Accordingly, the i-POI system can be configured to provide the sector 202a to the coverage zones 16a-d, the sector 202b to coverage zone 16e, and the sector 202c to coverage zone 16f. Providing a single sector 202a to the coverage zones 16a-d inside the stadium can provide sufficient capacity density for each of the coverage zones 16a-d. Providing the sectors 202b, 202c to the coverage zone 16e inside the stadium can provide sufficient capacity density for each of the coverage zones 16a-d."

	EX1011, ¶48: "The i-POI system 14 can be re-configured via the controller 108 in response to changes concentration of wireless devices in the respective coverage zones. Figure 38 depicts the i-POI system 14 providing sectors 202a-c to the coverage zones 16a-f according to an subsequent configuration of the i-POI system 14. For example, if the DAS 10 services a stadium and the surrounding parking lot, more wireless devices will be concentrated inside the stadium than in the parking lot after an event begins. The i-POI system 14 can be reconfigured such that the sector 202a is provided to the coverage zone 16a, the sector 202b is provided to the coverage zones 16b, 16c, and the sector 202a is provided to the coverage zones 16d-f. The configuration of i-POI system 14 depicted in Figure 38 thus increases the capacity density of the coverage zones 16a-d as compared to the configuration of i-POI system 14 depicted in Figure 3A." EX1011, ¶49: "Although Figures 3A, 38 depict three sectors provided to six coverage zones, multiple sectors can be provided to a single coverage zone. For example, the signals of a first sector associated with a first telecommunication system operator and the signals of a second sector associated with a second telecommunication system operator can be combined and distributed to the same coverage zone or group of coverage zones. The number of coverage zones to which an i-POI system distributes sectors can be greater than or equal to the number of sectors distributed by the i-POI system." EX1011, ¶50: "Figure 4 depicts an embodiment of a DAS 10' that includes an **i-POI systems 14a in communication with other i-POI systems** 14b, 14c [**i.e., a first router in communication with a second router**]. The interconnected i-POI systems can communicate via any suitable communication medium, such as copper cable or optical link. An i-POI system 14a can provide the sectors received by the i-POI system 14a to the i-POI systems 14b, 14c. The sectors can be provided as digital data streams. By providing digital data streams to the i-POI systems 14b, 14c representing the sectors received by the i-POI system 14a, the DAS 10' can be expanded to provide coverage to a larger environment without requiring additional connections between the base stations 12a-n and the i-POI systems 14b, 14c. EX1011,¶ 51: "Figure 5 depicts an embodiment of an i-POI system 14' with an output section of i-POI system 14' that includes one or more i-POI interface cards 302a-n. The i-POI system 14' can communicate with other i-POI systems via the i-POI interface cards 302a-n. The i-POI system 14' can either provide sectors to coverage zones via the zone interface cards 106a-n or provide sectors to other i-POI systems via one or more i-POI

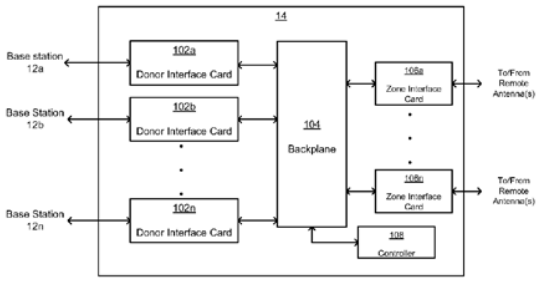
	interface cards 302a-n. Examples of the i-POI interface cards 302a-n can include copper or optical interface cards."
Claim 2	
2. The base station router of claim 1, wherein each communication channel corresponds to a signal configured for carrying data.	*See* EX1011, ¶¶ 6, 8, 12-13, 17, 24, 27, 29, 33. For example, and without limitation, *see* EX1011, ¶ 12: "An i-POI system can include donor interface cards, a backplane, and zone interface cards. A donor interface card interfaces with a base station and can provide digital data streams representing the signals of a sector to the backplane. The backplane can route digital signals from donor cards to one or more zone interface cards. The i-POI system can provide signals of a sector via the zone interface card to one or more remote antennas in a coverage zone."
Claim 3	
3. The base station router of claim 1, wherein the plurality of communication channels comprises a plurality of RF channels.	*See* EX1011, ¶¶ 6, 8, 20-22, 25, 28-30, 34, 46. For example, and without limitation, *see* EX1011, ¶ 21: "In some embodiments, the i-POI system 14 can communicate with both the base stations 12a-n and the remote antennas 18a-p using analog RF signals."
Claim 4	
4. The base station router of claim 1, wherein the plurality of communication channels comprises a plurality of digital signals, wherein each digital signal represents an RF channel.	*See* EX1011, ¶¶ 6, 8, 12, 21-24, 28-30, 33-35. For example, and without limitation, *see* EX1011, ¶ 22: "In other embodiments, the i-POI system 14 can communicate digital signals with the base stations 12a-n and communicate analog RF signals with the remote antennas 18a-p." *See also id.* ¶ 23: "In other embodiments, the i-POI system 14 can communicate digital signals with remote antenna units associated with remote antennas 18a-p. Processing signals from the base stations 12a-n can include converting signals in one digital format used by the base stations 12a-n into a different digital format used by the remote antenna units."
Claim 5	
5. The base station router of claim 1, wherein redistributing the availability of the at least one sector comprises increasing the number of communication	*See* EX1011, ¶¶ 8, 10, 37, 44-49, Figs. 3A, 3B.

channels provided to a first remote antenna unit in the first coverage zone and decreasing the number of communication channels provided to a second remote antenna unit in the second coverage zone.	 For example, and without limitation: EX1011, ¶ 8: "The i-POI system can redistribute capacity by changing which sectors are provided to which coverage zones. A sector can represent an amount of telecommunication capacity that can be allocated to wireless devices in one or more coverage zones. Increasing the bandwidth associated with a sector can increase the capacity represented by the sector. A sector can include one or more analog RF channels or digital signals representing RF channels, signals in one or more analog or digital RF bands, and/or one or more multiple-input and multiple-output ('MIMO') data streams." EX1011, ¶ 10: "Increasing the number of coverage zones to which a sector is distributed can decrease the capacity density of each coverage zone. The capacity density of a coverage zone can include the number of sectors distributed to the coverage zone. If more wireless devices are concentrated in a first coverage zone than are concentrated in a second coverage zone, the i-POI system can shift capacity from the second coverage zone to the first coverage zone. The i-POI can shift capacity by reducing the number of coverage zones to which a sector is distributed. By distributing the sector to fewer coverage zones (and thus a smaller physical area), the capacity density (i.e., the capacity per physical area) is increased. The number of coverage zones to which an i-POI system distributes sectors can be greater than or equal to the number of sectors distributed by the i-POI system."

Claim 6	
6. The base station router of claim 1, wherein the controller is further configured for executing a scheduling algorithm outputting a traffic indicator and redistributing the availability of the at least one sector from the first coverage zone to the second coverage zone in response to the traffic indicator, wherein the traffic indicator comprises a schedule indicator stored in a tangible memory device.	*See* EX1011, ¶¶ 36-37, 47 Figs. 2, 3A, 3B, 5. For example, and without limitation: EX1011, ¶ 37: "For example, the controller 108 may include a configuration manager that can trigger based on the detection of certain events. Examples of events include a scheduled event of a game, concert, or other type of event, scheduled sequence of events with pre-game, game, and post-game configurations, ..." EX1011, ¶ 47: "For example, a DAS 10 may service a stadium and a parking lot surrounding the stadium, with the coverage zones 16a-d corresponding to different sections of the stadium and the coverage zones 16e-f corresponding to the parking lot. Before an event hosted in the stadium begins, fewer wireless devices will be concentrated in the stadium than in the parking lot. The coverage zones 16a-d may therefore require less capacity than the coverage zones 16e, 16f. Accordingly, the i-POI system can be configured to provide the sector 202a to the coverage zones 16a-d, the sector 202b to coverage zone 16e, and the sector 202c to coverage zone 16f."
Claim 7	
7. The base station router of claim 1, wherein the controller is further configured for identifying a spectrum of signals in the first coverage zone and the second coverage zone, determining a traffic indicator based on the spectrum of signals, and redistributing the availability of the at least one sector from the first coverage zone to the second coverage zone in response to the traffic indicator, wherein the traffic indicator comprises a quantity of mobile devices in each coverage zone.	*See* EX1011, ¶¶ 36-39, 42-44, 47-48, Figs. 2, 3A, 3B, 5. For example, and without limitation: EX1011, ¶ 37 "The controller 108 may include configuration and report manager functions. In some embodiments, the controller 108 can detect traffic and perform measurements independent of the wireless network standard and protocol. For example, the controller 108 may include a configuration manager that can trigger based on the detection of certain events. Examples of events include a scheduled event of a game, concert, or other type of event, 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. The controller 108 may also include a report manager that can generate reports on traffic, spurious signals, usage, and other types of information. The controller 108 can implement any process for measuring uplink signals for traffic and other types of information, and reporting the information. Certain systems and processes that can be used to do so are described in U.S. Serial No. 12/778,312, filed May 12, 2010 and titled "System and Method for Detecting and Measuring Uplink Traffic

	in Signal Repeating Systems," the entirety of which is incorporated herein by reference." EX1011, ¶ 38: "In some embodiments, an i-POI system 14 can determine a location of a specific wireless device within the environment in which the DAS 10 is deployed. The i-POI system 14 can communicate with one of the base stations 12a-n to determine an identifier for the specific wireless device. An identifier for a wireless device can include any attributes of a communication link between a base station and a wireless device used to identify the wireless device. For example, the identifier can include the transmit and receive frequencies assigned to a wireless device used in frequency division multiple access schemes, a communication time slot assigned to the wireless device used in frequency division multiple access schemes, and/or a spreading code assigned to a wireless device in a code division multiple access scheme." EX1011, ¶ 38: "The i-POI system 14 can determine a channel over which the specific wireless device is communicating. A channel can include a connection, such as a transmit and receive frequency, over which a wireless device and a base station can communicate via the DAS. A sector of a base station received by a donor card of the i-POI system 14 can include the channel. The i-POI system 14 can determine a coverage zone to which the channel is being provided by determining which sector includes the channel and which coverage zone is receiving the sector." EX1011, ¶ 42: "In some embodiments, the i-POI system can include one or more spectrum analyzers that can analyze uplink and downlink signals. A spectrum analyzer can be a separate device disposed in the i-POI system or can be disposed in one or more of the donor interface cards 102a-n, the backplane 104, and/or the zone interface cards 106a-n. The spectrum analyzer can determine the frequencies of the component signals included in the uplink and downlink signals. The spectrum analyzer can store data representing the spectrum of uplink and downlink signals in a memory. The memory can be disposed in the i-POI system or in an external device." EX1011, ¶ 42: "The spectrum of the uplink and downlink signals can be used for additional processing of the uplink and downlink signals. Additional processing can include determining the frequencies being used in the respective coverage zone. Determining the frequencies being used in the respective coverage zones can be used to determine whether to redistribute the capacity of the DAS. Additional processing can also include identifying spurious signals, such as noise recovered by the remote antennas that can distort uplink signals, that can be removed using programmable band

	pass filters disposed in the i-POI system." EX1011, ¶ 43: "The spectrum of the uplink and downlink signals can be used for additional processing of the uplink and downlink signals. Additional processing can include determining the frequencies being used in the respective coverage zone. Determining the frequencies being used in the respective coverage zones can be used to determine whether to redistribute the capacity of the DAS. Additional processing can also include identifying spurious signals, such as noise recovered by the remote antennas that can distort uplink signals, that can be removed using programmable band pass filters disposed in the i-POI system." EX1011, ¶ 48: "The i-POI system 14 can be re-configured via the controller 108 in response to changes concentration of wireless devices in the respective coverage zones. Figure 38 depicts the i-POI system 14 providing sectors 202a-c to the coverage zones 16a-f according to an subsequent configuration of the i-POI system 14. For example, if the DAS 10 services a stadium and the surrounding parking lot, more wireless devices will be concentrated inside the stadium than in the parking lot after an event begins. The i-POI system 14 can be reconfigured such that the sector 202a is provided to the coverage zone 16a, the sector 202b is provided to the coverage zones 16b, 16c, and the sector 202[c] is provided to the coverage zones 16d-f. The configuration of i-POI system 14 depicted in Figure 38 thus increases the capacity density of the coverage zones 16a-d as compared to the configuration of i-POI system 14 depicted in Figure 3A."
Claim 8	
8. The base station router of claim 1, further comprising: an interface module configured for transforming signals associated with a plurality of sectors into digital data streams;	*See* EX1011, ¶¶ 19-21, 24, 33-35, 49. For example, and without limitation, *see* EX1011, ¶ 24: "For example, an i-POI system 14 communicating with remote antenna units may receive downlink signals that are digital signals in different standardized formats from the base stations 12a-n. The i-POI system 14 can convert the downlink signals to digital data streams in a common format and combine the digital data streams into a combined digital data stream. The i-POI system 14 can provide the combined digital data stream to the remote antenna units."
wherein the digital signal processing circuitry is further configured for: combining a first subset of the digital data streams associated	*See* EX1011, ¶¶ 19-21, 24, 33-35, 49, and Figs. 1, 2, 3A, 3B, 4 and 5. For example, and without limitation: EX1011, ¶9: "The signals of a sector can be provided to a coverage zone via the i-POI system. The signals of a sector can also be divided among two or more coverage zones providing coverage to a physical area. All of the

with a first sector into a first combined digital data stream; combining a second subset of the digital data streams associated with a second sector into a second combined digital data stream; and providing the first combined digital data stream and the second combined digital data stream to a first zone interface card configured for communicating with a first remote antenna unit in the first coverage zone and a second zone interface card configured for communicating with a second remote antenna unit in the second coverage zone.	signals of a sector can be radiated by the remote antennas of one or more coverage zones included in a physical area." EX1011, ¶10: "Increasing the number of coverage zones to which a sector is distributed can decrease the capacity density of each coverage zone. The capacity density of a coverage zone can include the number of sectors distributed to the coverage zone. If more wireless devices are concentrated in a first coverage zone than are concentrated in a second coverage zone, the i-POI system can shift capacity from the second coverage zone to the first coverage zone. The i-POI can shift capacity by reducing the number of coverage zones to which a sector is distributed. By distributing the sector to fewer coverage zones (and thus a smaller physical area), the capacity density (i.e., the capacity per physical area) is increased. The number of coverage zones to which an i-FPOI system distributes sectors can be greater than or equal to the number of sectors distributed by the i-POI system." EX1011, ¶12: "An i-POI system can include donor interface cards, a backplane, and zone interface cards. A donor interface card interfaces with a base station and can provide digital data streams representing the signals of a sector to the backplane. The backplane can route digital signals from donor cards to one or more zone interface cards. The i-POI system can provide signals of a sector via **the zone interface card to one or more remote antennas in a coverage zone**."  FIG. 2 EX1011, ¶19: "The i-POI system 14 can include circuitry for processing the signals communicated between the base stations 12a-n and the coverage zones 16a-f. Processing the signals can include **transforming the signals received from the base stations 12a-n into a digital format**. Processing the signals can also include filtering downlink signals from the base stations 12a-n." EX1011, ¶20: "The i-POI system 14 can also include circuitry for routing signals from the base stations 12a-n to the remote antennas 16a-f. Routing the signals can include **combining the signals of the sectors** from

	one or more base stations 12a-n. In some embodiments, the i-POI system 14 can **combine signals from multiple sectors** associated with a common telecommunication system operator if the signals are associated with different frequency bands or different non-overlapping segments of the same RF band. Routing the signals can also include transforming the signals into a format used by the remote antennas (e.g., analog RF signals), and **providing the combined signals to the remote antennas for specific coverage zones**." EX1011, ¶ 24: "For example, an i-POI system 14 communicating with remote antenna units may receive downlink signals that are digital signals in different standardized formats from the base stations 12a-n. The i-POI system 14 can convert the downlink signals to digital data streams in a common format and combine the digital data streams into a combined digital data stream. The i-POI system 14 can provide the combined digital data stream to the remote antenna units. Sectors provided as MIMO data streams, for example, can be combined with other digital data streams and provided to a common remote antenna unit. The remote antenna units can de-multiplex the combined digital data stream into digital data streams representing individual downlink signals." *See also id.* ¶ 49: "Although Figures 3A, 38 depict three sectors provided to six coverage zones, multiple sectors can be provided to a single coverage zone. For example, the signals of a first sector associated with a first telecommunication system operator and the signals of a second sector associated with a second telecommunication system operator can be combined and distributed to the same coverage zone or group of coverage zones. The number of coverage zones to which an i-POI system distributes sectors can be greater than or equal to the number of sectors distributed by the i-POI system."
Claim 9	
9. A distributed antenna system, comprising:	*See e.g.,* EX1011, ¶¶ 6, 12-14, 16, 30, 50, 51, and Figs. 1, 2, 3A, 3B, 4, 5. For example, and without limitation: EX1011, ¶ 6: "Certain aspects and embodiments are directed to an intelligent point of interface ('i-POI') system that can be disposed in a distributed antenna system (DAS) and that can redistribute capacity among coverage zones serviced by the DAS."

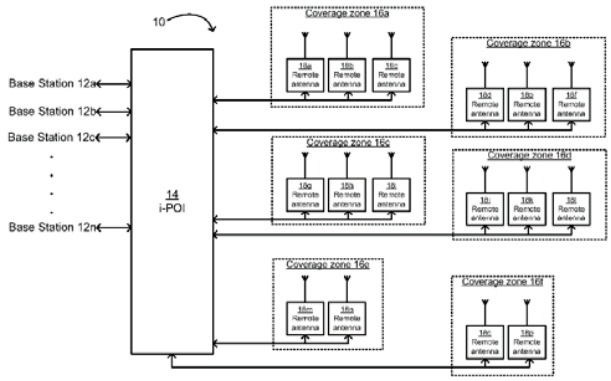


FIG. 1

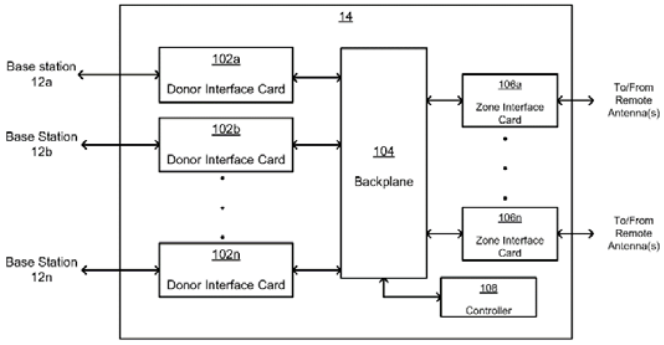


FIG. 2

FIG. 3A

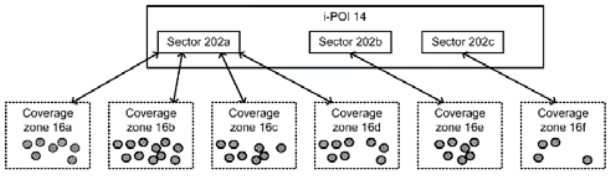
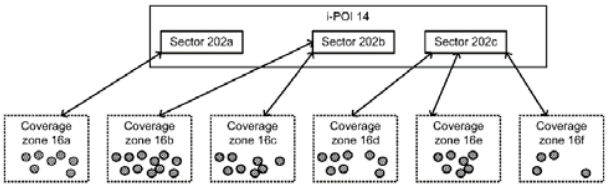


FIG. 3B



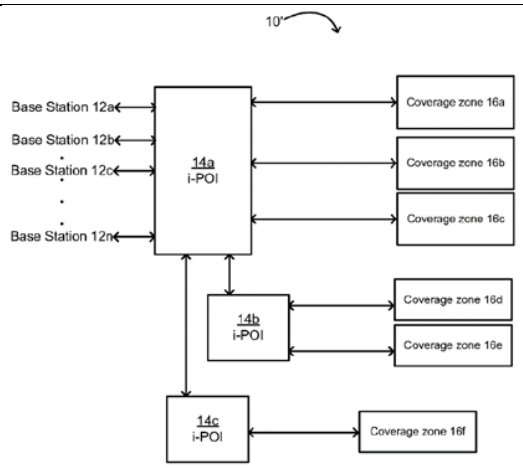


FIG. 4

a first remote antenna unit configured for wirelessly communicating with mobile devices located in a first coverage zone;

a second remote antenna unit configured for wirelessly communicating with mobile devices located in a second coverage zone;

See e.g., EX1011, ¶¶ 6, 12-14, 16, 30, 50, 51, and Figs. 1, 2, 3A, 3B, 4, 5.

For example, and without limitation:

EX1011, ¶ 7: "A coverage zone can include one or more remote antennas that provide signal coverage to an area. The remote antennas in a coverage zone can communicate with the i-POI system over a serial link. The remote antennas can wirelessly communicate the signals from the i-POI system to wireless devices positioned in a coverage zone."

EX1011, ¶ 16. "Figure 1 depicts a DAS 10 having an i-POI system 14 in communication with the base stations 12*a–n* and with the remote antenna 18a–p of coverage zones 16*a–f*."

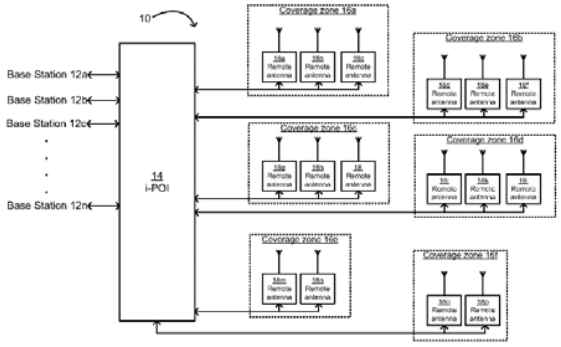
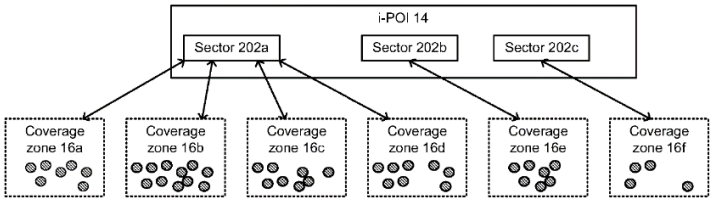
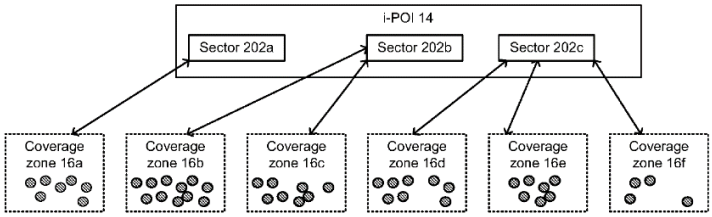


FIG. 1

EX1006, Fig. 1.

a base station router configured for receiving a sector from a base station and distributing an availability of the sector to the first remote antenna unit and the second remote antenna unit, the sector comprising a plurality of communication channels and representing an amount of telecommunication capacity; and	*See* EX1011, ¶¶ 7-9, 11-14, 17-20, 27-28, 33-30, 36, 38-39, 44-48, 50-51 and Figs. 1, 2, 3A, 3B, 4 and 5. For example, and without limitation: EX1011, ¶6: "An example of an i-POI system is an intelligent base transceiver station ('BTS') router." EX1011, ¶8: "The i-POI system can redistribute capacity by changing which sectors are provided to which coverage zones. A sector can represent an amount of telecommunication capacity that can be allocated to wireless devices in one or more coverage zones. . . . A sector can include one or more analog RF channels or digital signals representing RF channels, signals in one or more analog or digital RF bands, and/or one or more multiple-input and multiple output ('MIMO') data streams." EX1011, Figs. 3A, 3B (below). FIG. 3A  FIG. 3B  EX1011, ¶9: "The signals of a sector can be provided to a coverage zone via the i-POI system. The signals of a sector can also be divided among two or more coverage zones providing coverage to a physical area. All of the signals of a sector can be radiated by the remote antennas of one or more coverage zones included in a physical area." EX1011, ¶11: "Sectors from base stations associated with different telecommunications system operators can be distributed to one or more common coverage zones."

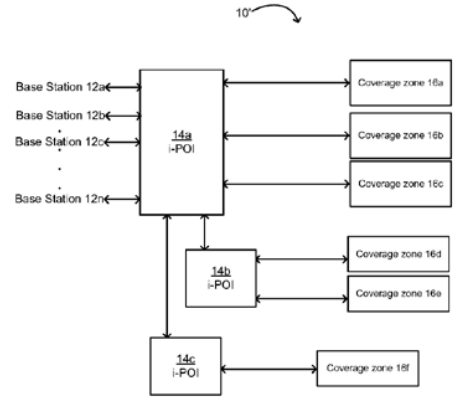
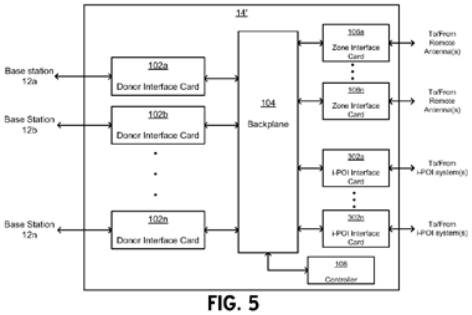
	EX1011, ¶18: "The i-POI system 14 can communicate sectors between the base stations 12*a–n* and the coverage zones 16*a–f*. . . . The remote antennas in the coverage zones of the physical area can radiate the signals of the sector distributed to the physical area."
a remote base station router configured for managing an availability of additional sectors for remote coverage zones,	*See* EX1011, ¶¶ 7-9, 11-14, 17-20, 27-28, 33-30, 36, 38-39, 44-48, 50-51 and Figs. 1, 2, 3A, 3B, 4 and 5. EX1011, ¶2: "Figure 2 is a block diagram of an i-POI system with an interface section, an output section, and a backplane according to one embodiment." EX1011, ¶4: "Figure 4 is a block diagram of **interconnected i-POI systems [i.e., a first router interconnected to second router]** according to one embodiment." See also, EX1011, ¶6 stating that "An example of an i-POI system is an intelligent **base transceiver station ("BTS") router.**"  FIG. 4  FIG. 5

FIG. 3A

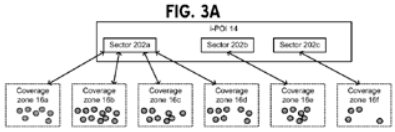
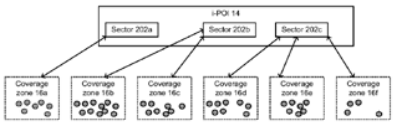


FIG. 3B



For example, and without limitation:

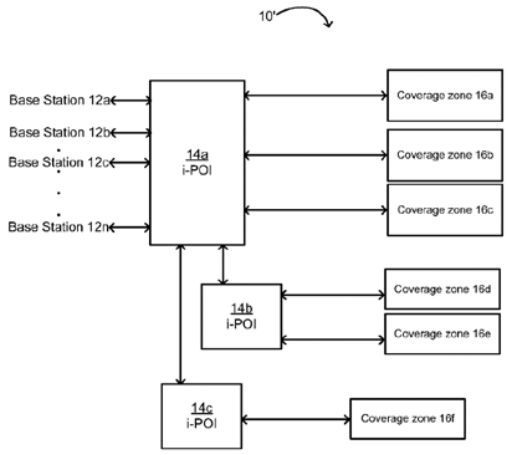
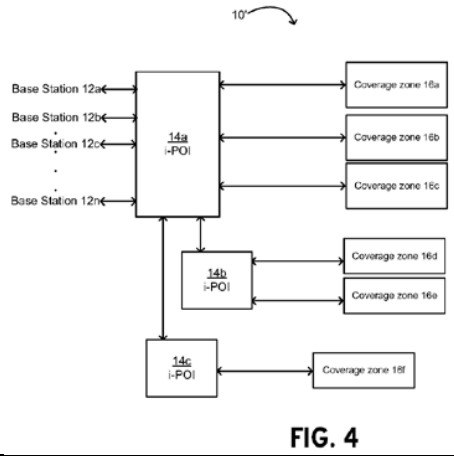
EX1011, ¶9: "The signals of a sector can be provided to a coverage zone via the i-POI system. The signals of a sector can also be divided among two or more coverage zones providing coverage to a physical area. All of the signals of a sector can be radiated by the remote antennas of one or more coverage zones included in a physical area."

EX1011, ¶7: "A coverage zone can include one or more remote antennas that provide signal coverage to an area. The remote antennas in a coverage zone can communicate with the i-POI system over a serial link. The remote antennas can wirelessly communicate the signals from the i-POI system to wireless devices positioned in a coverage zone."

EX1011, ¶0018: "The i-POI system 14 can communicate sectors between the base stations 12*a–n* and the coverage zones 16*a–f*. . . . The remote antennas in the coverage zones of the physical area can radiate the signals of the sector distributed to the physical area."

EX1011, ¶ 50: **Figure 4 depicts an embodiment of a DAS 10' that includes an i-POI systems 14a [i.e., a first router] in communication with other i-POI systems 14b, 14c [i.e., a second router].** The interconnected i-POI systems can communicate via any suitable communication medium, such as copper cable or optical link. An i-POI system 14a can provide the sectors received by the i-POI system 14a to the i-POI systems 14b, 14c. The sectors can be provided as digital data streams. By providing digital data streams to the i-POI systems 14b, 14c representing the sectors received by the i-POI system 14a, the DAS 1 O' can be expanded to provide coverage to a larger environment without requiring additional connections between the base stations 12a-n and the i-POI systems 14b, 14c.

EX1011, ¶ 51: "Figure 5 depicts an embodiment of an i-POI system 14' with an output section of iPOI system 14' that includes one or more i-POI interface cards 302a-n. **The i-POI system 14' can communicate with other i-POI systems** via the i-POI interface cards 302a-n. The i-POI system 14' **can either provide sectors to coverage zones via the zone interface cards**

	106a-n **or provide sectors to other i-POI systems via one or more i-POI interface cards 302a-n.**  FIG. 4
wherein redistributing the availability of the at least one additional sector decreases a capacity density of at least one of the first and second coverage zones managed by the base station router and increases a capacity density of at least one remote coverage zone managed by the remote base station router.	*See* EX1011, ¶¶ 7-9, 11-14, 17-20, 27-28, 33-30, 36, 38-39, 44-48, 50-51 and Figs. 1, 2, 3A, 3B, 4 and 5. EX1011, ¶2: "Figure 2 is a block diagram of an i-POI system with an interface section, an output section, and a backplane according to one embodiment." EX1011, ¶4: "Figure 4 is a block diagram of **interconnected i-POI systems [i.e., a first router interconnected to second router]** according to one embodiment." See also, EX1011, ¶6 stating that "An example of an i-POI system is an intelligent **base transceiver station ("BTS") router.**"  FIG. 4

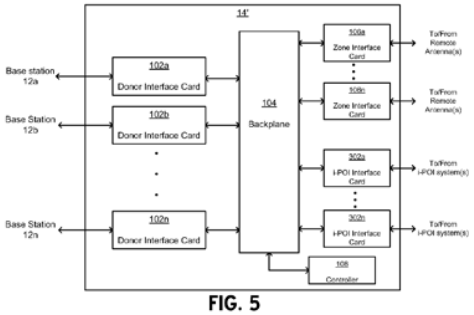


FIG. 5

FIG. 3A

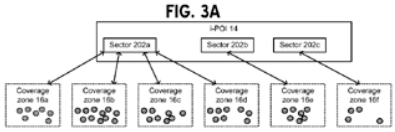
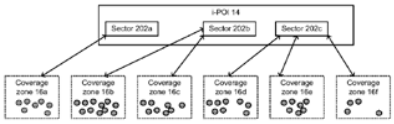


FIG. 3B



For example, and without limitation:

EX1011, ¶ 6: "Certain aspects and embodiments are directed to an intelligent point of interface ("i-POI") system that can be disposed in a distributed antenna system (DAS) and that can redistribute capacity among coverage zones serviced by the DAS. A DAS can include a unit, such as an i-POI system, in communication with carrier systems, such as base stations of cellular service providers. The i-POI system can provide one or more signals, such as analog RF signals or digitized RF signals, over a serial link to the remote antennas in the coverage zone. An example of an i-POI system is an intelligent base transceiver station ("BTS") router."

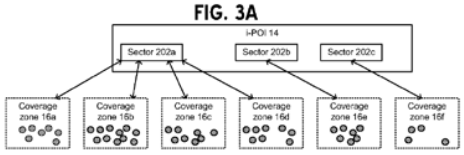
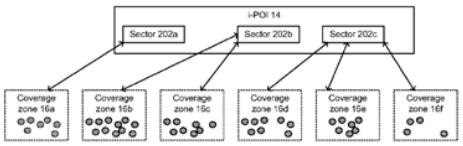
EX1011, ¶ 8: "The i-POI system can redistribute capacity by changing which sectors are provided to which coverage zones. A sector can represent an amount of telecommunication capacity that can be allocated to wireless devices in one or more coverage zones. Increasing the bandwidth associated with a sector can increase the capacity represented by the sector. A sector can include one or more analog RF channels or digital signals representing RF channels, signals in one or more analog or digital RF bands, and/or one or more multiple-input and multiple-output ("MIMO") data streams."

EX1011, ¶ 36: "The i-POI system 14 can also include a controller 108. The controller 108 can re-configure the configurable digital signal processing circuitry of the backplane 104 to change the routing of signals from the

	base stations 12a-n to the coverage zone 16a-f. The controller 108 can receive input representing changes to the routing of signals by the i-POI system 14. The input can be received via a graphical user interface or from an automation algorithm for determining the demand on each of the coverage zones. In some embodiments, as depicted in Figure 2, the controller 108 can be disposed in the i-POI system 14. In other embodiments, the controller 108 can be disposed in a separate device external to and in communication with the i-POI system 14." EX1011, ¶45: "Figure 3A depicts the i-POI system 14, according to an initial configuration, providing sectors 202a-c to the coverage zones 16a-f. The i-POI system 14 can be configured to communicate the signals of sector 202a to the coverage zones 16a-d, the signals of sector 202b to the coverage zone 16e, and the signals of sector 202c to the coverage zone 16f. The capacity of sector 202a is divided among the coverage zones 16a-d, while the entire capacity of sector 202b is provided to coverage zone 16e and the entire capacity of sector 202c is provided to coverage zone 16f. Accordingly, the capacity density of each of the coverage zones 16a-d is less than the capacity density of each of the coverage zones 16e-f." EX1011, ¶46: "The signals of a sector can be divided among the coverage zones. For example, a first wireless device in the coverage zone 16a may communicate using a first RF channel of sector 202a and a second wireless device in the coverage zone 16a may communicate using a second RF channel of sector 202a. The first and second RF channels of the sector 202a may be included in a common frequency band but be distributed to different coverage areas." EX1011, ¶47: "For example, a DAS 10 may service a stadium and a parking lot surrounding the stadium, with the coverage zones 16a-d corresponding to different sections of the stadium and the coverage zones 16e-f corresponding to the parking lot. Before an event hosted in the stadium begins, fewer wireless devices will be concentrated in the stadium than in the parking lot. The coverage zones 16a-d may therefore require less capacity than the coverage zones 16e, 16f. Accordingly, the i-POI system can be configured to provide the sector 202a to the coverage zones 16a-d, the sector 202b to coverage zone 16e, and the sector 202c to coverage zone 16f. Providing a single sector 202a to the coverage zones 16a-d inside the stadium can provide sufficient capacity density for each of the coverage zones 16a-d. Providing the sectors 202b, 202c to the coverage zone 16e inside the stadium can provide sufficient capacity density for each of the coverage zones 16a-d."

	EX1011, ¶48: "The i-POI system 14 can be re-configured via the controller 108 in response to changes concentration of wireless devices in the respective coverage zones. Figure 38 depicts the i-POI system 14 providing sectors 202a-c to the coverage zones 16a-f according to an subsequent configuration of the i-POI system 14. For example, if the DAS 10 services a stadium and the surrounding parking lot, more wireless devices will be concentrated inside the stadium than in the parking lot after an event begins. The i-POI system 14 can be reconfigured such that the sector 202a is provided to the coverage zone 16a, the sector 202b is provided to the coverage zones 16b, 16c, and the sector 202a is provided to the coverage zones 16d-f. The configuration of i-POI system 14 depicted in Figure 38 thus increases the capacity density of the coverage zones 16a-d as compared to the configuration of i-POI system 14 depicted in Figure 3A." EX1011, ¶49: "Although Figures 3A, 38 depict three sectors provided to six coverage zones, multiple sectors can be provided to a single coverage zone. For example, the signals of a first sector associated with a first telecommunication system operator and the signals of a second sector associated with a second telecommunication system operator can be combined and distributed to the same coverage zone or group of coverage zones. The number of coverage zones to which an i-POI system distributes sectors can be greater than or equal to the number of sectors distributed by the i-POI system." EX1011, ¶50: "Figure 4 depicts an embodiment of a DAS 10' that includes an **i-POI systems 14a in communication with other i-POI systems** 14b, 14c [**i.e., a first router in communication with a second router**]. The interconnected i-POI systems can communicate via any suitable communication medium, such as copper cable or optical link. An i-POI system 14a can provide the sectors received by the i-POI system 14a to the i-POI systems 14b, 14c. The sectors can be provided as digital data streams. By providing digital data streams to the i-POI systems 14b, 14c representing the sectors received by the i-POI system 14a, the DAS 10' can be expanded to provide coverage to a larger environment without requiring additional connections between the base stations 12a-n and the i-POI systems 14b, 14c. EX1011,¶ 51: "Figure 5 depicts an embodiment of an i-POI system 14' with an output section of i-POI system 14' that includes one or more i-POI interface cards 302a-n. The i-POI system 14' can communicate with other i-POI systems via the i-POI interface cards 302a-n. The i-POI system 14' can either provide sectors to coverage zones via the zone interface cards 106a-n or provide sectors to other i-POI systems via one or more i-POI

	interface cards 302a-n. Examples of the i-POI interface cards 302a-n can include copper or optical interface cards."
Claim 10	
10. The distributed antenna system of claim 9, wherein each communication channel corresponds to a signal configured for carrying data.	*See* EX1011, ¶¶ 6, 8, 12-13, 17, 24, 27, 29, 33. For example, and without limitation, *see* EX1011, ¶ 12: "An i-POI system can include donor interface cards, a backplane, and zone interface cards. A donor interface card interfaces with a base station and can provide digital data streams representing the signals of a sector to the backplane. The backplane can route digital signals from donor cards to one or more zone interface cards. The i-POI system can provide signals of a sector via the zone interface card to one or more remote antennas in a coverage zone."
Claim 11	
11. The distributed antenna system of claim 9, wherein the plurality of communication channels comprises a plurality of RF channels.	*See* EX1011, ¶¶ 6, 8, 20-22, 25, 28-30, 34, 46. For example, and without limitation, *see* EX1011, ¶ 21: "In some embodiments, the i-POI system 14 can communicate with both the base stations 12a-n and the remote antennas 18a-p using analog RF signals."
Claim 12	
12. The distributed antenna system of claim 9, wherein the plurality of communication channels comprises a plurality of digital signals, wherein each digital signal represents an RF channel.	*See* EX1011, ¶¶ 6, 8, 12, 21-24, 28-30, 33-35. For example, and without limitation, *see* EX1011, ¶ 22: "In other embodiments, the i-POI system 14 can communicate digital signals with the base stations 12a-n and communicate analog RF signals with the remote antennas 18a-p." *See also id.* ¶ 23: "In other embodiments, the i-POI system 14 can communicate digital signals with remote antenna units associated with remote antennas 18a-p. Processing signals from the base stations 12a-n can include converting signals in one digital format used by the base stations 12a-n into a different digital format used by the remote antenna units."
Claim 13	
13. The distributed antenna system of	*See* EX1011, ¶¶ 8, 10, 37, 44-48, Figs. 3A, 3B.

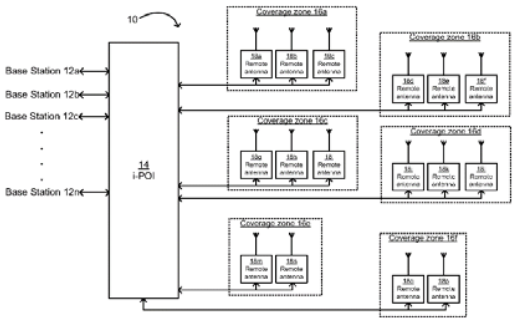
claim 9, wherein redistributing the availability of at least one sector comprises increasing the number of communication channels provided to the first remote antenna unit and decreasing the number of communication channels provided to the second remote antenna unit.	FIG. 3A  FIG. 3B  For example, and without limitation: EX1011, ¶ 8: "The i-POI system can redistribute capacity by changing which sectors are provided to which coverage zones. A sector can represent an amount of telecommunication capacity that can be allocated to wireless devices in one or more coverage zones. Increasing the bandwidth associated with a sector can increase the capacity represented by the sector. A sector can include one or more analog RF channels or digital signals representing RF channels, signals in one or more analog or digital RF bands, and/or one or more multiple-input and multiple-output ('MIMO') data streams." EX1011, ¶ 10: "Increasing the number of coverage zones to which a sector is distributed can decrease the capacity density of each coverage zone. The capacity density of a coverage zone can include the number of sectors distributed to the coverage zone. If more wireless devices are concentrated in a first coverage zone than are concentrated in a second coverage zone, the i-POI system can shift capacity from the second coverage zone to the first coverage zone. The i-POI can shift capacity by reducing the number of coverage zones to which a sector is distributed. By distributing the sector to fewer coverage zones (and thus a smaller physical area), the capacity density (i.e., the capacity per physical area) is increased. The number of coverage zones to which an i-POI system distributes sectors can be greater than or equal to the number of sectors distributed by the i-POI system."
Claim 14	
14. The distributed antenna system of claim 9, wherein the base station router is further configured for executing a scheduling algorithm outputting a traffic indicator and	*See* EX1011, ¶¶ 36-37, 47 Figs. 2, 3A, 3B, 5. For example, and without limitation: EX1011, ¶ 37: "For example, the controller 108 may include a configuration manager that can trigger based on the detection of certain events. Examples of events include a scheduled event of a game, concert,

redistributing the availability of an additional sector from the first coverage zone to the second coverage zone in response to a traffic indicator, wherein the traffic indicator comprises a schedule indicator stored in a tangible memory device.	or other type of event, scheduled sequence of events with pre-game, game, and post-game configurations, ...” EX1011, ¶ 47: “For example, a DAS 10 may service a stadium and a parking lot surrounding the stadium, with the coverage zones 16a-d corresponding to different sections of the stadium and the coverage zones 16e-f corresponding to the parking lot. Before an event hosted in the stadium begins, fewer wireless devices will be concentrated in the stadium than in the parking lot. The coverage zones 16a-d may therefore require less capacity than the coverage zones 16e, 16f. Accordingly, the i-POI system can be configured to provide the sector 202a to the coverage zones 16a-d, the sector 202b to coverage zone 16e, and the sector 202c to coverage zone 16f.”
Claim 15	
15. The distributed antenna system of claim 9, wherein the base station router is further configured for: identifying a spectrum of signals in the first coverage zone and the second coverage zone: determining a traffic indicator based on the spectrum of signals; and redistributing the availability of the at least one sector from the first coverage zone to the second coverage zone in response to a traffic indicator, wherein the traffic indicator comprises a quantity of mobile devices in each coverage zone.	*See* EX1011, ¶¶ 36-39, 42-44, 47-48, Figs. 2, 3A, 3B, 5. For example, and without limitation: EX1011, ¶ 37 “The controller 108 may include configuration and report manager functions. In some embodiments, the controller 108 can detect traffic and perform measurements independent of the wireless network standard and protocol. For example, the controller 108 may include a configuration manager that can trigger based on the detection of certain events. Examples of events include a scheduled event of a game, concert, or other type of event, 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. The controller 108 may also include a report manager that can generate reports on traffic, spurious signals, usage, and other types of information. The controller 108 can implement any process for measuring uplink signals for traffic and other types of information, and reporting the information. Certain systems and processes that can be used to do so are described in U.S. Serial No. 12/778,312, filed May 12, 2010 and titled "System and Method for Detecting and Measuring Uplink Traffic in Signal Repeating Systems," the entirety of which is incorporated herein by reference.” EX1011, ¶ 38: “In some embodiments, an i-POI system 14 can determine a location of a specific wireless device within the environment in which the DAS 10 is deployed. The i-POI system 14 can communicate with one of the base stations 12a-n to determine an identifier for the specific wireless device. An identifier for a wireless device can include any attributes of a communication link between a base station and a wireless device used to

	identify the wireless device. For example, the identifier can include the transmit and receive frequencies assigned to a wireless device used in frequency division multiple access schemes, a communication time slot assigned to the wireless device used in frequency division multiple access schemes, and/or a spreading code assigned to a wireless device in a code division multiple access scheme." EX1011, ¶ 38: "The i-POI system 14 can determine a channel over which the specific wireless device is communicating. A channel can include a connection, such as a transmit and receive frequency, over which a wireless device and a base station can communicate via the DAS. A sector of a base station received by a donor card of the i-POI system 14 can include the channel. The i-POI system 14 can determine a coverage zone to which the channel is being provided by determining which sector includes the channel and which coverage zone is receiving the sector." EX1011, ¶ 42: "In some embodiments, the i-POI system can include one or more spectrum analyzers that can analyze uplink and downlink signals. A spectrum analyzer can be a separate device disposed in the i-POI system or can be disposed in one or more of the donor interface cards 102a-n, the backplane 104, and/or the zone interface cards 106a-n. The spectrum analyzer can determine the frequencies of the component signals included in the uplink and downlink signals. The spectrum analyzer can store data representing the spectrum of uplink and downlink signals in a memory. The memory can be disposed in the i-POI system or in an external device." EX1011, ¶ 42: "The spectrum of the uplink and downlink signals can be used for additional processing of the uplink and downlink signals. Additional processing can include determining the frequencies being used in the respective coverage zone. Determining the frequencies being used in the respective coverage zones can be used to determine whether to redistribute the capacity of the DAS. Additional processing can also include identifying spurious signals, such as noise recovered by the remote antennas that can distort uplink signals, that can be removed using programmable band pass filters disposed in the i-POI system." EX1011, ¶ 43: "The spectrum of the uplink and downlink signals can be used for additional processing of the uplink and downlink signals. Additional processing can include determining the frequencies being used in the respective coverage zone. Determining the frequencies being used in the respective coverage zones can be used to determine whether to redistribute the capacity of the DAS. Additional processing can also include identifying spurious signals, such as noise recovered by the remote

	antennas that can distort uplink signals, that can be removed using programmable band pass filters disposed in the i-POI system." EX1011, ¶ 48: "The i-POI system 14 can be re-configured via the controller 108 in response to changes concentration of wireless devices in the respective coverage zones. Figure 38 depicts the i-POI system 14 providing sectors 202a-c to the coverage zones 16a-f according to an subsequent configuration of the i-POI system 14. For example, if the DAS 10 services a stadium and the surrounding parking lot, more wireless devices will be concentrated inside the stadium than in the parking lot after an event begins. The i-POI system 14 can be reconfigured such that the sector 202a is provided to the coverage zone 16a, the sector 202b is provided to the coverage zones 16b, 16c, and the sector 202[c] is provided to the coverage zones 16d-f. The configuration of i-POI system 14 depicted in Figure 38 thus increases the capacity density of the coverage zones 16a-d as compared to the configuration of i-POI system 14 depicted in Figure 3A."
Claim 16	
15. The distributed antenna system of claim 9, wherein the base station router is further configured for: identifying a spectrum of signals in the first coverage zone and the second coverage zone: determining a traffic indicator based on the spectrum of signals; and redistributing the availability of the at least one sector from the first coverage zone to the second coverage zone in response to a traffic indicator, wherein the traffic indicator comprises a quantity of mobile	*See* EX1011, ¶¶ 36-39, 42-44, 47-48, Figs. 2, 3A, 3B, 5. For example, and without limitation: EX1011, ¶ 37 "The controller 108 may include configuration and report manager functions. In some embodiments, the controller 108 can detect traffic and perform measurements independent of the wireless network standard and protocol. For example, the controller 108 may include a configuration manager that can trigger based on the detection of certain events. Examples of events include a scheduled event of a game, concert, or other type of event, 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. The controller 108 may also include a report manager that can generate reports on traffic, spurious signals, usage, and other types of information. The controller 108 can implement any process for measuring uplink signals for traffic and other types of information, and reporting the information. Certain systems and processes that can be used to do so are described in U.S. Serial No. 12/778,312, filed May 12, 2010 and titled "System and Method for Detecting and Measuring Uplink Traffic in Signal Repeating Systems," the entirety of which is incorporated herein by reference." EX1011, ¶ 38: "In some embodiments, an i-POI system 14 can determine a location of a specific wireless device within the environment in which

devices in each coverage zone.	the DAS 10 is deployed. The i-POI system 14 can communicate with one of the base stations 12a-n to determine an identifier for the specific wireless device. An identifier for a wireless device can include any attributes of a communication link between a base station and a wireless device used to identify the wireless device. For example, the identifier can include the transmit and receive frequencies assigned to a wireless device used in frequency division multiple access schemes, a communication time slot assigned to the wireless device used in frequency division multiple access schemes, and/or a spreading code assigned to a wireless device in a code division multiple access scheme." EX1011, ¶ 38: "The i-POI system 14 can determine a channel over which the specific wireless device is communicating. A channel can include a connection, such as a transmit and receive frequency, over which a wireless device and a base station can communicate via the DAS. A sector of a base station received by a donor card of the i-POI system 14 can include the channel. The i-POI system 14 can determine a coverage zone to which the channel is being provided by determining which sector includes the channel and which coverage zone is receiving the sector." EX1011, ¶ 42: "In some embodiments, the i-POI system can include one or more spectrum analyzers that can analyze uplink and downlink signals. A spectrum analyzer can be a separate device disposed in the i-POI system or can be disposed in one or more of the donor interface cards 102a-n, the backplane 104, and/or the zone interface cards 106a-n. The spectrum analyzer can determine the frequencies of the component signals included in the uplink and downlink signals. The spectrum analyzer can store data representing the spectrum of uplink and downlink signals in a memory. The memory can be disposed in the i-POI system or in an external device." EX1011, ¶ 42: "The spectrum of the uplink and downlink signals can be used for additional processing of the uplink and downlink signals. Additional processing can include determining the frequencies being used in the respective coverage zone. Determining the frequencies being used in the respective coverage zones can be used to determine whether to redistribute the capacity of the DAS. Additional processing can also include identifying spurious signals, such as noise recovered by the remote antennas that can distort uplink signals, that can be removed using programmable band pass filters disposed in the i-POI system." EX1011, ¶ 43: "The spectrum of the uplink and downlink signals can be used for additional processing of the uplink and downlink signals. Additional processing can include determining the frequencies being used

	in the respective coverage zone. Determining the frequencies being used in the respective coverage zones can be used to determine whether to redistribute the capacity of the DAS. Additional processing can also include identifying spurious signals, such as noise recovered by the remote antennas that can distort uplink signals, that can be removed using programmable band pass filters disposed in the i-POI system." EX1011, ¶ 48: "The i-POI system 14 can be re-configured via the controller 108 in response to changes concentration of wireless devices in the respective coverage zones. Figure 38 depicts the i-POI system 14 providing sectors 202a-c to the coverage zones 16a-f according to an subsequent configuration of the i-POI system 14. For example, if the DAS 10 services a stadium and the surrounding parking lot, more wireless devices will be concentrated inside the stadium than in the parking lot after an event begins. The i-POI system 14 can be reconfigured such that the sector 202a is provided to the coverage zone 16a, the sector 202b is provided to the coverage zones 16b, 16c, and the sector 202[c] is provided to the coverage zones 16d-f. The configuration of i-POI system 14 depicted in Figure 38 thus increases the capacity density of the coverage zones 16a-d as compared to the configuration of i-POI system 14 depicted in Figure 3A."
Claim 17	
17. A method, comprising: distributing, by a base station router, an availability of a sector received from a base station to a first coverage zone, the sector comprising a plurality of communication channels and representing an amount of telecommunication capacity; redistributing, by the base station router, the availability of the sector from the first coverage	*See* EX1011, ¶¶ 7-9, 11-14, 17-20, 27-28, 33-30, 36, 38-39, 44-48, 50-51 and Figs. 1, 2, 3A, 3B, 4 and 5.  FIG. 1

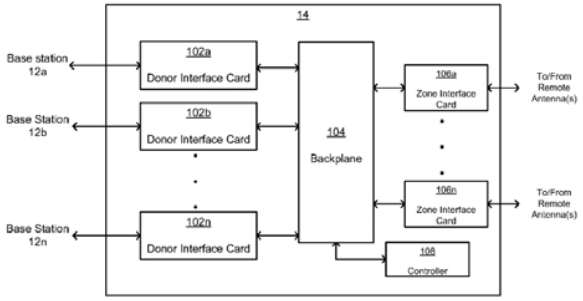
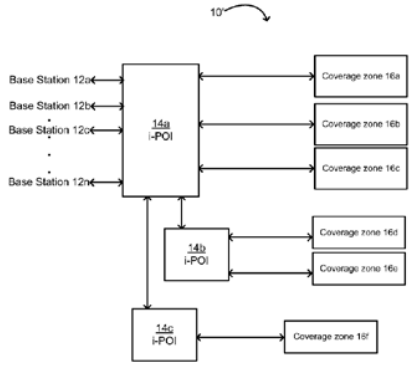
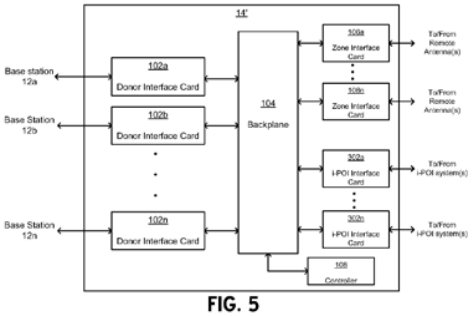
zone to a second coverage zone; and redistributing, by the base station router, an additional availability of at least one additional sector received from the base station between at least one of the coverage zones managed by the base station router and at least one remote coverage zone managed by a remote base station router,	 FIG. 2 EX1011, ¶2: "Figure 2 is a block diagram of an i-POI system with an interface section, an output section, and a backplane according to one embodiment." EX1011, ¶4: "Figure 4 is a block diagram of **interconnected i-POI systems [i.e., a first router interconnected to second router]** according to one embodiment." See also, EX1011, ¶6 stating that "An example of an i-POI system is an intelligent **base transceiver station ("BTS") router.**"  FIG. 4  FIG. 5

FIG. 3A

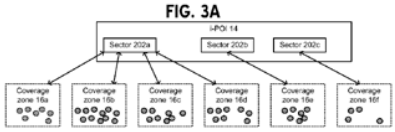
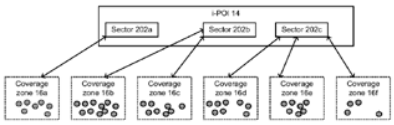


FIG. 3B



For example, and without limitation:

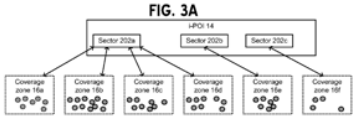
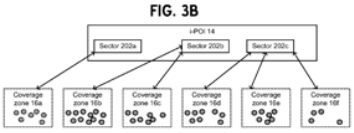
EX1011, ¶ 6: "Certain aspects and embodiments are directed to an intelligent point of interface ("i-POI") system that can be disposed in a distributed antenna system (DAS) and that can redistribute capacity among coverage zones serviced by the DAS. A DAS can include a unit, such as an i-POI system, in communication with carrier systems, such as base stations of cellular service providers. The i-POI system can provide one or more signals, such as analog RF signals or digitized RF signals, over a serial link to the remote antennas in the coverage zone. An example of an i-POI system is an intelligent base transceiver station ("BTS") router."

EX1011, ¶ 8: "The i-POI system can redistribute capacity by changing which sectors are provided to which coverage zones. A sector can represent an amount of telecommunication capacity that can be allocated to wireless devices in one or more coverage zones. Increasing the bandwidth associated with a sector can increase the capacity represented by the sector. A sector can include one or more analog RF channels or digital signals representing RF channels, signals in one or more analog or digital RF bands, and/or one or more multiple-input and multiple-output ("MIMO") data streams."

EX1011, ¶ 36: "The i-POI system 14 can also include a controller 108. The controller 108 can re-configure the configurable digital signal processing circuitry of the backplane 104 to change the routing of signals from the base stations 12a-n to the coverage zone 16a-f. The controller 108 can receive input representing changes to the routing of signals by the i-POI system 14. The input can be received via a graphical user interface or from an automation algorithm for determining the demand on each of the coverage zones. In some embodiments, as depicted in Figure 2, the controller 108 can be disposed in the i-POI system 14. In other embodiments, the controller 108 can be disposed in a separate device external to and in communication with the i-POI system 14."

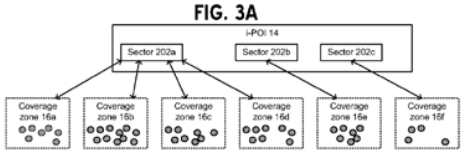
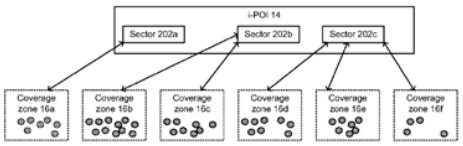
EX1011, ¶45: "Figure 3A depicts the i-POI system 14, according to an initial configuration, providing sectors 202a-c to the coverage zones 16a-f. The i-POI system 14 can be configured to communicate the signals of sector

	202a to the coverage zones 16a-d, the signals of sector 202b to the coverage zone 16e, and the signals of sector 202c to the coverage zone 16f. The capacity of sector 202a is divided among the coverage zones 16a-d, while the entire capacity of sector 202b is provided to coverage zone 16e and the entire capacity of sector 202c is provided to coverage zone 16f. Accordingly, the capacity density of each of the coverage zones 16a-d is less than the capacity density of each of the coverage zones 16e-f." EX1011, ¶46: "The signals of a sector can be divided among the coverage zones. For example, a first wireless device in the coverage zone 16a may communicate using a first RF channel of sector 202a and a second wireless device in the coverage zone 16a may communicate using a second RF channel of sector 202a. The first and second RF channels of the sector 202a may be included in a common frequency band but be distributed to different coverage areas." EX1011, ¶47: "For example, a DAS 10 may service a stadium and a parking lot surrounding the stadium, with the coverage zones 16a-d corresponding to different sections of the stadium and the coverage zones 16e-f corresponding to the parking lot. Before an event hosted in the stadium begins, fewer wireless devices will be concentrated in the stadium than in the parking lot. The coverage zones 16a-d may therefore require less capacity than the coverage zones 16e, 16f. Accordingly, the i-POI system can be configured to provide the sector 202a to the coverage zones 16a-d, the sector 202b to coverage zone 16e, and the sector 202c to coverage zone 16f. Providing a single sector 202a to the coverage zones 16a-d inside the stadium can provide sufficient capacity density for each of the coverage zones 16a-d. Providing the sectors 202b, 202c to the coverage zone 16e inside the stadium can provide sufficient capacity density for each of the coverage zones 16a-d." EX1011, ¶48: "The i-POI system 14 can be re-configured via the controller 108 in response to changes concentration of wireless devices in the respective coverage zones. Figure 38 depicts the i-POI system 14 providing sectors 202a-c to the coverage zones 16a-f according to an subsequent configuration of the i-POI system 14. For example, if the DAS 10 services a stadium and the surrounding parking lot, more wireless devices will be concentrated inside the stadium than in the parking lot after an event begins. The i-POI system 14 can be reconfigured such that the sector 202a is provided to the coverage zone 16a, the sector 202b is provided to the coverage zones 16b, 16c, and the sector 202a is provided to the coverage zones 16d-f. The configuration of i-POI system 14 depicted in Figure 38 thus increases the capacity density of the coverage zones 16a-d as compared to the configuration of i-POI system

	14 depicted in Figure 3A." EX1011, ¶49: "Although Figures 3A, 38 depict three sectors provided to six coverage zones, multiple sectors can be provided to a single coverage zone. For example, the signals of a first sector associated with a first telecommunication system operator and the signals of a second sector associated with a second telecommunication system operator can be combined and distributed to the same coverage zone or group of coverage zones. The number of coverage zones to which an i-POI system distributes sectors can be greater than or equal to the number of sectors distributed by the i-POI system." EX1011, ¶50: "Figure 4 depicts an embodiment of a DAS 10' that includes an **i-POI systems 14a in communication with other i-POI systems** 14b, 14c [**i.e., a first router in communication with a second router**]. The interconnected i-POI systems can communicate via any suitable communication medium, such as copper cable or optical link. An i-POI system 14a can provide the sectors received by the i-POI system 14a to the i-POI systems 14b, 14c. The sectors can be provided as digital data streams. By providing digital data streams to the i-POI systems 14b, 14c representing the sectors received by the i-POI system 14a, the DAS 10' can be expanded to provide coverage to a larger environment without requiring additional connections between the base stations 12a-n and the i-POI systems 14b, 14c. EX1011,¶ 51: "Figure 5 depicts an embodiment of an i-POI system 14' with an output section of i-POI system 14' that includes one or more i-POI interface cards 302a-n. The i-POI system 14' can communicate with other i-POI systems via the i-POI interface cards 302a-n. The i-POI system 14' can either provide sectors to coverage zones via the zone interface cards 106a-n or provide sectors to other i-POI systems via one or more i-POI interface cards 302a-n. Examples of the i-POI interface cards 302a-n can include copper or optical interface cards."
wherein redistributing the availability of the at least one additional sector decreases a capacity density of at least one coverage zone managed by the base station router and increases a capacity density of the at least one remote coverage	*See* EX1011, ¶¶ 8, 10, 37, 44-49, Figs. 3A, 3B. FIG. 3A  FIG. 3B 

zone managed by the remote base station router.	For example, and without limitation: EX1011, ¶ 8: "The i-POI system can redistribute capacity by changing which sectors are provided to which coverage zones. A sector can represent an amount of telecommunication capacity that can be allocated to wireless devices in one or more coverage zones. Increasing the bandwidth associated with a sector can increase the capacity represented by the sector. A sector can include one or more analog RF channels or digital signals representing RF channels, signals in one or more analog or digital RF bands, and/or one or more multiple-input and multiple-output ('MIMO') data streams." EX1011, ¶ 10: "Increasing the number of coverage zones to which a sector is distributed can decrease the capacity density of each coverage zone. The capacity density of a coverage zone can include the number of sectors distributed to the coverage zone. If more wireless devices are concentrated in a first coverage zone than are concentrated in a second coverage zone, the i-POI system can shift capacity from the second coverage zone to the first coverage zone. The i-POI can shift capacity by reducing the number of coverage zones to which a sector is distributed. By distributing the sector to fewer coverage zones (and thus a smaller physical area), the capacity density (i.e., the capacity per physical area) is increased. The number of coverage zones to which an i-POI system distributes sectors can be greater than or equal to the number of sectors distributed by the i-POI system." EX1011, ¶45: "Figure 3A depicts the i-POI system 14, according to an initial configuration, providing sectors 202a-c to the coverage zones 16a-f. The i-POI system 14 can be configured to communicate the signals of sector 202a to the coverage zones 16a-d, the signals of sector 202b to the coverage zone 16e, and the signals of sector 202c to the coverage zone 16f. The capacity of sector 202a is divided among the coverage zones 16a-d, while the entire capacity of sector 202b is provided to coverage zone 16e and the entire capacity of sector 202c is provided to coverage zone 16f. Accordingly, the capacity density of each of the coverage zones 16a-d is less than the capacity density of each of the coverage zones 16e-f." EX1011, ¶46: "The signals of a sector can be divided among the coverage zones. For example, a first wireless device in the coverage zone 16a may communicate using a first RF channel of sector 202a and a second wireless device in the coverage zone 16a may communicate using a second RF channel of sector 202a. The first and second RF channels of the sector 202a may be included in a common frequency band but be distributed to different coverage areas."

