

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

DECLARATION OF DR. ANTHONY ACAMPORA

In Support of Inter Partes Review
of U.S. Patent No. 11,026,232

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I, Anthony Acampora, Ph.D., declare as follows.

I. Introduction

A. Engagement

1. I have been retained by Petitioner, CommScope Technologies LLC, (“CommScope” or “Ppetitioner”) to provide expert opinions in connection with a petition for inter partes review before the United States Patent and Trademark Office. This declaration involves my expert opinions and expert knowledge related to U.S. Patent No. 11,026,232 (“the ‘232 Patent”), titled “Remotely Reconfigurable Distributed Antenna System and Methods,” and its field of endeavor.

2. I have been asked to provide my independent technical review, analysis, insights, and opinions regarding the ‘232 Patent and the references that form the basis for the grounds of unpatentability set forth in the Petition for Inter Partes Review of the ‘232 Patent. The statements made herein are based on my own knowledge and opinions.

3. To summarize the opinions stated herein, it is my opinion that the claims of the '232 patent are invalid as obvious based on the following grounds:

Ground 1: Hettstedt plus Wellington	(claims 1-7, 9, 11-17, 19-20)
Ground 2: Hettstedt alone	(claims 1-7, 9, 11-17, 19-20)
Ground 3: Wu alone	(claims 1-7, 9, 12-17, 19-20)
Ground 4: Wu plus Sabat	(claims 1-7, 9, 12-17, 19-20)

Ground 5: Any of Grounds 1-4 plus Fischer	(claims 8, 18)
Ground 6: Any of Grounds 1-4 plus Conyers	(claim 10)
Ground 7: Ground 4 plus Hettstedt	(claim 11)

I also state my opinion herein that the disclosure of the Hettstedt reference would enable one of ordinary skill in the art to make or carry out the system disclosed therein without undue experimentation.

B. 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.

II. 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 '232 patent specification, claims, and prosecution history. I have been asked to assume for the purpose of this analysis that the priority date of the '232 patent is September 14, 2010, which is the date of Provisional Application No. 61/382,836.

19. I have 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. 11,026,232
1002	Prosecution History of U.S. Patent No. 11,026,232
1003	[Present] Declaration of Dr. Anthony Acampora
1004	<i>Curriculum Vitae</i> of Dr. Anthony Acampora
1005	U.S. Patent Application Publication No. 2008/0119198 A1 to Hettstedt et al. (“Hettstedt”)
1006	U.S. Patent Application Publication No. 2010/0128676 A1 to Wu et al. (“Wu”)
1007	U.S. Patent No. 8,112,094 (“Wellington”).
1008	U.S. Patent Application Publication No. 2010/0177759 (“Fischer”)
1009	U.S. Patent No. 7,398,106 (“Conyers”)
1010	U.S. Patent Application Publication No. 2009/0180426 A1 (“Sabat”).
1011	U.S. Patent No. 6,266,531 (“Zadeh”)
1012	U.S. Patent No. 5,796,722 (“Kotzin”)
1013	U.S. Patent No. 5,241,685 (“Bodin”)
1014	U.S. Patent No. 5,454,026 (“Tanaka”)
1015	U.S. Patent No. 5,666,356 (“Fleming”)
1016	U.S. Patent No. 5,790,955 (“Tomoike”)
1017	Common Public Radio Interface (CPRI); Interface Specification V4.0 (2008-06-30)
1018	U.S. Patent Application Publication No. 2005/0157675 A1 (“Feder”)
1019	U.S. Patent No. 8,958,789 (“Bauman”)
1020	U.S. Patent No. 8,346,091 (“Kummetz”)
1021	U.S. Patent No. 6,801,767 (“Schwartz”)
1022	U.S. Patent No. 6,785,558 (“Stratford”)
1023	U.S. Patent No. 7,313,415 (“Wake”)
1024	U.S. Patent No. 8,737,454 (“Wala”)
1025	U.S. Patent No. 8,583,100 (“Koziy”)
1026	U.S. Patent No. 8,204,544 (“Beaudin”)
1027	U.S. Patent No. 7,474,891 (“Toms”)
1028	U.S. Patent No. 7,848,747 (“Wala”)
1029	U.S. Patent No. 5,644,622 (“Russell”)
1030	U.S. Patent Application Publication No. 2008/0174502 A1 (“Oren”)

1031	U.S. Patent No. 6,349,200 (“Sabat 200”)
1032	NEWTON’S TELECOM DICTIONARY 785 (2000).
1033	Provisional Application No. 61/382836
1034	EP. Patent Application Publication No. EP 1924209A1 (“Hettstedt EP”)
1035	U.S. Patent No. 6,963,552 (“Sabat 552”)
1036	MERRIAM-WEBSTER’S COLLEGIATE DICTIONARY (10 th ed. 2002)(excerpt)
1037	HARGRAVE’S COMMUNICATIONS DICTIONARY (2001)
1038	U.S. Patent No. 10,080,178 (“the ‘178 patent”)
1039	IPR2020-01473 Institution Decision (‘178 patent IPR)
1040	IPR2020-01473 Judgment (‘178 patent IPR)
1041	IPR2018-00571 Final Written Decision (‘473 patent IPR)
1042	U.S. Patent No. 9,531,473 (“the ‘473 patent”)
1043	U.S. Patent No. 5,642,405
1044	U.S. Patent Application Publication No. 2006/0258305A1
1045	U.S. Patent No. 7,286,507 (“Oh”)

III. Relevant Legal Principles

A. Person of Ordinary Skill in the Art

20. I have been informed that a person of ordinary skill in the art (“POSITA”) 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.

21. The '232 patent relates to wireless communication systems. Generally speaking, the '232 patent is directed to wireless communication systems employing distributed antenna systems. *See* Ex. 1001 ('232 Patent) Abstract; 1:28-32. 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 '232 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.

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

B. Claim Construction Standard

23. 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.

24. 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. Any prior claim construction determination concerning a term of the claim in a civil action, or a proceeding before the International Trade Commission, that is timely made of record in the inter partes review proceeding will be considered by the PTAB. 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.

25. 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.

26. 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.

C. Anticipation and Obviousness Law

27. 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.

28. 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.

29. I understand that a patent claim is also invalid if the claims would have been obvious to a POSITA 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 POSITA as of the time of the invention.

30. 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 POSITA 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 non-obviousness.

31. 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 POSITA at the time of the invention.

32. 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.

33. 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. 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.

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

35. 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.

36. 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 POSITA would not have had an adequate teaching, suggestion, or motivation to combine the references.

37. 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.

D. Prior Art Enablement Law

38. To serve as an anticipating reference, I understand the reference must enable that which it is asserted to anticipate. When the anticipating reference is an issued U.S. patent or published U.S. patent application, I understand it is presumed enabled.

39. I understand that the disclosure in an assertedly anticipating reference must be adequate to enable possession of the desired subject matter. I understand that enablement requires that the prior art reference teach one of ordinary skill in the art to make or carry out the claimed invention without undue experimentation. It is insufficient to name or describe the desired subject matter if it cannot be produced without undue experimentation.

40. I understand that the determination of what level of experimentation is “undue,” so as to render a disclosure non-enabling, is made from the viewpoint of persons experienced in the field of the invention.

41. I understand that the determination of what constitutes undue experimentation in a given case requires the application of a standard of reasonableness, having due regard for the nature of the invention and the state of the art. I understand the undue experimentation test is not merely quantitative, since a considerable amount of experimentation is permissible if it is merely routine. I understand that that determination of whether the requisite amount of experimentation is undue may include consideration of: (1) the quantity of experimentation necessary, (2) the amount of direction or guidance presented, (3) the presence or absence of working examples, (4) the nature of the invention, (5) the state of the prior art, (6) the relative skill of those in the art, (7) the predictability or unpredictability of the art, and (8) the breadth of the claims

IV. Technology Background: Distributed Antenna Systems

42. Distributed antenna systems are typically used to extend or improve wireless communications coverage in areas that are difficult for signals from traditional communications towers and antennas to reach. For example, signals from distant cell towers may not penetrate inside buildings or into tunnels or may not reach other blind spots blocked or covered by geographic features such as hills, buildings, or valleys. Distributed antenna systems are deployed inside these blind spots. Distributed antenna systems typically receive communication signals from a base station, transport those signals using cables to a collection of smaller antennas

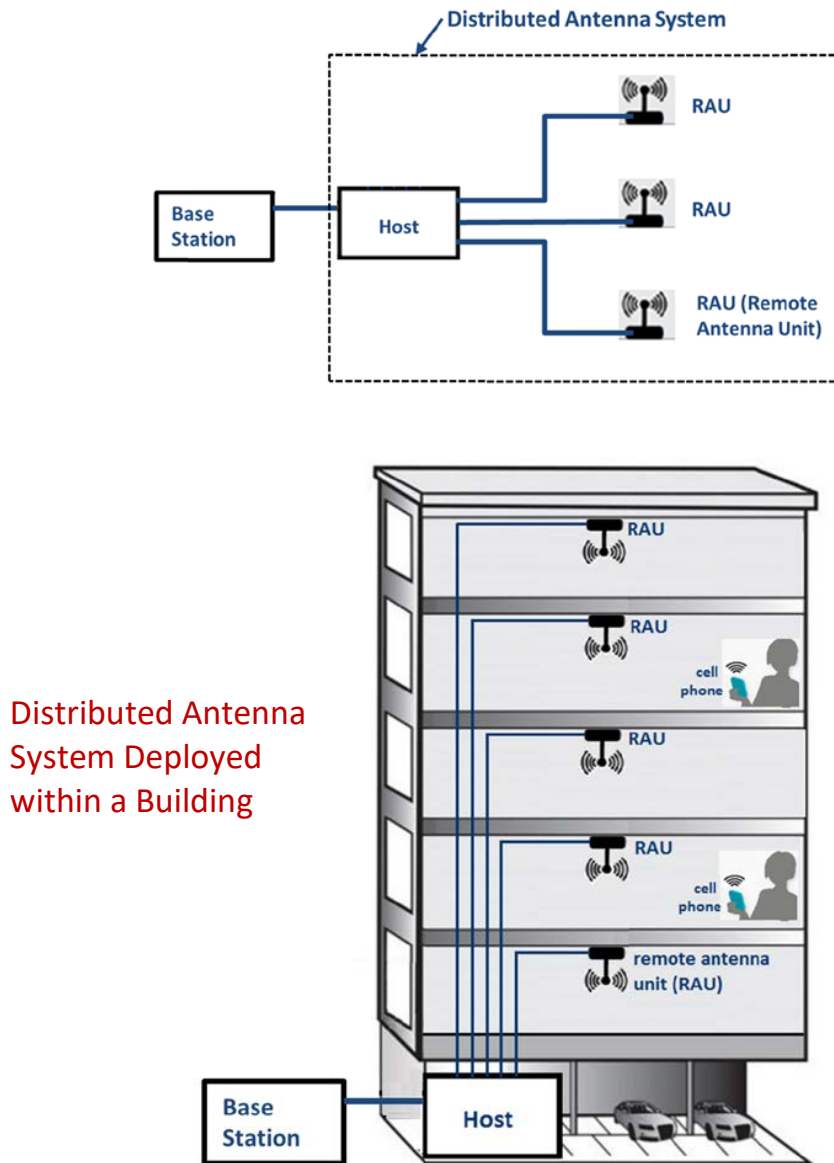
that have been distributed inside the building or targeted coverage area, and rebroadcast the wireless signals into the targeted area to wireless units such as mobile phones. The systems also transport communication signals in the opposite direction. That is, the collection of smaller antennas receives wireless communications from, for example, mobile phones within the targeted coverage area and transport those signals over cabling back to the base station. *See, e.g.*, Ex. 1010 (U.S. Patent Application Pub. No. 2009/0180426 A1) (“Sabat”). Sabat discloses:

...Distributed Antenna Systems are used to provide wireless communications coverage where it is impractical to install a conventional base station. An example is in-building coverage where low cost radiating antennas are desired and base stations represent either too large or too expensive a solution. Distributed Antenna Systems allow a donor base station to be located outside the desired coverage area and its RF signals are distributed to multiple antennas using either electrical or optical means. A means to distribute the base station's signals to more than one antenna is termed simulcast. In the direction toward the wireless user, i.e., downlink/forward path, the signal is replicated for each remote location. On the return direction, i.e., uplink/reverse path, the signals from multiple remote locations are summed to create a single composite signal for the base station.

Ex. 1010 ¶0005.

43. Distributed antenna systems were known in the art and had been deployed for years prior to the filing of the '232 patent. In the two drawings below, I have illustrated the basic building blocks of a distributed antenna system employing distributed remote antennas to expand the reach of a wireless

communications network. The first drawing illustrates the general concept. The second drawing illustrates how such a system may be deployed within a building.



44. As indicated in the drawings, the main components of a distributed antenna system are the host or hub coupled by cabling to multiple remote antenna

units that are remote from the host. The host, which is usually positioned in close proximity to the base station, receives signals from the base station, converts the signal to an appropriate form for distribution over cabling, and then transmits the resulting signals to the remote antenna units that are scattered in the desired coverage area. The remote units convert and condition the signal to an appropriate form for wireless transmission and then radiate the signals wirelessly using antennas to wireless devices such as cell phones in the coverage area. In the reverse direction, the remote units receive wireless signals transmitted by cell phones in their coverage areas, convert these into an appropriate form for transmission over cabling back to the host which then, for example, delivers a composite signal to the base station as if all the incoming signals had been received by a single antenna.

45. There were multiple approaches known in the art for building a distributed antenna system. As explained, for example, in the Sabat prior art reference (Ex.1010), both analog and digital DAS systems were known, and the communication link between the host units and the remote units could be either an analog interface or a digital interface. *See, e.g.*, Ex. 1010 Figs. 1-2; ¶¶0006-0008, ¶0013. The cabling could be copper cabling (for shorter distances) or optical fiber cable (for longer distances). It was also known that in a DAS using digital distribution between the host and remote units, the interface between the base

station and the host unit could be either analog or digital. Typically, where the host receives analog radio frequency (“RF”) signals from the base station, the host will include analog to digital converters to sample the RF signals to convert them to digital for transmission to the remote units which will then reconvert the signals from digital to analog before wireless transmission. Similar steps are taken for signals traveling in the reverse direction from the cell phones. *See, e.g.*, Ex. 1010 ¶0013 (“A digital distribution network, illustrated in FIG. 2, adds the extra steps of Analog-to-Digital and Digital-to-Analog conversions at both ends of the DAS network.”).

V. Overview of the ‘232 Patent

A. The ‘232 Specification

46. The ‘232 patent discloses a DAS that includes at least one digital access unit (DAU) that serves as the host or interface between the base station and remote radio units (RRUs). Ex. 1001, 6:13-17; Fig. 4. On one end the DAU is coupled to the base station, and, on the other end, the DAU communicates with the RRUs. *Id.* Fig. 4 shows the disclosed DAS in context, reproduced below with annotations. *Id.*

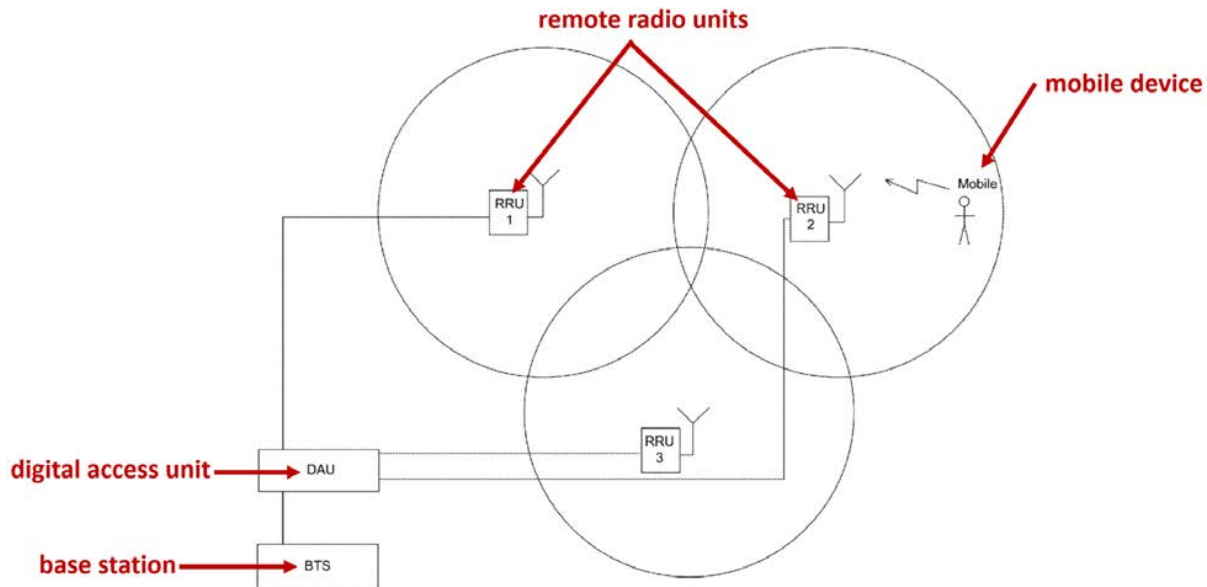


Figure 4 Indoor Localization System of GSM and LTE

47. The DAU receives radio resources (or capacity) comprising RF carriers from a base station. The DAU transmits those carriers to the RRUs. Each RRU includes a programmable frequency selective digital upconverter (DUC) that selects which subset of carriers the RRU will transmit. By configuring each RRU's digital upconverter, the DAU controls what subset each RRU transmits.

48. The '232 patent describes that efficient allocation of base station RF carriers is complicated by movement of subscribers. Ex. 1001 at 1:36-58. At lunchtime when subscribers move from office floors to the cafeteria floor resources allocated to office floors may be under-used and resources allocated to the cafeteria may be over-used.

49. To perform capacity redistribution to address changing capacity needs, the DAU and RRUs are disclosed to included embedded software control

modules for “determining and/or setting the appropriate amount of radio resources ... assigned to a particular RRU or group of RRUs to meet desired capacity and throughput objectives.” *Id.*, 11:49-57; Fig. 7. The DAU embedded software includes: (a) “DAU Monitoring module, that detects which carriers and corresponding time slots are active for each RRU” and (b) “DAU Management Control module” that communicates with each RRU’s control module “to enable or disable specific radio resources” for that RRU. *Id.* 11:49-12:24; Fig. 7. As an example, the ‘232 patent describes that the DAU Monitoring Module identifies when “a particular downlink carrier is loaded by a percentage greater than a predetermined threshold,” and if that occurs, the DAU Management Control Module modifies the system configuration to deploy additional radio resources to the RRU. *Id.* 12:5-18.

50. Figure 1 illustrates a resource allocation in the preferred embodiment.

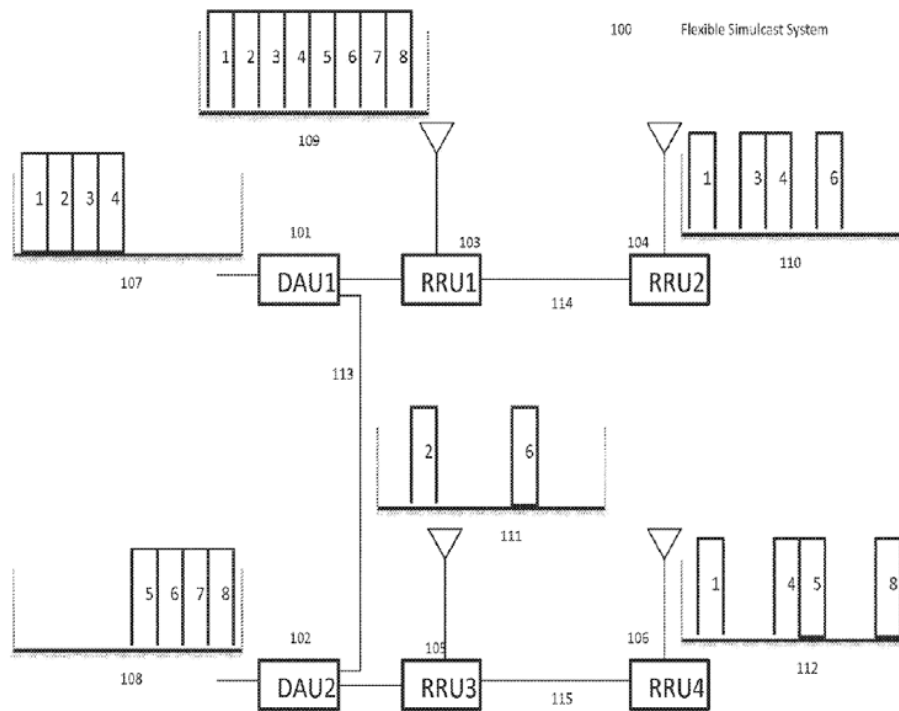


Figure 1: Flexible Simulcast Downlink Example

Id. at Fig. 1. Downlink signals (107, 108) fed from base stations enter the system at left and are received by DAU1 and DAU2 respectively. The two base station signals each represent a set of four carrier signals where each carrier signal is a “radio resource.” Each RRU uses a subset of the eight total carrier signals, up to the full set. RRU1, which the patent says may correspond to a cafeteria, uses all eight resources (or signals). Id. at 6:51-60. This means it can access the “full capacity” of the base stations. Id. In comparison, RRU2 uses less capacity. It only uses four resources, which is a function of the setting of its DUC/DDCs. Id. at 6:60-7:5.

B. The ‘232 Claims

51. The ‘232 patent has three independent claims (1, 12, 20). The claims use different nouns than the specification. The claims refer to a “central node” a “wireless access point” and an “operator hub.” None of these terms appears in the specification. The claims appear to use the term “central node” to refer to the digital access unit (DAU) in the specification. The term “wireless access point” is used in the claims to refer to the remote radio unit (RRU) in the specification. The term “operator hub” is used in the claims to refer to the base station in the specification. This is how the examiner applied the claim terms when examining the prior art. See, e.g., Ex. 1002 A119 (“operator hub (base station 14)” and “wireless access points (remote unit 16)”).

52. The three independent claims include similar limitations but are written as a system (Claim 1), method (Claim 12), and computer-readable storage media that cause a processor to perform a series of steps (Claim 20). The claims recite that the central node receives radio resources from an operator hub using a specific communication protocol. The specific protocol is the standardized “Common Public Radio Interface” (CPRI) protocol. The claims then recite assigning a subset of the radio resources to a first wireless access point and assigning a different, smaller subset to a second access point. Finally, the claims refer to assigning additional radio resources to the second access point “in response

to a change in need of a number of wireless subscribers coupled to the second access point and which of the second subset is loaded beyond a threshold.” Ex. 1001, Claim 12. The Claims Appendix lists the full text of each of the claims and labels each element with a letter (A, B, C, etc.). Due to the overlap in the claims, I may refer to the claim elements by these letters.

53. Below is a chart comparing the independent claims. I included some underlining merely for context.

Claim 1	Claim 12	Claim 20
1. A wireless system comprising: one or more central nodes that <u>receive a number of a plurality of radio resources</u> from an operator hub that enables wireless communications and that provides the plurality of radio resources to a radio access network using the Common Public Radio Interface (CPRI) protocol; and a plurality of wireless access points that is coupled to the one or more central nodes and distributes one or more wireless signals to one or more wireless subscribers, the plurality of wireless access points including at least a first access point and a second access point, wherein one or more central nodes <u>assigns a</u>	12. A method comprising: <u>receiving a plurality of radio resources</u> from an operator hub that operates using a Common Public Radio Interface (CPRI) protocol; <u>assigning a first subset of the plurality of radio</u>	20. One or more non-transitory computer readable storage media storing instructions that, when executed by one or more processors, cause the one or more processors to perform the steps of: <u>receiving a plurality of radio resources</u> from an operator hub that operates using a Common Public Radio Interface (CPRI) protocol; <u>assigning a first subset of the plurality of radio</u>

<u>first subset of the number of the plurality of radio resources</u> to the first access point and a second subset of the number of the plurality of radio resources to the second access point, the first subset including more radio resources than the second subset, and	<u>resources</u> to a first access point included in a plurality of wireless access points and a second subset of the plurality of radio resources to a second access point included in the plurality of wireless access points, the first subset including more radio resources than the second subset; and	<u>resources</u> to a first access point included in a plurality of wireless access points and a second subset of the plurality of radio resources to a second access point included in the plurality of wireless access points, the first subset including more radio resources than the second subset; and
wherein, <u>in response to a change in need of a number of wireless subscribers</u> coupled to the second access point and which of the second subset is loaded beyond a threshold, the one or more central nodes <u>assign additional radio resources</u> of the plurality of radio resources to the second access point.	<u>in response to a change in need of a number of wireless subscribers</u> coupled to the second access point and which of the second subset is loaded beyond a threshold, <u>assigning one or more additional radio resources</u> of the plurality of radio resources to the second access point.	<u>in response to a change in need by a number of wireless subscribers</u> coupled to the second access point and which of the second subset is loaded beyond a threshold, <u>assigning one or more additional radio resources</u> of the plurality of radio resources to the second access point.

54. Independent method claim 12 and its dependent claims 13-19 closely track the language of system claims 1-4 and 6-9 respectively. Using the system described in claims 1-4 and 6-9 results in performing the methods recited in claims 12-19. Showing that the system claims 1-4 and 6-9 are unpatentable likewise establishes that the method claims 12-19 are unpatentable for the same reasons.

That is, claim 1 is representative of claim 12. Claim 2 is representative of claim 13, and so on.

55. Below is a chart showing the overlapping dependent claims.

Dependent claims from Claim 1	Dependent claims from Claim 12
2. The wireless system of claim 1, wherein the change in need is determined based on a change in capacity needed by the number of wireless subscribers coupled to the second access point or a change in throughput needed by the number of wireless subscribers coupled to the second access point.	13. The method of claim 12, wherein the change in need is determined based on a change in capacity needed by the number of wireless subscribers coupled to the second access point or a change in throughput needed by the number of wireless subscribers coupled to the second access point.
3. The wireless system of claim 1, wherein the additional resources are included in the first subset prior to being assigned to the second access point, and wherein the one or more central nodes assign the additional radio resources of the plurality of radio resources to the second access point comprises removing the additional resources from the first subset assigned to the first access point.	14. The method of claim 12, wherein the one or more additional resources are included in the first subset prior to being assigned to the second access point, and wherein assigning the one or more additional radio resources comprises removing the one or more additional resources from the first subset assigned to the first access point.
4. The wireless system of claim 1, wherein the one or more central nodes analyze one or more transmission parameters associated with the second access point to determine the change in need.	15. The method of claim 12, further comprising analyzing one or more transmission parameters associated with the second access point to determine the change in need.
6. The wireless system of claim 1, wherein the first access point belongs to a first sector and the second access point belongs to a second sector.	16. The method of claim 12, where the first access point belongs to a first sector and the second access point belongs to a second sector.

7. The wireless system of claim 1, wherein the first access point belongs to a first building and the second access point belongs to a second building.	17. The method of claim 12, where the first access point belongs to a first building and the second access point belongs to a second building.
8. The wireless system of claim 1, wherein at least one of the plurality of wireless access points enables communication between an IP device and the one or more central nodes.	18. The method of claim 12, wherein at least one of the plurality of wireless access points enables communication between an IP device and one or more central nodes.
9. The wireless system of claim 1, wherein at least two of the plurality of wireless access points are connected in a daisy chain manner to relay communications between at least a subset of the plurality of wireless access points.	19. The method of claim 12, wherein at least two of the plurality of wireless access points are connected in a daisy chain manner to relay communications between at least a subset of the plurality of wireless access points.

56. The claims of the ‘232 patent overlap with and are similar to the claims of U.S. Patent the 10,080,178 patent (Ex. 1038), which the PTAB has already found to be invalid. *See* Ex. 1039 (IPR Institution); Ex. 1040 (Judgment). A significant feature of overlap between the sets of claims is that they both recite the concept of reconfiguring the number of radio resources (e.g., carrier channels) used by a remote unit in a wireless communication system based on a condition relating to load.

57. For example, claim 1 of the ‘232 patent substantially overlaps with claim 1 of the ‘178 patent and its dependent claims. *See* Ex. 1039.

58. Claim 1 of the '232 patent recites the following (with element numbers added):

1. A wireless system comprising:

[i] one or more central nodes that receive a number of a plurality of radio resources from an operator hub that enables wireless communications and that provides the plurality of radio resources to a radio access network using the Common Public Radio Interface (CPRI) protocol; and

[ii] a plurality of wireless access points that is coupled to the one or more central nodes and distributes one or more wireless signals to one or more wireless subscribers, the plurality of wireless access points including at least a first access point and a second access point,

[iii] wherein one or more central nodes assigns a first subset of the number of the plurality of radio resources to the first access point and a second subset of the number of the plurality of radio resources to the second access point, the first subset including more radio resources than the second subset, and

[iv] wherein, in response to a change in need of a number of wireless subscribers coupled to the second access point and which of the second subset is loaded beyond a threshold, the one or more central nodes assign additional radio resources of the plurality of radio resources to the second access point.

59. Element [i] of claim 1 of the '232 patent substantially overlaps with Claim 1 of the '178 patent. Element [i] is about "one or more central nodes." Similarly, claim 1 of the '178 patent is about a "host unit." The '232 patent does not explain any difference between a host unit and a central node. In fact, neither the '232 specification nor the '178 specification use the phrases "host unit" or "central node."

60. Element [i] of claim 1 of the ‘232 patent also recites language about “a number of a plurality of radio resources from an operator hub.” Similarly, claim 1 of the ‘178 patent recites “a plurality of downlink channel signals from the at least one signal source.” A downlink channel signal is an example of a radio resource. Element [i] of claim 1 of the ‘232 patent also recites language about “wireless communications.” Similarly, claim 1 of the ‘178 patent specifies that the host unit is for use in the transport of “wireless communications.”