	EX1011, ¶47: "For example, a DAS 10 may service a stadium and a parking lot surrounding the stadium, with the coverage zones 16a-d corresponding to different sections of the stadium and the coverage zones 16e-f corresponding to the parking lot. Before an event hosted in the stadium begins, fewer wireless devices will be concentrated in the stadium than in the parking lot. The coverage zones 16a-d may therefore require less capacity than the coverage zones 16e, 16f. Accordingly, the i-POI system can be configured to provide the sector 202a to the coverage zones 16a-d, the sector 202b to coverage zone 16e, and the sector 202c to coverage zone 16f. Providing a single sector 202a to the coverage zones 16a-d inside the stadium can provide sufficient capacity density for each of the coverage zones 16a-d. Providing the sectors 202b, 202c to the coverage zone 16e inside the stadium can provide sufficient capacity density for each of the coverage zones 16a-d." EX1011, ¶48: "The i-POI system 14 can be re-configured via the controller 108 in response to changes concentration of wireless devices in the respective coverage zones. Figure 38 depicts the i-POI system 14 providing sectors 202a-c to the coverage zones 16a-f according to an subsequent configuration of the i-POI system 14. For example, if the DAS 10 services a stadium and the surrounding parking lot, more wireless devices will be concentrated inside the stadium than in the parking lot after an event begins. The i-POI system 14 can be reconfigured such that the sector 202a is provided to the coverage zone 16a, the sector 202b is provided to the coverage zones 16b, 16c, and the sector 202a is provided to the coverage zones 16d-f. The configuration of i-POI system 14 depicted in Figure 38 thus increases the capacity density of the coverage zones 16a-d as compared to the configuration of i-POI system 14 depicted in Figure 3A." EX1011, ¶49: "Although Figures 3A, 38 depict three sectors provided to six coverage zones, multiple sectors can be provided to a single coverage zone. For example, the signals of a first sector associated with a first telecommunication system operator and the signals of a second sector associated with a second telecommunication system operator can be combined and distributed to the same coverage zone or group of coverage zones. The number of coverage zones to which an i-POI system distributes sectors can be greater than or equal to the number of sectors distributed by the i-POI system."
Claim 18	
18. The method of claim 17, wherein	*See* EX1011, ¶¶ 8, 10, 37, 44-49, Figs. 3A, 3B.

redistributing the availability of at least one sector comprises increasing the number of communication channels provided to a first remote antenna unit in the first coverage zone and decreasing the number of communication channels provided to a second remote antenna unit in the second coverage zone.	FIG. 3A  FIG. 3B  For example, and without limitation: EX1011, ¶ 8: "The i-POI system can redistribute capacity by changing which sectors are provided to which coverage zones. A sector can represent an amount of telecommunication capacity that can be allocated to wireless devices in one or more coverage zones. Increasing the bandwidth associated with a sector can increase the capacity represented by the sector. A sector can include one or more analog RF channels or digital signals representing RF channels, signals in one or more analog or digital RF bands, and/or one or more multiple-input and multiple-output ('MIMO') data streams." EX1011, ¶ 10: "Increasing the number of coverage zones to which a sector is distributed can decrease the capacity density of each coverage zone. The capacity density of a coverage zone can include the number of sectors distributed to the coverage zone. If more wireless devices are concentrated in a first coverage zone than are concentrated in a second coverage zone, the i-POI system can shift capacity from the second coverage zone to the first coverage zone. The i-POI can shift capacity by reducing the number of coverage zones to which a sector is distributed. By distributing the sector to fewer coverage zones (and thus a smaller physical area), the capacity density (i.e., the capacity per physical area) is increased. The number of coverage zones to which an i-POI system distributes sectors can be greater than or equal to the number of sectors distributed by the i-POI system."
Claim 19	
19. The method of claim 17, further comprising detecting a traffic indicator by executing a scheduling algorithm outputting	*See* EX1011, ¶¶ 36-37, 47 Figs. 2, 3A, 3B, 5. For example, and without limitation, EX1011: ¶ 37: "For example, the controller 108 may include a configuration manager that can trigger based on the detection of certain events. Examples of events include a scheduled event of a game, concert, or other

the traffic indicator; and redistributing the availability of the sector from the first coverage zone to the second coverage zone in response to detecting the traffic indicator, wherein the traffic indicator comprises a schedule indicator stored in a tangible memory device.	type of event, scheduled sequence of events with pre-game, game, and post-game configurations, ..." ¶ 47: "For example, a DAS 10 may service a stadium and a parking lot surrounding the stadium, with the coverage zones 16a-d corresponding to different sections of the stadium and the coverage zones 16e-f corresponding to the parking lot. Before an event hosted in the stadium begins, fewer wireless devices will be concentrated in the stadium than in the parking lot. The coverage zones 16a-d may therefore require less capacity than the coverage zones 16e, 16f. Accordingly, the i-POI system can be configured to provide the sector 202a to the coverage zones 16a-d, the sector 202b to coverage zone 16e, and the sector 202c to coverage zone 16f."
Claim 19	
20. The method of claim 17, further comprising redistributing the availability of the sector from the first coverage zone to the second coverage zone in response to detecting a traffic indicator, wherein detecting the traffic indicator comprises: identifying a spectrum of signals in the first coverage zone and the second coverage zone; and determining the traffic indicator based on the spectrum of signals, wherein the traffic indicator comprises a quantity of mobile devices in each coverage zone.	*See* EX1011, ¶¶ 36-39, 42-44, 47-48, Figs. 2, 3A, 3B, 5. For example, and without limitation: EX1011, ¶ 37 "The controller 108 may include configuration and report manager functions. In some embodiments, the controller 108 can detect traffic and perform measurements independent of the wireless network standard and protocol. For example, the controller 108 may include a configuration manager that can trigger based on the detection of certain events. Examples of events include a scheduled event of a game, concert, or other type of event, 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. The controller 108 may also include a report manager that can generate reports on traffic, spurious signals, usage, and other types of information. The controller 108 can implement any process for measuring uplink signals for traffic and other types of information, and reporting the information. Certain systems and processes that can be used to do so are described in U.S. Serial No. 12/778,312, filed May 12, 2010 and titled "System and Method for Detecting and Measuring Uplink Traffic in Signal Repeating Systems," the entirety of which is incorporated herein by reference." EX1011, ¶ 38: "In some embodiments, an i-POI system 14 can determine a location of a specific wireless device within the environment in which the DAS 10 is deployed. The i-POI system 14 can communicate with one of the base stations 12a-n to determine an identifier for the specific wireless device. An identifier for a wireless device can include any attributes of a

	communication link between a base station and a wireless device used to identify the wireless device. For example, the identifier can include the transmit and receive frequencies assigned to a wireless device used in frequency division multiple access schemes, a communication time slot assigned to the wireless device used in frequency division multiple access schemes, and/or a spreading code assigned to a wireless device in a code division multiple access scheme." EX1011, ¶ 38: "The i-POI system 14 can determine a channel over which the specific wireless device is communicating. A channel can include a connection, such as a transmit and receive frequency, over which a wireless device and a base station can communicate via the DAS. A sector of a base station received by a donor card of the i-POI system 14 can include the channel. The i-POI system 14 can determine a coverage zone to which the channel is being provided by determining which sector includes the channel and which coverage zone is receiving the sector." EX1011, ¶ 42: "In some embodiments, the i-POI system can include one or more spectrum analyzers that can analyze uplink and downlink signals. A spectrum analyzer can be a separate device disposed in the i-POI system or can be disposed in one or more of the donor interface cards 102a-n, the backplane 104, and/or the zone interface cards 106a-n. The spectrum analyzer can determine the frequencies of the component signals included in the uplink and downlink signals. The spectrum analyzer can store data representing the spectrum of uplink and downlink signals in a memory. The memory can be disposed in the i-POI system or in an external device." EX1011, ¶ 42: "The spectrum of the uplink and downlink signals can be used for additional processing of the uplink and downlink signals. Additional processing can include determining the frequencies being used in the respective coverage zone. Determining the frequencies being used in the respective coverage zones can be used to determine whether to redistribute the capacity of the DAS. Additional processing can also include identifying spurious signals, such as noise recovered by the remote antennas that can distort uplink signals, that can be removed using programmable band pass filters disposed in the i-POI system." EX1011, ¶ 43: "The spectrum of the uplink and downlink signals can be used for additional processing of the uplink and downlink signals. Additional processing can include determining the frequencies being used in the respective coverage zone. Determining the frequencies being used in the respective coverage zones can be used to determine whether to redistribute the capacity of the DAS. Additional processing can also include

	identifying spurious signals, such as noise recovered by the remote antennas that can distort uplink signals, that can be removed using programmable band pass filters disposed in the i-POI system." EX1011, ¶ 48: "The i-POI system 14 can be re-configured via the controller 108 in response to changes concentration of wireless devices in the respective coverage zones. Figure 38 depicts the i-POI system 14 providing sectors 202a-c to the coverage zones 16a-f according to an subsequent configuration of the i-POI system 14. For example, if the DAS 10 services a stadium and the surrounding parking lot, more wireless devices will be concentrated inside the stadium than in the parking lot after an event begins. The i-POI system 14 can be reconfigured such that the sector 202a is provided to the coverage zone 16a, the sector 202b is provided to the coverage zones 16b, 16c, and the sector 202[c] is provided to the coverage zones 16d-f. The configuration of i-POI system 14 depicted in Figure 38 thus increases the capacity density of the coverage zones 16a-d as compared to the configuration of i-POI system 14 depicted in Figure 3A."

75. The Kummetz-464 disclosures relied in grounds 2-5 also find support in the disclosure of the Kummetz-363 provisional application of EX1011. The table below shows exemplary subject matter in EX1011 that corresponds to EX1005.

Figures and citations to Kummetz-464 Disclosures (EX1005)	**Corresponding Figures and citations in Kummetz-363 provisional application (EX1011)**
• Fig. 1 • 2:14-15 • 5:14 to 7:44	• Fig. 1 • ¶1 • ¶¶16-29

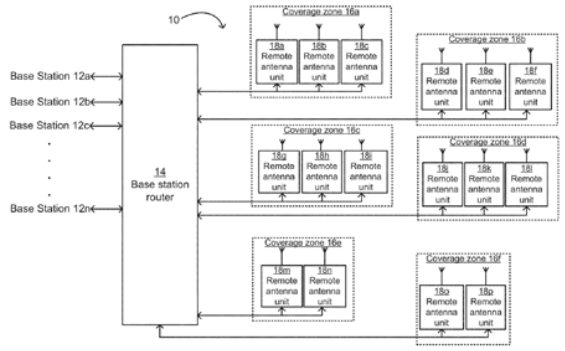


FIG. 1

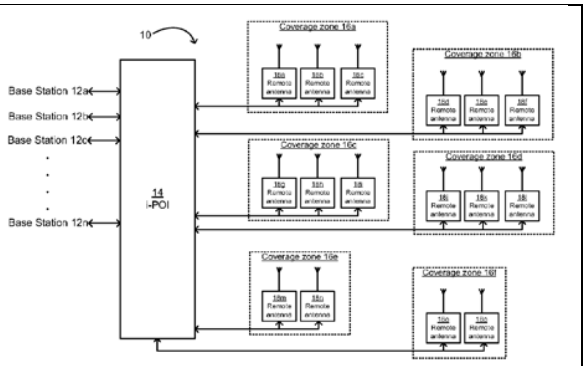


FIG. 1

- Fig. 2
- 2:16-18
- 7:45 to 8:62

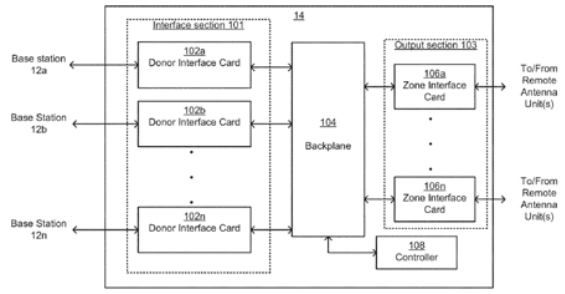


FIG. 2

- Fig. 2
- ¶2
- ¶¶30-36

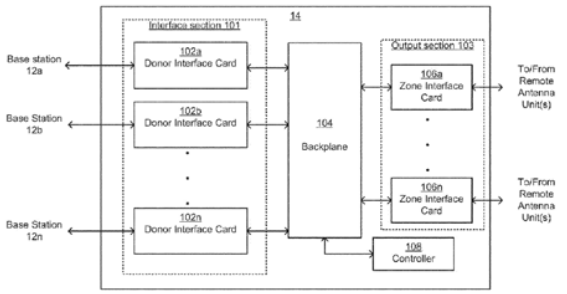


FIG. 2

- Figs. 4 and 5
- 2:21-26
- 10:30 to 11:38

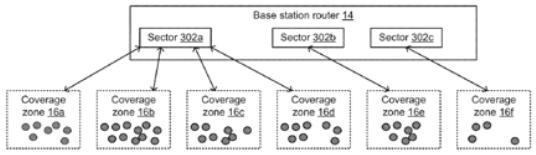


FIG. 4

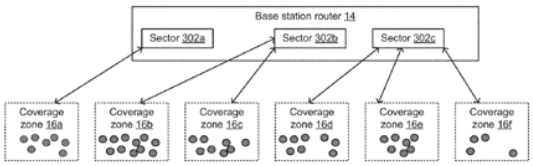


FIG. 5

- Figs. 3A and 3B
- ¶3
- ¶¶44-49

FIG. 3A

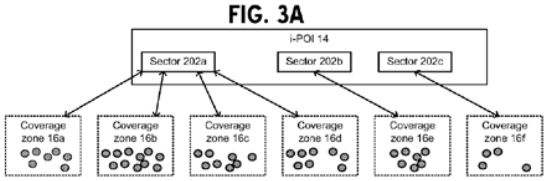
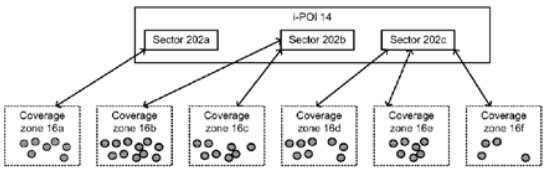
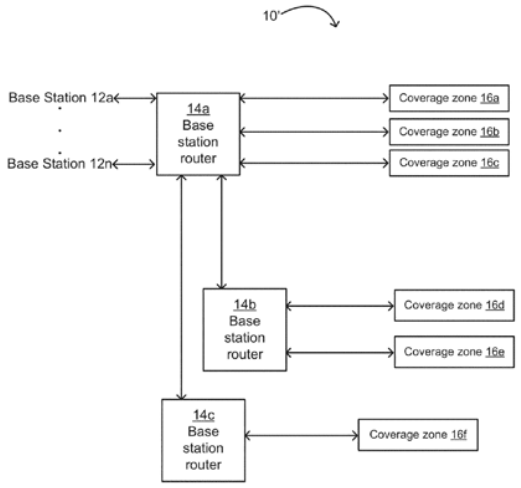
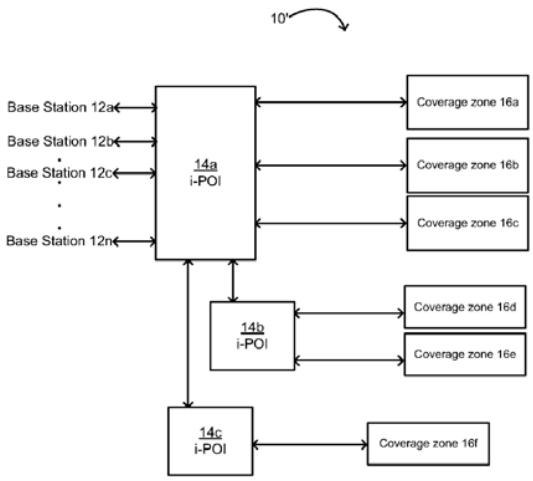
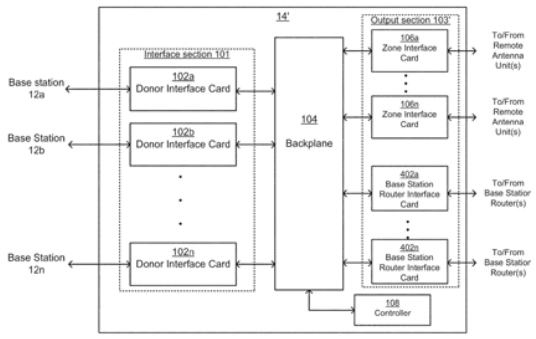
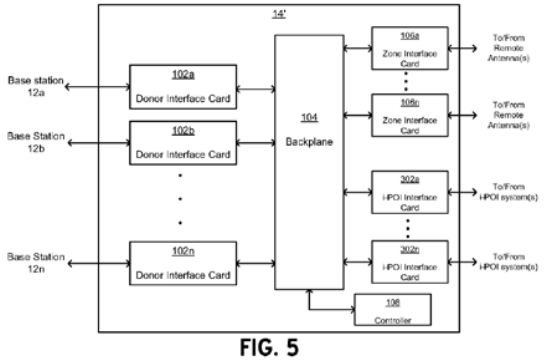


FIG. 3B



- Fig. 6
- 2:27-28

- Fig. 4
- ¶4

• 11:39-52  FIG. 6	• ¶50  FIG. 4
• Fig. 7 • 2:29-31 • 11:53-62  FIG. 7	• Fig. 5 • ¶5 • ¶51  FIG. 5
• 2:40-46, 2:54-58	• ¶6 and Figs. 1, 2, 3A, 3B, and 4
• 3:6-30	• ¶¶7-9 and Figs. 1, 2, 3A, 3B, and 4
• 3:43 to 8:62	• ¶¶10-36 and Figs. 1, 2, 3A, 3B, and 4
• 9:42 to 12:23	• ¶¶37-39, ¶¶44-51, ¶¶42-43, and Figs. 1, 2, 3A, 3B, and 4
• 12:24-65	• ¶¶40-41 and Figs. 1, 2, 3A, 3B, and 4
• Abstract, 1:21–33, 1:40–2:4	• ¶¶6-10, ¶12 • Fig. 1 and ¶¶16-29 • Fig. 2 and ¶¶30-36 • Figs. 3A, 3B and ¶¶44-49

2. Overview of Kummetz-464

76. Kummetz-464 is directed to a "base station router for a distributed antenna systems." EX1005, 1:16-16, Abstract. "A distributed antenna system ("DAS") can be used to extend coverage of a cellular communication system." EX1005, 1:20-25. The Kummetz-464 DAS includes a router 14 coupled to a plurality of coverage areas or zones where each zone is served by one or more distributed remote antenna units. EX1005, Fig. 1, Fig. 2, 2:54-59 ("The base station router can provide one or more signals … to a set of remote antenna units in the coverage zone. A set of remote antenna units can include one or more antenna units"); 3:7-8 ("A coverage zone can include one or more remote antenna units that provide signal coverage to an area"); 4:27 ("to one or more remote antenna units in a coverage zone"); 7:4-5 (referring to the coverage zones of Fig. 1, stating that each "of the coverage zones 16a-f can include one or more remote antenna units")

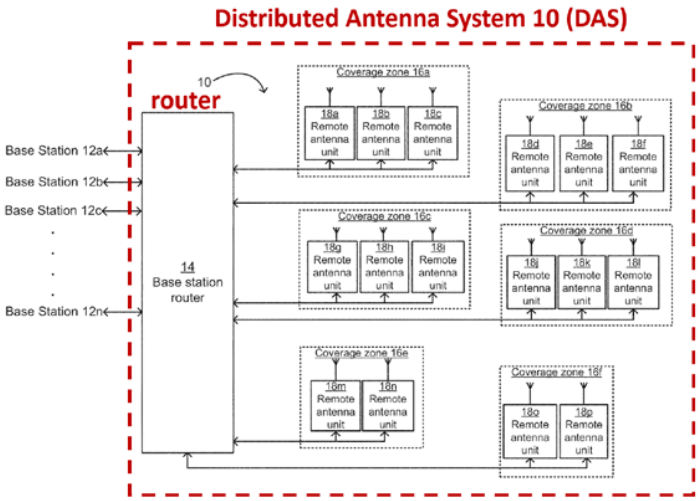


FIG. 1

EX1005, Fig. 1.

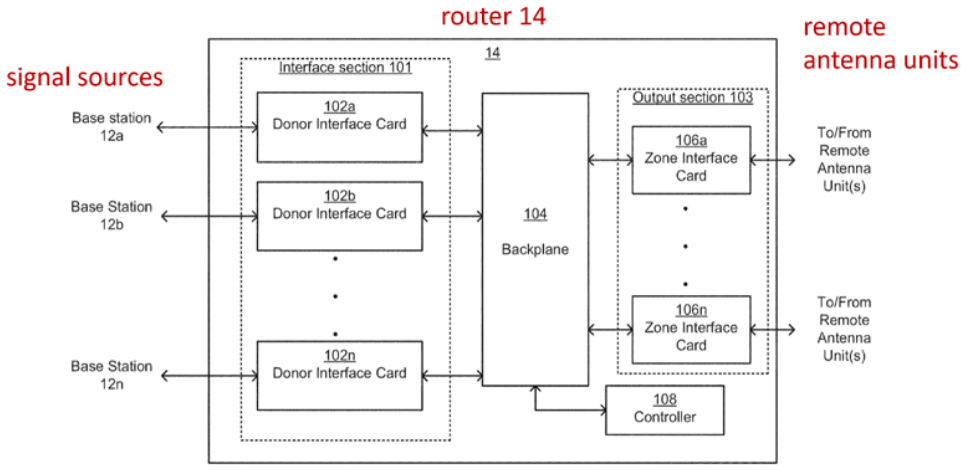


FIG. 2

EX1005, Fig. 2.

77. Problem addressed. The Kummetz-464 DAS addresses the same problem addressed by the '382 patent, i.e., the problem load balancing in a distributed wireless network and, in particular, for venues in which the wireless subscribers frequently move and congregate in areas within the venue. Kummetz-464 uses the example of a venue for hosting sports events. The coverage areas for such a sporting event venue includes: (a) inside a stadium and (b) the parking lots surrounding the stadium. EX1005, 10:30 – 11:39, Figs. 4, 5. For such a venue, "the signal capacity needed to provide signal coverage to different physical areas [e.g., inside stadium and surrounding parking lots] can change over time." EX1005, 1:27-30, 6:65-67. To address that problem, the Kummetz-464 discloses a

DAS that can connect to multiple sources of radio resources (e.g., multiple base stations) and that provides a router for distributing radio resource capacity adaptively. EX1005, 1:34-35.

> The distributed antenna system includes a first remote antenna unit, a second remote antenna unit, and a base station router. The first remote antenna unit can wirelessly communicate with mobile devices located in a first coverage zone. The second remote antenna unit can wirelessly communicate with mobile devices located in a second coverage zone. The base station router can distribute an availability of a sector to the first remote antenna unit and the second remote antenna unit. The sector can include communication channels [i.e., radio resources] and represent an amount of telecommunication capacity. The base station router can redistribute the availability of the sector from the first remote antenna unit to the second remote antenna unit in response to detecting a traffic indicator.

EX1005, 1:51-63.

> In another aspect, a method is provided. The method involves distributing an availability of a sector to a first coverage zone. The sector includes communication channels [radio resources] and represents an amount of telecommunication capacity. The method also involves receiving a traffic indicator. The method also involves, in response to receiving the traffic indicator, redistributing the availability of the sector from the first coverage zone to a second coverage zone.

EX1005, 1:64 to 2:4.

78. Sectors/radio resources. Kummetz-464 describes that, in the downlink direction, base stations 12a–12n send signals to base station router 14.

EX1005 at 5:14–31. These signals are associated with one or more sectors, where each sector includes communication channels (radio resources) and represents an amount of telecommunication capacity. EX1005 at 1:43–46, 1:64–67, 3:20–24, 5:19–23, 5:28–31, Fig. 1, Fig. 2. Different sectors may also be associated with different telecommunications system operators. EX1005 at 4:5–7, 5:19–23. Base station router 14 can route signals between base stations 12a–12n and the remote antenna units in the coverage zones 16a–16f. EX1005 at 5:32–33, 5:50–62.

79. Each coverage zone or area may correspond to a coverage area of a single remote. Kummetz-464 refers to the coverage areas of a venue as zones. Each zone may be served by one or more remote antenna units. EX1005, Fig. 1, Fig. 2, 2:54-59; 3:7-8; 4:27 ("to one or more remote antenna units in a coverage zone"); 7:4-5. Thus, each coverage zone or area may correspond to the coverage area of a single remote antenna unit.

80. Router input and output configured as input/output ports. Base station router 14 includes an input interface (interface section 101) that receives signals from and provides signals to the base stations 12a–12n, allowing uplink and downlink functionality. EX1005 at 6:11-15 (link may use common digital formats, e.g., CPRI (Common Public Radio Interface), ORI (Open Radio equipment Interface)), 7:45–48, 7:50–52, 7:66–8:1, 8:8–10, Fig. 2 (annotated below; Fig. 2 shows bi-directional link for transporting signals between a base station and a

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

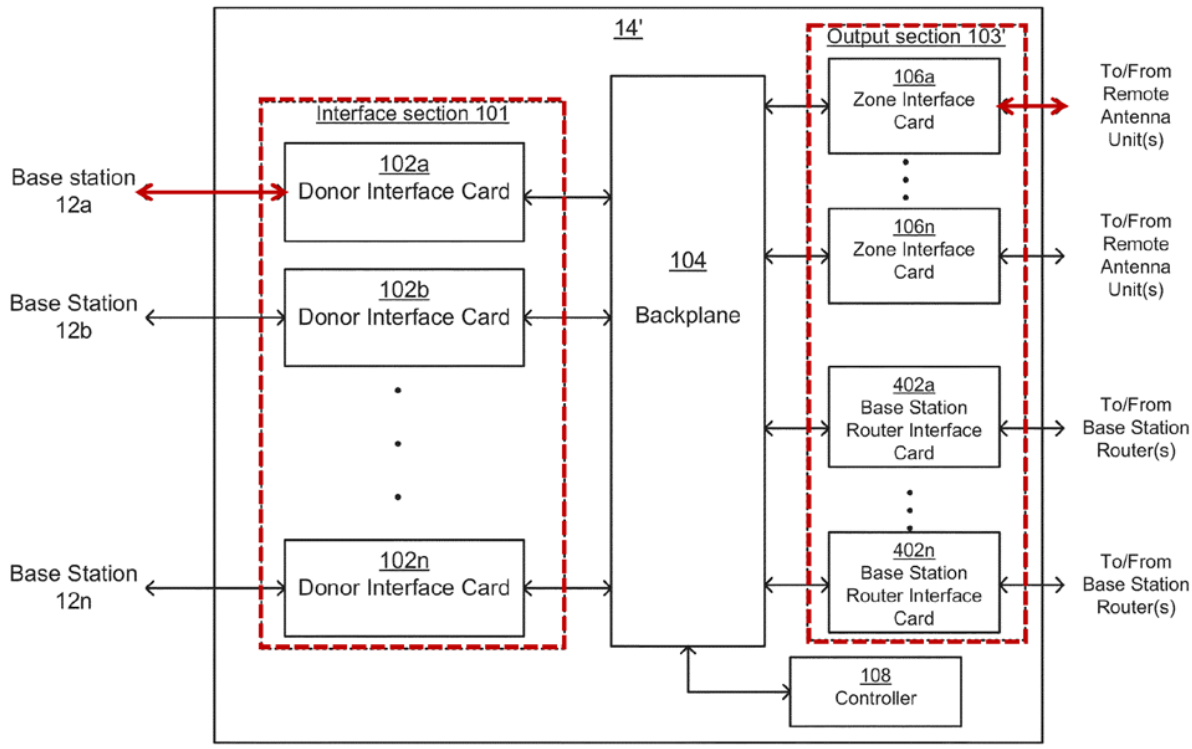


FIG. 2

EX1005, Fig. 2.

81. Distributed radio resources to the remote antenna units. Base station router 14 includes circuitry for routing signals from base stations 12a–12n to remote antenna units in coverage zones 16a–16f. EX1005 at 5:50–52. Each of coverage zones 16a–16f contains one or more remote antenna units (e.g., remote antenna units 18a–18c for coverage zone 16a) that wirelessly communicate (radiate) the signals received from base station router 14 to wireless devices positioned in their physical area. EX1005 at 3:7–8, 3:12–14, 3:28–30, 3:51–53,

5:37–39, 7:4–8. The one or more remote units in one coverage zone receive the same group of signals from base station router 14. EX1005 at 7:8–10. These coverages zones thus provide extended signal coverage for base stations 12a–12n. EX1005 at 1:21–25, 5:16–19, 6:63–7:3.

82. Kummetz-464 teaches that the zone may correspond to the coverage area of one remote antenna unit. EX1005, 3:7-8, 7:4-5. A Kummetz-464 system may include only two remote antenna units with the first remote unit providing wireless coverage to a first zone and a second remote unit providing wireless coverage to a second zone. EX1005, 1:50-63.

> In another aspect, a distributed antenna system is provided. The distributed antenna system includes a first remote antenna unit, a second remote antenna unit, and a base station router. The first remote antenna unit can wirelessly communicate with mobile devices located in a first coverage zone. The second remote antenna unit can wirelessly communicate with mobile devices located in a second coverage zone. The base station router can distribute an availability of a sector to the first remote antenna unit and the second remote antenna unit. The sector can include communication channels and represent an amount of telecommunication capacity. The base station router can redistribute the availability of the sector from the first remote antenna unit to the second remote antenna unit in response to detecting a traffic indicator.

EX1005, 1:50-63.

83. Controller (traffic monitoring unit) that can detect traffic indicators such as number of mobile devices in a coverage zone. Base station router 14

includes a controller that itself includes executable instructions for a configuration engine. EX1005 at 2:19–20, 8:54-58, 8:63–67, 9:22-25, Fig. 2 (controller 108), Fig. 3 (below).

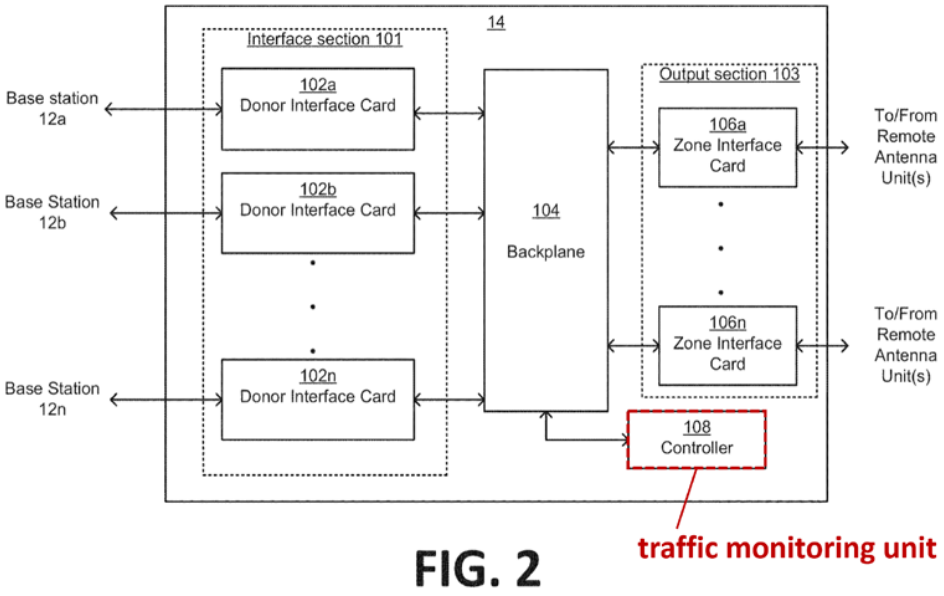


FIG. 2

EX1005, Fig. 1.

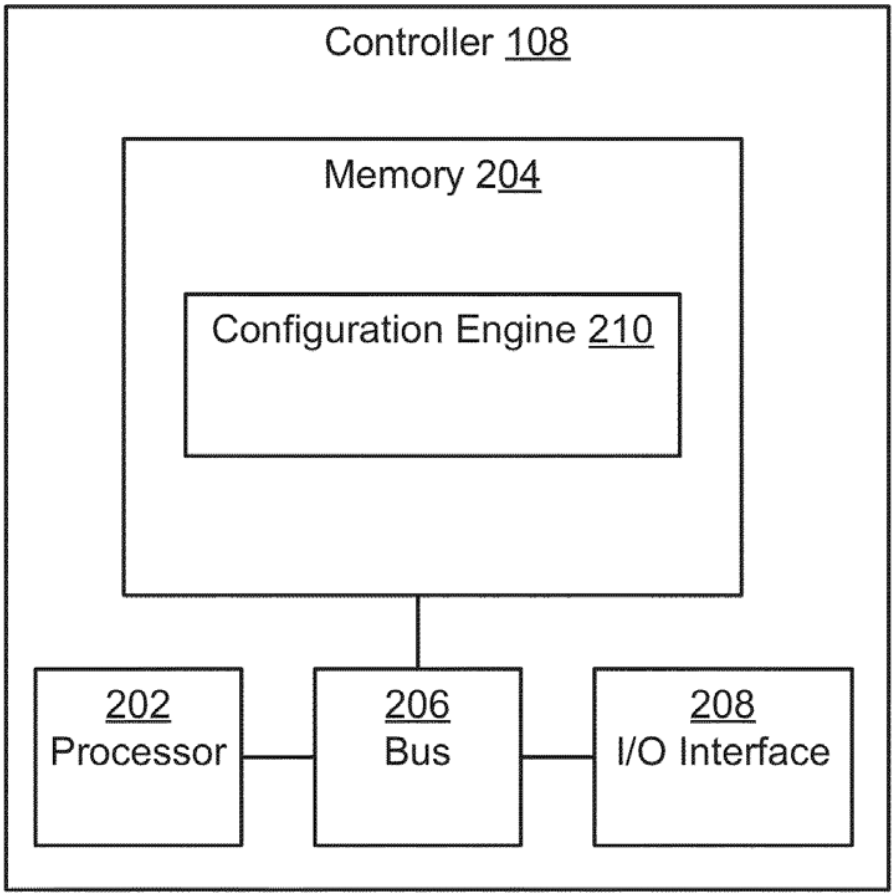


FIG. 3

EX1005, Fig. 3.

84. The controller of the Kummetz-464 system can detect traffic and determine the number of mobile devices in each coverage zone (the Kummetz-464 refers to these measures as traffic indicators). EX1005, 9:44-47 ("A traffic indicator can include data describing or otherwise corresponding to a number of mobile devices in each coverage zone"); 9:52-54 ("the controller 108 can detect

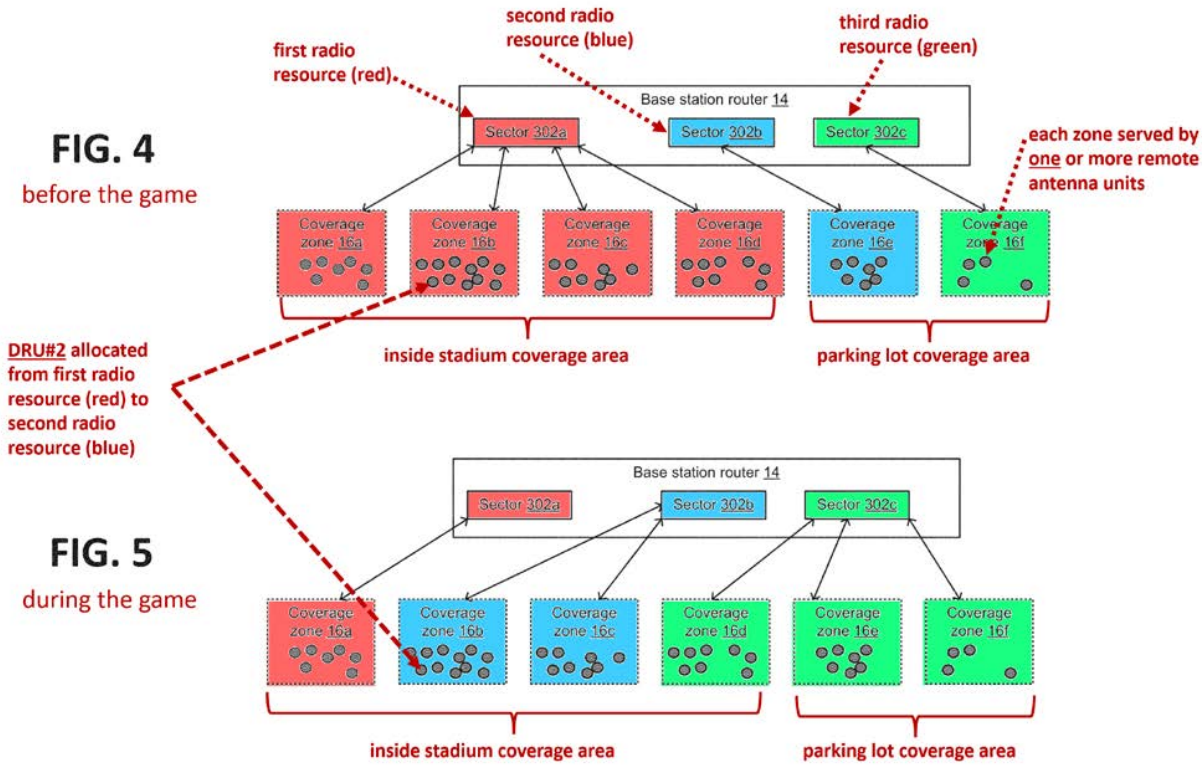
traffic and perform measurements independent of a wireless network Standard and protocol"); 9:40-65. As discussed below, the traffic indicators detected by Kummetz-464 are examples of key performance indicators (KPIs).

85. Kummetz-464 also teaches that the controller can be a separate device external to and in communication with base station router 14. EX1005 at 8:59–62. The controller 108 can re-configure the configurable digital signal processing circuitry of a backplane in the base station router to change the routing of signals from the base stations 12a–12n to coverage zones 16a–16f. EX1005 at 8:55–58.

86. The controller of Kummetz-464 can receive data describing the routing of signals by the base station router 14, including data relating to the determined demand on each of coverage zones 16a–16f. EX1005 at 9:34–39. "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." EX1005 at 9:40–44. This redistribution changes which sectors are provided to which coverage zones. EX1005 at 3:15–16. For example, one sector may be distributed to a decreased number of coverage zones, which will increase the capacity density for those zones (how many mobile devices can use telecommunications services in the zones). EX1005 at 3:43–49, 3:54–68.

87. Redistributing radio resource capacity based on traffic indicators.

Figs. 4 and 5 (below, annotated) are provided by Kummetz-464 to illustrate an example of how the system may adaptively distribute capacity before and during a sporting event hosted a venue with coverage areas that include: (a) inside a stadium, and (b) the parking lots surrounding the stadium. EX1005, 10:64 - 11:28. Fig. 4 shows that, before the game, when the mobile devices are concentrated in the parking lots, the Kummetz-464 system distributes more capacity to the parking lot coverage areas. Id. Fig. 5 shows that, around the start of the game when the controller determines that more mobile devices are located inside the stadium, the Kummetz-464 system distributes more capacity to the stadium coverage areas. Id. During the game, Kummetz-464 Fig. 5 allocates more capacity inside the stadium since the area within the stadium is now served by three dedicated sectors and one shared sector, whereas beforehand, that area inside the stadium was served by a single sector. Similarly, whereas the initial configuration (Fig. 4) provided two sectors to serve the parking lot, the subsequent configuration provides a single shared sector to serve that area.

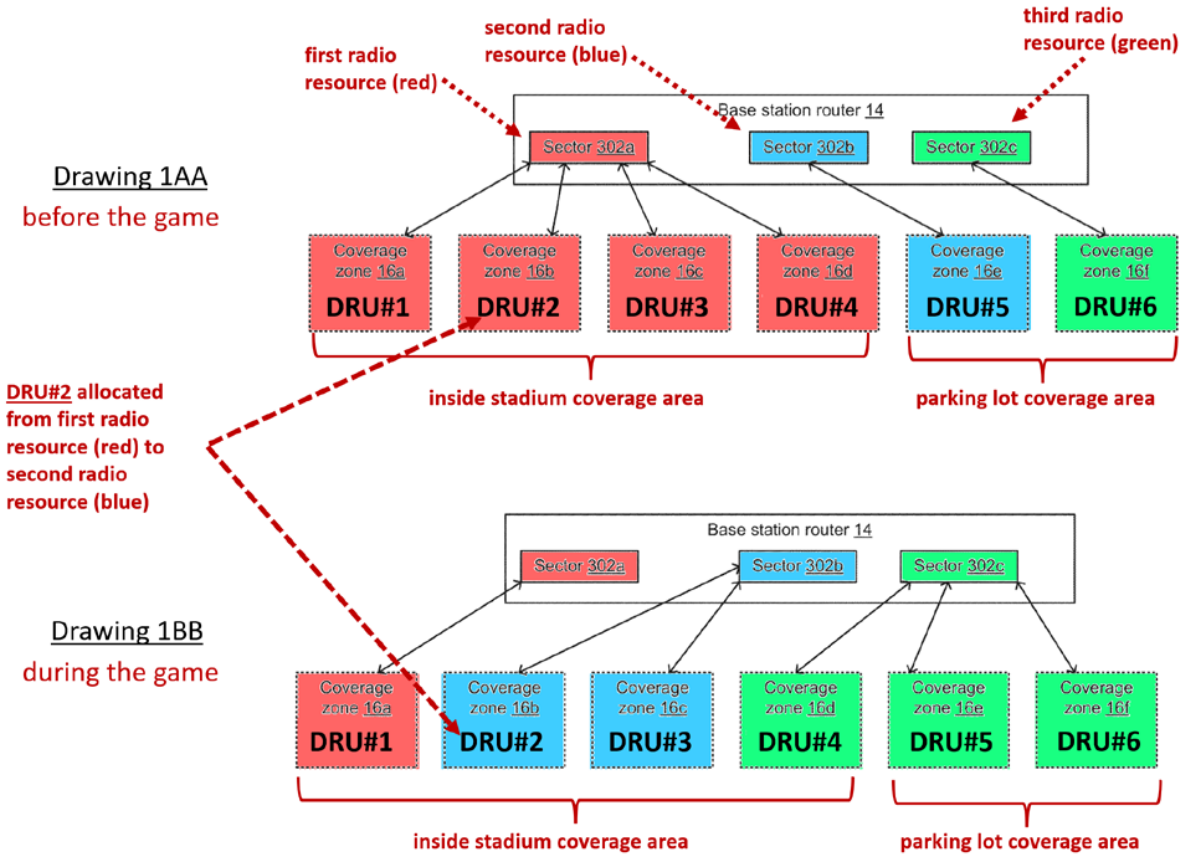


EX1005, Figs. 4, 5.

88. The shift to increased capacity inside the stadium can also be seen for a specific DRU located inside the stadium, e.g., DRU#2 which I have identified above in Figs. 4 and 5 of Kummetz-464. As shown, the reconfiguration under the Kummetz-464 system includes allocating DRU#2 from a first radio resource of sector one (red, shared by all the DRUs inside the stadium before the game) to a second radio resource of sector 2 (blue, which is dedicated to the DRUs on zones 16b and 16c during the game).

89. It should be noted that under the Kummetz-464 disclosure, each coverage zone shown in Figs. 4 and 5 could be served by a single remote antenna

unit. E.g., EX1005, 2:57-59; 3:7-8; 4:24-25; 7:4-5. To illustrate this point, I have re-illustrated Figs. 4 and 5 below as Drawings 1AA and 1BB, respectively. As with Fig. 5 above, Drawing 1BB shows that, around the start of the game when the controller determines that more mobile devices are located inside the stadium, the Kummetz-464 system distributes more capacity to the stadium coverage areas (i.e., the coverage areas of DRUs 1-4). As shown, the reconfiguration under the Kummetz-464 system includes allocating DRU#2 from a first radio resource of sector one (red) to a second radio resource of sector 2 (blue).



90. Kummetz-464 discloses that a redistribution of capacity may be in response to the detection of a traffic indicator such as a number of mobile devices. EX1005 at 1:46–1:48, 1:60–1:63, 9:42–44.

> 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.

EX1005 at 9:44–52.

C. Wu: U.S. Patent Application Pub. No. 2010/0128676

91. Wu published on May 27, 2010 and is prior art to the ‘382 patent. EX1007.

92. It should be noted that Wu is also an asserted reference in in IPR2018-00571 relating to Patent Owner’s U.S. Patent U.S. Patent No. 9,531,473 (‘473 patent). EX1016 (paper 53, PTAB Final Written Decision finding the challenged claims unpatentable). The ‘473 patent also considered the problem of load balancing in a distributed wireless network. EX1019, Abstract, 3:64 – 4:8 (“This advanced system architecture enables … flexible simulcast, automatic traffic load-balancing, network and radio resource optimization, network calibration, … traffic monitoring … .”).

93. In August of 2019, the PTAB issued a final written decision finding all the challenged claims of the ‘473 patent to be unpatentable. EX1016 at 37. Claims 6–8, 11–13, and 18–21 of the ’473 patent were found to be unpatentable as anticipated by and obvious over Wu. Id. Claims 9, 10, and 14–17 of the ’473 patent were found to be rendered obvious in view of Wu and Sabat (EX1018) (U.S. Patent Application Pub. No. 2009/0180426)). Id.

94. In October of 2019, the Patent Owner filed the application for the ‘382 patent. EX1001. Wu was not disclosed or considered by the patent office during prosecution of the ‘382 patent. EX1001, EX1002.

95. Wu discloses a distributed wireless network and addresses the same problem of load balancing when conditions and events within the network’s coverage areas change. EX1007, ¶5. Wu explains the problem.

> Known carrier transport systems comprise terminals that digitize entire bands regardless of the carrier channels within in the band to ensure the terminals can operate with multiple carriers or standards. Such systems offer flexibility, but lack fine grained control over carrier channels, which results in many deficiencies. For example, a backhaul link can become unnecessarily congested because an entire band is digitized as opposed to only active carrier channels. Furthermore, such systems also lack the ability to allocate carrier channels from one cell region to another in response to various events or conditions. … .
>
> A better carrier channel transport system would allow fine grained control over carrier channels from a single band or multiple bands by splitting carrier channels from their bands

> and routing the channels to RTUs as desired through a matrix switch according to a routing policy, possibly where the routing policy can be updated or reconfigured as desired.

EX1007, ¶5.

96. Wu describes a system where signals are communicated between base transceiver stations and remote transceiver units (RTUs). EX1007, Figs. 1 and 2. The Wu system provides fine grain control over the distributed carrier channels, splitting and routing carrier channels according to a routing policy. EX1007 [54], [57], ¶¶ 9, 11, 38–44. The base transceiver station may receive signals within a plurality of frequency bands, each of which may comprise multiple channels. EX1007, ¶¶ 11, 35, 37, 38. Figure 2 of Wu, reproduced below, is a schematic of a base transceiver station and associated host units.

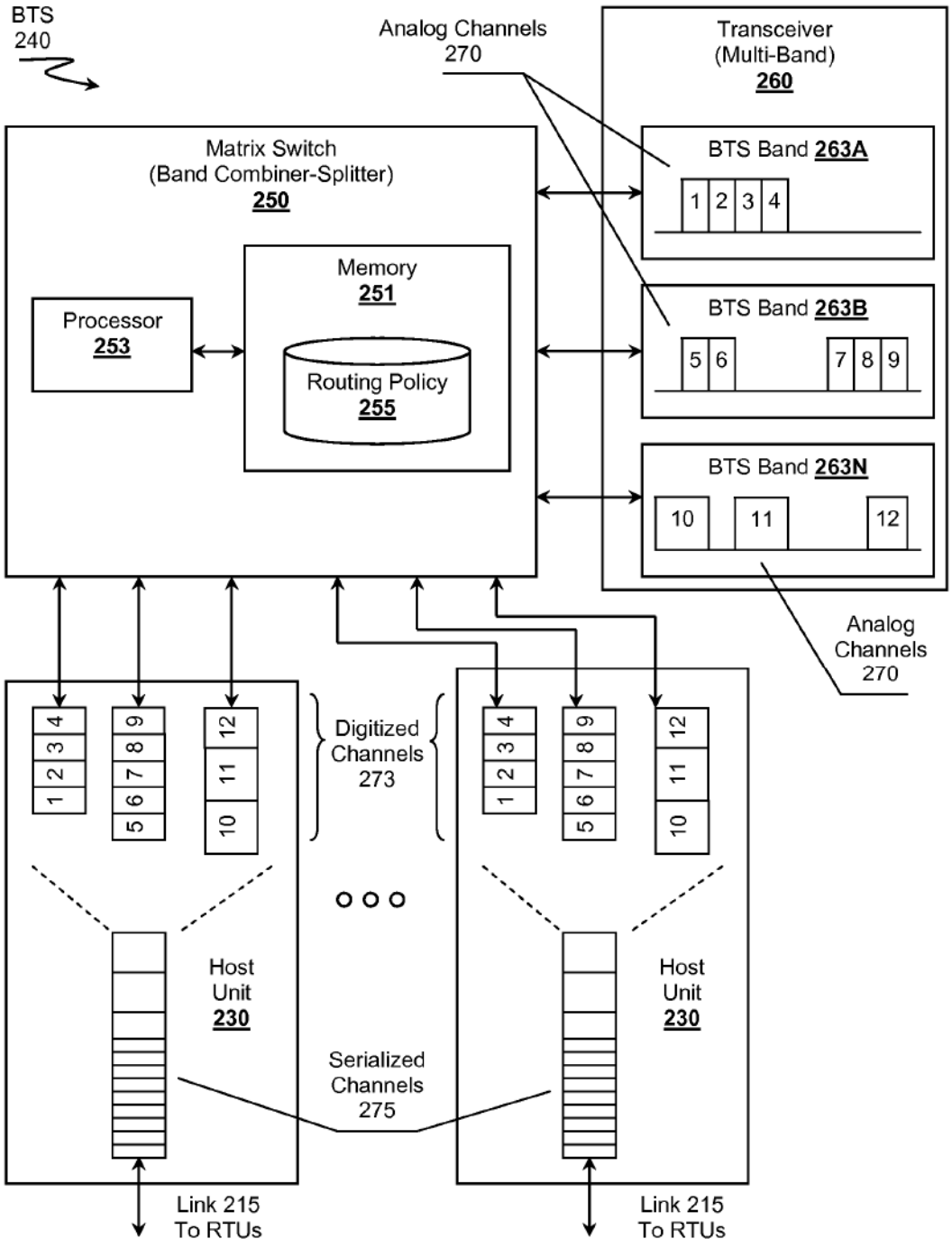

BTS
240
Analog Channels
270
Transceiver
(Multi-Band)
260
Matrix Switch
(Band Combiner-Splitter)
250
BTS Band 263A
1 2 3 4
Memory
251
Processor
253
BTS Band 263B
5 6 7 8 9
Routing Policy
255
BTS Band 263N
10 11 12
Analog
Channels
270
Digitized
Channels
273
Host
Unit
230
Host
Unit
230
Serialized
Channels
275
Link 215
To RTUs
Link 215
To RTUs

Figure 2

EX1007, Fig. 2

97. Figure 2 of Wu shows base transceiver station (BTS) 240 including transceiver 260, matrix switch 250, and host units 230. EX1007, ¶¶ 15, 34–36. Transceiver 260 receives signals on BTS bands 263A through 264N, and each may include multiple channels 270, e.g., channels 270 labelled 5 through 9 in BTS band 263B. *Id.* ¶¶ 35, 37. Transceiver 260 forwards the received channels 270 to matrix switch 250 that routes them according to routing policy 255 to host unit 230, which further distributes them to RTUs over link 215. EX1007, ¶ 38.

98. The Wu system is shown and described to employ bi-directional links for communicating signals between base transceiver stations and remote transceiver units (RTUs). EX1007 at Fig. 2, ¶36 ("The discussion regarding the routing of channels 1-12 from host units to RTUs is presented as channels flowing from transceiver 260, through host units 230, to RTUs. It should be noted that the disclosed system is considered to be bi-directional where carrier channel signals can be received by host units 230 from RTUs, then forwarded to multi-band transceiver 260 or a booster for transmission within bands 263."); ¶49 ("As previously discussed, preferred links 215 utilize a standard for exchanging data on channels 273 (e.g., CPRI, OBSAI, etc.). One should appreciate that host unit 230 can operate bi-directionally where it can receive serialized channels 275 from an RTU, de-serialize the channels back into digitized channel 273, restore analog

channels 270, and send the signals of the channels back to switch 250 within their proper channels 270."); ¶56 (the "contemplated system can be bi-directional in nature").

99. The routing policy employed in the Wu system can be reconfigured in order to change the routing of channels to the various RTUs. EX1007, ¶¶ 48, 49. Channels may be routed, allocated, or distributed, for example, based on anticipated requirements of areas at a certain time of day, on current traffic load, or on other calculated metrics tied to a quality of service such as a calculated traffic rate, consumed bandwidth or other derived metrics. EX1007 at ¶¶ 42, 43, 44, 48, 49.

100. Wu explains that the routing policy 255 "can comprise one or more rules" that will control how the switch distributes channels to the RTUs. EX1007, ¶40. The rules of policy 255 can operate as functions of one or more metrics available to switch 250. EX1007, ¶41. Wu explains that "metrics" can include observed or measured metrics, calculated metrics or other types of parameters or attributes of the system. EX1007, ¶42.

101. Observed or measured metrics (KPIs). Wu further explains observed or measured metrics in ¶42:

> Observed metrics are considered to be those having values that are measured by BTS 240, matrix switch 250, or other device associated with the system. Example observed

> metrics include a time (e.g., absolute, relative, date, etc.), a rate, a threshold, a quantity, a count, or other type of data that is measurable.

EX1007, ¶42.

102. Calculated metrics (corresponding to QoS). Wu explains that calculated metrics are metrics that are derived from other metrics such as measured metrics. Wu provides examples of calculated metrics that describe or indicate a quality of the wireless service (i.e., the performance of the network).

> A calculated metric is considered to be a metric that has a value, or multiple values, as derived from a function operating on other metrics. Example, calculated metrics can include a traffic rate, a consumed bandwidth, an aggregated count, or other derived metrics.

EX1007, ¶42.

103. The Wu system includes a processor 253 that "can be configured to analyze traffic metrics (e.g., data rate, call rate, consumed bandwidth, etc.) and correlate various metrics with a signature of potential traffic issues, load balancing for example." Wu at ¶44.

D. Prior art topologies commonly used to connect remote antenna units in a DAS

104. Before the effective date of '382 patent, prior art DAS systems, as well as the CPRI standard commonly used in the DAS transport links of such prior art systems, disclosed various topologies that could be used in connecting remote

antenna units, including: (a) star, (b) daisy chain, (c) ring or loop, or some combination of (a) – (c) topologies. EX1005, Fig. 1 (disclosing combination of star and daisy chain); EX1010 (Evans) at Fig. 3 (star), Fig. 4 (daisy chain), Fig. 6 (ring or loop). See also EX1010 at ¶5 ("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").

105. Example topologies disclosed in and supported by CPRI include (a) star, (b) daisy chain, (c) ring or loop. EX1009, Section 2.3 and Figs. 3, 4, 5, 5A, 5B, 5C, 5D, 5E.

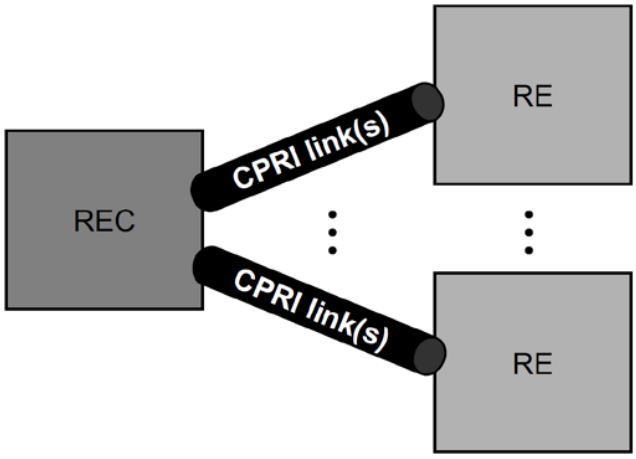


Figure 5: Multiple point-to-point links between one REC and several REs (star topology)

EX1008, Fig. 5.

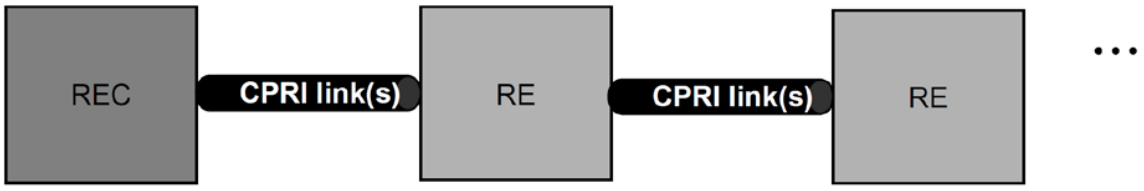


Figure 5A: Chain topology

EX1009, Fig. 5A

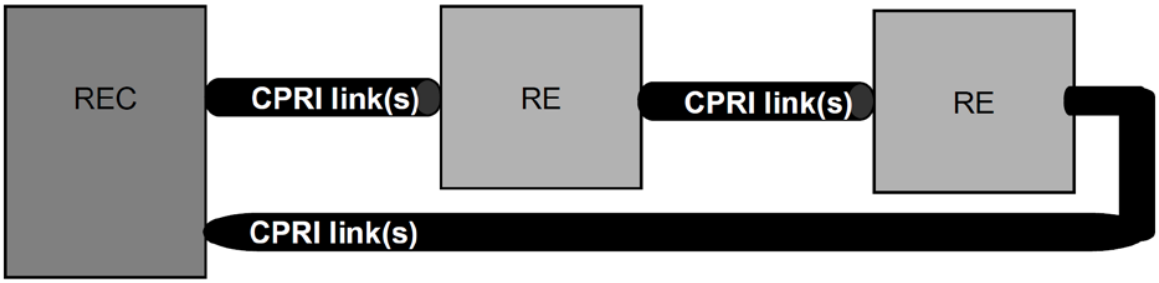


Figure 5C: Ring topology

EX1009, Fig. 5C.

106. In designing and deploying a DAS, a POSA would have understood that topology used, including those of (a) – (c), was a matter of design choice. Implementing any of such topologies in a DAS would have been routine and would have led to predictable results.

VIII. GROUNDS

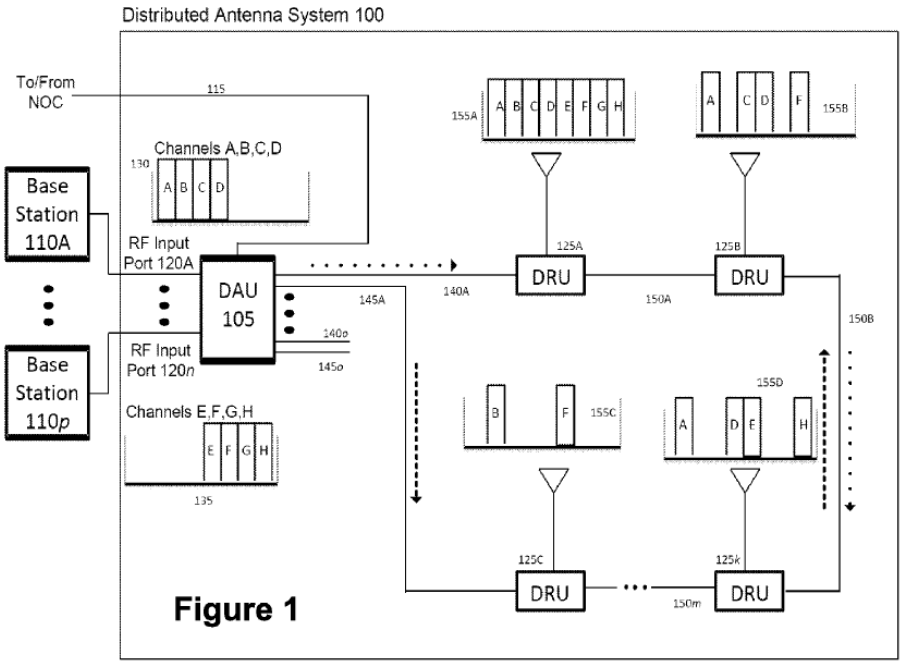
A. Ground 1: Stapleton anticipates all claims

1. Independent Claim 1

a. Element 1A

"A system comprising"

107. Stapleton discloses the preamble. Specifically, Stapleton discloses a distributed antenna *system* (DAS). Figure 1, for example, shows distributed antenna system (100):



EX1006, Fig. 2. As shown, DAS (100) comprises a digital access unit (DAU) (105) and a plurality of digital remote units (DRUs) (125). Stapleton provides an overview of the system in Paragraph 28:

> The present invention is a novel Reconfigurable Distributed Antenna System that provides a high degree of flexibility to manage, control, re-configure, enhance and facilitate the radio resource efficiency, usage and overall performance of the distributed wireless network. FIG. 1 illustrates an embodiment of the Distributed Antenna System 100 in accordance with the present invention. The system employs a Digital Access Unit functionality 105 (hereinafter "DAU"). The DAU 105 serves as an interface between associated base stations (BTS) 110A-B and a plurality of digital remote units (DRU) 125A-n, although only four DRU's are shown in FIG. 1. … In addition, those skilled in the art will recognize that a DAU is monitored and controlled by a remote network operations center ("NOC"), as indicated at bidirectional link 115 in FIG. 1. Such links are typically Ethernet connections or external modems, but can be any form of link suitable for remote monitoring and control. The NOC has the capability to remotely configure the DAU parameter settings which in turn configures the DRU's parameter settings. The NOC can request information from the DAUs. The DAUs can subsequently request information from the DRUs. The information requested includes but is not limited to uplink power, downlink power, optical error rate, gain settings, active carriers, etc.

EX1006, ¶0028. Stapleton also illustrates its system in Figs. 2-4, 7, 8.

b. Element 1B

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

108. Stapleton discloses each part of this limitation.

109. *First*, Stapleton discloses "*one or more Digital Access Units (DAUs)*." Paragraph 28 of Stapleton expressly teaches its system employs "Digital Access Unit functionality 105 (hereinafter 'DAU')." EX1006, ¶0028. Figure 1, for example, shows a DAU (105):

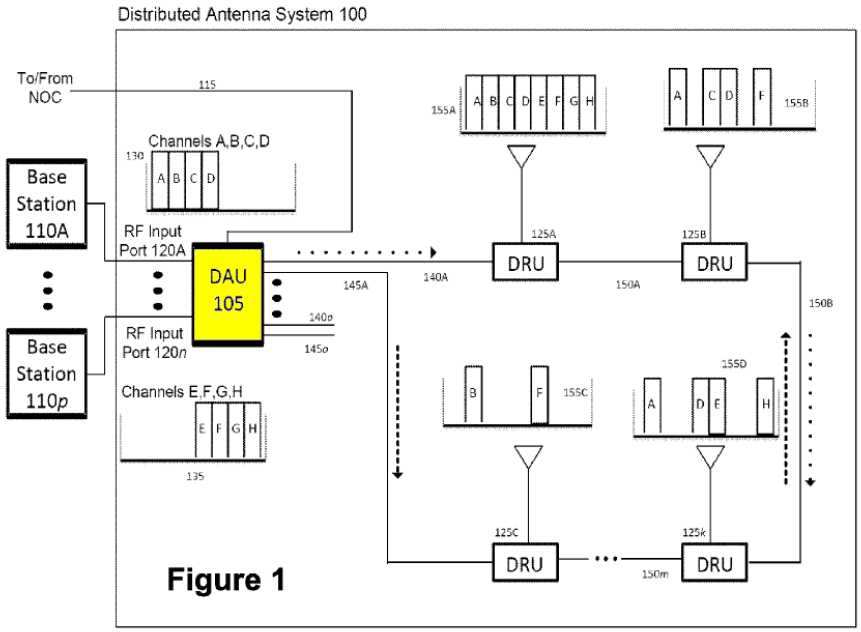


Figure 1

EX1006, Fig. 1. Stapleton further teaches that the DAS may include more than one DAU. Figure 4, for example, shows two DAUs (400, 415). EX1006, Fig. 4 (below, annotated).

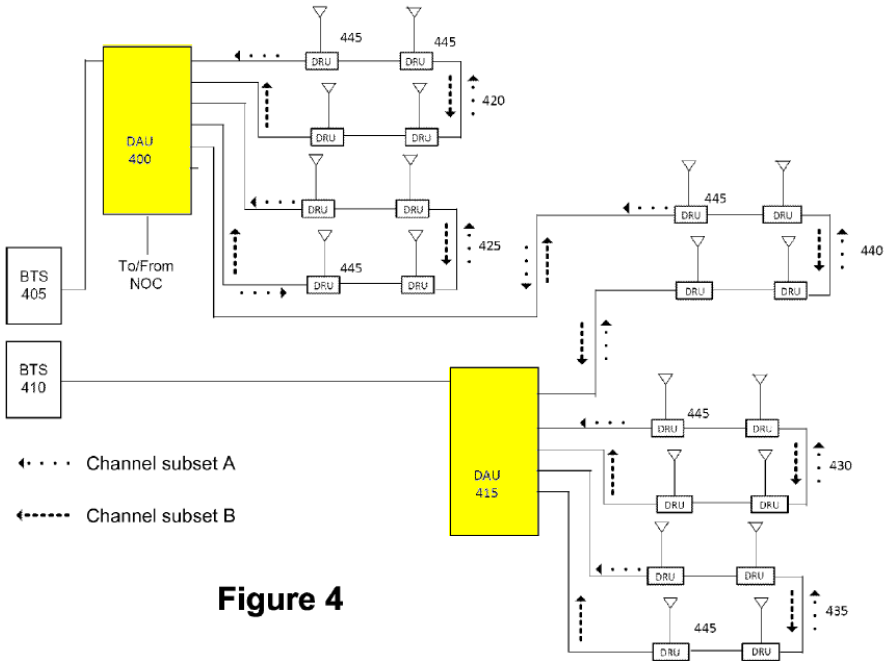


Figure 4

See also EX1006, ¶0023 ("FIG. 4 is a block diagram in accordance with an embodiment of the invention showing the basic structure and an example of a unidirectional channelized uplink or downlink transport. This example of a five ring scenario *comprises two DAUs* and twenty DRUs."). Figure 8 shows another example of more than one DAU. *See* EX1006, ¶0027 ("FIG. 8 illustrates in block diagram form an embodiment of a DAS according to an aspect of the invention, including daisy-chained *DAU's*.").

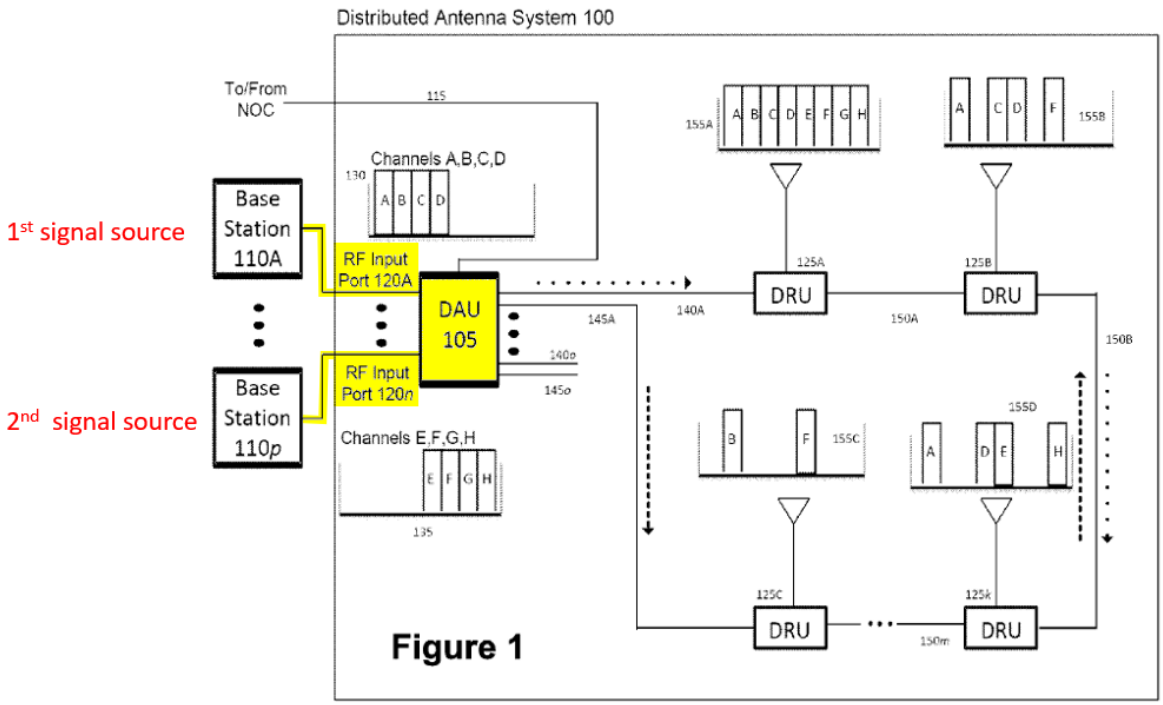
110. Second, Stapleton teaches that its DAUs are "operable to receive at least one signal from at least one of a first signal source and a second signal source from one or more of a plurality of signal sources." Stapleton teaches that its DAU is an interface to plural "base stations 110A-B." EX1006, ¶0028 ("The system

employs a Digital Access Unit functionality 105 (hereinafter 'DAU'). The DAU 105 serves as an interface between associated base stations (BTS) 110A-B and a plurality of digital remote units (DRU) 125A-n, although only four DRU's are shown in FIG. 1.") A base station is an example of a "signal source." EX1006, ¶0028 ("…a distributed antenna system having n base stations, each providing m RF outputs for transmission by one or more associated DAU's to o DRU's…"); EX1006, ¶0029 ("RF input **signals** 120A through 120 n are received at the DAU 105 **from one or more base station units (BTS)** indicated at 110A through 110 p."). The preferred embodiment of a signal source in the '382 patent is a base station. EX1001 4:62-5:8 ("A distributed antenna system (DAS) provides an efficient means of utilization of base station resources. … This approach facilitates transport of the RF signals from the base stations to a remote location or area served by the DRUs."); 7:1-2 ("DAU 1 (102) receives downlink signals from BTS…"); 8:10 ("DAU 1 (202) receives downlink signals from BTS…"); 8:38-39 ("DAU 1 (302) receives downlink signals from BTS…"); Figs. 1-3, 6-8. Because Stapleton teaches that the DAU interfaces with plural "base stations" it teaches a plurality of signal sources.