61. Element [i] of claim 1 of the ‘232 patent also recites language about “Common Public Radio Interface (CPRI) protocol.” Similarly, the ‘178 patent’s dependent claim 9 (from claim 1) recites “...the Common Public Radio Interface (CPRI) standard.”

62. Element [ii] of claim 1 of the ‘232 patent substantially overlaps with Claim 1 of the ‘178 patent. Element [ii] is about “a plurality of wireless access points.” Similarly, claim 1 of the ‘178 patent recites language about “a plurality of remote units.” The ‘232 specification never uses the phrase “access point” or “wireless access point.” The ‘232 patent does not teach there is any difference between a wireless access point and a remote unit. The specification discloses that the remote radio units are wirelessly communicating with mobile end users. The remote radio units are the only examples given of a wireless access point. Claims

10 and 21 of the '178 patent, as further examples, also recite “a plurality of remote units, including at least a first remote unit and a second remote unit.”

63. Element [ii] of claim 1 of the '232 patent also recites that the plurality of wireless access points is “coupled to the one or more central nodes.” Similarly, claim 1 of the '178 patent recites that the host unit (an example of a central node) comprises “at least one interface to communicatively couple the host unit to a plurality of remote units.”

64. Element [iii] of claim 1 of the '232 patent substantially overlaps Claim 1 of the '178 patent. Element [iii] describes a “first subset” and “a second subset.” Similarly, claim 1 of the '178 patent recites language about “a first set of downlink channel signals” and “a second set of downlink channel signals.” Claim 21 of the '178 patent, as a further example, similarly recites language about “a first portion” and “a second portion.”

65. Element [iii] of claim 1 of the '232 patent also recites language differentiating the first subset and second set. Specifically, Element [iii] of claim 1 of the '232 patent recites “the first subset including more radio resources than the second subset.” Similarly, claim 1 of the '178 patent recites language differentiating the first set and second set. Specifically, claim 1 of the '178 patent recites “wherein a number of downlink channel signals in the first set of downlink channel signals is different from a number of downlink channel signals in the

second set of downlink channel signals.” For example, the concept of a “different” “number” of downlink channel signals in the first set (as recited in the ‘178 patent) substantially overlaps with the concept of including “more” radio resources in the first subset (as recited in ‘232 patent). A readily apparent example of the “number” being “different” is where the first set includes “more” than the second set.

66. Element [iv] of claim 1 of the ‘232 patent substantially overlaps with Claim 1 of the ‘178 patent and its dependent claims. Element [iv] recites language about “in response to a change in need of a number of wireless subscribers.” Similarly, the ‘178 patent’s dependent claim 5 (from claim 1) recites language about “based on a change in subscriber needs...” The concept of “...need of a number of wireless subscribers” (as recited in the ‘232 patent) substantially overlaps with the concept of “...a change in subscriber needs” (as recited in the ‘178 patent).

67. Element [iv] of claim 1 of the ‘232 patent also recites language about “in response to ... loaded beyond a threshold, the one or more central nodes assign additional radio resources of the plurality of radio resources to the second access point.” Similarly, the ‘178 patent’s dependent claim 4 (from claim 1) recites language about “...based on load balancing, to dynamically change from (a) sending the digital representations of the first set of downlink channel signals to the first remote unit to (b) sending the digital representations of the second set of

downlink channel signals to the first remote unit.” The concept of “...loaded beyond a threshold” (as recited in the ’232 patent) substantially overlaps with the concept of “...load balancing” (as recited in the ’178 patent).

C. The ‘232 Prosecution History

68. The ‘232 patent had an abbreviated prosecution without any formal rejections. Applicant filed the application with a request for prioritized examination. Ex. 1002 at A1. Six weeks later, the Examiner issued a Notice of Allowance. Ex. 1002 at A61-69.

69. After the Notice of Allowance, the Applicant and Examiner had an interview about one reference: EP1,924,109. Ex. 1034 (referred to as “Heinz-Dieter” during prosecution but I may also refer to it herein as “Hettstedt EP”). The interview summary described Hettstedt EP as a potential reference that “teaches all of the allowable subject matter of claims 1, 12, and 20.” Ex. 1002A123, A175. Patent Owner, therefore, “agreed to amend claims 1, 12, and 20.” *Id.* Patent Owner authorized an Examiner Amendment that added the following underlined language about a “threshold” to each independent claim:

1. (Currently Amended) A wireless system comprising:

one or more central nodes that receive a number of a plurality of radio resources from an operator hub that enables wireless communications and that provides the plurality of radio resources to a radio access network using the Common Public Radio Interface (CPRI) protocol; and

a plurality of wireless access points that is coupled to the one or more central nodes and distributes one or more wireless signals to one or more wireless subscribers, the plurality of wireless access points including at least a first access point and a second access point, wherein one or more central nodes assigns a first subset of the number of the plurality of radio resources to the first access point and a second subset of the number of the plurality of radio resources to the second access point, the first subset including more radio resources than the second subset, and

wherein, in response to a change in need of a number of wireless subscribers coupled to the second access point and which of the second subset is loaded beyond a threshold, the one or more central nodes assign additional radio resources of the plurality of radio resources to the second access point.

Ex. 1002 A117-119. The Examiner then issued a Supplemental Notice of Allowability that cited this amended limitation. *Id.* A119-121.

VI. Summary of the Asserted Prior Art

A. Primary References

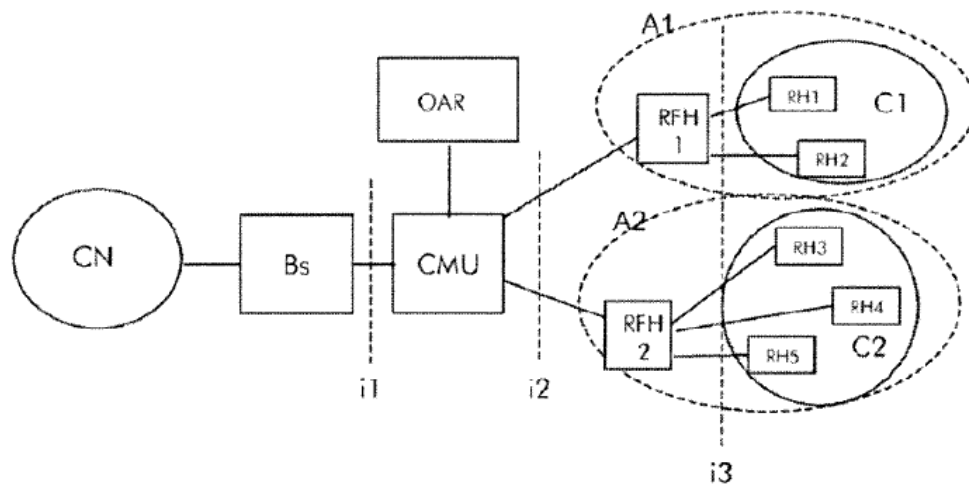
1. “Hettstedt”

70. “Hettstedt” is U.S. Patent Pub. No. 2008/0119198. Ex. 1005.

Hettstedt discloses “a method and a system for wireless cellular indoor communications.” *Id.* ¶0008. Specifically, it discloses a method and system with

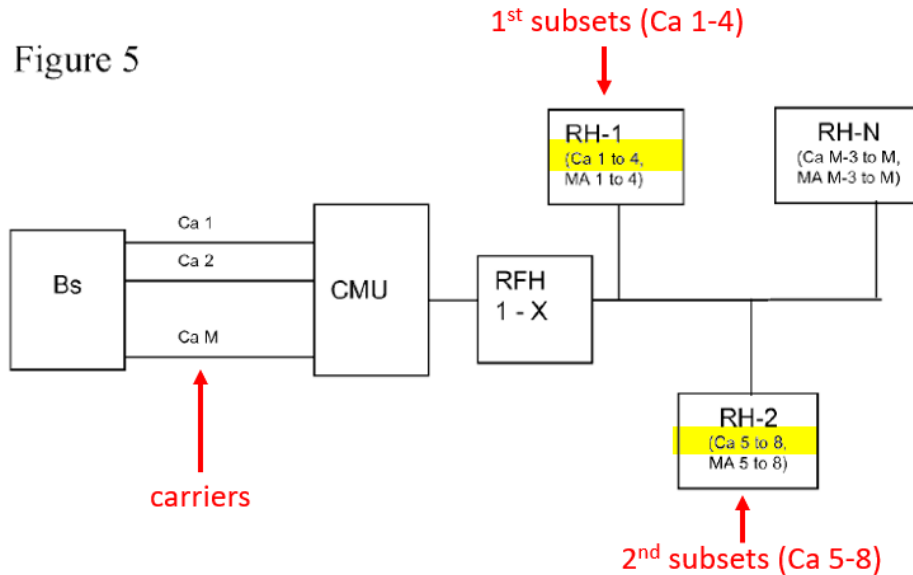
“improved cell and load balancing management.” *Id.* Figure 3 shows the main components of the Hettstedt’s system:

Figure 3



“Bs” is the base station; “CMU” is the cell management unit; “RFH1-2” are RF hubs; “RH1-RH5” are the radio heads. *Id.* ¶0039. The CMU receives carriers from the base station and “performs the frequency allocation of the remote radio heads.” *Id.* ¶0028. This involves “packaging and addressing” the carriers from the base station, through the RF hubs, to the remote radio heads. *Id.* ¶0028; ¶0040. The radio heads (RH) provide the “RF air interfaces” to the mobile devices located inside the various indoor environments (not pictured). *Id.* ¶0050. The dashed circles A1-A2 are each an “indoor location area” (e.g., building). *Id.* ¶0051, ¶0002. The dashed lines i1-i3 are “digital interfaces.” The i1 digital interface between the base station and the CMU may use the “CPRI” protocol. *Id.* ¶0040.

Figure 5 illustrates an “example” of the CMU distributing the carriers from the base station to the radio heads:



In this example, the base station provides a set of “M” carriers, and the CMU initially distributes subsets of four carriers to each radio head. *Id.* ¶0053. In this example, the CMU distributes the subsets using the “MAC address.” Carriers 1-4 are distributed to RH-1 using MAC addresses 1-4 (“MA 1 to 4”). *Id.* Carriers 5-8 are distributed to RH-2 using MAC addresses 5-8 (“MA 5 to 8”). *Id.*

This distribution, however, is not fixed. The CMU provides “flexible” cell management that allows for “adaptive cell reconfiguration.” *Id.* ¶0044, ¶0042. More specifically, the CMU provides “efficient load balancing.” Ex. 1005 ¶0044. The CMU does this “through the shifting of un-used carriers from radio heads inside areas of low traffic load to radio heads inside areas of high traffic load.” *Id.*

The system comprises the means for (1) “de-activation” of un-used carriers, (2) “shifting” these carriers “from radio where these carriers are not used for radio heads with high load on their active carriers,” and (3) “activation of the shifted carriers” at radio heads of “high loading.” *Id.* To accomplish this, the CMU performs “individual load identification for each carrier on each of the radio heads” by “air interface activity detection and interference sensing.” *Id.* Performing this load balancing, “capacity can follow moving users in complex buildings, such as airports, stations, etc., with dynamic distribution of hot-spots.” *Id.* ¶0029.

Hettstedt further expressly teaches that the activation of the shifted carriers occurs where the radio heads “are loaded over a predetermined value” (i.e., “*loaded beyond a threshold*”). *Id.* Claim 3. There is no discussion in the prosecution history of this specific disclosure. The Notice of Allowance merely cites Paragraphs 0016-0020 and the Abstract and never addressed this additional disclosure. Hettstedt is a related U.S. counterpart of the “Heinz-Dieter” reference that the prosecution history acknowledged “teaches all of the allowable subject matter of claims 1, 12, and 20” prior to the examiner’s amendment. Ex. 1002 A123, A175. It is, therefore, important to note that Hettstedt actually does contain disclosure of the “*loaded beyond a threshold*” feature added by the examiner’s

amendment, but it appears in a portion of Hettstedt that was never discussed during prosecution.

2. “Wu”: U.S. Patent Application Pub. No. 2010/0128676

71. Wu (Ex. 1006) was filed Nov. 11, 2009, and published on May 27, 2010. Wu describes carrier transport systems for use by wireless carriers to transport signals from base stations into wireless coverage areas. Ex. 1006. Wu notes that wireless service providers utilize various bands of frequencies. *Id.* ¶¶0003. Each service provider uses one or more carrier channels within their frequency bands to carry voice or other data. *Id.* Wu discloses that known systems utilize a terminal that digitizes entire frequency bands from base stations and that then transmit the digitized signals over fiber links to remote transceiver units (RTUs) in a coverage area. *Id.* ¶¶0004-05. Wu explains that such systems lack “fine grained control” over carrier channels and lack the ability to allocate carrier channels from one cell region to another in response to various events or conditions. *Id.*

72. Wu discloses an improved system that allows fine grained control over carrier channels from a single band or multiple bands by splitting carrier channels from their bands and routing channels “individually, collectively as shown, or in arbitrary groups” to RTUs as desired using a matrix switch according to a routing policy, where the routing policy can be updated or reconfigured as

desired. *Id.* ¶0049; *see also id.* ¶¶0009, 0011; 0038-39, 0047. Wu discloses that “more channels” can be allocated when needed to increase the bandwidth available in a particular region. *Id.* ¶¶0046; ¶¶0039-45. Wu teaches using processors to implement a routing policy having rules based on “threshold criteria” relating to metrics such as “current traffic load” for triggering a reconfiguration “to allocate more channels” where needed. *Id.* ¶¶0040-0046.

Figure 1 of Wu shows the basic components of its carrier transport system:

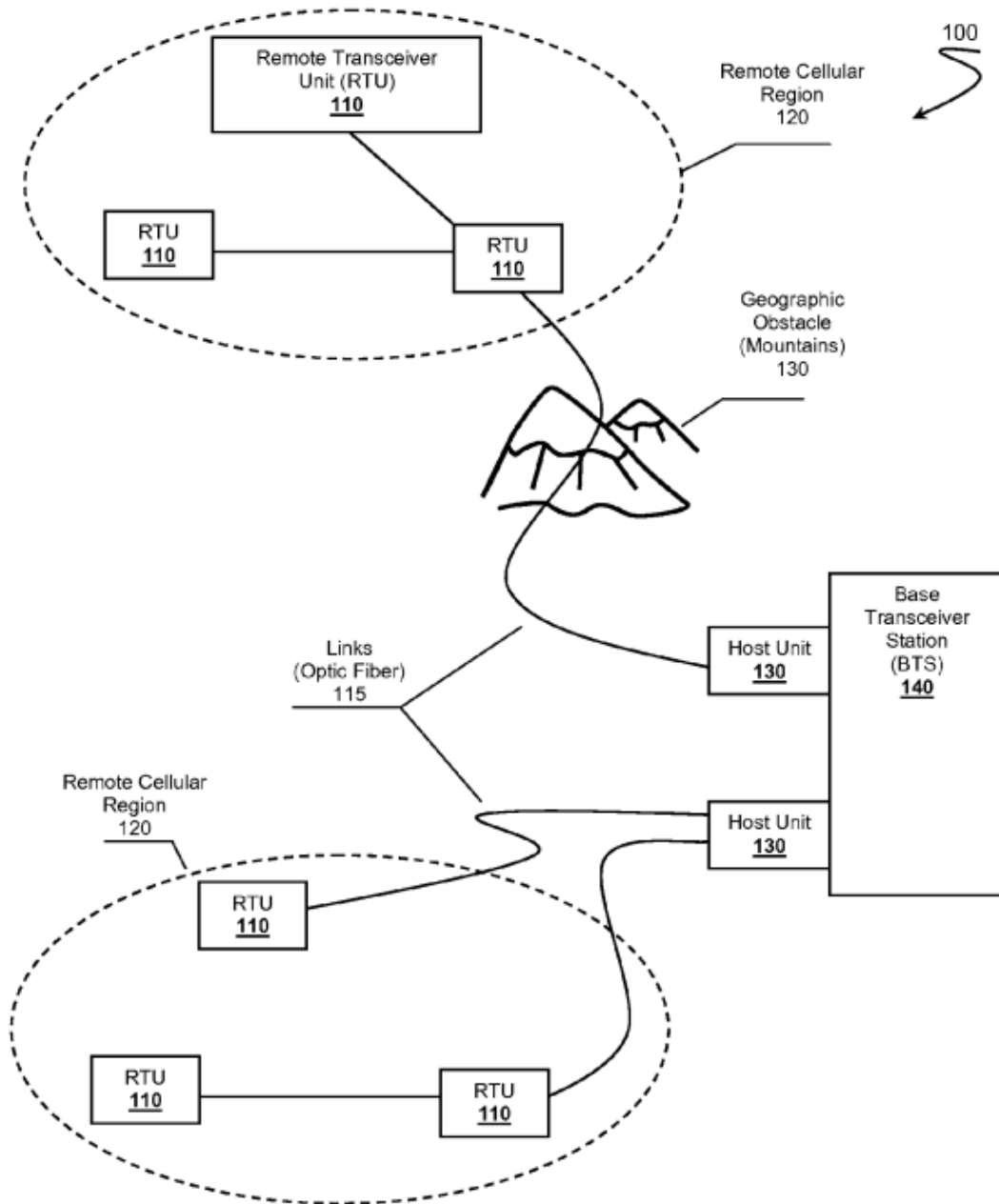


Figure 1

Ex. 1006 Fig. 1.

73. Figure 2 of Wu shows the matrix switch 250 that, in combination with units 230, can individually route different channels to different remote transceiver units 410, which are shown in Figure. 4. *Id.* ¶¶0038-40.

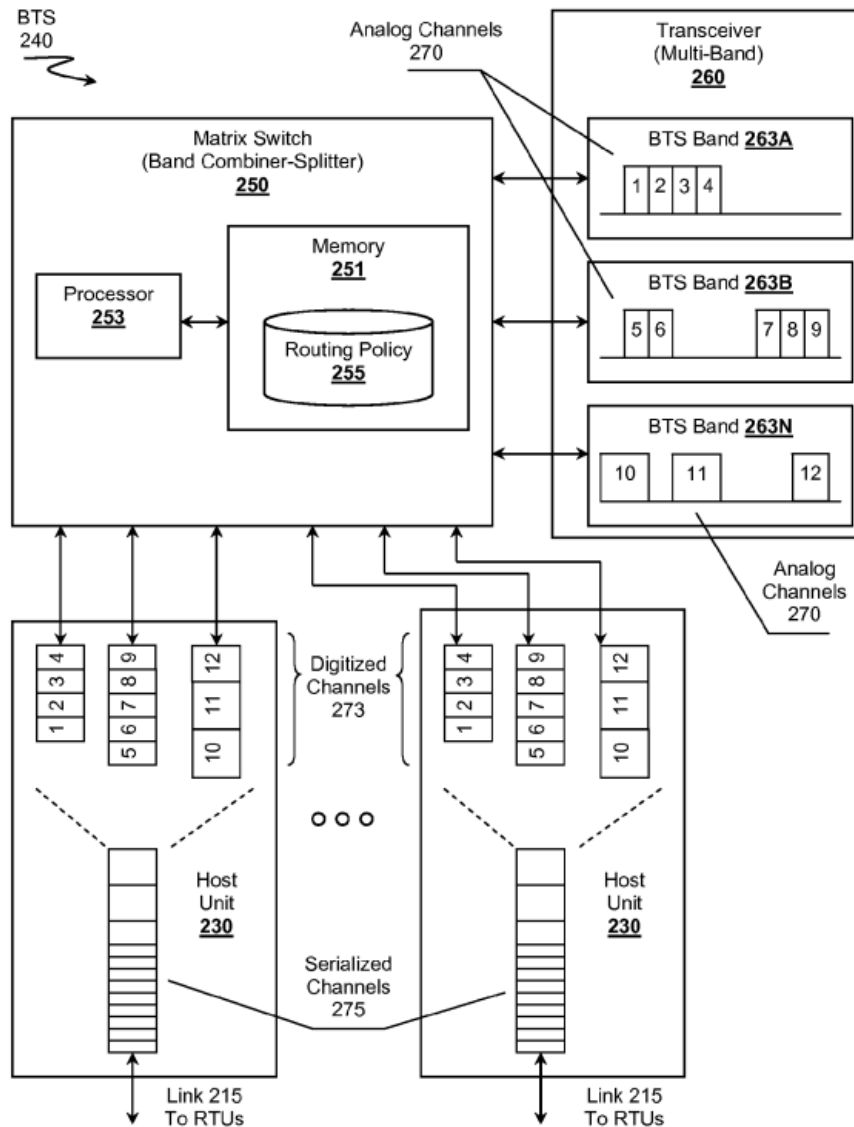


Figure 2

Id. Fig. 2.

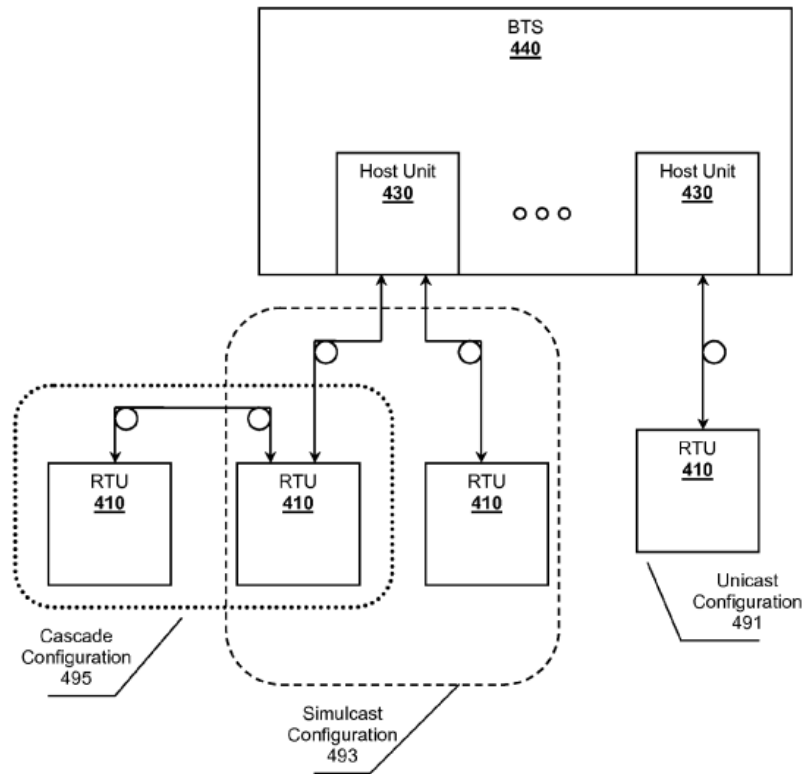


Figure 4

Ex. 1006 Fig. 4.

74. The system utilizes standard protocols for communicating signals over the links, including CPRI. *See id.* ¶¶0031; ¶¶0049.

B. Secondary References

1. “Wellington”: U.S. Patent No. 8,112,094

75. The Wellington reference (Ex. 1007) is a U.S. patent having a filing date of June 9, 2005. Wellington disclosed that wireless communications systems

could monitor cell traffic on one or more operational carriers within a cell and when the load reaches a predetermined level or threshold, another carrier can be automatically added to handle the overload. See, *e.g.*, Ex. 1007 1:59-63; Fig. 2; 4:18-38; Figure 3; 5:7-55.

2. “Sabat”: U.S. Patent Application Pub. No. 2009/0180426A1

76. The Sabat reference (Ex. 1010) published on July 16, 2009. Sabat disclosed a distributed antenna system in which the hub communicates with base stations using the standardized CPRI protocol. Ex. 1010 ¶¶0032, ¶¶0036, ¶¶0038. Sabat taught that this was particularly appropriate when the distributed antenna system is coupled to a digital base station. Ex. 1010 ¶¶0014.

3. “Fischer”: U.S. Patent Application. Pub. No. 2010/0177759

77. The Fischer reference (Ex.1008) published on July 15, 2010 and has an application date of September 9, 2009. Fischer disclosed that a distributed antenna system could be used not only to transport digital RF supporting telephone service, but the same system could also at the same time be used to transport internet protocol (IP) communications to support wireless LAN devices such as Wi-Fi enabled devices. FIGS. 1-5, Title, Abstract, ¶¶0004, ¶¶0014-0021, ¶¶0023-0024, ¶¶0027-0033.

4. “Conyers”: U.S. Patent No. 7,398,106

78. The Conyers reference (Ex. 1009) issued on July 8, 2008. Conyers disclosed that software modules in wireless radio communication systems could be used to dynamically adjust the power levels of radio frequency transmissions from remote radio head units. Ex. 1009, 2:32-38; 2:63-3:3; 6:13-17; 6:45-53; 6:60-7:12; Figs. 2, 1A, 1B.

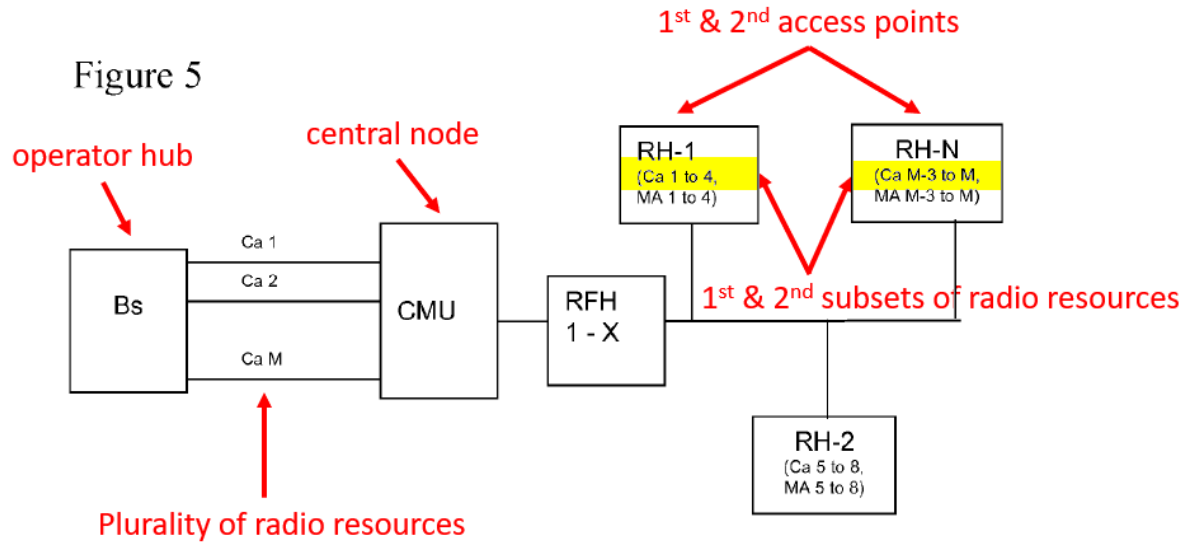
VII. Ground 1: The combination of Hettstedt plus Wellington renders claims 1-7, 9, 11-17, 19-20 obvious

79. During original prosecution, Patent Owner purportedly distinguished Hettstedt by adding the language about “which of the second subset is loaded beyond a threshold.” See Ex. 1002, A117-A119. The Wellington references, however, discloses this added concept of “which of the second subset is loaded beyond a threshold.” For the reasons discussed in the body of my analysis, a POSITA would have found that the combination of Hettstedt and Wellington to render these claims obvious. The combination of Hettstedt and Wellington discloses every element of these claims.

80. For the purpose of this ground, I assumed that Hettstedt failed to teach the added language. That said, I do not agree that Patent Owner properly distinguished Hettstedt. As discussed in a later ground, Hettstedt itself contains disclosure about a “predetermined value” (i.e., a threshold).

A. Independent Claim 1

81. The combination of Hettstedt and Wellington discloses each element of claim 1. Figure 5 of Hettstedt provides an overview showing many of the elements:



Ex. 1005, Fig. 5.¹

1. Element 1A

“A wireless system comprising”

82. Hettstedt discloses a “wireless cellular indoor communications system,” which discloses the preamble. Numerous disclosures in Hettstedt make this clear:

¹ All annotations, emphasis, colored boxes, red text and arrows, and highlighting added.

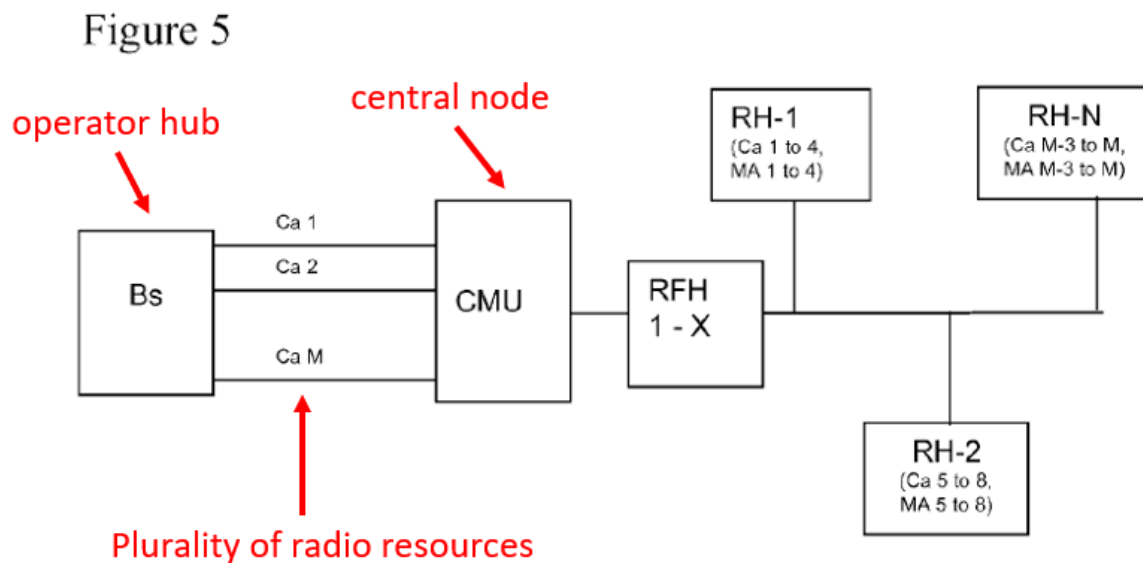
- “The present invention relates to indoor communications systems, and particularly to wireless cellular communications systems in buildings and tunnels.” Ex. 1005, ¶0002.
- “The object of the present invention is to provide a method and a system for wireless cellular indoor communications with improved cell and load balancing management.” Ex. 1005, ¶0008.
- “The object is achieved by a wireless cellular indoor communications system comprising at least one base station connected to a cell management unit through a first digital connection interface...” Ex. 1005, ¶0009.
- “FIG. 3 shows a first example of a wireless cellular indoor communications system, with separated cell configuration, according to the invention.” Ex. 1005, ¶0035; see also ¶¶0036-0038; Figs. 2-6.
- “In the downlink direction, communications core network signals intended for the mobile station inside the indoor environment, e.g. a building or a tunnel, are received by the base station Bs. Said signals are then passed in digital form through a first connection interface i1, e.g. an electrical or optical connection using Ethernet protocol or of other standards (e.g. OBSAI or CPRI), to the cell management unit CMU. The cell management unit CMU performs data packaging in downlink and forwards said digital packets through a second digital connection interface i2, e.g. an electrical or optical connection using Ethernet protocol, to the RF Hubs RFH1 and RFH2, which in turn pass the packets through a third connection interface i3, e.g. an electrical or optical connection using Ethernet protocol, to the remote radio heads RH1 to RH5. Similarly, in the uplink direction, radio signals Ws transmitted by the mobile stations located in the indoor environment are received by the remote radio heads RH1 to RH5 and sent to the core network CN with data packaging in the RF Hubs.” Ex. 1005, ¶¶0040-0041.