111. Stapleton teaches that the DAU receives plural "RF inputs signals" (*at least one signal*) from the "one or more base station units" (the *first and second signal source*). EX1006, ¶0029 ("For the downlink (DL) path, *RF input signals*

120A through 120n are received at the DAU 105 from one or more base station units (BTS) indicated at 110A through 110p.")

112. Here is an annotation of Figure 1 showing that Stapleton teaches this limitation:



As shown, DAU (105) receives RF input signal 120A (*at least one signal*) from base station 110A (*a first signal source*). DAU (105) also receives RF input signal 120N (another example of *at least one signal*) from base station 110p (*a second signal source*). EX1006, ¶0028-0029.

113. Here is another annotation of Figure 4 showing that Stapleton teaches this limitation:

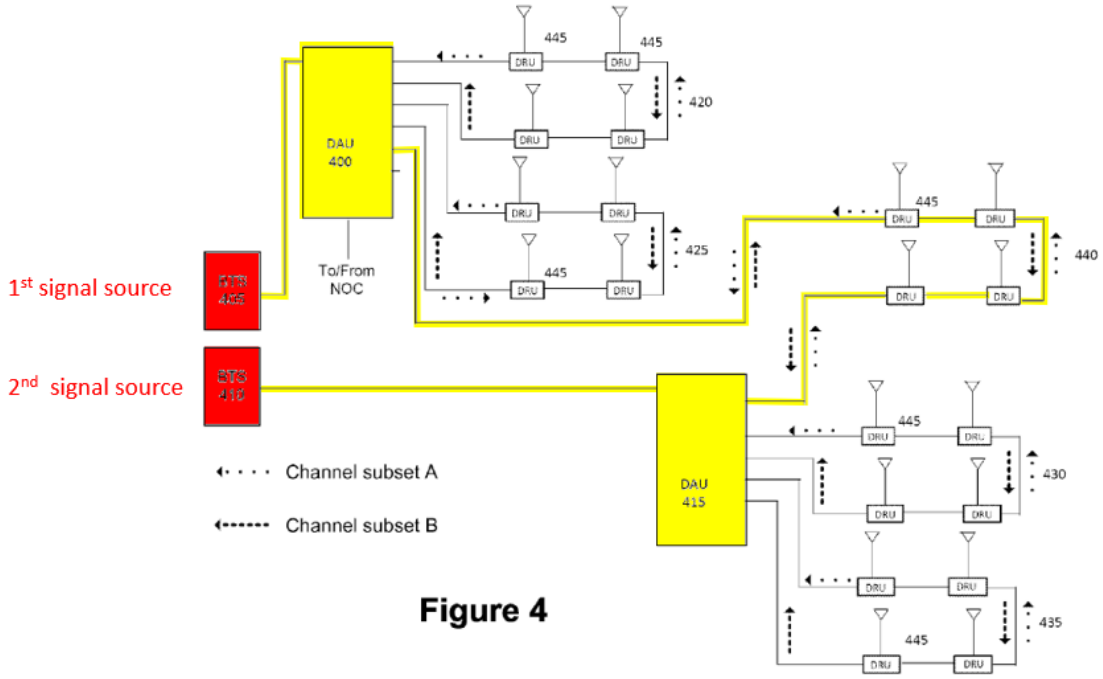


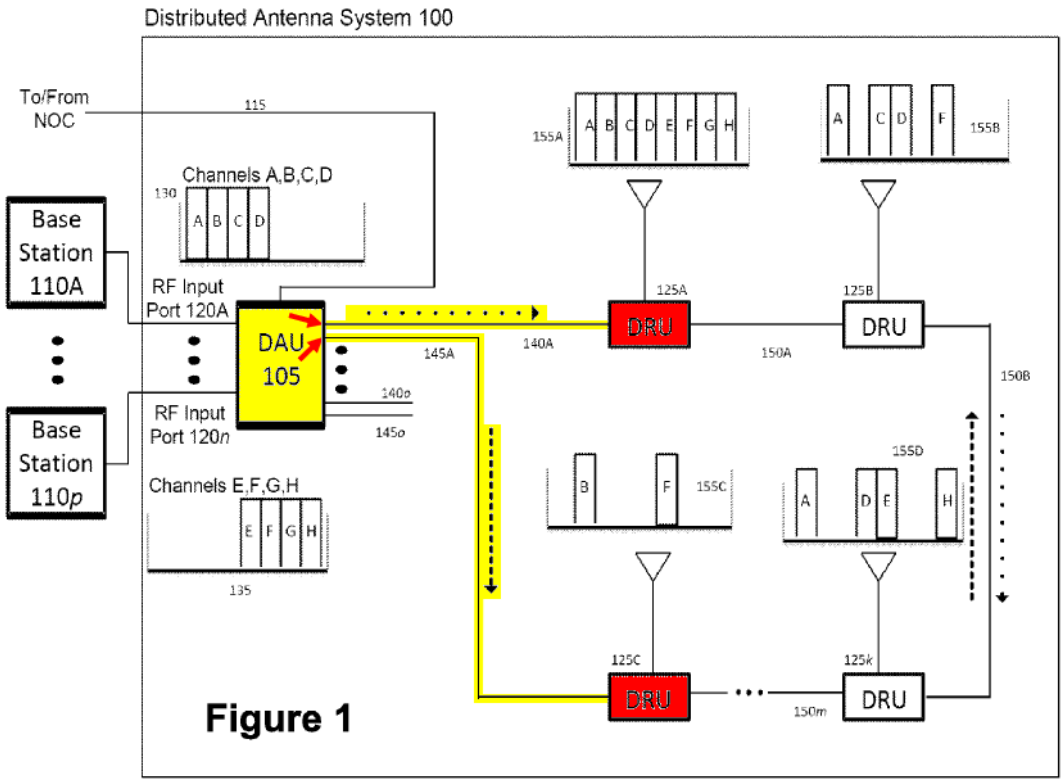
Figure 4

As shown, each DAU (400, 415) is 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 (BTS 410 and BTS 405). EX1006, ¶0045 ("In the embodiment of FIG. 4, a first composite signal enters a first DAU 400 at that DAU's RF input port from a base station 405, and a second downlink input signal from, e.g., a second base station 410 belonging to a different wireless operator enters DAU 415 at that second DAU's RF input port."). For example, DAU 400 is operable to directly receive at least one signal from a BTS 405 (*a first signal source*). Further, as shown by cable 440 (yellow), DAU 400 is operable to *indirectly* receive at least one signal from a BTS 410 (*a second signal source*). EX1006, ¶0044 ("In this embodiment, signals belonging to both the first operator

and the second operator are converted and transported to the DRU's 445 on ring 440 because DAU 400 and DAU 405 are daisy-chained through the fiber optic cable 440."). Specifically, DAU 400 indirectly receives the signal through its daisy-chain connection to DAU 405, i.e., the signal from BTS 410 goes through DAU 405 through the optical cable 440 to DAU 400.

114. *Third*, Stapleton teaches "*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.*" Stapleton teaches multiple examples of each of the recited "*input*" and "*output*" ports. In this context, a "port" is the physical structure to which a cable connects to the DAU. Said another way, it is the point of entry for the cable into the DAU. The port matches the type of cable connection. An optical cable, for example, will have an optical port. An ethernet cable, for example, will have an Ethernet port. A coaxial cable, for example, will have a coaxial port. If the port did not match the cable, the cable and port would not work. The physical hardware would not connect (e.g., the cable would not align/fit with the port) and/or the signals would not transfer correctly (e.g., optical signals from an optical cable would not transfer correctly to coaxial port). Furthermore, the port must match the directionality of the cable, i.e., if the cable is bidirectional, the port must also be bidirectional to work properly. Otherwise, the cable would not work in both directions.

115. *An <u>output port</u>*. Stapleton teaches that DAU has an "optical *output*" that feeds the signal to the DRU via a bidirectional cable. EX1006, ¶0033 ("One *optical output of DAU* 105 is fed to DRU 125A, *via bidirectional optical cable* 140A. A second *optical output* of DAU 105 is fed via bidirectional optical cable 145A to DRU3. Similarly, bidirectional optical cables 150, 155 and 160 connect DRU's 125A-n in a ring configuration, such that DRU 125A connects to DRU 125B via cable 150A, DRU 125B connects to DRU 125n via cable 150B, and DRU 125k connects to DRU 125C, or the kth-1 DRU, via cable 150m."). Here is an annotation of Figure 1 showing this:



The yellow lines here correspond to optical cables. The DAU's must include a corresponding optical port for an optical cable to connect to the DAU; otherwise, the cable would not function. Thus, the DAU inherently includes an optical port. The optical port is an output port because it is used to output signals from the DAU to the DRUs. EX1006, ¶0033 ("One optical output of DAU 105 is fed to DRU 125A, via bidirectional optical cable 140A."). Furthermore, before outputting the signal to the DRUs, Stapleton teaches that the DAU translates the signal to optical signal using "pluggable SFP modules." EX1006, ¶0029. A "pluggable" SFP module is an example of an optical port. It is physical structure that receives and connects the optical cable.

116. Figure 4 of Stapleton also includes this same output port feature at the DAU that outputs signals to the DRUs. Annotated below is one example:

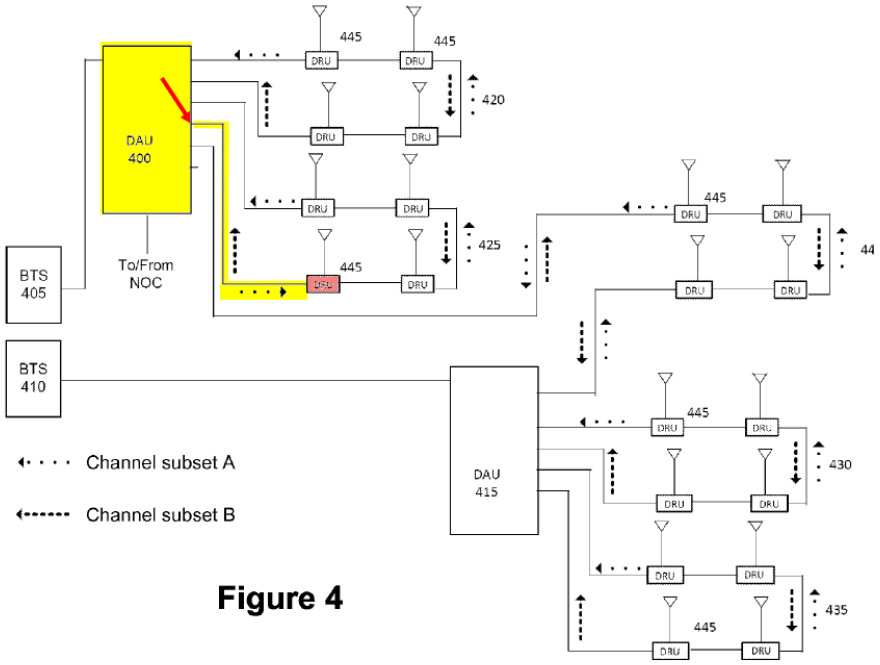


Figure 4

117. Figure 3 of Stapleton also includes this same output port feature at the DAU that outputs signals to the DRUs. Annotated below is one example:

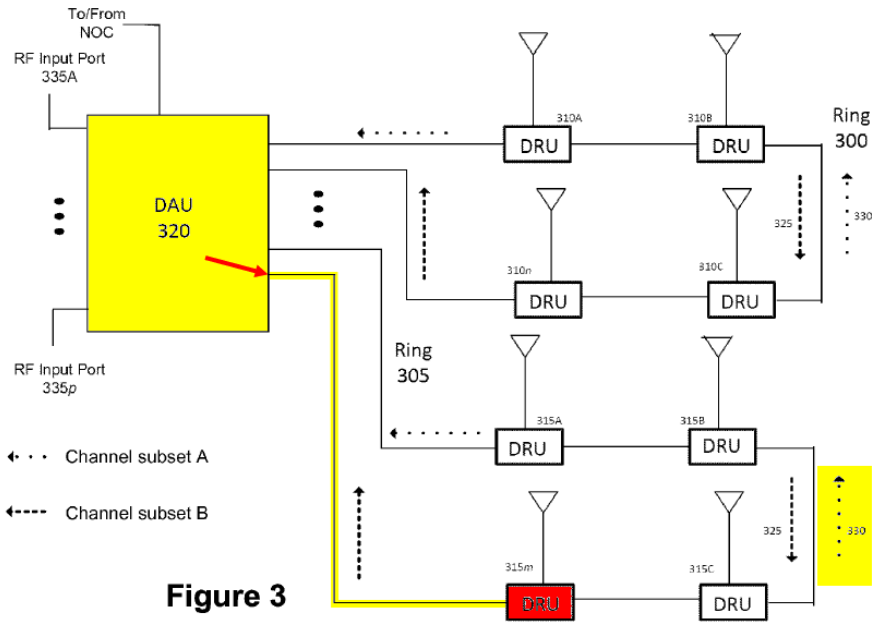


Figure 3

118. Stapleton has further express disclosure that the DAU must have a port for each DAU-to-DRU connection. Stapleton teaches DAU and DRUs frames the packets they transmit back and forth using the "CPRI" standard. EX1006, ¶0048 (The *DAU and DRUs frame the individual data packets* corresponding to their respective radio signature using the *Common Public Interface Standard (CPRI)*. Other Interface standards are applicable provided they uniquely identify data packets with respective DRUs. Header information is transmitted along with the data packet which identifies the DRU and DAU that corresponds to the individual data packet."). In other words, the DAU and DRUs format the communications over the below cable (yellow) using CPRI:

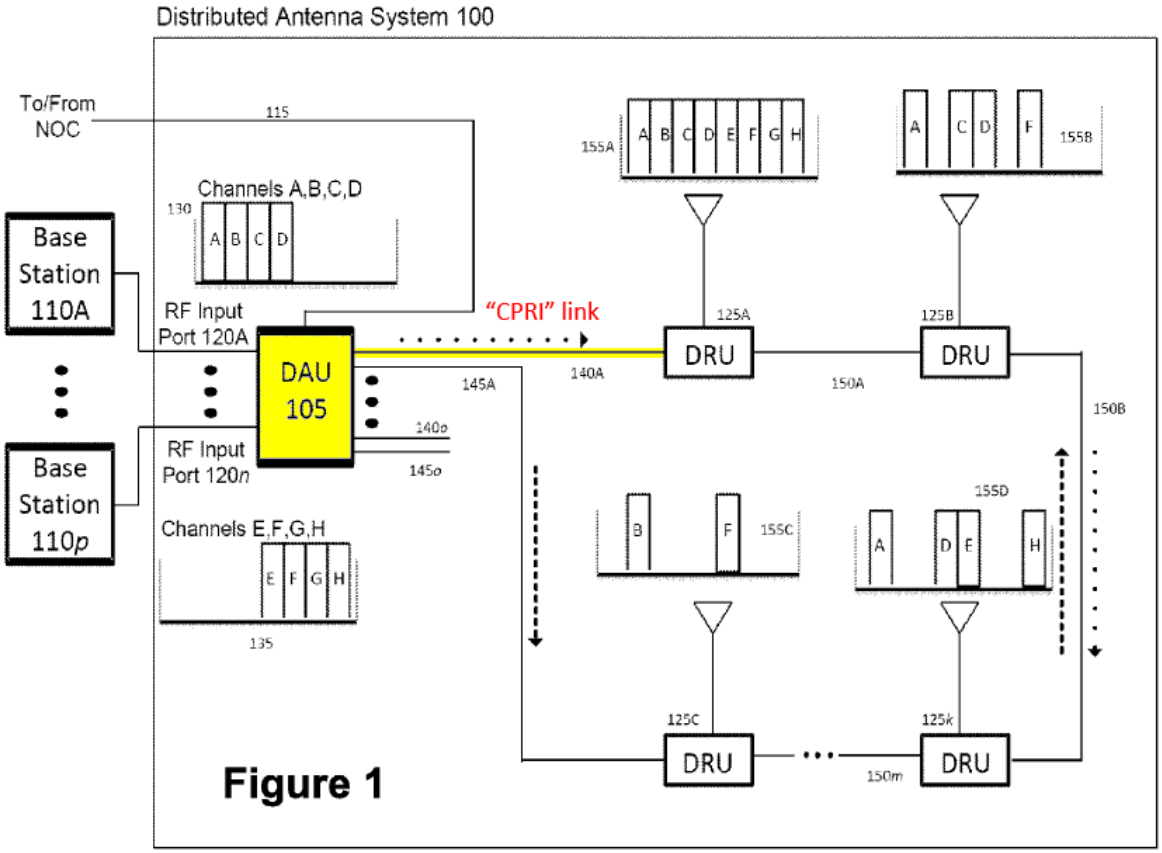


Figure 1

When two nodes (here the DAU and DRU) communicate using CPRI, that is called a CPRI link. The CPRI standard defines a link between two nodes (here the DAU and DRU) as a *bidirectional* interface between two *ports*:

> **Link:**
>
> The term "link" is used to indicate the bidirectional interface in between two directly connected ports, either between REC and RE, or between two nodes, using one transmission line per direction. A working link consists of a master port, a bidirectional cable, and a slave port.
>
> Master/master and slave/slave links are not covered by this specification (for the definition of master and slave see below).

EX1009 at 7. The CPRI standard illustrates these bidirectional ports in Figures 1 and 2:

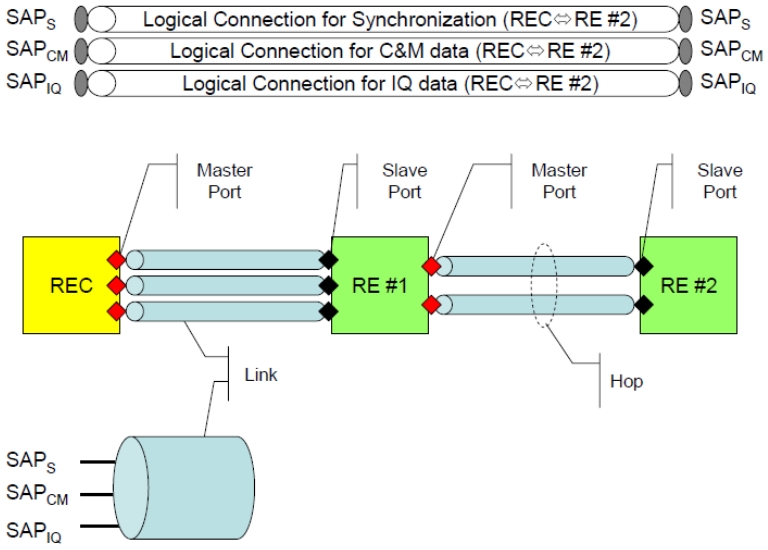


Figure 1A: Illustration of basic definitions

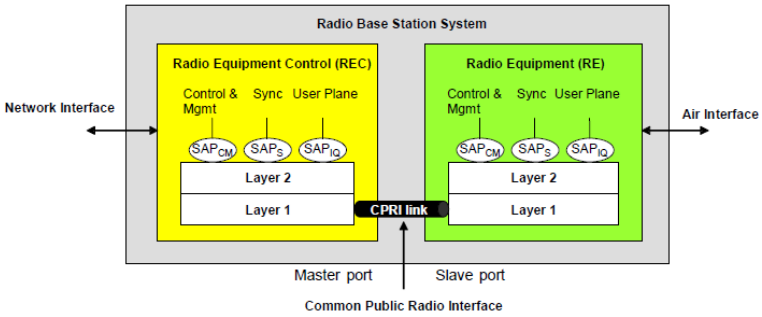


Figure 2: Basic System Architecture and Common Public Radio Interface Definition

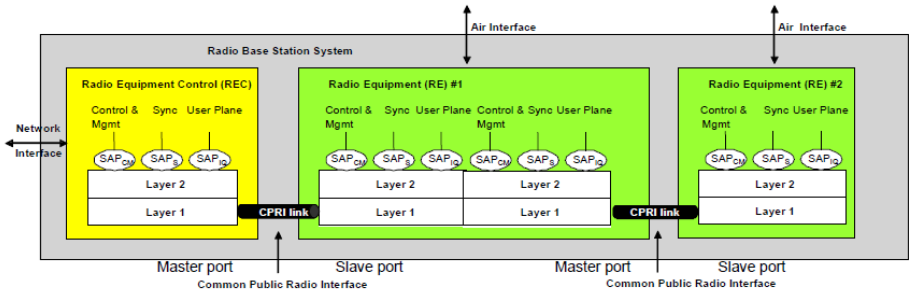


Figure 2A: System Architecture with a link between REs

EX1009 at 8, 10. Thus, because the DAU uses CPRI to communicate with the DRU, the DAU must have a port that is configured for bidirectional operations, i.e., downlink/uplink. As shown above, the port is an output port because it outputs signals to the DRU. Thus, because the DAU uses CPRI to communicate with the DRU, it inherently has *an output port configured as an uplink/downlink port*.

119. *An input port*. Stapleton teaches multiple examples of an input port.

120. *First example of an input port*. Stapleton teaches that each DAU can be daisy-chained through a fiber optic cable to another DAU. EX1006, ¶0044, ¶0057, Fig. 4, Fig. 8. Figure 4, for example, shows this:

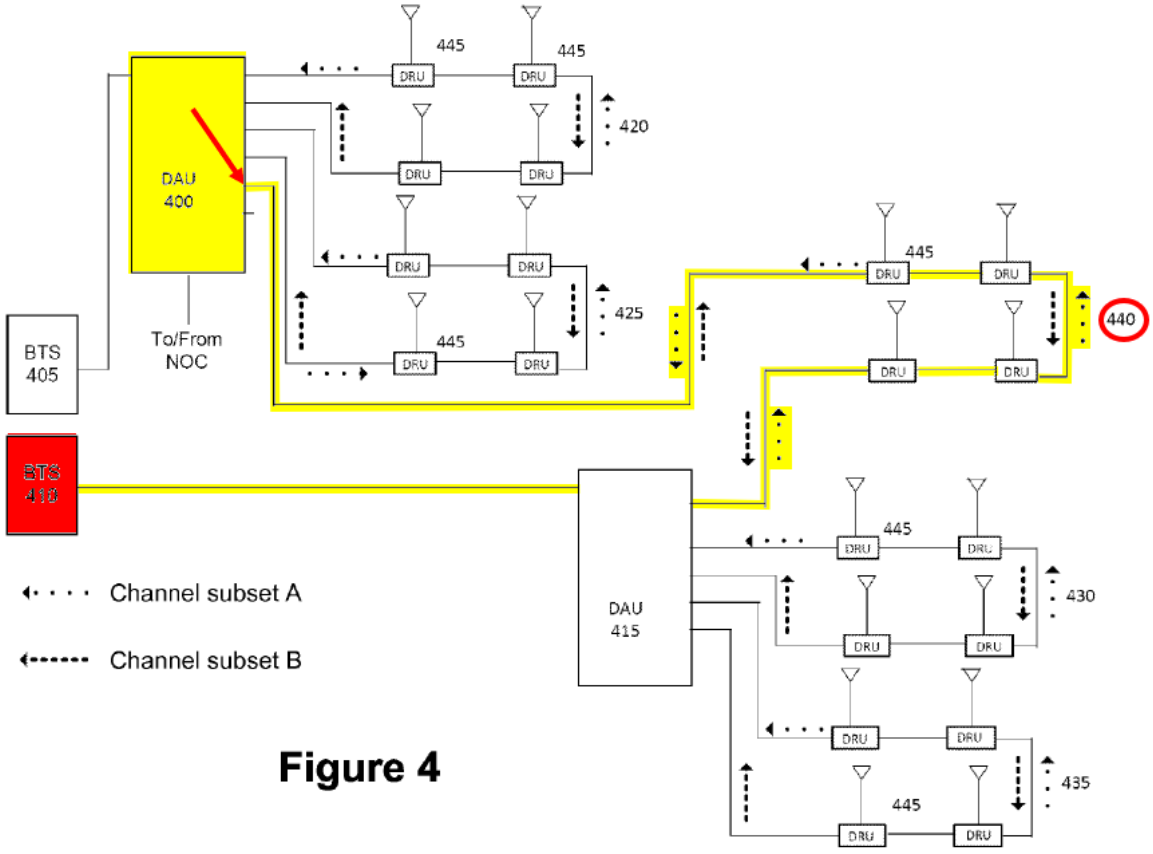


Figure 4

Numeral 440 (circled in red) is a fiber optic cable that daisy-chains DAU 400 (yellow) and DAU 415 (white). EX1006, ¶0044 ("DAU 400 and DAU 405 are daisy-chained through the fiber optic cable 440.") DAU 400 inherently includes a corresponding port for the fiber optic cable 440 to connect to the DAU 400; otherwise, the cable would not function because it would be disconnected. The red arrow added to the figure above indicates where there must be a port in DAU 400 to connect to the fiber cable. Further, this is an example of an *input* port because, for example, it is the input by which the DAU indirectly receives signals

from BTS 410. DAU 400 can then distribute those input signals to the DRUs to which it is connected. DAU 400 also contains an input port that directly connects to BTS 405, which is another example of an input port as recited in the claim. This port is discussed below as the "third example."

121. *Second example of an input port*. Stapleton expressly teaches that each DAU includes an "RF input port" (which is an example of the claimed "*input port*") for the DAU to receive RF signal from the base stations. EX1006, ¶0032 ("In such instances, the DAU will receive a composite downlink input signal 130 from, e.g., a first base station 110A belonging to one wireless operator, enters the DAU 105 *at the RF input port 120A*. Composite signal 130 comprises carriers A-D. A second composite downlink input signal from e.g., a pth base station 110p belonging to the same wireless operator enters DAU1 at the DAU1 *RF input port 120n*."), *see also* ¶0036 ("transport from the DAU input to any specific DRU output any specific narrow frequency band or bands, RF carriers or RF channels which are available at the respective *RF input port of either DAU*."), ¶0044, ¶¶0028-0029. Figure 1 shows these "input ports":

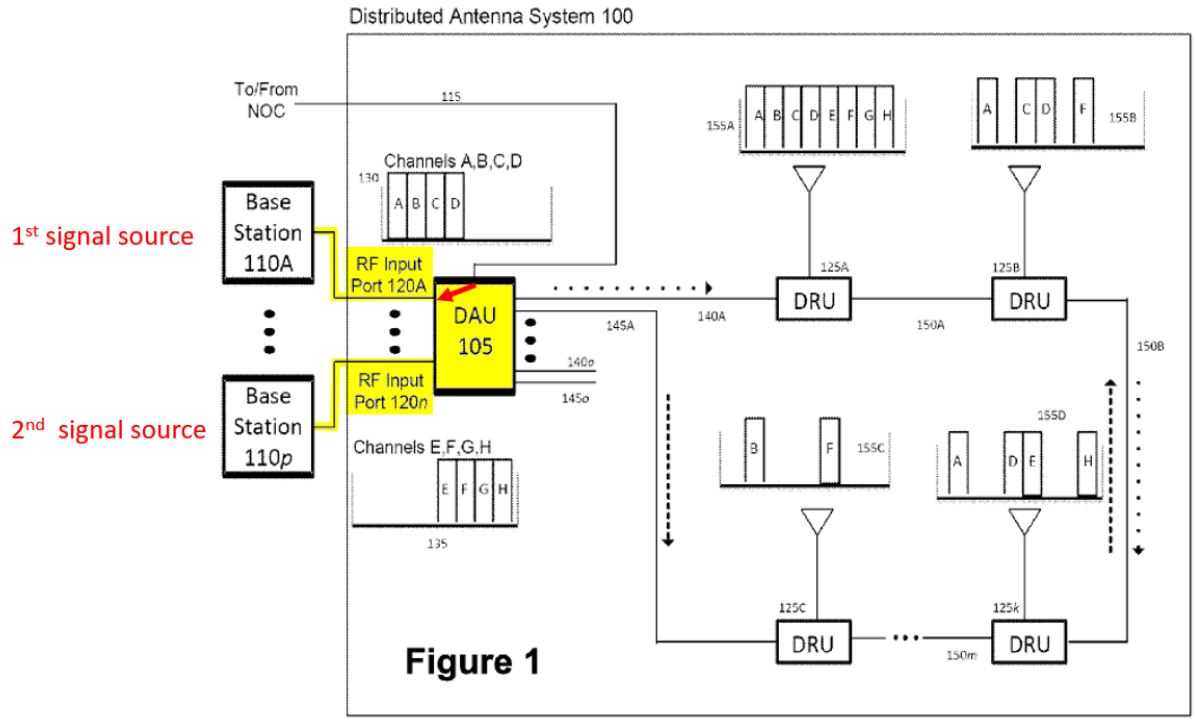


Figure 1

Figure 4 shows this same feature as well:

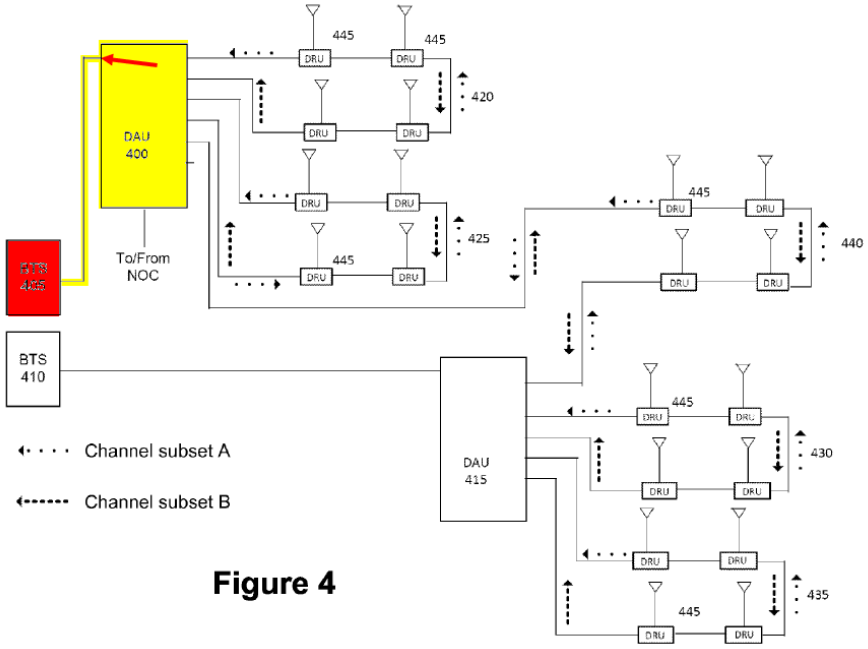


Figure 4

Figure 3 shows this same feature as well:

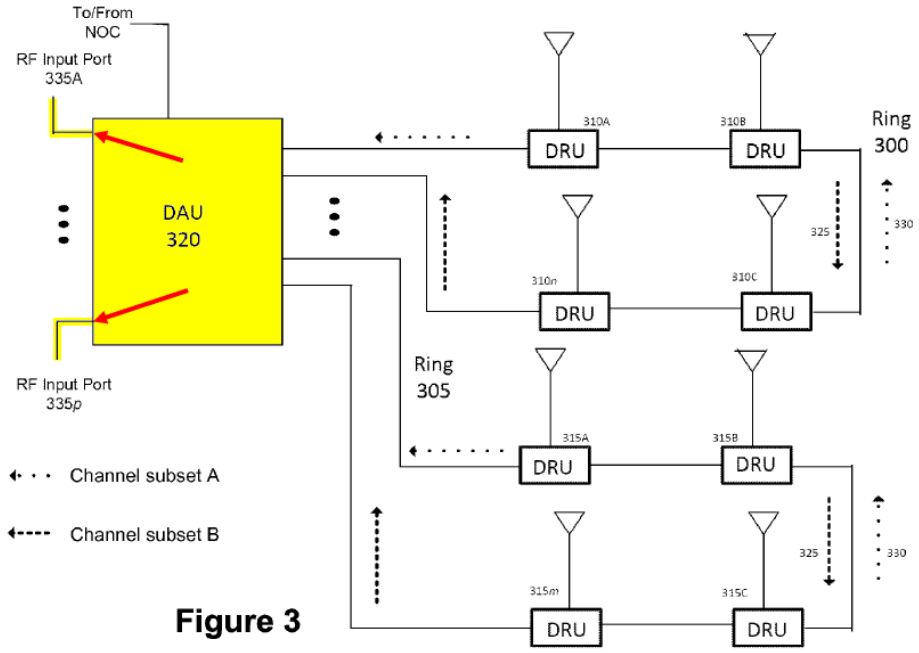
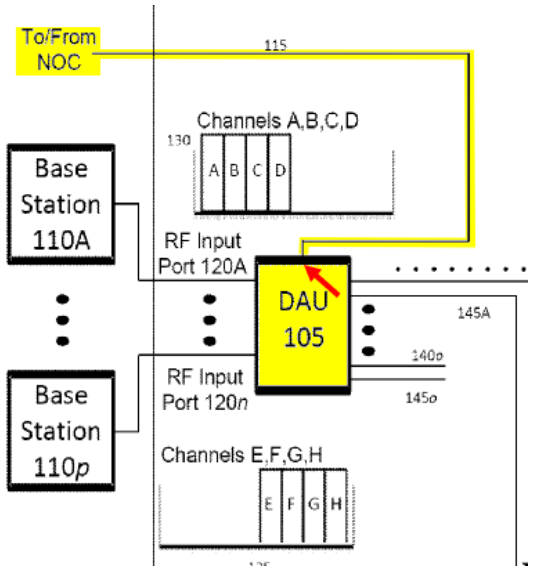


Figure 3

122. *Third example of an input port.* Stapleton teaches that its DAU connects to the NOC via a "bidirectional link (115)" such as an "Ethernet" connection. EX1006, ¶0028, ¶0017. Figure 1 shows this:



For such an Ethernet link to function, the DAU must have a matching Ethernet port. This NOC-to-DAU port an input port because the DAU receives command "from" the NOC-to-DAU connection, i.e., *inputs*. EX1006, ¶0036, ¶0054. Because the link is bidirectional, the matching port must also be bidirectional (i.e., configured as an *uplink/downlink port*). Further, the port must be bidirectional because the DAU can receive commands (*downlink*) from the NOC and provide information back to the NOC (*uplink*) via cable 115. EX1006, ¶0054, ¶0029.

123. *Alternative example of an input port*. Even if Patent Owner disputed all three of these examples of the DAU's input ports, that would not distinguish Stapleton. Recall Stapleton's DAU has a pluggable SFP modules (port) for each of *multiple* DAU-to-DRU connections that both transmit outputs (Fig. 1) and receive inputs (Fig. 2)—one of these multiple ports could alternatively be the recited input port. Stapleton teaches that in the upstream direction the DAU receives input signals (optical signals) from the DAU-to-DRU connection. EX1006, ¶0031 ("Referring next to FIG. 2, an embodiment of an uplink (UL) path….Channels received at the antenna associated with each DRU are converted into optical signals by each DRU 125A-125k. Optical signals received from the DRU's are de-serialized and de-framed by the DAU 105."). The black arrow (circled) in Figure 4 below shows the DAU 400 receives input signal from the DRUs:

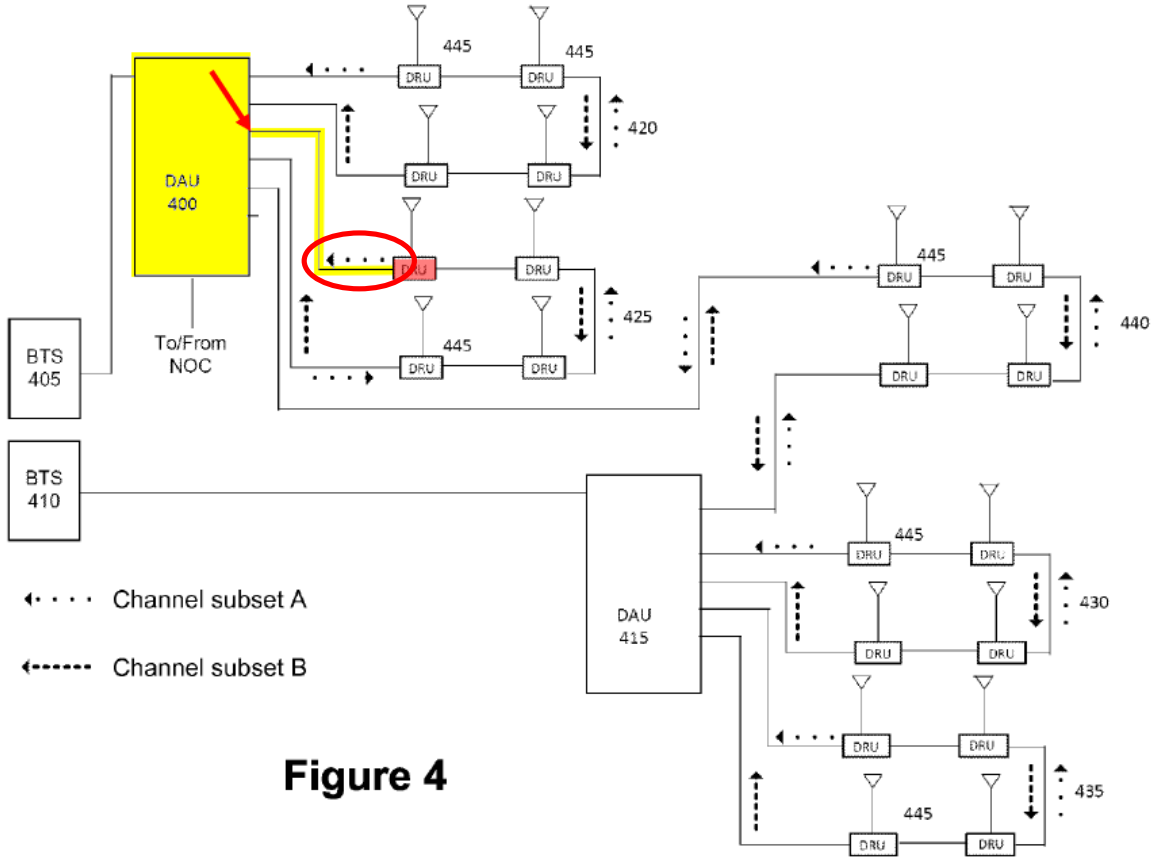


Figure 4

Figure 2 shows this same feature. Specifically, arrows in Figure 2 show that DAU 105 receives input signal signals from the DRUs:

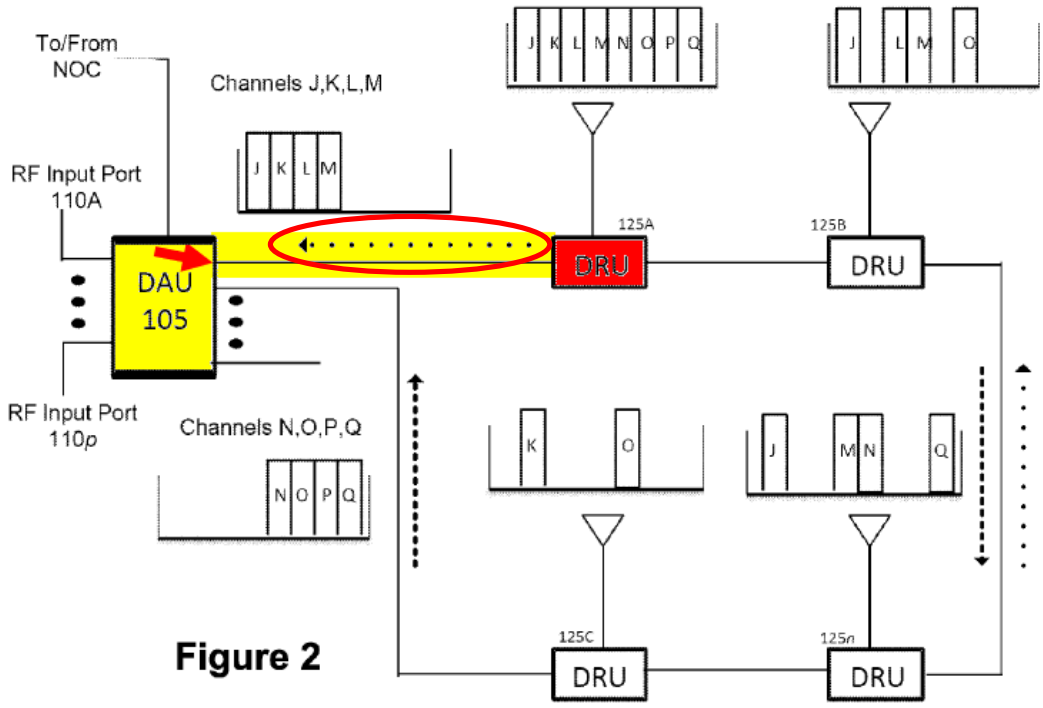


Figure 2

DAU 105 must include a corresponding input port for the fiber optic cable from the DRU to connect to the DAU; otherwise, the cable would not function because it would be disconnected. Figure 3 shows this same feature as well:

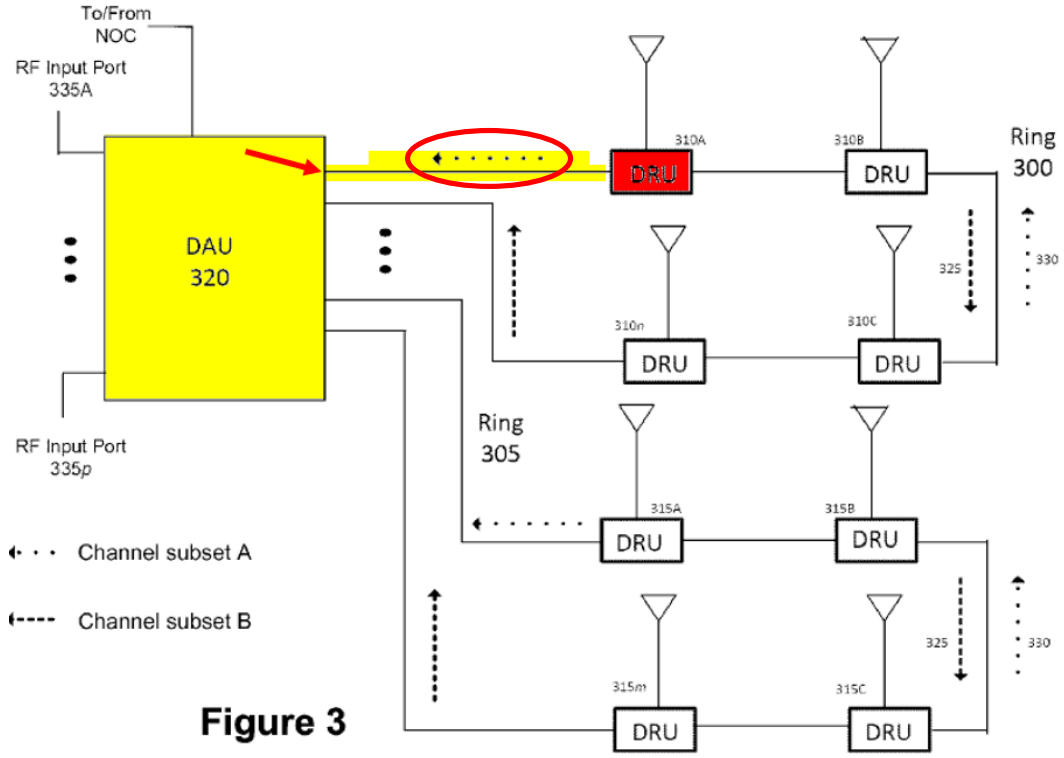


Figure 3

EX1006, ¶0041.

124. To be clear, this alternative example does not require double counting any individual port as being the input and output port. Figure 1, for example, shows numerous DAU-to-DRU connections:

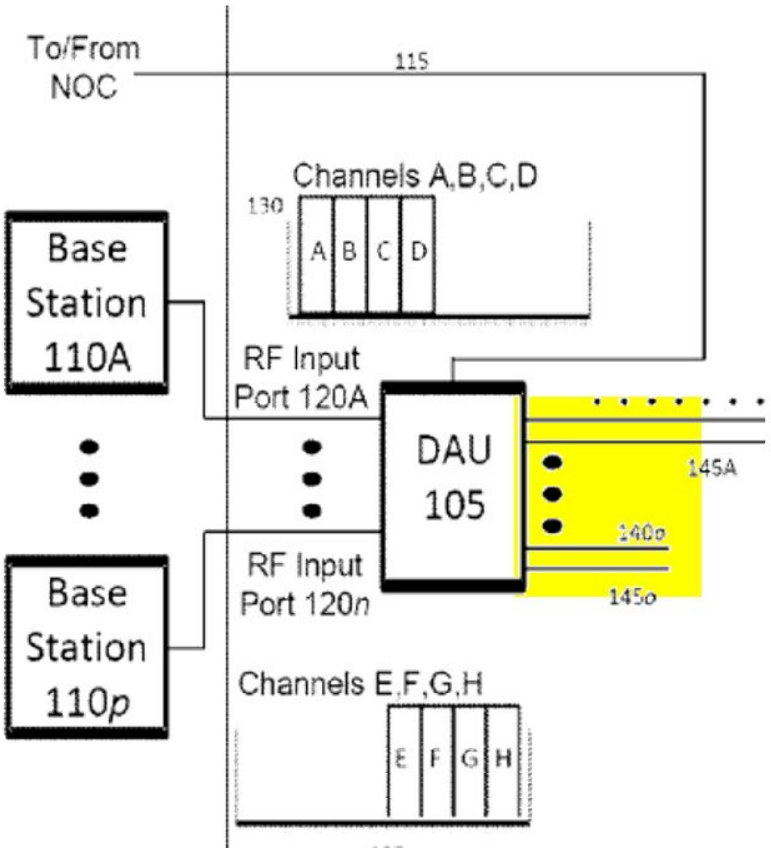


Figure 4 also shows multiple DAU-to-DRU connections:

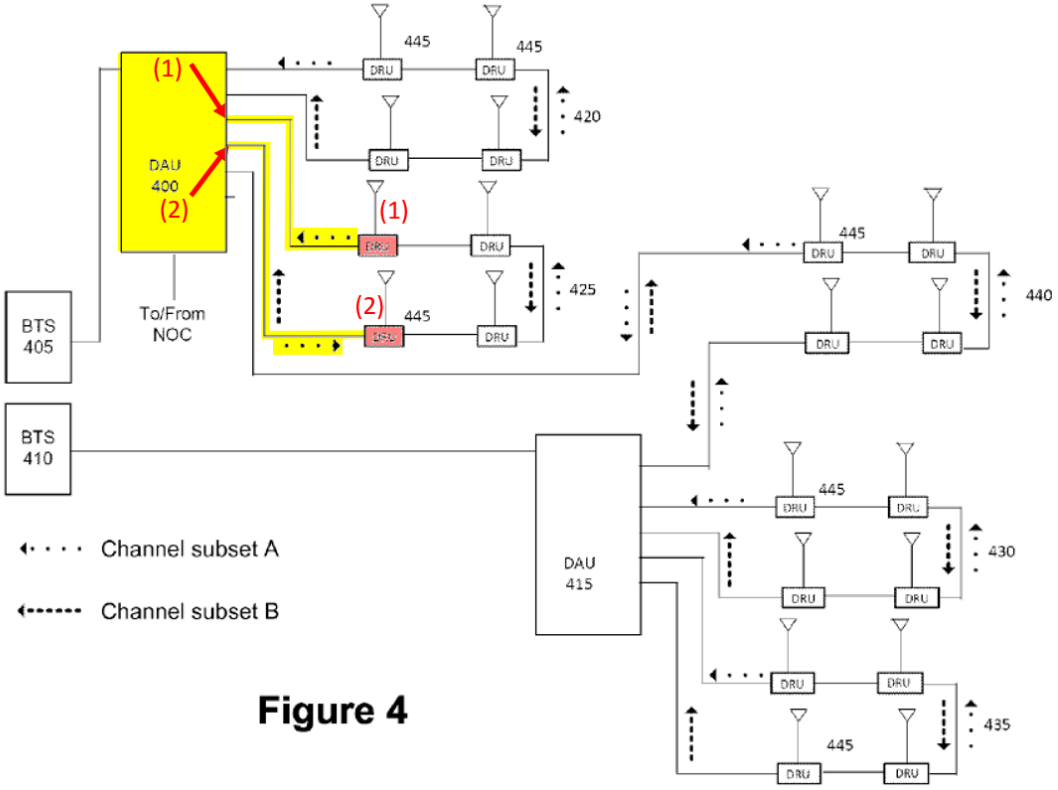


Figure 4

Here, there is a port leading directly to DRU (1) and another port leading directly to DRU (2) as pointed out below. The same is true for Figures 1 and 3. In all these examples, there are at least two DAU-to-DRU connections – at least one of which is the claimed outport port (and the other of which could alternatively be the claimed input port).

125. *Configured as an uplink/downlink port.* Each of the above examples is configured as an *uplink/downlink port.* As explained below, a POSA understands that each port corresponds to a bidirectional cable. A bidirectional cable carries signals in both the downlink direction and uplink direction. Thus, the

corresponding port for the cable is also configured for signals in both directions, i.e., *configured as an uplink/downlink port*. To be clear, the port must match the directionality of the cable, i.e., if the cable is bidirectional, the port must also be bidirectional to work properly. Otherwise, the cable would work in both directions.

126. *Port for the DAU-to-DAU connection*. Figure 4, for example, expressly shows input port (red arrow) for the DAU-to-DAU connection connects to a bidirectional cable (black arrows highlighted in yellow are shown in both directions):

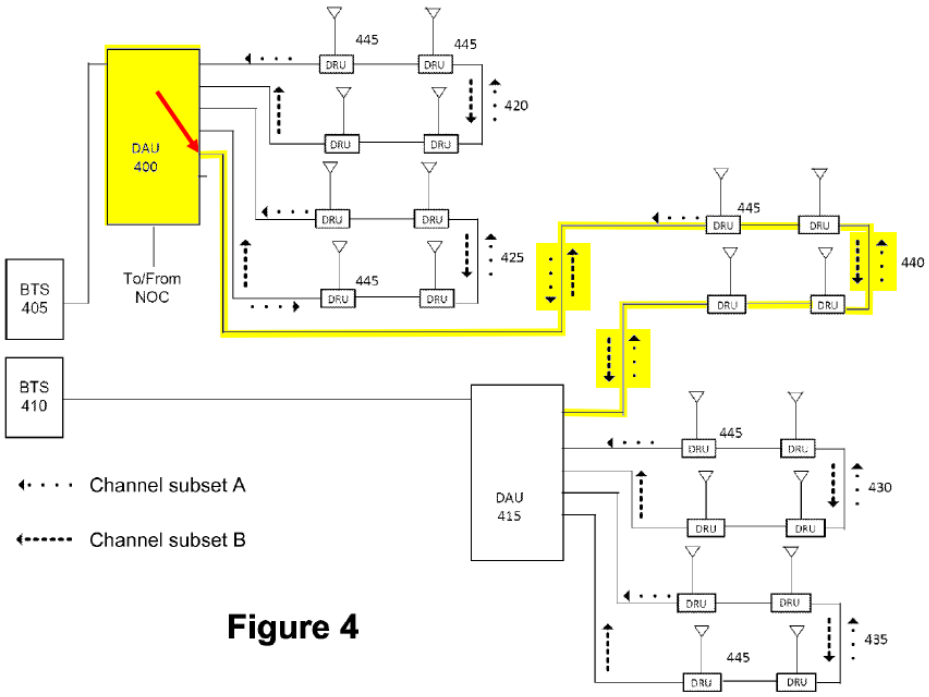


Figure 4

A POSA also knows that cable 440 is a bidirectional cable because Stapleton describes cable 440 in the singular ("optic cable 440"); for a singular cable to carry signals in both directions as shown in Figure 4 it must be a bidirectional cable. EX1006, ¶0044. Stapleton provides further details of the DAU-to-DAU port connection in provisional patent application 61/382,836 (EX1017), which Stapleton incorporated by reference. EX1006, ¶0012. The incorporated '836 provisional application expressly teaches that that the DAU-to-DAU connection is via a "bidirectional" optical cable. EX1017 ¶0030 ("second optical output of DAU 1 is fed via bidirectional optical cable 113 to DAU2. This connection facilitates networking of DAU1 and DAU2.").

127. *Ports for the DAU-to-DRU connections*. Stapleton expressly teaches that the optical cable between the DAUs and DRUs is a "bidirectional optical cable." EX1006, ¶0033 ("One optical output of DAU 105 is fed to DRU 125A, *via bidirectional optical cable 140A*. A second optical output of DAU 105 is fed *via bidirectional optical cable 145A to DRU3*. Similarly, *bidirectional optical cables 150, 155 and 160 connect DRU's 125A-n in a ring configuration*, such that DRU 125A connects to DRU 125B via cable 150A, DRU 125B connects to DRU 125n via cable 150B, and DRU 125k connects to DRU 125C, or the kth-1 DRU, via cable 150m. …DRU 125B is fed by a second optical port of DRU 125A *via bidirectional optical cable 150A*. The optical cable 150A performs the function of

daisy chaining DRU 125A with DRU125B.") Figures 1-2 show the cables between the DAU and DRUs are configured to carry signals in both directions:

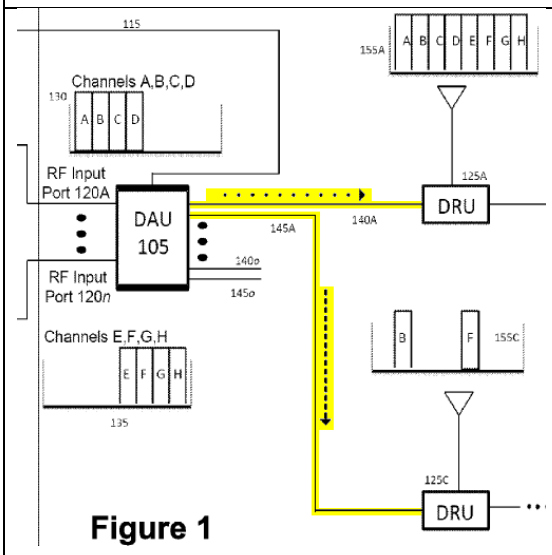
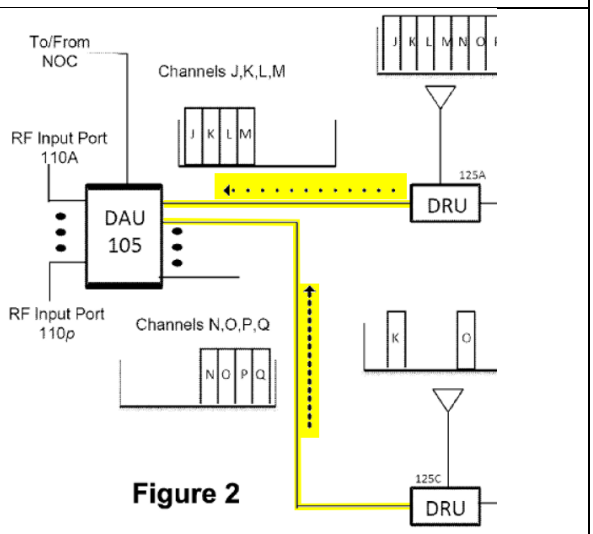
Figure 1 (downlink)	**Figure 2 (uplink)**
	

Figure 4 also shows this:

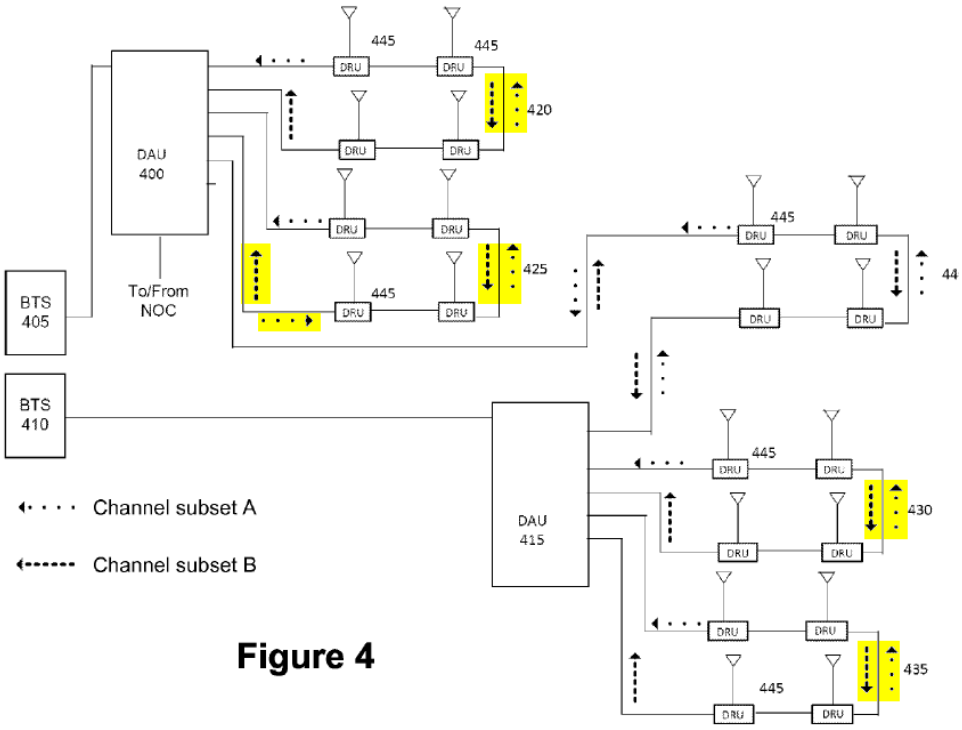
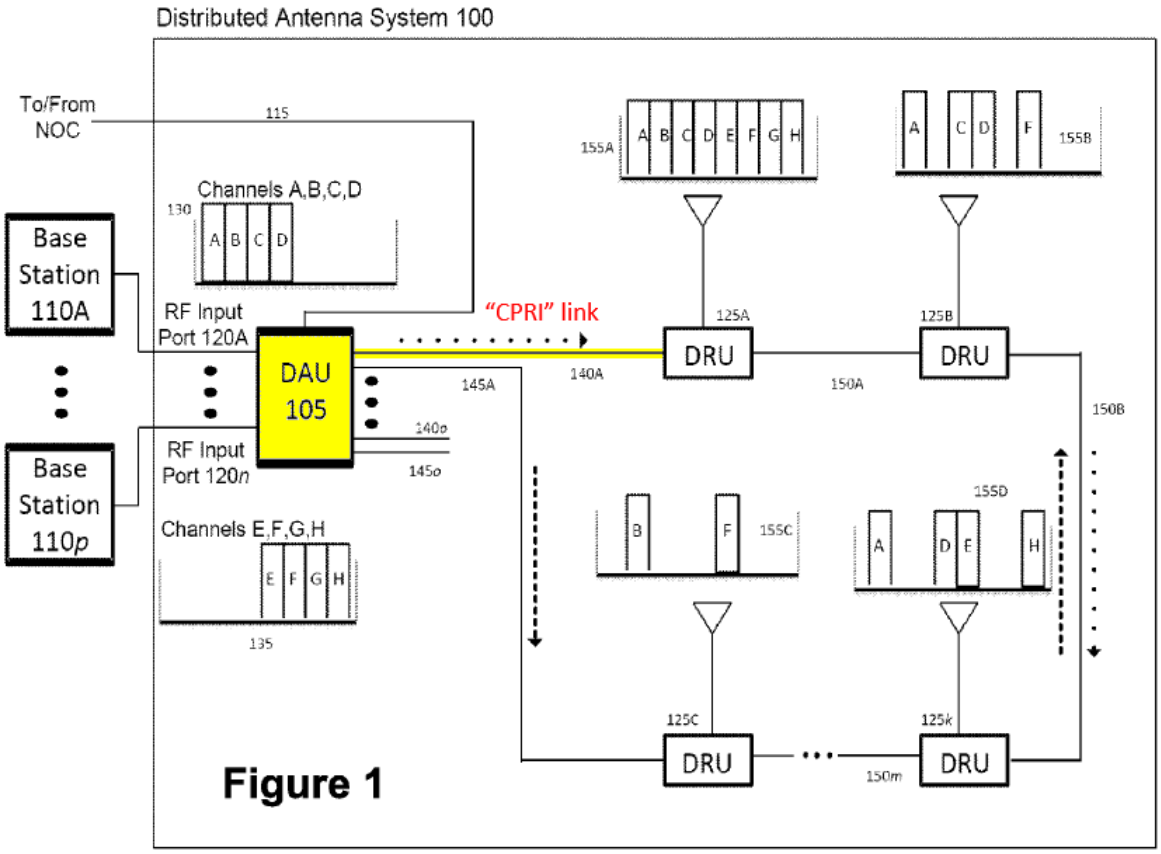


Figure 4

See EX1006, ¶0044. Figure 3 also shows this.

128. Stapleton's DAU-DRU ports teach *an input port configured as an uplink/downlink port* for a further reason. Stapleton teach DAU and DRUs frames the packets they transmit back and forth using the "CPRI" standard. EX1006, ¶0048 (The *DAU and DRUs frame the individual data packets* corresponding to their respective radio signature using the *Common Public Interface Standard (CPRI)*. Other Interface standards are applicable provided they uniquely identify data packets with respective DRUs. Header information is transmitted along with the data packet which identifies the DRU and DAU that corresponds to the

individual data packet.”). In other words, the DAU and DRUs format the communications over the below cable (yellow) using CPRI:



EX1006, Fig. 1. When two nodes (here the DAU and DRU) communicate using CPRI, that is called a CPRI link. The CPRI standard defines a link between two nodes (here the DAU and DRU) as a *bidirectional* interface between two *ports*:

Link:

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

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

EX1009 at 7. The CPRI standard illustrates these bidirectional ports in Figures 1 and 2:

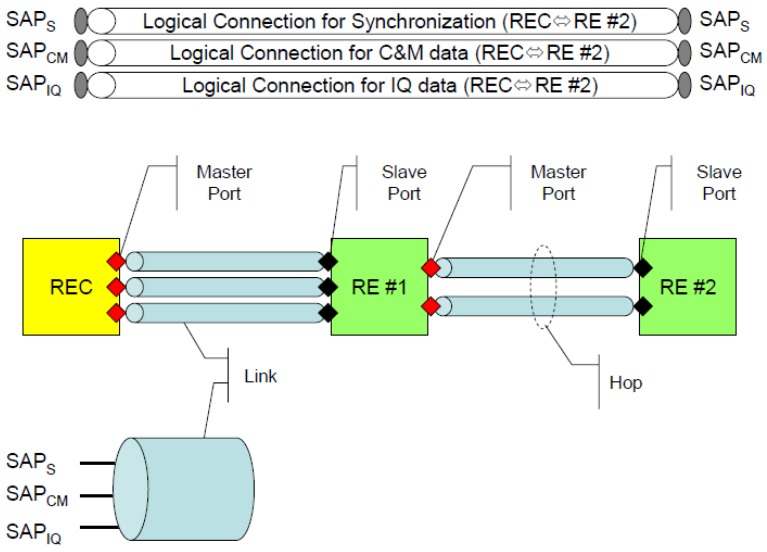


Figure 1A: Illustration of basic definitions

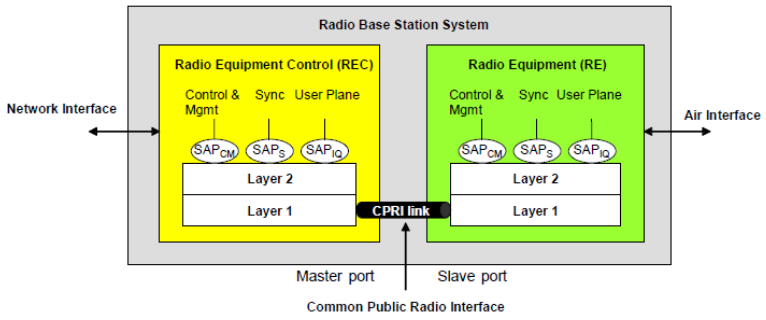


Figure 2: Basic System Architecture and Common Public Radio Interface Definition

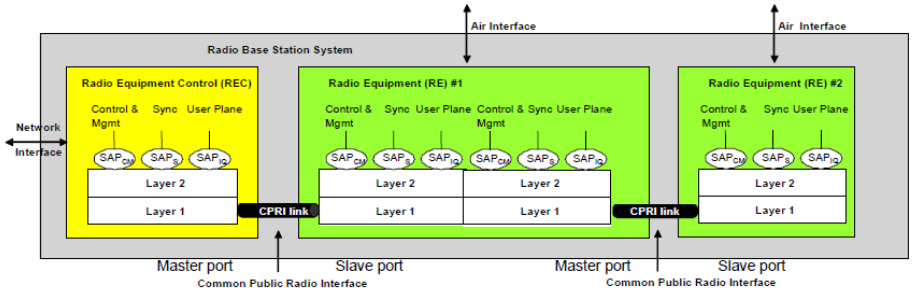


Figure 2A: System Architecture with a link between REs

EX1009 at 8, 10. Thus, because the DAU uses CPRI to communicate with the DRU, the DAU must have a port that is configured for bidirectional operations, i.e., downlink/uplink. As shown above, the port is an output port because it outputs signals to the DRU. Thus, because the DAU uses CPRI to communicate with the DRU, it inherently has *an output port configured as an uplink/downlink port*.

129. *Ports for the DAU to BTS connection*. A POSA also understands that the input port for the connection between the DAU and BTS is configured to carry both uplink and downlink signals. Figure 3 shows that DAU has input ports numbered A….p

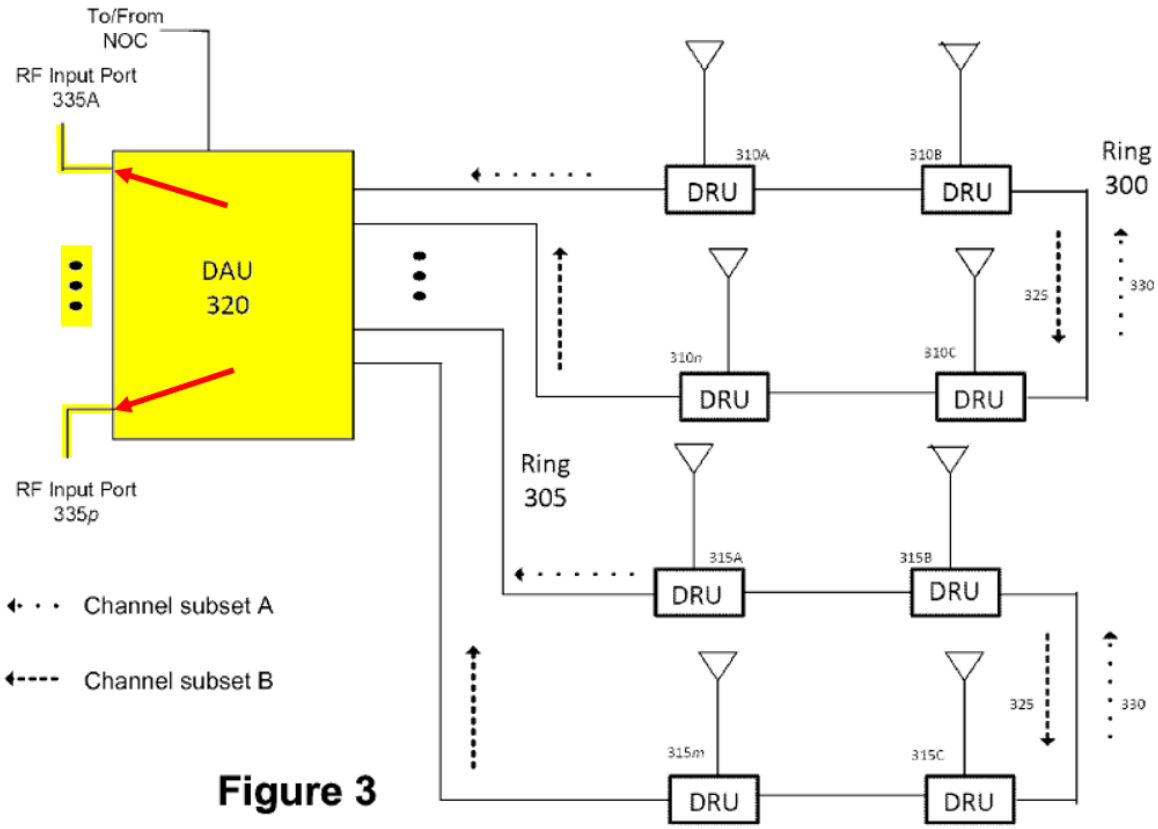


Figure 3

The numbers A…*p* and vertical "…" correspond to the different base stations, which are shown in Figure 1 and numbered A…*p*:

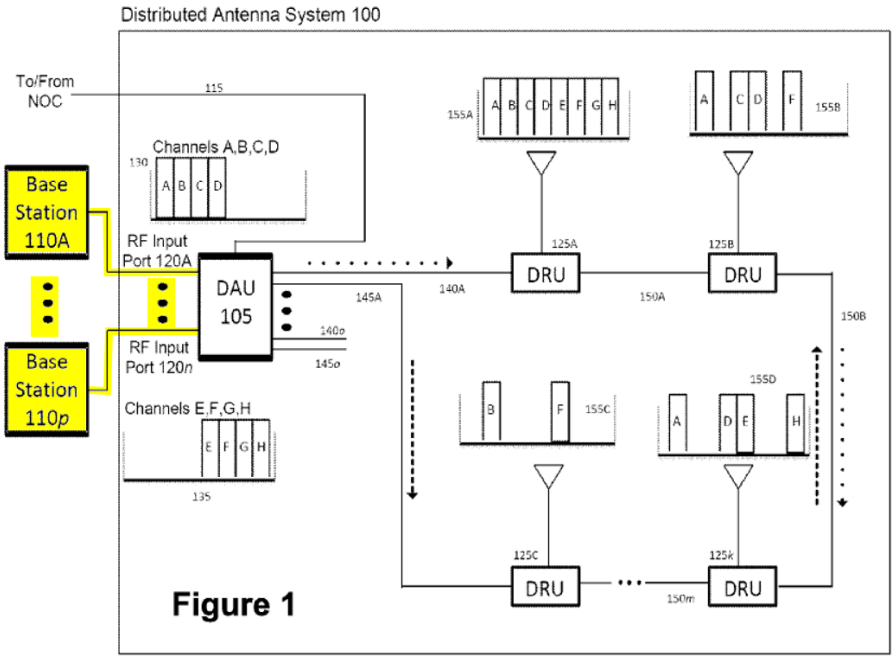


Figure 1

Paragraph 44 of Stapleton explains that these RF input ports "in turn" communicate with the base stations with reference to both the downlink *and* uplink signals:

> The *downlink* channels available from the plurality of DRU's are divided into two subsets which flow in opposite directions around the two daisy-chained rings. The *uplink* channels are transported in a similar fashion. The channels are grouped into the two subsets so as to maximize the data transport to and from the DRUs. The *DAU in turn communicates with one or more BTS's via RF Ports 335A-p*.

EX1006, ¶0041. To be clear, the use of the plural "RF Ports" refers to the fact there can be plural "one or more BTS's." Thus, (a) RF Port 335A would communicate the applicable uplink/downlink channels to the corresponding base station A (see Figure 1), (b) RF Port 335P would communicate the

uplink/downlink channels to the corresponding base station *p* (see Figure 1), (c) and so on for any additional base stations represented by the vertical "…". Stapleton's specification further confirms the RF input port is configured for uplink and downlink signals with Figures 1-2. Figures 1-2 illustrate the same feature as Figure 3. The specification confirms that this feature receives downlink signal with reference to Figure 1 and confirm this feature also transmits uplink signals with reference to Figure 2.

130. Finally, to be clear, none of these examples require combining separate features of different embodiments. The disclosure for Figures 1-2 itself shows an input port (e.g., either the port that receives the input signal from the BTS or the port that receivers the input signal from the DRU) and an export port (e.g., the port that transmit a signal to another DRU). The disclosure for Figure 4 itself shows an input port (e.g., the port that receives an input signal from a daisy-chained DAU, the port that directly receives the input signal from the BTS, or the port that receivers the input signal from the DRU) and an export port (e.g., the port that transmit a signal to another DRU). Furthermore, when Stapleton describes Figure 4 after previously describing Figures 1-2, Stapleton teaches: "All the previously mentioned features and advantages accrue to each of the two wireless operators. EX1006, ¶0044. Likewise, Stapleton teaches that one embodiment of Figure 1 is where there "more than one DAU" is present, i.e., Figure 1 can contain

the functionality in Figure 4. EX1006, ¶0040 ("Referring again to FIG. 1, a further embodiment in accordance with another aspect of the present invention may be better understood. In … If there is more than one DAU present, in an embodiment one DAU is designated a Master DAU by the NOC, and the Management Control module located in the Master DAU makes decisions to optimize the overall transport capacity.").

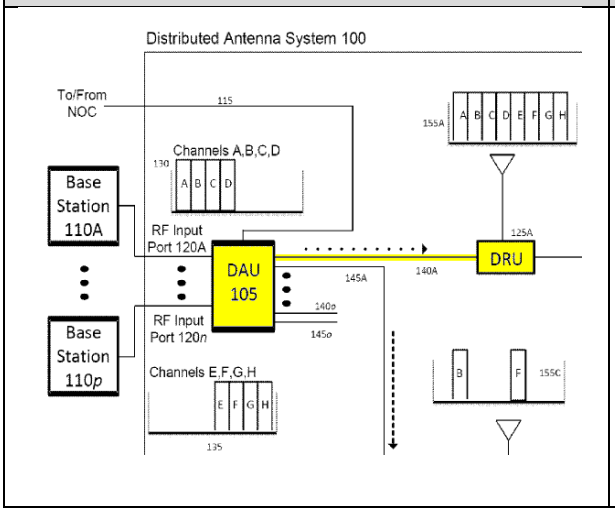
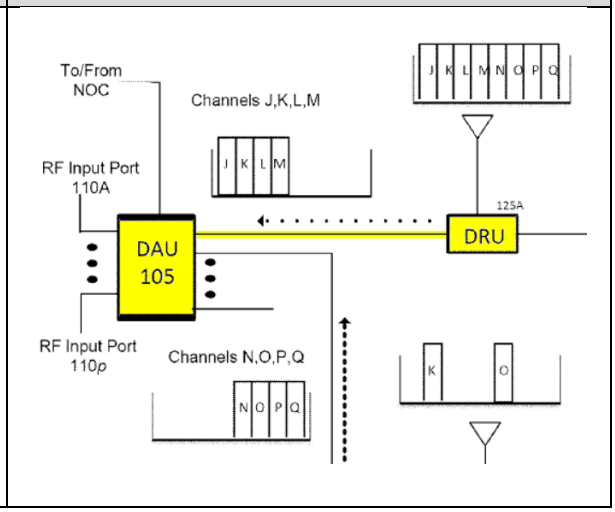
131. To summarize, an input port at the DAU that satisfies all the limitations of this claim element can be found in any of (i) a port that supports the DAU-DAU connection, (ii) a port that supports the DRU-DAU connection, and (iii) a port that supports the BTS-DAU connection. An output port at the DAU that satisfies all the limitations of this claim element can be found, for example, in any of the other ports that support a DAU-DRU connection. The DAU-DAU port and the DAU-BTS port also could be the recited output port depending on what port is chosen as the input port to avoid double-counting.

c. Element 1C

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

132. Stapleton discloses this limitation.

133. Stapleton expressly teaches that its DAS comprises a "a plurality of digital remote units (DRU)." EX1006, ¶0028. Figures 1-2 illustrate that the DRU are connected to the one or more DAUs in both the downlink and uplink path. Here are annotated figures showing the connection between one DAU (105) and one DRU (125A):

Downlink path (Figure 1, cropped)	**Uplink path (Figure 2, cropped)**
	

The back arrows in the figures show that the DRU are *operable to transport signals between one or more of the one or more DRUs and the one or more DAUs*. Stapleton confirms this in his specification:

> For the *downlink* (DL) path, RF input signals 120A through 120n are received at the DAU 105 from one or more base station units (BTS) indicated at 110A through 110p. The RF input signals are separately down-converted, digitized, and converted to baseband (using a Digital Down-Converter) by the DAU. Data streams are then I/Q mapped and framed and specific parallel data streams are then independently serialized and translated to optical signals using pluggable SFP modules, again by the DAU 105. *The independently serialized, parallel data streams are then delivered to different DRU's 125A-*

125k, typically over optical fiber cable arranged, in at least some embodiments, in a ring configuration indicated at connection pairs 140A-145A, or, in other embodiments, a daisy chain configuration. In addition, each DAU can support a plurality of rings with associated DRU's, where the additional rings are indicated by fiber optic pairs up through 140o-145o. It will be appreciated by those skilled in the art that the number of RF inputs, DAU's and DRU's and rings is limited only by network performance factors, such as delay. In addition, as discussed in connection with FIG. 4 herein, the DAS can be further extended by using a ring or daisy-chain of DAU's, each of which supports an arrangement of DRU's and rings as shown in FIG. 1.

Referring next to FIG. 2, an embodiment of an *uplink* (UL) path in accordance with the invention can be better appreciated. Channels received at the antenna associated with each DRU are converted into optical signals by each DRU 125A-125k. *Optical signals received from the DRU's are de-serialized and de-framed by the DAU 105,* and are also up-converted digitally using a Digital Up-Converter implemented within the DAU 105. Each data stream is then independently converted to the analog domain and up-converted to the appropriate RF frequency band, still within the DAU 105 in the illustrated implementation, although this functionality can be separate. The RF signals are then delivered to the appropriate one of a plurality of BTS' 110A-110p. As with the arrangement shown in FIG. 1, the direction of propagation of each channel is controlled by the DAU, with some channels propagating in a clockwise direction and others in a counterclockwise direction. Also as discussed in connection with FIG. 1, while adjacent channels are shown as propagating in the same direction in FIG. 2, this is not required and any channel can be selected to propagate in either direction.

EX1006, ¶¶0029-0031.

d. Element 1D

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

resource, each radio resource comprising a subset of the plurality of DRUs"

134. Stapleton teaches each part of this limitation.

135. *First*, Stapleton teaches *a plurality of radio resources formed from the one or more DRUs*. Stapleton teaches that a key function of the DAU is setting the amount of radio resources used by each DRU: "One such key function is determining and/or setting the appropriate amount of *radio resources* (such as RF carriers, CDMA codes or TDMA time slots) assigned to a *particular DRU or group of DRUs* to meet desired capacity and throughput objectives." EX1006, ¶0054; *see also* ¶0058 ("[T]he DAU Management Control module can adaptively modify the system configuration to begin to deploy, typically although not necessarily slowly, additional *radio resources* (such as RF carriers, CDMA codes or TDMA time slots) *for use by a particular DRU* which need those radio resources within its coverage area. At the same time, usually the DAU Management Control module adaptively modifies the system configuration to begin to remove, again typically slowly, certain *radio resources* (such as RF carriers, CDMA codes or TDMA time slots) *for use by a particular DRU* where that DRU no longer needs those radio resources within its coverage area.").

136. Like the '382 patent, Stapleton explains that the "radio resources" are "RF carriers." EX1006, ¶0054 ("radio resources (such as *RF carriers*, CDMA

codes or TDMA time slots)"). Figure 1 shows an example where there are eight radio resource labeled as channels A, B, C, D, E, F, G, H output by the different DRUs:

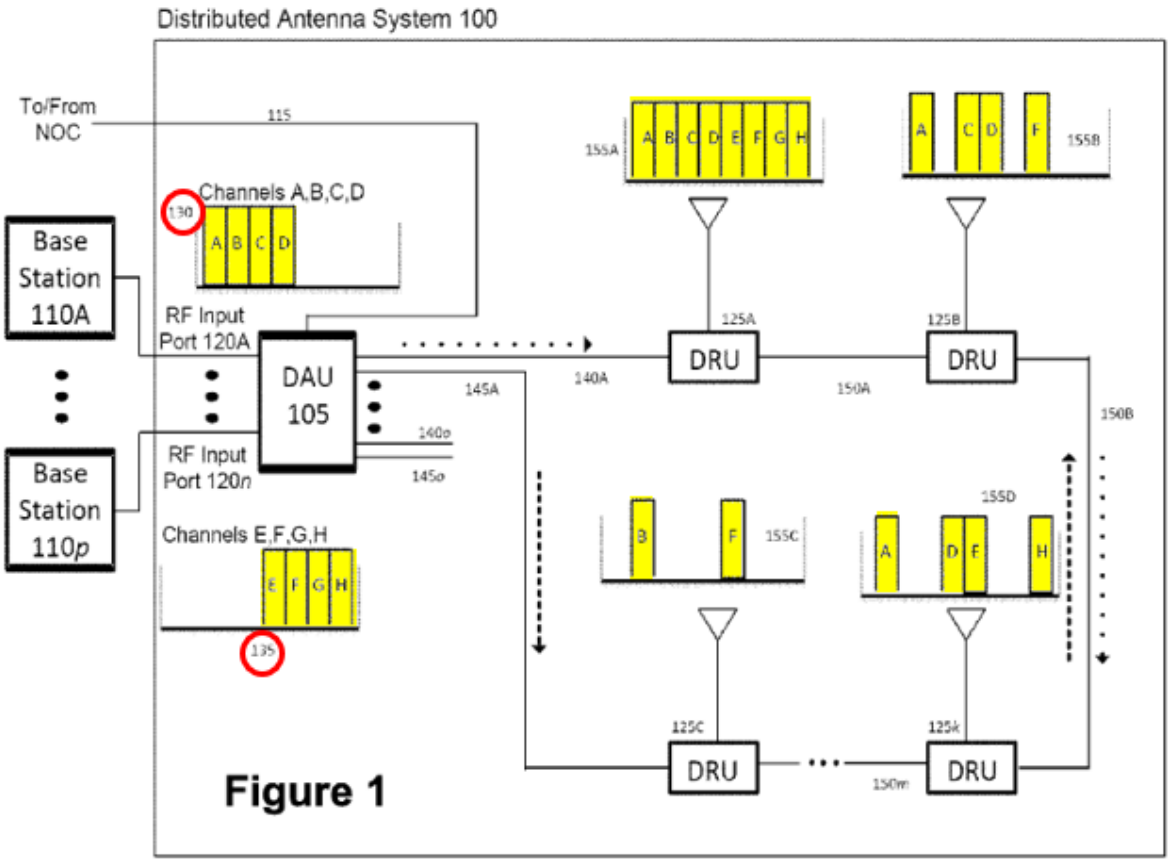


Figure 1

Stapleton's specification explains that these channels correspond to carriers. EX1006, ¶0032. More specifically, Stapleton's specification explains the (1) numeral 130 (circled in red) is a "composite" downlink signal that "comprises carriers A-D" and (2) numeral 135 (circled in red) is a "composite" downlink signal that "comprises carriers E-H." EX1006, ¶0032 ("Referring again to FIG. 1,

it ….DAU will receive a composite downlink input signal 130 from, e.g., a first base station 110A belonging to one wireless operator, enters the DAU 105 at the RF input port 120A. Composite signal 130 *comprises carriers A-D*. A second composite downlink input signal from e.g., a pth base station 110p belonging to the same wireless operator enters DAU1 at the DAU1 RF input port 120n. Composite signal 135 *comprises carriers E-H*.").

137. Further, Stapleton teaches that the radio resources are formed as wireless transmissions via antennae at the DRUs. Figure 1, for example, shows this:

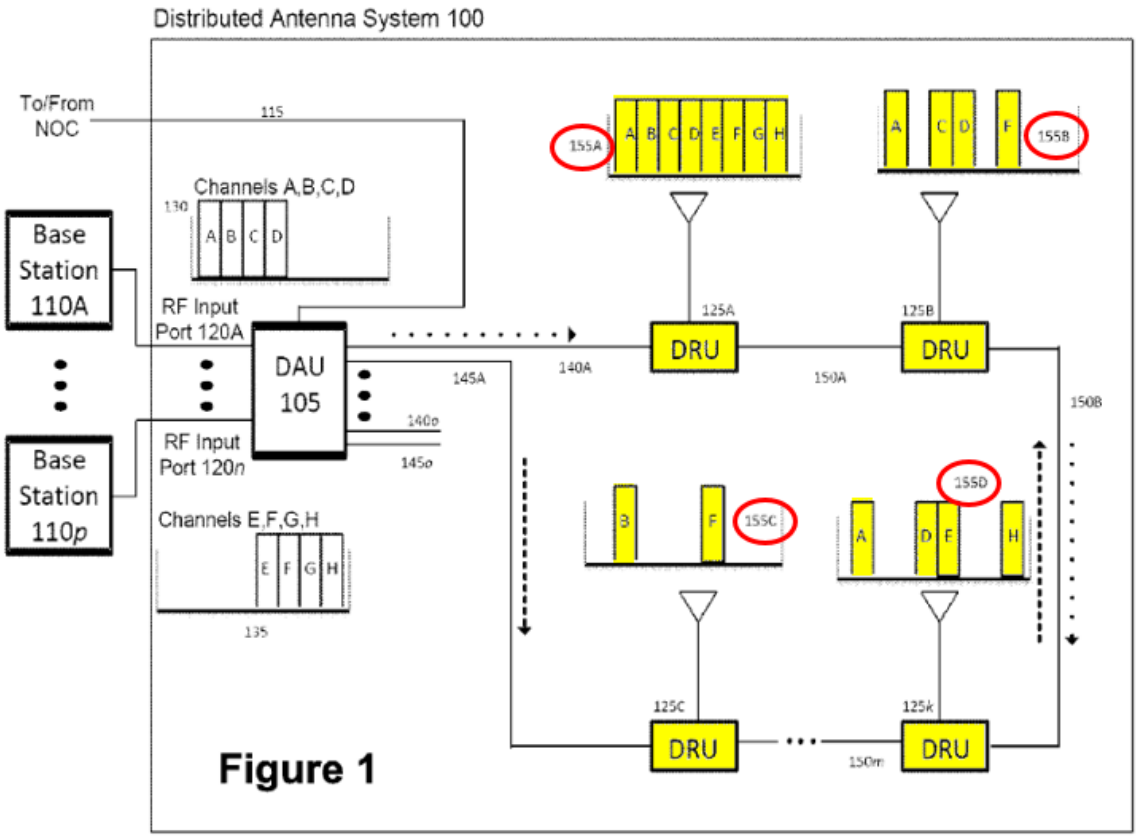


Figure 1

Numerals 155A, 155B, 125C, 155D (circled in red) are output signals formed by the DRU and transmitted from their antennas (the triangle structure). EX1006, ¶0033-0035 ("downlink output signal 155A at the antenna port of DRU 125A…. downlink output signal 155C at the antenna port of DRU 125C…. downlink output signal 155D at the antenna port of DRU 125n.") Stapleton explains that the DRU's have "Digital Up-Converters" (DUCs) that "enable or disable specific *radio resources* from being transmitted by a particular DRU or group of DRUs." EX1006, ¶0056 ("In turn, the DRU Management Control module 725 within the

DRU Embedded Software Control Module sets the individual parameters of all the DRU Digital Up-Converters 730 to enable or disable specific radio resources from being transmitted by a particular DRU or group of DRUs, and also sets the individual parameters of all the DRU Digital Down-Converters 735 to enable or disable specific radio resources from being transmitted by a particular DRU or group of DRUs."); *see also* EX1006, ¶0034 ("The individual Digital Remote Units have integrated frequency selective DUCs and DDCs with gain control for each carrier. The DAU's can remotely turn on and off the individual carriers via the gain control parameters."). Stapleton illustrates this in Figure 7:

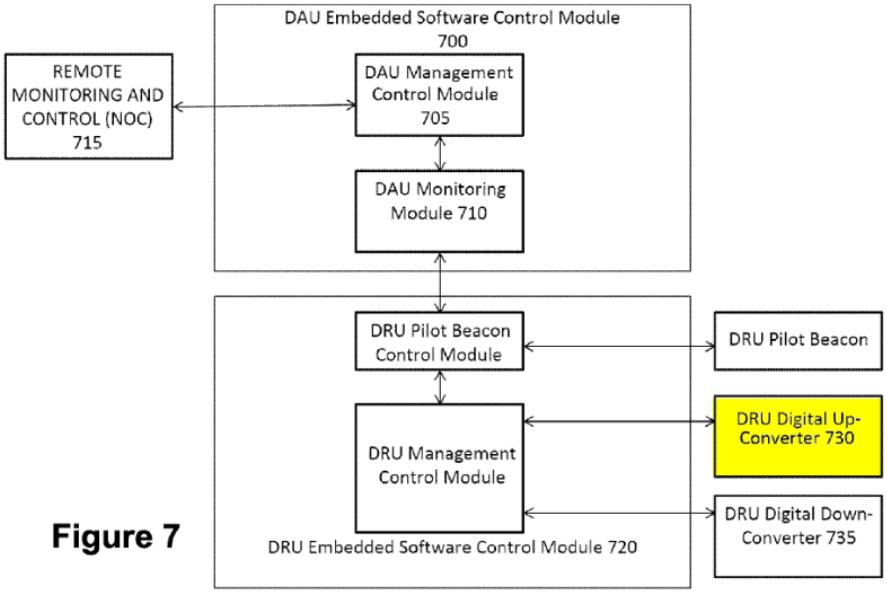


Figure 7

Stapleton's specification explains that the DRU receives a signal from the DAU. EX1006, ¶0029, Fig. 1. Then, the DRU based on its software settings forms an

output signal containing the correct radio resources (A-H). EX1006, ¶0033 ("One optical output of DAU 105 is fed to DRU 125A, via bidirectional optical cable 140A. …. Depending upon the embodiment, the *software settings within DRU 125A are configured either manually or automatically, such that carriers A-H are present in the downlink output signal 155A at the antenna port of DRU 125A*."), EX1006, ¶0034 (explaining the same process for DRU 125B), EX1006, ¶0035 (explaining the same process for DRU 125C).

138. *Second*, Stapleton teaches a *first radio resource and a second radio resource different from the first radio resource*. As shown above in Figure 1, the radio resources are different RF carriers (e.g., A vs. B or C vs. D) that come from different base stations. Stapleton specifically teaches that the system can operate with different RF channels. EX1006, ¶0025 ("…different frequency channels with multiple DRUs according to the present invention."), Fig. 6.

139. *Third*, Stapleton teaches *each radio resource comprising a subset of the plurality of DRU*s. As shown in Figure 1, each radio resource is used by a subset of the DRUs:

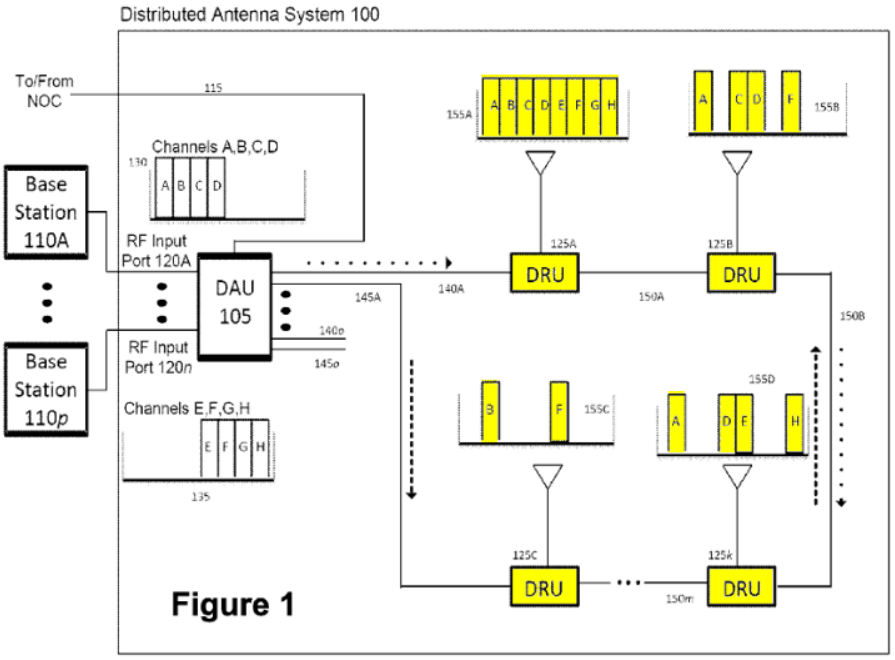


Figure 1

Stapleton also expressly teaches this in his specification: "One such key function is determining and/or setting the appropriate amount of *radio resources* (such as RF carriers, CDMA codes or TDMA time slots) assigned to a *particular DRU or group of DRUs* to meet desired capacity and throughput objectives." EX1006, ¶0054; *see also* EX1006, ¶0058 ("certain *radio resources* (such as RF carriers, CDMA codes or TDMA time slots) for *use by a particular DRU*").

140. If Patent Owner argues that the invention in the challenged '382 patent involves sectorization, that does not distinguish Stapleton for at least two reasons.

141. First, the actual claims of the '382 patent say nothing about "sectorization" or "sectors." Neither term is a limitation of the claim.

142. Second, Stapleton discloses these "sectors" under Patent Owner's own construction of that term. Patent Owner argued the proper construction of "sector" was the following during IPR of the parent patent to the '382 patent: "a grouping of DRUs in a particular area or region." Patent Owner's Preliminary Response at 24 in IPR2021-00408. Stapleton expressly teaches that radio resources can correspond to a "group of DRUs." EX1006, ¶0054 ("One such key function is determining and/or setting the appropriate amount of *radio resources (such as RF carriers, CDMA codes or TDMA time slots) assigned to a particular DRU or group of DRUs* to meet desired capacity and throughput objectives."), ¶0056 ("In turn, the DRU Management Control module 725 within the DRU Embedded Software Control Module sets the individual parameters of all the DRU Digital Up-Converters 730 to *enable or disable specific radio resources from being transmitted by a particular DRU or group of DRUs*…."). The DRUs each have a "coverage radius" that correspond to a coverage zone/coverage area, which is an example of a "particular area or region" as recited in Patent Owner's proposed construction of "sector" in the IPR of the parent claim. EX1006, ¶0052 ("*Each DRU has a coverage radius* that can be adjusted based on the power transmission from that particular remote unit. The DAU controls the various DRU's transmission power and can optimize the *overall coverage zone*."), ¶0046 ("if a company meeting were suddenly convened in the area of the enterprise

corresponding to the *coverage area of DRU 125B*."), ¶0035 ("Typically, the capacity of DRU 125n is set to a much lower value than DRU 125A, however, the relative capacity settings of each of DRU's 125A-n can be adjusted dynamically to meet the capacity needs *within the coverage zones determined by the physical positions of antennas connected to those DRU's*"), ¶0058 ("If that occurs, the DAU Management Control module can adaptively modify the system configuration to begin to deploy, typically although not necessarily slowly, additional radio resources (such as RF carriers, CDMA codes or TDMA time slots) for use by a particular DRU which need those radio resources *within its coverage area*. At the same time, usually the DAU Management Control module adaptively modifies the system configuration to begin to remove, again typically slowly, certain radio resources (such as RF carriers, CDMA codes or TDMA time slots) for use by a particular DRU where that DRU no longer needs those radio resources *within its coverage area*.") Thus, even if Patent Owner's idea of a "sector" were wrongly imported in the claim, Stapleton's disclosure would meet even Patent Owner's construction of "sector."

e. Element 1E

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

143. Stapleton teaches that its system includes *"a traffic monitoring unit coupled to at least one of the DAUs."* Stapleton teaches several examples of this claim limitation.

144. *First*, Stapleton teaches that that DAU contains an "embedded software control module" (700). Figure 7 shows module (700):

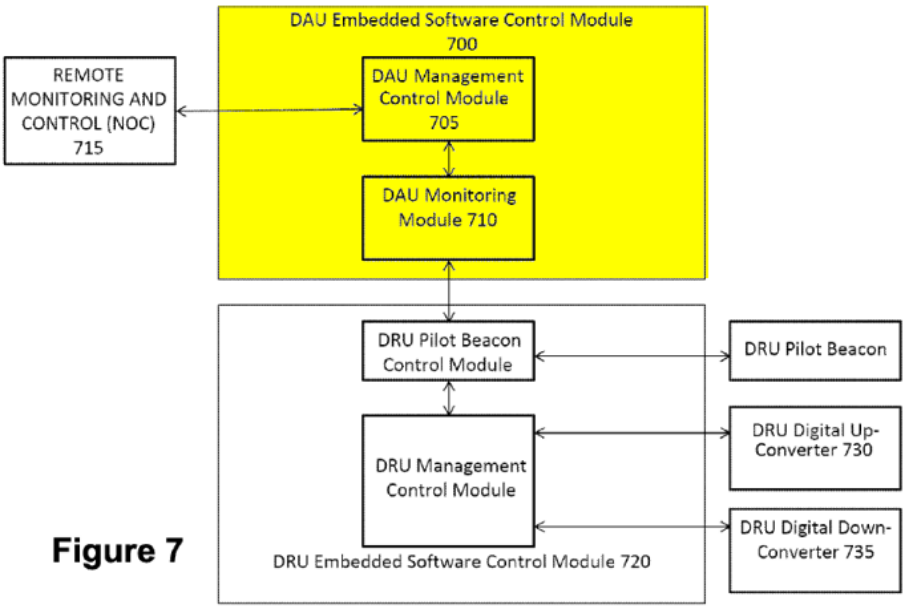


Figure 7

Stapleton at Fig. 7, ¶0054 ("Referring next to FIG. 7, the software embedded in the DAU and DRU, which controls the operation of keys functions of these devices, can be better understood. In particular, the DAU embedded software control module 700 comprises a DAU Management Control Module 705 and a DAU monitoring module 710.").

145. The DAU's embedded software control module (700) is an example of a "*traffic monitoring unit.*" Stapleton expressly teaches that this module performs *monitoring* using the sub-module called the "DAU *monitoring* module" (710). ¶0054 ("The DAU embedded software control module 700 comprises a DAU Management Control Module 705 and a DAU monitoring module 710."). Specifically, Stapleton teaches that the DAU's embedded software control module, through the monitoring sub-module, contains an algorithm that monitors the traffic by detecting which carriers and corresponding time slots are active for each DRU to help identify when a particular carrier (*radio resource*) is overloaded. EX1006, ¶0058 ("An algorithm operating within the DAU Monitoring module which detects which carriers and corresponding time slots for each carrier are active for each DRU provides information to the DAU Management Control module to help identify when, e.g., a particular downlink carrier is loaded by a percentage greater than a predetermined threshold whose value is communicated to the DAU Management Control module by the DAU's Remote Monitoring and Control function 715."); *see also* ¶0055 ("The DAU Monitoring module, in addition to other functions, detects which carriers and corresponding time slots are active for each DRU."). Monitoring which carriers and time slots are active is an example of traffic monitoring. The carriers and time slots are the mechanism that carries the downlink traffic from the base stations, through the DAU, to the DRUs, and

ultimately to the users communicating with the DRU. The traffic is higher when there is a higher number of carriers and time slots that are active, and the traffic is comparatively lower when fewer carriers and time slots active. Furthermore, Stapleton expressly teaches that its system employing these modules enables "*traffic* monitoring" and "automatic *traffic* load-balancing." EX1006, ¶0010.

146. Here are two examples to illustrate the point that the DAU's embedded software control module is monitoring traffic by monitoring which carriers and time slots are active. Consider a carrier with 8 time slots. If all 8 time slots are active, then the network traffic on that carrier is high. By comparison, if only 1 time slot is active and 7 are inactive, the network traffic on that carrier is comparatively low. Consider also the example in Figure 1. Figure 1 shows the yellow DRU has eight carriers (A-F) and the red DRU has two carriers (B, F):

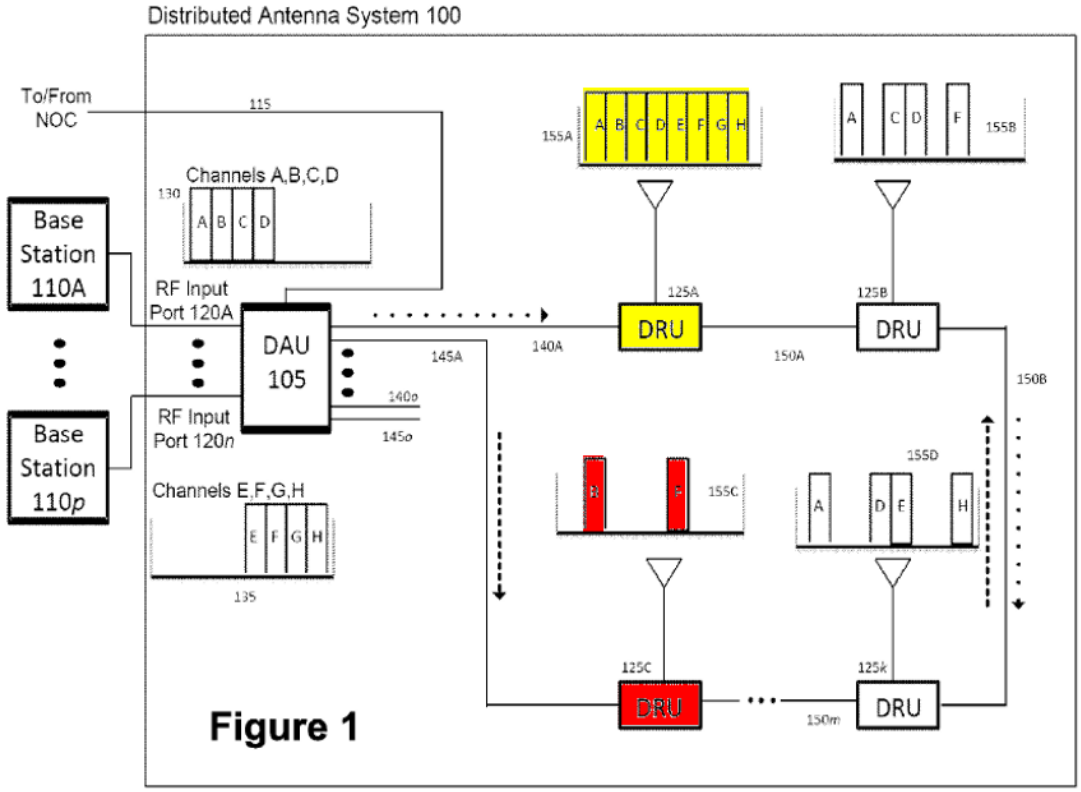


Figure 1

If both the carriers (B and F) are active at the red DRU, then the network traffic at that DRU is comparatively high for the carriers at that DRU. By comparison, if only 1 of the 8 carriers are active at the yellow DRU (e.g., A is active and B-H are inactive), then the network traffic at that DRU is comparatively low for the carriers at that DRU.

147. *Second*, Stapleton teaches that its system includes a "remote network operations center (NOC)." EX1006, ¶0028 ("In addition, those skilled in the art will recognize that a DAU is monitored and controlled by a remote network

operations center ("NOC"), as indicated at bidirectional link 115 in FIG. 1.").

Figure 1 shows the NOC is connected to the DAU:

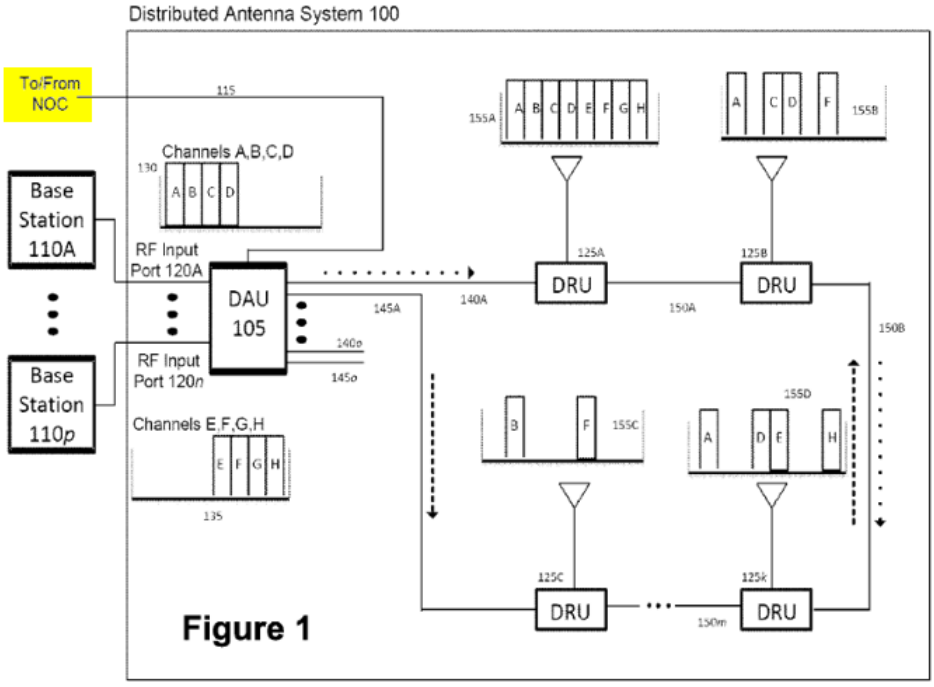


Figure 7 further shows that the NOC communicates with the software modules inside the DAU:

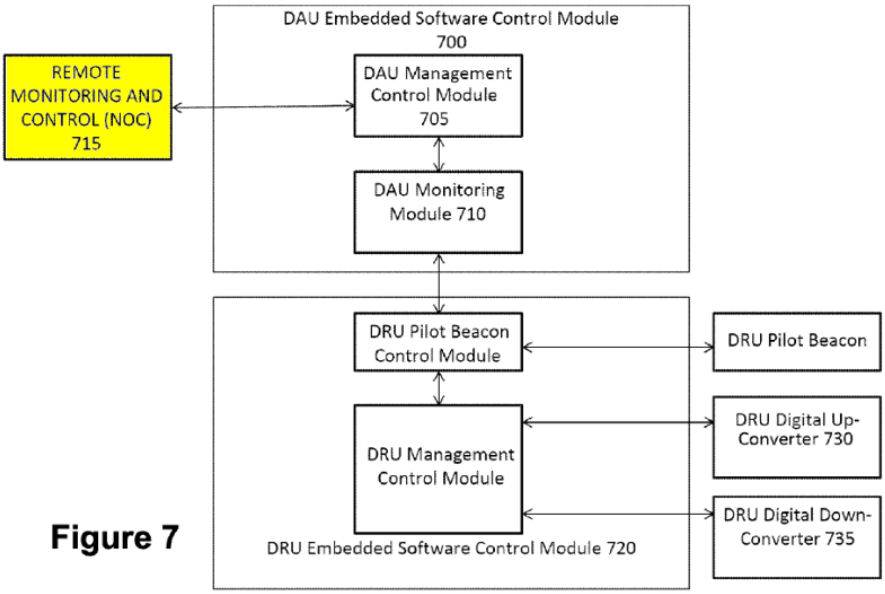


Figure 7

EX1006 at Fig. 7, ¶0054 ("The DAU Management Control Module 705 communicates with the NOC 715").

148. The NOC is another example of the claimed "*traffic monitoring unit.*" Stapleton expressly teaches that the NOC "monitors" the DAS. EX1006, ¶0054 ("As noted previously, the NOC 715 *monitors the DAS operation* and sends commands to the DAU's for configuring various functions of the DRU's as well as the DAU, in at least some embodiments."), ¶0028 ("In addition, those skilled in the art will recognize that a DAU is *monitored* and controlled by a remote network operations center ("NOC"), as indicated at bidirectional link 115 in FIG. 1."). Stapleton labeled in NOC in Figure 7 (see above) as the "remote *monitoring* and

control" unit. Stapleton expressly teaches that the monitoring being performed is "*traffic* monitoring" for "automatic *traffic* load-balancing." EX1006, ¶0010.

149. More specifically, the NOC is a *traffic* monitoring unit for two reasons. (1) Stapleton teaches that the NOC performs traffic monitoring by requesting information about the traffic from the DAU. To unpack this, Stapleton explains that the system can determine which carriers and time slots are active (and thereby monitor the traffic levels) by "performing power detection of the individual time slots." EX1006, ¶0037. Stapleton further explains that the NOC monitors this information by requesting it from the DAU, including requesting the (a) result of the power detection, (b) uplink power, (c) downlink power, and (d) active carriers. EX1006, ¶0028 ("*The NOC can request information from the DAUs.* … The information requested includes but is not limited to *uplink power*, *downlink power*, optical error rate, gain settings, *active carriers*, etc."), ¶0037 ("The carriers and time slots are monitored by the DAU by filtering the signals and *performing power detection of the individual time slots, which information can be conveyed to the NOC as desired*."). These all provide information about the traffic in the DAS. (2) In addition, the NOC participates in the traffic monitoring by setting the threshold for the traffic monitoring. As mentioned above, the DAU's embedded software module checks if a downlink carrier is loaded by a percentage greater than a "threshold," i.e., the carrier is overloaded due to high traffic.

EX1006, ¶0058 ("An algorithm operating within the DAU Monitoring module which detects which carriers and corresponding time slots for each carrier are active for each DRU provides information to the DAU Management Control module to help identify when, e.g., a particular downlink carrier is loaded by a percentage greater than a predetermined threshold whose value is communicated to the DAU Management Control module by the DAU's Remote Monitoring and Control function 715"). Stapleton teaches that this traffic "threshold" is set by the Remote Monitoring and Control function (715)—numeral 715 is the NOC. EX1006, ¶0058 ("… a predetermined threshold whose value is communicated to the DAU Management Control module by the DAU's *Remote Monitoring and Control function 715*"); EX1006, ¶0054 ("The DAU Management Control Module 705 communicates with the *NOC 715*.")

150. In summary, the NOC is also an example of the claimed *traffic monitoring unit* because it:

> (1) *monitors the DAS*. EX1006, ¶0054 ("NOC 715 monitors the DAS"), ¶0028 ("monitored and controlled by a remote network operations center ('NOC')")
>
> (2) *specifically monitors the traffic information by requesting it from the DAU*, including requesting the (a) result of the power detection, (b) uplink power, (c) downlink power, and (d) active carriers. EX1006, ¶0028.
>
> (2) *specifically participates in the traffic monitoring by setting the threshold for the traffic monitoring*. EX1006, ¶0058 ("…a particular

> downlink carrier is loaded by a percentage greater than a predetermined threshold whose value is communicated to the DAU Management Control module by the DAU's Remote Monitoring and Control function 715.")
>
> (4) *participates in setting the appropriate amount of radio resources*. EX1006, ¶0054 ("As noted previously, the NOC 715 monitors the DAS operation and sends commands to the DAU's for configuring various functions of the DRU's as well as the DAU, in at least some embodiments").

151. *Third*, like the DAU, Stapleton teaches its DRU's contain and embedded software module 720. Fig. 7, EX1006, ¶¶0054-0056. I explain this alternative example in my section, below, on dependent claim 7.

f. Element 1F

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

152. Stapleton teaches the DAU's software module (the *traffic monitoring unit*) determines three different examples of this claim limitation.

153. *First*, Stapleton teaches that the DAU's monitoring module "detects" (which is a form of "*determining"*) which "carriers and corresponding time slots for each carrier are active for each DRU (which is an example of a "*key performance indicators*"). EX1006, ¶0058 ("An algorithm operating within the

DAU Monitoring module which detects which carriers and corresponding time slots for each carrier are active for each DRU.") The information about which carriers and corresponding time slots is a key performance indicator because it is the indicator used by the algorithm in the DAU to (1) help identify if a downlink carrier (*radio resource*) is overloaded (2) such that a DRU needs additional radio resources. EX1006, ¶0058 ("An *algorithm* operating within the DAU Monitoring module which detects which carriers and corresponding time slots for each carrier are active for each DRU *provides information* to the DAU Management Control *module to help identify when, e.g., a particular downlink carrier is loaded by a percentage greater than a predetermined threshold* whose value is communicated to the DAU Management Control module by the DAU's Remote Monitoring and Control function 715. *If that occurs*, the DAU Management Control module can *adaptively modify the system configuration to begin to deploy, typically although not necessarily slowly, additional radio resources (such as RF carriers, CDMA codes or TDMA time slots) for use by a particular DRU which need those radio resources within its coverage area*").

154. Which carriers and corresponding time slots are active is a KPI of the *network traffic*. The more carriers and time slots that are active the higher the network traffic. Here are two examples to illustrate this point. Consider a carrier with 8 time slots. If all 8 time slots are active, then the network traffic on that

carrier is high. By comparison, if only 1 time slot is active and 7 are inactive, the network traffic on that carrier is comparatively low. Consider also the example in Figure 1. Figure 1 shows the yellow DRU has eight carriers (A-F) and the red DRU has two carriers (B, F):

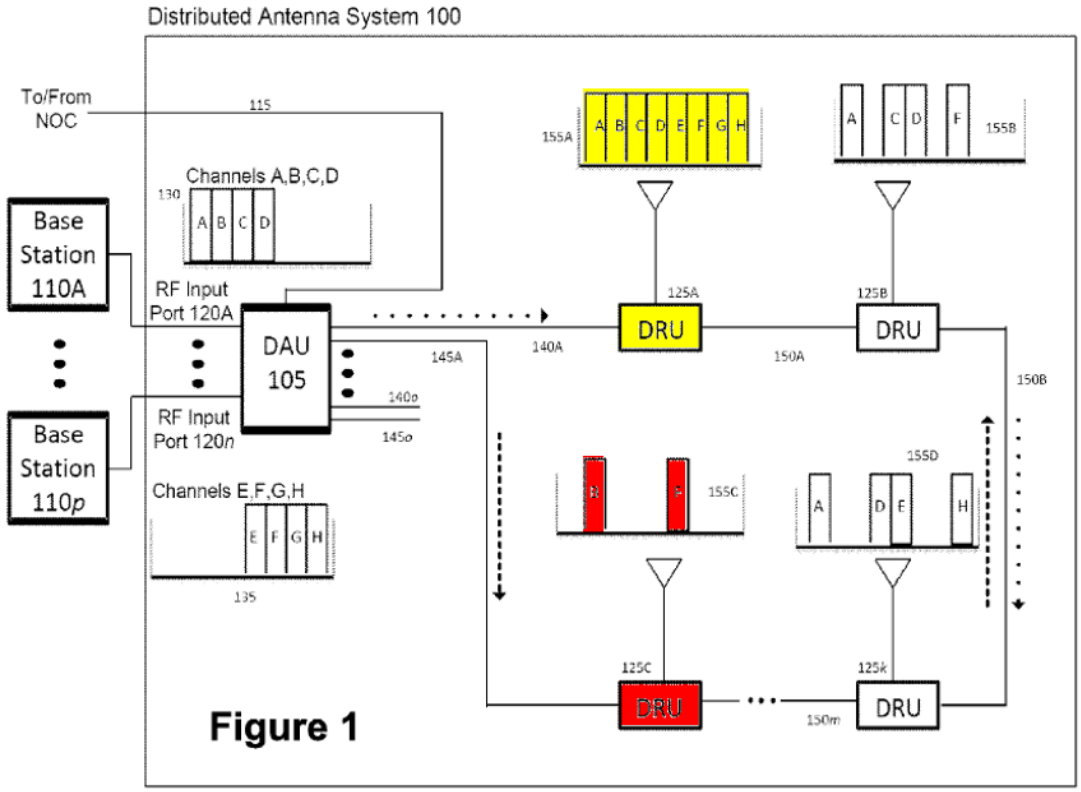


Figure 1

If both the carriers (B and F) are active at the red DRU, then the network traffic at that DRU is comparatively high for the carriers at that DRU. By comparison, if only 1 of the 8 carriers are active at the yellow DRU (e.g., A is active and B-H are inactive), then the network traffic at that DRU is comparatively low for the carriers

at that DRU. More generally, Stapleton teaches that the purpose of this functionality is to enable "*traffic* monitoring" and "automatic *traffic* load-balancing." EX1006, ¶0010.

155. Furthermore, the challenged '382 patent supports the conclusion that determining which carriers and corresponding time slots are active is a "*KPI"* as recited in the claim. The '382 patent explains that a KPI can comprise information "such as" information about *power*, specifically, "average *power* of uplink channels" and "average *power* of downlink channels." EX1001, 10:40-45. Likewise, Stapleton teaches that the DAU determines which carriers and corresponding time slots are active by "*power detection*." EX1006, ¶0037 ("The carriers and time slots are monitored by the DAU by filtering the signals and performing *power detection* of the individual time slots, which information can be conveyed to the NOC as desired."). Stapleton teaches that the DAU can do this for either uplink or downlink signals. EX1006, ¶0028 ("The DAUs can subsequently request information from the DRUs. The information requested includes but is not limited to *uplink power*, *downlink power*, optical error rate, gain settings, active carriers, etc."). In this way, the example taught in Stapleton of determining which carriers and corresponding time slots is similar to the example KPI taught in the challenged '382 patent because both examples involve power detection for the downlink or uplink signals.

156. *Second*, the load percentage identified by the DAU's software is an example of *quality of service (QoS) of a network traffic*. The higher the load percentage the higher the network traffic on that carrier. EX1006, ¶0058 ("identify when, e.g., a particular downlink carrier is loaded by a percentage greater than a predetermined threshold whose value is communicated to the DAU Management Control module by the DAU's Remote Monitoring and Control function 715.") This load percentage is compared to the threshold, i.e., to check if the load percentage is greater than the threshold. Where the load percentage is very high, it becomes more likely that new call requests cannot be handled due to lack of available resources (e.g., time slots on the carrier), i.e., the quality of performance is lower. The load percentage is a function of which time slots are active (a *KPI*), e.g., the load percentage is 100% if 8 of 8 total time slots are active.

157. Load percentage is a QoS at least because it indicates the fraction of available resources that are actually in use. When the load percentage is very high on the resources within a wireless network, there is an increased likelihood that future newly arriving calls will be blocked due to lack of available resources. In other words, where the resources are overloaded, the quality of performance as measured by the call blocking probability is lower (higher call blocking probability means lower network performance or quality). The DAU's traffic monitoring process uses the load percentage threshold to determine whether a DRU needs

additional radio resources because the current downlink carrier (*radio resource*) is overloaded. Specifically, Stapleton teaches: "An algorithm operating within the DAU Monitoring module which detects which carriers and corresponding time slots for each carrier are active for each DRU *provides information* to the DAU Management Control *module to help identify when, e.g., a particular downlink carrier is loaded by a percentage greater than a predetermined threshold* whose value is communicated to the DAU Management Control module by the DAU's Remote Monitoring and Control function 715. *If that occurs*, the DAU Management Control module can *adaptively modify the system configuration to begin to deploy, typically although not necessarily slowly, additional radio resources (such as RF carriers, CDMA codes or TDMA time slots) for use by a particular DRU which need those radio resources within its coverage area*." EX1006, ¶0058.

158. The load percentage and corresponding threshold value (the *QoS*) is also a function of the KPI because the percentage is a function of which carriers and/or timeslots are active (the KPI). EX1006, ¶0058 ("An algorithm operating within the DAU Monitoring module which detects *which carriers and corresponding time slots for each carrier are active* for each DRU provides information to the DAU Management Control module to help identify when, e.g., a particular downlink carrier is loaded by a percentage greater than *a predetermined*

threshold whose value is communicated to the DAU Management Control module by the DAU's Remote Monitoring and Control function 715.").

159. *Third*, related to the above, the result of the comparison of the load percentage to the threshold is also another example of a QoS. Stapleton teaches that the DAU's software checks if the load is "greater than" than the threshold, and "if that occurs," deploys additional radio resources. EX1006, ¶0058 ("An algorithm operating within the DAU Monitoring module which detects which carriers and corresponding time slots for each carrier are active for each DRU provides information to the DAU Management Control module to help identify when, e.g., a particular downlink carrier is loaded by a percentage *greater than a predetermined threshold whose value* …. If that occurs, the DAU Management Control module can adaptively modify the system configuration to begin to deploy, typically although not necessarily slowly, additional radio resources …."). In other words, the result of this comparison (above the threshold vs. below the threshold) is a QoS.

160. The result of this comparison (above the threshold vs. below the threshold) is a QoS of the *network traffic* for the same reasons discussed above. The result (above vs. below the threshold) describes the quality of service on the network for that carrier. The RF carrier (the *radio resource*) is comparatively less available for new calls when the load percentage is above the threshold. Whether

the load percentage is above the threshold is a function of the detected activity on carriers/time slots (a KPI). Further, the result is part of the "*traffic* monitoring" and "automatic *traffic* load-balancing" process. EX1006, ¶0010, ¶0058.

161. The result of this comparison (above the threshold vs. below the threshold) also meets the claim language requiring that the QoS be a *"function of the one or more KPIs."* The result is calculated by comparing the detected load percentage, i.e., which carriers and corresponding time slots for each carrier are active (the *KPI*) to the threshold. EX1006, ¶0058. In other words, the result is essentially the logical comparison: Is load > threshold? Thus, the result is a direct function of the detected load, based on which carriers and corresponding time slots for each carrier are active. The detected load is one of the two inputs to the logical comparison. The result of the comparison is a function of the KPI (because it results from a comparison with this detected load). EX1006, ¶0058.

162. To be clear, Stapleton also teaches that the other example of the traffic monitoring unit (the NOC and DRU's embedded software) also are configured to determine KPIs and/or QoS as recited in this claim limitation. My section on claim 10 and claim 7, below, shows this. For brevity, I will incorporate that analysis here.

g. Element 1G

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

163. Stapleton teaches this limitation.

164. *First*, Stapleton emphasizes that its system enables a reconfigurable DAS that can re-configure the radio resources: "The present invention is a novel *Reconfigurable* Distributed Antenna System that provides a high degree of flexibility to manage, control, *re-configure*, enhance and facilitate the *radio resource* efficiency, usage and overall performance of the distributed wireless network." EX1006, ¶0028. This is an express teaching to *"reconfigure the plurality of radio resources"* as recited in the claim. Stapleton emphasizes that a "key function" of the DAU's embedded software module (an example of the claimed *traffic monitoring module*) is setting the appropriate amount of "radio resources." EX1006, ¶0054 ("One such key function is determining and/or setting the appropriate amount of *radio resources* (such as RF carriers, CDMA codes or TDMA time slots) assigned to a particular DRU or group of DRUs to meet desired capacity and throughput objectives."). The action of "setting the appropriate amount of radio resources" that are "assigned to a particular DRU or group of

DRUs" is an example of *"allocating"* the radio resources as recited in the claim limitation.

165. *Second*, Stapleton expressly teaches the DAU Management Control module (which is part of the DAU's embedded software module i.e., the claimed *traffic monitoring module*) can reconfigure the radio resources by deploying an "additional radio resources" for "use by a particular DRU which need those radio resources within its coverage area." EX1006, ¶58.

> An algorithm operating within the DAU Monitoring module which detects which carriers and corresponding time slots for each carrier are active for each DRU provides information to the DAU Management Control module to help identify when, e.g., a particular downlink carrier is loaded by a percentage greater than a predetermined threshold whose value is communicated to the DAU Management Control module by the DAU's Remote Monitoring and Control function 715. *If that occurs, the DAU Management Control module* can adaptively modify the system configuration to *begin to deploy*, typically although not necessarily slowly, *additional radio resources* (such as RF carriers, CDMA codes or TDMA time slots) *for use by a particular DRU* which need those radio resources within its coverage area. At the same time, usually the DAU Management Control module adaptively modifies the system configuration to begin to remove, again typically slowly, certain radio resources (such as RF carriers, CDMA codes or TDMA time slots) for use by a particular DRU where that DRU no longer needs those radio resources within its coverage area.

EX1006, ¶0058. The actions of deploying an additional radio resource for use by a particular DRU is an example of allocating at least one DRU "*to the second radio resource.*" In other words, (a) before the load on the downlink carrier exceeded

the threshold, the DRU was allocated a downlink carrier (the *first radio resource*) and (b) after the load on the downlink carrier exceeded the threshold, the DRU was allocated to an "additional radio resource" (the *second radio resource*).

166. If the claim requires removing a *first radio resource*, that does not distinguish Stapleton. Paragraph 58 of Stapleton also teaches to remove radio resources at the same time as adding the additional radio resources:

> An algorithm operating within the DAU Monitoring module which detects which carriers and corresponding time slots for each carrier are active for each DRU provides information to the DAU Management Control module to help identify when, e.g., a particular downlink carrier is loaded by a percentage greater than a predetermined threshold whose value is communicated to the DAU Management Control module by the DAU's Remote Monitoring and Control function 715. If that occurs, the DAU Management Control module can adaptively modify the system configuration to begin to deploy, typically although not necessarily slowly, additional radio resources (such as RF carriers, CDMA codes or TDMA time slots) for use by a particular DRU which need those radio resources within its coverage area. *At the same time*, usually the DAU Management Control module adaptively modifies the system configuration to begin to *remove*, again typically slowly, *certain radio resources (such as RF carriers, CDMA codes or TDMA time slots) for use by a particular DRU where that DRU no longer needs those radio resources within its coverage area*.

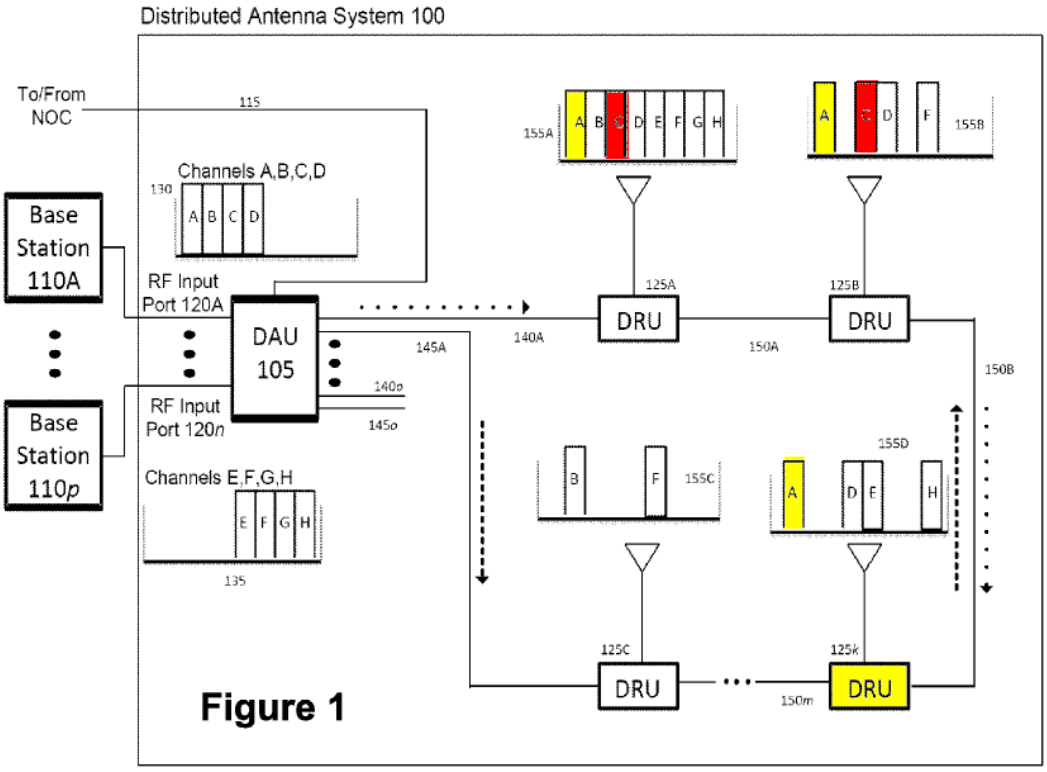
EX1006, ¶0058. The actions of "at the same time" removing a certain radio resource and deploying an additional radio resource for use by a particular DRU is an example of *"allocating at least one DRU from the first radio resource to the second radio resource."* In other words, this is an example of allocating at least

one DRU *from the first radio resource* (the "certain radio resources" that get removed) *to the second radio resource* (the "additional" radio resources that get deployed) *based on a KPI* (e.g., the load as determined by the number of active carriers and time slots).

167. Consider again the case where the detected load on a downlink carrier exceeds the threshold. If that occurs, Stapleton teaches to re-allocate the DRU to an "additional radio resource" (the *second radio resource*). The DRU no longer needs the overloaded downlink carrier (the *first radio resource*) because it has a new radio resource. Thus, the Stapleton disclosure includes allocating at least one DRU from the first radio resource (the overloaded downlink carrier) to the second radio resource (the additional radio resource).

168. *Third*, Stapleton teaches that the decision to reconfigure the radio resources is based on the (1) load percentage (an example of a QoS) which is calculated by determining which carriers and time slots are active (an example of a *KPI*), (2) the threshold (another example of a *QoS*), and (3) the result of comparing the two, i.e., is the load above or below the threshold (another example of a *QoS*). EX1006, ¶0058.

169. Here is an example of applying Stapleton teachings to Figure 1. Consider the yellow DRU in Figure 1:



Based on its algorithm, the DAU's embedded software module can determine that radio resource "A" is overloaded. For example, radio resource "A" will be overloaded if 100% of its timeslot are being used because it is serving users at three different DRUs. As a result, the DAU's embedded software module can deploy an additional radio resource "C" to the yellow DRU. "C" is not overloaded based on detecting that there are few carriers or timeslots that are active. At the same time, the DAU can remove radio resource "A" from the yellow DRU. The yellow DRU does not need this radio resource anymore because it now has radio

resource C. This is an example of allocating at least one DRU (the yellow DRU) from the first radio resource (A) to the second radio resource (C).

170. *Fourth*, as further confirmation that Stapleton discloses this limitation, Stapleton's disclosure addresses the same underlying goal addressed by the '382 patent. The '382 patent teaches to reallocate radio resources to achieve "load balancing." EX1001at 11:15-29. Likewise, Stapleton teaches that its disclosure enables "load balancing." EX1006, ¶0010 ("The present invention enables …traffic load-balancing." The disclosures in the '382 patent and Stapleton both address the *same* background "example" for when reconfiguring radio resources is needed, which is where users congregate in one place such as the cafeteria at lunchtime. *Compare* EX1001 at 1:35-41 ("One of the most difficult challenges faced by network operators is caused by the physical movement of subscribers from one location to another, and particularly when wireless subscribers congregate in large numbers at one location. *A notable example* is a business enterprise facility during *lunchtime*, when a large number of wireless subscribers visit a lunch room or *cafeteria location in the building*. At that time, a large number of subscribers have moved away from their offices and usual work areas. It's likely that during lunchtime, there are many locations throughout the facility where there are very few subscribers.") *with* EX1006, ¶0033 ("A possible application for DRU125A is a *cafeteria* in an enterprise building during the *lunch*

hour where a large number of wireless subscribers are gathered.") *and* EX1006, ¶0004 ("In order to provide DAS network capacity which is high enough to meet short-term needs of network subscribers in *specific locations* yet also avoid costly and inefficient deployment of radio resources, DAS network planners prefer to employ DAS architectures and solutions which provide a high degree of dynamic flexibility. Therefore, it would be advantageous for wireless network operators to employ a DAS solution which has a high degree of flexibility to implement dynamic rearrangements based on ever-changing network conditions and subscriber needs.")

171. To be clear, Stapleton also teaches that the other examples of the traffic monitoring unit (the NOC and DRU's embedded software) also are configured to reconfigure the radio resources as recited in this claim limitation. My section on claim 10 and claim 7, below, shows this. For brevity, I incorporate that analysis here.

172. Therefore, Stapleton anticipates this claim.

2. Independent Claim 10

173. Claim 10 is almost identical to claim 1. The following chart compares the text of claim 1 to the text of claim 10, with the differences highlighted.

1. A system comprising:	10. A system comprising:

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,	one or more Digital Access Units (DAUs) operable to receive at least one signal from at least one of a first signal source and a second signal source from one or more of a plurality of signal sources,
each DAU of the one of more DAUs including an input port configured as an uplink/downlink port and an output port configured as an uplink/downlink port;	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;
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;	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;
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,	a plurality of radio resources for”ed from the one or more DRUs comprising a first radio resource and a second radio resource different from the first radio resource,
each radio resource comprising a subset of the plurality of DRUs; and	each radio resource comprising a subset of the one or more DRUs; and
a traffic monitoring unit coupled to at least one of the DAUs, wherein the traffic monitoring unit is configured to:	a traffic monitoring unit external to and couplable to at least one of the DAUs, 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	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 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.	DAUs, wherein the QoS is a function of the one or more KPIs; 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.