83. In other words, Hettstedt’s systems communicates with mobile stations through radio heads that transmit (downlink) and receive (uplink) radio signals (wireless signals).

2. Elements 1B and 1C

“...one or more central nodes that receive a number of a plurality of radio resources from an operator hub that enables wireless communications and that provides the plurality of radio resources to a radio access network using the Common Public Radio Interface (CPRI) protocol”

84. Hettstedt discloses each part of this limitation. Here is an annotation of Figure 5, showing various parts of this limitation:



Ex. 1005, Fig. 5.

85. **“one or more central nodes...”** As shown in Figure 5, Hettstedt’s cell management unit (CMU) is the “*central node*” between the base stations (Bs) and remote radio heads (RHs). Ex. 1005 at ¶0042 (“The cell management unit CMU provides transparent operation of the radio heads RH1 to RH5 from the base station...”). It manages various centralized functions: “The cell management unit provides data management in terms of packaging and addressing to the radio heads

in downlink and un-packaging and addressing to the base stations in uplink. Since the cell management unit performs the frequency allocation of the remote radio heads. Ex. 1005, ¶0028; *see also* ¶¶0043-0048.

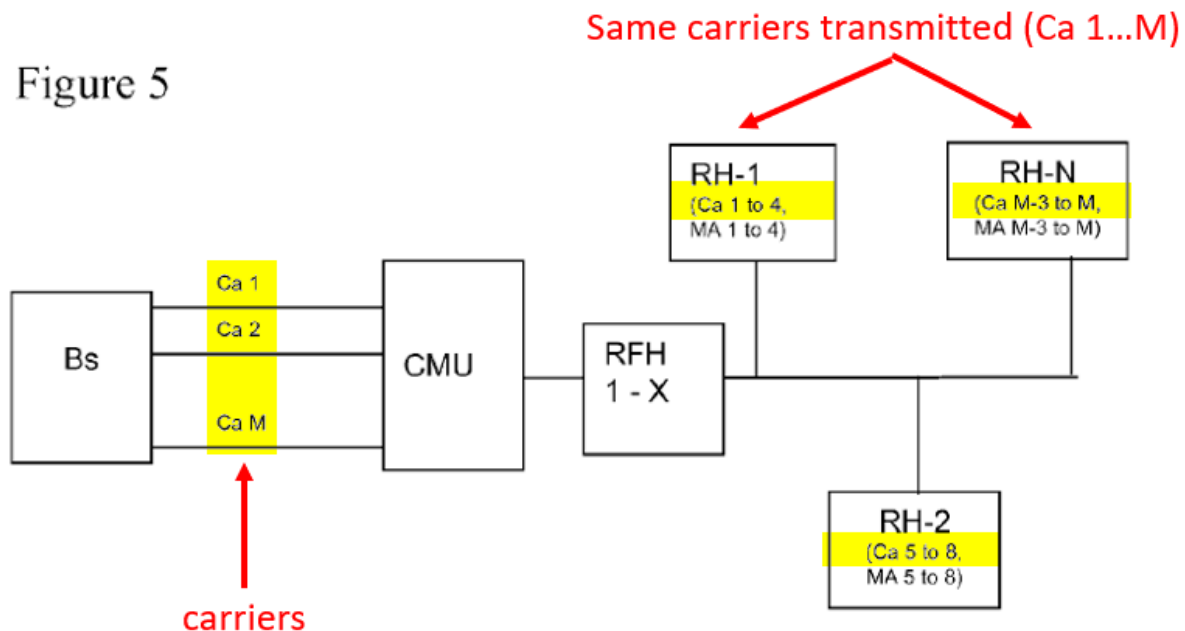
86. “**...an operator hub...**” Hettstedt’s base station is an “*operator hub*.” Hettstedt teaches that the base station provides services from “operators.” Ex. 1005, ¶0054 (“The eight BS can cover different services of different operators.”).

87. The ‘232 patent recognizes that a base station corresponds to a “wireless operator.” Ex. 1001, 6:33-34 (“base station belonging to one wireless operator”). To the extent there is a disclosed example of an operator hub in the specification of the ‘232 patent, a base station is the disclosed example. *See id.*, Figs. 1-6.

88. “**one or more central nodes that receive a number of a plurality of radio resources from an operator hub...**” As explained below, Hettstedt’s CMU (*central node*) receive a plurality of carriers (“*receive a number of a plurality of radio resources*”) from the base station (*operator hub*).

89. Figure 5 below, for example, shows that the CMU performing “carrier distribution.” Ex. 1005, ¶0053. The CMU receives “M” carriers from the base station. *Id.*, ¶0053 (“The base station Bs provides the M carriers Ca1 to CaM to the cell management unit CMU which in turn distributes...”). The “carriers” in

Hettstedt are “radio resources.” They are the resources used by Hettstedt radio heads. *Id.*, ¶0050 (“The remote radio heads are equipped to transmit four carriers...”) Figure 5, for example, shows this:



Id., Fig. 5. In other words, the carriers are the resources ultimately used by the radio heads to transmit information-bearing signals to the end user mobile devices. Modulation of the amplitude, phase, and frequency characteristics of the carriers allows the carriers to carry payload information (such as voice or data communications). The exact type of modulation used depends on the air interface protocol chosen for the system and is performed by the base station. The mobile devices can be, for example, “mobile phones” or “handheld computers.” *Id.*, ¶0004.

90. Figure 6 provides another example of the CMU receiving carriers from the base stations and distributing them. Specifically, the CMU receives 4 carriers from each of 8 base stations for a total of 32 carriers. *Id.*, ¶0054 (“In the example of the figure the cell management unit CMU operates on eight base stations BS1 to BS8 ... Each base station can provide four carriers at individual services.”); *see also* Fig. 6.

91. I note that Hettstedt disclosure parallels the disclosure in the ‘232 patent. Like Hettstedt, the ‘232 patent teaches that a central node (DAU) receives “carriers” from a “base station.” This is shown, for example, in Figure 1 and the accompanying text. Here is Figure 1:

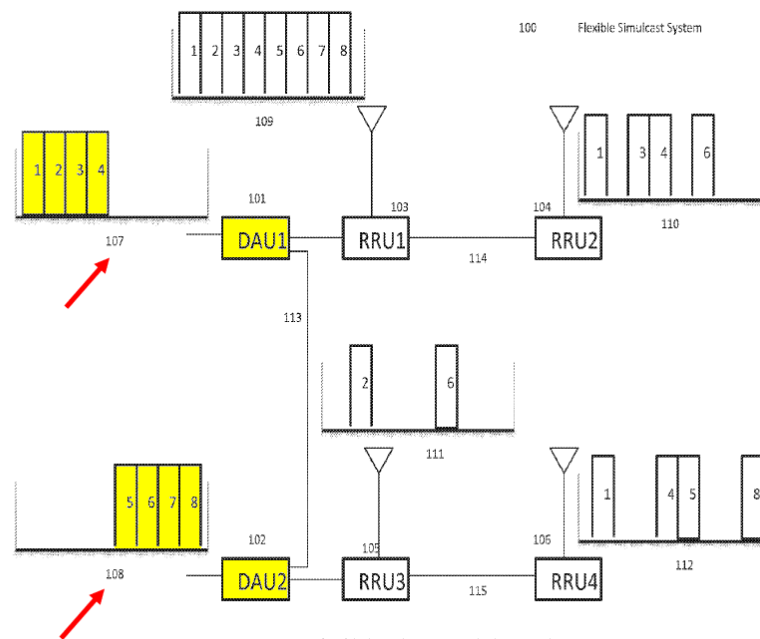


Figure 1: Flexible Simulcast Downlink Example

Ex. 1001, Fig. 1.

92. The specification text explains that numerals 107 and 108 are each from a “base station” and are comprised of “Carriers 1-4” and “Carriers 5-8,” respectively. Ex. 1001, 6:33-39 (“A composite downlink input signal 107 from, e.g., a base station belonging to one wireless operator enters DAU1 at the DAU1 RF input port. Composite signal 107 is comprised of Carriers 1-4. A second composite downlink input signal from e.g., a second base station belonging to the same wireless operator enters DAU2 at the DAU2 RF input port. Composite signal 108 is comprised of Carriers 5-8.”); see also 6:13-19 (“The system employs a Digital Access Unit functionality (hereinafter “DAU”). The DAU serves as an interface to the base station (BTS). The DAU is (at one end) connected to the BTS, and on the other side connected to multiple RRUs. For the downlink (DL) path, RF signals received from the BTS are separately down-converted, digitized, and converted to baseband (using a Digital Down-Converter). The ‘232 patent teaches that RF “carrier” are “radio resources.” Ex. 1001, 12:13-18 (“...deploy additional radio resources (such as RF carriers, CDMA codes or TDMA time slots)”)).

93. If Patent Owner argues that receiving “radio resources” is not satisfied by merely receiving payload data, then that does not distinguish the ‘232 patent from Hettstedt. Hettstedt’s carriers received from the base station are not merely underlying payload data. Hettstedt teaches the carriers come from a “conventional” base station. Ex. 1005, ¶0042. A conventional base station does

not provide merely payload data; rather, it modulates data onto carriers by manipulating the phase, amplitude, and frequency characteristics of the carrier in response to the data as defined by the chosen air interface protocol for the system (GSM, CDMA, LTE). It is the base station that applies the air interface protocol to impregnate carriers with the underlying payload data using the process of modulation. The modulated carrier signals can be expressed in real form or complex form. When expressed in complex form, the modulated carrier signal includes paired I and Q streams and is sometimes referred to as a baseband signal. Further, as explained in the prior paragraph, the modulation of the signals provided by the base station will be used and can be seen in the actual transmission from the remote unit (and are not merely the payload data prior to modulation).

94. **“...from an operator hub that enables wireless communications and that provides the plurality of radio resources to a radio access network using the Common Public Radio Interface (CPRI) protocol.”** Hettstedt discloses the final language of this limitation, i.e., *“from an operator hub that enables wireless communications and that provides the plurality of radio resources to a radio access network using the Common Public Radio Interface (CPRI) protocol.”*

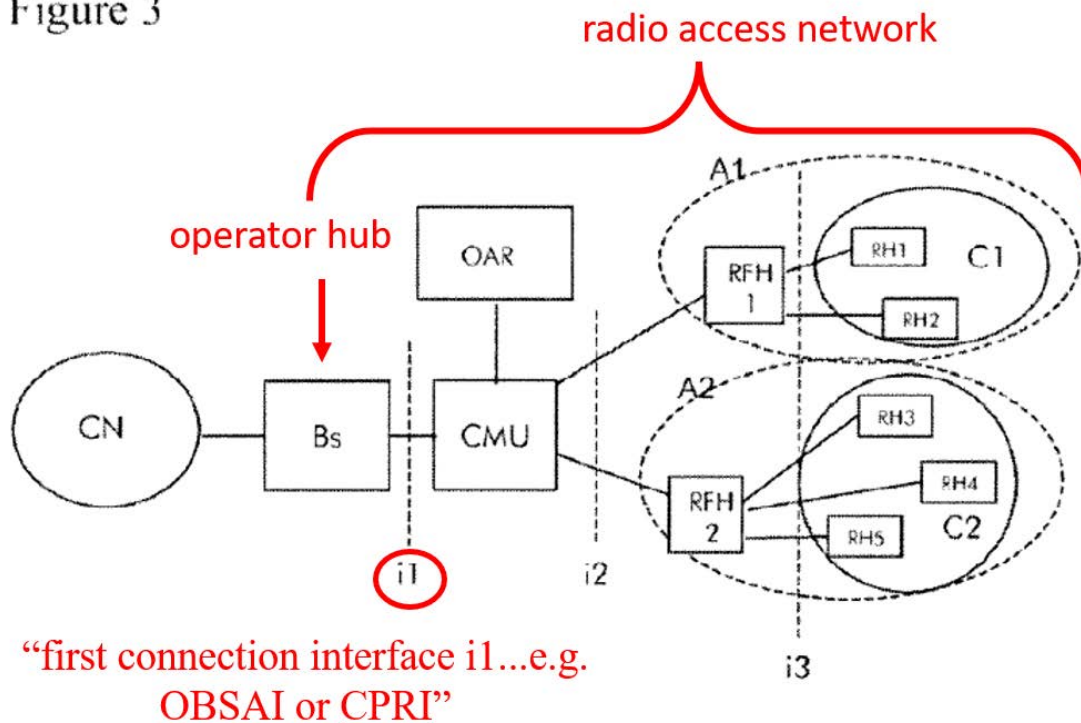
95. First, as already explained in the section above on the preamble, Hettstedt system provides *“wireless communication.”* Hettstedt’s base station

(*operator hub*) enables that wireless communication by communicating with the core network and providing the carriers. *Id.*, ¶¶ 0040-0041.

96. Second, Hettstedt's base station (*operator hub*) provides the carriers to the CMU and radio heads. The CMU and radio heads are a "*radio access network*." They provide the radio (RF) link for the end user devices to access the larger network. *Id.*, ¶0050 ("The remote radio heads RH1 to RH5 are *RF air interfaces* to users providing a digital interface to the network."); ¶0041 ("radio signals *Ws* transmitted by the mobile stations located in the indoor environment are received by the remote radio heads RH1 to RH5 and sent to the core network CN...").

97. Third, Hettstedt teaches that the base station (*operator hub*) can use "CPRI" to provide the carriers over the "i1" interface. *Id.*, ¶0040 ("....received by the base station Bs. Said signals are then passed in digital form through a first connection interface i1, e.g. an electrical or optical connection using Ethernet protocol or of other standards (e.g. OBSAI or CPRI), to the cell management unit CMU."). Here is an annotation of Figure 3 showing this:

Figure 3



Ex. 1005, Fig. 3.

98. In summary, Hettstedt discloses a cell management unit (“one or more central nodes”) that receives carriers (radio resources) from the base station (operator hub) where the base station provides the carriers using CPRI to enable the wireless communication.

3. Element 1D

“a plurality of wireless access points that is coupled to the one or more central nodes and distributes one or more wireless signals to one or more wireless subscribers, the plurality of wireless access points including at least a first access point and a second access point,”

99. Hettstedt discloses a plurality of remote radio heads (RHs) coupled to the CMU (the claimed *central node*). Figure 3 and 5, for example, shows multiple remote radio heads (annotated in yellow) coupled to the CMU:

Figure 5

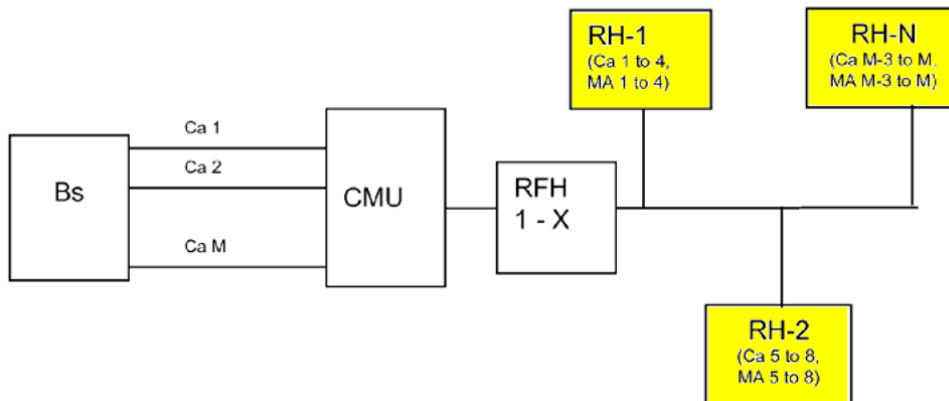


Figure 5

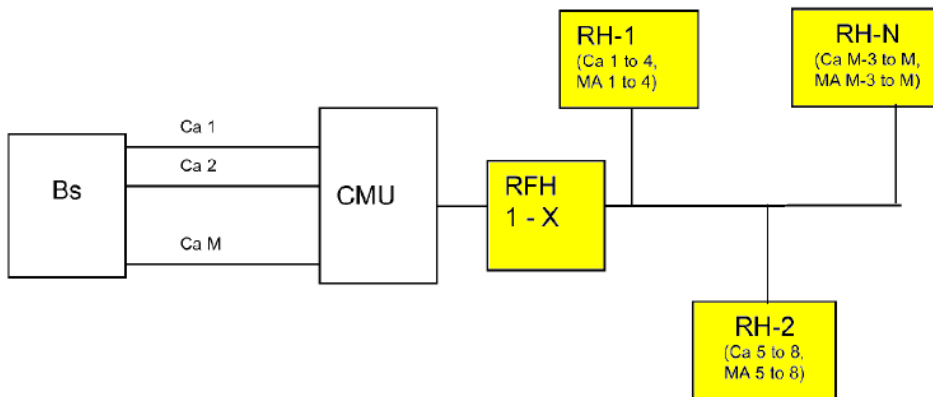
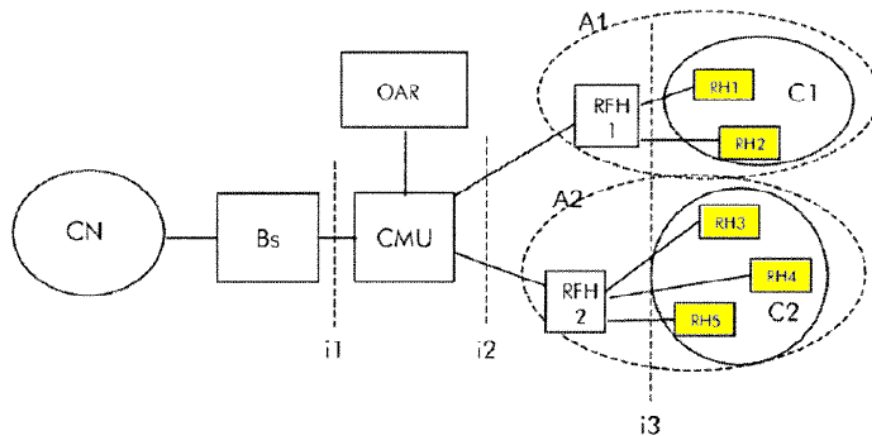


Figure 3



Ex. 1005, Figs. 3, 5; *see also* Figs. 4, 6. Each figure shows at least a first and second remote radio heads.

100. Hettstedt’s remote radio heads are examples of wireless access points. They provide the end user devices access to the base station and broader communication network (e.g., the core network). *See* Ex. 1005, Figs. 2-6; ¶¶0040-0041. More specifically, they provide wireless access. Hettstedt explains that the remote radio heads are “RF air interfaces to users providing a digital interface to the network.” Ex. 1005, ¶0050. As used here, “RF” refers to radio frequency, i.e., wireless signals. In the downlink, the RHs transmit radio signals (i.e., wireless signals) to the end user devices. Ex. 1005, ¶0040. In the uplink, they receive radio signals (i.e., wireless signals) from the end user devices and relay communications back to the base stations and core network. Ex. 1005, ¶0041 (“Similarly, in the uplink direction, radio signals Ws transmitted by the mobile stations located in the

indoor environment are received by the remote radio heads RH1 to RH5 and sent to the core network CN with data packaging in the RF Hubs.”). By the term remote radio heads, a POSITA understands that the remote radio heads communicate radio signals, i.e., wireless signals.

101. Hettstedt’s disclosure closely parallel the ’232 patent, which likewise discloses plural “RRUs” (Remote Radio Head units). Ex. 1001, 6:14-17; Fig. 1.

102. Hettstedt’s discloses the final language about “*distributes one or more wireless signals to one or more wireless subscribers.*” Specifically, Hettstedt’s RRHs communicate “radio signals” (*wireless signals*) to “users” or “mobile stations” (*wireless subscribers*). Ex. 1005, ¶0050 (“The remote radio heads RH1 to RH5 are RF air interfaces to users...The remote radio heads are equipped to transmit four carriers...”); ¶0041 (“...radio signals Ws transmitted by the mobile stations located in the indoor environment are received by the remote radio heads”); ¶0008 (“wireless cellular indoor communications”). These mobile devices can be “mobile phones” or “handheld computers,” which are examples of wireless subscribers. *Id.*, ¶0004.

4. Element 1E

“wherein one or more central nodes assigns a first subset of the number of the plurality of radio resources to the first access point and a second subset of the number of the plurality of radio resources to the second access point, the first subset including more radio resources than the second subset, and”

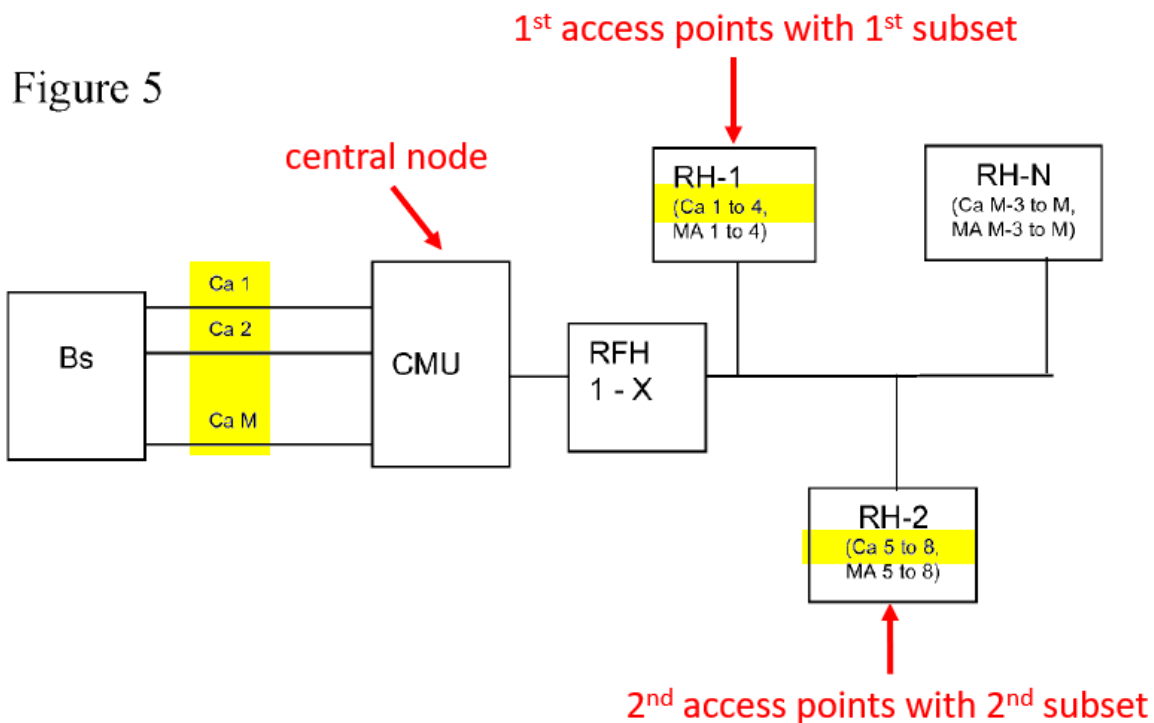
103. Hettstedt discloses this limitation through its disclosures that the CMU (*central node*) performs (a) “mapping” of carriers to individuals RHs (b) de-activating, shifting, activating the carriers between the RHs. As part of mapping the carriers to the individual RHs, each RH has a subset. As part of de-activating, shifting, activating the carriers at the radio heads, some RHs have more carriers.

104. **“wherein one or more central nodes assigns...”** Hettstedt discloses that CMU (*a central node*) is the unit that assigns the subsets for carriers (*radio resources*) to the RRHs (*access points*). The CMU “comprises” the functionality for “mapping” of the “carriers” “to individual radio heads.” *Id.*, ¶¶0043-0044. The CMU “performs the frequency allocation of the remote radio heads.” *Id.*, ¶0028. Further, the CMU “comprises” the functionality for “de-activation” of the carriers per radio head, “shifting” carriers from radio heads, and “activations” of the shifted carriers at locations (radio heads) of high loading. *Id.*, ¶¶0043-0044; ¶0029. In the Fig. 5 example below, the CMU uses MAC addresses for this assignment. *Id.*, ¶0053. The CMU is the entity that performs the addressing. *Id.*, ¶0028 (“The cell management unit provides data management in terms of packaging and addressing to the radio heads in downlink and un-packaging and addressing to the base stations in uplink.”).

“...assigns a first subset of the number of the plurality of radio resources to the first access point and a second subset of the number of the plurality of radio resources to the second access point.”

105. As discussed in the prior element, the CMU assigns carriers to plural radio heads (access points). Ex. 1005, ¶0028 (“Since the cell management unit performs the frequency allocation of the remote radio heads...”); ¶0043 (“The CMU preferably comprises the following functionality means for de-activation of un-used carriers per radio head on an individual basis; means for shifting carriers from radio heads, where these carriers are not used for radio heads with high load on their active carriers, means for activation of the shifted carriers at locations (radio heads) of high loading.”); *see also* Figs. 3-6 (showing multiple radio heads).

106. Figure 5 shows an example of a first and second set of carriers assigned by the CMU:



Id., Fig. 5; ¶0053. In this example, the CMU assigns carriers 1-4 (*first subset*) to RH-1 (*first access point*) and carriers 5-8 (*second subset*) to RH-2 (*second access point*). *Id.*, ¶0053.

107. “...the first subset including more radio resources than the second subset.” Hettstedt discloses that the set of carriers at one RH can include more carriers than another RH. Figure 5 pictures an example where each RH has four carriers. Notably, this is merely an “example” of one configuration. *Id.*, ¶0037 (“FIG. 5 shows an example of carrier distribution according to the wireless cellular indoor communications method of the invention.”)

108. Further, the example is not static. *Id.*, ¶0044 (“de-activation” and “shifting”); ¶0050 (“reconfiguration”). Hettstedt teaches that CMU comprises the means for (1) “de-activation” of un-used carriers, (2) “shifting” these carriers “from radio where these carriers are not used for radio heads with high load on their active carriers,” and (3) “activation of the shifted carriers” at radio heads of “high loading.” *Id.*, ¶0044. The actions of de-activating, shifting, and activating carriers changes the number of carriers in the subsets such that some RHs will have more carriers than others.

109. I note that, during prosecution the Examiner concluded the related-EP version of Hettstedt disclosed assigning a first and second subset with the “first subset including more radio resources than the second subset” and cited the

teachings about de-activating, shifting, and activating carriers. See Ex. 1002, A120-121.

110. As an example, consider where the CMU de-activates two carriers at RH2 in Figure 5. Now, the first subset of carriers at RRH1 has more carriers than the second subset of carriers at RRH2 (four carriers compared to two carriers).

111. Finally, I note that Hettstedt's disclosure parallels the '232 patent. Consider the '232 patent's teaching the DAU can "remove" radio resources from "use by a particular RRU which no longer needs those radio resources." Ex. 1001, 12:20-24. This corresponds to Hettstedt's disclosure that the CMU can *deactivate* un-used carriers per remote radio head. Ex. 1005, ¶0044; ¶0049. Consider also the '232 patent's teaching that DAU can "deploy additional" radio resources from "use by a particular RRU" which needs them becomes of load conditions. Ex. 1001, 12:15-18. This corresponds to Hettstedt's disclosure that the CMU can *activate* carriers at remote radio heads with high load. Ex. 1005, ¶0044; ¶0049.

112. To the extent that Patent Owner argues Hettstedt only discloses the radio heads have the same number of carriers, I disagree. Such an interpretation would give no meaning to Hettstedt express teachings about de-activating, shifting, and activating carriers. *Id.*, ¶0044. As noted above, Figure 5 is merely an "example." *Id.*, ¶0037.

5. Element 1F

“wherein, in response to a change in need of a number of wireless subscribers coupled to the second access point and which of the second subset is loaded beyond a threshold, the one or more central nodes assign additional radio resources of the plurality of radio resources to the second access point.”

113. Patent Owner purportedly distinguished Hettstedt from this limitation during prosecution by adding the clause: “which of the second subset is loaded beyond a threshold.” Ex. 1002 at A117-121. The combination of Hettstedt and Wellington discloses the added clause and renders the claim obvious.

114. Before discussing the added clause, I first discuss the other clauses. I note that Patent Owner did not dispute Hettstedt discloses the other clauses during original prosecution.

115. **“wherein, in response to a change in need of a number of wireless subscribers coupled to the second access point...”** Hettstedt discloses the CMU responds to “a change in need of a number of wireless subscribers coupled to the second access point.” Hettstedt teaches that the CMU performs load balancing by shifting carriers from RHs inside areas of “low traffic load” to RHs inside areas of “high traffic load.” Ex. 1005, ¶0044. The traffic load at the RH is a measure of the need of the wireless subscribers at the RH. Hettstedt teaches that traffic load changes, for example, because of “moving users.” *Id.*, ¶0029. By shifting carriers between radio heads, Hettstedt explains: “In this way, capacity can follow moving

users in complex buildings, such as airports, stations, etc., with dynamic distribution of hot-spots.” *Id.*, ¶0029.

116. When the traffic load for an RH changes from low to high, that is an example of *a change in need of the wireless subscribers* coupled to the RH (and the RH where the change occurs can be considered the *second access point*). Hettstedt teaches to measure the load at “each” of the remote radio heads, which would include a “second access point.” *Id.*, ¶0044 (“individual load identification for each carrier on each of the radio heads.”). Hettstedt teaches that the need changes. As an example, Hettstedt discusses the fact that hot-spots develop and users move, which involve the needs changing. *Id.*, ¶0029. As another example, Hettstedt discusses that carriers can become “un-used” in areas of low traffic load, and shifted to areas of high traffic load because of changing needs. *Id.*, ¶0044. More generally, by the fact that Hettstedt performs load balancing, a POSITA understands that traffic load changes (otherwise, no load balancing would be needed). *Id.*, ¶¶0043-0044. Likewise, by the fact that Hettstedt performs reconfiguration that is “adaptive to current cell scenarios” a POSITA understands that traffic load changes (otherwise, no adaption would be needed). *Id.*, ¶0008, ¶0009, ¶0016, ¶¶0043-0044.

117. I note that Hettstedt’s disclosure parallels the ‘232 patent. The example given in the ‘232 patent is the movement of users. Ex. 1001, 1:42-53;

6:57-60. Similarly, Hettstedt discloses the purpose of load balancing is so that “capacity can follow moving users in complex buildings” with “dynamic distribution of hot-spots.” *Id.*, ¶0029.

118. **“...the one or more central nodes assign additional radio resources of the plurality of radio resources to the second access point.”**

Hettstedt also discloses the CMU “assigns additional radio resources of the plurality of radio resources to the second access point” in response to the change in need.

119. The CMU shifts carriers (*radio resources*) to the radio heads with high load and activates those carriers at those radio heads. *Id.*, ¶¶0043-0044; ¶0029. The actions of shifting carriers to a radio head and activating those carriers is example of “assign[ing] additional radio resources” to that radio head. The radio heads with high load can be considered the “second access point” recited in the claim. The shifted carriers are “additional” radio resources for the high load radio head because those radio heads did not formerly have those carriers; rather, the carriers had to be shifted and activated at those radio heads.

120. If Patent Owner suggests that the shifted carrier is not an “additional” carrier, that is wrong. The shifted carriers are in addition to the carriers already present at the high load radio heads. I note that Hettstedt does not teach to de-activate any carriers at the high load radio heads (the only de-activation mention is

at the low load radio heads). Therefore, Hettstedt discloses to assign additional resources (by shifting and activating carriers) at the second access point (the RH with “high load”).

121. If Patent Owner argues the plural language “additional radio resources” requires assigning plural additional radio resources, that does not distinguish Hettstedt. Hettstedt describes shifting plural carriers. *Id.*, ¶0043 (“de-activation of un-used carriers . . . shifting carriers from radio heads, where these carriers are not used for radio heads with high load on their active carriers . . . activation of the shifted carriers at locations (radio heads) of high loading”).

Added language: “which of the second subset is loaded beyond a threshold”

Hettstedt’s existing disclosure

122. Hettstedt already discloses (and claims) the example that the carriers are shifted to the radio heads that are “loaded over a predetermined value.”

3. The wireless cellular indoor communications system of claim 2, wherein the means for shifting un-used carriers from remote radio heads inside areas of low traffic load to remote radio heads inside areas of high traffic load comprise means for individual load identification for each carrier on each of the radio heads by air interface activity detection and interference sensing, means for de-activation of un-used carriers per remote radio head on an individual basis; means for shifting carriers from radio heads, where these carriers are not used for radio heads with high load on their active carriers, means for activation of the shifted carriers at locations where the remote radio heads are loaded over a predetermined value.

Ex. 1005, Claim 3.

123. Hettstedt further teaches that each radio head has as subset of carriers (see Fig. 5) and that Hettstedt's load balancing process involves identifying the load "for each carrier on each of the radio heads" (which, thus, includes the *second subset*). *Id.*, ¶0043; Claim 3.

124. Assuming for the sake of this ground that Hettstedt's teachings do not themselves disclose determining "which of the second subset is loaded beyond a threshold," Wellington further discloses this part of the limitations and the combination of Hettstedt and Wellington render the claim obvious.

Wellington's additional disclosure

125. Wellington discloses the concept of allocating additional carriers when a subset of carriers is loaded beyond a threshold. Figures 2 illustrates this concept.² Specifically, "FIG.2 illustrates a methodology of managing cell congestion by adding a carrier according to an innovative aspect." Ex. 1007, 2:26-30. Here is Figure 2 with several steps annotated (in yellow):

² Figure 3 also illustrates this concept. Figure 3 builds off Figure 2. It both illustrates "adding" a carrier (like Figure 2) when the congestion is high and further teaches to drop the additional carrier later if the congestion reduces. Ex. 1007, 5:25-55; Fig. 3.

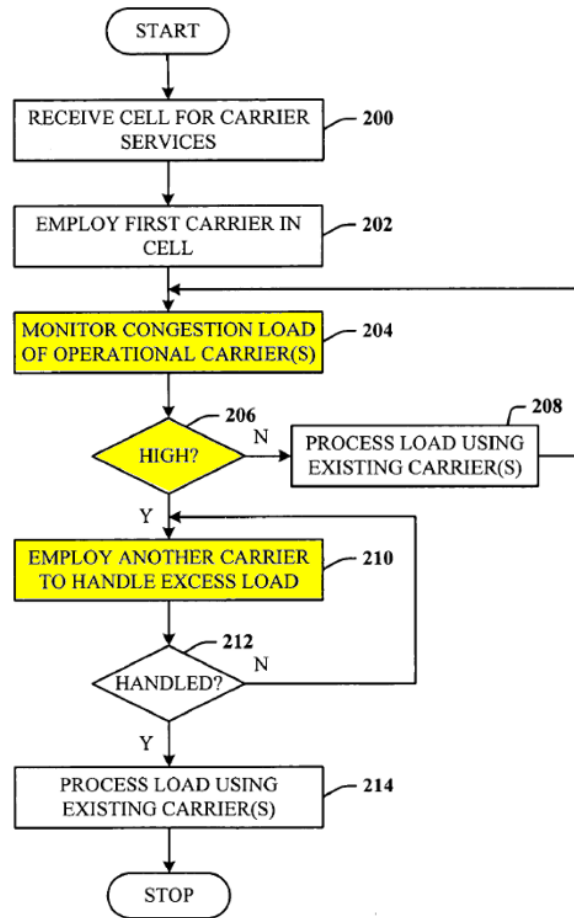


FIG. 2

Id., Fig. 2; see also Fig. 3.

126. At step 204, “cell congestion is monitored on the operational carrier(s).” *Id.*, 5:9-10. The “operational carrier(s)” are the *subset*. I note that, if Patent Owner argues that a subset is less than the full set, that would not distinguish Wellington or this combination. In Wellington, we know that the “operational carrier(s)” is less than the full set of carriers because more carriers can be added to the operational carriers. *See, e.g., id.*, Fig. 2 (Step 210). At step 206,

“the system determines if the congestion is high such that an additional carrier should be added to handle the overflow from the existing carrier or set of carrier(s).” *Id.*, 5:10-13. To decide if the congestion is “high,” Wellington further teaches this determination can be made by comparing the congestion to a “predetermined level”: “When congestion in the one or more carriers reaches a predetermined level, another carrier can be automatically added to handle the overload.” *Id.*, 1:61-63.

127. This is an example of the recited assigning an additional radio resource (here “another carrier”) when the subset (here “the one or more carriers”) is loaded beyond a threshold (here “a predetermined level”). A “predetermined level” is a threshold. Ex. 1036 (Merriam-Webster’s Collegiate Dictionary defining threshold: “*a level, point, or value above which something is true or will take place and below which it is not or will not*”); Ex. 1037 (Hargrave’s Communications Dictionary defining threshold: “A value used to denote predetermined *levels*.”). Wellington also discloses trigger conditions for the carrier management. Figure 4 is informative.³ Figure 4 “illustrates a block diagram of a system 400 that facilitates carrier management in a communications cell in accordance with another aspect of the innovation.” Ex. 1007, 5:55-57. The block diagram contains a “trigger component” (see yellow):

³ Figure 10 also illustrates this.

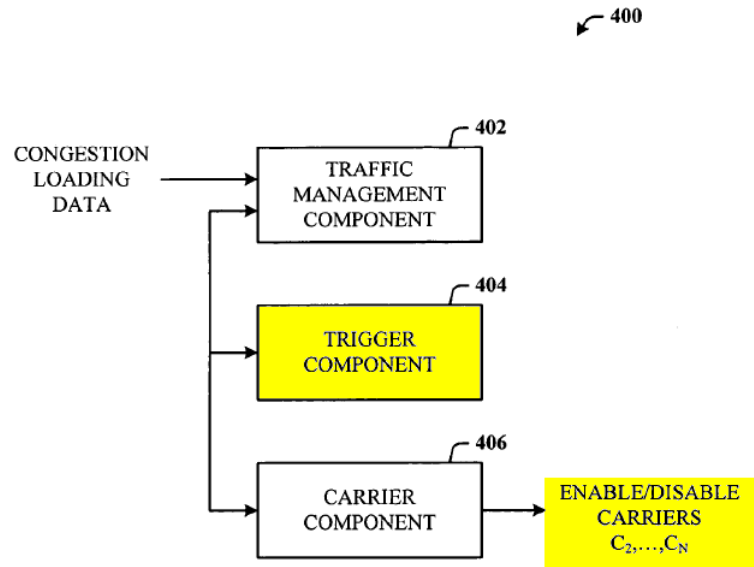


FIG. 4

Ex. 1007 at Trigger component 404 (yellow) “monitors one or more triggers which indicate that congestion in the existing carrier or carriers is at a point that requires an additional carrier.” *Id.*, 5:65-67. In response to the triggers, the next component (carrier component 406) “then deploys (enables) additional carriers (denoted $C_2, \dots, C_N$).” *Id.*, 6:13-18. Wellington discloses (in his own claims) that the trigger component can be configured to use a “predetermined threshold”:

1. A system, comprising:

a trigger component configured to determine that the congestion loading of the first carrier meets a condition of a predetermined function; and

a carrier component configured to dynamically enable a second carrier in the cell in response to the congestion loading meeting the condition of the predetermined function...

8. The system of claim 1, wherein the trigger component is further configured to determine that congestion loading is below a predetermined threshold; and the carrier component is configured to dynamically disable the second carrier in response to the congestion loading being below the predetermined threshold, wherein the second carrier is not operational in the cell after being disabled.

Id., Claims 1, 8. If Patent Owner argues this disclosure is for disabling an additional carrier as compared to enabling the additional carrier, I note that it would have been obvious to a POSITA that the trigger component could equally use a predetermined threshold to assess whether to enable an additional carrier, i.e., that the trigger component could dynamically enable the second carrier in response to the congestion loading being above a predetermined threshold. This is disclosure that the trigger component – which is common to enabling or disabling component – can use a “predetermined threshold.”

The combination of Hettstedt & Wellington’s additional disclosure

128. A POSITA would have found it obvious to combine Hettstedt with Wellington’s teaching. Specifically, a POSITA would have found it obvious to incorporate a trigger condition in the CMU as taught by Wellington such that CMU triggers the load balancing to shift additional carriers when it determines the load on the existing set of carriers at a high traffic radio head is beyond a threshold. Said another way, as part of Hettstedt’s existing teaching to identify the load on each carrier at each radio head, a POSITA would have found it obvious to identify when the set of carriers at a radio head is beyond a threshold (by comparing the

identified load to the threshold) and then trigger the load balancing process of shifting additional carriers from lower traffic radio. This is an obvious extension of Hettstedt's existing teaching⁴ to (a) identify the load on the carriers at each radio head (i.e., the subset), (b) determine when a radio head is loaded beyond a predetermined value, and (c) perform the management automatically (i.e., with a trigger).

129. A POSITA would have found this combination obvious for at least four reasons.

130. **First**, there were well-known motivations that would have prompted a POSITA to make this combination. (1) A POSITA would have been motivated to implement Wellington's teaching to *obviate the need for a human operator or user to perform the load balancing (i.e., improve the system by making it automatic and responsive to real-time conditions)*. See, e.g., *Id.*, 4:38-52 ("The carrier component 104 can operate dynamically such that deployment of additional carriers can occur dynamically based on traffic congestion at any given moment in time. For example, as described supra, when congestion of an existing carrier is high such that blocking can occur, the carrier component 104 automatically deploys an

⁴ The analysis of this Ground *assumes* that Hettstedt does not already teach or make obvious by itself determining which of the second subset is loaded beyond a threshold. As explained below in Ground 2, it is my opinion that Hettstedt, by itself, would at least render this limitation obvious. See, e.g., Claim 3 of Hettstedt.

additional carrier (e.g., the 2nd carrier C₂). When cell congestion decreases such that all traffic can be handled by the first carrier or the previous set of carriers, the carrier component 104 causes the last added carrier to be disabled or removed from operation. ...Thus, carrier deployment and removal can occur quickly to handle dynamically changing characteristics in cell congestion.”); see also *id.*, 8:47-50 (“FIG. 10 illustrates a system 1000 that employs an artificial intelligence (AI) which facilitates automating one or more features in accordance with the subject innovation.”); Fig. 10; Claim 26 (“in response to a congestion level of the first universal mobile telecommunications system carrier satisfying the predetermined congestion criterion, automatically deploying a second universal mobile telecommunications system carrier in the cell.”). A threshold-based trigger avoids the need for the system to wait for user inputs. A POSITA would naturally use a threshold for the trigger as taught by Wellington because a threshold is readily programmable and machine-executable. It does not require any subjective judgment. (2) A POSITA would have been motivated to implement Wellington’s teaching to improve the *adaptability of the system*. A benefit of a threshold-based trigger is that system can fine-tune the load balancing simply by adjusting the threshold. See, e.g., Ex. 1011, Summary of the Invention (“The present invention is directed to telecommunications systems and methods for providing adaptive thresholds for cell load sharing (CLS) based upon the current traffic situations.”);

4:11-27 (“The amount that the CLS thresholds are changed can be determined by the BSC 220, for example, by using a look-up table 225”); Fig. 4; Ex. 1012, 4:54-56 (“To provide added flexibility, the threshold value of step 216 may be a fixed value, or alternatively it may be variable, depending on the system configuration.”); Ex. 1013, 4:59-60 (“The threshold values may be varied dynamically in accordance with the present invention.”). There is no need to reprogram significant software.

131. The references themselves (Hettstedt and Wellington) supports these motivations and the combination. Hettstedt’s goal is “efficient” load balancing. Ex. 1005, ¶0011; ¶0021; ¶0027; ¶0044; Claim 1. Wellington’s teaching improves efficiency by eliminating the inefficiency of waiting for a human user’s input. Hettstedt contemplates scenarios where waiting for a user input for load balancing is not realistic such as sudden “hot spots.” *Id.*, ¶0029 (“moving users in complex buildings, such as airports, stations, etc., with dynamic distribution of hot-spots.”). Wellington, in turn, teaches that its method means that carrier deployment and removal “can occur quickly to handle dynamically changing characteristics in cell congestion.” Ex. 1007, 5:50-52. Moreover, Hettstedt contemplates that its system could be made “automatic” and “adaptive,” but does not provide details of the triggers to make the system automatic. Ex. 1005, ¶0011 (“adaptive cell reconfiguration”); ¶0021, ¶0028, ¶¶0041-0043 (same); ¶0042 (“automatic cell

management for adaptive cell configurations”). Thus, Wellington’s naturally improves Hettstedt’s existing disclosure. In sum, the combination (a) improves Hettstedt’s stated goal (efficient load balancing), and (b) furthers Hettstedt’s existing suggestion to make the system automatic and adaptive, and (c) does so it way that easy to implement (because a threshold-based trigger is readily programmable and machine-executable).

132. **Second**, this combination is a predictable variation of Hettstedt. Both the result and fact of the combination is predictable. (1) Determining whether the load is beyond “threshold” is a logical mathematical-type operation (e.g., IF load > threshold, THEN...). A logical mathematical-type operation is the quintessential example of something that yields a predicable result. There is no subjective or unexpected part of the result. (2) The fact of the combination is particularly predicable given Hettstedt’s existing teachings. Hettstedt’s already teaches to (a) determine whether the radio heads are “loaded over a predetermined value” (b) by identifying the load on the carriers at the radio heads (their subsets). Ex. 1005, ¶0044, Claim 3. A “predetermined value” is an example of a threshold. Indeed, the example disclosed in the ‘232 patent of a threshold is a predetermined value. Ex. 1001, 12:10-13 (“...a *predetermined* threshold whose *value* is communicated”). A POSITA could readily implement this combination. Hettstedt also already discloses how to determine the load. The step of comparing the load to

a threshold merely require a simple “if/then” statement that can be easily programmed. See Ex. 1006, ¶0045 (explaining that signatures of desirable triggering criteria can be “programmable instructions”); ¶0040 (“Policy 255 is considered to include programmable instructions stored on a computer readable memory 251 that can be executed within processor 253 that configures switch 250 to properly route the channels.”). No special components are required to implement an if/then statement, just a standard processor.

133. **Third**, this combination merely calls for using a known technique to improve a similar device. Wellington’s disclosure shows that comparing the load to a threshold and using the comparison to trigger load balancing is a known technique. Many other references, as show above, corroborate this.

- U.S. Patent No. 6,266,531 (Ex. 1011) discloses a “System and method for adaptive thresholds for cell load sharing.” Ex. 1011, Title. The reference explains the background state of the art: “Many wireless service providers have a feature called Cell Load Sharing (CLS), which is an efficient way to distribute the traffic evenly in the wireless system....In the current CLS functionality, one threshold defines at what load the traffic load shall be distributed to neighboring cells 27 (BTS's 28) and another threshold determines at what load the traffic from neighboring cells 27 can be accepted.” *Id.*, 2:14-33. The reference further discloses making those thresholds “adaptive.” *Id.*, 2:54-56 (“It is, therefore, an object of the present invention to provide for adaptive thresholds based upon the traffic load to determine cell load sharing between neighboring cells.”). In other words, the reference teaches to (a) monitor load, (b) compare the load to a threshold, and (c) use that comparison “threshold” as a trigger (e.g., to distribute the traffic load to a neighboring cell).
- U.S. Patent No. 5,796,722 (Ex. 1012) discloses a “Method and apparatus for dynamic load balancing using handoff.” Ex. 1012, Title. The reference

teaches to (a) monitor load, (b) compare the load to a threshold, and (c) use that comparison “threshold” as a trigger (e.g., to handoff subscribers). *Id.*, Fig. 4:44-53 (“The method of FIG. 2 expands on the prior art where, in step 214, the communication system begins an iterative process of monitoring a load metric and, in 216, comparing the updated metric against a threshold. If the metric reaches the threshold, the communication system will, in step 220, handoff a preferential subscriber to a suitable alternative carrier. In this manner, the communication system mitigates the effects of the load imbalance in accordance with the invention.”); Fig. 2. The reference explains that the threshold can be fixed or variable. *Id.*, 4:54-56 (“To provide added flexibility, the threshold value of step 216 may be a fixed value, or alternatively it may be variable, depending on the system configuration.”).

- U.S. Patent No. 5,241,685 (Ex. 1013) discloses “Load sharing control for a mobile cellular radio system.” Ex. 1013, Title. The reference explains: “According to the present invention, the loads in neighboring cells are balanced by dynamically adjusting the signal strength thresholds which are individual for the relationship between any two cells. When a cell is being overloaded, the system determines whether there are any not overloaded neighboring cells and which of the cells is least loaded. If such a cell exists, the signal strength threshold of the overloaded cell in the direction from this neighboring cell is increased, and/or the signal strength threshold of the neighboring cell in the direction from the overloaded cell is decreased. By dynamically varying the thresholds, the effective areas of the cells are either increased or decreased and the cell shapes changed.” *Id.*, 2:50-64. The reference teaches to (a) monitor received signal strength, (b) compare it to a threshold, and (c) use that comparison “threshold” as a trigger (e.g., to handoff subscribers to a neighboring cell). *Id.*, Fig. 4; 4:27-40.
- U.S. Patent No. 5,454,026 (Ex. 1014) discloses a “Mobile communication congestion control system.” Ex. 1014, Title. The reference explains that “conventional” systems uses “threshold values.” *Id.*, 1:8-15 (“In a conventional system for performing congestion control using the usages of traffic channels in a mobile communication system, a mobile switching center has threshold values for the usages of the traffic channels. The mobile switching center compares the traffic channel usage with the usage threshold value and sends a hand-over instruction to a mobile station, as needed.”) The reference teaches to (a) monitor the usage of a traffic channel, (b) compare it to a threshold, and (c) use that comparison “threshold” as a

trigger (e.g., initiate a handoff). *Id.*, Abstract (“A mobile communication system contains a mobile switching center connected to a plurality of base stations constituting a radio service zone and a plurality of mobile stations. The mobile switching center monitors the usage of a traffic channel for each radio service zone and has a usage threshold value for each radio service zone, and informs those to the mobile station via the base station. The busy mobile station compares the traffic channel usage information and the usage threshold value information and the radio zone communicated. When the traffic channel usage is greater than the usage threshold value, the mobile station selects a hand-over radio zone destination based on the received signal strength and quality, and the traffic channel usage information and the usage threshold value information of the adjacent zone, and then transmits a hand-over request designating the hand-over radio zone destination to the mobile switching center.”)

- U.S. Patent No. 5,666,356 (Ex. 2015) discloses a “Method and apparatus for controlling calls in a code division multiple access system.” Ex. 1015, Title. It also teaches to use a “threshold.” *Id.*, (“The method includes the steps of receiving a call attempt request to be placed over a target cell of the CDMA system (202), calculating an effective load for the cell (204), comparing the effective load to a threshold (206), and denying the call attempt request by sending a denial message if the effective load exceeds the threshold (212).”); *see also* Fig. 3.
- U.S. Patent No. 5,790,955 (Ex. 2016) discloses a “Mobile communication system which performs communication restriction control.” Ex. 1016, Title. It also recognizes that “conventional” systems trigger a load balancing action when the usages “exceeds” the “threshold.” *Id.*, 1:48-60 (“In the conventional mobile communication system, the following schemes are known as communication restriction schemes for preventing the above channel block: a scheme in which when a communication channel for an originating operation is to be assigned to a given mobile station, the restriction level of the communication channel is changed in accordance with the frequency of assignment failure of the communication channel in a busy state, and a scheme in which a communication channel usage and threshold in a radio zone are notified to a mobile station at predetermined intervals, and hand-over to an adjacent zone is performed when the usage exceeds the threshold.”). The reference further teaches to use multiple thresholds. *Id.*, 3:25-31 (“The communication restriction control section 33 includes a usage calculation section 33a for calculating a communication

channel usage in each of the zones of the radio base stations 41 and 42, and a comparison section 33b for comparing the usage calculated by the usage calculation section 33a with two predetermined thresholds (to be described later).”).

134. Hettstedt and Wellington address similar systems. Both involve multi-carrier wireless cellular systems that operate using the same type of radio resource (carriers). A POSITA would recognize that Wellington would improve Hettstedt in a similar way because both references rely on the same concept of activating/de-activating carriers based on monitoring the load on the carriers. *Compare* Ex. 1005, ¶0044 with Ex. 1007, 5:25-55, Fig. 3. Furthermore, a POSITA reading Hettstedt would naturally consider Wellington because both references are specifically concerned with cell management. Consider that Hettstedt’s main component is a “cell management unit,” and Wellington discloses “methodology of managing cell congestion.” *Compare* Ex. 1005, ¶0039, ¶0043 with Ex. 1007, 4:59-60. A POSITA reading Hettstedt would also naturally consider implementing Wellington’s technique in Hettstedt’s CMU. Hettstedt’s contemplates its cell management can be performed by “software control,” and Wellington provides such a “software algorithm” for cell management. *Compare* Ex. 1005, ¶0028, ¶0043 with Ex. 1007, 1:42-46.

135. **Fourth**, there is only a finite number of predictable solutions given Hettstedt’s existing teachings. Recall that Hettstedt already teaches to determine when the radio heads are “loaded over a predetermined value” and the fact that the

disclosed example in the '232 patent of a threshold is a pre-determined value. It is hard to imagine any other option for implementing Hettstedt's teaching.

136. Therefore, the combination of Hettstedt plus Wellington render claim 1 obvious.

B. Independent Claim 12

137. Independent Claim 12 recites essentially the same limitations as Independent Claim 1, except in the form of a method. The preamble of Claim 12 recites "A method comprising."

138. Hettstedt expressly discloses a "method." Hettstedt's summary section, for example, makes clear it discloses both a system and a method: "SUMMARY OF THE INVENTION: The object of the present invention is to provide a method and a system for wireless cellular indoor communications with improved cell and load balancing management." Ex. 1005, ¶0008; see also Title ("Method and System For Wireless Cellular Indoor Communications"). In this way, Hettstedt's disclosure disclosed above equally applies to Hettstedt's implementation as a system or as method performed by the system. *See also Id.*, ¶¶0016-25 ("This object is further achieved by a method for wireless cellular indoor communications, the method comprising..."); ¶0037 ("FIG. 5 shows an example of carrier distribution according to the wireless cellular indoor communications method of the invention."); Fig. 5. Stated another way, using

Hettstedt's system as described above for claim 1 results in performing the methods recited in claim 12.

139. Therefore, to the extent the preamble of claim 12 is a limitation, Hettstedt discloses it.

140. After the preamble, the body of the claim 12 recites essentially the same limitations as the those discussed above for independent claim 1. Thus, the combination of Hettstedt and Wellington disclose the limitations in the body of claim 12 for the same reasons discussed above for claim 1. Therefore, the combination of Hettstedt and Wellington render claim 12 obvious for the same reasons discussed above.

141. To be clear, Wellington's disclosure equally applies to a method. Wellington explains that its disclosure equally applies to system components and method in a number of different forms. Ex. 1007, 3:1-13 ("As used in this application, the terms 'component' and 'system' are intended to refer to a computer-related entity, either hardware, a combination of hardware and software, software, or software in execution. For example, a component can be, but is not limited to being, a process running on a processor, a processor, a hard disk drive, multiple storage drives (of optical and/or magnetic storage medium), an object, an executable, a thread of execution, a program, and/or a computer. By way of illustration, both an application running on a server and the server can be a

component. One or more components can reside within a process and/or thread of execution, and a component can be localized on one computer and/or distributed between two or more computers.”). Wellington claims both a system and method. Ex. 1006, Claims 26-35 (“26. A method comprising...”), Claims 1-25 (“A system, comprising...”). As further express disclosure, Wellington’s Figure 2 discussed above, for example, illustrates a “methodology.” Ex. 1007, 4:59-60 (“FIG. 2 illustrates a methodology of managing cell congestion by adding a carrier according to an innovative aspect.”); *see also* 5:25-27 (“FIG. 3 illustrates a methodology of managing cell congestion by dynamically adding and reducing the number of carriers according to an innovative aspect.”).

C. Independent Claim 20

142. Independent Claim 20 recites the same limitations as Independent 12, except with a different preamble. The preamble of Claim 20 recites: “One or more non-transitory computer readable storage media storing instructions that, when executed by one or more processors, cause the one or more processors to perform the steps of...”

143. A POSITA would understand that Hettstedt inherently discloses this preamble for a number of reasons.

144. **First**, Hettstedt expressly teaches that the CMU’s cell management can be performed “by software control” and “automatically.” Ex. 1005, ¶0028; *see*

also (“explaining the CMU is the “cell management unit.”) In order for the disclosed cell management to be performed by software or automatically, a POSITA would understand that that the CMU must contain one or more processors to execute the software and one or more non-transitory computer readable storage media to store the software instructions. For example, the CMU’s software control involves “mapping” means (*Id.*, ¶0045) to map the carriers to radio heads (i.e., instructions), and a POSITA would store such mapping instructions in non-transitory” storage, and not in transitory storage, because Hettstedt’s system is not intended for transitory or temporary operation. Cellular systems like Hettstedt’s are designed to operate for years and accommodate power loss and failure (by using non-transitory storage). Although the mapping of carriers-to-radio heads may change, the underlying procedure (i.e., the instructions) for updating the mapping do not change unless there is a system upgrade to the software.

145. **Second**, Hettstedt teaches that the CMU comprises an “intelligent switching unit,” a “complex matrix function,” and “mapping” means using “MAC addresses” to implement the cell management. *Id.*, ¶0042 (“The cell management unit CMU provides transparent operation of the radio heads RH1 to RH5 from the base station and comprises...an intelligent switching unit for data distribution and cell organization configurable in size and functionality according to system dimensions, a complex matrix function to combine different base stations with a

number of RF hubs ...”); ¶0045 (“mapping means from carriers or time, frequency or time-frequency allocations to individual radio heads, as identified e.g. through their MAC addresses or the connectors of the respective digital lines to which the radio heads are connected”). Considering the CMU is performing these functions, a POSITA would recognize that these structures and means involve a processor and stored instructions, especially in the context of the CMU performing the cell management functions by software or automatically. A POSITA would recognize that implementing and executing a complex matrix function in the digital domain involves a processor (and storage media to store the function). A processor and instructions are needed, for example, to properly process the data from the different base stations such that the data is combined in the downlink and separated in the uplink. Likewise, a POSITA would recognize that implementing an “intelligent” switching unit responsive to “mapping” data in the digital domain involves storage media to store the mapping data and its correlations (carriers, MAC addresses, etc.) and a processor to program the intelligent switching unit to properly implement the mapping data.