174. The limitations of claim 10 are all disclosed by Stapleton for the same reasons that the matching claim limitations of claim 1 are disclosed.

175. The only substantive further limitation added by claim 10 that requires additional analysis is the limitation that the traffic monitoring unit is "external to" at least one of the DAUs. Stapleton discloses this for *three* reasons.

176. *First*, if there are "more than one DAU present," Stapleton teaches one DAU is "designated a Master DAU" and "the Management Control module located in the Master DAU makes decisions to optimize the overall transport capacity." EX1006, ¶0040 ("Referring again to FIG. 1…."), see also Figs. 4, 8. The Master DAU's management control module is an example of "*a traffic monitoring unit external to and couplable to at least one of the DAUs."* It is external to all DAUs other than the Master DAU. Paragraph 58, quoted in the section on Claim 1, explains that the "management control module" is the specific part of the embedded software module that reconfigures the radio resources (by

deploying/removing radio resources). EX1006, ¶0058. Further, although the management module does not monitor which carriers and time slots are active, it is the module with the "threshold" that identifies whether a carrier is overloaded (a *QoS*). 0058 ("to help identify when, e.g., a particular downlink carrier is loaded by a percentage greater than a predetermined threshold whose value is communicated to the *DAU Management Control* module by the DAU's Remote Monitoring and Control function 715. If that occurs, the *DAU Management Control module* can adaptively modify…"). The claim only requires the traffic monitoring unit determine "one" of a KPI "and/or" QoS; thus, this satisfies the claim.

177. *Second*, alternatively, Stapleton includes a remote network operations center (NOC) that performs "remote monitoring and control." EX1006, ¶0028. Figures 1 and 7 (cropped) shows the NOC is external to and couplable to at least one of the DAUs:

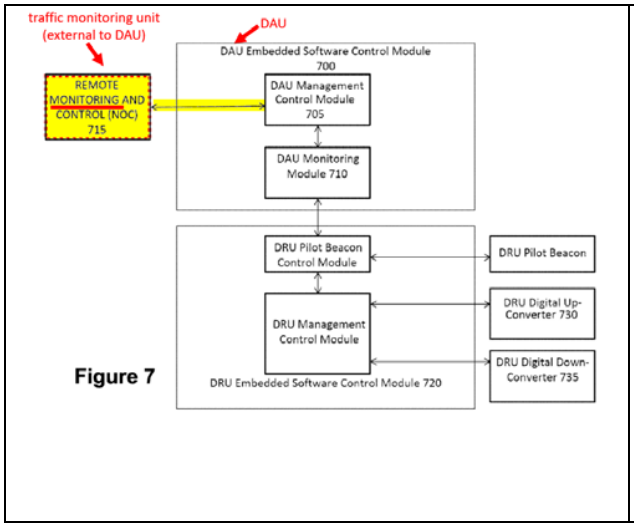


Figure 7

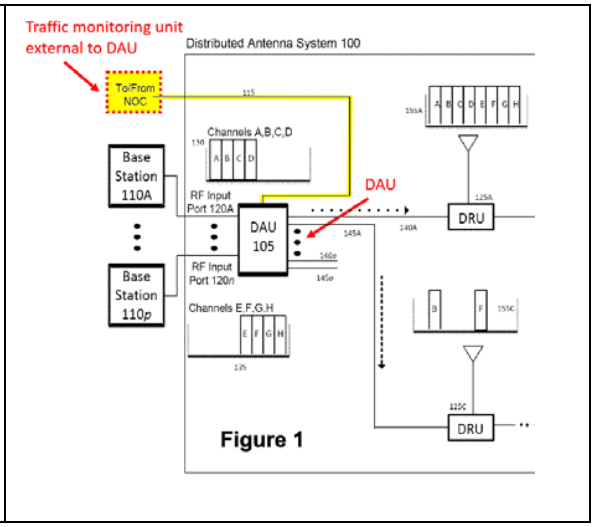


Figure 1

See also EX1006, ¶0054.

178. The NOC is an example of the claimed *"traffic monitoring unit."* Stapleton expressly teaches that the NOC "monitors" the DAS. EX1006, ¶0054 ("As noted previously, the NOC 715 *monitors the DAS operation* and sends commands to the DAU's for configuring various functions of the DRU's as well as the DAU, in at least some embodiments."), ¶0028 ("In addition, those skilled in the art will recognize that a DAU is *monitored* and controlled by a remote network operations center ("NOC"), as indicated at bidirectional link 115 in FIG. 1."). Stapleton labeled in NOC in Figure 7 (see above) as the "remote *monitoring* and control" unit. Stapleton expressly teaches that the monitoring being performed is "*traffic* monitoring" for "automatic *traffic* load-balancing." EX1006, ¶0010.

179. More specifically, the NOC is a *traffic* monitoring unit for two reasons. (1) Stapleton teaches that the NOC performs traffic monitoring by requesting information about the traffic from the DAU. To unpack this, Stapleton explains that the system can determine which carriers and time slots are active (and thereby monitor the traffic levels) by "performing power detection of the individual time slots." EX1006, ¶0037. Stapleton further explains that the NOC monitors this information by requesting it from the DAU, including requesting the (a) result of the power detection, (b) uplink power, (c) downlink power, and (d) active carriers. EX1006, ¶0028 ("*The NOC can request information from the*

DAUs. … The information requested includes but is not limited to *uplink power, downlink power*, optical error rate, gain settings, *active carriers*, etc."), ¶0037 ("The carriers and time slots are monitored by the DAU by filtering the signals and *performing power detection of the individual time slots, which information can be conveyed to the NOC as desired*."). These all provide information about the traffic in the DAS. In short, the NOC can request the same information the DAU uses to monitor the traffic (which carriers are time slots are active). (2) In addition, the NOC participates in the traffic monitoring by setting the threshold for the traffic monitoring. As mentioned above, the DAU's embedded software module uses an algorithm to help identify if a downlink carrier is loaded by a percentage greater than a "threshold," i.e., the carrier is overloaded due to high traffic. EX1006, ¶0058 ("An algorithm operating within the DAU Monitoring module which detects which carriers and corresponding time slots for each carrier are active for each DRU provides information to the DAU Management Control module to help identify when, e.g., a particular downlink carrier is loaded by a percentage greater than a predetermined threshold whose value is communicated to the DAU Management Control module by the DAU's Remote Monitoring and Control function 715"). Stapleton teaches that this traffic "threshold" is set by the Remote Monitoring and Control function (715)—numeral 715 is the NOC. EX1006, ¶0058 ("… a predetermined threshold whose value is communicated to the DAU

Management Control module by the DAU's *Remote Monitoring and Control function 715*"); ¶0054 ("The DAU Management Control Module 705 communicates with the *NOC 715*.")

180. In summary, the NOC is also an example of the claimed *traffic monitoring unit* because it:

> (1) *monitors the DAS*. EX1006, ¶0054 ("NOC 715 monitors the DAS"), ¶0028 ("monitored and controlled by a remote network operations center ('NOC')")
>
> (2) *specifically monitors the traffic information by requesting it from the DAU,* including requesting the (a) result of the power detection, (b) uplink power, (c) downlink power, and (d) active carriers. EX1006, ¶0028.
>
> (2) *specifically participates in the traffic monitoring by setting the threshold for the traffic monitoring*. EX1006, ¶0058 ("…a particular downlink carrier is loaded by a percentage greater than a predetermined threshold whose value is communicated to the DAU Management Control module by the DAU's Remote Monitoring and Control function 715.")
>
> (4) *participates in setting the appropriate amount of radio resources*. EX1006, ¶0054 ("As noted previously, the NOC 715 monitors the DAS operation and sends commands to the DAU's for configuring various functions of the DRU's as well as the DAU, in at least some embodiments").

181. The NOC is *"configured to: determine one or more of one or more key performance indicators (KPIs) and/or a quality of service (QoS) …."* The NOC sets the "threshold" value for the traffic monitoring process. EX1006, ¶0058 ("….a predetermined threshold whose value is communicated to the DAU

Management Control module by the DAU's Remote Monitoring and Control function 715."). The threshold is at least one of a *key performance indicators (KPIs)* or a *quality of service (QoS)*. It is a key value used by the DAU's software to decide when to trigger additional radio resource and indicates the limit for when performance is acceptable (i.e., when the performance is below the threshold). ¶0058. The threshold value can also be considered a *quality of service (QoS) of a network traffic*. It sets the goal the DAU is attempting to achieve for network traffic on the downlink carriers. By setting the load percentage threshold higher/lower, the NOC can determine how quickly the system will deploy additional radio resources, which affects the quality of the service at the DRUs using the radio resources. Here is an example to illustrate this point. Compare the quality of service if the NOC sets the threshold at 95% vs. 50%. In the case of 95%, the system will only deploy additional radio resources if the load on a carrier is greater than 95%. In the case of 50%, the system will deploy additional radio resources if the load on a carrier is greater than 50%. Thus, by setting the threshold higher or lower, the NOC can determine how quickly the system will deploy additional radio resources, which affects the quality of the service at the DRUs using the radio resources. More generally, Stapleton teaches that the purpose of this functionality is to enable "*traffic* monitoring" and "automatic *traffic* load-balancing." EX1006, ¶0010. The threshold value is also a *function of one*

more KPIs because it is compared to the load percentage which is calculated from which carriers and time slots are active (the *KPIs*). Said another way, the threshold represents the minimum value that can be calculated from the KPIs that will trigger deployment of an additional radio resource.

182. The NOC is configured to perform the claimed *reconfiguring* the *radio resources* because the NOC sends "commands" through the DAU that reconfigure that digital upconverter within the DRUs, which in turn changes which radio resources the DRUs form at their outputs. EX1006, ¶0036 ("Digital Up Converters located within the DRU can be dynamically reconfigured as the result of commands from the NOC."); ¶0028, ¶0054. Paragraph 37 is informative:

> The carriers and time slots are *monitored* by the DAU by filtering the signals and performing power detection of the individual time slots, which information can be conveyed to the NOC as desired. *Then*, as with the Digital Up Converters, the Field Programmable Gate Arrays (FPGA) in the DAU or DRU can be dynamically reconfigured *by commands received from the NOC* in a manner analogous to software programmability.

EX1006, ¶0037. By the term "then," a POSA understands that the reconfiguration is based on the monitoring of the carriers and time slots (the *KPI*). *See also* EX1006, ¶¶0054-0058. Stapleton explains that this capability is illustrated in Figure 1 where—"through commands received from the NOC"—only specific RF carriers (*radio resources*) appear at the output of the DRUs. EX1006, ¶0036 ("This capability is illustrated in FIG. 1 where only specific frequency bands or RF

carriers appear at the output of a given DRU. More specifically, *through commands* received from the NOC, the FPGA's in the DAU and one or more of the associated DRU's can be reprogrammed or reconfigured to convert and transport only the desired narrow bandwidths.").

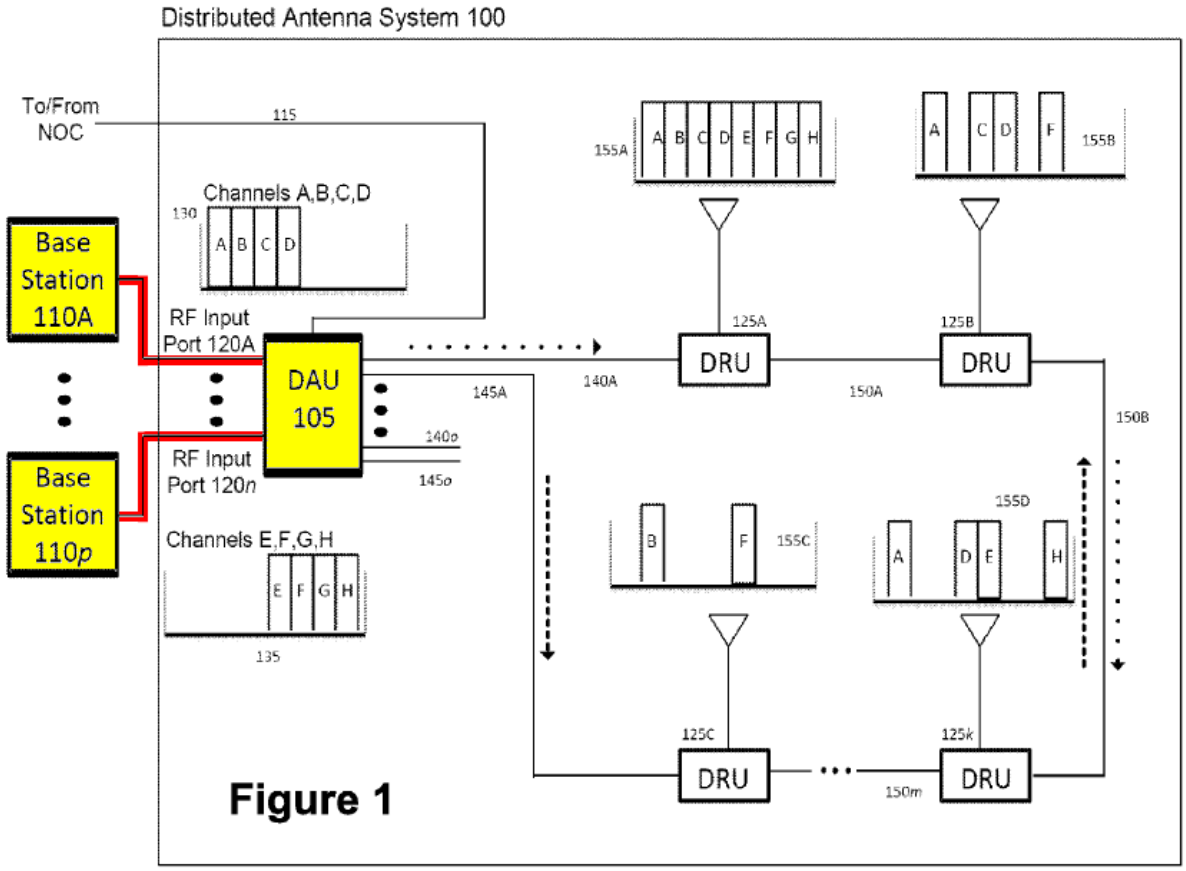
183. *Third*, my analysis on dependent claim 7, below, explains that Stapleton also teaches the DRU has its own embedded software, which is another example of a traffic monitoring unit which is *"external to and couplable to at least one of the DAU."* For brevity, I will incorporate that analysis here.

3. Dependent Claim 2

> **"2. The system of claim 1, further comprising a one or more Base Transceiver Stations (BTSs) coupled to the one or more DAUs, wherein each BTS comprises the plurality of radio resources"**

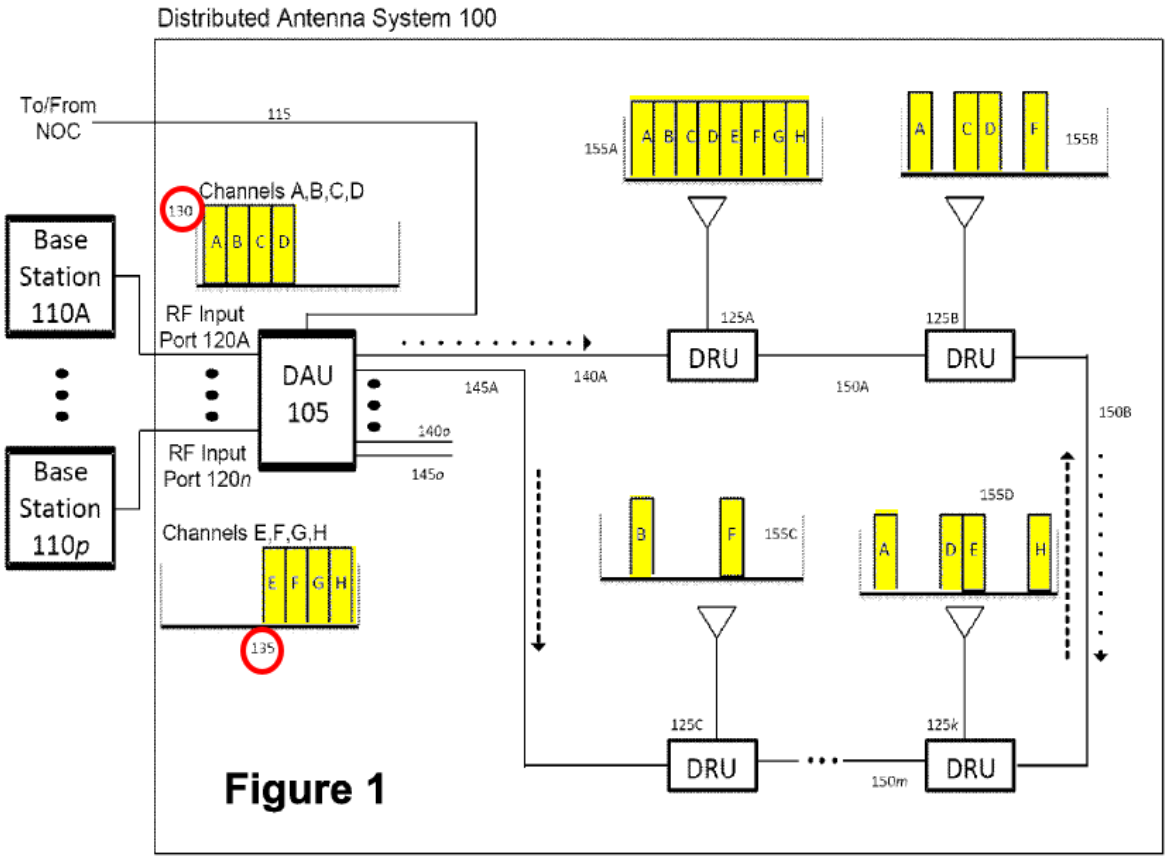
184. Stapleton teaches the limitation(s) added by this dependent claim.

185. *First*, Stapleton teaches that the DAU serves as an interface to plural base stations (the recited *one or more Base Transceiver Stations*). EX1006, ¶0028 ("The DAU 105 serves as an interface between associated base stations (BTS) 110A-B"). As shown in Figure 1, for example, the DAU is connected to the base stations by cables (annotated in red):



186. *Second*, Stapleton teaches that the base stations include the *radio resources*, which they provide to the DAU. In Figure 1, for example, the first base station (110A) outputs a composite downlink signal that "comprises carriers A-D" and the second base station (110p) outputs a composite downlink signal that "comprises carriers E-H." EX1006, ¶0032 ("Referring again to FIG. 1 … the DAU will receive a composite downlink input signal 130 from, e.g., a first base station 110A belonging to one wireless operator, enters the DAU 105 at the RF input port 120A. Composite signal 130 *comprises carriers A-D*. A second

composite downlink input signal from e.g., a pth base station 110p belonging to the same wireless operator enters DAU1 at the DAU1 RF input port 120n. Composite signal 135 *comprises carriers E-H*.") As already explained, these RF carriers are the radio resources. EX1006, ¶0054 ("radio resources (such as RF carriers, CDMA codes or TDMA time slots)"). The following annotation shows that these RF carriers (*radio resources*) are the same RF carriers (*radio resources*) used by the DRUs:



Therefore, Stapleton anticipates this claim.

4. Dependent Claim 3

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

187. *First*, Stapleton's system comprises a *"network optimization goal."* Stapleton's DAU comprises software that checks whether "a particular downlink carrier is loaded by a percentage greater than a predetermined *threshold*." EX1006, ¶0058. The '382 patent confirms that an embodiment of a "network

optimization goal" is to compare a metric "against a *threshold*." EX1001 at 11:20-23. Stapleton's *"goal"* is to have the particular downlink carrier loaded by a percentage less than the threshold; otherwise, Stapleton determines it needs to deploy additional radio resources. Stapleton expressly teaches the DAU's software operates "to optimize" the capacity. EX1006, ¶0040. Deploying additional radio resources based on the threshold is an example of optimizing the network. *See* EX1006 ¶0058 ("*If that occurs*, the DAU Management Control module can adaptively modify the system configuration to begin to deploy, typically although not necessarily slowly, additional radio resources (such as RF carriers, CDMA codes or TDMA time slots) for use by a particular DRU which need those radio resources within its coverage area."), ¶0010 ("The present invention enables … *network and radio resource optimization*").

Second, Stapleton's goal comprises "a percentage of users associated with each of the plurality of radio resources." Stapleton expressly teaches it goal comprises "a *percentage*." EX1006, ¶0058 ("a particular downlink carrier is loaded by a *percentage* greater than a predetermined threshold.") The '382 patent teaches that an embodiment of a "a percentage of users associated with each of the plurality of radio resources" is where the percentage "relate[s] to the number of users" per radio resources. EX1001 at 7:50-53. Equally, Stapleton's percentage relates to the number of users associated with each particular downlink carrier

(Stapleton's *radio resources*). EX1006, ¶0054 ("radio resources…such as *RF carriers*, CDMA codes or TDMA time slots).") Stapleton's percentage relates to the number of active time slots. EX1006, ¶0058. ("which carriers and corresponding *time slots* for each carrier *are active* for each DRU provides information to the DAU Management Control module to help identify when, e.g., a particular downlink carrier is loaded by a percentage greater than a predetermined threshold"). *The number of active time slots relates to the number of users*. In GSM systems, for example, each active time slot on each GSM 200 KHz radio carrier represents a voice conversation with a user. If 8 of 8 time slots on a carrier are active, there are eight active users. Said another way, if 8 of 8 times slots are active, the percentage of users is 100% for that downlink carrier.

188. To be clear, Stapleton includes GSM systems. Stapleton, for example, teaches to consult the '593 provisional application (which it incorporates) regarding processing "various signal formats and modulation types." EX1006, ¶0045 ("As disclosed in U.S. Provisional Application Ser. No. 61/374,593…and again referring to FIG. 1 of the instant patent application, the Digital Up Converters present in the DRU's of the present invention can be programmed to *process various signal formats and modulation types*…"); see also EX-1006 ¶0032 ("The functionality of the DAU 105, and DRU's 125A-125k, respectively, are explained in detail in U.S. Provisional Application Ser. No. 61/374,593…

incorporated herein by reference"), ¶¶0046-0047, ¶0001 (incorporating the '593 application). In turn, the incorporated provisional teaches this includes GSM:

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

EX1021, ¶0025, *see also* EX1021, ¶0001.[2]

189. Stapleton's disclosure further confirms that its resource allocations relate to the number of users, which Stapleton calls "subscribers". Stapleton, for example, teaches to allocate additional radio resources to DRU 125A in Figure 1 because that is where there are "a large number of wireless *subscribers*" (i.e., *users*). EX1006, ¶0033 ("A possible application for DRU125A is a cafeteria in an enterprise building during the lunch hour where a large number of wireless subscribers are gathered."). Stapleton teaches to perform the reconfiguration based on "*subscriber* needs" in order to address the needs of subscribers in "specific locations" (e.g., particular DRUs). EX1006, ¶0004 ("In order to provide DAS

[2] Stapleton also incorporates the '836 provisional application (EX1017) that covers GSM networks. EX-1006 ¶0001, ¶0012, ¶0036 (incorporating and discussing the '836 provisional application) *with* '836 provisional application, EX1017 at ¶0019 ("object of the present invention to enhance *GSM* and L TE 10 indoor location accuracy…").

network capacity which is high enough to meet short-term needs of network *subscribers in specific locations* … it would be advantageous for wireless network operators to employ a DAS solution which has a high degree of flexibility to implement dynamic rearrangements *based on* ever-changing network conditions and *subscriber needs*."). Further, Stapleton incorporates U.S. Provisional Application Ser. No. 61/382,836 ("the '836 provisional application" at EX1017). EX1006, ¶0012 ("It is an object of the present invention to provide Flexible Simulcast capabilities, as disclosed in U.S. Provisional Application Ser. No. 61/382,836, entitled 'Remotely Reconfigurable Distributed Antenna System and Methods,' filed Sep. 14, 2010, incorporated herein by reference…") The '836 provisional application specifically teaches that the DAU can (1) "track" users and (2) "record a running data base" about the information. EX1017, ¶0019.

190. Finally, Stapleton monitors the plural active "carriers"; thus, it checks the percentage of users associated with each carrier (*radio resource*).

5. Dependent Claim 4

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

191. Stapleton anticipates this claim for the same reasons discussed in my sections on independent claim 10 (above) and dependent claim 8 (below). My analysis for Claim 10 identifies two examples where the traffic monitoring unit

that are external to the one or more DAU: (1) the NOC and (2) management control module in the Master DAU. My analysis for claim 7, below, identifies a third example where the traffic monitoring unit that are external to the one or more DAU: the DRU's embedded software.

6. Dependent Claim 5

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

192. Stapleton disclosed this. As explained for parent claim 1, Stapleton teaches that the DAU includes an embedded software control module (700) that is an example of the recited "*traffic monitoring unit.*" Figure 7 shows this:

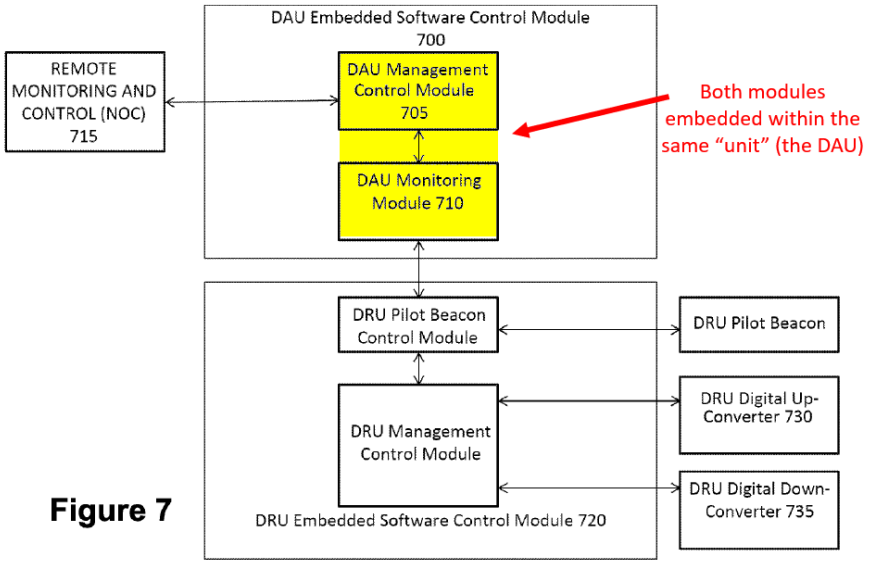


Figure 7

See also EX1006, ¶0054.

193. Because the software control module is "embedded" within the DAU, it meets the claim langauge requiring the traffic monitoring unit be *"provided as a component of each of the one or more DAUs."* EX1006, ¶0054 ("Referring next to FIG. 7, the software *embedded* in the DAU and DRU, which controls the operation of keys functions of these devices, can be better understood. In particular, the DAU *embedded* software control module 700 comprises a DAU Management Control Module 705 and a DAU monitoring module 710."). Therefore, Stapleton anticipates this claim.

7. Dependent Claim 6

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

194. Stapleton disclosed this for the same reason it discloses dependent claim 4 and 5.

195. *First*, as explained for dependent claim 5, Stapleton teaches that the DAU includes an embedded software control module (700) that is an example of the recited *"traffic monitoring unit."* EX1006, ¶0054, Fig. 7. In other words, there is an *"traffic monitoring unit"* inside the DAU (because it is embedded in the DAU). This means the *"traffic monitoring unit"* is external to the DRUs because the entire DAU that contains the *"traffic monitoring unit"* is external to the DRUs. Figures 1 and 7 show this:

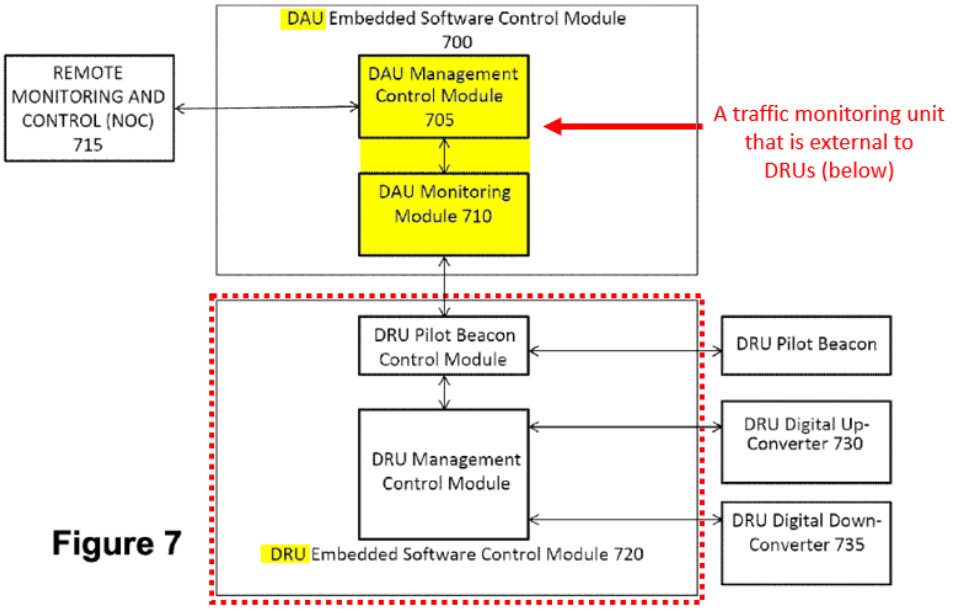


Figure 7

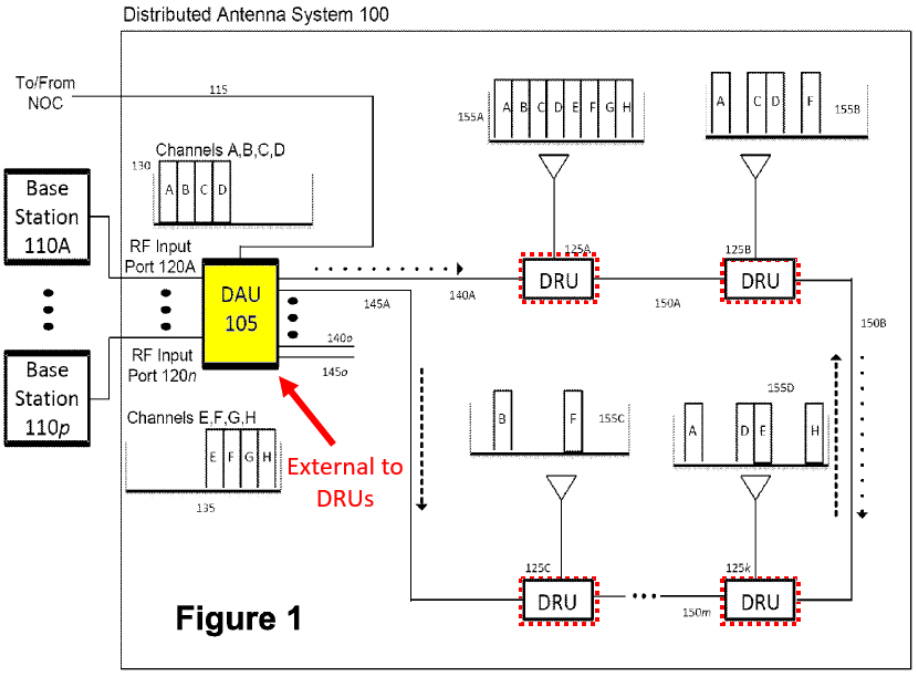


Figure 1

The software can also be in a Master DAU, as discussed above.

196. *Second*, as explained for dependent claim 4, Stapleton teaches that its system includes a remote network operations center (NOC) that is another example of the recited "*traffic monitoring unit.*" Figures 1 and 7 show that the NOC is external to the DRUs:

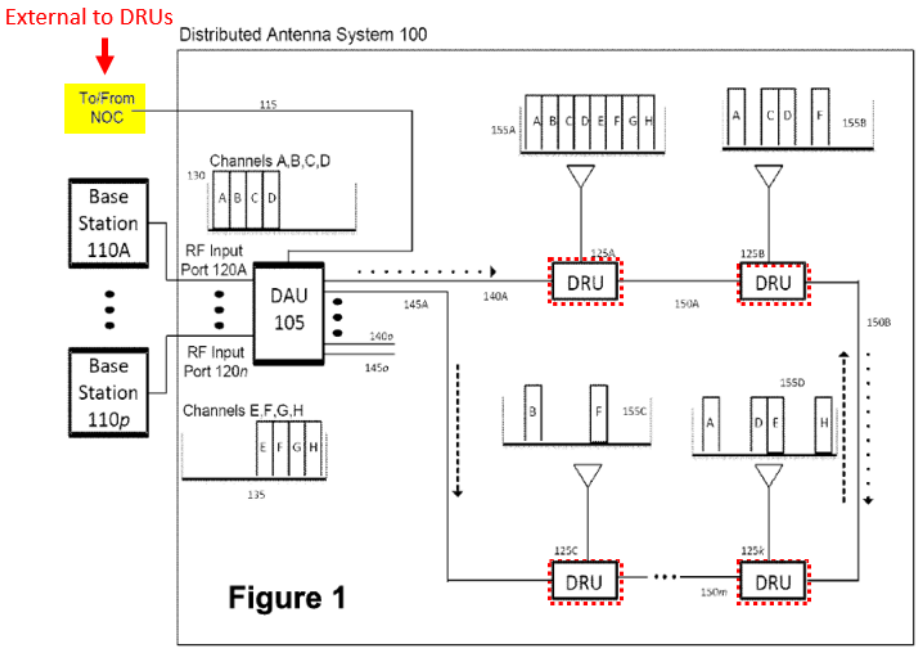


Figure 1

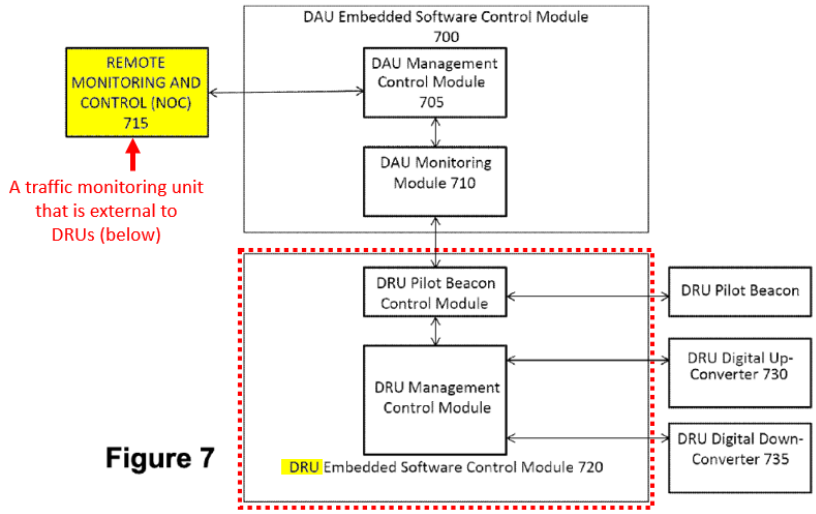


Figure 7

197. Therefore, Stapleton anticipates this claim.

8. Dependent Claim 7

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

198. Stapleton disclosed this. Specifically, Stapleton teaches that DRUs contain an embedded software control module (like the DAU) that is an example of the *traffic monitoring unit* recited in the claim. Figure 7 shows this module:

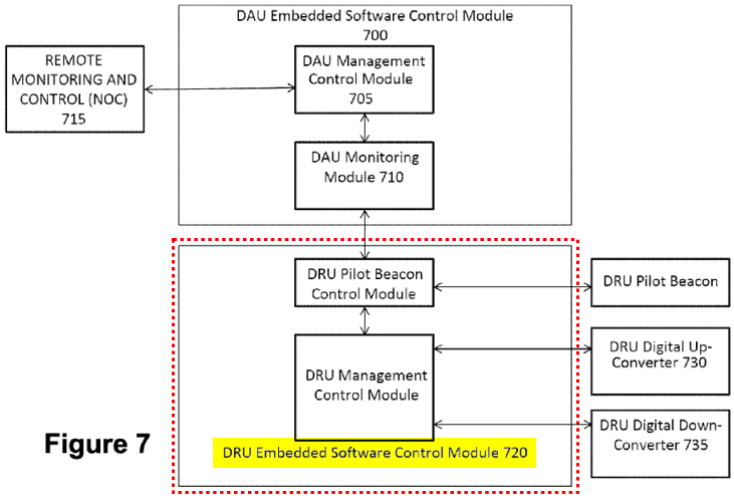


Figure 7

EX1006, ¶0054 ("The DAU Management Control module communicates with the DRU Embedded Software Control module 720 over a fiber optic link control channel via a control protocol."). As explained below, the DRU's embedded software control module meets the requirements in parent claim 1 for "*the traffic monitoring unit*."

199. Parent claim 1 provides the antecedent basis for *"the traffic monitoring unit"* and states that the traffic monitoring unit is:

(1) "coupled to at least one of the DAUs"

(2) "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"

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

200. *First*, as shown in Figure 7, the DRU's embedded software module (the *traffic monitoring unit* for this claim) is communicatively coupled to the DAU:

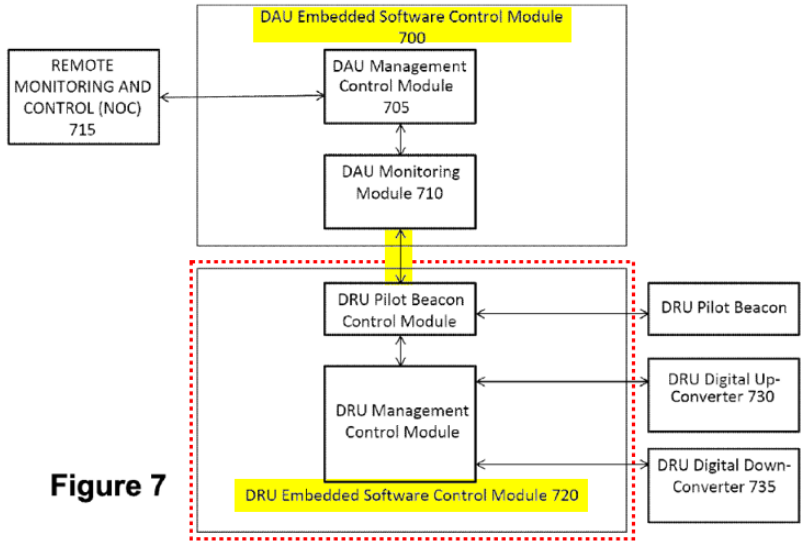


Figure 7

More specifically, Stapleton teaches that DRU embedded software control module is communicatively coupled to the DAU "over a fiber optic link control channel

via a control protocol." EX1006, ¶0054 ("The DAU Management Control module communicates with the DRU Embedded Software Control module 720 over a fiber optic link control channel via a control protocol."). This corresponds to the bidirectional link (heighted in yellow above) between the control modules at the DAU and DRU. *See also* Figure 1 (showing the DRU's are coupled to the DAU).

201. *Second*, Stapleton teaches that the DRU embedded software module (the *traffic monitoring unit* for this claim) is configured to determine *one or more key performance indicators (KPIs)*. Specifically, Stapleton teaches that the DRU measures (1) "downlink power," (2) "uplink power," and (3) "gain" / "active carriers." EX1006, ¶0028 ("The DAUs can subsequently *request information from the DRUs*. The information requested includes but is not limited to *uplink power, downlink power*, optical error rate, *gain settings, active carriers, etc.*"), ¶0055 ("DRU functions or features that the header would control in the DRU are typically implementation specific and can include, among other things, measuring *uplink and downlink power*, *measuring gain of uplink and downlink*, and monitoring alarms in the DRU."). These are *key performance indicators* as recited in the claim because these indicators are the information about how the network is performing and are used to determine which carriers and time slots are active, which is used to identify the load on the carriers and reallocate the radio resources. EX1006, ¶0058. The uplink/downlink power is the informaiton used to determine

which time slots are active. EX1006, ¶0037 ("The carriers and time slots are monitored by the DAU by filtering the signals and *performing power detection of the individual time slots*"). The DRU's information about active carriers is also, logically, the information used to determine which carriers are active. The gain, which the DRU measure, is also relevant because gain determines whether the carriers on and off (i.e., active or inactive). EX1006, ¶0034 ("The DAU's can remotely turn on and off the individual carriers via the gain control parameters.")

202. Paragraph 55 of Stapleton, for example, teaches that DRUs has the functionality to measure these KPI (e.g., uplink and downlink power) and does so when requested by the DAU's embedded software control module:

> The DAU Monitoring module, in addition to other functions, detects which carriers and corresponding time slots are active for each DRU. The DAU Management Control module communicates with the DRU Embedded Software Control module 720 over a fiber optic link control channel *via a control protocol*. In an embodiment, the control protocol comprises headers together with packets of data, such that both control information and data are transmitted to the DRU's together as a message. *DRU functions* or features that the header would control in the DRU are typically implementation specific and can include, among other things, *measuring uplink and downlink power*, measuring gain of uplink and downlink, and monitoring alarms in the DRU.

EX1006, ¶55. The DAU control this measurement process *"via a control protocol."*

203. *Third*, the DRU's embedded software (the *traffic monitoring unit* for this claim) is further configured to reconfigure the plurality of radio resources based on one or more of the one or more KPIs and/or the QoS by allocating at least one DRU from the first radio resource to the second radio resource.

204. As background, as discussed for parent claim 1, Stapleton teaches that DAU's embedded software control module issues commands to the DRU for the DRU to reconfigure the radio resources being transmitted at that DRU if the DAU determines that the load on the downlink carrier (*radio resource*) is greater than a threshold based on "power detection" (e.g., the uplink and downlink power measured by the DRUs when determining which carriers/time slots were active). EX1006, ¶0058 (explaining the reconfiguring), ¶0037 (explaining the power detection: "The carriers and time slots are monitored by the DAU by filtering the signals and performing *power detection* of the individual time slots, which information can be conveyed to the NOC as desired.").

205. *Relevant here*, like the DAU's embedded software control module discussed for parent claim 1, Stapleton teaches that the DRUs' embedded software is also configured to "*reconfigure the plurality of radio resources…*" as recited in this claim. Specifically, based on the commands from the DAUs, the DRUs' embedded software module reconfigures the settings of the digital up and down converters (DUCs / DDCs) in the DRUs that enable and disable the individual

carriers (the *radio resources*) for the DRUs. EX1006, ¶0034, ¶0037, ¶¶0055-0056. Paragraphs 34 explains that the DRUs have digital up and down converters (DUCs / DDCs)

> The individual Digital Remote Units have *integrated frequency selective DUCs and DDCs* with gain control for each carrier. The *DAU's can remotely turn on and off the individual carriers via the gain control parameters*.

Paragraphs 55-56 of Stapleton explains that that DRU's embedded software control module reconfigures the settings of the digital up and down converters (DUCs / DDCs) in the DRUs:

> The DAU Monitoring module, in addition to other functions, detects which carriers and corresponding time slots are active for each DRU. The DAU Management Control module communicates with the DRU Embedded Software Control module 720 over a fiber optic link control channel via a control protocol. …. In turn, the *DRU Management Control module 725 within the DRU Embedded Software Control Module sets the individual parameters of all the DRU Digital Up-Converters 730 to enable or disable specific radio resources from being transmitted by a particular DRU or group of DRUs*, and also sets the individual parameters of all the DRU Digital Down-Converters 735 to enable or disable specific radio resources from being transmitted by a particular DRU or group of DRUs.

EX1006, ¶¶55-56. *See also* EX1006, ¶0037, ¶¶0033-0036. Note that the consequence of DRU's embedded software control module setting the parameter of the digital up and down converters (DUCs / DDCs) is "to enable or disable specific radio resources from being transmitted by a particular DRU or group of DRUs." EX1006, ¶56. Finally, as explained in parent claim 1, this process is initiated

based on KPI or QoS determination (e.g., the downlink carrier being loaded greater than a threshold). Thus, this is example of the functionality of being configured to "*reconfigure the plurality of radio resources based on one or more of the one or more KPIs and/or the QoS by allocating at least one DRU from the first radio resource to the second radio resource.*"

206. Figure 7 shows that the DRU's embedded software module control participates in reconfiguring the radio resources by reconfiguring the digital up/down converters in the DRUs that enable/disable the specific radio resources:

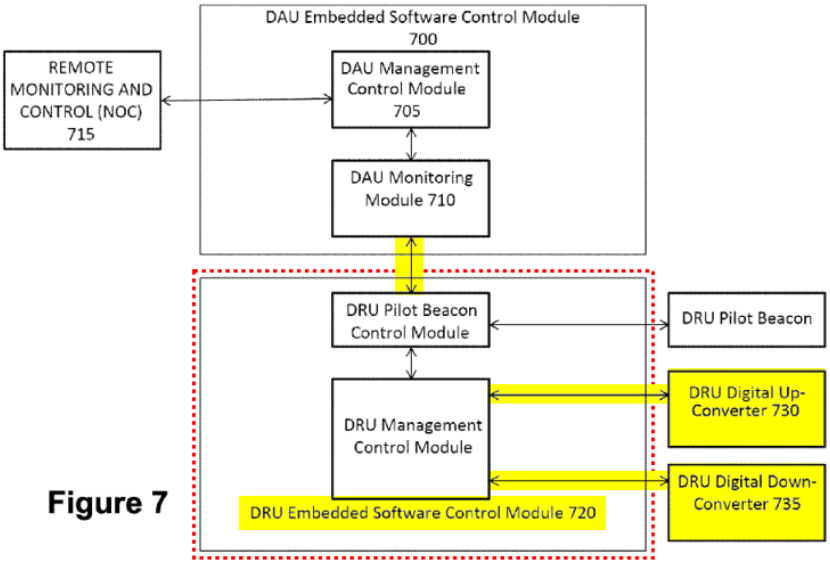


Figure 7

207. In summary, the DRU's embedded software control module also meets the requirements in parent claim 1 for "*the traffic monitoring unit*." Therefore, Stapleton anticipates the claim.

9. Dependent Claim 8

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

208. Stapleton disclosed this. As explained for parent claim 1, Stapleton teaches that DAU monitoring module (which is part of the DAU's embedded software control module that constitutes the claimed "*traffic monitoring unit*") is configured to monitor which carriers/time slots are active (*KPIs*) for each DRU in its DAS and uses that information "to help identify" when a particular downlink carrier is loaded by a percentage greater than a threshold. EX1006, ¶0058. This identification process is an example of analyzing plural KPIs (e.g., time slots and carriers). Notably, the software is configured to do this for "each" DRU, which involves plural KPIs (the carriers/time slots active for a first DRU, second DRU, etc.). See Fig. 1 (showing 4 DRUs and 8 carrier A…H). To be clear, Stapleton expressly teaches that its system is a DAS. EX1006, ¶0028 ("The present invention is a novel Reconfigurable Distributed Antenna System"). Thus, these are KPI of *"the DAS"* as recited in the claim.

209. To the extent "analyze" requires more than monitoring which carriers/time slots are active (*KPIs*), Stapleton teaches that too. Stapleton further teaches that DAU's embedded Management Control module (the other part of the DAU's embedded software control module that constitutes the claimed "*traffic monitoring unit*") uses the information about which carriers and time slots are

active "to help identify" when a particular downlink carrier is loaded by a percentage greater than a threshold. EX1006, ¶0058 ("An algorithm operating within the DAU Monitoring module which detects which carriers and corresponding time slots for each carrier are active for each DRU provides information to the DAU Management Control module *to help identify when*, e.g., a particular downlink carrier is loaded by a percentage greater than a predetermined threshold whose value is communicated to the DAU Management Control module by the DAU's Remote Monitoring and Control function 715."). Calculating a load percentage is an example of analyzing the KPIs (which carriers/time slots are active). In addition, comparing the load percentage to a threshold is also an example of further analysis of the KPIs (which carriers/time slots are active).

10. Dependent Claim 9

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

210. Stapleton disclosed this. As explained for parent claim 1, Stapleton's embedded software module in the DAU (the *traffic monitoring unit*) is configured to identify whether the load percentage on a particular carrier is "greater than" a threshold. EX1006, ¶0058 ("An *algorithm* operating within the DAU Monitoring module which detects which carriers and corresponding time slots for each carrier are active for each DRU provides information to the DAU Management Control

module to help identify when, e.g., a *particular downlink carrier is loaded by a percentage greater than a predetermined threshold whose value* ….”). The load percentage is a QoS. Therefore analyzing whether the load percentage is higher or lower than a threshold is an example of analyzing a QoS. The result of this comparison (above the threshold vs. below the threshold) is also a QoS value of the DAS. Because there are plural carriers (e.g., carriers A-H in Figure 1), the DAU’s embedded software control module will perform this comparison for plural carriers, which is an example of the DAU’s embedded software control module analyzed plural Quality of Service (QoS) values of the DAS.

11. Dependent Claim 11

> **“11. The system of claim 10, wherein the traffic monitoring unit is external to one or more Base Transceiver Stations (BTSs) and coupled to each of the one or more BTSs.”**

211. Stapleton discloses this for three reasons.

212. *First*, the alternative example of the traffic monitoring unit discussed above for claim 10 (the Master DAU) meets this claim. As shown in annotated Figures 4, below, an exemplary Master DAU is external to the BTSs and coupled to the BTSs (405, 410):

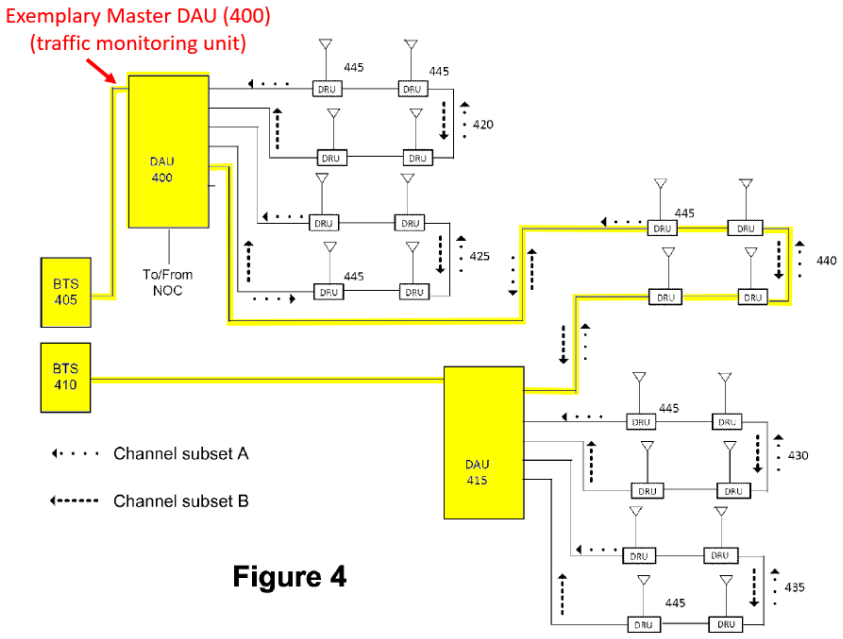


Figure 4

See also EX1006, Figs. 1, 8.

213. *Second*, the other examples of the traffic monitoring unit discussed above for claim 10 (the NOC) also meets this claim. Annotated Figure 1 shows the NOC (715) that is external to the BTSs and is also coupled to the BTSs (via a DAU):

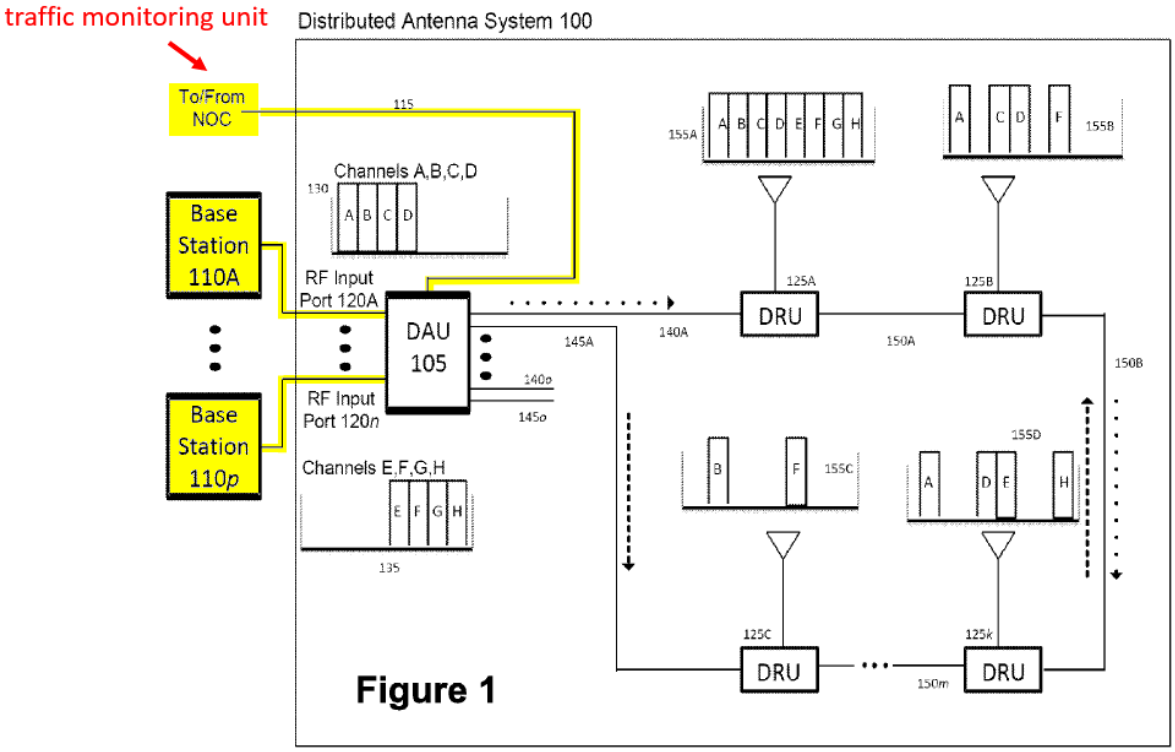


Figure 1

If Patent Owner argues this claim requires the traffic monitoring unit be more directly coupled to the BTSs (which the claim does not say), that does not distinguish Stapleton. Stapleton incorporated '836 application expressly teaches the NOC can be directly coupled to the BTS:

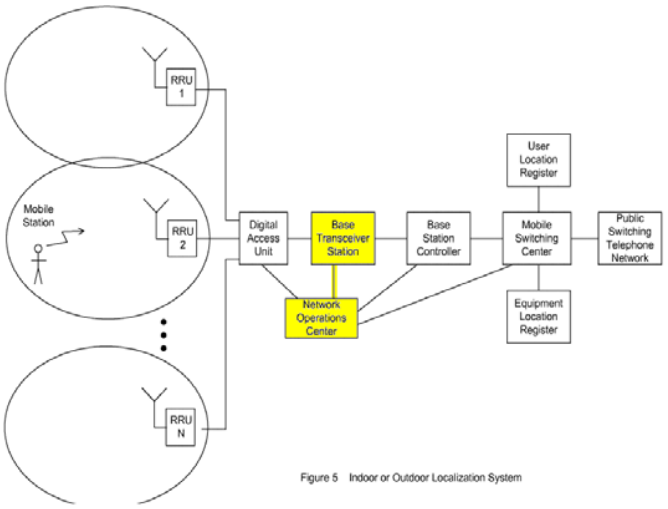


Figure 5 Indoor or Outdoor Localization System

EX1017 at Fig. 5. EX1006, ¶0001, ¶0012 (incorporating this application).

214. *Third*, the other example of the traffic monitoring unit discussed below for claim 7 (the DRU's embedded software) also meets this claim. Figure 1 shows this:

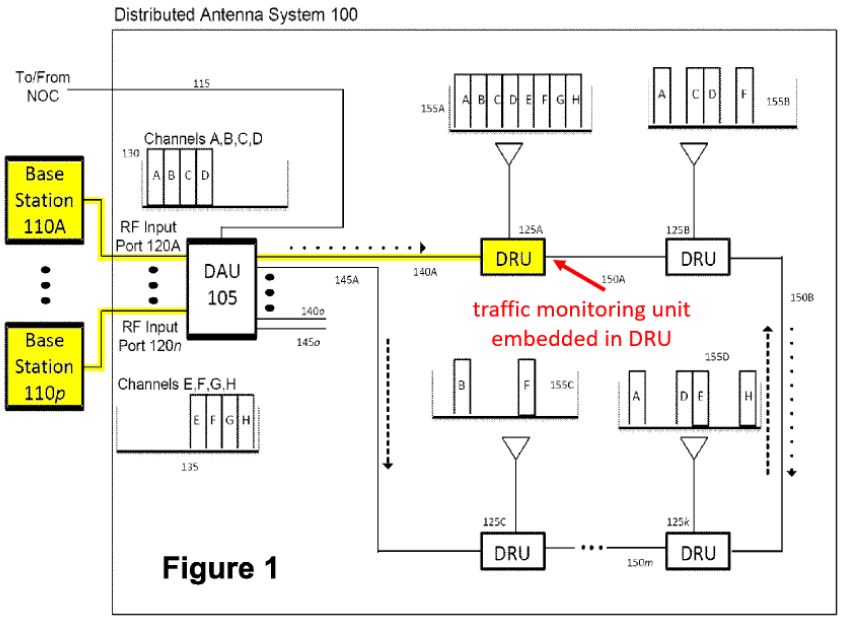


Figure 1

EX1006, ¶0029, ¶0031.

12. Dependent Claim 12

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

215. Stapleton discloses the limitations in this claim in several ways.

216. *First*, Stapleton's "remote *network* operations center" (NOC) is an example of the recited "*network optimization processor.*" As explained below, Stapleton teaches that NOC participates in the process that enables "network and radio resource *optimization*." EX1006, ¶0010. The NOC participates in the process that enables "network and radio resource *optimization*" in several ways.

217. The NOC sets the "threshold" used by the DAU's software to reallocate radio resources. EX1006, ¶0058 ("An algorithm … to help identify when, e.g., a particular downlink carrier is loaded by a percentage greater than a predetermined threshold whose value is communicated to the DAU Management Control module *by the DAU's Remote Monitoring and Control function 715*. If that occurs, the DAU Management Control module can adaptively modify the system configuration to begin to *deploy …. additional radio resources* (such as RF carriers, CDMA codes or TDMA time slots) for use by a particular DRU which need those radio resources within its coverage area. At the same time, usually the DAU Management Control module adaptively modifies the system configuration to begin to *remove*, again typically slowly, *certain radio resources* (such as RF

carriers, CDMA codes or TDMA time slots) for use by a particular DRU where that DRU no longer needs those radio resources within its coverage area.").

218. The NOC also issues "commands" to reconfigure which RF carriers (the radio resources) correspond to which DRUs. EX1006, ¶0036 ("Digital Up Converters located within the DRU can be dynamically *reconfigured* as the result of *commands from the NOC* to transport from the DAU input to *any specific DRU output* any specific narrow frequency band or bands, *RF carriers or RF channels* which are available at the respective RF input port of either DAU."); 0037 ("A related capability …. each DRU can be configured to transport any specific time slot or time slots of each carrier from the DAU input to any specific DRU output. The carriers and time slots are monitored by the DAU by filtering the signals and performing power detection of the individual time slots, which information can be conveyed to the NOC as desired. Then, as with the Digital Up Converters, the Field Programmable Gate Arrays (FPGA) in the DAU or DRU can be dynamically *reconfigured by commands received from the NOC in a manner analogous to software programmability*."), EX1006, ¶0028 ("NOC has the capability to remotely configure the DAU parameter settings which in turn configures the DRU's parameter settings."), ¶0054 ("As noted previously, the NOC 715 monitors the DAS operation and sends commands to the DAU's for configuring various functions of the DRU's as well as the DAU, in at least some embodiments.")

219. The NOC also constitutes a "processor" as recited in "network optimization processor" for two reasons. (1) The NOC meets the teachings in the specification of the challenged '382 patent for what constitutes a network optimization processor. The specification of the challenged '382 patent calls the network optimization processor a "Network Optimization *Unit*." EX1001 at 7:17-19. The NOC is a unit. *See* EX1006 at Figure 7. The '382 patent further teaches that the Network Optimization Unit (the disclosed example of the network optimization processor) can be "software." EX1001 at 7:34-36. Likewise, a POSA understands that the NOC comprises software. As already mentioned, Stapleton teaches that the NOC issues "commands." EX1006, ¶¶0036-0037, ¶0054. More specifically, Stapleton teaches that these commands are commands to reprogram the Field Programmable Gate Arrays in the DAU or DRU in "a manner analogous to *software* programmability." EX1006, ¶0037; *see also* EX1006, ¶0051 ("The reconfigurable system is adaptive or manually field-*programmable*, since the algorithms can be adjusted *like software* in the digital processor at any time."). Thus, the NOC matches the teaching in the challenged '382 patent that the network optimization processor can be software. EX1001 at 7:34-36. The NOC's software inherently requires a processor to run the software. (2) Stapleton teaches that the NOC operates in a two-step manner: (a) it requests information about the DAU's monitoring and (b) "then" (i.e., based on the information), sends

commands to dynamically reconfigure which RF carriers (the radio resources) correspond to which DRUs. EX1006, ¶0037 ("The carriers and time slots are *monitored* by the DAU by filtering the signals and performing power detection of the individual time slots, which i*nformation can be conveyed to the NOC as desired*. *Then*, as with the Digital Up Converters, the Field Programmable Gate Arrays (FPGA) in the DAU or DRU can be *dynamically reconfigured* by commands received from the NOC in a manner analogous to software programmability. The DAU detects which carriers and corresponding time slots are active.") Thus, a POSA knows that the NOC is *processing* the information received from the DAU's monitoring to determine which commands to "then" issue and, the POSA, therefore, knows the NOC inherently includes a processor.

220. The NOC also meets the claim language requiring the network optimization processor be "*coupled to the traffic monitoring unit.*" Following the arrows in Figure 7 shows that the NOC is communicatively coupled to at least two examples of the traffic monitoring unit (the Master DAU's monitoring module and DRU's software module).

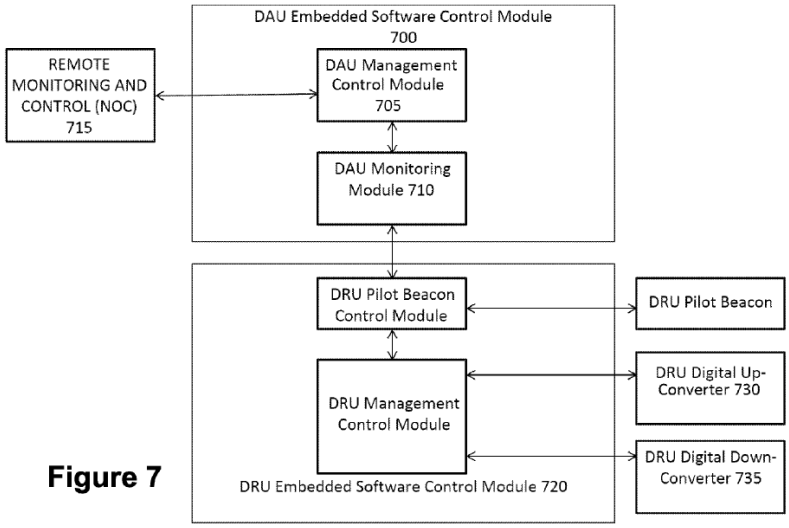


Figure 7

EX1006, ¶0054 ("Referring next to FIG. 7…The DAU Management Control Module 705 communicates with the NOC 715, and also the DAU monitoring module 710.") Figure 1 also shows this.

221. *Second*, alternatively, the Master DAU's monitoring module can be considered the network optimization processor and the NOC or DRU's software can instead be considered the traffic monitoring unit. Figure 7 shows that the DAU's software module is coupled to both of alternative examples of the *traffic monitoring unit*:

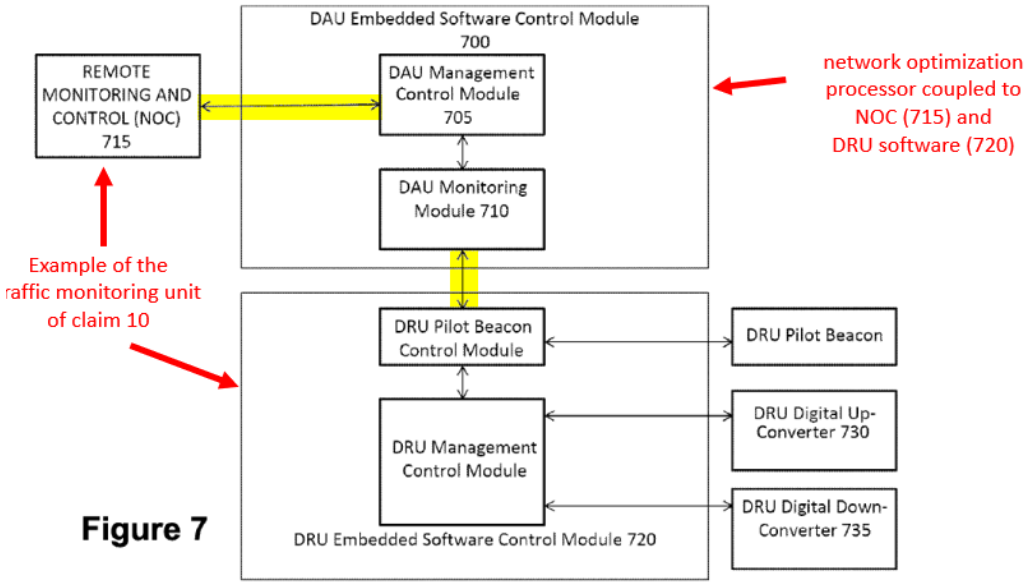


Figure 7

222. Stapleton teaches that DAU's software (e.g., the management control module) makes decisions "to optimize" the capacity. ¶0040. The process described in Paragraph 58 of deploying/removing radio resources optimizes the radio resources. EX1006, ¶0058. Stapleton call this "network and radio resource optimization." EX1006, ¶0010. The DAU "software" module matches the disclosed example of the network optimization processor, which is also "software." *Compare* the challenged EX1006 at 7:34-36 ("network optimization unit 120 (which can be *software* running on a sever)…") *with* EX1006, ¶0054 ("DAU embedded *software* control module 700"). Stapleton also teaches there is a "digital processor" for its algorithm (i.e., the algorithm in the DAU's software module).

EX1006, ¶0051 ("digital processor"), ¶¶0036-0037 (DAU contains an "FPGA," which is a processor).

13. Dependent Claim 13

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

223. Stapleton discloses the limitations in dependent claim 13 for the same reasons discussed in the next section for dependent claim 14. Specifically, the next section for dependent claim 14 shows that Stapleton discloses that the DAUs are coupled via *optical fibers* to the DRUs. That same example that meets the present claim. It is an example "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" as recited in the present claim. Notably, although the present claim limits the type of connections (optical fiber, ethernet, etc.,), it does not limit what the DAUs are coupled to (e.g., the base station, DRUs, etc.); thus, it covers the example where the relevant coupling is between the DAU and DRUs. Further, even if the claim were to be construed to require a DAU be coupled *to another DAU* via one of the recited link types, Stapleton also discloses this. For example, Figure 4 shows that DAU 400 is coupled to DAU 415 via bi-directional optical

fiber (that passes through four daisy-chained DRUs on a loop shared by both DAUs); EX1006, Fig. 4; ¶0044; see also ¶0029 (cables to DRUs are optical fiber).

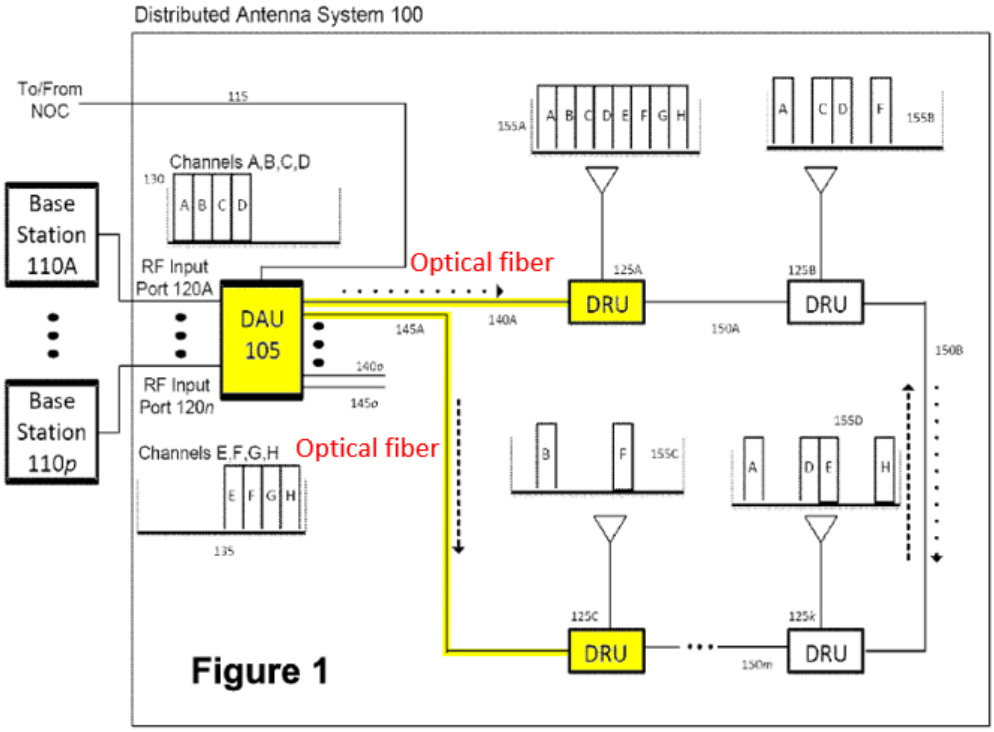
14. Dependent Claim 14

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

224. Stapleton discloses this.

225. Stapleton discloses that the DAUs are coupled to the DRUs via *optical fibers*. EX1006, ¶0029 ("For the downlink (DL) path, RF input signals 120A through 120n are received at the DAU 105….The independently serialized, parallel data streams are then *delivered to different DRU's 125A-125k, typically over optical fiber cable* arranged, in at least some embodiments, in a ring configuration indicated at connection pairs 140A-145A, or, in other embodiments, a daisy chain configuration."), ¶0033 ("One optical output of DAU 105 is fed to DRU 125A, via bidirectional *optical cable 140A*. A second optical output of DAU 105 is fed via bidirectional *optical cable 145A* to DRU3."), ¶0008 ("In at least some embodiments, the DAU communicates with the associated DRU's via an *optical* transport arrangement."), ¶0013 ("It is a further object of the present invention to balance the bidirectional data rate on the *optical fibers* so as to increase the maximum achievable data rate during operation on the ring network of

DRUs"), ¶0036 ("This approach also allows more efficient use of the available optical fiber transport bandwidth for neutral host applications, and allows transport of more individual operators' band segments over the optical fiber."). As applied to Figure 1, Stapleton teaches that numerals 140A and 145B are each an "optical cable" (¶0029) in the form of an "optical fiber cable" (¶0033) that connect the DAU (105) to the DRUs:



In summary, Stapleton anticipates this claim.

15. Dependent Claim 15

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

226. Stapleton discloses this. Stapleton expressly teaches that the DRUs can be connected in a "daisy chain configuration." EX1006, ¶0029 ("The independently serialized, parallel data streams are then delivered to different DRU's 125A-125k, typically over optical fiber cable arranged, in at least some embodiments, in a ring configuration indicated at connection pairs 140A-145A, or, in other embodiments, a *daisy chain configuration*."), ¶0007 ("Likewise, depending upon the implementation, the DRU's associated with a given DAU can be configured in either a linear or ring *Daisy chain configuration*.")

227. Figure 1, for example, illustrates DRUs 125A and 125B connected in a daisy chain configuration:

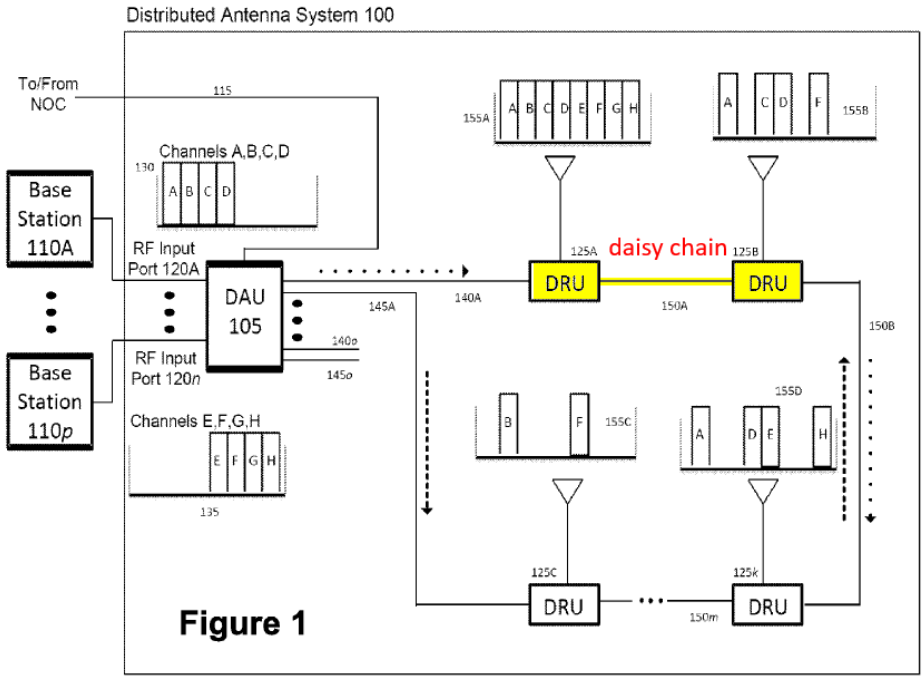


Figure 1

Stapleton explains that the optical cable 150A "performs the function of daisy chaining DRU 125A with DRU125B." EX1006, ¶0034. DRUs 125C and 125K are also connected in a daisy chain configuration.

228. Figures 3, 4, and 6 also show DRUs connected in daisy-chain configurations. EX1006, ¶0041 ("Referring to FIG. 3, an alternative embodiment of the present invention wherein a single DAU controls a plurality of rings, each comprising a *plurality of daisy-chained DRU's*, can be better understood. In FIG. 3, two daisy-chained rings, indicated at 300 and 305, are shown although the number of rings could be greater…"), ¶0044 ("Referring next to FIG. 4, a still further an alternative embodiment of the present invention may be understood. … Each of the rings comprises daisy-chained DRU's generally indicated at 445 and connected via, for example, fiber optic links, as discussed in connection with FIG. 1."), ¶0053 ("Referring next to FIG. 6, a still further alternative embodiment may be better appreciated. … a plurality of DRU's, indicated as DRU1-DRU60, daisy-chained along three separate rings 635, 640 and 645 for achieving the desired coverage."); see also EX1006, Figs. 3-4, 6.

229. Therefore, Stapleton anticipates this claim.

16. Dependent Claim 16

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

230. Stapleton discloses this limitation. Stapleton discloses this, for example, in Figure 8 which shows multiple DRUs connected to the DAU in a star configuration.

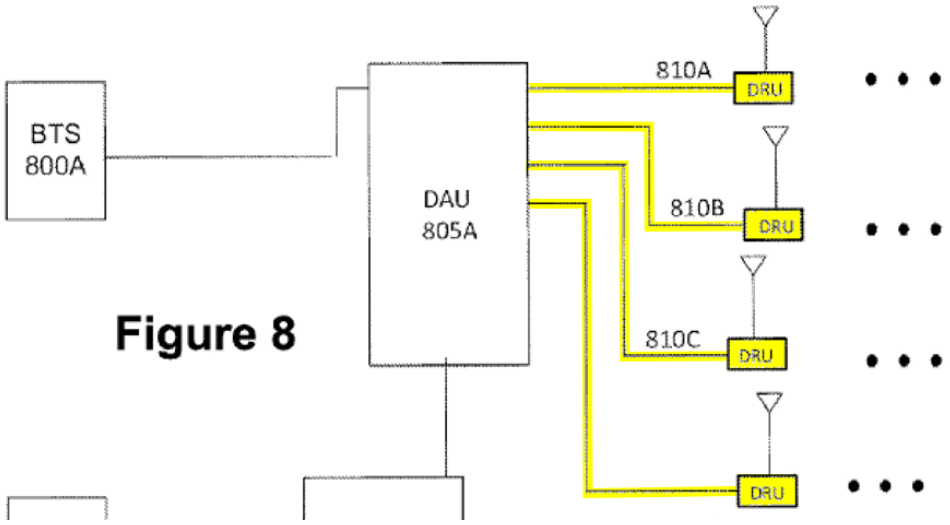
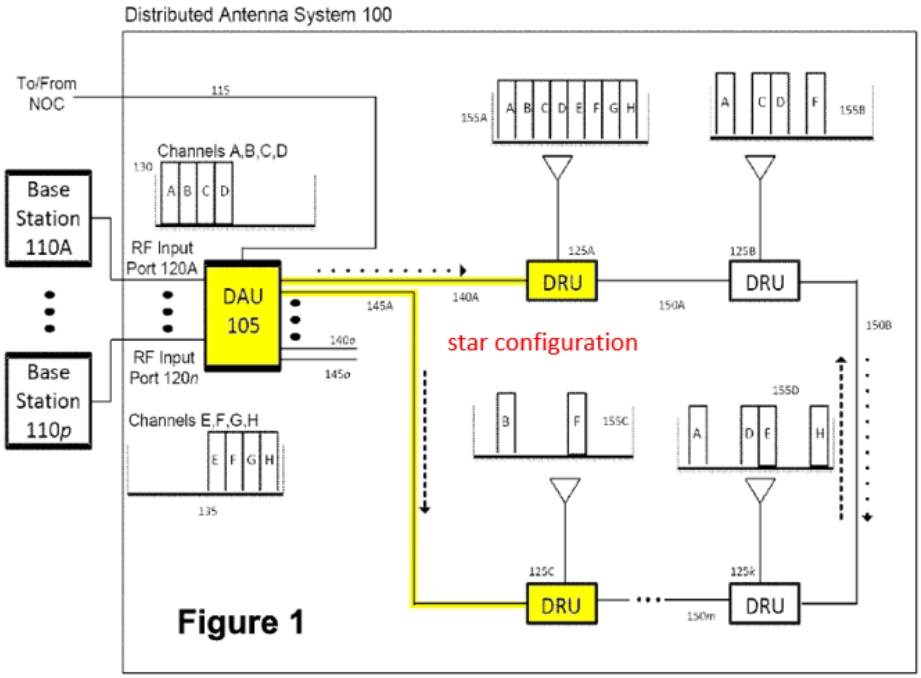


Figure 8

EX1006, Fig. 8 (cropped); ¶0057 ("The DAU's are daisy-chained, and each DAU communicates with one or more daisy-chains 810A-810 m of DRU's which may or may not be arranged in a ring configuration.")

231. In addition, Figure 1, illustrates two DRUs 125A and 125C connected to the DAU 105 in a star configuration:



232. Therefore, Stapleton anticipates this claim. For completeness, Figures 3-4, and 6 show similar configurations where each DRU that starts a daisy-chain of other DRUs is connected back to the DAU in a star configuration.

17. Dependent Claim 17

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

233. Stapleton teaches its DAUs can be indirectly connected to one or more BTSs (through another DAU) via an optical fiber, which meets this claim. Figure 4, for example, shows that DAU 415 is indirectly coupled to BTS 405 via "optical cable 440" (red):

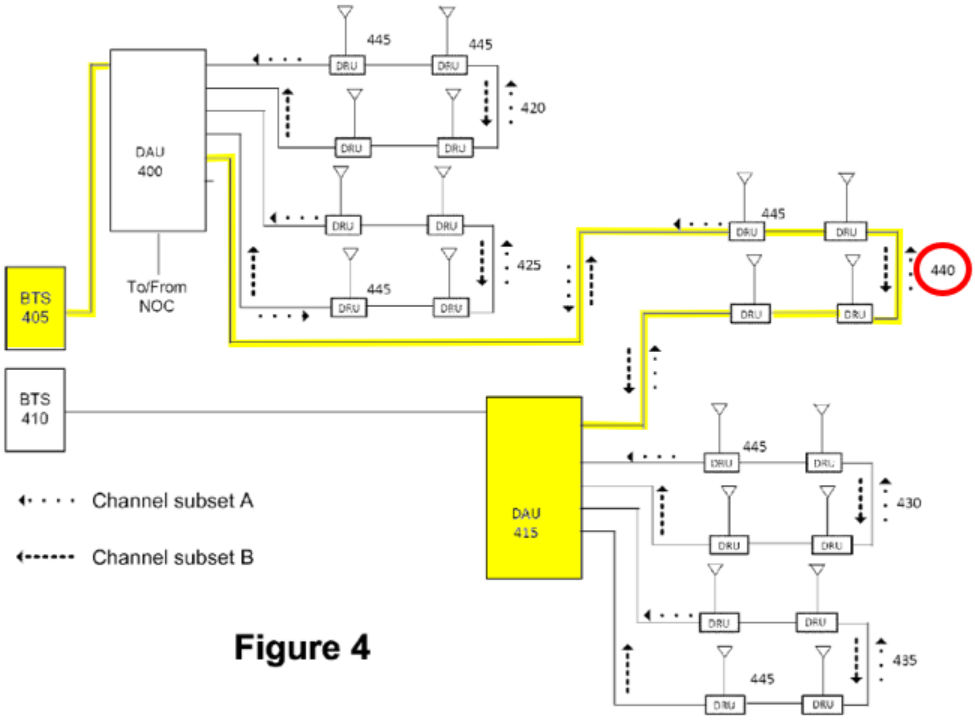


Figure 4

234. Optical cables are optical fiber. EX1006, ¶0036 ("The present invention …allows more efficient use of the available optical fiber transport"), ¶0006 ("transport media e.g., optical fiber"). The incorporated '836 provisional explains such optical cables provides access to the carriers from the other base station. '836 provisional, EX1017, ¶0030. EX1006, ¶0001, ¶ 0012, ¶0036 (incorporating).

18. Dependent Claim 18

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

235. Stapleton discloses this. Stapleton teaches that DRUs can be connected in a "ring configuration." EX1006, ¶0007 ("Likewise, depending upon the implementation, the DRU's associated with a given DAU can be configured in either a linear or *ring* Daisy chain configuration."), ¶0009 ("By the use of a *ring configuration* for connecting, in at least some embodiments, *the DRU's* and/or the DAU's, fault tolerance is built into the system, with resulting high availability. In single DAU embodiments, each DRU is accessible through two paths, and therefore remains available even in the event of a line break."), ¶0013 ("It is a further object of the present invention to balance the bidirectional data rate on the optical fibers so as to increase the maximum achievable data rate during operation on the *ring network of DRUs*.") Stapleton confirms this expressly claiming a "loop configuration" in his claim 1. Stapleton at Claim 1 ("providing at least one digital access unit configured to communicate with at least some remote radio units, linking in a *loop configuration* the one or more remote radio units and the at least one digital access unit whereby each remote radio unit can be accessed in either direction around the loop")

236. Figure 1, for example, shows four DRUs connected in a ring (i.e., loop) to the DAU (105):

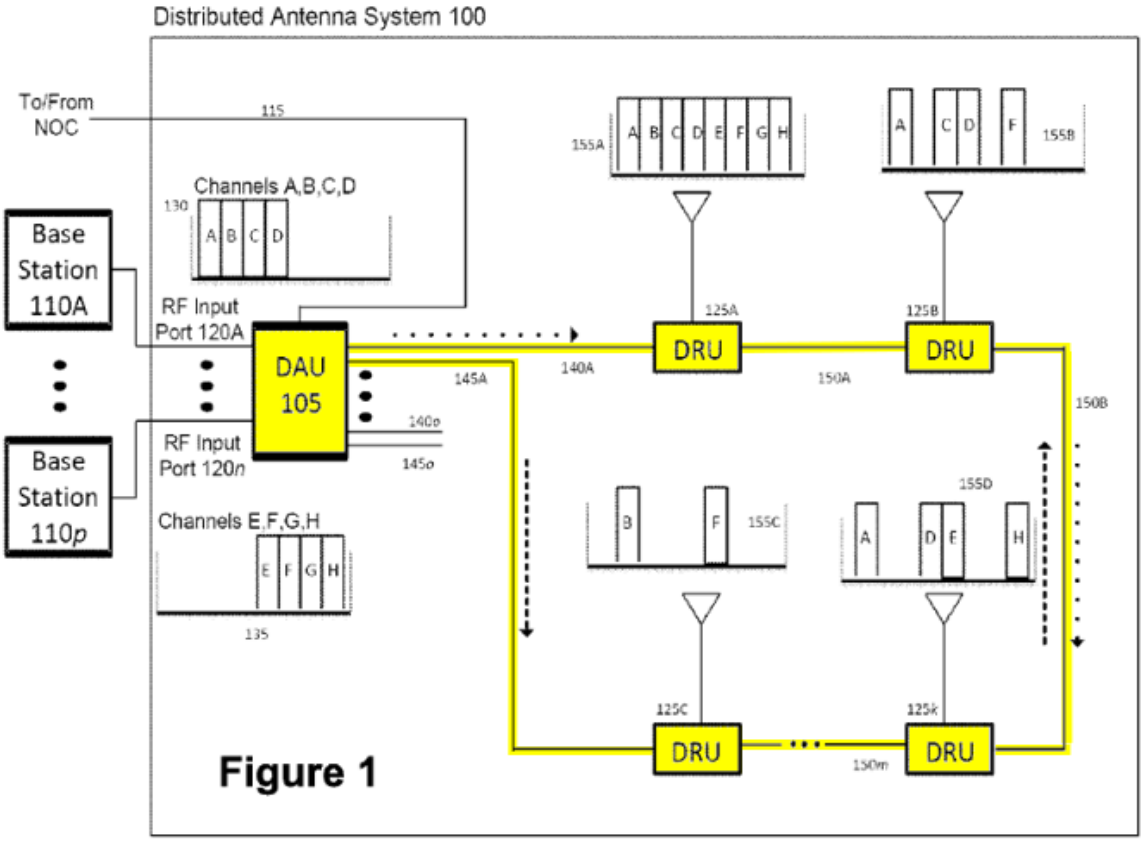


Figure 1

Stapleton's specification repeatedly explains that this is a ring (i.e., loop). EX1006, ¶0020 ("FIG. 1 is a block diagram according to one embodiment of the invention showing the basic structure and an example of a unidirectional, channelized downlink transport, one ring scenario based on having one DAU and four DRUs."), ¶0029 ("For the downlink (DL) path, RF input signals 120A through 120n are received at the DAU 105 …. The independently serialized, parallel data streams are then delivered to different DRU's 125A-125k, typically over optical fiber cable arranged, in at least some embodiments, in a *ring configuration*

indicated at connection pairs 140A-145A, or, in other embodiments, a daisy chain configuration. In addition, each DAU can support a *plurality of rings* with associated DRU's, where the *additional rings* are indicated by fiber optic pairs up through 140o-145o."), EX1006, ¶0033 ("Similarly, bidirectional optical cables 150, 155 and 160 connect DRU's 125A-n in a *ring configuration*, such that DRU 125A connects to DRU 125B via cable 150A, DRU 125B connects to DRU 125n via cable 150B, and DRU 125k connects to DRU 125C, or the kth-1 DRU, via cable 150m.")

237. As shown by the black arrows in Figure 1, the radio resources can be transported in either the clockwise or counterclockwise direction around the ring. EX1006, ¶0030 ("One function of the DAU 105 is to determine the direction in which downlinked channels are propagated around the ring. As just one example, the embodiment shown in FIG. 1 is configured to have downlink channels A, B, C and D propagate in a first direction, for example clockwise, and channels E, F, G, and H propagate in the counter direction…"), ¶0039 ("Referring to FIG. 1, downlink channels A, B, C, and D are transmitted in a clockwise sense around the ring of DRU's 125A-k. On the other hand, downlink channels E, F, G and H are transmitted in a counterclockwise sense around the ring of DRU's."), ¶0040 ("DAU is able to automatically and adaptively re-allocate data transport resources

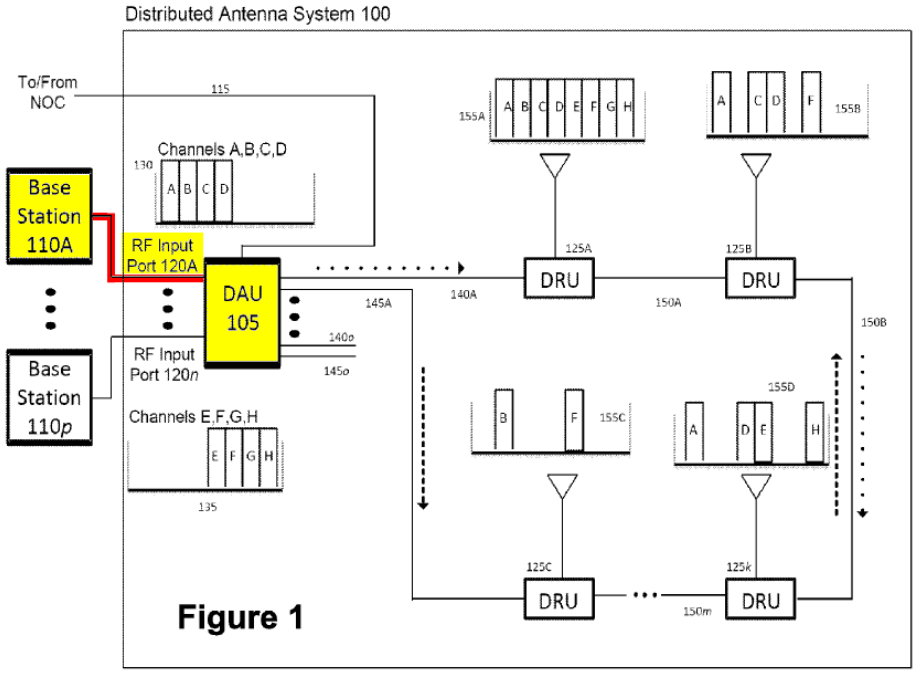
on the clockwise direction of the ring and on the counter-clockwise direction of the ring to maximize the overall transport capacity.")

238. Therefore, Stapleton anticipates this claim. For completeness, Figures 2-4 also show ring configurations. EX1006, ¶0021 ("FIG. 2 is a block diagram in accordance with an embodiment of the invention showing the basic structure and an example of a unidirectional, channelized uplink transport, one *ring* scenario based on having one DAU and four DRUs."), ¶0022 ("FIG. 3 is a block diagram in accordance with an embodiment of the invention showing the basic structure and an example of a unidirectional, channelized uplink transport, *two ring* scenario based on having one DAU and eight DRUs."), ¶0023 ("FIG. 4 is a block diagram in accordance with an embodiment of the invention showing the basic structure and an example of a unidirectional channelized uplink or downlink transport. This example of a *five ring* scenario comprises two DAUs and twenty DRUs.")

19. Dependent Claim 19

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

239. Stapleton discloses this. Figure 1, for example, shows that the DAU (105) has a "RF input port" that connected to a base station (110A):



See also EX1006, ¶0032 ("In such instances, the DAU will receive a composite downlink input signal 130 from, e.g., a *first base station 110A* belonging to one wireless operator, *enters the DAU 105 at the RF input port 120A*"), ¶0036 ("transport from the DAU input to any specific DRU output any specific narrow frequency band or bands, RF carriers or RF channels which are available at the respective *RF input port of either DAU*."), ¶0044 ("The arrangement illustrated in FIG. 1 comprised downlink signals from *two separate base stations belonging to the same wireless operator entering the DAU 105 at input ports 110A and 110p*, respectively. In the embodiment of FIG. 4, a first composite signal enters a first DAU 400 at that DAU's RF input port from a base station 405, and a second composite downlink input signal from, e.g., a second base station 410 belonging to

a different wireless operator enters DAU 415 at that second DAU's RF input port."), ¶0028 ("The DAU 105 serves as an interface between associated base stations (BTS)"), ¶0029 ("For the downlink (DL) path, RF input signals 120A through 120n are received at the DAU 105 from one or more base station units (BTS) indicated at 110A through 110p.").

240. This is an example of *wherein a single DAU port is connected to one or more BTSs*. Thus, Stapleton anticipates this claim.

B. Ground 2: Stapleton alone or in combination with Kummetz-464 renders all claims (1-19) obvious

1. Independent Claims 1 and 10

241. If Patent Owner argues that Stapleton does not anticipate the independent claims (claims 1 and 10), alternatively, Stapleton renders these claims obvious in view of (a) Stapleton alone or (b) Stapleton in combination with Kummetz-464. To be clear, my lead opinion is that Stapleton anticipates the independent claims (claim 1 and 10).

a. Element 1B/10B

"…configured as an uplink/downlink port"

242. Element 1B recites "one or more Digital Access Units (DAUs) operable to receive at least one signal from at least one of a first signal source and a second signal source from one or more of a plurality of signal sources, each DAU

of the one of more DAUs including an input port configured as an uplink/downlink port and an output port configured as an uplink/downlink port."

243. My lead opinion is that Stapleton discloses Element 1B/10B. Stapleton teaches that the DAU receives input from multiple cable connections (the DAU-to-DAU connection, DAU-to-BTS-connections, etc.) and outputs over multiple cable connections (e.g., the multiple DAU-to-DRU connections). As explained above, a POSA understands that the DAU necessarily has a port corresponding to each of these connections; otherwise, each cable could not connect to the DAU. Further, as explained above, a POSA would understand that each of these cables are bidirectional (i.e., carry uplink and downlink signals), which means the corresponding port is also bidirectional (i.e., configured to carry uplink and downlink signals); otherwise, the cable would not function with the port.

244. If Patent Owner contends that the disclosure in Stapleton fails to anticipate, then, at a minimum, Stapleton itself renders obvious to configure each port of the DAU as an uplink/downlink port.

Obvious in view of Stapleton alone

245. Stapleton itself renders obvious to configure each port of the DAU as an uplink/downlink port, including the recited uplink and downlink ports for multiple reasons.

246. *First*, this is an instance where there are only a finite number of well-known predictable options. Specifically, there are only two main options for a port in a DAS: (1) a simplex port or (2) a duplex port. A duplex port is bidirectional (both downlink and uplink). A simplex port is unidirectional (either uplink or downlink). Both of these options are well-known and taught in textbooks for cabling professionals. EX1023, 4. Further, both are available off-the-shelf. The selection of one of two well-known choices is a strong example of obviousness.

247. *Second*, there is nothing unpredictable about selecting a duplex port over a uni-directional port and there are well-known motivations to select a duplex port (i.e., configure a port as an uplink/downlink port). (1) Selecting a duplex port *halves* the number of ports, which provides the benefit of a more compact design that saves space. (2) Likewise, selecting a duplex port can cut in half the number and length of cables needed, which provides the benefit of reduced cost and easier installation. Consider: A DAU with a duplex port can connect to the BTS with one bidirectional cable. But a DAU with simplex ports needs two ports and two cables to connect to the same BTS—one for the downlink connection and one for the uplink connection). (3) Selecting a bidirectional port also provides the ability to use a single already-existing cable in an existing installation without the expense associated with installing additional cabling (which can potentially require temporarily destroying and then repairing walls/floors/streets to gain necessary

access). (4) Relatedly, selecting a duplex port makes installation easier because the installer only needs to run and connect half the number of cables. Relatedly, it would make installation easier to use the same type of port for all the connections (e.g., a bidirectional port for the BTS-DAU input port and a bidirectional port for the DAU-DRU output port) because the installer would not need to change techniques for different connections.

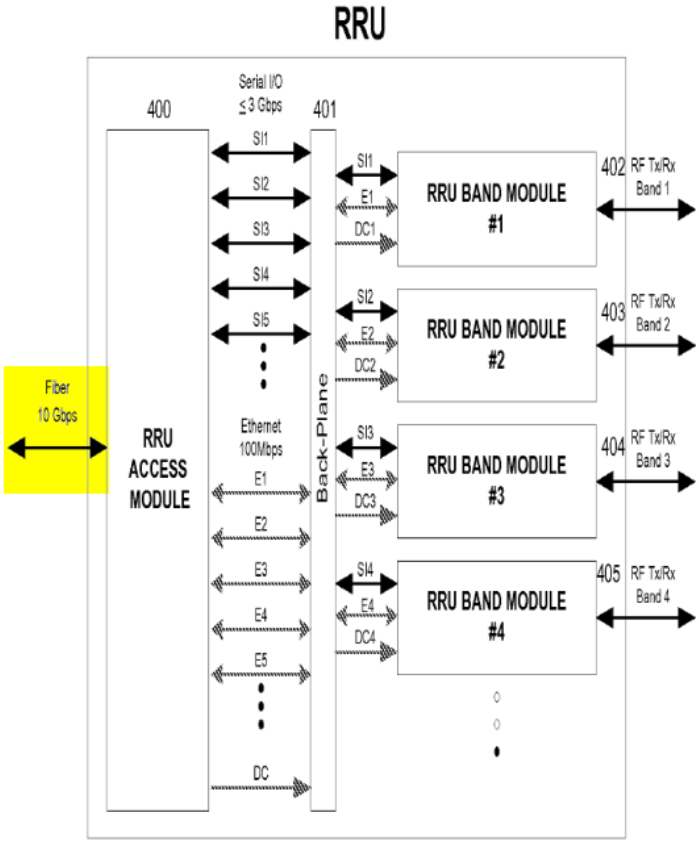
248. *Third*, configuring each port of the DAU as a bidirectional uplink/downlink port (i.e., a duplex port) is a predicable variation of Stapleton. Stapleton already teaches to use bidirectional cables. EX1006, ¶0013, ¶¶0033-0034, ¶0039. Furthermore, Stapleton already teaches it system operates in both the downlink (see Figure 1) and uplink (see Figure 2) directions; thus, there is a need to serve both directions. EX1006, ¶¶0020-0021, ¶¶0029-0031.

249. *Finally*, it would be obvious for the BTS-DAU input port to be a bidirectional port configured as an uplink/downlink port for several additional reasons.

250. (1) Stapleton already teaches that the other connections in the system are bidirectional (DAU-DAU and DAU-DRU). *See* Ground 1. Thus, configuring the input port for the BTS-DAU connection as a bidirectional port (uplink/downlink port) only calls for extending Stapleton's existing disclosure from its other connections (DAU-DAU and DAU-DRU) to this connection (BTS-

DAU). Further, it would make installation easier to use the same type of port for all the connections (e.g., a bidirectional port for the BTS-DAU input port and a bidirectional port for the DAU-DRU output port) because the installer would not need to change techniques for different connections, which provides an additional motivation for configuring the BTS-DAU input port as an uplink/downlink port in addition to the motivations already discussed.

251. (2) The incorporated provisional application of EX1021 (U.S. Provisional Application Ser. No. 61/374593, entitled "Neutral Host Architecture for a Distributed Antenna System" filed Aug. 17, 2010) teaches that the connection with the BTS can be a bidirectional fiber. EX1006, ¶0032 (incorporated). Figure 4 of EX1021 teaches that the access module (400) can communicate with a BTS. EX1021, ¶0021 ('593 provisional application). Figure 4 shows that communication as a bidirectional fiber link:



EX1021, Fig. 4.

252. (3) A POSA would have been motivated to configure the input port corresponding to the BTS-DAU connection as an uplink/downlink port to enable the DAU to communicate with the newer class of base stations (digital CPRI base station). Background references teach that there is a newer class of base stations with digital inputs/outputs that operate according to industry standards such as CPRI. E.g., EX1018 (Sabat), ¶0014 ("There is now a new class of base stations with digital input and outputs …. Detailed specifications of two digital base station interfaces are the Common Public Radio Interface (CPRI)"). The '593 provisional

application (EX1021) incorporated by Stapleton (EX1006) also acknowledges there are BTS that use CPRI. EX1021 at ¶0002 ("The BTS communicates with multiple Remote Radio Heads via optical fiber. …. the Common Public Radio Interface (CPRI … introduced publicly-defined interfaces separating the Base Transceiver Station (BTS) or Digital Access Unit and the remote radio head unit (RRU) parts of a base station by employing optical fiber transport."). There are many benefits for a DAS that communicates with a digital base station (as opposed to analog base stations): improved resistance to noise/errors, increased range, and the ability to remove costly analog-to-digital converter component at the DAU because the signal is already digital. Stapleton would enjoy these benefits if it communicated digitally with digital base stations. For example, Stapleton could remove its current processing whereby the DAU needs to digitize the analog input signal from the base station (which involves the costly analog-to-digital converter component) because the signal would already be digital. EX1006, ¶0029 (discussing the fact that the current DAU in Stapleton must digitize the signal from the base station: "The RF input signals are separately down-converted, digitized, and converted to baseband (using a Digital Down-Converter) by the DAU."). Further, Stapleton would enjoy greater flexibility for where to locate the DAU and its DAS because the digital signal from a digital base station can travel farther without corruption compared to analog signals. CPRI provides the additional

specific benefit of interoperability with digital base stations from different manufacturers because CPRI is an industry standard (not a proprietary connection to a digital base station).

253. This background gets to the critical point: by definition, Stapleton must use a port with a bidirectional interface to connect to a digital CPRI base station. To communicate with digital base stations using CPRI, you must use a CPRI link, which the CPRI standard illustrated below:

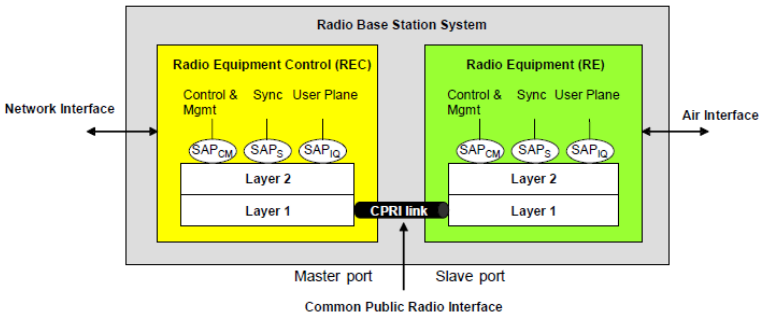


Figure 2: Basic System Architecture and Common Public Radio Interface Definition

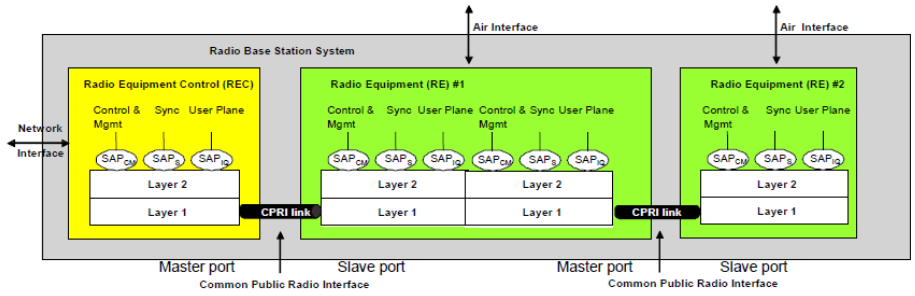


Figure 2A: System Architecture with a link between REs

EX1009 at 8, 10. By definition, these links are "bidirectional"

Link:

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

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

EX1009 at 7. Thus, a POSA would have been motivated to configure the input port corresponding to the BTS-DAU connection as an uplink/downlink port to enable the DAU to communicate with the new class of base stations (digital CPRI base station). This is a predictable variation of Stapleton because (a) Stapleton already teaches to use CPRI (EX1006, ¶0048) and (b) Stapleton's incorporated '593 provisional application (EX1021) further already teaches the possibility of connecting to a CPRI base station (EX1021, ¶0002). Further, a POSA would have a reasonable expectation of success. (1) A POSA would already have access to the CPRI standard (because it was public) and its teaching for how to connect to CPRI base stations and the role of the ports and bidirectional interface. (2) A POSA would already have access to background references that explained how to connect a DAS to a digital base station. *E.g.*, EX1018 (Sabat), ¶0030 ("FIG. 3 is a preferred embodiment of the invention illustrating a simple top level diagram of a digital host base station 102 in conjunction with a Distributed Antenna System (DAS) network…").

Obvious in view of Stapleton in combination with Kummetz-464

254. Ground 3 (e.g., under element 1B) explains that Kummetz-464's ports are bidirectional, i.e., configured as uplink/downlink ports as recited in the claim.

255. A POSA would have been motivated to combine Stapleton and Kummetz-464 to configure each port of Stapleton's DAU as an uplink/downlink port, including the recited uplink and downlink port, as taught by Kummetz-464 for multiple reasons.

256. *First*, the same motivations and rationale discussed for obviousness in view of Stapleton itself apply to this combination.

257. *Second*, with specific regard to the input port for the BTS-DAU connection in Stapleton, Kummetz-464 teaches to use a bidirectional connection for the connection to the BTS. See Ground 3, element 1B. Figures 1 and 2 of Kummetz-464, for example, shows this:

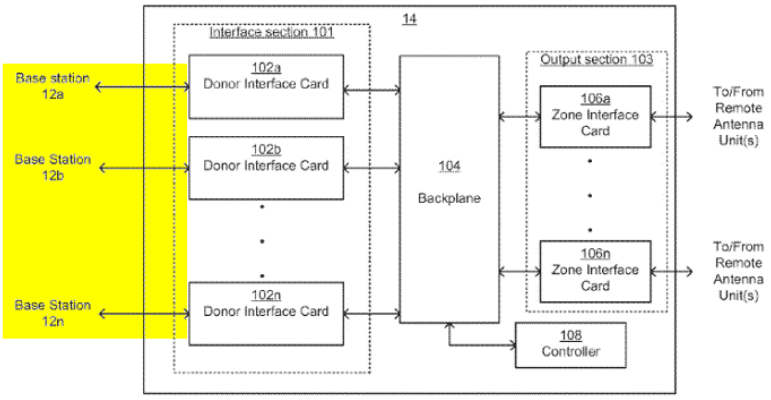


FIG. 2

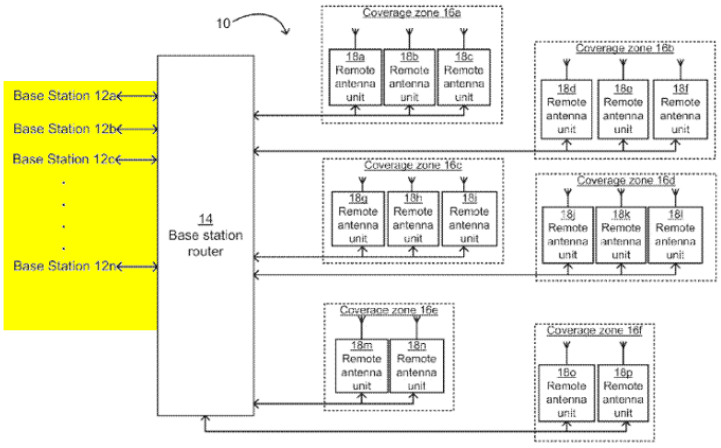


FIG. 1

See also Ground 3, element 1B. In addition, Kummetz-464 further supports the motivation to include a bidirectional port to connect to a digital base station using CPRI. Kummetz-464 specifically suggests the options of connecting to a digital base station using CPRI. EX1005 at 7:50-65 ("In other aspects, transforming the signals can include converting digital signals in different st*andardized formats, such as CPRI or ORI data packets, from different base stations*…").

258. *Third*, a POSA reading Stapleton would naturally look to Kummetz-464. Kummetz-464 and Stapleton disclose similar systems. (1) They both disclose distributed antenna systems. *Compare* EX1006, ¶0028 ("The present invention is a novel Reconfigurable *Distributed Antenna System*…") *with* EX1005 at 2:40-53 ("Certain aspects and examples are directed to a base station router, such as a base station sector router, that can be disposed in a *distributed antenna system ("DAS")*…"). (2) They both address the similar goal of adjusting or redistributing

the capacity throughout the coverage zones of the DAS as needed. *Compare* EX1006, ¶0035 ("Typically, the capacity of DRU 125n is set to a much lower value than DRU 125A, however, the relative capacity settings of each of DRU's 125A-n can be *adjusted dynamically to meet the capacity needs within the coverage zones* determined by the physical positions of antennas connected to those DRU's), ¶0054 ("One such key function is determining and/or setting the appropriate amount of radio resources (such as RF carriers, CDMA codes or TDMA time slots) assigned to a particular DRU or group of DRUs *to meet desired capacity and throughput objective*") *with* EX1005 at 2:40-53 ("Certain aspects and examples are directed to a base station router, such as a base station sector router, that can be disposed in a distributed antenna system ("DAS") and that can *redistribute capacity among coverage zones serviced by the DAS. …. Redistributing capacity* can include modifying the distribution of sectors to coverage zones of the DAS."). (3) They both address the same problem of users gathering in one place (e.g., a cafeteria or stadium). *Compare* EX1006, ¶0033 ("A possible application for DRU125A is a cafeteria in an enterprise building during the lunch hour where a large number of wireless subscribers are gathered."), ¶0004 ("network subscribers in specific locations") *with* EX1005 at 11:17-21 ("For example, if the DAS 10 services a stadium and the surrounding parking lot, more

wireless devices will be concentrated inside the stadium than in the parking lot after an event begins.")

b. Element 1G/10G

"…allocating at least one DRU from the first radio resource to the second radio resource"

259. Element 1G/10G recites: "wherein the traffic monitoring unit is configured to: … reconfigure the plurality of radio resources based on one or more of the one or more KPIs and/or the QoS by allocating at least one DRU from the first radio resource to the second radio resource."

260. My lead opinion is that Stapleton discloses Element 1G/10G. Stapleton, for example, teaches to reconfigure the radio resources based on the load (e.g., a *KPI*) exceeding a threshold (e.g., a *QoS*) by allocating a "particular DRU" (the *at least one DRU*) an additional radio resources (the *second radio resource*) and removing certain radio resources at the same time. EX1006, ¶0058.

261. If the proper construction of *"allocating at least one DRU from the first radio resource to the second radio resource"* requires removing the *first radio resource*, Ground 1 explains that Stapleton has disclosure for this as well. Paragraph 58 of Stapleton teaches that, at the same time the additional radio resource is added, radio resources are removed.

262. If Patent Owner contends this is not sufficiently expressed so as to anticipate, at a minimum, Stapleton itself renders this obvious.

Obvious in view of Stapleton alone

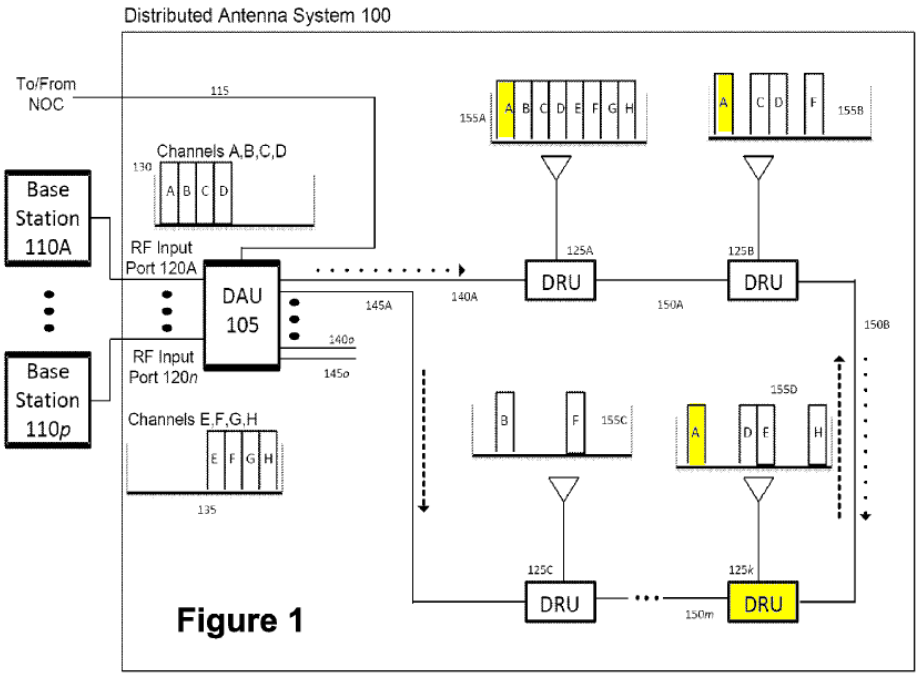
263. A POSA would find it obvious that the "particular DRU" from which certain radio resource are removed (as already taught by Stapleton itself) and the DRU to which the additional radio resources are added (as already taught by Stapleton itself) can apply to the same DRU, which is an example of *allocating at least one DRU from the first radio resource to the second radio resource*.

264. *First*, combining the actions of removing/adding is a predicable example of Stapleton's teachings. Stapleton does not restrict the actions of deploying additional radio resources vs. removing other certain radio resources to different DRUs. Further, Stapleton teaches to perform "load balancing," which involves both adding and removing radio resources. EX1006, ¶0009.

265. *Second,* there is a motivation to combine the actions of adding radio resources and removing other different radio resources, specifically, *to improve the load balancing across the multiple DRUs*. There are a finite number of radio resources. Figure 1, for example, shows eight radio resources (A…H). *See* EX1006 at Fig. 1. Replacing a high load radio resource with a lower load radio resource at a DRU both adds less burdened capacity at that DRU while at the same time decreasing the load on the burdened radio resource that is often still in use at

other DRUs. This would have motivated a POSA to perform the addition and removal of a radio resource at the same DRU.

266. Here is an example. Stapleton teaches that multiple DRUs may use the same radio resource. Figure 1, for example, shows three DRUs using carrier "A"



267. Consider the same example discussed for claim 1: the DAU deploys an additional radio resource (e.g., C) to DRU 125k because "A" is overloaded. If A is *not* removed at the same time from DRU 125k, A would remain highly loaded because it is still being used by three DRUs. In contrast, it improves the load balancing to remove A from the DRU 125k at the same time C is added. This

reduces the overall load on A for the other two DRUs (125A/125B) because there are only two, not three, DRUs consuming this radio resource.

268. Here is a more detailed example to illustrate this. Consider a DAU connected to two DRUs (#1 and #2) where both DRUs start with the same radio resource (carrier A) that has 8 time slots. Now consider that each DRUs needs to serve four users, i.e., each DRU needs four time slots to carry the user's communications. The load percentage on carrier A is 100% because the two DRUs together consume all 8 of 8 time slots. If the desired threshold is 60%, the DAU will determine that A is overloaded and deploy an additional radio resource (e.g., carrier B) to a particular DRU (e.g., DRU#1). The DAU should at the same time remove the overloaded radio resource A from DRU#1 – this balances the load across DRU #1 and #2. Now, the load on both DRUs and radio resources will be only 50%, specifically, (1) DRU#1 uses 4 of 8 time slots of Carrier B (50%) and (2) DRU#2 uses 4 of 8 time slots of Carrier A (50%). Thus, performing the action of deploying the additional radio resource to the DRU and removing the overloaded radio resource from that same DRU improved the overall load balancing and meets the goal of the load percentage on both carriers being less than the threshold (60%). This is why Stapleton teaches that at "the same time" the DAU deploys the additional radio resource it can remove the old radio resource. EX1006, ¶0058.

269. These motivations are consistent with Stapleton's disclosure. Stapleton teaches that it is advantageous to provide a "a high degree of flexibility" to facilitate "radio resource efficiency." EX1006, ¶0004 ("Therefore, it would be *advantageous* for wireless network operators to employ a DAS solution which has a *high degree of flexibility* to implement dynamic rearrangements based on ever-changing network conditions and subscriber needs."), ¶0010 ("Thus, the configuration of the advanced system architecture of the present invention provides a *high degree of flexibility* to manage, control, enhance and *facilitate the radio resource efficiency*, usage, availability, and overall performance of the distributed wireless network."). Further, one of the goals of Stapleton's disclosure is to enable load balancing. EX1006, ¶0010 ("The present invention enables specialized applications and enhancements including Flexible Simulcast, automatic traffic *load-balancing*…").

270. *Third*, a POSA would have a reasonable expectation of success. Stapleton already teaches all the components necessary to combine adding/removing radio resources at the same particular DRU. Stapleton teaches that the individual DRUs have embedded frequency selective digital up and down converters (DUCs/DDCs) "for each carrier" (i.e., each radio resource). Stapleton 34, Fig. 4. Stapleton already teaches that these DUCs/DDCs can enable or disable the specific radio resource. EX1006, ¶0056 ("In turn, the DRU Management

Control module 725 within the DRU Embedded Software Control Module sets the individual parameters of all the DRU Digital Up-Converters 730 to enable or disable specific radio resources from being transmitted by a particular DRU or group of DRUs.") Stapleton already teaches that the DAU and NOC can control these DUCs/DDCs by issuing commands. EX1006, ¶0034 ("The DAU's can remotely turn on and off the individual carriers via the gain control parameters."), *see also* EX1006, ¶0054, ¶0036, ¶0037. Thus, a POSA would only need to use the already-disclosed structure for this obvious approach. Performing the actions of adding a new radio resource and removing an old radio at the same DRU is trivial. This merely requires sending one additional command to disable an old radio resource in addition to the command to enable the additional radio resources.

Obvious in view of Stapleton combined with Kummetz-464.

271. Ground 3 (e.g., under element 1G), below, explains that Kummetz-464 teaches to shift DRUs from one radio resource to another when needed by removing the first radio resource and adding the second radio resource. In other words, when capacity must be redistributed at a particular DRU in a coverage zone, Kummetz-464 teaches to both remove the old (*first*) radio resource and shift to a new (*second*) radio resource at that particular DRU.

272. A POSA would have found it obvious to combine Stapleton with the teaching of Kummetz-464 for multiple reasons. In other words, in view of

Kummetz-464, a POSA would have found it obvious that the "particular DRU" for which certain radio resource are removed (as already taught by Stapleton itself) and the "particular DRU" for the additional radio resources are added (as already taught by Stapleton itself) can apply to the same DRU.

273. *First*, the same motivations and rationale discussed for obviousness in view of Stapleton itself apply to the combination of Stapleton with Kummetz-464.

274. *Second*, a POSA reading Stapleton would naturally look to Kummetz-464. Kummetz-464 and Stapleton disclose similar systems. (1) They both disclose distributed antenna systems. *Compare* EX1006, ¶0028 ("The present invention is a novel Reconfigurable *Distributed Antenna System*…") *with* EX1005 at 2:40-53 ("Certain aspects and examples are directed to a base station router, such as a base station sector router, that can be disposed in a *distributed antenna system ("DAS")*…"). (2) They both address the similar goal of adjusting or redistributing the capacity throughout the coverage zones of the DAS as needed. *Compare* EX1006, ¶0035 ("Typically, the capacity of DRU 125n is set to a much lower value than DRU 125A, however, the relative capacity settings of each of DRU's 125A-n can be *adjusted dynamically to meet the capacity needs within the coverage zones* determined by the physical positions of antennas connected to those DRU's), ¶0054 ("One such key function is determining and/or setting the appropriate amount of radio resources (such as RF carriers, CDMA codes or

TDMA time slots) assigned to a particular DRU or group of DRUs *to meet desired capacity and throughput objective*") *with* Kummetz-464. EX1005 at 2:40-53 ("Certain aspects and examples are directed to a base station router, such as a base station sector router, that can be disposed in a distributed antenna system ("DAS") and that can *redistribute capacity among coverage zones serviced by the DAS*. …. *Redistributing capacity* can include modifying the distribution of sectors to coverage zones of the DAS."). (3) They both address the same problem of users gathering in one place (e.g., a cafeteria or stadium). *Compare* EX1006, ¶0033 ("A possible application for DRU125A is a cafeteria in an enterprise building during the lunch hour where a large number of wireless subscribers are gathered."), ¶0004 ("network subscribers in specific locations") *with* Kummetz-464. EX1005 at 11:17-21 ("For example, if the DAS 10 services a stadium and the surrounding parking lot, more wireless devices will be concentrated inside the stadium than in the parking lot after an event begins.")

275. Thus, the combination only calls for using a known technique (reallocating radio resources) to improve similar devices (another DAS) in the same way (by shifting the radio resources where the users gather).

2. Dependent Claim 3

276. Dependent claim 3 recites: "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." Stapleton renders this claim obvious in view of (a) itself or (b) in combination with Kummetz-464.

277. It should be noted that '382 patent defines "optimization" to include performance improvements, even if complete optimization is not achieved.

> Although embodiments are discussed in terms of optimization of DAS networks, the term optimization is properly understood to include performance improvements in comparison to conventional systems, even if complete optimization is not achieved. Thus, optimization does not require the maximum values for traffic management metrics, but also includes distribution of traffic that improves system performance while remaining short of maximum performance.

EX1001, 6:7-15.

278. The '382 patent teaches that the network optimization unit 120 can implement a network optimization goal (*e.g.*, number of users per sector) based on traffic information in the form of key performance indicators (KPIs):

> KPI may comprise information such as: number of blocked calls, number of active calls, average power of uplink channels, average power of downlink channels, traffic on each sector, failed calls, number of satisfied users, number of unsatisfied users, number of users operating through a given DRU, and the like.

EX1001, 10:38-45;

> The network optimization unit can implement a network optimization goal, which may relate to the number of users per sector, for example, that each sector carry a percentage of traffic less than 50% of the total traffic… that each sector

> have less than 50% of the users…, or the like. Thus, the optimization goals can include metrics of the system performance. Although the system may not reach the goals, progress toward the goals can be provided, improving the user experience.

EX1001, 7:51-61;

> As an example of optimizing network performance, a base station typically has three sectors. The DRU can be allocated to different sectors in order to improve performance by shifting traffic from a first sector (e.g., a high traffic sector) to a second sector (e.g., a low traffic sector) by shifting a DRU allocated to the first sector to the second sector. … the system performance can be improved using the techniques described herein, for example, by measuring the traffic load on the DRUs, performing load balancing of the traffic on the DRUs, to reduce the load on a first DRU characterized by a first traffic load by shifting the load to a second DRU characterized by a second traffic load less than the first traffic load. In the optimization process, system performance can be measured against a predetermined threshold, with the optimization process terminating once the predetermined threshold has been reached.

EX-1001, 11:6-23;

> FIG. 10 illustrates one embodiment of the DAS network calculation of the KPIs and QoS. The important parameters for determining the DAS network QoS include the number of users allocated to a given DRU, the spatial distance between the various DRUs, as well as identifying which DRUs are assigned to which BTS sector.

EX-1001, 11:33-38;

> FIG. 11 illustrates one embodiment of the flow chart for the optimization algorithm. In this embodiment an Estimation Distribution Algorithm (EDA) is used. Various DRU

> allocation scenarios are investigated to determine the optimum DRU scenario that achieves the highest QoS..

EX1001, 11:39-43;

> Network Optimization
>
> The network's performance (expressed by the number of KPIs from different parts of the network) determines the QoS values. Different operators may have different defined business goals and different services of interest. Based on these considerations, efficient and cost effective network performance management varies from operator to operator. Therefore, QoS metrics could be defined and mapped to a set of KPIs. When a set of KPIs is used, then the mapping needs to be represented by a weighted normalized function.

EX-1001, 11:54-63.

Obvious in view of Stapleton itself.

279. As discussed in Ground 1, Stapleton already discloses the recited *"network optimization goal."* Stapleton's goal is to have the particular downlink carrier loaded by a percentage less than the threshold; otherwise, Stapleton determines it needs to deploy additional radio resources. Further, as discussed in Ground 1, Stapleton expressly teaches the goal comprises a "*percentage*." If Stapleton teaching is not sufficiently express that the percentage is the percentage of "users associated with each of the plurality of radio resources," a POSA would find this obvious in view of Stapleton's disclosure. In other words, a POSA would have found it obvious that Stapleton's already-disclosed network optimization process could calculate the load percentage as a percentage of users

associated with each radio resource and compare that load percentage to a threshold.

280. *First*, this is a predicable variation of Stapleton's disclosure. The number of users associated with each radio resource describes the load on the radio resources. Stapleton's disclosure already covers "load." EX-1006 ¶0058 ("a particular downlink carrier is loaded by a percentage greater than a predetermined threshold"). Further, Stapleton already expressly teaches to consider the "number of wireless subscribers" (i.e., *users*) when allocating radio resources. Stapleton, for example, teaches to allocate additional radio resources to DRU125A in Figure 1 because that is where there are "a large number of wireless subscribers." EX1006, ¶0033 ("A possible application for DRU125A is a cafeteria in an enterprise building during the lunch hour where a large number of wireless subscribers are gathered."). Stapleton already expressly teaches to perform the reconfiguration based on "subscriber needs" (the subscriber are the *users* as recited in the claim). EX1006, ¶0004 ("Therefore, it would be advantageous for wireless network operators to employ a DAS solution which has a high degree of flexibility to implement dynamic rearrangements based on ever-changing network conditions and subscriber needs.") Further, Stapleton discloses a way to determine the number of users occupying each radio resource by detecting how many timeslots are active. EX1006, ¶0058

281. Said another way, a POSA would find this claim particularly obvious because Stapleton's existing technique already reflects the percentage *of users* associated with each of the plurality of radio resources. Recall that Stapleton teaches to detect the number of active time slots on a carrier. EX1006, ¶0010. The number active time slots for a carrier (*radio resources*) reflects the number of users associated with the carrier (*radio resources*) because in well-known wireless standards (e.g., GSM) each active time slot represent is voice conversation for a user.

282. *Second*, there were multiple motivations to implement Stapleton's optimization process so that it accounts for the number of users associated with each radio resource.

283. *As a first motivation*, a POSA would have been motivated to implement Stapleton's optimization process so that it accounts for the number of users associated with each radio resource to improve Stapleton's ability to *meet the needs of network subscribers when they gather in specific locations.* Stapleton itself already recognizes that distributed antenna systems need to provide sufficient capacity (*radio resources*) to meet the needs of subscribers (i.e., *users*) when they gather in specific locations (e.g., a cafeteria at lunch time). EX1006, ¶0004 ("In order to provide DAS network capacity which is high enough to meet short-term needs of network subscribers in specific locations"), ¶0033 ("A possible

application for DRU125A is a cafeteria in an enterprise building during the lunch hour where a large number of wireless subscribers are gathered.”). Implementing Stapleton’s optimization process so that it accounts for the number of users associated with each radio resource directly addresses this issue of subscribers (i.e., *users*) when they gather in specific locations. Here is an example. Consider the yellow DRU below:

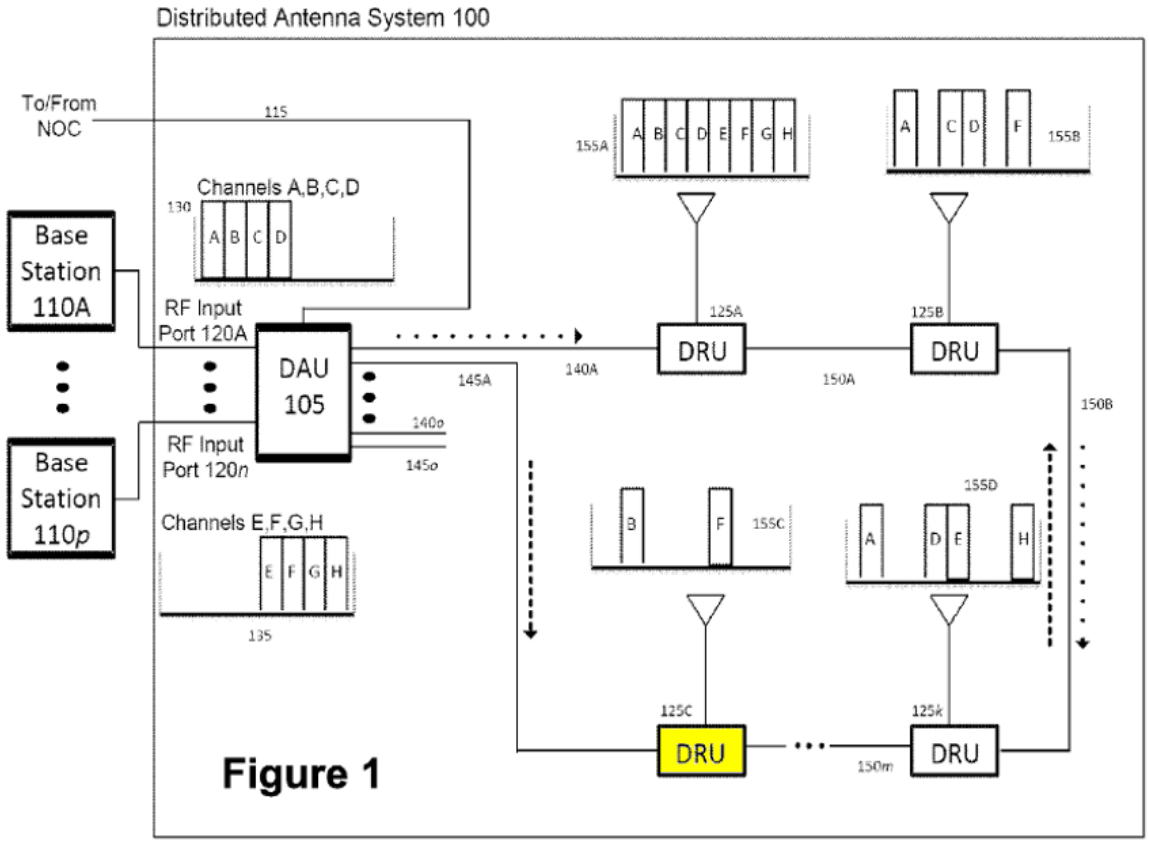


Figure 1

Suppose the yellow DRU is in the cafeteria. Now consider Stapleton’s already-disclosed context of subscribers (*users*) gathering in the cafeteria during lunchtime

(e.g., 90 of 100 total users). At that time, the percentage of the total users (100) users associated with radio resources B and F is too high. Thus, implementing Stapleton's optimization process so that it accounts for the number of users when provisioning resources to DRUs directly addresses this issue of subscribers (i.e., *users*) gathering in specific locations. For the same reason, it also improves Stapleton' stated goal of "radio resource optimization" (¶0010).

284. *As a second motivation*, a POSA would have been motivated to implement Stapleton's optimization process so that it accounts for the number of users associated with each radio resource to *reduce the number of blocked/dropped calls and ensure balance coverage throughout the DAS*.

285. *Third*, a POSA would have a reasonable expectation of success in implementing Stapleton's network optimization process to compare the percentage of users associated with each radio resources to a threshold. Calculating a percentage of users is a basic division operation (number of users on this radio resources / total users). Further, the provisional '836 application incorporated in Stapleton already teaches a feature to determine the number of users ("track the radio signatures of all the active users within its network and record a running data base"). EX1017, ¶0019. The logic to assess whether the percentage of users is meeting the goal is a simple IF/THEN logical operation (e.g., IF percentage of users for a radio resource > the threshold percentage, THEN deploy additional

radio resources). Further, Stapleton also teaches that the DAU's software is in communication with the NOC, which could alternatively provide information about which users are associated with which radio resources. EX1006, ¶0058 ("threshold whose value is communicated to the DAU Management Control module by the DAU's Remote Monitoring and Control function *715*"), ¶0054 ("The DAU Management Control Module 705 communicates with the *NOC 715*").

Obvious in view of Stapleton combined with Kummetz-464

286. As discussed in Ground 1, Stapleton already discloses the recited "network optimization goal." Stapleton's goal is to have the particular downlink carrier loaded by a percentage less than the threshold; otherwise, Stapleton determines it needs to deploy additional radio resources. Further, as discussed in Ground 1, Stapleton expressly teaches the goal comprises a "percentage." If Stapleton's teaching does not sufficiently express that the percentage is the percentage of "users associated with each of the plurality of radio resources," a POSA would find this obvious in view of Kummetz-464's disclosure.

287. Kummetz-464 teaches a distributed antenna system can redistribute capacity (e.g., radio resources such as carriers) based in part on detecting traffic indicators such as the number of mobile devices in a coverage zone. EX1005, 9:40-47:

> The configuration engine 210 can include a configuration management function for determining how to redistribute signal capacity among coverage zones. The configuration engine 210 can execute the configuration management function in response to the detection of a traffic indicator. A traffic indicator can include data describing or otherwise corresponding to a number of mobile devices in each coverage zone.

See also EX1005, 11:13-15:

> The base station router 14 can be re-configured via the controller 108 in response to changes concentration of wireless devices in the respective coverage zones. FIG. 5 depicts the base station router 14 providing sectors 302 a-c to the coverage zones 16 a-f according to a subsequent configuration of the base station router 14. For example, if the DAS 10 services a stadium and the surrounding parking lot, more wireless devices will be concentrated inside the stadium than in the parking lot after an event begins. The base station router 14 can be reconfigured such that the sector 302 a is provided to the coverage zone 16 a, the sector 302 b is provided to the coverage zones 16 b, 16 c, and the sector 302 a is provided to the coverage zones 16 d-f. The configuration of base station router 14 depicted in FIG. 5 thus increases the capacity density of the coverage zones 16 a-d as compared to the configuration of the base station router 14 depicted in FIG. 3.