146. Even if Hettstedt does not inherently disclose the preamble, a POSITA would find the preamble obvious. By the relevant time period (2010), processors and non-transitory computer readable storage media storing for instruction were extremely well-known standard components to implement

software in this art. They were part of the basic background art and common knowledge in this art. Examples include:

Ex. 1006: U.S. Patent Application Publication No. 2010/0128676 A1 to Wu

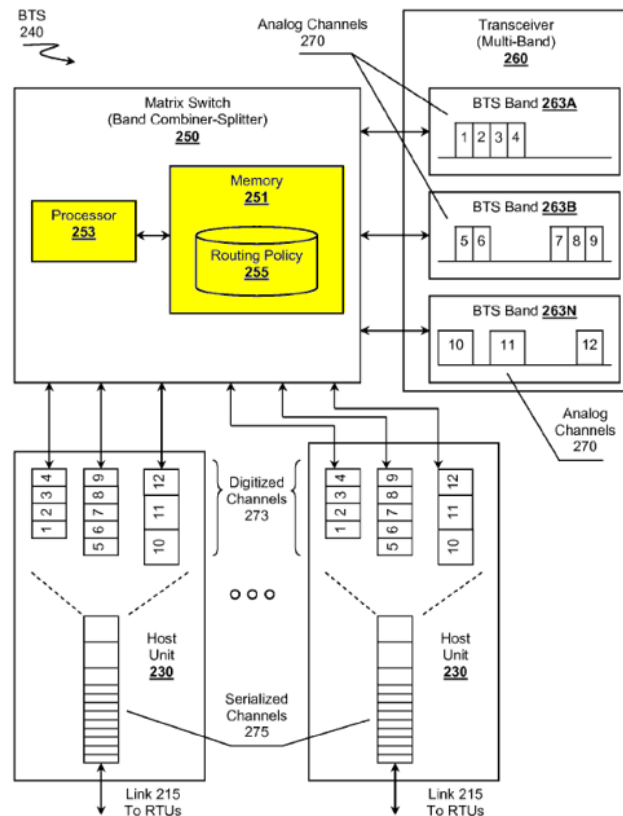


Figure 2

“[0040] Routing policy 255 can comprises one or more rules that govern behavior of switch 250 with respect to how analog channels 270 should be routed to host units 230 for further distribution to RTUs. Policy 255 is considered to include programmatic instructions stored on a computer readable memory 251 that can be executed within processor 253 that configures switch 250 to properly route the channels.”

“[0048]... It is also contemplated that policy 255 could be reconfigured by physically replacing memory 251 storing policy 255 (e.g., flash card, hard drive, solid state driver, etc.).”

Ex. 1045: U.S. Patent No. 7,286,507 (“Oh”):

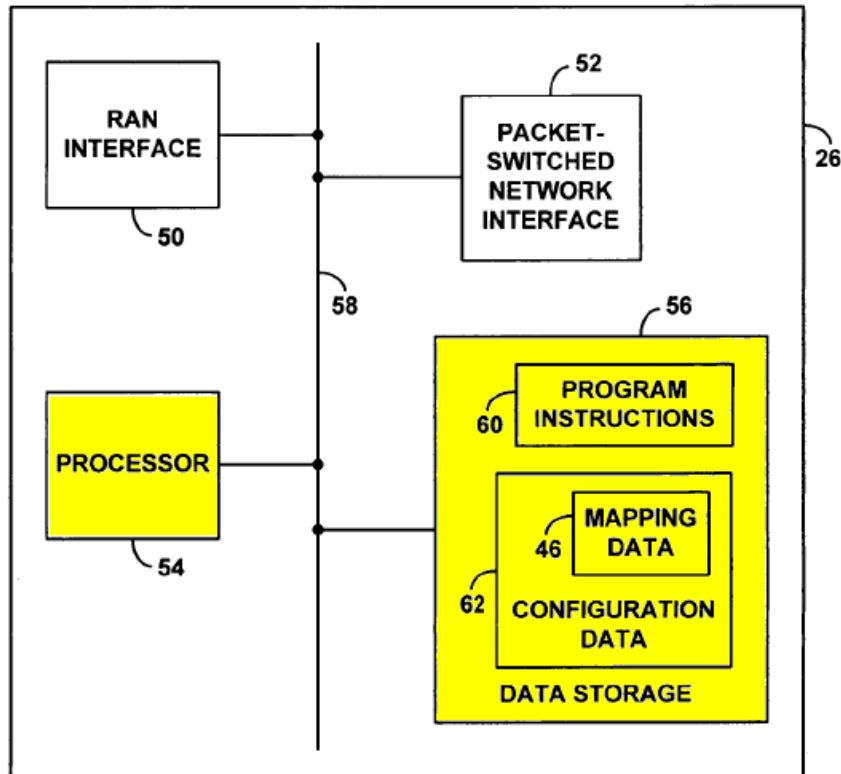


FIG. 3

“FIG. 3 is next a simplified block diagram depicting an exemplary DAS hub 26 arranged to support the functions described above. As shown, the DAS hub 26 includes a RAN interface 50, a packet-switched network interface 52, a processor 54, and data storage 56, all of which may be coupled together by a system bus, network, or other mechanism 58. These and/or other DAS hub components can reside in a single device or in multiple devices.”

“Processor 54 may comprise one or more general purpose processors (e.g., INTEL microprocessors) and/or one or more special-purpose or dedicated processors (e.g., digital signal processors). Data storage 56, in turn, may

comprise one or more volatile and/or non-volatile storage components and may be integrated in whole or in part with processor 54. As shown, data storage 56 preferably contains program instructions 60 and configuration data 62, including mapping data 46. Program instructions 60 may comprise machine language instructions executable by processor 54 to carry out various functions described herein. For example, program instructions 60 may define the web server and setup interface functions described above, as well as logic to facilitate communication with RAN 12 via RAN interface 50, logic to facilitate communication on packet-switched network 40, and logic to interface between RAN and packet-switched network communications. As another example, in accordance with the exemplary embodiment, program instructions 60 will preferably define logic to cause processor 50 to automatically consult mapping data 46 when faced with incoming traffic from RAN 12 or outgoing traffic from a DAS antenna unit IP address, so as to determine where to route the traffic as described above. To facilitate management of these communications, DAS hub 26 may maintain in data storage 52 a separate traffic queue per DAS antenna unit IP address, and perhaps two queues per DAS antenna unit IP address, one for incoming traffic and one for outgoing traffic.”

Ex. 1007: U.S. Patent No. 8,112,094 (“Wellington”)(discussed below).

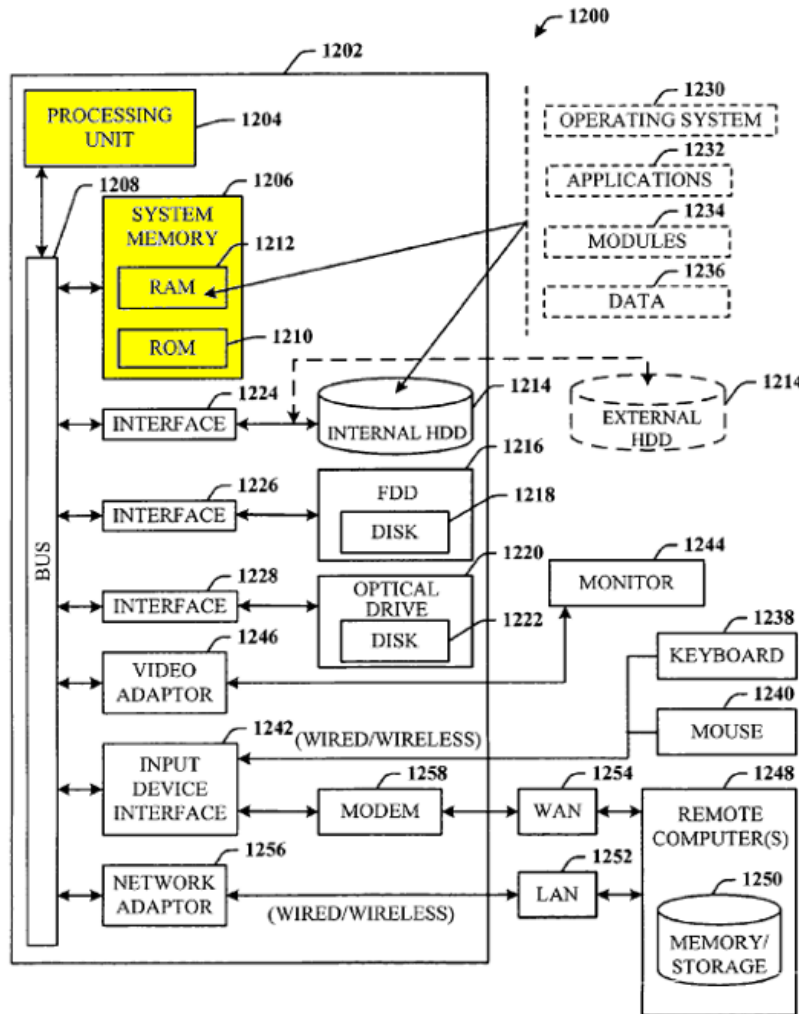


FIG. 12

Referring now to FIG. 12, there is illustrated a block diagram of a computer operable to execute the disclosed carrier management architecture. ... While the description above is in the general context of computer-executable instructions that may run on one or more computers, those skilled in the art will recognize that the innovation also can be implemented in combination with other program modules and/or as a combination of hardware and software.
Ex. 1007, 12:42-53.

A computer typically includes a variety of computer-readable media. Computer-readable media can be any available media that can be accessed by the computer and includes both volatile and non-volatile media, removable and non-removable media. By way of example, and

not limitation, computer-readable media can comprise computer storage media and communication media. Computer storage media includes both volatile and non-volatile, removable and non-removable media implemented in any method or technology for storage of information such as computer-readable instructions, data structures, program modules or other data. Computer storage media includes, but is not limited to, RAM, ROM, EEPROM, flash memory or other memory technology, CD-ROM, digital video disk (DVD) or other optical disk storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices, or any other medium which can be used to store the desired information and which can be accessed by the computer.

Id., 13:4-21.

Communication media typically embodies computer-readable instructions, data structures, program modules or other data in a modulated data signal such as a carrier wave or other transport mechanism, and includes any information delivery media. The term "modulated data signal" means a signal that has one or more of its characteristics set or changed in such a manner as to encode information in the signal. By way of example, and not limitation, communication media includes wired media such as a wired network or direct-wired connection, and wireless media such as acoustic, RF, infrared and other wireless media. Combinations of the any of the above should also be included within the scope of computer-readable media.

Id., 13:22-34.

With reference again to FIG. 12, the exemplary environment 1200 for implementing various aspects includes a computer 1202, the computer 1202 including a processing unit 1204, a system memory 1206 and a system bus 1208. The system bus 1208 couples system components including, but not limited to, the system memory 1206 to the processing unit 1204. The processing unit 1204 can be any of various commercially available processors. Dual microprocessors and other multi-processor architectures may also be employed as the processing unit 1204. ...

Id., 13:35-44.

The system memory 1206 includes read-only memory (ROM) 1210 and random access memory (RAM) 1212. A basic input/output system

(BIOS) is stored in a non-volatile memory 1210 such as ROM, EPROM, EEPROM, which BIOS contains the basic routines that help to transfer information between elements within the computer 1202, such as during start-up. The RAM 1212 can also include a high-speed RAM such as static RAM for caching data.”
Id., 13:49-56.

147. A POSITA would have a reasonable expectation of success: the recited components were standard components. The ‘232 patent does not suggest any inventive skill is required to implement the recited instructions in these standard components. A POSITA would have been motivated to include the elements recited in the preamble to obtain the benefit of using standard, widely available components when implementing Hettstedt.

148. I note that Wellington also expressly discloses using “one or more non-transitory computer readable storage media storing instructions that, when executed by one or more processors, cause the one or more processors to perform” cell management steps. Wellington explains its description is in the context of “computer-executable instructions that may run on one or more computers.” *Id.*, 12:48-54. Wellington further explains that the computer includes computer storage media (i.e., the recited “*one or more non-transitory computer readable storage media storing*”) for storage of these instructions (i.e., the recited “*instructions*”):

A computer typically includes a variety of computer-readable media. Computer-readable media can be any available media that can be accessed by the computer and includes both volatile and non-volatile media, removable and non-removable media. By way of example, and not limitation, computer-readable media can comprise computer

storage media and communication media. Computer storage media includes both volatile and non-volatile, removable and non-removable media implemented in any method or technology for storage of information such as computer-readable instructions, data structures, program modules or other data. Computer storage media includes, but is not limited to, RAM, ROM, EEPROM, flash memory or other memory technology, CD-ROM, digital video disk (DVD) or other optical disk storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices, or any other medium which can be used to store the desired information and which can be accessed by the computer.

Id., 13:4-21. Wellington further teaches the implementation involves one or more processors:

“As used in this application, the terms ‘component’ and ‘system’ are intended to refer to a computer-related entity, either hardware, a combination of hardware and software, software, or software in execution. For example, a component can be, but is not limited to being, a process running on a processor, a processor, a hard disk drive, multiple storage drives (of optical and/or magnetic storage medium), an object, an executable, a thread of execution, a program, and/or a computer. By way of illustration, both an application running on a server and the server can be a component. One or more components can reside within a process and/or thread of execution, and a component can be localized on one computer and/or distributed between two or more computers.”

Id., 3:1-13. Wellington’s Fig. 12, for example, illustrates an example of “a block diagram of a computer operable to execute the disclosed carrier management architecture.” *Id.*, 12:42-44. Figure 12 teaches to include a processor (e.g., 1204) and one or more non-transitory computer readable storage media (e.g., 1206):

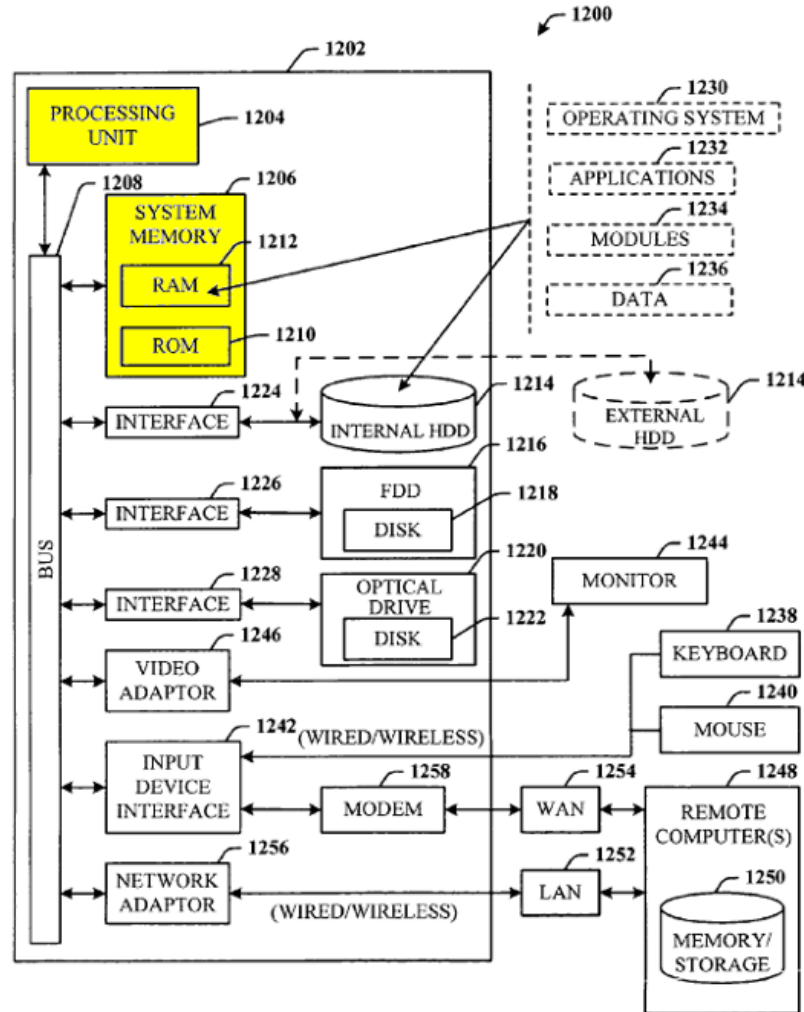


FIG. 12

Id., Fig. 12. Wellington explains 1204 and 1206 as follows:

With reference again to FIG. 12, the exemplary environment 1200 for implementing various aspects includes a computer 1202, the computer 1202 including a processing unit 1204, a system memory 1206 and a system bus 1208. The system bus 1208 couples system components including, but not limited to, the system memory 1206 to the processing unit 1204. The processing unit 1204 can be any of various commercially available processors. Dual microprocessors and other multi-processor architectures may also be employed as the processing unit 1204. ...

The system memory 1206 includes read-only memory (ROM) 1210 and random access memory (RAM) 1212. A basic input/output system (BIOS) is stored in a non-volatile memory 1210 such as ROM, EPROM, EEPROM, which BIOS contains the basic routines that help to transfer information between elements within the computer 1202, such as during start-up. The RAM 1212 can also include a high-speed RAM such as static RAM for caching data.

Id., 13:35-56. Like Patent Owner’s claim at issue, Wellington also discloses in its claims “A non-transitory computer readable storage medium comprising computer executable instructions that, in response to execution by a computing system, cause the computing system to perform operations, comprising...” *Id.*, Claims 36-40.

149. Therefore, to the extent this preamble is a limitation, the combination Hettstedt and Wellington disclose the preamble and render it obvious.

150. After the preamble, the body of the claim 12 recites essentially the same limitations as the those discussed above for independent claim 1 (and the same as those disclosed above for Claim 12). Thus, the combination of Hettstedt and Wellington disclose the limitations in the body of claim 20 for the same reasons discussed above for claim 1 and 12. Therefore, the combination of Hettstedt and Wellington render claim 20 obvious for the same reasons discussed above.

D. Dependent Claims

1. Claims 2 and 13

“2. The wireless system of claim 1, wherein the change in need is determined based on a change in capacity needed by the number of wireless subscribers

coupled to the second access point or a change in throughput needed by the number of wireless subscribers coupled to the second access point.”

“13. The method of claim 12, wherein the change in need is determined based on a change in capacity needed by the number of wireless subscribers coupled to the second access point or a change in throughput needed by the number of wireless subscribers coupled to the second access point.”

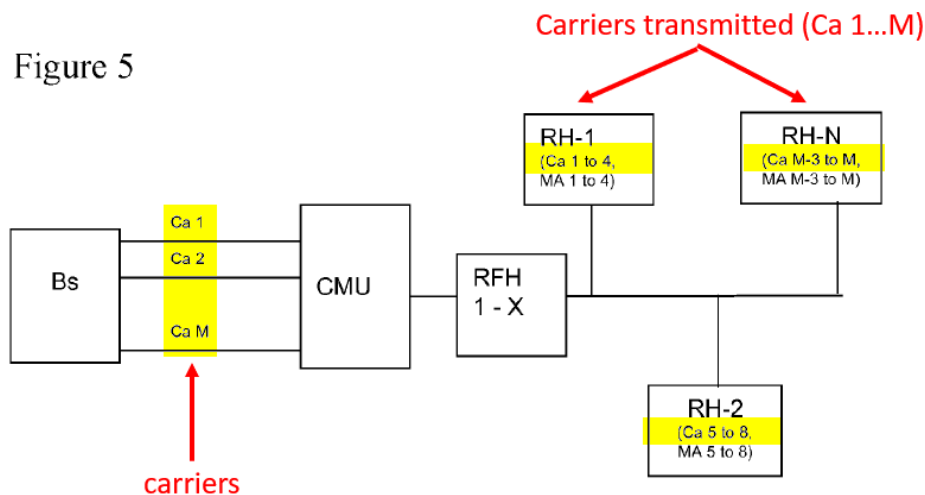
151. Hettstedt teaches the limitations added by these dependent claims.

Hettstedt has multiple teachings that disclose this dependent claim.

152. **First**, Hettstedt teaches its load balancing technique for shifting carriers to radio heads at location of high traffic means “*capacity* can follow moving users in complex buildings” for “dynamic distribution of *hot spots*.” Ex. 1005, ¶0029. A “hot spot” is an example of a change in the capacity needed by the wireless subscribers coupled to the radio head at the location of the hot spot. The radio at the location of the hot spot is an example of *the second access point*. Thus, a POSITA understands that Hettstedt’s load balancing and the determination whether there is a change in need (e.g., when a hot spot forms or when the traffic load changes from low to high at a radio head) are based on where the capacity is needed.

153. Here again, Hettstedt’s disclosure parallels the ‘232 patent’s disclosure. The ‘232 patent’s example of a change in capacity needed is when wireless users gather at one location (i.e., form a hot spot by moving to the location). Ex. 1001, 6:54-63; 1:42-52.

154. **Second**, Hettstedt shifts carriers to “remote radio heads at locations of high traffic.” Ex. 1005, ¶0029. The “remote radio heads at locations of high traffic” are examples of radio heads where there is a change in capacity needed by the number of wireless subscribers coupled to that access point. Hettstedt determines whether there is a change in need (e.g., a change from low to high traffic) by “individual load identification for each carrier on each of the radio heads by air interface activity detection and interference sensing.” Ex. 1005, ¶0043. The “load” on the carriers at a radio head is a measure of the capacity needed by the wireless subscribers coupled to the radio head. The carriers are the capacity supplied by the base station and allocated to the radio heads. Ex. 1005, ¶0050; ¶¶0053-54. Figure 5, for example, show this:



Ex. 1005, Fig. 5. Detecting the activity on the carriers at a radio head (i.e., “activity detection”) is a measure of how much of the carriers (capacity) are being

used by the wireless subscribers at that radio head. Thus, shifting additional carriers to a radio head (the *second access point*) where the CMU now identifies high load on the existing carriers at that radio head because of the activity of the subscribers on those existing carriers is an example of *wherein the change in need is determined based on a change in capacity needed by the number of wireless subscribers coupled to the second access point*. Because Hettstedt does this identification for “each of the radio heads,” Hettstedt necessarily discloses “...*second access point*.”

155. **Third**, Hettstedt teaches to shift carriers to the “locations where the radio heads are loaded over a predetermined value.” Ex. 1005, Claim 3. Being loaded over a predetermined value is an example of a change in capacity needed by the number of wireless subscribers coupled to that radio head (i.e., *second access point*) because, as already explained, load is a measure of the capacity needed and being loaded over a set value represents a change in that need.

156. Therefore, this claim is obvious in view of the combination of Hettstedt and Wellington.

2. Claim 3 and 14

“3. The wireless system of claim 1, wherein the additional resources are included in the first subset prior to being assigned to the second access point, and wherein the one or more central nodes assign the additional radio resources of the plurality of radio resources to the second access point comprises removing the additional resources from the first subset assigned to the first access point.”

“14. The method of claim 12, wherein the one or more additional resources are included in the first subset prior to being assigned to the second access point, and wherein assigning the one or more additional radio resources comprises removing the one or more additional resources from the first subset assigned to the first access point.”

157. Hettstedt teaches the limitations added by these dependent claims.

Hettstedt’s teaches that its load balancing involves the carriers (*additional resources*) being both (1) “de-activated” at the RHs with low traffic load (i.e., *removed*) and (2) “shifted” to RHs with high traffic load where they are “activated” (i.e., *assigned*). Ex. 1005, ¶0029; ¶0044. Here is a more granular explanation of the clauses in this claim.

158. **“wherein the additional resources are included in the first subset prior to being assigned to the second access point...”** Hettstedt’s discloses that the CMU performs “shifting of un-used carriers from radio heads inside areas of low traffic load to radio heads inside areas of high traffic load.” *Id.*, ¶0044. In other words, prior to shifting, the carrier was included in the subset of the low traffic RH (*first subset*) prior to being assigned to the high traffic RH (*second access point*).

159. **“...wherein the one or more central nodes assign the additional radio resources of the plurality of radio resources to the second access point comprises removing the additional resources from the first subset assigned to the first access point.”** In addition to activating the shifted carrier at the high

traffic remote radio head, Hettstedt's teaches that CMU performs the de-activation of the shifted carriers at the low traffic remote radio head. *Id.*, ¶0044. De-activation of a carrier is an example of "*removing*" a carrier. The example of removing a carrier in the '232 patent is turning it "off." Ex. 1001, 7:3-5. There is no patentable distinction between de-activating a carrier and turning the carrier off.

160. Therefore, this claim is obvious in view of the combination of Hettstedt and Wellington.

3. Claim 4 and 15

"4. The wireless system of claim 1, wherein the one or more central nodes analyze one or more transmission parameters associated with the second access point to determine the change in need."

"15. The method of claim 12, further comprising analyzing one or more transmission parameters associated with the second access point to determine the change in need."

161. Hettstedt teaches the limitations added by these dependent claims.

162. As I already explained for Claim 1, Hettstedt teaches that the CMU (*central node*) determines changes in need (e.g., high load vs. low load) of the radio heads (*access points*) during load balancing.

163. As to this claim, Hettstedt's further teaches that CMU (*central node*) analyzes the same transmission parameter that is disclosed in the '232 specification. The '232 specification discloses a module that "detects" which carriers are "active" to determine how the carrier is loaded. *Id.*, 12:5-13. Hettstedt

likewise teaches that the CMU performs “*activity detection*” for each carrier. Ex. 1005, ¶0044. Hettstedt teaches that the CMU performs: “individual load identification for each carrier on each of the radio heads by air interface activity detection and interference sensing.” *Id.* As applied to this claim, the level of activity on the carriers (e.g., high activity vs. low activity) is an example of *one or more transmission parameters*. Hettstedt teaches to “analyze” the air activity where it teaches to perform “activity detection” to identify the load. Because Hettstedt teaches to perform this analysis for “each” radio head, it discloses *analyzing one or more transmission parameters associated with the second access point*.

164. Therefore, this claim is obvious in view of the combination of Hettstedt and Wellington.

4. Claim 5

“5. The wireless system of claim 1, wherein the one or more central nodes determines the change in need by determining that at least one transmission parameter associated with the second access point is greater than a threshold.”

165. Hettstedt teaches the limitations added by this dependent claim. As I explained in the prior claim, Hettstedt teaches that the CMU (*central node*) determines the change in need by analyzing the same transmission parameter that is disclosed in the ‘232 specification (the level of activity on the carriers). Hettstedt further teaches to do this analysis for “each carrier on each of the radio

heads” to identify “where the remote radio heads are loaded over a predetermined value. *Id.*, ¶0044, Claim 3. Thus, Hettstedt teaches to identify each radio head (which includes a *second access point*) where the level of activity on the carriers (the *transmission parameter*) is “over” (*greater than*) the “predetermined value” (the “*threshold*”).

166. To the extent that this is not already a disclosure of this claim element, this claim is obvious as discussed above in view of Wellington teaching to monitor a parameter (e.g., the recited *transmission parameter*) and trigger additional carriers when the parameter reaches a “predetermined level” or “predetermined threshold.” Ex. 1007, 1:64-67 (“In yet another aspect thereof, a trigger component is provided that monitors one or more parameters that trigger enablement of an additional carrier in the cell over the existing carriers that currently exist in operation.”); 9:40-49, Claim 12. For the same reasons discussed for the independent claim, a POSITA would have found it obvious to combine Hettstedt with Wellington’s teaching such that the CMU includes a trigger condition that monitors the level of activity on the carriers (the *transmission parameters*) and triggers the CMU to start the process of shifting carriers to the high activity radio heads (the *second access point*) when the level of activity on the existing carriers is greater than the “predetermined level” or “predetermined threshold” defined by the trigger and as taught by Wellington.

167. Therefore, this claim is obvious in view of the combination of Hettstedt and Wellington.

5. Claims 6 and 16

“6. The wireless system of claim 1, wherein the first access point belongs to a first sector and the second access point belongs to a second sector.”

“16. The method of claim 12, where the first access point belongs to a first sector and the second access point belongs to a second sector.”

168. Hettstedt teaches the limitations added by these dependent claims. As explained below, a POSITA uses “sector” to refer to either distinct coverage areas or distinct radio resources. Which of these meanings applies here does not matter: Hettstedt discloses both.

169. The term “sector” has been used by different users to refer to different but related concepts within the same context of cellular communication systems. Historically, the term “sector” in cellular systems developed from the transition away from omnidirectional antennas to more targeted antennas that would cover only a directional portion of the cell coverage area. That is, through a process called “sectoring” or “sectorization” a cellular radio cell was divided up into smaller sectors (typically three sectors) each covering a different directional azimuthal arc from the radio tower (traditionally each 120°). Each sector was served by a different directional antenna. The channels or radio resources available for use would likewise be divided into different subgroups, e.g., three

subgroups, one subgroup for each sector of the cell area to be covered. *See, e.g.,*

Ex. 1032 (Newton's Telecom Dictionary):

Sectoring The process of dividing a mobile cellular radio cell into sectors, or smaller patterns of coverage. Traditionally, all cell antennae were omnidirectional; that is to say that they provided coverage in a 360-degree pattern. Sectoring is applied when either the capacity of the cell site is insufficient or when interference becomes a problem. Sectoring divides the number of channels assigned to the cell into smaller groups of channels, which are assigned to a sector through the use of directional antennae. Commonly, the cell antenna is divided into three sectors, each with a 120-degree coverage pattern. ...

170. For example, within the field of cellular communications using base stations, a POSITA would understand “sector” to cover either (or both) of the following two related concepts: (1) a portion of the geographical area covered by a base station, and (2) the group of radio resources assigned to the corresponding portion of the base station's geographical area of coverage.

171. Out of this context, the term “sector” is sometimes used to refer to the smaller, often triangular portion of the coverage area intended to be covered by one of the three directional antennas. But the term is also sometimes used to refer to the distinct subgroup of radio resources or channels intended for use within a particular area.

172. The term “sector” is not used in the '232 patent specification. “Sector” is only mentioned briefly in Provisional App. No. 61/382836 which includes the following description and Figure 7:

Figure 7 illustrates an embodiment of a three-sector implementation of an RRU-based system architecture, in which a base station server 700 is optically linked to a plurality of RRU's 710 to provide adequate coverage for a site.

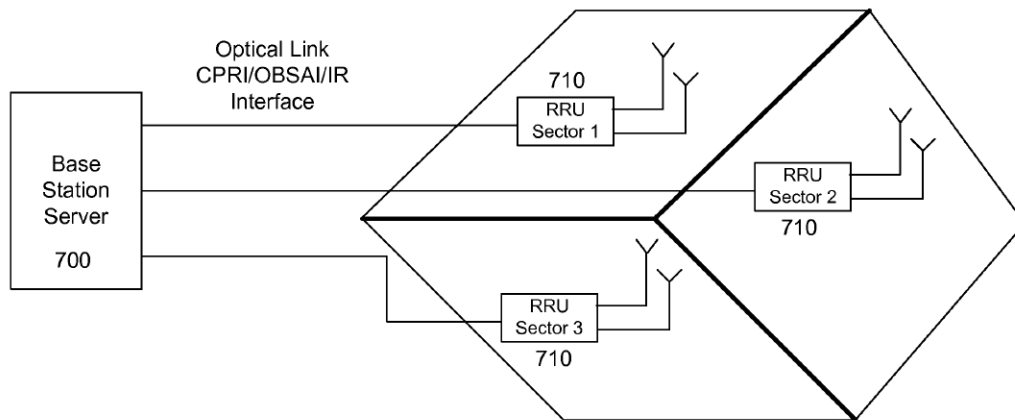


Figure 7

See Ex. 1033, A278 (lines 7-14). In the figure: (a) each RRU appears to be located within its own region or area, (b) the areas appear to be adjacent, (c) there is one RRU in each region, (d) the term “sector” appears within each RRU, and (e) each RRU appears to be fed by an independent optical link from a base station server.

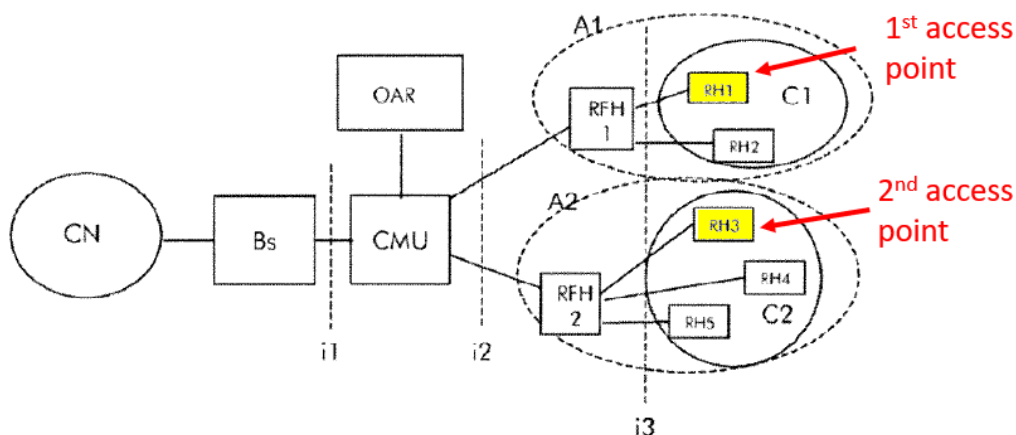
173. Whether “sector” is being used in claims 6 and 16 to refer to distinct coverage areas or to distinct radio resources does not matter because Hettstedt teaches both.

174. **Distinct coverage areas.** Hettstedt teaches that the radio heads (*access points*) may belong to different coverage areas comprising “different” cell

areas and “different” location areas. Ex. 1005, ¶0052 (“Each remote radio head can service a different cell area ... being in different location areas”).

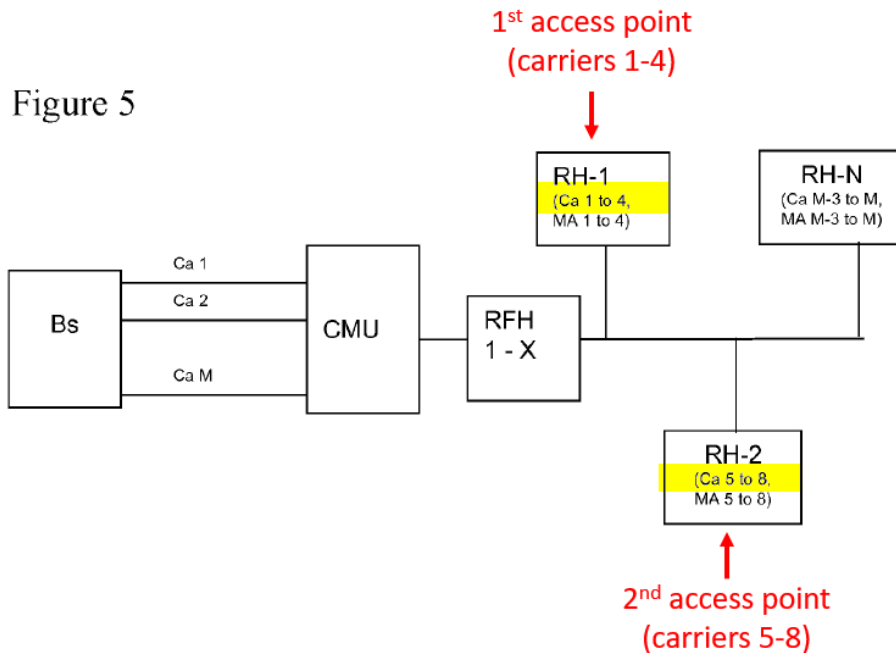
175. Hettstedt’s Figure 3 is informative. It illustrates an example where (1) RH1 belong to “first cell area C1” inside “first indoor location area A1” and (2) RH3 belongs to “second cell area C2” inside “second indoor location area A2”:

Figure 3



Id., Fig. 3, ¶0052.

176. **Distinct radio resources.** Hettstedt also teaches that RHs can have distinct sets of carriers (radio resources). Figure 5, for example, shows this:



Id., ¶0053.

177. Furthermore, a POSITA would understand that a division of radio resources similar to that depicted in Figure 5 could be applied to assign a subset (sector) of radio resources to the radio heads in cell C1 of Figure 3 different from the subset assigned to the radio heads in cell C2.

178. Hettstedt further teaches each RH can operate “operate individually for dedicated operators only.” *Id.*, ¶0050. This is further example of where each RH has a distinct set of radio resources as each operator corresponds to different radio resources.

179. Because Hettstedt teaches each radio head may belong to distinct cells, locations, and carrier sets, Hettstedt discloses this claim under any meaning of “sector.”

180. Therefore, this claim is obvious in view of the combination of Hettstedt and Wellington.

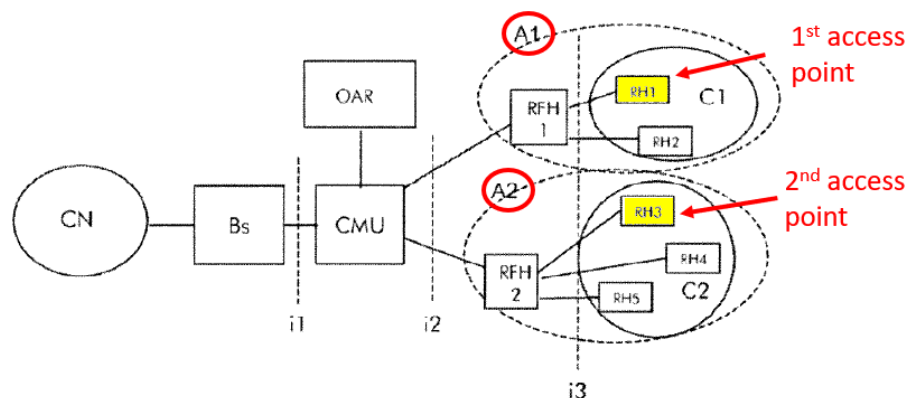
6. Claims 7 and 17

“7. The wireless system of claim 1, wherein the first access point belongs to a first building and the second access point belongs to a second building.”

“17. The method of claim 12, where the first access point belongs to a first building and the second access point belongs to a second building.”

181. Hettstedt teaches the limitations added by these dependent claims. Hettstedt teaches that the radio heads (the *access points*) may belong to different indoor location areas. *Id.*, ¶0052. Hettstedt’s Figure 3 is informative. It discloses an example where (1) RH1 belong to “first indoor location area A1” and (2) RH3 belongs to “second indoor location area A2”:

Figure 3



Id., Fig. 3. Hettstedt teaches these indoor locations may be “buildings.” *Id.*, ¶0002 (“...in buildings and tunnels”); ¶0029 (“complex buildings, such as airports, stations, etc.”).

182. Therefore, this claim is obvious in view of the combination of Hettstedt and Wellington.

7. Claims 9 and 19

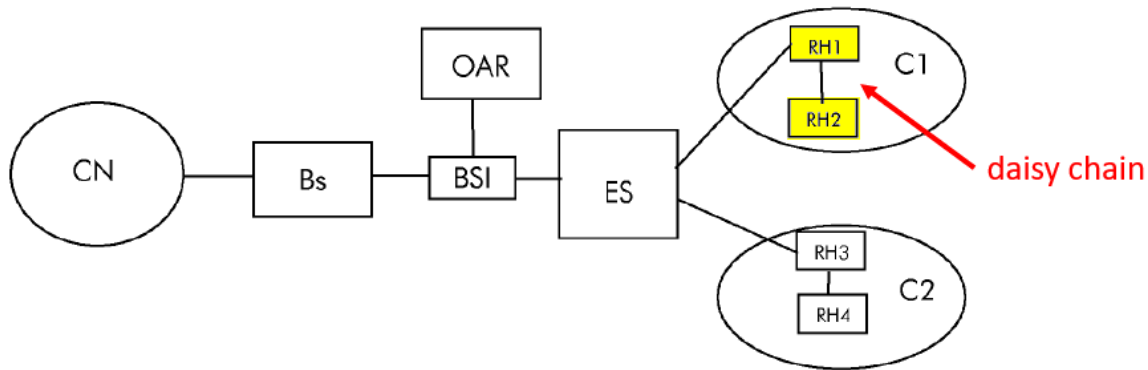
“9. The wireless system of claim 1, wherein at least two of the plurality of wireless access points are connected in a daisy chain manner to relay communications between at least a subset of the plurality of wireless access points.”

“19. The method of claim 12, wherein at least two of the plurality of wireless access points are connected in a daisy chain manner to relay communications between at least a subset of the plurality of wireless access points.”

183. Hettstedt itself renders the limitations added by these claims obvious. Hettstedt teaches a plurality of radio heads (*wireless access points*). A POSITA would have found it obvious to daisy-chain at least two of the radio heads.

184. First, Hettstedt itself already illustrated daisy-chaining in its background discussion of a similar “known indoor communications system” shown in Figure 2:

Figure 2



Id., Fig. 2; ¶0006. The Ethernet switch in Figure 2 feeds ethernet packets into the daisy-chained RH (e.g., RH1, RH2). The same daisy-chaining could equally be employed with Hettstedt’s CMU which also feeds Ethernet packets to radio heads. Further, in paragraph 0006, Hettstedt identifies an example of the system he shows in Figure 2: U.S. Patent App. Publication No. 2005/0157675 A1 (‘675 publication). *Id.*, ¶0006. The ‘675 publication explains how radio heads may be “cascaded” (i.e., daisy-chained). Ex. 1018, ¶¶0025-26, ¶0028 (explaining how). Thus, Hettstedt’s own specification points a POSITA to an example that expressly explained how to daisy-chain radio heads.

185. Second, Hettstedt itself teaches to deploy its system in scenarios that are well-recognized in the art to implicate daisy-chaining. Specifically, Hettstedt

teaches to deploy its system in “tunnels” and “airports,” which both include long corridors (e.g., the tunnel itself and the various terminals in the airports). Ex. 1005, ¶0002, ¶0040. The background art, for example, (1) explains “One problem with remote antennas, however, is that coaxial cable cannot be run long distances due to attenuation. Remote antennas are difficult to install along a highway or through a tunnel due to this attenuation problem.” and (2) teach to use a “a daisy-chain arrangement” to solve this problem. Ex. 1019 (Bauman), 1:40-43, 2:57-59, 1:54-57, 3:56-61, 5:42-59 (Claim 1, which recites “daisy-chained” remote units). In these situations, the closest connection point for each radio head is the prior radio head, not the CMU at the start of the tunnel or terminal. Thus, daisy-chaining the radio heads reduces the cables and installation effort compared to running each cable back to the CMU at the start of the tunnel.

186. A POSITA would have been motivated to connect at least two of Hettstedt’s radio heads in a daisy chain manner to relay communication between them to obtain the well-known benefits of: (1) reduced cabling and cost and (2) ease of installation/maintenance. As already noted, Hettstedt naturally implicate these benefits because Hettstedt teaches to deploy its system in “tunnels” and “airports.”

187. A POSITA would have a reasonable expectation of success. (1) Daisy-chaining wireless access points involves adding a port to connect a cable

between them. Hettstedt's radio heads necessarily already include a port (to connect to the upstream RFH); thus, this change essentially calls for duplicating an existing type of structure. Further, it was well known how to relay communications in a daisy-chain, e.g., by forwarding in the downlink and forwarding or summing in the uplink. Hettstedt communications have addresses, and a POSITA knows that addressing can be used to relay communications. (2) As mentioned above, Hettstedt's own specification points a POSITA to another publication that expressly explained how to daisy-chain radio heads. (3) The '232 patent does not disclose anything inventive or unexpected about the step of incorporating the claimed daisy-chain interface.

188. Many other references corroborate that connecting remote units in a daisy chain manner to relay communications between them was a known technique.

189. As an example, U.S. Patent No. 8,958,789 to Bauman ("Bauman", Ex. 1019) discloses configuring the remote units of a digital distributed antenna system in a daisy-chain configuration which even addressed how to daisy-chain when simulcasting (i.e. sending and receiving on the same resources at multiple remote units):

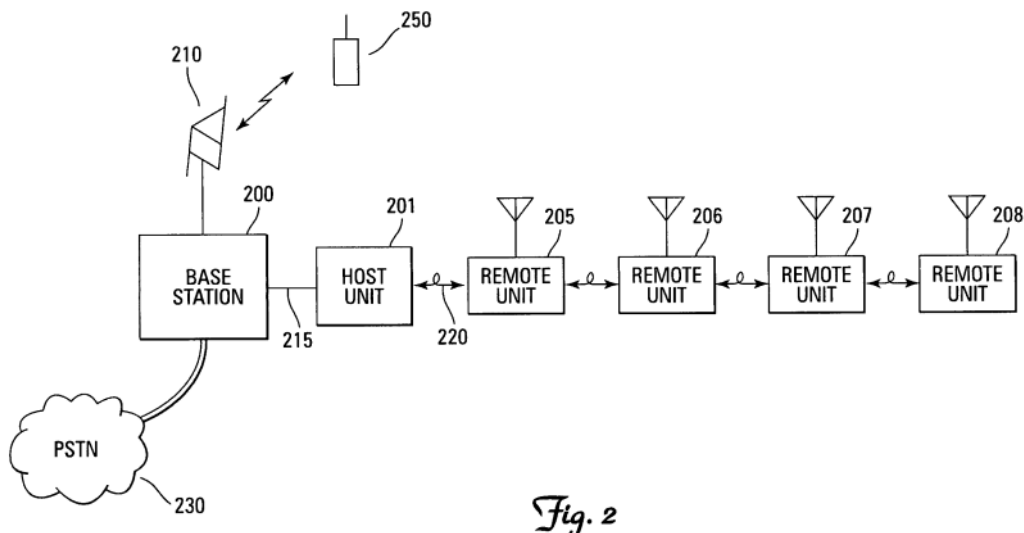
The embodiments of the present invention encompass a distributed digital antenna system that has a host unit for converting radio frequency signals to digital optical signals and digital optical signals to radio frequency signals. The digital

optical signals are transmitted over an optical medium to a plurality of remote units that are **daisy-chained** along the optical medium.

Ex. 1019, 1:51-60 (emphasis added).

One or more remote units (205-208) are connected to the host unit (201) through an optical medium, such as a fiber optic line (220), that is connected in a daisy-chain arrangement. The remote units (205-208) are placed in locations that require additional signal coverage due to a lack of coverage by the base station (200).

Ex. 1019, 3:56-61.



Ex. 1019, Fig. 2. In Bauman, each remote unit digitally sums the signal received from any remote units further along the daisy-chain and then passes the summed signal upstream.

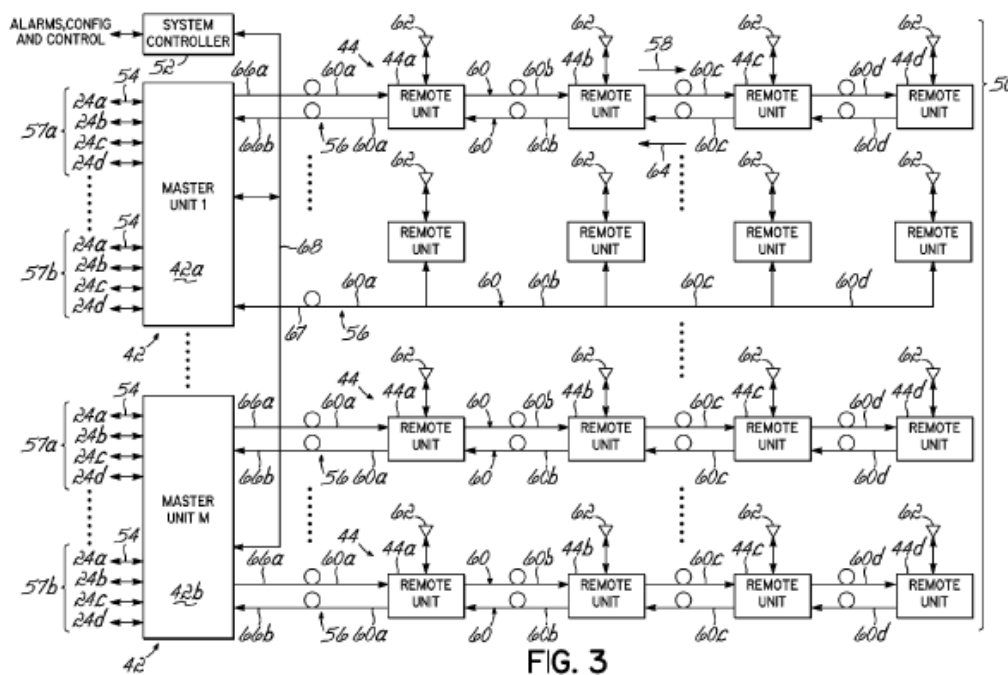
The digitized received signal is input to a summer (315) to be added to the digitized signals from the preceding remote units in the daisy-chain. The input of the summer (315), therefore, is coupled to an output of a previous remote unit. The output of the summer (315) is a summation signal that is

coupled to either the input of a subsequent remote unit or to the host unit. The host unit thus receives a summation signal that represents the sum of all the signals received by the remote units (105-108) of the system.

Ex. 1019, 4:25-33.

190. As another example, U.S Patent No. 8,346,091 (“Kummetz”, Ex.

1020) discloses a digital DAS with daisy-chained remote units in Fig. 3:



Ex. 1020, Fig. 3.

191. As a third example, U.S. Patent No. 6,801,767 (“Schwartz”, Ex. 1021) discloses the daisy-chaining concept: “The employment of a novel hybrid star/**cascaded** architecture provides a modular, flexible and efficient way of distributing multiband wireless RF signals. ... This novel architecture of the

present invention provides a modular, flexible, and efficient way of transporting and distributing multiband wireless communications signals, which is particularly effective in an indoor environment.” Ex. 1021, 8:45-47, 9:59-63. Fig. 1 shows the remote units in a daisy-chain:

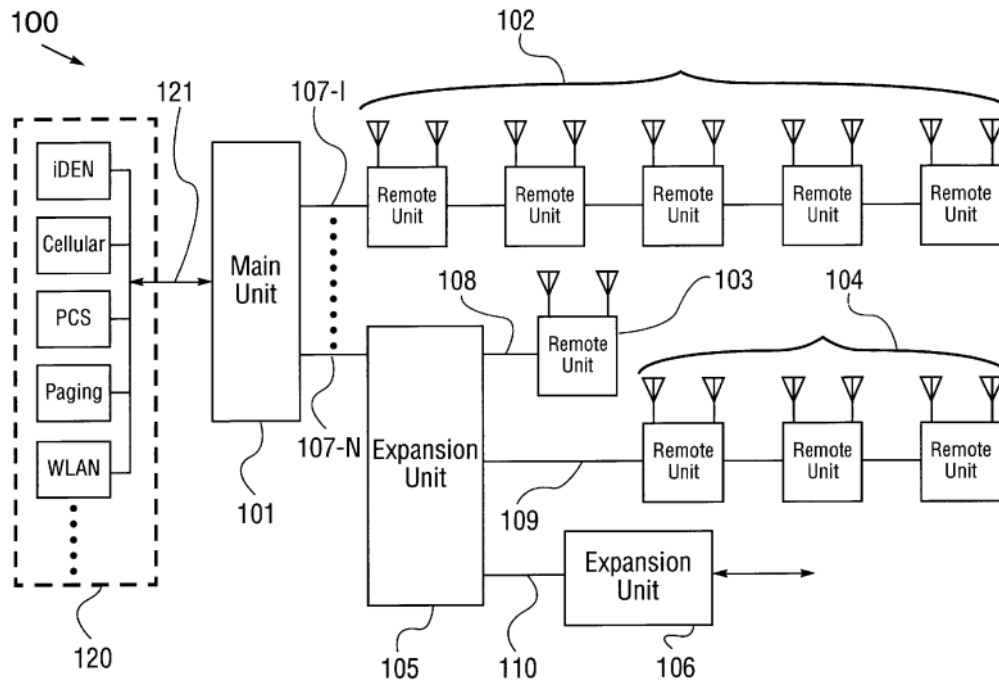


Fig. 1

Ex. 1021, Fig. 1.

192. As another example, U.S. Patent No. 6,785,558 (“Stratford”, Ex. 1022) teaches multiple topologies including daisy-chain topology and teaches that the daisy-chain can be constructed using well-known add/drop multiplexers to enable different signals to be carried to different remote units along a single fiber cable path. See, e.g., Ex. 1022, 9:39-44 (“When either lit fiber is used, or a ring or

daisy-chain architecture is employed, network access equipment is required to interface with the optical network. For example, a SONET/SDH system would require add/drop multiplexers at both the digital hub and the NAN sites to multiplex the digital data onto the existing optical network.”); *see also* Fig. 8; 5:29-31 (“FIG. 8 is a block diagram illustrating a daisy chain architecture for a communication System according to a preferred embodiment of the invention.”).

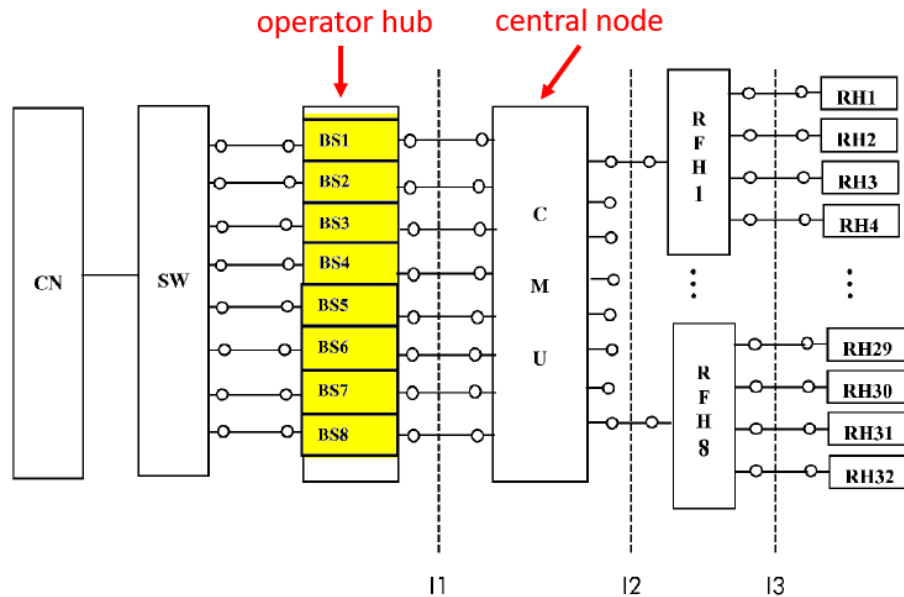
8. Claim 11

“11. The wireless system of claim 1, wherein the one or more one or more central nodes are coupled to a plurality of operator networks via the operator hub.”

193. Hettstedt teaches the limitations added by this dependent claim. As I already explained for Claim 1, Hettstedt includes a CMU (*central node*).

194. As to this claim, Hettstedt further teaches that the CMU provides “multi-operator functions.” Ex. 1005, ¶¶0026-27; ¶0042. Figure 6, for example, shows the CMU connected to multiple base stations (grouped in the same box):

Figure 6

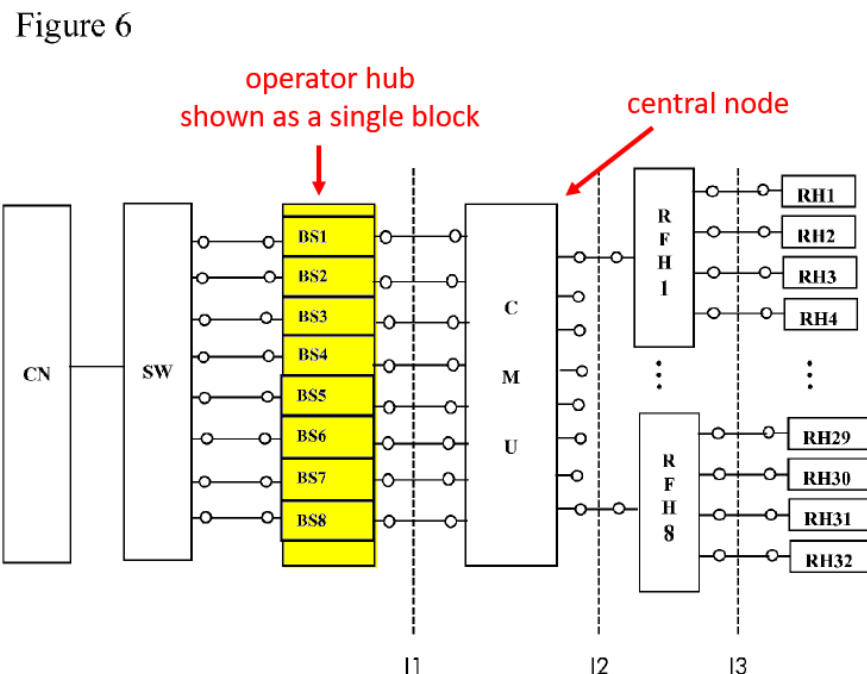


Id., Fig. 6; ¶0054. Hettstedt teaches that the CMU comprises a matrix “to combine different base stations.” *Id.*, ¶0042.

195. Regarding the claim language about “operator networks,” Hettstedt explains that the base stations can provide services from plural “different operators.” *Id.*, ¶0054. A POSITA understands that the disclosure of plural “different operators” means there are a plurality of operator networks because each operator must have a network to function. Thus, Hettstedt discloses an example where the CMU (*central node*) is coupled to a plurality of operator networks via the different base stations (*operator hub*). The base stations, together, correspond to the operator hub, with different sets of base stations being operated by different network operators.

196. Again, I note that Hettstedt disclosure closely parallels the ‘232 patent. The ostensible disclosure of this claim in the ‘232 patent is a “multi-operator” DAU coupled to different base stations where the base stations belong to different operators, which is precisely what Hettstedt discloses as discussed above.
Ex. 1001, 7:59-8:9; 6:32-51

197. If Patent Owner argues the claim requires a single operator hub, that would not distinguish this claim of the ‘232 patent from Hettstedt. Figure 6 discloses the plural base stations as within a single block:



Ex. 1005, Fig. 6. Because they are shown as a single block, a POSITA understands this means they are co-located and can be considered as a single unit (sometimes called a “base station hotel”).

198. If Patent Owner argues Figure 6 in Hettstedt only illustrates the base stations connecting to a single set of boxes (SW, CN), that is consistent with Hettstedt's disclosure of this claim element. One of skill in the art understands that the "core network" carries signals and control on behalf of multiple operators. Focusing on the CN shown in Figure 6 misunderstands the point of Figure 6. Figure 6 illustrates the "wireless cellular indoor communications system," not the details of the networks upstream to the operators' wireless networks. *Id.*, ¶¶0038. A POSITA understands the boxes (SW, CN) are merely generic placeholders. They are not intended to illustrate the full details of those networks much less suggest there is only one operator network. Such an interpretation would give no meaning to Hettstedt's teaching that the CMU provides "multi-operator functions." *Id.*, ¶¶0026-27; ¶0042.

199. For comparison, the '232 patent also does not show separate details for different operator network, but rather presents a high-level block diagram. *See, e.g.,* Ex. 1001, Fig. 1, Fig. 5 (only showing one mobile switching network).

200. Therefore, this claim is obvious in view of the combination of Hettstedt and Wellington.

VIII. Ground 2: Hettstedt by itself renders obvious claims 1-7, 9, 11-17, and 19-20

201. As already noted, Patent Owner purportedly distinguished Hettstedt during prosecution by adding the clause: “which of the second subset is loaded beyond a threshold.” The prior ground discussed a secondary reference that teaches this “threshold” element that was never disclosed or discussed during the prosecution history.