288. The location of mobile devices in Kummetz-464 is the location of *users*. This is evident from the way Kummetz-464 determines the location of the mobile devices. The location of the mobile devices in Kummetz-464 is based on the mobile device's detected *use* of an allocated carrier or time slot. EX1005, 9:66-10:21:

In some aspects, a base station router **14** can determine a location of a specific wireless device within the environment in which the DAS **10** is deployed. The base station router **14** can communicate with one of the base stations **12** *a-n* to determine an identifier for the specific wireless device. For example, the configure engine **210** can configure the processor of the controller **108** to generate a request for such an identifier to be provided to a base station. An identifier for a wireless device can include any attributes of a communication link between a base station and a wireless device used to identify the wireless device. For example, the identifier can include the transmit and receive frequencies assigned to a wireless device *used* in frequency division multiple access schemes, a communication time slot assigned to the wireless device *used* in time division multiple access schemes, and/or a spreading code assigned to a wireless device in a code division multiple access scheme.
The base station router 14 can determine a channel over which the specific wireless device *is communicating*. The channel can include a connection, such as a transmit and receive frequency or a band of transmit and receive frequencies, over which a wireless device and a base station can communicate via the DAS.

EX1005, 12:40-55:

By communicating via the reference receiver input **602** with a detection device **604**, the base station router **14** can detect the geographic location of a particular wireless device in a coverage zone of the DAS **10**. The detection device **604** can determine the RSSI of an uplink signal from the wireless device at each remote antenna unit. The base station router **14** can communicate with the detection device **604** to identify which remote antenna unit receives the uplink signal at the strongest RSSI. The base station router **14** can determine that the remote antenna unit receiving the uplink signal at the strongest RSSI is the remote antenna unit associated with the wireless device. The processor **202** of

> the controller **108** base station router **14** can access a data file stored in the memory **204**. The data file can include data describing the geographical location of each remote antenna unit. The processor **202** can determine the geographical location of the wireless device from the data file based on the geographical location of the remote antenna unit that is associated with the wireless device.

289. A POSA would be motivated to calculate Stapleton's load percentage based on the number of users as taught by Kummetz-464 for multiple reasons. First, calculating the load percentage as a percentage of users can allow the system to predict where demand on radio resources are likely to increase. Where the number of users is high, demand is likely also to be high or at least is likely to become high in the near future. Determining where demand for resources is likely to increase provides an opportunity for the system to divert additional resources before the demand becomes problematically high. In other words, it allows the resources to be redistributed before the problems occur.

290. Second, redistributing capacity based on a percentage of users is a way to more equitably allocate resources to users. By taking into account the percentage of users, it drives the resource allocation algorithm toward an allocation that favors fairness among users, rather than give preference to a few users that may be consuming a large quantity of resources.

291. A POSA would have a reasonable expectation of success to calculate the load percentage taught by Stapleton as a percentage of users because it is a

simple mathematical calculation (a simple division operation relating users on a resource to the total number of users). This type of mathematical operation is easily performed by the processors present in Stapleton's system.

292. Therefore, a POSA would have found it obvious to calculate the load percentage for each radio resource as taught by Stapleton based on the number of users taught by Kummetz-464. Therefore, claim 3 is invalid as obvious.

3. Dependent Claim 17

293. Dependent claim 17 recites: "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." Stapleton further renders this claim obvious in view of (a) itself or (b) in combination with Kummetz-464.

Obviousness in view of Stapleton itself

294. Stapleton already teaches the DAU can be indirectly connected to the BTS via an optical fiber. If the claim is limited to direct connections (which it does not say), a POSA would have found this obvious. Figure 1 shows that DAU and BTS are directly connected by a cable (red):

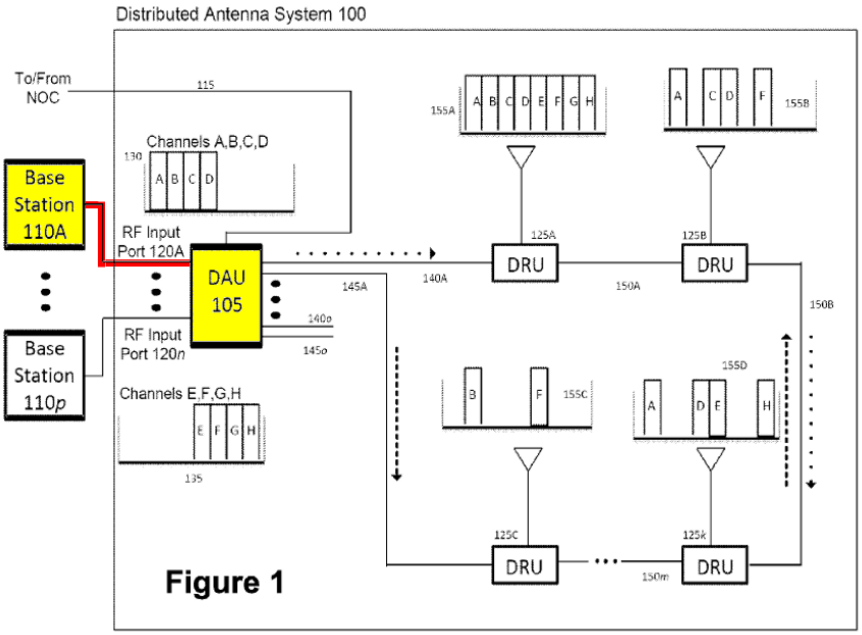


Figure 1

295. Although Stapleton does not expressly teach the type of cable for this direct connection, Stapleton teaches the type of cable can be an optical fiber for the DAU's other direct connections, i.e., the DAU-to-DRU direct connection. EX1006, ¶0029 ("DAU …. delivered to different DRU's…over optical fiber cable"), ¶0033 ("optical cable."), ¶0013 ("optical fibers"), Fig. 1. Thus, the subject matter of this claim only requires extending Stapleton's existing teaching from the DAU-DRU connection to the DAU-BTS connection, which is a predictable variation. Stapleton itself suggests this. Stapleton incorporates a provisional that teaches to use optical fiber for the cable connection to a base station. EX1021, ¶0002 ("BTS communicates…via optical fiber), ¶0016 ("communicate with the BTS using different optical wavelengths over one fiber").

296. Furthermore, the Incorporated '593 provisional application of (EX1021) in Stapleton expressly teaches to use *optical fiber* for the cable connection to a base station. EX1021, ¶0002 ("The *BTS* communicates with multiple Remote Radio Heads via *optical fiber*. For example, the Open Base Station Architecture Initiative (OBSAI), the Common Public Radio Interface (CPRI), and the IR Interface standards introduced publicly-defined interfaces separating the *Base Transceiver Station (BTS) or Digital Access Unit* and the remote radio head unit (RRU) parts of a base station by *employing optical fiber transport*."), ¶0016 ("In an embodiment, the two distinct bit streams *communicate with the BTS* using different *optical wavelengths over one fiber*, although multiple fibers can be used in alternative arrangements.").

297. A POSA would consider the subject matter of this claim obvious in view of Stapleton's disclosure in its specification and the incorporated '593 provisional patent application of EX1021. Specifically, a POSA would consider it an obvious variation of Stapleton's existing disclosure to implement the cable connection between the DAU and base station using *optical fiber*. This merely requires combining (a) Stapleton's existing disclosure that the DAU is connected to the base stations via a cable connection (b) Stapleton's disclosure in the incorporated '593 provisional application to use *optical fiber* for the cable connection to a base station.

298. *First*, this is an instance where there are only a finite number of predicable options for the cabled connection between the DAU and base stations. There are only a finite number of options for cabled connection in a DAS: optical fiber or one of coaxial, twisted pair, or ethernet cable.[3] The challenge '382 patent does not teach that there is anything unpredictable about selecting optical fiber. It is an off-the-shelf cable type. Optical fiber yields predictable results for the reasons discussed in the next paragraph and because it is merely an off-the-shelf standard component. Thus, optical fiber as is merely a predictable option selected from one of only a small number of options.

299. *Second*, the choice to use optical fiber is a highly predicable variation of Stapleton's existing disclosure. As already explained, (1) Stapleton already teaches to use optical fiber for other connections to the DAU and (2) Stapleton's incorporated '593 provisional application already teaches to use *optical fiber* for the cable connection to a base station.

300. Further, the choice to use optical fiber is consistent with Stapleton's existing disclosure. Stapleton teaches that its system "allows transport of more individual *operators' band segments over the optical fiber*." EX1006, ¶0036. The

[3] The other options listed in the claim are for non-cabled wireless connections (microwave line of sight link, wireless link, and/or satellite link). Figure 1 of Stapleton shows to use a cabled connection (i.e., a wired, not wireless connection).

operators' band segments come from the base stations. EX1006, ¶0053 ("The input frequency *bands* 605-630 (here denoted as six frequency bands at 700, 800, 850, 1900, 2100 and 2600 MHz) are *input into the DAU 600 from the BTS's (not shown)*."), ¶0032 ("a wireless operator may have more than one RF carrier per channel allocated to a single base station."). Thus, the transport path of the operators' band segments includes the cable connection from the base station to the DAU. In this way, the choice to use optical fiber follows Stapleton's existing disclosure to transport the operators' band segments over optical fiber.

301. *Third*, there were multiple well-known motivations to choose optical fiber for the connection between the DAU and the BTS. (1) Optical fiber enables higher data rates than the alternative coaxial cable. (2) Optical fiber decreases signal loss. (3) Optical fiber would also have the added benefit of simplifying the deployment by having only one cable type for both connections (BTS to DAU and DAU to DRU), which would allow reusing of cables for the different connections.

302. *Fourth*, a POSA would also have been motivated to choose optical fiber for the connection between the DAU and the BTS to gain the benefit (discussed above) of communicating the newer class of digital base stations (CPRI base stations). When the base station communicated with remote nodes (which applies to Stapleton because the DAU and DRU are remote from the base station), the CPRI standard defines that the interface for the CPRI link is *optical*:

The specification has the following scope (with reference to Figure 1):

1. A digitized and serial internal radio base station interface that establishes a connection between 'Radio Equipment Control' (REC) and 'Radio Equipment' (RE) enabling single-hop and multi-hop topologies is specified.[1]
2. Three different information flows (User Plane data, Control and Management Plane data, and Synchronization Plane data) are multiplexed over the interface.
3. The specification covers layers 1 and 2.
   - 3a. The physical layer (layer 1) supports both an electrical interface (e.g., what is used in traditional radio base stations), and an optical interface (e.g. for radio base stations with remote radio equipment).
   - 3b. Layer 2 supports flexibility and scalability.

EX1009 at 4-5, 27. CPRI then explains the optical interface comprises optical cabling and optical connections:

4.2.4. Optical Interface

4.2.4.1. Optical Cabling

The cable performance shall be such that transmitter and receiver performance requirements in section 3 are fulfilled. The fiber cables recommended for CPRI are:

- IEC 60793-2:2002.Type A1a (50/125 µm multimode) [4]
- IEC 60793-2:2002.Type A1b (62.5/125 µm multimode) [4]
- IEC 60793-2 :2002.Type B1 (10/125 µm single-mode) [5]

The exception characteristic as specified in IEEE 802.3-2005 [1] Table 38-12 and IEEE 802.3-2005 [1] Table 53-14 may be taken into account.

4.2.4.2. Optical Connectors

CPRI optical implementation may use connector solutions that are described and defined in ISO/IEC 14165-115 [3] (Fiber channel FC-PI) or IEEE 802.3-2005 [1].

These solutions are known to achieve the performance requirements in section 3. A high flexibility in the choice of connector and transceiver can be achieved by adopting the SFP building practice.

EX1009 at 29. Thus, a POSA would find it predictable that the DAU's input port to the BTS could be configured to connect to bidirectional optical cables as suggested by CPRI, i.e., the input port could be configured as an uplink/downlink port for an optical cable. This is predictable variation of Stapleton because (a) Stapleton already teaches to use CPRI (EX1006, ¶0048) and (b) Stapleton's incorporated '593 provisional application further already teaches connecting to a CPRI base station (EX1021, ¶0002). Further, a POSA would have a reasonable

expectation of success. (1) Optical fiber was commercially available, and optical fiber is not unpredictable rather it performs the well-defined function of transporting signals from one end to the other. (2) A POSA would already have access to the CPRI standard (because it was public) and its teaching for how to connect to CPRI base stations and the role of the optical connection. (3) A POSA would already have access to background references that explained how to connect a DAS to a digital base station. *E.g.*, EX1018 (Sabat), ¶0030 ("FIG. 3 is a preferred embodiment of the invention illustrating a simple top level diagram of a digital host base station 102 in conjunction with a Distributed Antenna System (DAS) network…").

303. *Fifth*, a POSA would have a reasonable expectation of success. Stapleton already teaches how to use optical fiber. E.g., EX1006, ¶0029 ("… translated to optical signals using pluggable SFP modules, again by the DAU 105. The independently serialized, parallel data streams are then delivered to different DRU's 125A-125k, typically over optical fiber cable ….). See also EX1017 at ¶0031. Further, Stapleton's incorporated '593 provisional application establishes that optical fiber can be used for the connection to a base station, and in fact, is used in multiple industry standards (e.g., CPRI and OBSAI). EX1021 at ¶0002 (The *BTS* communicates with multiple Remote Radio Heads via *optical fiber*. For example, the Open Base Station Architecture Initiative (OBSAI), the Common

Public Radio Interface (CPRI), and the IR Interface standards introduced publicly-defined interfaces separating the *Base Transceiver Station (BTS) or Digital Access Unit* and the remote radio head unit (RRU) parts of a base station by *employing optical fiber transport*.").

304. *Finally*, the '382 patent does not indicate there is anything inventive about using an optical fiber for the connection to the base station.

Obviousness of Stapleton combined with Kummetz-464

305. Ground 3 explains that Kummetz-464 has two relevant teachings for this claim.

306. *First*, Kummetz-464 teaches that its DAU (the router) can receive CPRI signals from the BTS, which means the DAU can connect to a BTS over a CPRI link. See Ground 3. The CPRI standard, as explained above, teaches to use optical cables when the BTS connects to a remote node, which applies to both Stapleton and Kummetz-464 because the DAU and DRUs in both discloses as remote from the base station.

307. *Second*, Kummetz-464 generally teaches that the communications medium can be an "optical fiber." EX1005, 7:16-18 ("Examples of a suitable communication medium include copper wire (such as a coaxial cable), *optical fiber*, and microwave or optical link.").

308. A POSA would have been motivated to combine Stapleton and Kummetz-464's teaching to make the DAU connect to the BTSs via at optical fiber for multiple reasons.

309. *First*, the same motivations and rationale discussed for obviousness in view of Stapleton itself apply to this combination. Further, Kummetz-464 supports the motivation of selecting optical fiber to connect to a CPRI base station—Kummetz-464 suggests this very option of receiving CPRI signals from a base station. EX1005 at 7:50-65.

310. *Second*, a POSA reading Stapleton would have naturally looked to Kummetz-464 for the reasons already discussed, i.e., they both disclose distributed antenna systems, they both address the similar goal of adjusting or redistributing the capacity throughout the coverage zones of the DAS as needed, and they both address the same problem of users gathering in one place (e.g., a cafeteria or stadium).

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

1. Claim 1

a. Element 1A

"A system comprising"

311. Kummetz-464 teaches element 1A because it discloses a "distributed antenna **system**" (DAS). See Fig. 1 (below). I have annotated Fig. 1 to identify

the "distributed antenna system 10" of the Kummetz-464 system. I have also identified the features of the Kummetz-464 system that correspond to the '382 patent's claimed signal sources (BTSs), digital access unit (DAU), and digital remote units (DRUs). The Kummetz-464 DAS can receive signals from one or more signal sources, "such as base stations of cellular service providers." EX1005, 2:44-46, Fig. 1. Note from Fig. 1 that each coverage zone contains several remote antenna units 18 which are examples of DRUs. The Kummetz-464 system includes a router (a DAU) "that can redistribute capacity among coverage zones serviced by the DAS." EX1005, 2:40-48. See also EX1005, 11:39-44 and Fig. 6 showing a Kummetz-464 embodiment that includes multiple interconnected routers (DAUs).

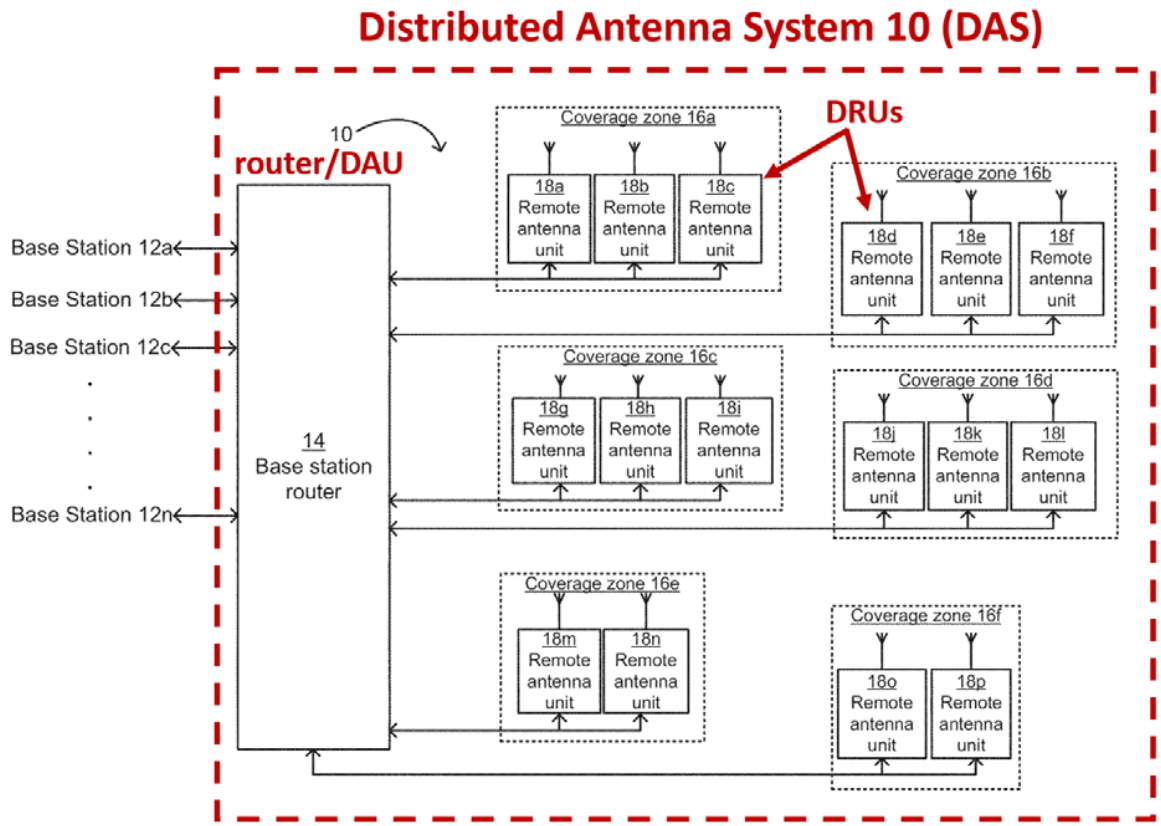


FIG. 1

b. Element 1B

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

312. Kummetz-464 teaches element 1B.

313. A DAU operable to receive at least one signal from at least one of a plurality of signal sources. The Kummetz-464 DAS includes one or more "base

station routers" operable to receive at least one signal from at least one of a first signal source (e.g., BTS 12a of Fig. 1) and a second signal source (e.g., BTS 12b of Fig. 1) from one or more of the plurality of signal sources (BTSs 12a-12n). EX1005 at Fig. 1. Fig. 1 of Kummetz-464 "depicts a DAS 10 having a base station router 14 [a DAU] in communication with base stations 12a-n and with remote antenna units 18a-p of coverage Zones 16a-f." EX1005, Fig. 1, 14:14-16, and Fig. 2 (below, annotated). "Different base stations 12*a–n* can be associated with different sectors of one telecommunication system operator and/or be associated with different sectors of different telecommunication system operators." EX1005, 5:19–23. The DAS of Kummetz-464 can also comprise multiple interconnected base station routers (DAUs) that likewise communicate with base stations 12*a–n*. EX1005 at Fig. 6, 4:59–5:4, 11:39–52.

314. A DAU including an input port and an output port, each configured as an uplink/downlink port. Base station router 14 (the DAU) includes an input interface (interface section 101) that receives signals from and provides signals to the base stations 12a–12n, supporting uplink and downlink functionality. EX1005 at 6:11-15 (link may use common digital formats, e.g., CPRI, ORI), 7:45–48, 7:50–52, 7:66–8:1, 8:8–10, Fig. 2 (annotated below; Fig. 2 shows a bi-directional link for transporting signals between a base station and a donor interface card). Base station router 14 also includes an output section that receives signals from and

provides signals to the remote antenna units, similarly, allowing uplink and downlink functionality. EX1005 at Fig. 2 (showing bi-directional link for transporting signals "To/From Remote Antenna Units"); 7:60-65 (link to/from remote antenna units may also use "common digital formats"), 6:11-15 (listing CPRI and ORI as examples of common digital formats), 7:45–49, 8:23–24, 8:27–32, 8:41–42. See also EX1013 at Fig. 2.3.1 and section 3.1 ("**ORI link:** bidirectional interface in between two directly-connected ORI **ports**, on two ORI nodes").

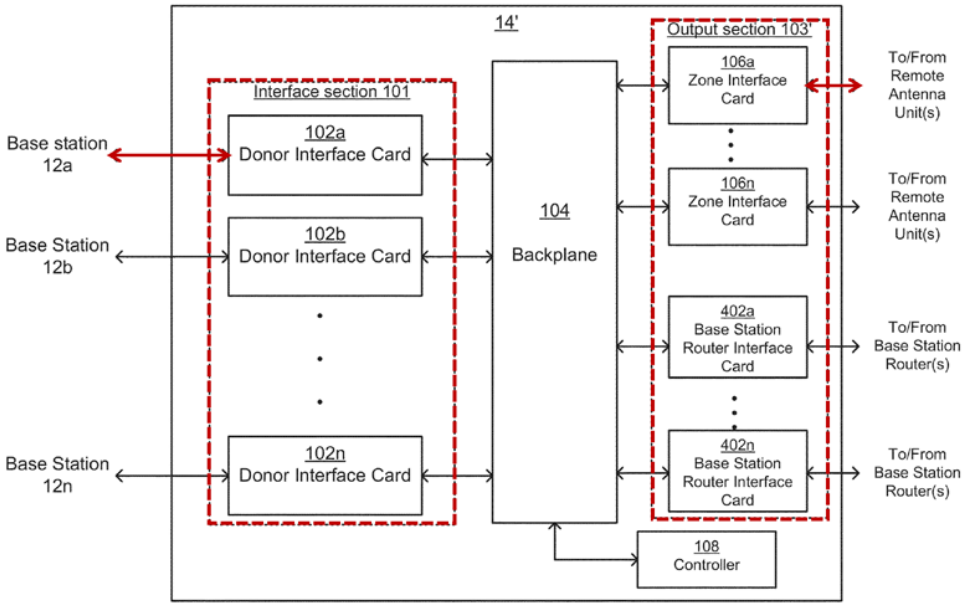


FIG. 2

315. In the interface section 101, each donor interface card of the Kummetz-464 router can process both (a) downlink signals received from a base

station over the bi-directional link and (b) uplink signals to be provided to the base station over the bi-directional link. EX1005, 7:50-8:1. With reference to Fig. 2 (below, showing use of a bi-directional link between a base station and donor interface card), the Kummetz-464 states:

> …the donor interface cards 102a-n can transform signals received from the base stations 12a-n, such as RF signals, into one or more digital data streams. … [and] can transform digital data streams into uplink signals to be provided to the base stations 12a-n.

EX1005, 7:50-8:1.

316. In the output section 103, each zone interface card of the Kummetz-464 router can process both (a) downlink signals to be provided to a DRU over the bi-directional link and (b) uplink signals received from the DRU over the bi-directional link. With reference to Fig. 2 (below, showing use of bi-directional links between remote antenna units and zone interface cards), the Kummetz-464 states:

> Each of the zone interface cards 106a–n can transform the combined data streams into downlink signals to be provided to the remote antenna units of one or more coverage zones. . . . [and in] an uplink direction, the zone interface cards 106a-n can receive uplink signals from one or more remote antenna units. The uplink signals can be converted to digital data streams and provided to the backplane 104. The backplane 104 can combine the digital data streams into serialized data streams via the configurable digital signal processing circuitry.

EX1005, 8:27–47.

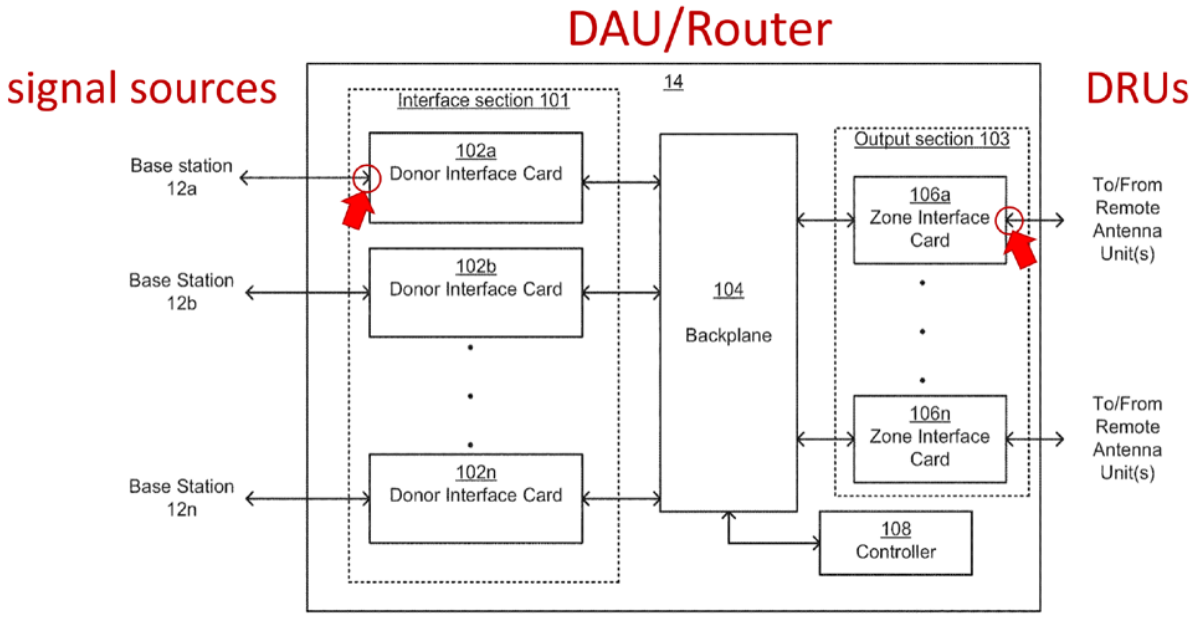


FIG. 2

317. Since the link coupling a base station to a donor interface card is shown to be bi-directional, a person of skill in the art would understand the donor interface card 102a to include a bi-directional port, i.e., that is configured as an uplink/downlink port. See Fig. 2 above, annotated to include a red arrow in interface section 101). Likewise, since the link coupling a zone interface card to the remotes (i.e., as indicated in Fig. 2, for transporting signals "To/From Remote Antenna Unit(s)") is shown to be bi-directional, a person of skill in the art would understand the zone interface card to include a bi-directional port, i.e., that is

configured as an uplink/downlink port. See Fig. 2 above, annotated to include red arrow in output section 103).

318. Further, Kummetz-464 discloses that the links can use the CPRI interface protocol which as I already explained above expressly defines its links to be a bidirectional interface between two ports. EX-1005 6:13, 7:59; EX-1009 (CPRI) at 7.

c. Element 1C

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

319. Kummetz-464 teaches element 1C because the disclosed DAS includes a plurality of "remote antenna units" (DRUs) coupled to the router (DAU) of the Kummetz-464 system. Each such DRU of the Kummetz-464 system is operable to transport signals to/from the router. EX1005, 8:23–54, Fig. 6, 11:39–52, Fig. 1 (below, annotated).

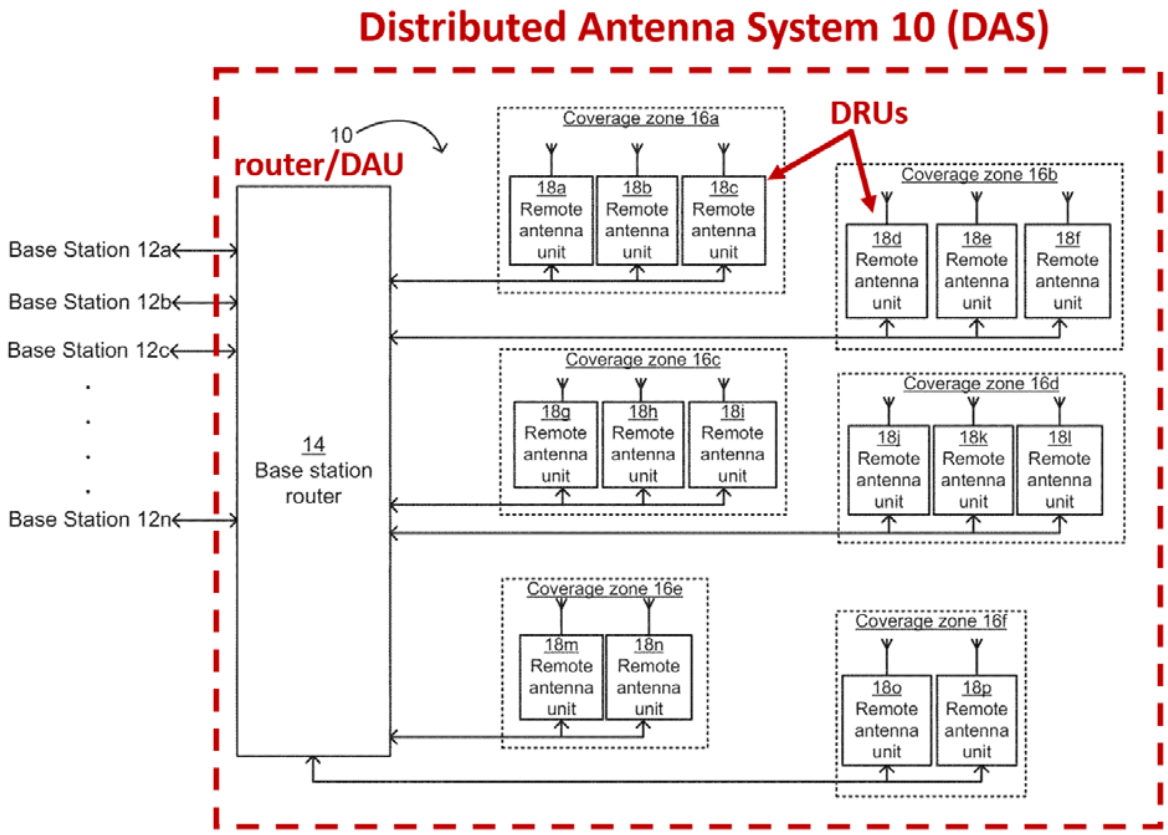


FIG. 1

320. As noted under element 1B, Kummetz-464 states that each base station router 14 comprises "zone interface cards 106a–n [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." EX1005, 8:23–54; EX1005, Fig. 6, 11:39–52.

321. The signals between the remote antenna units and base station routers can be either analog or digital, and, if digital, the remote antenna units "can convert

the digital signals to analog RF signals and radiate the RF signals into the coverage zones." EX1005, 8:32–40; 6:16–43.

d. Element 1D

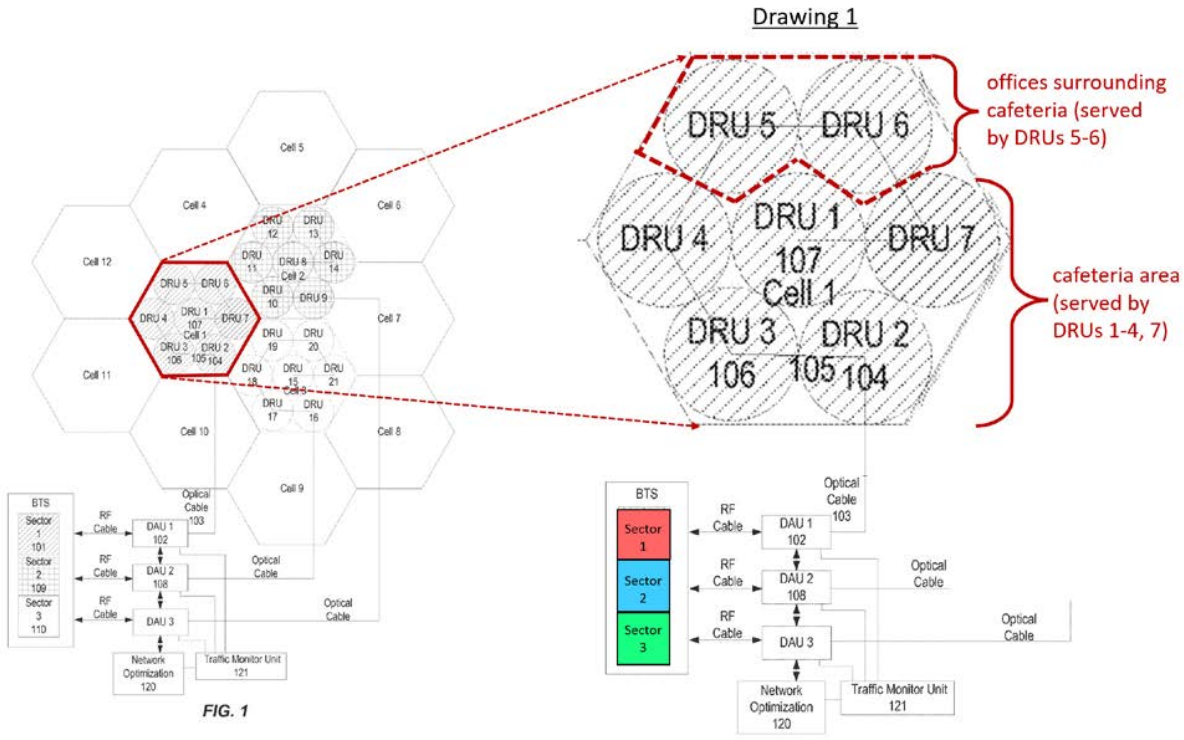
"a plurality of radio resources formed from the one or more DRUs comprising a first radio resource and a second radio resource different from the first radio resource, each radio resource comprising a subset of the plurality of DRUs"

322. A POSA would at least understand element 1D to cover the '382 patent's disclosed operation of how radio resources are "formed from the DRUs" within a coverage area. Kummetz-464 discloses the same operation, and thus teaches element 1D.

323. Drawing 1 (below, right) corresponds to Fig. 1 of the '382 patent but focuses only on the coverage area of cell 1. Drawing 1 is provided to illustrate how the '382 system operates to address the capacity problem "when wireless subscribers congregate in large numbers at one location."

> A notable example is a business enterprise facility during lunchtime, when a large number of wireless subscribers visit a … cafeteria location in the building. At that time, a large number of subscribers have moved away from their offices and usual work areas. … . [I]t is very likely that the lunchtime scenario will present some unexpected challenges with regard to available wireless capacity and data throughput.

EX1001, 1:31-48.



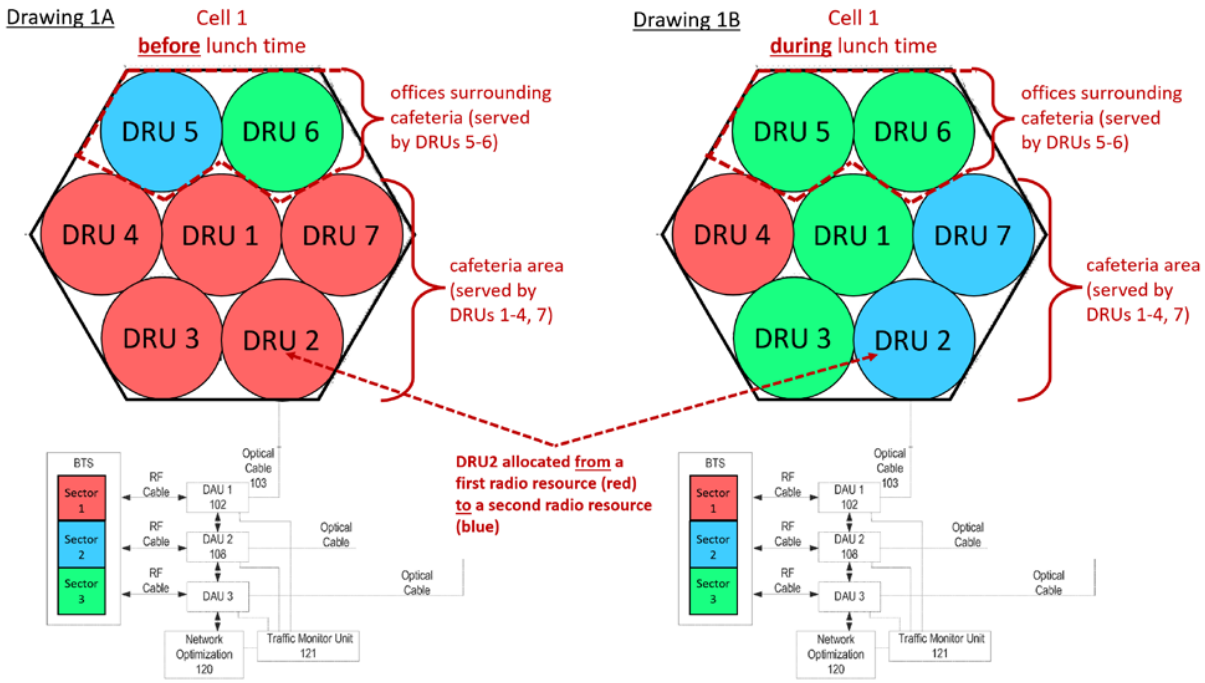
324. As illustrated in the '382 patent system of Drawing 1: (a) the venue's coverage area includes two locations including the cafeteria area and the office area, each served by a different subset of DRUs (DRUs 1-4, 7 serve the cafeteria and DRUs 5, 6 serve the office area); (b) the DAS receives "a plurality of radio resources" from the BTS, including a first, second, and third radio resource, red, blue and green, respectively; and (c) each of the red, blue and green radio resources are available to the router for distribution to all, or any subset, of DRUs 1-7 serving the coverage area. While each of the red, blue, and green radio resources are received by a different DAU, the DAUs are interconnected and thus

each of the red, blue and green radio resources are available to DAU1 for distribution to DRUs 1-7 serving the coverage area. EX1001, 7:8-13.

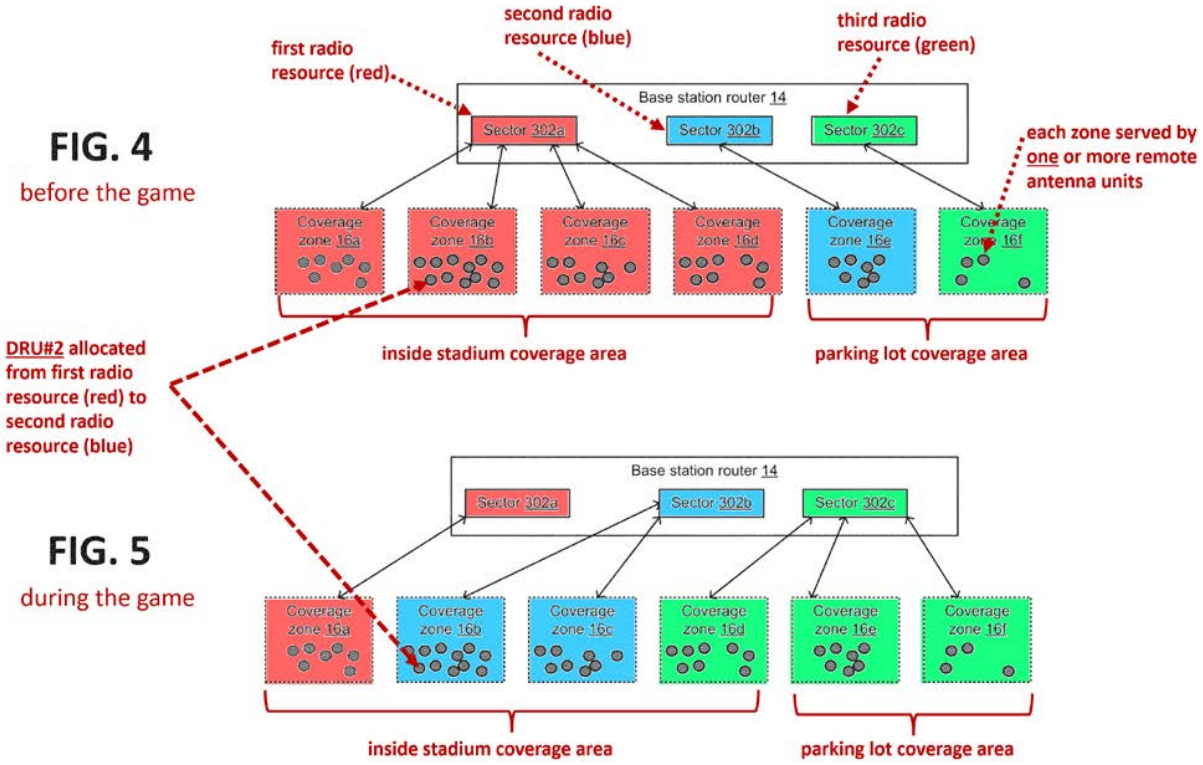
325. Drawing 1A (below) illustrates how DAU1 allocates and distributes the red, blue and green radio resources to DRUs 1-7 before lunch time. Consistent with the '382 patent's disclosure, before lunch time, the DAU 1 distributes less capacity to the cafeteria (e.g., only the red radio resource is distributed to DRUs 1-4, 7 that serve the cafeteria).

326. Drawing 1B (below) illustrates how DAU1, after detecting that most of the wireless subscribers have moved to the cafeteria, allocates and redistributes the red, blue and green radio resources during lunch time. Consistent with the '382 patent's disclosure, during lunch time, DAU 1 distributes: (a) the red radio resource to DRU 1 serving a portion of the cafeteria, (b) the blue radio resource to DRUs 2 and 7 serving a portion of cafeteria, and (c) the green radio source (green) to DRUs 1, 3, 5 and 6, with DRUs 1 and 3 serving a portion of the cafeteria and DRUs 5 and 6 serving the office area.

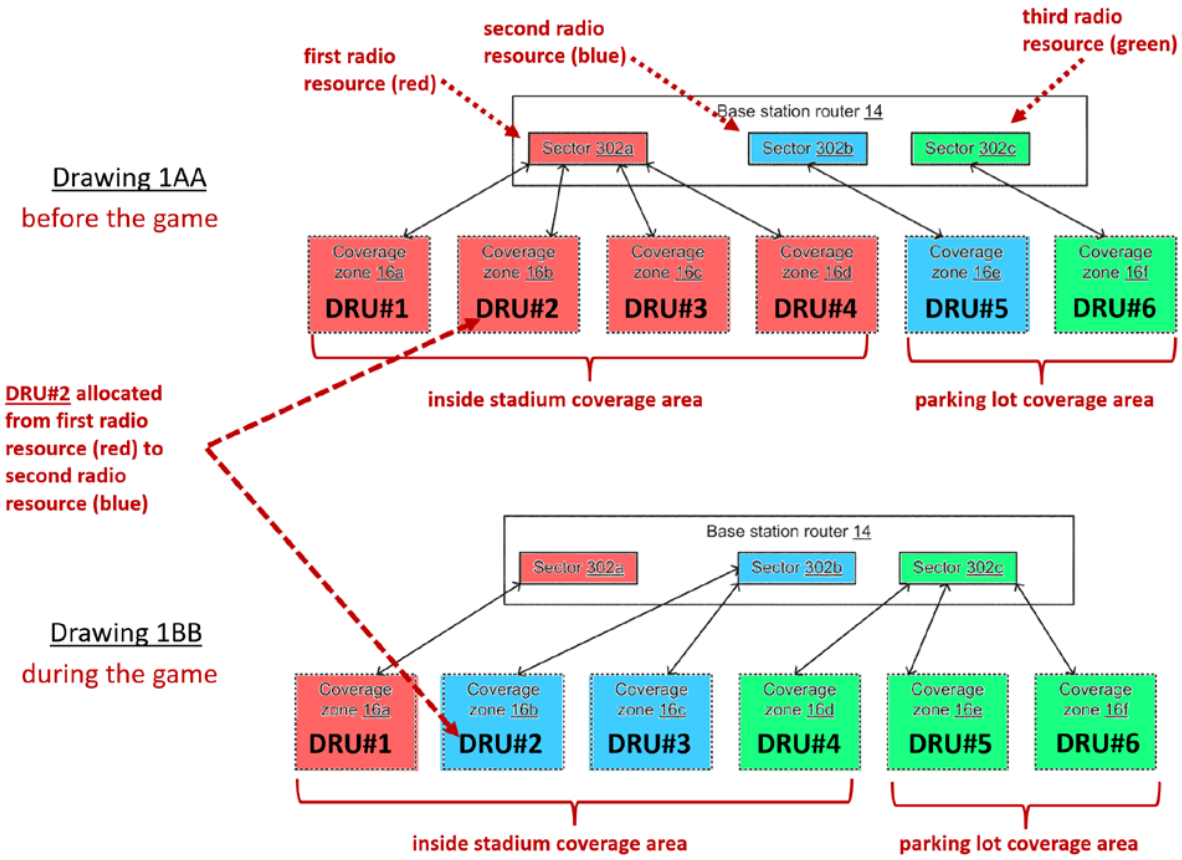
327. Before lunch time (Drawing 1A) and during lunch time (Drawing 1B), the red, blue and green radio resources are formed from the one or more DRUs within the coverage area in accordance with how DAU1 allocated and distributed the first, second, and third radio resources to the DRUs.



328. Kummetz-464 discloses the same operation as discussed for the '382 patent. Figs. 4 and 5 of Kummetz-464 illustrate an example of how the system adaptively distribute capacity before and during a sporting event hosted at a venue with a coverage area that includes: (a) inside a stadium, and (b) the parking lots surrounding the stadium. EX1005, 10:64 - 11:28.



329. Kummetz-464 teaches that each coverage zone in Figs. 4 and 5 could be served one remote antenna unit (DRU). EX1005, 2:58-59, 3:7-8, 4:27, 7:4-5. Drawings 1AA (below) and 1BB (below) are provided to illustrate such a system in which each zone is served by a single remote.



330. Just like the DAS of '382 patent, in the Kummetz-464 DAS: (a) the venue's coverage area includes two locations each served by a different subset of DRUs (DRUs 1-4 serve the stadium and DRUs 5, 6 serve the parking lot); (b) the DAS also receives "a plurality of radio resources" from the BTS, including a first, second, and third radio resource, red, blue and green, respectively; and (c) each of the red, blue and green radio resources available to the router for allocation and distribution to all, or any subset, of DRUs 1-6 serving the coverage area.

331. Consistent with the '382 patent's disclosure, before the game (Drawing 1AA), the Kummetz-464 router distributes less capacity to the stadium

(i.e, only the red radio resource is distributed to DRUs 1-4 that serve the stadium). Also, consistent with the '382 patent's disclosure, the Kummetz-464 router, after detecting that conditions have changed during the game (Drawing 1BB) (i.e., a change in a traffic indicator such as the number of users in each coverage zone), redistributes the red, blue and green radio resources, providing more capacity to the stadium area.

332. Kummetz-464 thus discloses the same operation as discussed for the '382 patent. Before the game (Drawing 1AA) and during the game (Drawing 1BB), the red, blue and green radio resources are formed from the one or more DRUs within the coverage area in accordance with how the router allocated and distributed the first, second, and third radio resources to the DRUs. Kummetz-464 thus discloses element 1D.

e. Element 1E

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

333. Kummetz-464 discloses element 1E because the Kummetz-464 system includes a "controller 108" that can "change the routing of signals from the base stations 12*a–n* to the coverage zones 16*a–f*," as illustrated in Fig. 2 (below, annotated) and described in Kummetz-464. EX1005 at 8:54–58, 8:63-9:25, 9:34-65, Figs 2, 3.

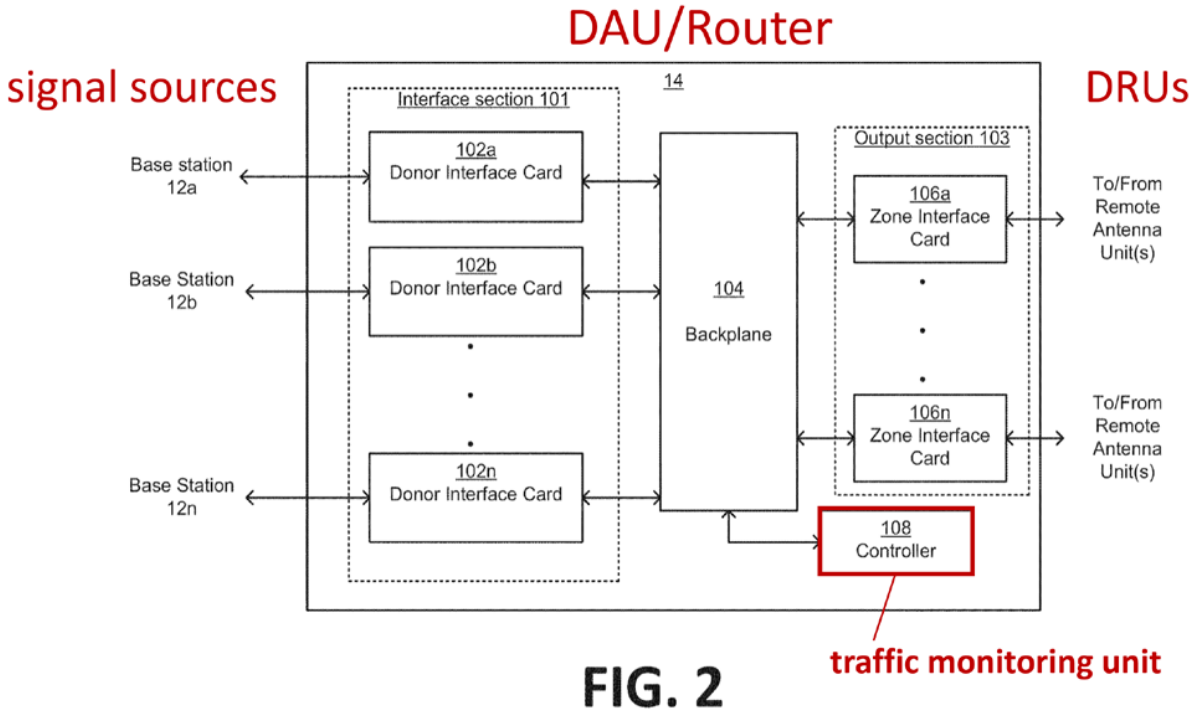


FIG. 2

334. Kummetz-464 teaches that "the controller 108 can be disposed in the base station router 14" [a DAU] as shown in Fig. 2. EX1005 at 8:58-59. Kummetz-464 also teaches that "the controller 108 can be disposed in a separate device external to and in communication with the base station router 14." EX1005 at 8:60-62.

335. As illustrated in Figure 3 below, the controller 108 includes a processor 202, memory 204, a bus 206, and an input/output (I/O) interface 208. EX1005, 8:63–9:21.

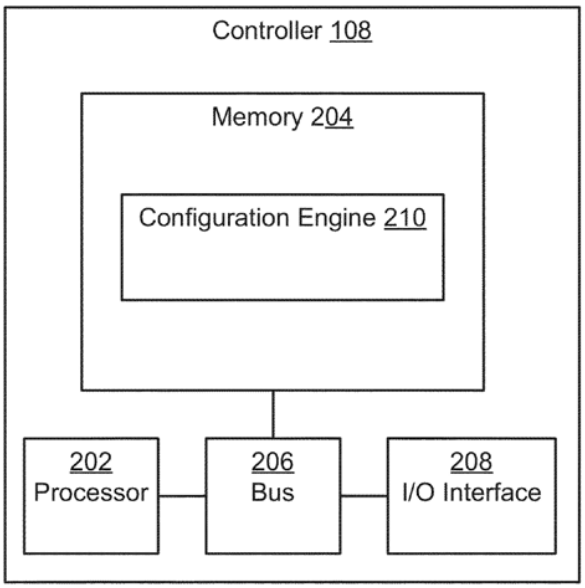


FIG. 3

336. The processor 202 of Kummetz-464 Fig. 3 "can communicate data describing the routing of signals by the base station router 14 . . . through a graphical user interface or from an automation algorithm stored in the memory 204 for determining the demand on each of the coverage zones." EX1005, 9:34–39. The instructions stored in memory can also include a "configuration engine 210 [that] can cause the controller 108 to redistribute capacity in the DAS 100" and that can "execute the configuration management function in response to the detection of a traffic indicator." EX1005, 9:22–25, 9:40–54.

337. "The configuration engine 210" of the controller "can execute the configuration management function in response to the detection of a traffic

indicator. A traffic indicator can include data describing or otherwise corresponding to a number of mobile devices in each coverage zone." EX1005, 9:42-47; 9:47-54.

338. Kummetz-464 further states:

> The configuration engine 210 can also include a report manager function for generating reports on traffic, spurious signals, usage, and other types of information. The processor 202 can execute the configuration engine 210 so as to configure the controller 108 to implement any process for measuring uplink signals for traffic and other types of information and reporting the information. Certain systems and processes that can be used to do so are described in U.S. Ser. No. 12/778,312, filed May 12, 2010 and titled "System and Method for Detecting and Measuring Uplink Traffic in Signal Repeating Systems."

EX1005 at 9:55–65. See also 9:66-10:43 where Kummetz-464 describes how a base station router can determine the locations of the cell phones. By communicating with the base station, the base station router determines the channel assigned to each mobile. Id. Then, by determining where the sector containing that channel has been assigned, the base station router determines the zone in which the cell phone is located. Id. Further, at 11:13-15, Kummetz-464 states that the base station router can be reconfigured in response to changes in the concentration of wireless devices within each zone. Concentration of devices is another traffic indicator. Further, at 11:64-12:18 and Figure 8, Kummetz-464 describes the use of a spectrum analyzer to determine the frequencies used in each

zone. This is another traffic measurement yielding a traffic indicator that can be used to redistribute capacity. Figure 9 and 12:24-65 describe the use of a reference receiver and detection devices to pinpoint the remote unit in which a particular device is located and that is another traffic measurement yielding a traffic indication that could be used to redistribute capacity.

339. Kummetz-464 thus discloses element 1E.

f. Element 1F

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

340. It should be noted that element 1F requires the traffic monitoring unit to determine only one of two alternatives: (a) determining a key performance indicator (KPI) **or** (b) determining a quality of service (QoS). Thus, prior art disclosing a traffic monitoring unit that determines only one of the two alternatives satisfies element 1F.

341. Kummetz-464 discloses this element because it discloses a traffic monitoring unit (controller 108) that determines at least one KPI (e.g., the "traffic indicators" in Kummetz-464 such as detecting traffic and other measurements that correspond to the number of users in each coverage zone) that is used by the

controller and router to redistribute capacity. EX1005, 9:44-54. Kummetz-464 states:

> A traffic indicator can include data describing or otherwise corresponding to a number of mobile devices in each coverage zone. Examples of a traffic indicator can include 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.

EX1005, 9:44–54. Detecting and making measurements of traffic and other metrics such as failure events, interference, locations of users, and the number of mobile users per sector are examples of key performance indicators (KPIs). Id.

342. In addition, Kummetz-464 teaches that a traffic indicator can also be compared to a "low" threshold value or a "high" threshold value. Id. The high and low threshold values are examples of QoS values of network traffic. The threshold values are a function of one more traffic indicators (KPIs) because the thresholds are chosen in light of and are compared to the measured traffic indicators such as number of mobile users per sector and the thresholds are used to assess traffic measurements to decide whether to trigger adding or removing radio resources. A POSA would understand, for example, a high threshold value to indicate an upper limit for when performance is acceptable (i.e., acceptable performance when the

measured traffic indicator is below the high threshold). It sets the goal the system is attempting to achieve for network traffic. By setting threshold values, the controller can determine how quickly the system will deploy additional radio resources, which affects the quality of the service at the remote antenna units using the radio resources.

343. The Kummetz-464 controller 108 can "communicate data describing the routing of signals by the base station router 14" and "implement any process for measuring uplink signals for traffic and other types of information." EX1005, 9:34–35, 9:55–65.

344. Kummetz-464 further discloses that the controller 108, via configuration engine 210, can trigger a redistribution of signal capacity among coverage zones, wherein each coverage zone includes one or more remote antenna unit(s). EX1005, 9:31-65, 3:7-8. For example, Kummetz-464 discloses that "[t]he configuration engine 210 can include execute the configuration management function in response to the detection of a traffic indicator. A traffic indicator can include data describing or otherwise corresponding to a number of mobile devices in each coverage zone." EX1005, 9:40–47. See also 9:47-54.

345. Kummetz-464 further states:

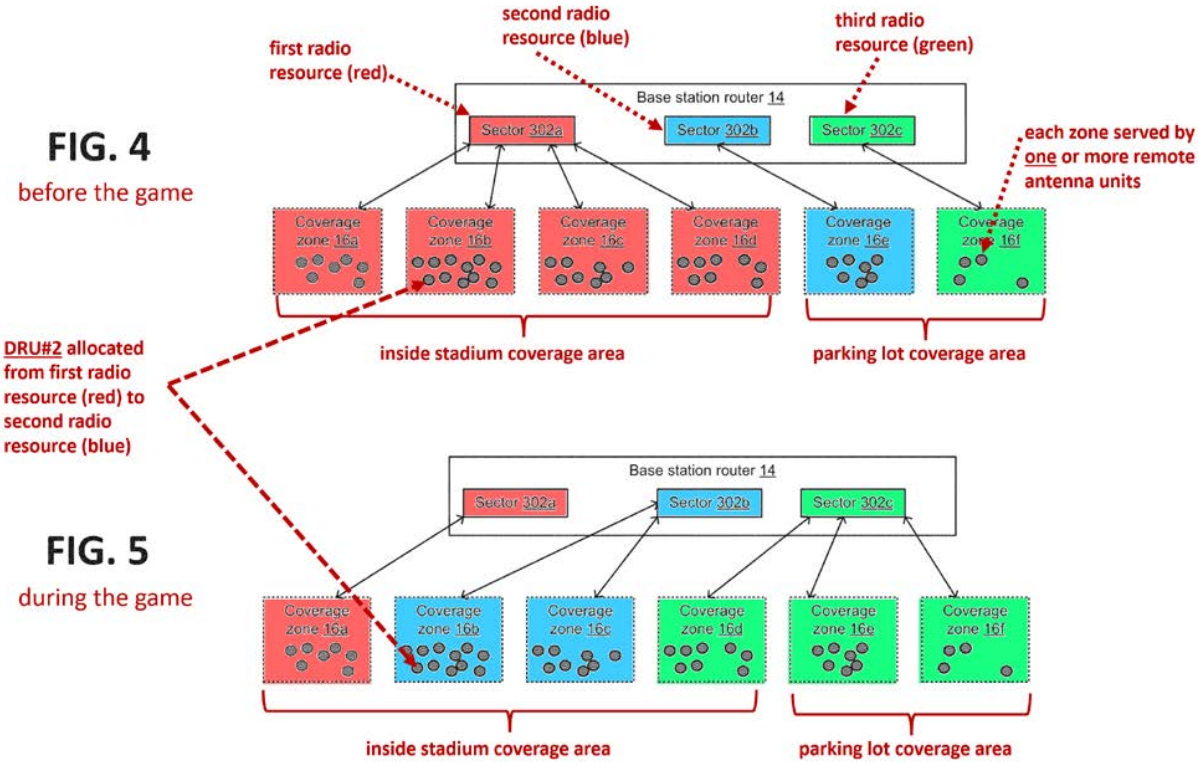
> The configuration engine 210 can also include a report manager function for generating reports on traffic, spurious signals, usage, and other types of information. The processor

> 202 can execute the configuration engine 210 so as to configure the controller 108 to implement any process for measuring uplink signals for traffic and other types of information and reporting the information. Certain systems and processes that can be used to do so are described in U.S. Ser. No. 12/778,312, filed May 12, 2010 and titled "System and Method for Detecting and Measuring Uplink Traffic in Signal Repeating Systems."

EX1005, 9:55–65. See also 9:66-10:43 where Kummetz-464 describes how a base station router can determine the locations of the cell phones. By communicating with the base station, the base station router determines the channel assigned to each mobile. Id. Then, by determining where the sector containing that channel has been assigned, the base station router determines the zone in which the cell phone is located. Id. Note that, because the determination of location is in part based on the channel assigned, it is not merely the location of a user, but the location of a user that the network is currently communicating with. Therefore, it is a property of the system in operation, not merely an attribute about a cell phone that may or may not be communicating. Further, Kummetz-464 at 11:13-15 states that the base station router can be reconfigured in response to changes in the concentration of wireless devices within each zone. Concentration of devices is another traffic indicator. EX1005, 9:44-47, 11:13-15. Further, at 11:64-12:18 and Figure 8, Kummetz-464 describes the use of a spectrum analyzer to determine the frequencies used in each zone. This is another traffic measurement yielding a

traffic indicator that can be used to redistribute capacity. Figure 9 and 12:24-65 describe the use of a reference receiver and detection devices to pinpoint the remote unit in which a particular device is located and that is another traffic measurement yielding a traffic indication that could be used to redistribute capacity.

346. Figs. 4 and 5 (below, annotated) and the corresponding written specification describes an example of how the Kummetz-464 controller (a traffic monitoring unit) can use the measured "traffic indicators" such as the number of mobile devices in each coverage zone to reconfigure capacity distribution. See, e.g., the remote antenna unit I have designated DRU#2 in Figs. 4 and 5; from before the game to during the game, DRU#2 is allocated from a first radio resource (red) to a second radio resource. EX1005, 11:13–15, Figs. 4–5, 10:30–43. See also Drawing 1AA which corresponds to Kummetz-464 Fig. 4, except that Drawing 1AA includes only one remote antenna unit (DRU) per a zone as disclosed by Kummetz-464. EX1005, 2:58-59; 3:7-8 ("A coverage zone can include one or more remote antenna units"); 4:27 ("one or more remote antenna units in a coverage zone"); 7:4-5 ("Each of the coverage zones 16a-f [of Figs. 4 and 5] can include one or more remote antenna units"). Drawing 1BB corresponds to Kummetz-464 Fig. 5, except that Drawing 1BB includes only one remote antenna unit (DRU) per a zone as disclosed by Kummetz-464. Id.



EX1005, Figs. 4, 5.

347. The Kummetz-464 disclosure is consistent with the Patent Owner' '382 patent disclosure with regard to KPIs. EX1001, 10:37–45. The '382 patent explains that "using the KPIs of the network traffic, the DAS network can be modified to improve system performance. As an example, if a particular DRU has a higher load than other adjacent DRUs, traffic can be routed to the adjacent DRUs in order to reduce the load on the particular DRU." EX1001, 10:62–66.

g. Element 1G

"wherein the traffic monitoring unit is configured to: … reconfigure the plurality of radio resources based on one or more of the one or more KPIs and/or the

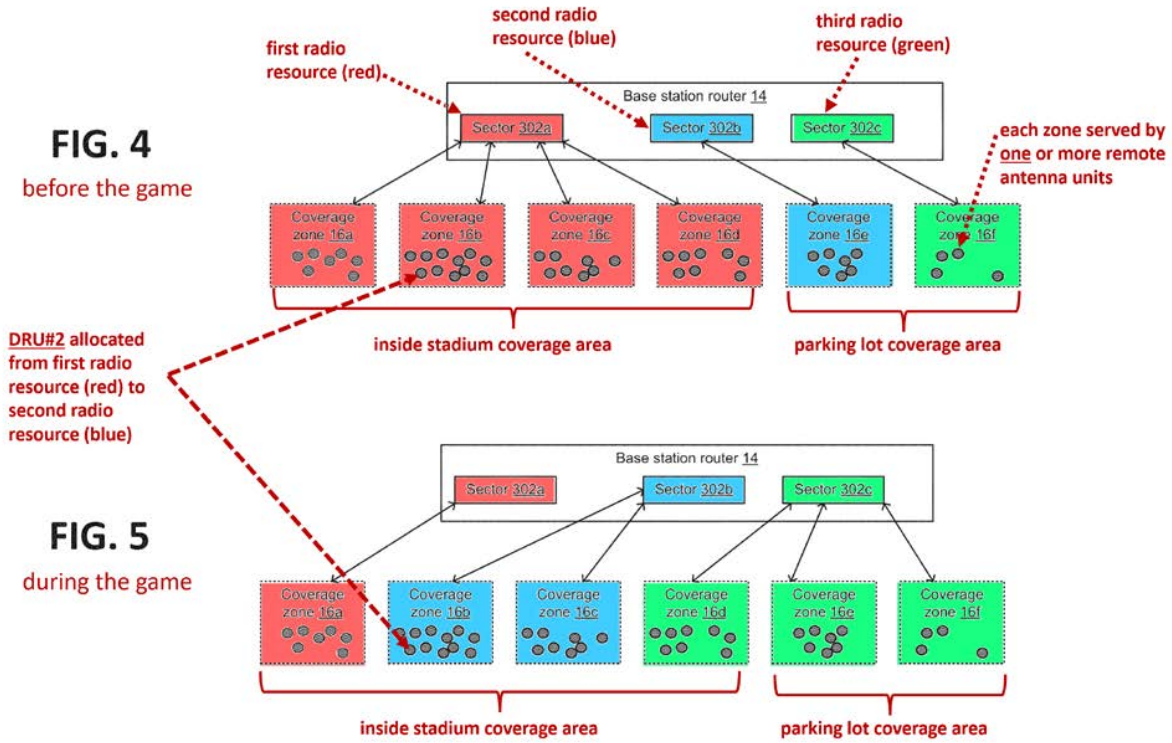
QoS by allocating at least one DRU from the first radio resource to the second radio resource"

348. It should be noted that element 1G requires the traffic monitoring unit to reconfigure the plurality of radio resources based on only one of two alternatives, i.e., based on: (a) a key performance indicator (KPI) **or** (b) a quality of service (QoS). Thus, prior art disclosing a traffic monitoring unit that reconfigures based on a KPI would satisfy element 1G.

349. The discussion under element 1F of ground 3 is incorporated under this element by reference. As discussed under element 1F, Kummetz-464 teaches to determine one or more key performance indicators (KPIs) and a quality of service (QoS) of a network traffic and to use such KPIs and QoS to trigger the controller to reconfigure radio resources.