202. Hettstedt itself discloses (in its own claims) that the carriers are shifted to the radio heads that are “loaded over a *predetermined value*.” *Id.*, Claim 3. The example threshold disclosed in the ‘232 patent is a predetermined value. Ex. 1001, 12:10-13 (“...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.”). The ordinary meaning of “threshold” refers to a “value.” Ex. 1036 (defining threshold: “a level, point, or value above which something is true or will take place and below which it is not or will not”); Ex. 1037 (defining threshold: “A value used to denote predetermined levels.”). Further, there is no significant difference between “loaded over” (Hettstedt) and “loaded beyond” (‘232 patent).

203. A POSITA would have found the added element at least obvious in view of Hettstedt’s own disclosure. Hettstedt already teaches:

- Each radio head has a “subset” (see Fig. 5)

- The CMU shifts and activate additional carriers to radio heads with “high load on their active carriers” (their *subset*).
- The CMU identifies the load on “each carrier and each radio head.”
- The CMU activates the carriers at the radio heads “are *loaded over a predetermined value*.”

A POSITA would have found it obvious to implement these teaching together, i.e., to identify which radio heads have a high load on their active carriers by determining whether the load on their active carriers is “loaded over” (i.e., “*loaded beyond*”) the predetermined value (i.e., the threshold). In other words, a POSITA would have found it obvious to have the CMU assign an additional radio resource (by shifting and activating a carrier) when the load on the subset at a radio head exceeds the predetermined value. Any “high” load subset constitutes an example of the recited “second subset.” A POSITA would have found it obvious to use Hettstedt’s “predetermined value” as a threshold—that is within the ordinary meaning of threshold. Furthermore, the

204. A POSITA would have been motivated to use Hettstedt’s predetermined value as the recited threshold to realize Hettstedt’s teaching to identify which radio heads have “high” load and enable the CMU to perform its cells management “automatically” (by simply comparing the load to the threshold).

205. Hettstedt already discloses the building blocks, including a predetermined value and how to identify the load on the subsets (by activity

detection). Determining whether the load is over the predetermined value is a simple mathematical comparison, easily implemented.

IX. Hettstedt and Enablement

206. I am aware that, in a different case, Patent Owner disputed whether Hettstedt's disclosure is enabling. I understand that Hettstedt is presumptively enabled because it is a published United States patent application.

207. In my opinion, the disclosures I cited from Hettstedt are enabled. In fact, Hettstedt provides essentially the same level of disclosure as the '232 patent. Both Hettstedt and the '232 patent teach to measure load using activity detection. *Compare* Ex. 1005, ¶0044 ("activity detection") *with* Ex. 1001, 11:58-59 ("detects which carriers and corresponding time slots are active"). Both Hettstedt and the '232 patent teach to use a threshold/predetermined value when assigning additional resources. *Compare* Ex. 1005, Claim 3 ("loaded over a predetermined value") *with* Ex. 1001, 12:9-11 ("...identify when, e.g., a particular downlink carrier is loaded by a percentage greater than a predetermined threshold value"). Both Hettstedt and '232 patent teach the use of addressing and a switch to distribute the carriers (and thus achieve load balancing by shifting radio resources among the remote units). *Compare* Ex. 1005, ¶0042 ("intelligent switching unit for data distribution and cell organization"), ¶0028 ("The cell management unit provides data management in terms of packaging and addressing to the radio heads"), ¶0045 ("mapping means

... e.g. through their MAC addresses”) with Ex. 1001, 8:48-55 (“...since the base station signals are digitized, packetized, routed and switched to the desired RRU”); 9:13-21 (“...Other Interface standards are applicable provided they uniquely identify data packets with respective RRUs. Header information is transmitted along with the data packet which identifies the RRU and DAU that corresponds to the individual data packet.”). Using these features, a POSITA would know how to make and use Hettstedt’s disclosure.

208. I am aware that, in a different case, Patent Owner disputed whether a POSITA would know how to configure / reconfigure the radio heads themselves in Hettstedt.

209. **First**, none of the limitations in the claim expressly require configuring / reconfiguring the radio heads themselves. Rather, the claims recites that the central node (not the wireless access point) is what assigns additional radio resources: “the one or more central nodes assign additional radio resources of the plurality of radio resources to the second access point.” *See, e.g.*, Ex. 1001, Claim 1.

210. Hettstedt provides enabling disclosure for the CMU assigning additional resources. Hettstedt discloses that the CMU (1) packages and addresses carriers, (2) maps carriers to individual radio heads, as identified e.g. through their MAC addresses, and (3) comprises an intelligent switching unit to distribute the

addressed data packets to the remote radio heads. Ex. 1005, ¶¶0028, ¶¶0042, ¶¶0045, ¶¶0053. Using these features, a POSITA would understand how to make and use the CMU assigning additional resources, e.g., by addressing the additional radio resources to the desired remote radio and using the switch to direct that addressed data packets with the carriers to that remote radio.

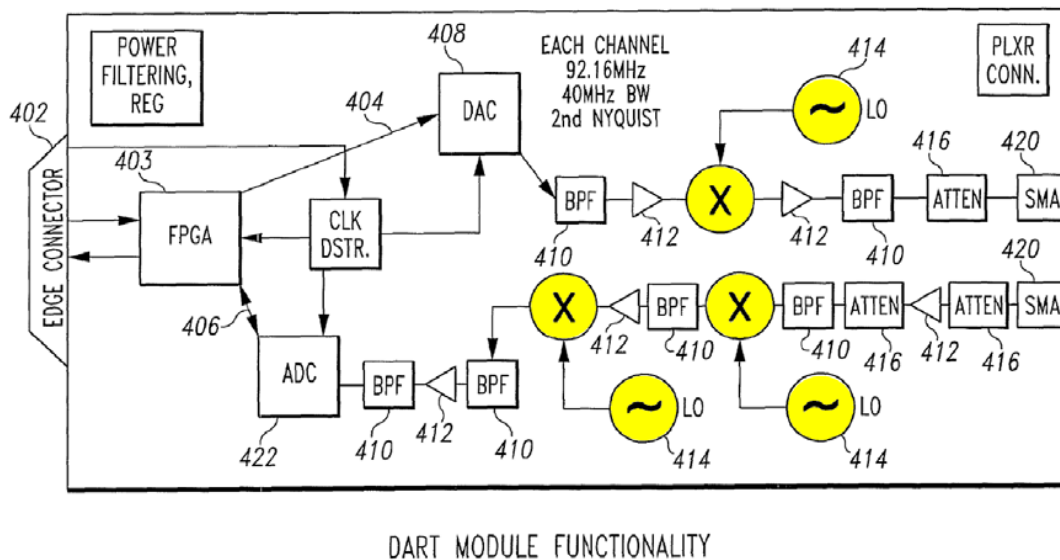
211. **Second**, *even supposing for the sake of argument that configuring / reconfiguring the radio heads themselves was required*, a POSITA would readily know how to configure or reconfigure the radio heads in Hettstedt. It was very well known how to re-tune a radio head so that each downlink signal is radiated on the correct frequency and each uplink signal is converted from its arriving frequency to baseband. The radio heads would be configured / reconfigured to accomplish this using mixers and oscillators (e.g., a VCO or voltage-controlled oscillator). Mixers and oscillators are extremely well-known components and processing steps.⁵ They can be implemented in both the digital and analog domain.⁶

212. Using oscillators and mixers to translate between (both to and from) the desired radio frequency used for wireless transmission and lower frequencies

⁵ See, e.g., Ex. 1023, Fig. 4; Ex. 1024 at Figs. 3-5; Ex. 1025 (Figs. 3-5); see also Ex. 1026, 7:47-49 (“It is further understood that a voltage controlled oscillator (VCO) may be used and tuned to arbitrary frequency for non-contiguous channel allocations.”).

⁶ For example, they can be implemented in FPGA. It was very well to implement FPGA in remote units. See, e.g., Ex. 1006, Figs. 7-1, 7-2.

(such as baseband or intermediate frequencies) has been ubiquitous in RF systems for decades prior to the '232 patent. For example, Ex. 1024 at Figure 4 shows the well-known combination of oscillators and mixers (with accompanying filters and amplifiers) that translate the frequency of modulated carrier signals to and from RF:



Ex. 1024, Fig. 4; *see also* Ex. 1023, Fig. 4.

213. The amount of translation (and therefore the resulting position along the RF spectrum of the transmitted wireless signal) is merely a function of the frequency of the signal output by the local oscillator that is mixed with the modulated signal. It was well-known that the system could be tuned to a different RF channel by changing the signals output by the local oscillators using, for example, a voltage controlled oscillator (an oscillator that can change the frequency that it outputs). *See* Ex. 1026, 7:47-49 ("It is further understood that a

voltage controlled oscillator (VCO) may be used and tuned to arbitrary frequency for non-contiguous channel allocations.”). As discussed below, it was also well-known that these same operations could be performed digitally. *See, e.g.*, Ex. 1027 (“dynamic digital up and down converters”); Ex. 1009 (DUC and DDC).

214. A POSITA would naturally understand to implement Hettstedt using mixers and oscillators. Hettstedt references tuning, which relates back to the concept that VCO for mixers can be tuned. Ex. 1005, 5:10-13 (“Since frequency allocation of each carrier can be tuned remotely by the cell management unit CMU, the remote radio heads RH1 to RH5 can represent an individual cell and/or can be part of a greater cell.”). Similarly, Hettstedt also teaches being “channel-selective.”

215. Further, a POSITA would understand that mixers and oscillators could be implemented in the digital domain using digital up/down converters. Digital up/down converters are well-known. Further, configurable digital up/down converters are well-known. For example, U.S. Patent No. 7,474,891 (“Toms”, Ex. 1027) teaches “Dynamic digital up and down converters.” Ex. 1027, Title. Toms explains that digital up and down converters can be “dynamically changed on the fly” using “parameters”:

“Embodiments of the present invention provide methods and systems to dynamically implement frequency, bandwidth and amplitude changing as well as reallocation of resources in mobile communications systems through the use of dynamically configured

digital up and down converters. In particular, in embodiments of the present invention, parameters that control the up and down converters are dynamically changed on the fly to change at least one of frequency, bandwidth and amplitude of a communication signal in a communication channel. Accordingly, the need for a large amount of resources dedicated to specific frequencies, bandwidths, and amplitudes for particular protocols is eliminated due to the dynamic nature of the digital up and down converter configurations in the present invention, thus leading to a more efficient and lower cost system.”

Id., 4:46-60. The digital up and down converters can be “configured” and “reconfigure[d]”:

...embodiments of the present invention is accomplished through digital up converter (DUC) circuit 119 and digital down converter (DDC) circuit 121. The DUC circuit 119 contains a plurality of dynamic configured digital up converters (DUCs) 117-1 through 117-N and the DDC circuit 121 contains a plurality of dynamic configured digital down converters (DDCs) 121-1 through 121-N.... . At the point of time...radio head interface 106 reconfigures the forward channel digital up converter to the new RF channel. Radio head interface 106 then reconfigures the associated reverse channel DDC 121 in the DDC circuit 119 to the new RF frequency. In some embodiments, reconfiguration of the reverse channel occurs after a time delay which in some embodiments is specified in the page header.

Id., 9:14-41 (emphasis added). The digital up and down converters can be loaded with any “parameters” and equipped with memory/registers to hold the parameters:

A configuration management unit 232 receives information from call processing software module 112 to reconfigure logic channel 230-1 for a new modulation protocol. In one embodiment, configuration management unit 232 looks up associated parameters for the modulation protocol from a table located in a memory unit 236. Through a control channel 234, configuration management unit 232 (or controller 232) loads appropriate parameters into DUC 222-1. The parameters include filter coefficients, numerically controlled oscillator

(NCO) frequency, interpolation/decimation rates, sampling rates and the like. In one embodiment, DUC 222-1 is adapted with a DUC buffer memory 223 that holds the parameters received from configuration management unit 232. In one embodiment, transmit engine 226-1 sends a synchronization signal to DUC 222-1 to load the parameters from the DUC buffer memory 223 into DUC 222-1's active registers. Once the parameters are loaded into the active registers, logic channel 230-1 begins operation under the modulation protocol specified by call processing software 112.

Id., 10:33-51; *see also* 10:52-11:3 (discussing another example for “signal bandwidth”); 11:4-54 (discussing DDCs). Toms explains that this technique “can be combined” with the radio head unit. *See id.*, 6:28-30 (“In still another embodiment, radio head unit 104 and radio head interface card 106 can be combined into a single card” where the DDC/DUCs are inside 106 as shown in Figs 1-3). Another example is U.S. Patent No. 7,398,106 (“Conyers”, Ex. 1009). Conyers teaches configuring/reconfiguring parameters for digital up and down converters (e.g., gain):

During initial configuration of communication system 100, digital up-converter (DUC) and digital down-converter (DDC) filter parameters and sampling rates are loaded into radio head interface 106 for one or more of the protocols supported by radio head unit 104. Such parameters include, but are not limited to, filter parameters and sampling rates necessary to support valid RF channel, signal bandwidth, signal gain, and protocol configurations. Additional details regarding the configuration and operation of DUCs and DDCs are discussed in the '673 Application, incorporated herein by reference. In one embodiment, the parameters are stored in a table in memory in radio head interface 106....Embodiments of the present invention provide for dynamic readjustment of the signal power level (i.e. the signal gain) of the signal broadcasted by radio head unit 104 by reconfiguring DUC 122-1 with filter parameters that either increase of

decrease the signal amplitudes of the complex RF data samples processed by DUC 122-1.

Ex. 1009, 6:1-7:24; see also Figs. 1-2. Numerous other patents describe DDCs/DUCs. *See, e.g.*, Ex. 1028.

216. Further, I note that communication to the radio heads in Hettstedt is packet-based. Ex. 1005 at 4:7-14 (“The cell management unit CMU performs data packaging in downlink and forwards said digital packets through a second digital connection interface i2, e.g. an electrical or optical connection using Ethernet protocol, to the RF Hubs RFH1 and RFH2, which in turn pass the packets through a third connection interface i3, e.g. an electrical or optical connection using Ethernet protocol, to the remote radio heads RH1 to RH5.”). It was well-known how to communicate any needed parameters (e.g., for the VCO) using packets. For example, the parameters could simply be inserted in the appropriate field of the packet’s header or trailer. Further, it was well-known to communicate parameters to radio heads. For example, the CPRI and OBSAI standard protocols for distributed base stations employing a remote radio head teach to communicate control and management (C&M) information. Communication of parameters also does not require “undue” experimentation. It is a standard part of digital communication.

217. Mixers and oscillators are a standard part of electrical engineering bachelor program and are standard components in wireless technology. Further,

setting and communicating parameters is a standard part of working with wireless technology. A POSITA with 2-3 years of experience working with wireless technology would be very familiar with how to communicate and set parameters for the components and processing. For example, Wu teaches using mixing and oscillators to select carriers. *See, e.g.*, Ex. 1006, Figs. 7-1, 7-2; *see also* Ex. 1024. These prior art references corroborates that a POSITA would know how to configure or reconfigure radio heads in Hettstedt and show possession of the desired subject matter.

218. For completeness, I note that a POSITA would readily understand how to duplicate components and processes (e.g., insert two, three, four, etc. mixers/oscillators instead of one) and implement digital up/down conversion. *See, e.g.*, Ex. 1028, Figs. 1-2.

219. In sum, *even supposing for the sake of argument that configuring / reconfiguring the radio heads themselves was required*, a POSITA would know how to implement Hettstedt. The following factors further support my conclusion. First, the quantity of experimentation necessary (if any at all) is low. As mentioned above, the components/processing involved yield predictable results and are well-known techniques. Second, the prior art provides working examples (see Wu). Third, the nature of Dali's alleged invention also supports my conclusion. Nothing in the claim suggests the underlying components/processing for

configuring/reconfiguring the radio head are the inventive aspect of the claimed subject matter. Fourth, the state of the art is advanced. For example, Digital RF transport systems date back to the 1990s. *See, e.g.*, U.S. Patent No. 5,644,622. Fifth, as noted above, the skill of those in the art would cover studying and/or working with the necessary components/techniques. Sixth, the technology involved here (mixers, oscillators, parameters) are predictable. Indeed, they can be done in the digital domain via digital processing, which is highly predictable and reliable.

X. Grounds 3 and 4: Wu renders claims 1-7, 9, 12-17, 19-20 obvious either alone or in combination with Sabat

220. The following figures from Wu have been annotated to show where the elements of the '232 patent can be found. Figure 1 provides a high level overview of the major components of the system, which includes a base transceiver station coupled to host units which are coupled by optic fiber links to remote transceiver units (RTUs) in remote cellular regions. Figures 2 and 4 provide more detailed views of the system which includes a matrix switch 250 for individually routing capacity to different RTUs as needed.

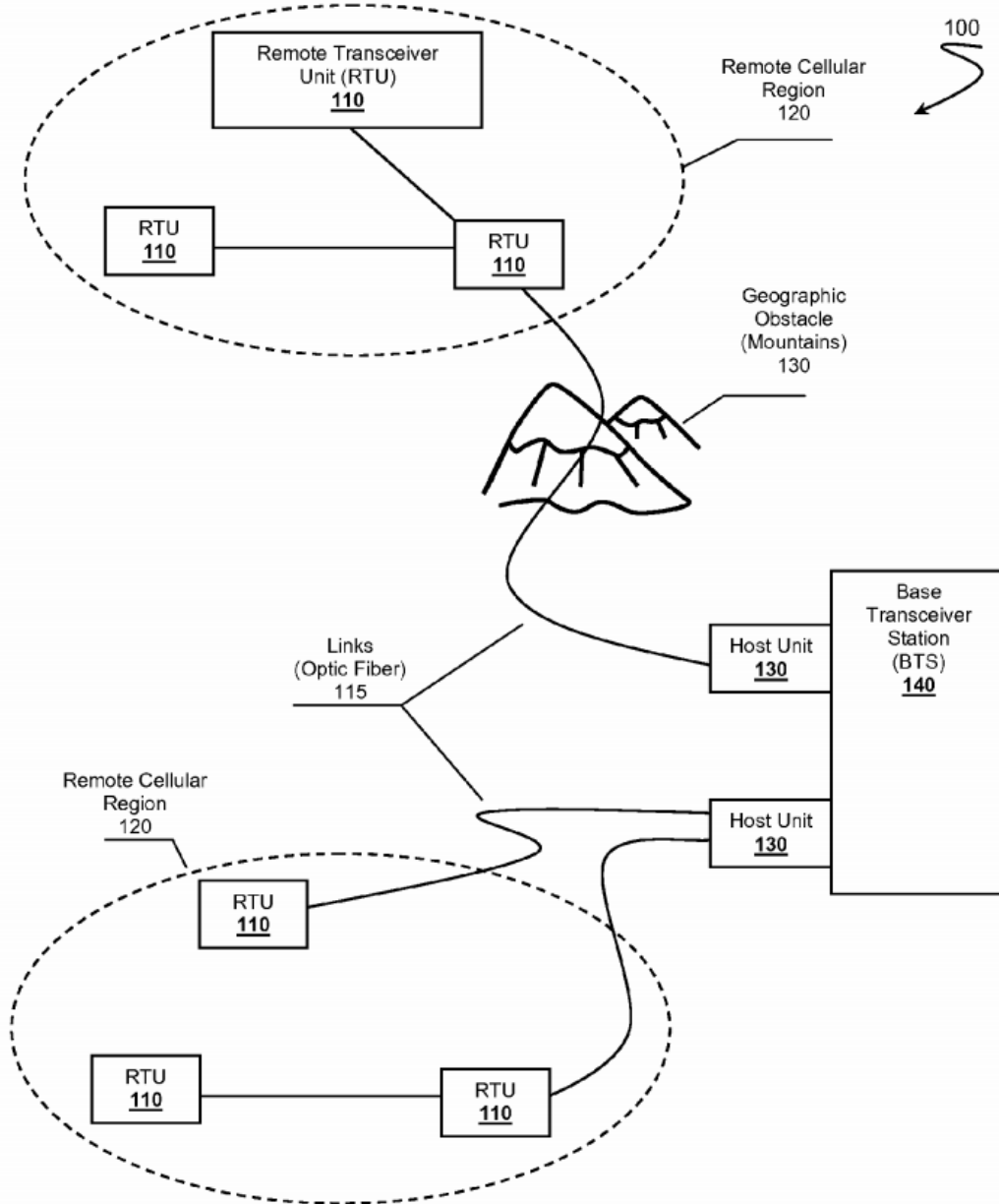


Figure 1

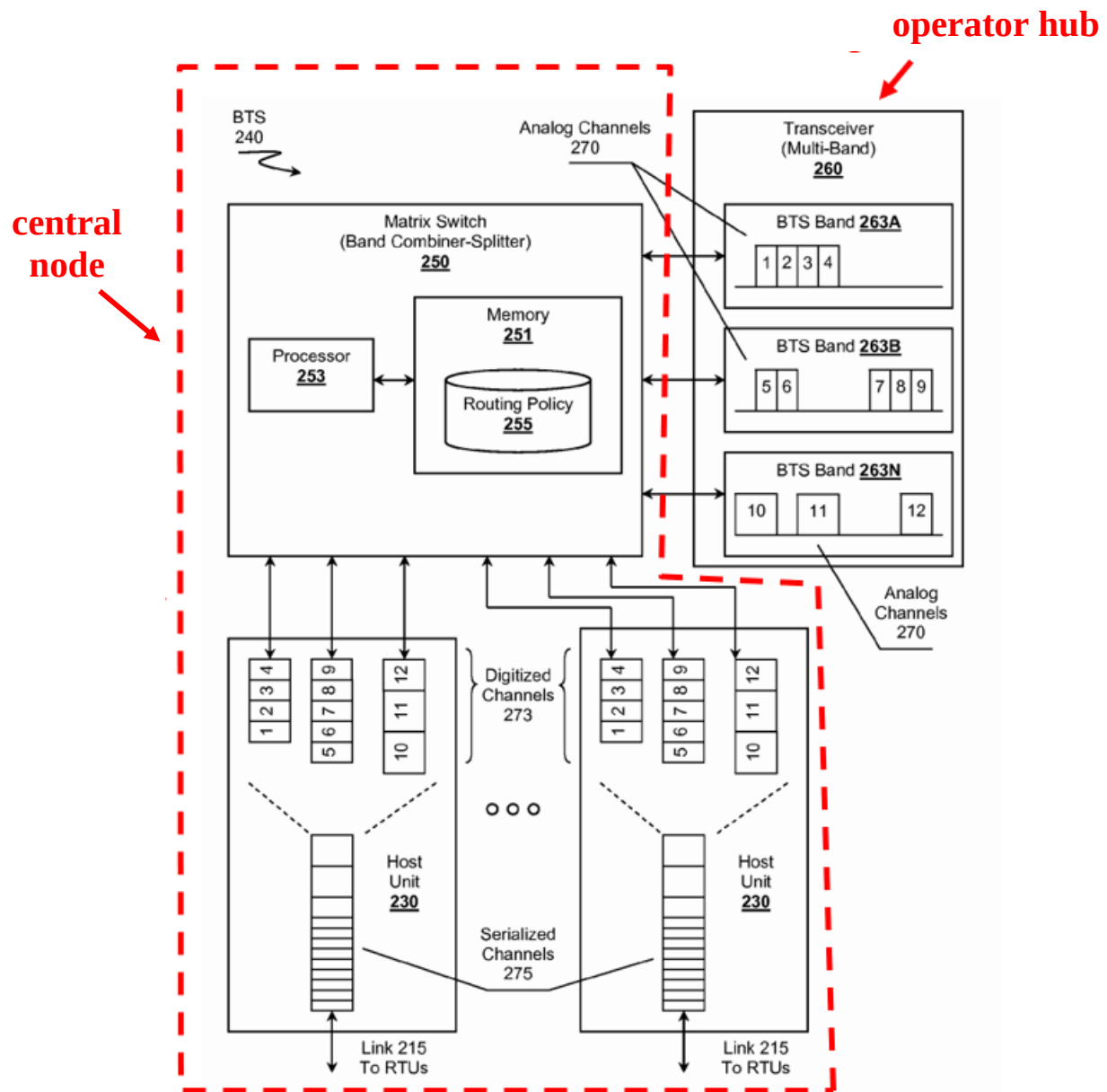
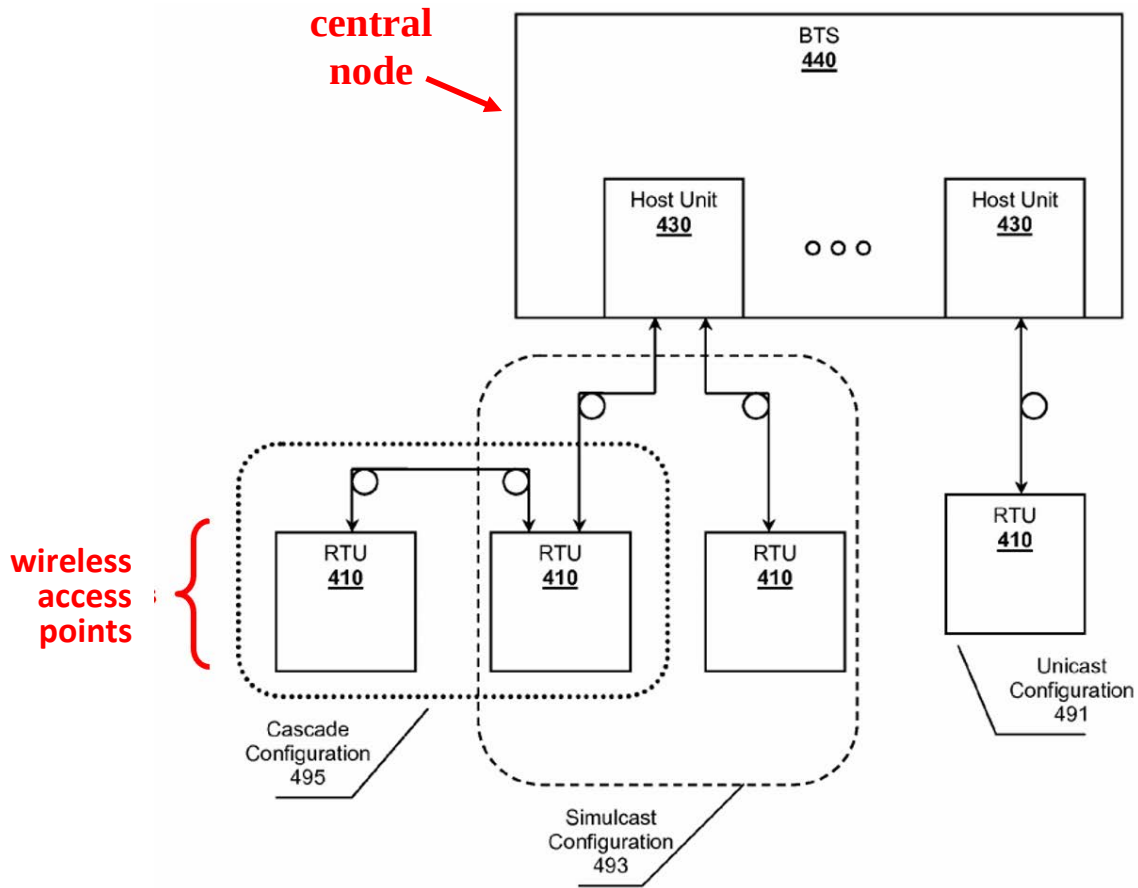


Figure 2



C. Independent Claim 1

1. Element 1A (and 12A):

“A wireless system comprising...”

221. Wu’s system is a wireless system. Wu discloses a system. Ex. 1006, ¶0011 (“The inventive subject matter provides apparatus, systems and methods in which a carrier channel distribution system can route individual carrier channels to Remote Transceiver Units (RTUs).”). Wireless systems support communications over the air, a very common example of which is a cellular mobile telephone system. Wu’s system is a wireless system. *Id.*, ¶0002 (“[t]he field of the invention

is *wireless* carrier channel technologies.”). Wu discloses that the RTUs (remote transceiver units) transmit and receive wireless communications with wireless devices located within their coverage areas. *Id.*, ¶0004 (“...providing various cell networks to provide coverage for their services. In some deployments, remote transceiver units (RTUs) provide coverage for a cell area.”), ¶0030 (“Distribution system 100 can support technologies or protocols including GSM, EDGE, CDMA, TDMA, FDMA, WCDMA, WiMAX, or other wireless technologies.”). Therefore, Wu discloses the preamble of claim 1 (Element 1A).

222. In addition, using the wireless system as described in Wu is a disclosure of “A method...” as further recited in the preamble of claim 12 (Element 12A). Wu discloses a method used in distributing wireless carrier channels. *Id.*, ¶0011 (“The inventive subject matter provides ... methods in which a carrier channel distribution system can route individual carrier channels to Remote Transceiver Units (RTUs).”); ¶0002 (“The field of the invention is wireless carrier channel technologies.”). Wireless refers to signals to be distributed over the air. Wu explains that the industry has provided various cell networks to provide coverage for their services. *Id.*, ¶0004.

2. Element 1B (and 12B, 20B):

“...one or more central nodes that receive a number of a plurality of radio resources from an operator hub that enables wireless communications and that provides the plurality of radio resources to a radio access network...”

223. The combination of the matrix switch 250 and units 130, 230 in Wu make up a “central node” of Claim 1. The combination of the switch 250 and units 230 make up a central node that manages communications to and from a plurality of more widely distributed RTUs and on behalf of the RTUs to and from the operator hub (transceiver 260). Units 130 are shown to be co-located at the centralized BTS in FIG. 1 of Wu (and also in Figure 4). Figure 2 shows a matrix switch is centrally located in the system between units 230 (which are the same units 130 from Figure 1) and the transceiver 260. I note that transceiver 260 is performing the functions of a conventional base transceiver station or “base station.” Although the embodiment shown in Figure 2 shows the transceiver co-located with the matrix switch and the host units, the specification points out that the transceiver 260 could, instead, be located remotely. *Id.*, ¶0034.