350. As discussed under element 1F, the Kummetz-464 discloses that "controller 108" (a traffic monitoring unit) can reconfigure the distribution of the first, second and third radio resource (sectors 302a, 302b and 302c received from the one or more base stations) based on one or more at least one KPI (e.g., one of the "traffic indicators" such as the detected traffic, interference, or number of mobile devices in each coverage zone). EX1005, 9:34–35, 9:44–54, 9:55–65, 11:13–15, Figs. 4–5, 10:30–11:28.

351. Kummetz-464 uses the example of venue for sports events that includes the physical coverage area inside a stadium (coverage zones 16a–d) and the physical coverage area of the parking lots surrounding the stadium (coverage zones 16e–f). Fig. 4 shows the distribution of radio resources before the sporting event begins, i.e., a first radio resource (sector 302a) is distributed to the zones inside the stadium. EX1005, 10:64–11:12. The number of wireless devices within the stadium (*i.e.*, KPI 1) and within the parking lot (*i.e.*, KPI 2) are compared, and reconfiguration of the sectors via controller 108 is triggered "in response to changes [in] concentration of wireless devices in the respective coverage zones." EX1005, 11: 13–28. Thus, a change in the KPIs (the number of wireless devices in each coverage zone) results in reconfiguration of the radio resources by allocating at least one DRU (e.g., DRU#2 identified below in Figs. 4 and 5) from a first radio resource (red) to a second radio resource (blue). EX1005, 10:30–11:28, Figs. 4, 5.



352. Kummetz-464 explains that "[b]efore an event hosted in the stadium begins, fewer wireless devices may be concentrated in the stadium in the parking lot." Kummetz-464 thus explains that before the hosted event begins:

> The coverage zones 16a-d [zones inside the stadium] may therefore require less capacity than the coverage zones 16e, 16f [zones in the parking lot surrounding the stadium]. Accordingly, the base station router 14 can be configured to provide the sector 302a [radio resources] to the coverage zones 16a-d, the sector 302b [radio resources] to coverage zone 16e, and the sector 302c [radio resources] to coverage zone 16f. Providing a single sector 302a to the coverage zones 16a-d inside the stadium can provide Sufficient capacity density for each of the coverage zones 16a-d. Providing the sectors 302b, 302c to the coverage zone 16e

> inside the stadium can provide Sufficient capacity density for each of the coverage zones 16a-d.

Kummetz-464 also explains that during the hosted event, "more wireless devices will be concentrated inside the stadium than in the parking lot after an event begins." EX1005, 11:18-21 Kummetz-464 thus explains that during the hosted event:

> The base station router 14 can be re-configured via the controller 108 in response to changes concentration of wireless devices in the respective coverage zones. FIG. 5 depicts the base station router 14 providing sectors 302a-c to the coverage zones16a-f according to a subsequent configuration of the base station router 14. For example, if the DAS 10 services a stadium and the surrounding parking lot, more wireless devices will be concentrated inside the stadium than in the parking lot after an event begins. The base station router 14 can be reconfigured such that the sector 302a [radio resources] is provided to the coverage zone 16a, the sector 302b [radio resources] is provided to the coverage zones 16b, 16c, and the sector 302a [radio resources] is provided to the coverage zones 16d-f. The configuration of base station router 14 depicted in FIG. 5 thus increases the capacity density of the coverage zones 16a-d [inside the stadium] as compared to the configuration of the base station router 14 depicted in FIG. 3 [*sic – Fig 4*].

EX1005, 11:13-28.

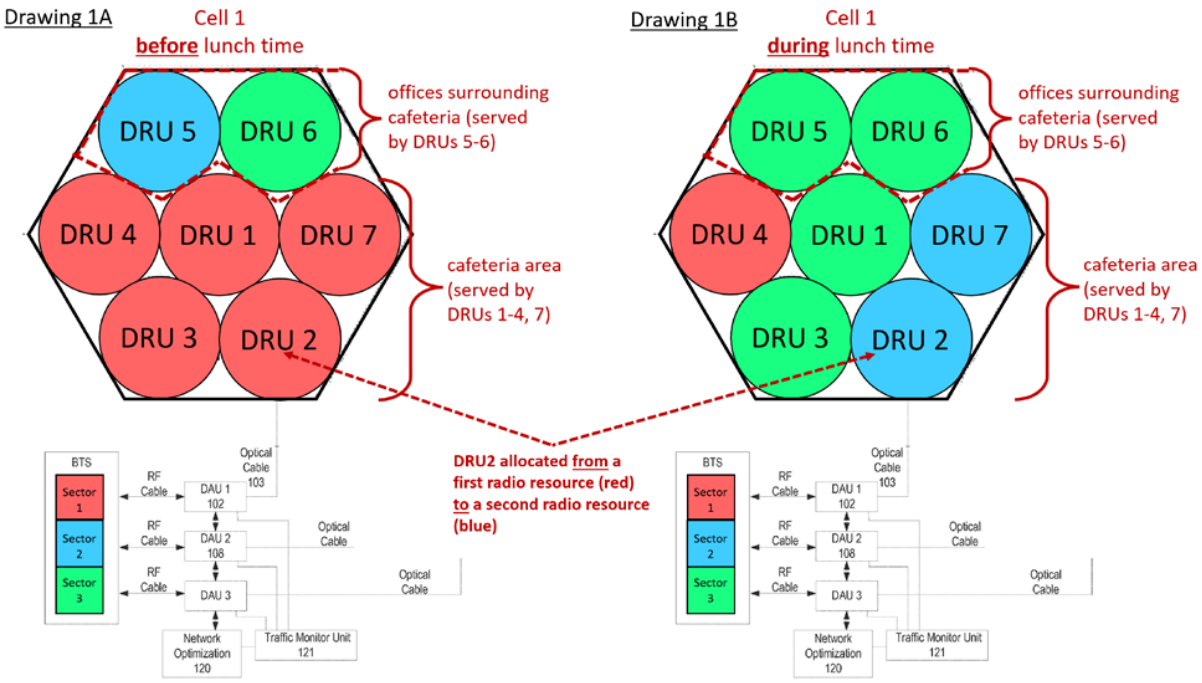
353. The Kummetz-464 use of a controller (traffic monitoring unit) to reconfigure the plurality of radio resources based on a KPI (such as the detected traffic, interference, or the measured number of users in each coverage zone) by allocating at least one remote antenna unit (DRU) from a first radio resource to a

second radio resource is the same as the operation of the system disclosed in the '382 patent. See Figs. 4 and 5 (above annotated) indicating that radio antenna unit designated DRU#2 in the example described by Kummetz-464 is allocated from a first radio resource (red) to a second radio resource blue.

354. The discussion about the operation of the Kummetz-464 system in element 1D and 1F is incorporated by reference. A POSA would at least understand element 1G to cover the '382 patent's disclosed operation of how the '382 patent system performs element 1G. Kummetz-464 discloses the same operation, and thus teaches element 1G.

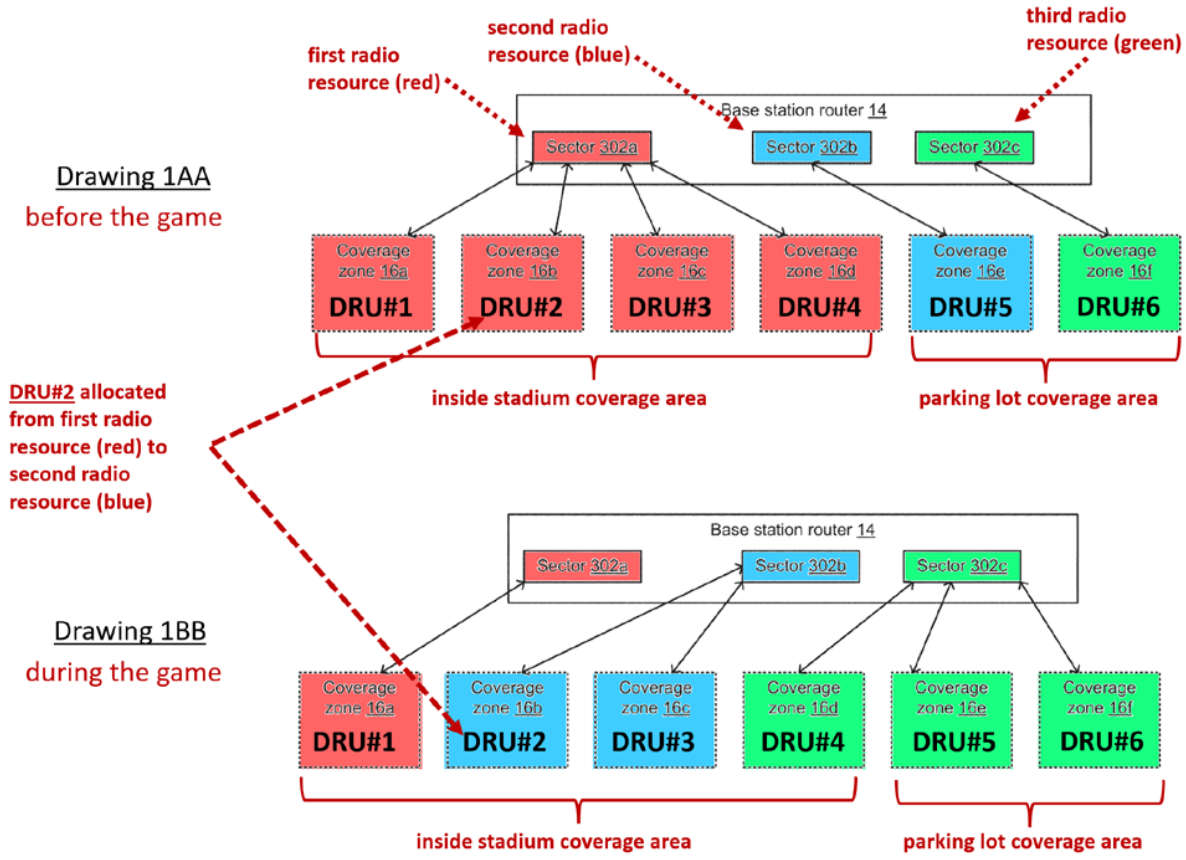
355. The operation of the '382 patent system. With reference to the example discussed in the EX1001 at 1:31-48, Drawing 1A (below) illustrates how DAU1 allocates and distributes the red, blue and green radio resources to DRUs 1-7 before lunch time. Consistent with the '382 patent's disclosure, before lunch time, the DAU 1 distributes less capacity to the cafeteria (e.g., only the red radio resource is distributed to DRUs 1-4, 7 that serve the cafeteria). By contrast, Drawing 1B (below) illustrates how DAU1, after detecting a KPI showing that most of the wireless subscribers have moved to the cafeteria, allocates and redistributes the red, blue and green radio resources during lunch time. Consistent with the '382 patent's disclosure, during lunch time, more capacity is shifted to the cafeteria. Further, to satisfy the operation of element 1G, the reconfiguring

includes "*allocating at least one DRU* [e.g., DRU#2, below] *from the first radio resource* [e.g., from red] *to the second radio resource* [e.g., blue]



356. The operation of the Kummetz-464 system is the same. With reference to the example discussed in the Kummetz-464 patent (EX1005, 10:64 - 11:28, Figs. 4,5), Drawing 1AA (below) illustrates how the router allocates and distributes the red, blue and green radio resources to DRUs 1-6 before the game. Consistent with the '382 patent's disclosure, before the game, the router distributes less capacity to the stadium (e.g., only the red radio resource is distributed to DRUs 1-4 that serve the stadium). By contrast, Drawing 1BB (below) illustrates how the router, after detecting a traffic indicator (*KPI*) (e.g., such as the number of users in each coverage zone) showing the wireless users have moved to the

stadium, allocates and redistributes the red, blue and green radio resources during the game. Consistent with the '382 patent's disclosure, during the game, more capacity is shifted to the stadium. Further, to satisfy the operation of element 1G, the reconfiguring includes "*allocating at least one DRU* [e.g., DRU#2, below] *from the first radio resource* [e.g., from red] *to the second radio resource* [e.g., blue].



357. Kummetz-464 discloses element 1G because it discloses the same operation as discussed for the '382 patent for satisfying element 1G.

2. Claim 2

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

358. Kummetz-464 discloses the limitations added by claim 2.

359. The term "BTS" is defined in the specification of the '382 patent as base transceiver station. EX1001 at code 57 (Abstract), 1:56-58 ("The system … includes one or more Base Transceiver Stations (BTSs)"). This is consistent with its plain and ordinary meaning to a POSA. Further, a POSA would also understand that a "typical base station comprises three independent radio resources, commonly known as sectors," as acknowledged by the '382 patent. EX1001, 5:8-13.

360. Each of Kummetz-464 Figs. 1 (reproduced below, annotated), 2 and 6 disclose a base station router 14 that is coupled to one or more base stations 12a–n.

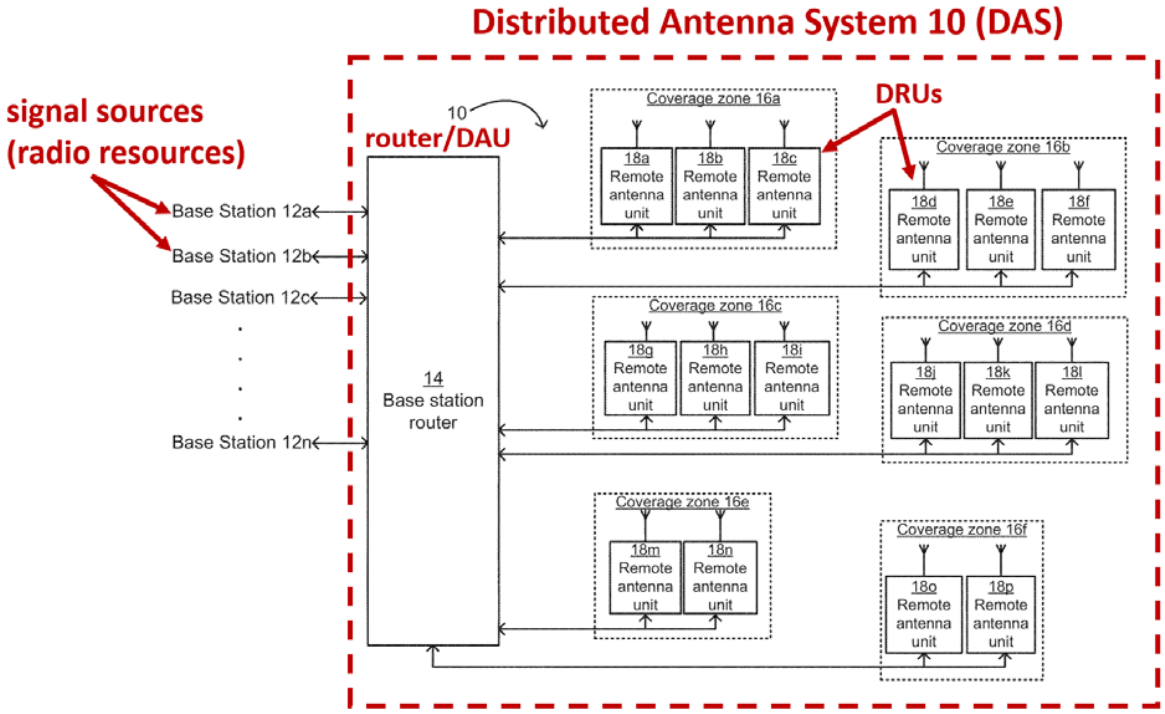


FIG. 1

EX1005, Fig. 1, 5:14-23 (also indicating that each base station can including multiple sectors, stating: "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.")

361. Kummetz-464 further discloses that each base station 12a–n can comprise one or more sectors (each sector representing a different set of radio sources, e.g., one or more frequency channels or RF bands). EX1005 at 5:50–54 ("Routing the signals can include combining the signals of the sectors from one or more base stations 12*a–n*."); 4:5–19, 5:19–22. The base station router 14 can combine signals from multiple sectors from the one or more base stations 12a–n.

EX1005, 5:54–58. The base station router 14 then distributes the one or more sectors of each base station 12a–n to the coverage zones. EX1005, 3:15–30, 10:30–43.

362. Based on the foregoing disclosures, a POSA would have understood that Kummetz-464 discloses the added limitations of claim 2.

3. Claim 4

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

363. As discussed under element 1E, Kummetz-464 discloses a traffic monitoring unit (i.e., controller 108). Kummetz-464 teaches that "the controller 108 can be disposed in the base station router 14" [a DAU] as shown in Fig. 2. EX1005 at 8:58-59. Kummetz-464 teaches the limitations added by claim 4 because Kummetz-464 also teaches that the controller 108 or traffic monitoring unit "can be disposed in a separate device external to and in communication with the base station router 14." EX1005 at 8:60-62.

4. Claim 5

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

364. For the reasons discussed above under element 1E and claim 4, Kummetz-464 discloses the limitations added by claim 5. Kummetz-464 teaches

that "the controller 108 can be disposed in the base station router 14" [a DAU] as shown in Fig. 2. EX1005 at 8:58-59.

5. Claim 6

"6. The system of claim 1 wherein the traffic monitoring unit is external to the plurality of DRUs."

365. For the reasons discussed above element 1E, Kummetz-464 discloses the limitations added by claim 6. Kummetz-464 discloses that the "controller 108" is provided as a component of a "base station router 14," and the "base station router 14" is external to "remote antenna units 18*a–p*." EX1005, Figs. 1–2, 5:14–16, 8:54–62.

6. Claim 8

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

366. For at least the reasons discussed above for elements 1F and 1G, Kummetz-464 discloses the limitations added by claim 8. In particular, Kummetz discloses that the "controller 108" can analyze one or more "traffic indicators" for the one or more "base station routers." Kummetz-464 states:

> A traffic indicator can include data describing or otherwise corresponding to a number of mobile devices in each coverage zone. Examples of a traffic indicator can include 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.

EX1005, 9:44–54. Comparing traffic measurements to low or high thresholds is an example of analyzing a key performance indicator. Further, the controller 108 can "communicate data describing the routing of signals by the base station router 14" and "implement any process for measuring uplink signals for traffic and other types of information." *Id.*, 9:34–35, 9:55–65. Kummetz's "traffic indicators" are consistent with the description of KPIs in the '382 patent Patent. EX1001, 10:33–38.

7. Claim 9

> **"9. The system of claim 1, wherein the traffic monitoring unit is configured to analyze Quality of Service (QoS) values of the DAS."**

367. Kummetz-464 discloses the limitation added by claim 9.

368. The discussion in ground under element 1F is incorporated by reference. Kummetz-464 explains, for example at column 9:40-54, how the controller (*traffic monitoring unit*) operates to detect and analyze traffic indicators.

> The configuration engine 210 can include a configuration management function for determining how to redistribute signal capacity among coverage zones. The configuration engine 210 can execute the configuration management function in response to the detection of a traffic indicator. 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.

EX1005, 9:40–54.

369. Detecting and making measurements of traffic and other metrics such as failure events, interference, locations of users, and the number of mobile users per sector are examples of key performance indicators (KPIs). Id.

370. In addition, Kummetz-464 teaches that a traffic indicator can also be compared to a "low" threshold value or a "high" threshold value. EX1005, 9:50-51. This is an example of analyzing QoS values of the DAS. The result of the comparison (passing threshold / not passing threshold) is a QoS value of network traffic and is a function of the KPIs. In addition, the high and low threshold values themselves are examples of QoS values of network traffic. The threshold values are a function of one more key traffic indicators (KPIs) because the thresholds are chosen in light of and are compared to the measured traffic indicators such as number of mobile users per sector and the thresholds are used to assess traffic measurements to decide whether to trigger adding or removing radio resources.

8. Claim 10

371. As explained above, Claim 10 has almost the same scope as dependent claim 4 which modifies claim 1 by requiring the traffic monitoring unit be external to the one or more DAUs. For the same reasons discussed above that claim 1, as modified by claim 4, is anticipated, Kummetz-464 also anticipates claim 10.

a. Element 10A

"A system comprising"

372. For the reasons discussed above regarding element 1A, Kummetz-464 discloses element 10A.

b. Element 10B

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

373. For the reasons discussed above regarding element 1B, Kummetz-464 discloses element 10B.

c. Element 10C

"one or more Digital Remote Units (DRUs) couplable to the one or more DAUs and operable to transport

signals between the one or more DRUs and the one or more DAUs;"

374. For the reasons discussed above regarding element 1C, Kummetz-464 discloses element 10C.

d. Element 10D

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

375. For the reasons discussed above regarding element 1D, Kummetz-464 discloses element 10D.

e. Element 10E

"a traffic monitoring unit external to and couplable to at least one of the DAUs, wherein the traffic monitoring unit is configured to:"

376. For the reasons discussed above regarding element 1E and claim 4 which modifies element 1E by requiring the traffic monitoring unit be "external to" at least one of the DAUs, Kummetz-464 discloses element 10C. Kummetz-464 discloses a traffic monitoring unit (i.e., controller 108). Kummetz-464 teaches that "the controller 108 can be disposed in the base station router 14" [a DAU] as shown in Fig. 2. EX1005 at 8:58-59. Kummetz-464 teaches that the controller

108 or traffic monitoring unit "can be disposed in a separate device external to and in communication with the base station router 14." EX1005 at 8:60-62.

f. Element 10F

"wherein the traffic monitoring unit is configured to: determine one or more of: 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"

377. For the reasons discussed above regarding element 1F, Kummetz-464 discloses element 10F.

g. Element 10G

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

378. For the reasons discussed above regarding element 1G, Kummetz-464 discloses element 10G.

9. Claim 11

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

379. For at least the reasons I discussed above for claim elements [1E] and [10E], Kummetz-464 discloses claim 11. Kummetz-464 discloses that the

"controller 108" may be provided as a component of a "base station router 14," and the "base station router 14" is external and coupled to each of "base stations 12*a*–*n*." EX1005, Figs. 1–2, 5:14–16, 7:50–8:7, 8:54–62. Based on the foregoing disclosures, a POSA would have understood that Kummetz-464 discloses the limitations added by claim 11.

10. Claim 12

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

380. Kummetz-464 discloses a network optimization processor coupled to the traffic monitoring unit. Kummetz states:

> The controller 108 can include a processor 202 that can execute code stored on a computer-readable medium . . . to cause the controller 108 to configure the base station router 14. Non-limiting examples of a processor 202 include a microprocessor, a peripheral interface controller ("PIC"), an application-specific integrated circuit ("ASIC"), a field-programmable gate array ("FPGA"), or other suitable processor. The processor 202 may include one processor or any number of processors.

EX1005, 8:64–9:5.

381. The Kummetz-464 controller also includes a configuration engine 210 that, when executed by the processor 202, can "implement any process for measuring uplink signals for traffic" and "can cause the controller 108 to redistribute capacity in the DAS 100." EX1005, 9:22–25, 9:55–61, Fig. 3. As I

discussed above for claim elements 1E, 1F and claim 3, the processor 202 (*i.e.*, network optimization processor) can cause the controller 108 to reconfigure the base station router 14 to optimize the network (*e.g.*, "in response to changes [in] concentration of wireless devices in the respective coverage zones"). EX1005, 11:13–15.

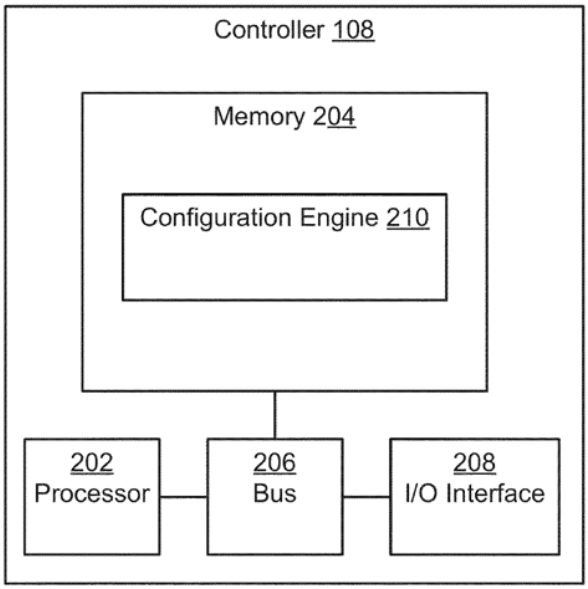


FIG. 3

382. Based on the foregoing disclosures, a POSA would have understood that Kummetz-464 discloses the limitations added by claim 12.

11. Claim 13

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

383. Kummetz-464 discloses the limitations added by claim 13. For example, Kummetz-464 discloses an embodiment comprising a plurality of base station routers 14a–c (DAUs) as illustrated in Figure 6. EX1005, 11:39–52, Fig. 6.

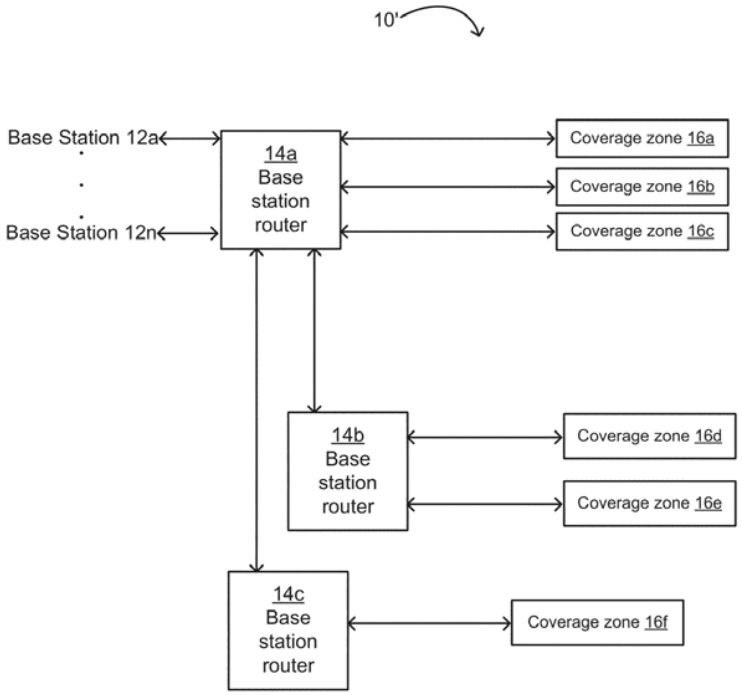


FIG. 6

384. Kummetz-464 states:

> 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.

EX1005, 4:61–5:4; *see id.*, 11:39–52.

385. Based on the foregoing disclosures, a POSA would have understood that Kummetz-464 discloses the limitations added by claim 13.

12. Claim 14

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

386. Kummetz discloses this additional limitation. Kummetz-464 states:

> 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.

EX1005, 7:12–19; *see* EX1005, 2:54–58, 3:7–14.

387. Based on the foregoing disclosures, a POSA would have understood that Kummetz-464 discloses the limitations added by claim 14.

13. Claim 15

> **"15. The system of claim 10, wherein the one or more DRUs are connected in a daisy chain configuration."**

388. Kummetz-464 discloses this additional limitation. Figure 1 of Kummetz-464 illustrates an embodiment in which a single base station router 14 is directly connected to multiple remote antenna units 18a–p. EX1005, 2:54–58, 3:7–

14, 5:14–16, 7:12–19, 7:45–49, 8:23–33. Kummetz-464 further discloses that the connections between a set of remote antenna units can be a "serial link," which a POSA would have understood as a reference to a daisy chain configuration. EX1005, 2:54–59.

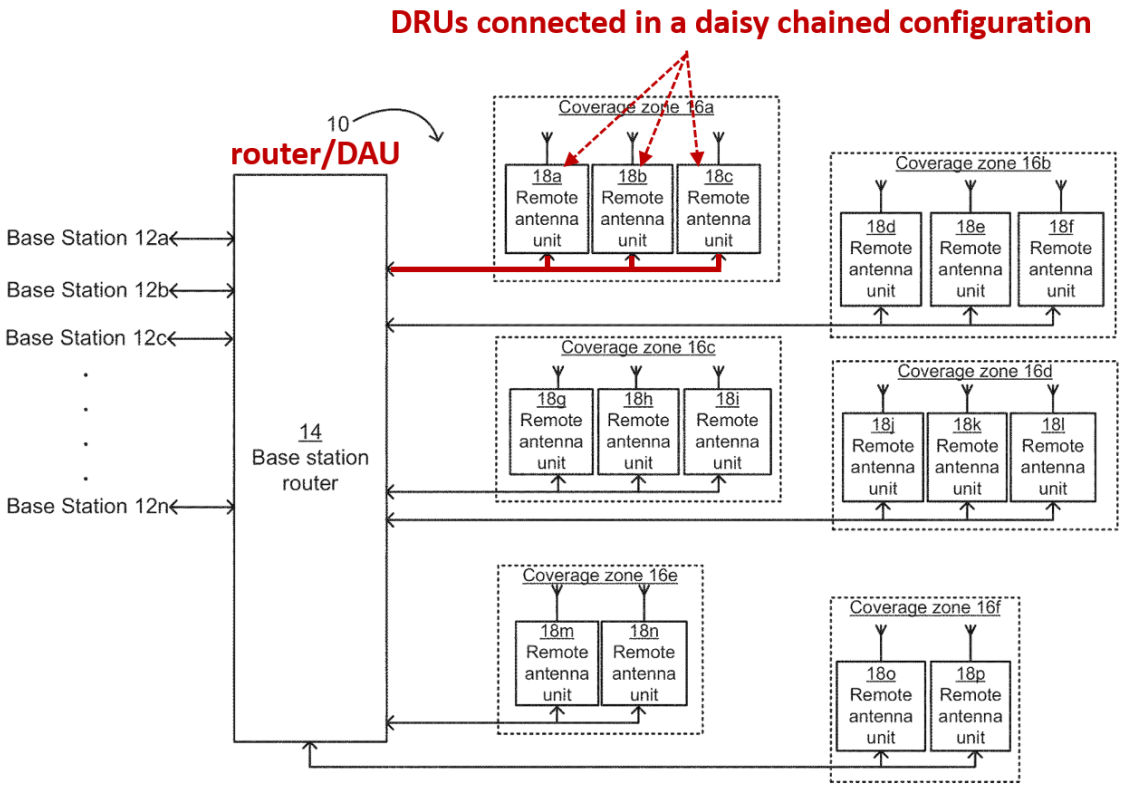


FIG. 1

14. Claim 16

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

389. A POSA would understand that a "star configuration" refers to a point-to-multipoint topology in which a central node is directly connected to a plurality of peripheral nodes—also called a "hub-and-spoke" configuration. That Kummetz-464 teaches the use of CPRI for the links reinforces that a POSA would have understood that a "star configuration" and "hub-and-spoke" configuration are synonymous. See EX1009, Section 2.3 and Figs. 5 (showing "star topology" supported by CPRI).

390. Kummetz-464 discloses the limitation added by claim 16 because Fig. 1 (below, annotated) of Kummetz-464 shows that DRUs 18a, 18d, 18g, 18j, 18m, and 18o are connected to router 14 (a DAU) in a star configuration. EX1005, 2:54–58, 3:7–14, 5:14–16, 7:12–19, 7:45–49, 8:23–33.

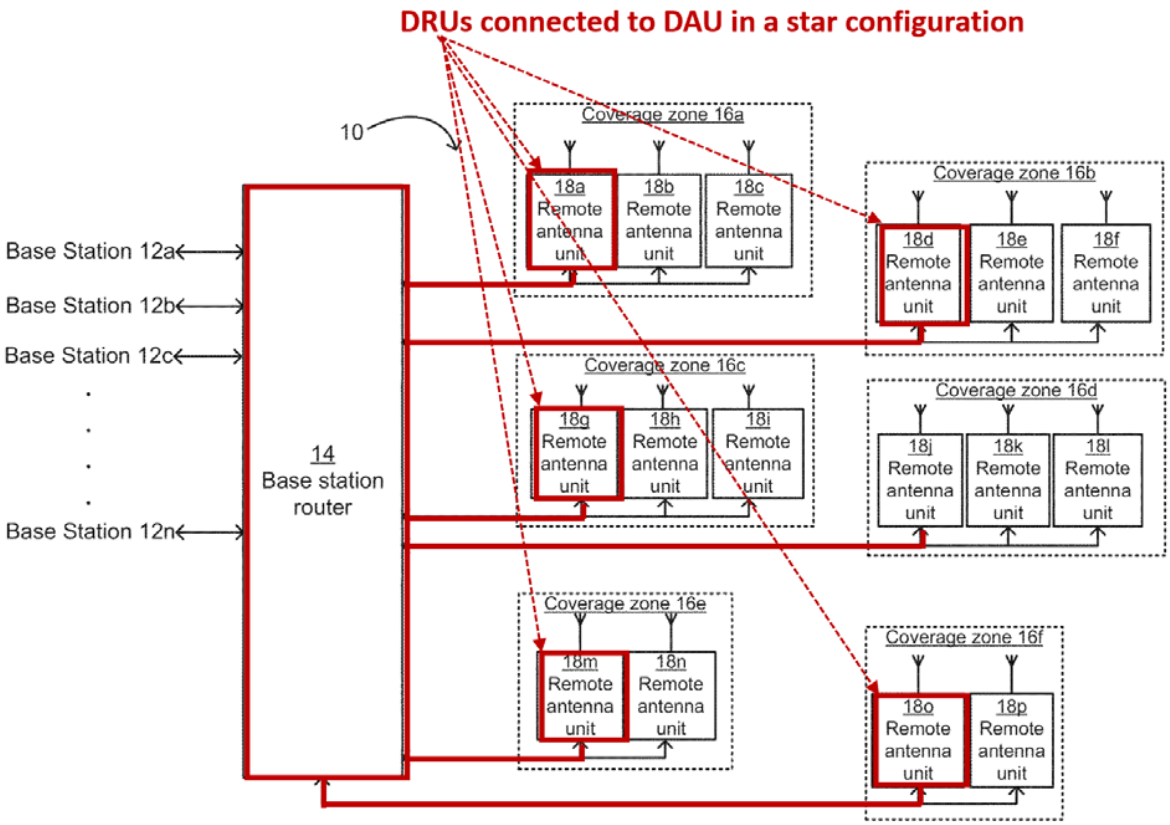


FIG. 1

EX1005, Fig. 1.

15. Claim 17

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

391. Kummetz-464 discloses the limitation added by claim 17. Kummetz-464 states that the base station router 14 "can receive signals from the base station

12*a–n* via a wired or wireless communication medium." EX1005, 5:24–25. Kummetz-464 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. EX1005, 4:66–5:4, 7:16–20. See also the discussion above under claims 13 and 14.

392. Thus, Kummetz-464 discloses both wired (*e.g.*, optical fiber) and wireless (*e.g.*, microwave, wireless, satellite) connections between the base station router 14 (a DAU) and base stations 12a–n.

393. Based on the foregoing disclosures, a POSA would have understood that Kummetz-464 discloses the limitation added by claim 17.

16. Claim 19

> **"19. The system of claim 10, wherein a single DAU port is connected to one or more BTSs."**

394. For the reasons discussed under claim element 1B and 10B Kummetz-464 the limitation added by claim 19.

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

1. Independent claims 1 and 10

395. If Patent Owner argues that Kummetz-464 does not anticipate the independent claims (claims 1 and 10), alternatively, Kummetz-464 renders these

claims obvious in view of (a) Kummetz-464 alone or (b) Kummetz-464 in combination with Wu. To be clear, my lead opinion is that Kummetz-464 anticipates the independent claims (claim 1 and 10).

a. Element 1B/10B

"…configured as an uplink/downlink port"

396. For the same reasons discussed under Ground 3, Kummetz-464 teaches each of the elements 1A and 1C-1G of claim 1, as well as elements 10A and 10C-10G.

397. It is my opinion that Kummetz-464 teaches element 1B/10B. The last clause of element 1B/10B requires "an input port" and "an output port" both "configured as an uplink/downlink port". Kummetz-464 Fig. 2 shows both (1) the link to the input of the router 14 and (2) the link to the output of the router as bi-

directional links.

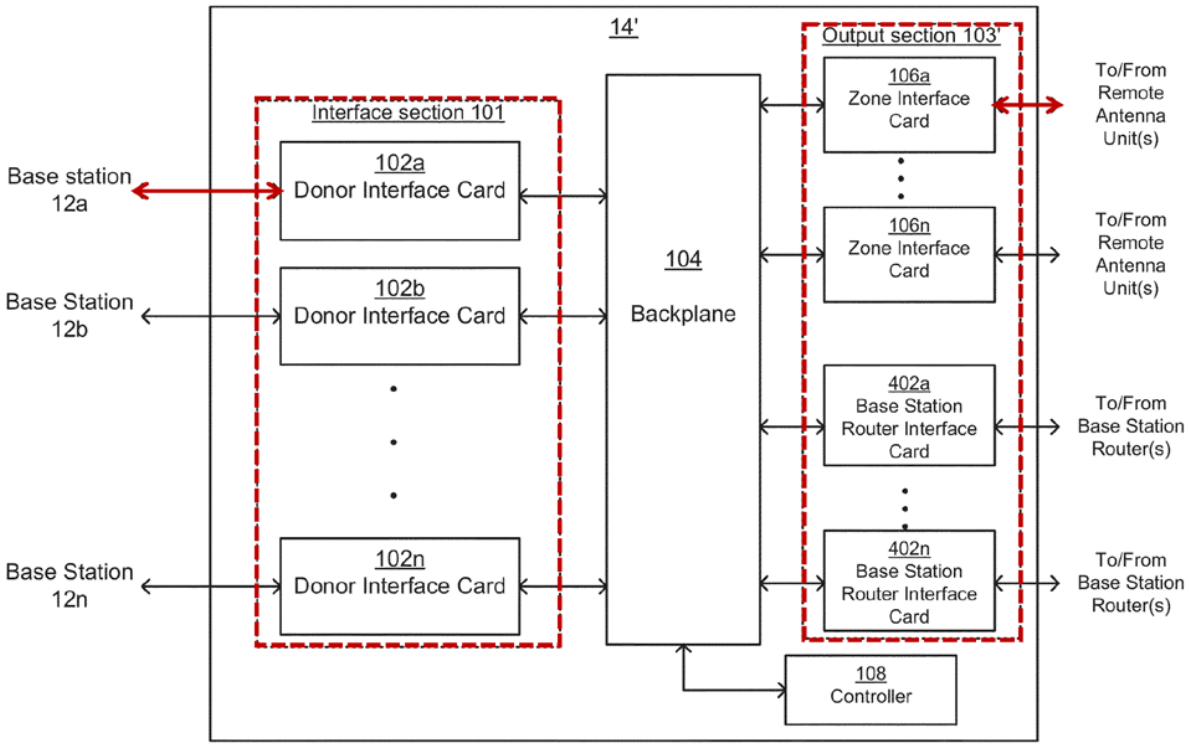


FIG. 2

398. The Kummetz-464 written specification, in addition to stating that the link between the base station and the router can use a common digital format such as CPRI, it also expressly describes the link as "bi-directional". EX1005, 4:21-23 ("A donor interface card can interface with a base station for bi-directional communications of sector signals"). Kummetz-464 also describes the link between the router and a remote antenna unit can employ a common digital format without expressly stating that the link is bi-directional.

399. **Obvious based on Kummetz-464 alone**. To extent it is argued that Kummetz-464 does not provide a disclosure describing the link between the router and a remote antenna unit can be bi-directional, then, based on Kummetz-464 alone it would have been obvious to a POSA to employ a bi-directional link between the router and the remote antenna units of Kummetz-464.

400. Kummetz-464 Fig. 2 specifically shows the use of bi-directional link for transporting signals "**To/From Remote Antenna Units**"); EX1005, Fig. 2. That Kummetz-464 states that the link "to/from remote antenna units" may also use "common digital formats" (EX1005 at 7:60-65) also would have suggested to a POSA to use CPRI or ORI digital formats both of which use bi-directional links. EX1005 at 6:11-15 (listing CPRI and ORI as examples of common digital formats), 7:45–49, 8:23–24, 8:27–32, 8:41–42. As discussed above, the CPRI interface protocol defines its links to be bidirectional between two directly connected ports. See also EX1013 at Fig. 2.3.1 and section 3.1 ("**ORI link:** bidirectional interface in between two directly-connected ORI **ports**, on two ORI nodes").

401. **Obvious on Kummetz-464 in view of Wu**. Wu also discloses a distributed antenna system and is directed to the same problem: load balancing in a DAS when conditionals in the coverage area changes. EX1007, ¶5. Wu also discloses a DAS that can dynamically route radio resources to address the problem.

EX1007, Title, Abstract, ¶9, ¶11, ¶¶38–44. For efficiency reasons, Wu teaches to use a bidirectional link using CPRI for the links to the remotes, a common digital format that employs bidirectional links. EX1007 at Fig. 2, ¶36 ("The discussion regarding the routing of channels 1-12 from host units to RTUs is presented as channels flowing from transceiver 260, through host units 230, to RTUs. It should be noted that the disclosed system is considered to be bi-directional where carrier channel signals can be received by host units 230 from RTUs, then forwarded to multi-band transceiver 260 or a booster for transmission within bands 263."); ¶49 ("As previously discussed, preferred links 215 utilize a standard for exchanging data on channels 273 (e.g., CPRI, OBSAI, etc.). The CPRI interface protocol defines its links to be bidirectional between two directly connected ports. EX1009, 7, 8, 10. Thus, based on Wu's disclosure of a DAS that addresses the same problem as addressed by Kummetz-464 and 'the 382 patent, a POSA would have been motivated to use a bi-directional link between the Kummetz-464 router output port and the remote antenna port. One would be motivated to use bidirectional ports to reduce the components, cost, and size of the system. Fewer ports and fewer cables would be necessary where bidirectional ports are employed.

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

bi-directional port would save cost over a system requiring two ports and two cables (one for the downlink and second for the uplink) would have reinforced with a POSA that Wu's bi-directional CPRI ports (i.e., in the link to the remote antenna units) could be successfully combined with the Kummetz-464 system.

2. Claim 3

> **"3. The system of claim 2, further comprising a network optimization goal comprising a percentage of users associated with each of the plurality of radio resources."**

403. If the Patent Owner argues that Kummetz-464 does not anticipate the claim 3, then, alternatively, Kummetz-464 alone renders claim 3 obvious.

404. It should be noted that '382 patent defines "optimization" to include performance improvements, even if complete optimization is not achieved.

> Although embodiments are discussed in terms of optimization of DAS networks, the term optimization is properly understood to include performance improvements in comparison to conventional systems, even if complete optimization is not achieved. Thus, optimization does not require the maximum values for traffic management metrics, but also includes distribution of traffic that improves system performance while remaining short of maximum performance.

EX1001, 6:7-15.

405. The ‘382 patent teaches that the network optimization unit 120 can implement a network optimization goal (*e.g.*, number of users per sector) based on traffic information in the form of key performance indicators (KPIs):

> KPI may comprise information such as: number of blocked calls, number of active calls, average power of uplink channels, average power of downlink channels, traffic on each sector, failed calls, number of satisfied users, number of unsatisfied users, number of users operating through a given DRU, and the like.

EX1001, 10:38-45;

> The network optimization unit can implement a network optimization goal, which may relate to the number of users per sector, for example, that each sector carry a percentage of traffic less than 50% of the total traffic… that each sector have less than 50% of the users…, or the like. Thus, the optimization goals can include metrics of the system performance. Although the system may not reach the goals, progress toward the goals can be provided, improving the user experience.

EX1001, 7:51-61;

> As an example of optimizing network performance, a base station typically has three sectors. The DRU can be allocated to different sectors in order to improve performance by shifting traffic from a first sector (e.g., a high traffic sector) to a second sector (e.g., a low traffic sector) by shifting a DRU allocated to the first sector to the second sector. … the system performance can be improved using the techniques described herein, for example, by measuring the traffic load on the DRUs, performing load balancing of the traffic on the DRUs, to reduce the load on a first DRU characterized by a first traffic load by shifting the load to a second DRU characterized by a second traffic load less than the first

> traffic load. In the optimization process, system performance can be measured against a predetermined threshold, with the optimization process terminating once the predetermined threshold has been reached.

EX-1001, 11:6-23;

> FIG. 10 illustrates one embodiment of the DAS network calculation of the KPIs and QoS. The important parameters for determining the DAS network QoS include the number of users allocated to a given DRU, the spatial distance between the various DRUs, as well as identifying which DRUs are assigned to which BTS sector.

EX-1001, 11:33-38;

> FIG. 11 illustrates one embodiment of the flow chart for the optimization algorithm. In this embodiment an Estimation Distribution Algorithm (EDA) is used. Various DRU allocation scenarios are investigated to determine the optimum DRU scenario that achieves the highest QoS..

EX1001, 11:39-43;

> Network Optimization
>
> The network's performance (expressed by the number of KPIs from different parts of the network) determines the QoS values. Different operators may have different defined business goals and different services of interest. Based on these considerations, efficient and cost effective network performance management varies from operator to operator. Therefore, QoS metrics could be defined and mapped to a set of KPIs. When a set of KPIs is used, then the mapping needs to be represented by a weighted normalized function.

EX-1001, 11:54-63.

Obvious in view of Kummetz-464 itself.

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

407. Also, as discussed under Ground 3, Kummetz-464 provides Figs. 4 and 5 to illustrate how the '382 system operates to address the capacity problem (and achieve the network optimization goal) when the system's coverage area is a sporting event venue that includes (a) a parking lot area and (b) stadium area. A POSA would understand that due to the nature of sporting events, before game time, a very large percentage of users are in the parking lot and a low percentage of users, if any, are in the stadium. Around the start of a game, that large percentage of users in the parking lot move in mass to inside the stadium, leaving a very low percentage, if any, in the parking lot during the game.

408. To trigger the redistribution and achieve the network optimization goal, the Kummetz-464 system measures or detects a traffic indicator such as *"data describing or otherwise corresponding to a number of mobile devices in each coverage zone" or "traffic measurements passing low or high thresholds."* EX1005, 9:34-54.

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

410. Patent Owner may argue that to satisfy claim 3, the system must use an indicator that represents a percentage, e.g., more than 50% of the total number of users have moved to inside the stadium. In other words, if Patent Owner argues that it is not enough that the traffic indicators only be used as an indication that its game time and thus indicating a large percentage of the users have moved to inside the stadium (or, by contrast a very low percentage of users, if any, remain in the parking lot), then it would have been obvious to POSA to use a traffic indicator expressed as a percentage of the total number of users that have moved inside the stadium.

411. Under the Kummetz-464 teachings, the system would already have (a) the total number of users; (b) the number of users in the parking lot, and (c) the

number of users in the stadium. Having a system that already provides the information of (a) – (c), using a traffic indicator expressed as a percentage is a predictable variation of the measured traffic indicators used in the Kummetz-464 system to achieve the same result – provide the system with data that indicates that a very large percentage of users have moved to inside the stadium and thus trigger the redistribution of capacity. In view of the Kummetz-464 teachings and the measured traffic data already provided by the Kummetz-464 system, a POSA would have understood that expressing the traffic indicator as a percentage was a matter of design choice and implementing that design choice would have been routine and would have predictably led to achieving the same result as taught by Kummetz-464.

412. A POSA would be motivated to state Kummetz-464 threshold as a percentage. First, calculating the load as a percentage of users can allow the system to predict where demand on radio resources are likely to increase. Where the number of users is high, demand is likely also to be high or at least is likely to become high in the near future. Determining where demand for resources is likely to increase provides an opportunity for the system to divert additional resources before the demand becomes problematically high. In other words, it allows the resources to be redistributed before the problems occur.

413. Second, redistributing capacity based on a percentage of users is a way to more equitably allocate resources to users. By taking into account the percentage of users, it drives the resource allocation algorithm toward an allocation that favors fairness among users, rather than give preference to a few users that may be consuming a large quantity of resources.

414. A POSA would have a reasonable expectation of success to calculate the load as a percentage of users because it is a simple mathematical calculation (a simple division operation relating users on a resource to the total number of users). This type of mathematical operation is easily performed by the processors present in Kummetz-464.

3. Claim 7

"7. The system of claim 1 wherein the traffic monitoring unit is provided as a component of each of the plurality of DRUs."

415. Kummetz-464 alone renders the limitation added by claim 7 obvious. Kummetz-464 discloses the controller (a traffic monitoring unit) "can be disposed in a separate device external to and in communication with the base station router 14." EX1005, 8:58–62. A POSA would understand that each of the remote antenna units of Kummetz-464 is an example of "a separate device" (i.e., external to the router) external to the router that the traffic monitoring unit could be disposed in as by Kummetz-464. Therefore, the teaching of Kummetz-464 (i.e.,

including the controller in a "separate device external to" the router) would have at least motivated a POSA to include a traffic monitoring unit within each of the "one or more" remote antenna units, one of the already-existing components of the system that already has access to the signals to be monitored via, e.g., RSSI (Received Signal Strength Indicator) measurements on received traffic signals. Also, a POSA would have understood that that RSSI is a measured indication of network traffic.

416. Doing so would have been an obvious design choice because there are only a limited number of existing components external to the router in Kummetz-464's system.

417. A POSA would have understood that providing a traffic monitoring unit within each of the one or more remote antenna units was a matter of design choice and implementing such a design would have been routine (e.g., power or signal strength detectors) and would have led to predictable results (measurements generating data relating to traffic received from user devices at the remote antenna units). A POSA would have also been motivated to position the traffic monitoring unit within the remote antenna unit because both the traffic, both in the uplink and downlink directions, passes through the remote antenna unit, providing a location where the traffic can thus be monitored.

418. In addition, the Kummetz-464 reference specifically refers a POSA to the disclosure of Kummetz-579 as teaching systems and processes for measuring uplink signals for traffic information and other types of information:

> The processor 202 can execute the configuration engine 210 so as to configure the controller 108 to implement any process for measuring uplink signals for traffic and other types of information, and reporting the information. Certain systems and processes that can be used to do so are described in U.S. Ser. No. 12/778,312, filed May 12, 2010 and titled "System and Method for Detecting and Measuring Uplink Traffic in Signal Repeating Systems."

EX1005, 9:57-65 (emphasis added). Application No. 12/778,312 published as US 2011/0281579 ("Kummetz-529") EX1008. Fig. 4 of Kummetz-579 discloses and shows a remote antenna unit of a DAS may include a measurement receiver (a traffic monitor unit) capable of measuring network traffic, which is one of the "traffic indicators" (*i.e.*, KPIs) identified in Kummetz-464. EX1008, Fig. 4 ("measurement receiver" 101), ¶38 ("FIGS. 4 and 4A illustrate implementation of the invention within a distributed antenna system, particularly within a remote antenna unit component 38") ; ¶39 ("FIG. 4 illustrates another embodiment of the invention implemented within a remote unit of the distributed antenna system"), ¶¶35-38 ("a suitable measurement receiver 101 is utilized to capture signals in the uplink path and to provide RSSI values reflective of the received power of such signals."):

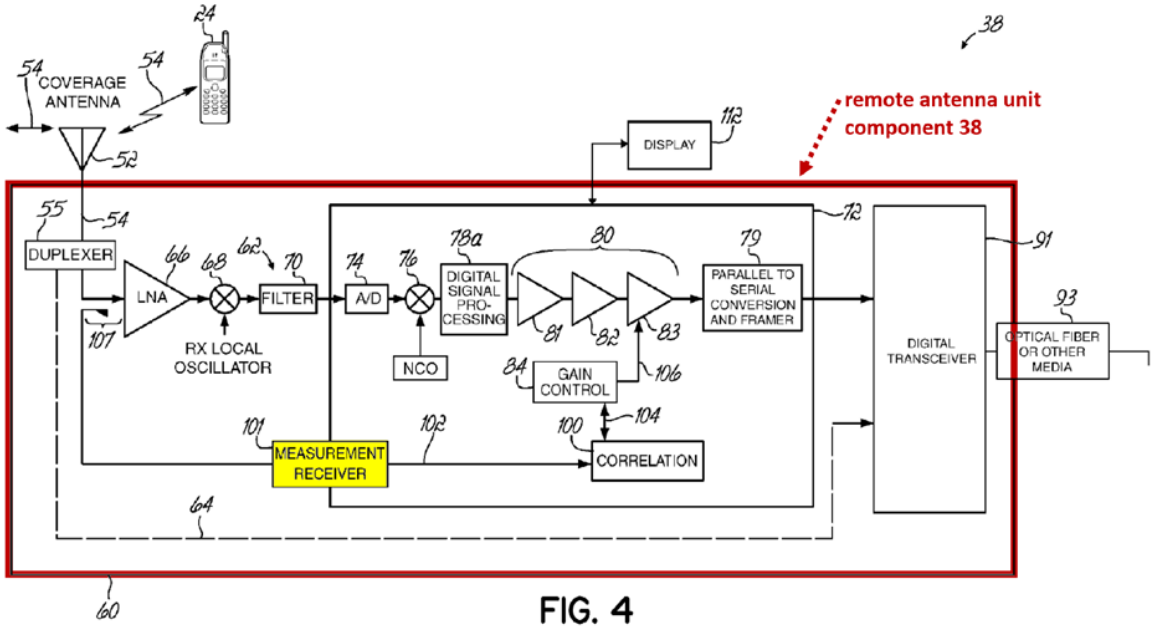


FIG. 4

EX1008, Fig. 4 (annotations added).

419. The measurement receiver included in the remote antenna unit of the Kummetz-579 system is described as "suitable . . . to capture signals in the uplink path and to provide RSSI [Received Signal Strength Indicator] values reflective of the received power of such signals." EX1008, ¶¶ 35-36. A POSA would have understood the remote antenna unit of the Kummetz-579 DAS to be analogous to the "remote antenna unit" of Kummetz-464 system. *Compare* EX1005, Figs. 1–2, 3:7–14, 3:28–30, 4:45–58, 5:14–16 *with* EX1008, Figs. 2, 4, 4a, ¶¶20-38. A POSA would have also understood "measurement receiver 101" is a traffic monitoring device capable of measuring network traffic, which is one of the "traffic

indicators" (i.e., KPIs) identified in Kummetz-464. Id. As noted, a POSA would have also understood that RSSI is a measured indication of network traffic.

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

4. Claim 9

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

421. If the Patent Owner argues that Kummetz-464 does not anticipate the claim 3, then, alternatively, Kummetz-464 alone or in view of Wu renders claim 9 obvious.

Obvious in view of Kummetz-464 itself

422. Kummetz-464 discloses a controller (*a traffic monitoring unit*). EX1005, 8:54–58, 8:63-9:25, 9:34-65, Figs 2, 3. Kummetz-464 also teaches that the controller operates to detect and analyze traffic indicators. EX1005, 9:40–54. Kummetz-464 further teaches that the controller can use low and high thresholds that are compared to measured traffic indicators. EX1005, 9:50-51. To the extent that Patent Owner contends that the teaching to compare a measured traffic indicator to a "low" threshold value or a "high" threshold value is not an

example of analyzing QoS values, then it would have been obvious to POSA to configure the Kummetz-464 DAS to analyze Quality of Service (QoS) values on Kummetz-464 alone.

423. A POSA would have found it obvious that the high and low threshold values could also be applied to analyze metrics that are calculated from the KPIs (i.e., to analyze QoS values of network traffic). Combining or deriving a QoS value as a function of the traffic indicators disclosed in Kummetz-464 and then analyzing those QoS values by comparing to a high or low threshold is predictable variant of Kummetz-464. Using raw data to calculate a separate QoS value such as rate (e.g., count per unit time) or a percentage (count per total) or a density are well-known, simple mathematical functions that can be used to describe the performance of the network. A POSA would be motivated, for example, to derive or combine raw KPI data in Kummetz-464 into a QoS value for analysis (e.g., by comparison to a threshold) for a number of reasons, including: (1) to simplify into a single decision analysis the inputs from multiple KPI measures; and (2) to genericize the values to that the analysis criteria (threshold) can be the same across multiple different air interface protocols (i.e., stating threshold as a percentage of a capacity total allows the same threshold to be applied whether the traffic is counted in time slots, carriers, resource blocks or some other measure). A POSA would have a reasonable expectation of success because these type of simple

mathematical functions are easy to program and execute by the processors already present in the Kummetz-464 system.

Obvious in view of Kummetz-464 combined with Wu

424. Wu discloses determining key performance indicators (KPIs) and quality of service (QoS) values and distributing radio resources based on such KPIs and QoS. Wu explains that the routing policy 255 "can comprise one or more rules" that will control how the switch distributes channels to the RTUs. EX1007, ¶40. The rules of policy 255 can operate as functions of one or more metrics available to switch 250. EX1007, ¶41. Wu explains that "metrics" can include observed or measured metrics, calculated metrics or other types of parameters or attributes of the system. EX1007, ¶42.

425. *Observed* or *measured metrics (KPIs).* Wu further explains observed or measures metrics in ¶42:

> Observed metrics are considered to be those having values that are measured by BTS 240, matrix switch 250, or other device associated with the system. Example observed metrics include a time (e.g., absolute, relative, date, etc.), a rate, a threshold, a quantity, a count, or other type of data that is measurable.

EX1007, ¶42.

426. Calculated *metrics (corresponding to QoS).* Wu explains that calculated metrics are metrics that are derived from other metrics such as measured

metrics. Wu provides examples of calculated metrics that describe or indicate a quality of the wireless service (i.e., the performance of the network).

> A calculated metric is considered to be a metric that has a value, or multiple values, as derived from a function operating on other metrics. Example, calculated metrics can include a traffic rate, a consumed bandwidth, an aggregated count, or other derived metrics.

EX1007, ¶42.

427. The Wu system includes a processor 253 that "can be configured to analyze traffic metrics (e.g., data rate, call rate, consumed bandwidth, etc.) and correlate various metrics with a signature of potential traffic issues, load balancing for example." EX1007 at ¶44.

428. *Motivation to combine*. A POSA reading Kummetz-464 would have naturally looked to Wu for the reasons discussed above and because they both disclose distributed antenna systems, they both disclose a system with the similar goal of adjusting or redistributing the capacity throughout the coverage zones of the DAS as needed, and they both address the same problem of load balancing in a DAS when conditionals in the coverage area changes. For further understanding of the network's performance and how to optimize, a POSA would have been motivated by Wu's teaching to employ the processor provided in the Kummetz-464 system to calculate and "analyze traffic metrics (e.g., data rate, call rate,

consumed bandwidth, etc.)" to assess the network's performance and identify potential balancing issues.

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

5. Claim 18

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

430. Before the effective date of the '382 patent, each of the (a) star, (b) daisy chain, and (c) loop topologies for connecting remote antenna units in a DAS were well known. Each of Kummetz-464, Evans, and Wu teach that the common digital format of CPRI may be used on the transport links to and from the remote antenna units. EX1005, 7:60-65 (link to/from remote antenna units may also use "common digital formats"), 6:11-15 (listing CPRI and ORI as examples of common digital formats), EX1010 (Evans) at ¶5 ("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"); EX1007 (Wu) at ¶31 ("Suitable standards include those based on the Common Public Radio Interface"). Example topologies disclosed in and supported by CPRI include, for example, (a) star, (b) daisy chain, (c) ring or loop. EX1009, Section 2.3 and Figs. 3, 4, 5, 5A, 5B, 5C, 5D, 5E. See also EX1005, Fig. 1 (disclosing combination of star and daisy chain); EX1010 (Evans) at Fig. 3 (star), Fig. 4 (daisy chain), Fig. 6 (ring or loop); EX1007, Fig. 1 (star and daisy chain).

431. Thus, in designing and deploying a DAS, a POSA would have understood that the topology used for connecting remote antenna units (i.e., star, daisy chain, loop or any combination thereof) was a matter of design choice, and implementing any of such topologies in a DAS would have been routine and would have led to predictable results.

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

432. For the reasons discussed under section VIII.A., Kummetz-464 teaches the limitations added by each of the claims 2-8, 11-17 and 19. Thus, Kummetz-464 alone or in combination with Wu would also render such claims obvious.

E. Ground 5: Kummetz-464 in combination with Kummetz-579 renders claim 7 obvious

"7. The system of claim 1 wherein the traffic monitoring unit is provided as a component of each of the plurality of DRUs."

433. If Patent Owner asserts that Kummetz-464 alone does not disclose or render obvious providing the traffic monitoring unit as a component of the DRUs, then Kummetz-464 in combination with Kummetz-579 renders claim 7 obvious.

434. Kummetz-464 discloses the controller (a traffic monitoring unit) "can be disposed in a separate device external to and in communication with the base station router 14." EX1005, 8:58–62. A POSA would understand that each of the remote antenna units of Kummetz-464 is an example of "a separate device" (i.e., external to the router) external to the router that the traffic monitoring unit could be disposed in as by Kummetz-464. Therefore, the teaching of Kummetz-464 (i.e., including the controller in a "separate device external to" the router) would have at least motivated a POSA to include a traffic monitoring unit within each of the "one or more" remote antenna units, one of the already-existing components of the system that already has access to the signals to be monitored via, e.g., RSSI measurements on received traffic signals.

435. A POSA would have understood that providing a traffic monitoring unit within each of the one or more remote antenna units was a matter of design

choice and implementing such a design would have been routine (e.g., power or signal strength detectors) and would have led to predictable results (measurements generating data relating to traffic received from user devices at the remote antenna units).

436. In addition, the Kummetz-464 reference specifically refers a POSA to the disclosure of Kummetz-579 as teaching systems and processes for measuring uplink signals for traffic and other types of information:

> The processor 202 can execute the configuration engine 210 so as to configure the controller 108 to implement any process for measuring uplink signals for traffic and other types of information, and reporting the information. Certain systems and processes that can be used to do so are described in U.S. Ser. No. 12/778,312, filed May 12, 2010 and titled "System and Method for Detecting and Measuring Uplink Traffic in Signal Repeating Systems."

EX-1005, 9:57-65 (emphasis added). Application No. 12/778,312 published as US 2011/0281579 ("Kummetz-579"). EX1008. Fig. 4 of Kummetz-579 discloses and shows a remote antenna unit of a DAS may include a measurement receiver (a traffic monitor unit) capable of measuring network traffic, which is one of the "traffic indicators" (*i.e.*, KPIs) identified in Kummetz-464. EX1008, Fig. 4 ("measurement receiver" 101), ¶38 ("FIGS. 4 and 4A illustrate implementation of the invention within a distributed antenna system, particularly within a remote antenna unit component 38") ; ¶39 ("FIG. 4 illustrates another embodiment of the

invention implemented within a remote unit of the distributed antenna system"), ¶¶35-38 ("a suitable measurement receiver 101 is utilized to capture signals in the uplink path and to provide RSSI values reflective of the received power of such signals."):

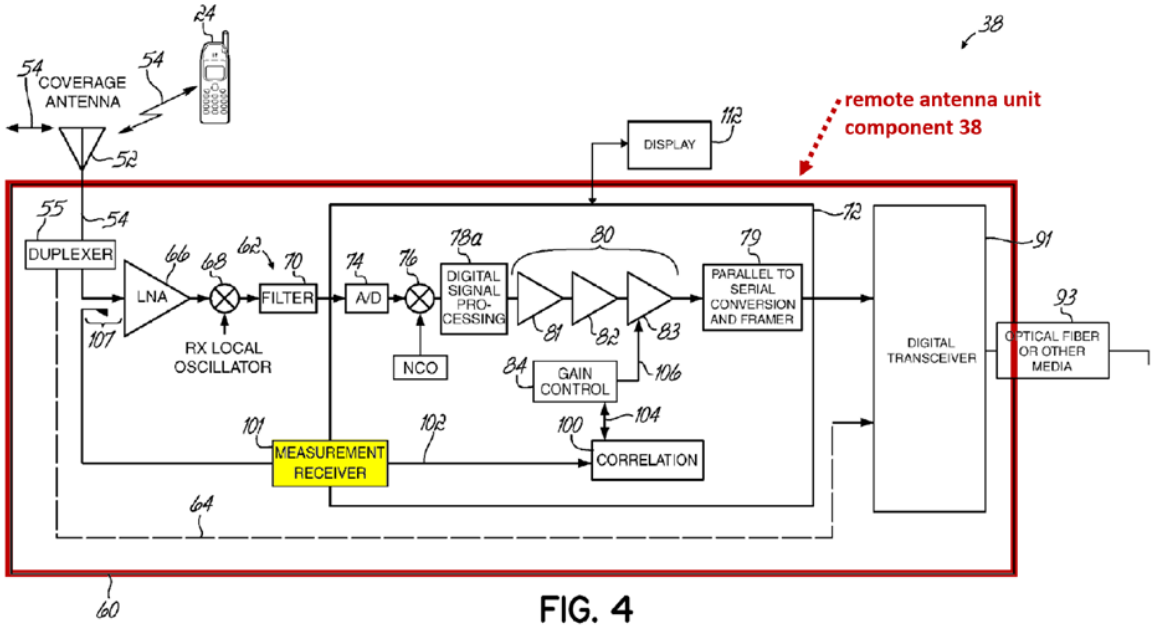


FIG. 4

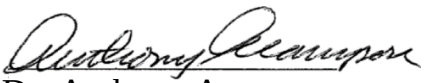
EX1008, Fig. 4 (annotations added).

437. The measurement receiver included in the remote antenna unit of the Kummetz-579 system is described as "suitable . . . to capture signals in the uplink path and to provide RSSI [Received Signal Strength Indicator] values reflective of the received power of such signals." EX1008, ¶¶ 35-36. A POSA would have understood the remote antenna unit of the Kummetz-579 DAS to be analogous to the "remote antenna unit" of Kummetz-464 system. Compare EX1005, Figs. 1–2,

3:7–14, 3:28–30, 4:45–58, 5:14–16 to EX1008, Figs. 2, 4, 4a, ¶¶20-38. A POSA would have also understood "measurement receiver 101" is a traffic monitoring device capable of measuring network traffic, which is one of the "traffic indicators" (i.e., KPIs) identified in Kummetz-464. Id.

438. One would have been motivated to position the traffic monitoring functions of the controller of Kummetz-464 in the remote antenna unit as taught by the placement of the measurement receiver in Kummetz-579 because (i) Kummetz-464 specifically teaches a POSA to look to the Kummetz-579 patent for systems to implement a controller as for measuring uplink signal traffic, (ii) the remote antenna unit is an already-existing component external to Kummetz-464's base station router (i.e., is a location external to the base station router taught by Kummetz-464, (iii) there are only a limited number of components in Kummetz-464's system that are external to the router that have access to the uplink/downlink signals to be monitored, (iv) placing a measurement receiver of the controller in already-existing remote antenna unit avoids additional cost and complexity of building, installing, and housing another component for the system. It would have been an obvious design choice to position the traffic monitoring unit (controller) in the remote antenna units as taught by Kummetz-579 which Kummetz-464 specifically references as teaching systems for measuring for traffic in a distributed antenna system.

Executed on: April 26, 2023



Dr. Anthony Acampora

APPENDIX - LISTING OF CHALLENGED CLAIMS

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

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

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

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