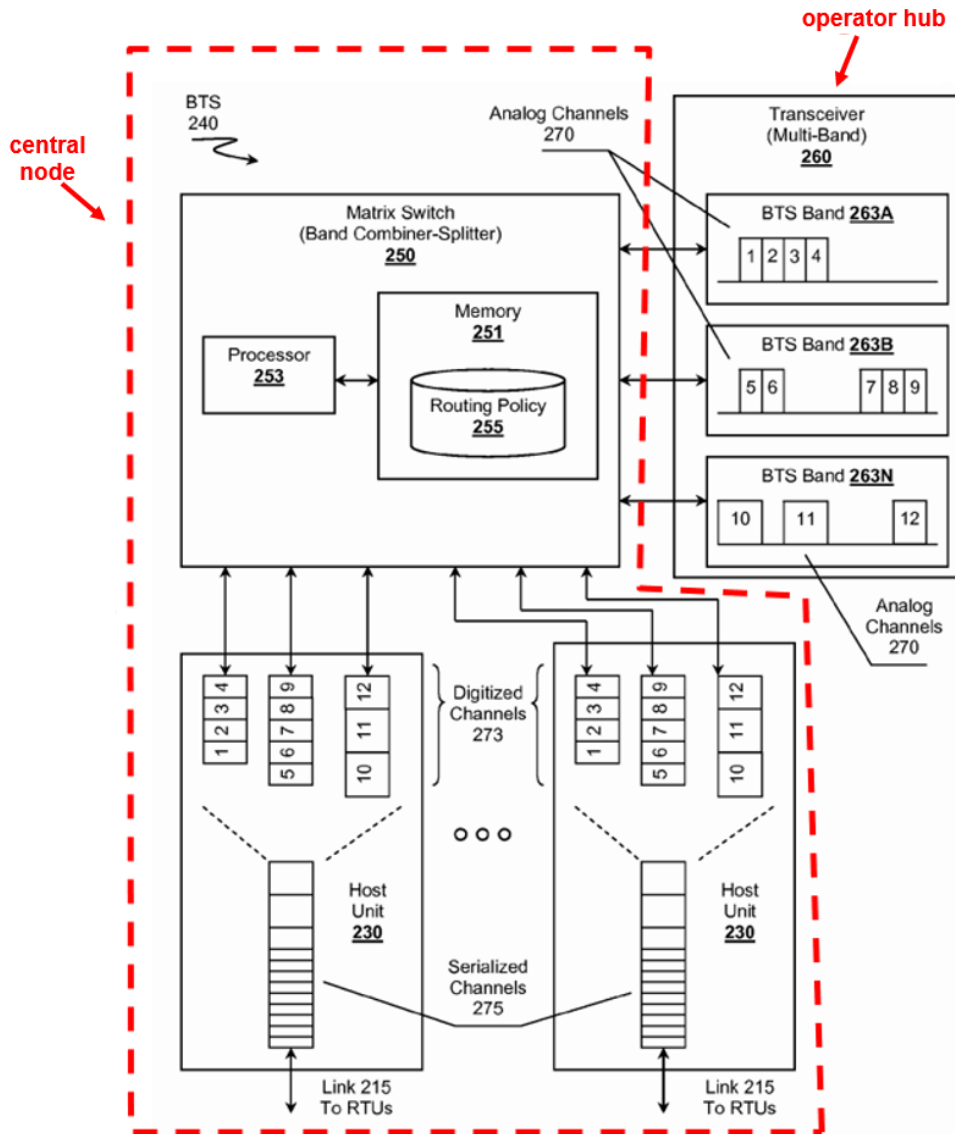
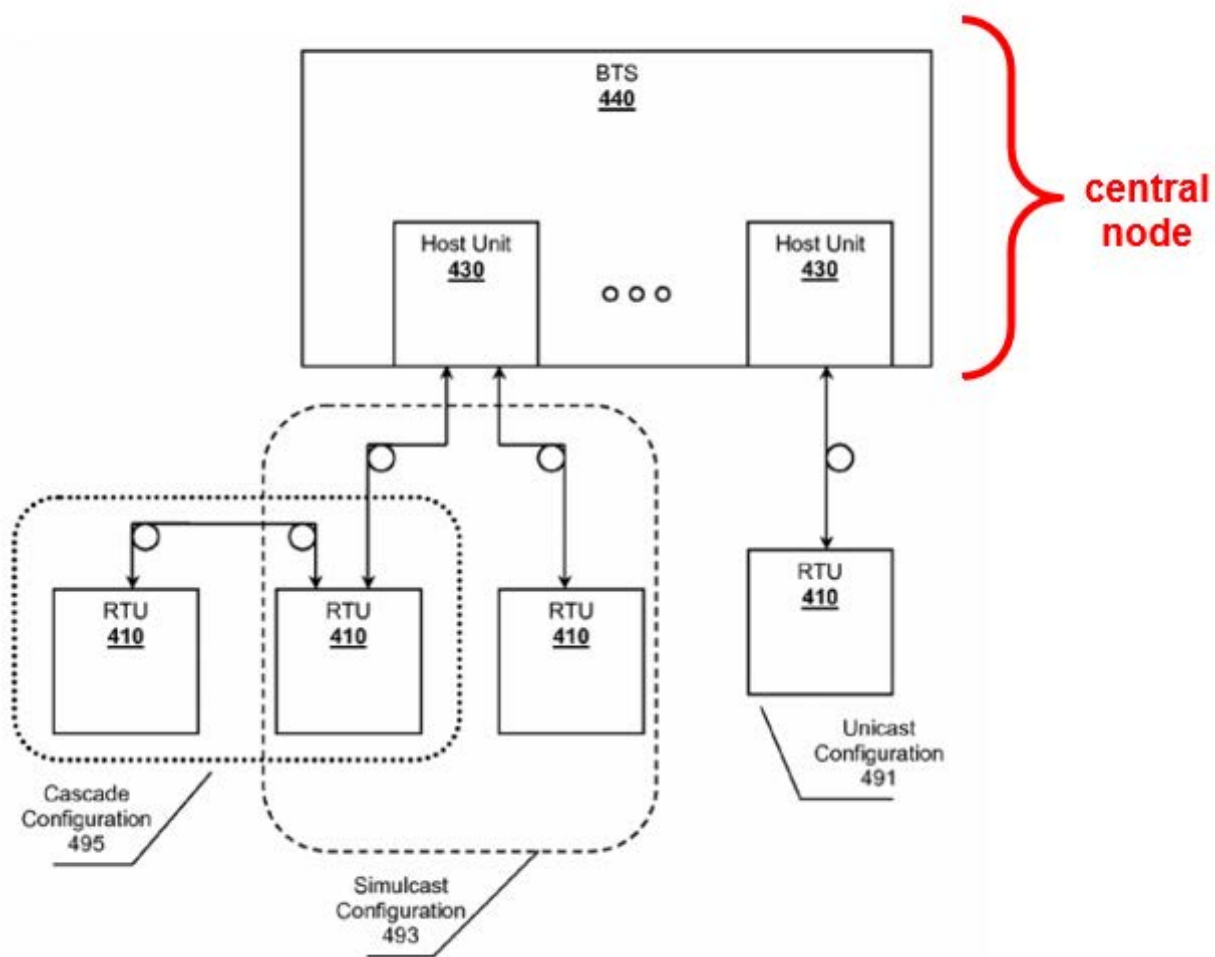


Figure 2



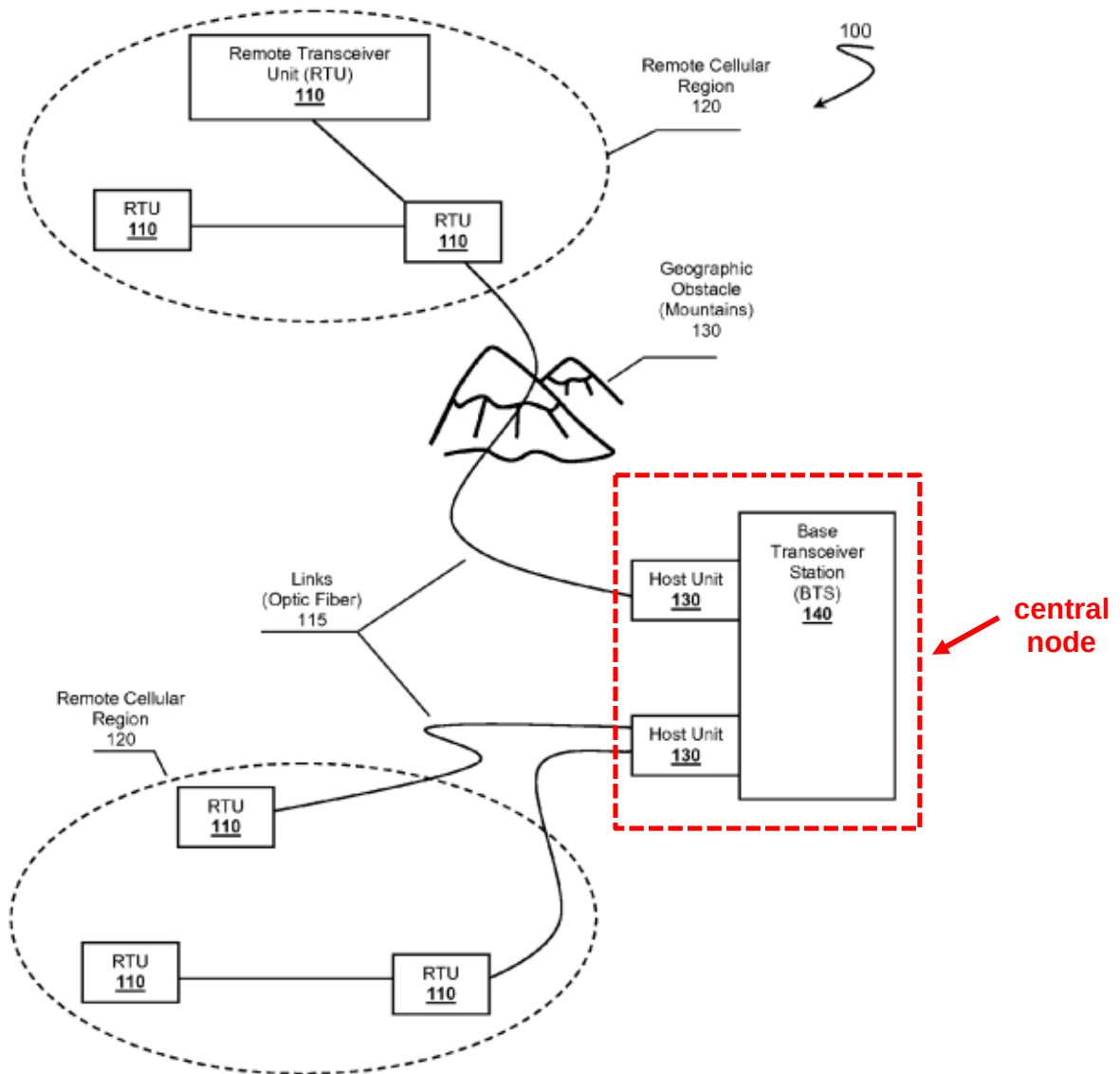
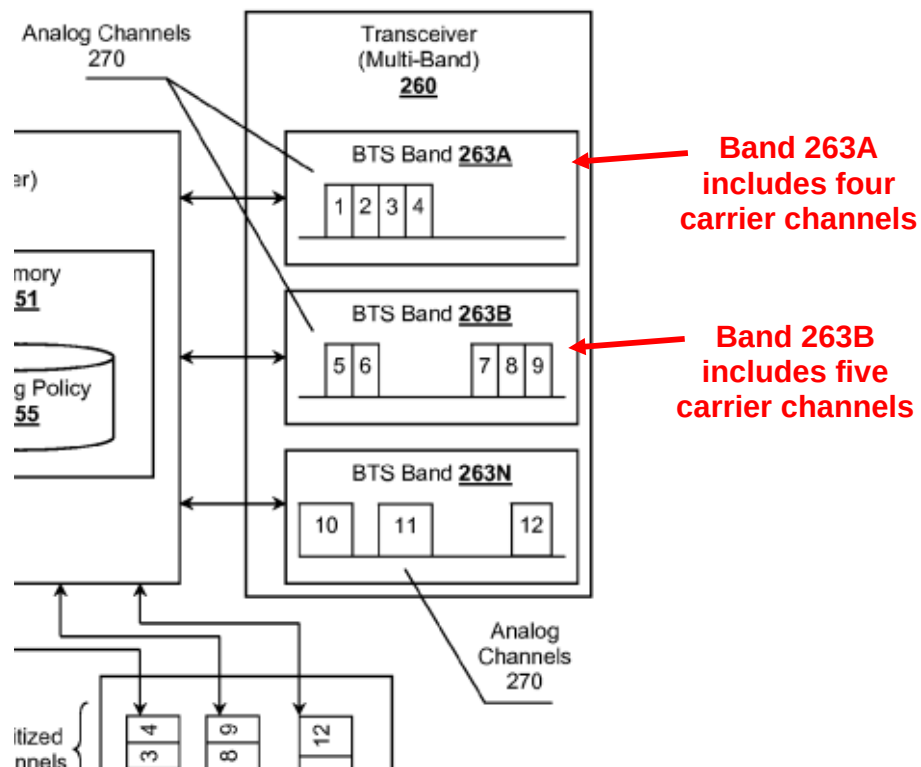


Figure 1

224. The multiband transceiver 260 corresponds to the claimed “operator hub” of Claim 1. The specification of Wu describes that the multiband transceiver may be co-located with the BTS matrix switch 250 as shown in the figures or alternatively may be located at a remote location. *Id.*, ¶0034. The multiband

transceiver 260 is configured to enable wireless communications by receiving and transmitting signals within multiple frequency bands, including the well-known radio frequency bands used for wireless communications such as the bands around 800 MHz 850 MHz, 1800 MHz, 1900 MHz. *Id.*, ¶0035. Each of these bands include “radio resources” as recited in claim 1. The bands are used to carry an operator’s wireless cellular communications using, for example, any of various known wireless technologies including GSM, EDGE, CDMA, TDMA, FDMA, WCDMA. *Id.*, ¶0030.

225. Wu discloses multiple types of radio resources. Each band from the multi-band transceiver 260 will include multiple radio resources that could be RF carriers, timeslots, or codes, depending on the wireless technology employed by the system (e.g., CDMA, TDMA, FDMA). Figure 2 of Wu shows that each band includes multiple radio resources. Band 263A, for example, includes four different RF channels. An RF channel is an RF carrier which the ‘232 patent identifies is an example of a radio resource. Ex. 1001, 4:18-19 (“the amount of radio resources (such as RF carriers, CDMA codes or TDMA time slots)”). Band 263B includes five channels. Ex. 1006, Fig. 2, ¶0035.



In the downlink direction, the bands of channels are transmitted from the multi-band transceiver to the host units via the matrix switch and from the host units to the remote transceiver units. *Id.*, ¶0036. At the remote transceiver units, the signals are transmitted wirelessly into the desired coverage areas at radio frequencies to wireless devices. Because Wu's system provides wireless radio frequency cellular communications over the air to and from wireless devices, it is an example of a radio access network.

Having shown where Element 1B is taught in Wu, it follows that Elements 12B and 20B in claims 12 and 20 respectively are disclosed by Wu for the same reasons.

3. Element 1C (and 12C, 20C):

“...using the Common Public Radio Interface (CPRI) protocol”

226. Element 1C refers to the operator hub providing the plurality of radio resources to a radio access network using a specific protocol, the CPRI protocol. CPRI was a well-known public standardized protocol for transmitting digital representations of RF carriers between portions of base station equipment and, as discussed below, is specifically designed and intended to support configurations where the components are *remote* from each other. Ex. 1017.

227. The Common Public Radio Interface (CPRI) Specification version 4.0 (2008-06-30) is Exhibit 1017. CPRI defines a public standard protocol for base station equipment sub-components to digitally interface or communicate with each other. *See, e.g.*, Ex. 1017, 4 (“Introduction”); 6 (“This specification defines the protocols for...”). The standard divides the base station functions into two halves or components which are labeled Radio Equipment Control (REC) components and Radio Equipment (RE) components. Ex. 1017, 4 (“Introduction”). The REC and RE are also called nodes in the CPRI standard. Ex. 1017, 6. By standardizing how these two halves of a base station communicate, different manufacturers can independently develop separate components that use the CPRI protocols. *See* Ex. 1017, 4 (“Motivation for CPRI”).

228. The CPRI standard recognizes that this division of the base station functions and the defined protocol for communicating between them permits the RE subcomponent to be located remotely from the REC subcomponent. *See, e.g.*, Ex. 1017, 9 (“2.2 System Architecture. Radio base stations should provide deployment flexibility for the mobile network operators, i.e., in addition to a concentrated radio base station, more flexible radio base station system architectures involving remote radio equipment shall be supported.”) (emphasis added); 4 (“The physical layer (layer 1) supports...an optical interface (e.g. for radio base stations with remote radio equipment).”) (emphasis added).

229. The CPRI standard describes the functional split between the REC component and the RE component:

The REC contains the radio functions of the digital baseband domain, whereas the RE contains the analogue radio frequency functions. The functional split between both parts is done in such a way that a generic interface based on In-Phase and Quadrature (IQ) data can be defined.

Id., 9. In essence, the CPRI standard breaks up a traditional base station into its two underlying components: (1) that which converts user signals into digital I & Q modulation components in accordance with the appropriate standards, and vice versa, and (2) that which actually radiates the RF signals from the digital I & Q representation (in the downlink direction) and receives RF signals for conversion to digital I & Q representation (in the uplink direction). This division allows the

base station antenna and analog RF equipment to be located remotely from the baseband functionality.

230. The CPRI interface is intended to transport mobile network operators' signals for supporting their wireless communication services. *See, e.g., Id.*, 9 (“mobile network operators”). The CPRI standard refers to payload data as the user plane data or digitized radio which takes the form of digital IQ samples. *Id.*, 6. Several IQ data flows are sent via one physical CPRI link. Each IQ data flow reflects the data of one antenna for one carrier, the so-called antenna-carrier (AxC.). *Id.*, 6. An “antenna-carrier (AxC)” is defined as: One antenna-carrier is the amount of digital baseband (IQ) U-plane data necessary for either reception or transmission of only one carrier at one independent antenna element. *Id.*, 7. Each CPRI link can multiplex multiple IQ data flows over the link, where each data flow represents the data of one antenna for one carrier. *See Id.*, 6 (“User Plane Data:...”).

231. Wu discloses using the CPRI protocol to communicate the channels between the host units (which are part of the central node) and the distributed remote transceiver units (wireless access points). Ex. 1006, ¶¶0031, ¶¶0049, ¶¶0050; ¶¶0055. Wu explains that the host units at the central node can include analog-to-digital converters and CPRI serializers to transmit the signals digitally to the remote units over fibers using the CPRI protocol. *See, e.g., Ex. 1006, Fig. 6-1*

(“SERDES...CPRI”), 6-2 (“ADC”); ¶0049; ¶0055 (“...the carrier channels are serialized using a CPRI standard.”).

232. Wu does not identify that the CPRI protocol is also used to communicate the bands from the multi-band transceiver 260 to the matrix switch 250. However, it was well known that the CPRI standard could be used as the communication protocol between a base transceiver station and the central unit of a distributed antenna system. In fact, as explained above, the CPRI standard was created to allow geographical separation of the RF/antenna and baseband components of a base transceiver station, so a simple extension of this would be to use CPRI as the interface between the baseband components of a base station and the host unit of a distributed antenna system. The Sabat reference (US Patent App. Pub. No. 2009/0180426) (Ex. 1010) did just this; it disclosed using CPRI in on both sides of the DAS hub (i.e. both between the hub and the base transceiver stations as well as between the hub and the remote units). It would have been obvious based on Wu alone or in combination with Sabat to use the CPRI protocol for the communication link between the operator hub (multi-band transceiver 260 in Wu) and the central node (matrix switch / host units in Wu).

233. It would have been obvious to do this based on Wu alone. In the embodiment illustrated in Figure 2, the transceiver is co-located with the matrix switch. Wu also discloses, however, that the multi-band transceiver 260 could

alternatively be remote from the other components of Wu's system. Ex. 1006,

¶0034 ("could be remotely coupled to transceiver 260").

234. As demonstrated by Wu itself which teaches using CPRI for communication links to *remote* RTUs, the CPRI protocol was known and specifically designed to link components of a base station that were remote from each other. Because Wu teaches that the transceiver could be located remotely from the other components such as the matrix switch, it would have been obvious to use a protocol designed to support communications between remote components of a base station system such as CPRI.

235. The CPRI protocol, because it was digital, provided known advantages for remote communication links. The benefits of digital signal streams, as opposed to analog, were well-known in the art. For example, digital signals are more immune to imperfections in real electronic systems which can spoil analog signals, digital signals can convey information with greater noise immunity (for example, a digital signal stream can be transported through a noisy channel without degradation), greater noise immunity can enable transport over longer distances. In some cases digital signal processing with off-the shelf programmable Digital Signal Processors (DSPs) or custom designed Application Specific Integrated Circuits (ASICs) can be less expensive, more reliable, and easier to manipulate than radio circuitry for processing analog RF signals. In addition, since CPRI is a

digital format, it becomes a simple matter (and much more desirable) to replace Wu's analog matrix switch with a far simpler digital switch. Using a digital matrix switch to interface to an upstream digital signal source also avoids the need for any RF equipment in the transceiver station.

236. Also, the open base station architecture standards such as CPRI and OBSAI were intentionally developed to provide a "flexible, cheaper and more scalable modular environment" for a radio access network. Ex. 1033, A278 (lines 7-14). These known advantages, as well as the advantage of an existing off-the-shelf protocol that was already employed at other links of the system, would have motivated one of ordinary skill in the art to employ the digital CPRI protocol when locating the transceiver 260 remotely from the matrix switch 250 of the central node.

237. In addition, one would have been motivated to use CPRI upstream of the matrix switch 250 to simplify Wu's system which already utilized CPRI to communicate downstream of the host units 130/230. Digital signal processing components are generally less expensive, more reliable, and easier to manipulate and control than the analog radio circuitry necessary for processing analog RF signals. Wu's system could be simplified by removing the expensive analog circuits in the host units (*see* Ex. 1006, Fig. 6-2 showing analog amplifiers, mixers, analog-to-digital converters). In other words, by using the digital CPRI protocol

on both sides of the central node, the system could avoid costly analog components. Making the matrix switch and its interface to the upstream signal source digital avoids the need for any RF equipment in the central node (matrix switch and host units).

238. Consider for example Wu's preferred embodiment. In the downstream direction, Wu starts with radio equipment in the multiband transceiver. These signals are switched in the analog domain, then digitized and transmitted to the remote unit where the signals are converted back to analog RF. By contrast, by providing a digital matrix switch and interface to a digital multiband transceiver (i.e., a transceiver that provides digital I & Q baseband representations of modulated RF signals as opposed to the modulated RF signals themselves), a digital representation of the multiband signals are presented to the digital matrix switch, transmitted digitally and only converted, for the first time, to analog RF at the remote units, thereby eliminating a complete set of unnecessary and expensive radio equipment. Note that this is consistent with CPRI itself whereby the only analog RF circuitry is in the remote antenna unit. Similar savings can be had in the upstream direction, by eliminating one set of analog RF receivers in the multiband transceiver, that is a digital representation of the signal would be present from the digital matrix switch to a digital multiband transceiver.

239. In addition, Wu discloses that the matrix switch only “preferably” operates in the analog domain. See Ex. 1006, ¶0038 (“Matrix switch 250 can operate as a combiner/splitter, preferably an analog combiner/splitter...” (emphasis added)). By indicating the matrix switch is only “preferably” analog, Wu tacitly acknowledges that a matrix switch could alternatively operate in the digital domain, that is, on digital signals. Because CPRI was a standardized protocol already used by Wu for other remote links in his disclosed system, a POSITA would have a reasonable expectation of success using for other links as well. In this way, extending the CPRI links to the upstream side of the central node is merely a predictable variation of Wu’s system, when the matrix switch is digital. When implementing digital signals for the links upstream from the matrix switch, it would have been obvious to continue to use CPRI which is already being used in Wu for the digital links between units 130/230 and the RTUs.

240. In addition to being obvious in light of Wu alone, the combination of Wu and Sabat (U.S. Patent App. Pub. No. 2009/0180426) (Ex. 1010) renders the use of CPRI from the base station to the central node of a distributed antenna system obvious. The Sabat reference had already used the CPRI protocol for the communication link between a digital base transceiver station and the central unit of a distributed antenna system. It would have been obvious to use CPRI as the protocol between the matrix switch and signal source (muti-band transceiver) in

Wu in light of Sabat for the Wu reference to operate with a digital base transceiver station.

241. Sabat taught that some base stations are digital base stations in that they output and receive digital signals to their associated transport systems or distributed antenna networks. As explained by Sabat, the central host unit or hub of the transport system needs to communicate digitally with such base stations. Sabat discloses the use of the CPRI protocol for this communication link. *See* Ex. 1010, ¶0014 (“There is now a new class of base stations with digital inputs and outputs....”); ¶¶0031-32 (“For this and subsequent diagrams, a specific digital base station interface (CPRI) will be used as an example....Accordingly, the Common Public Radio Interface (CPRI) detailed specification Versions 1.4, 2.4, 3.0 and 4.0, hereby incorporated by reference, is directed to the digital base station interface between radio equipment control and radio equipment (www.cpri.info/spec.html).”); ¶0034.

242. To make Wu’s system compatible with the known digital base stations as taught by Sabat, it would have been obvious to communicate upstream signals from the host unit to the base station using the known CPRI communication protocol, a protocol specifically designed for communication with base station components, and a protocol which is specifically taught by Sabat to be useful for this purpose.

243. One would be motivated to combine Wu with Sabat for the same reasons identified above (e.g., to obtain the well-known benefits of digital transmission links and to avoid the unnecessary expense of analog circuitry in the central units). In addition, one would be motivated to combine Wu with Sabat in this way to obtain the benefit taught by Sabat, which is to enable Wu's system to operate to distribute signals from digital base stations.

244. The similarity of Sabat's system to Wu's system would also have motivated this combination of Wu and Sabat. First, Sabat, like Wu, uses CPRI links between the central unit (DDR Hub 510) and the remote radio units 504. Sabat refers to these as "the remote side CPRI links" or the "remote side digital CPRI connections." Ex. 1010, ¶¶0036-37, ¶0038. Second, Sabat's system, like Wu's matrix switch, includes a fully programmable electronic switch in the central unit (DDR Hub 510) to enable re-distribution of capacity when desired. Third, Sabat, like Wu, recognized and disclosed that with a programmable switch re-assignments of capacity could be dynamically performed based on capacity loads such as when any sector becomes "overloaded." Ex. 1010, ¶¶0046-50. They both provide the flexibility to route any downstream signal to any remote unit. However, these many similarities would have motivated one of skill in the art to look to Sabat for its teaching of using the CPRI protocol between the central node in Wu (matrix switch) and the remotely located multi-band transceiver taught by

Wu. The difference, of course, is merely that Sabat's switch operates on digital signals and Wu's preferred embodiment operates on analog signals, letting units 230 perform the A-to-D and D-A conversions.

245. Having shown where Element 1C is obvious in light of Wu alone or in combination with Sabat, it follows that Elements 12C and 20C in claims 12 and 20 respectively are obvious for the same reasons.

4. Element 1D:

“a plurality of wireless access points that is coupled to the one or more central nodes and distributes one or more wireless signals to one or more wireless subscribers, the plurality of wireless access points including at least a first access point and a second access point,”

246. The remote transceiver units (RTUs 110, 310, 410) in Wu are a plurality of wireless access points that satisfy this limitation. *See, e.g.*, Ex. 1006, at Fig. 1, ¶0030, ¶0033, ¶0011. The RTUs in Wu are coupled to the central node via optical fibers from the RTUs to Wu's host units. *See, e.g.*, Ex. 1006, ¶0049 (“Host units 230 preferably serialize digitized channels 273 and sends the digitized data over communication links to one or more RTUs.”); ¶0051. The RTUs provide wireless coverage in a cell area. Ex. 1006, ¶0004 (“remote transceiver units (RTUs) provide coverage for a cell area”). The RTUs (remote “transceiver” units) transmit and receive wireless cellular signals to and from wireless devices (which are wireless subscribers) in each RTU's associated cellular coverage area or region, thereby providing wireless subscribers with wireless access to the

communication network. Ex. 1006, ¶10004. In the downlink, the RTUs are shown as including FPGAs, digital-to-analog converters, analog mixers and amplifiers for converting the digitized carriers arriving from the host units back into analog RF signals to be transmitted wirelessly into the desired coverage area to wireless devices, and in the uplink the RTUs include reciprocal components for converting the analog RF carriers received from mobile devices into digital CPRI signals for transport back to the central node (host units and matrix switch). Ex. 1006 Figs. 7-1, 7-2; ¶10050; ¶10056 (“RTU having similar structure of the host unit of FIG. 6 and that mirrors a host unit's functionality. As mentioned previously, the contemplated system can be bi-directional in nature.”). The Wu system specifically includes multiple RTUs (i.e., a first and second wireless access point) coupled to the same matrix switch via the same or different host units. Ex. 1006, ¶10051 (“Configurations can include one-to-one couplings, one-to-many couplings, or even many-to-many couplings if an applications calls for such a configuration.”); Fig. 1, Fig. 4, Fig. 6.

5. Element 1E (and 12E, 20E):

“wherein one or more central nodes assigns a first subset of the number of the plurality of radio resources to the first access point and a second subset of the number of the plurality of radio resources to the second access point, the first subset including more radio resources than the second subset, and”

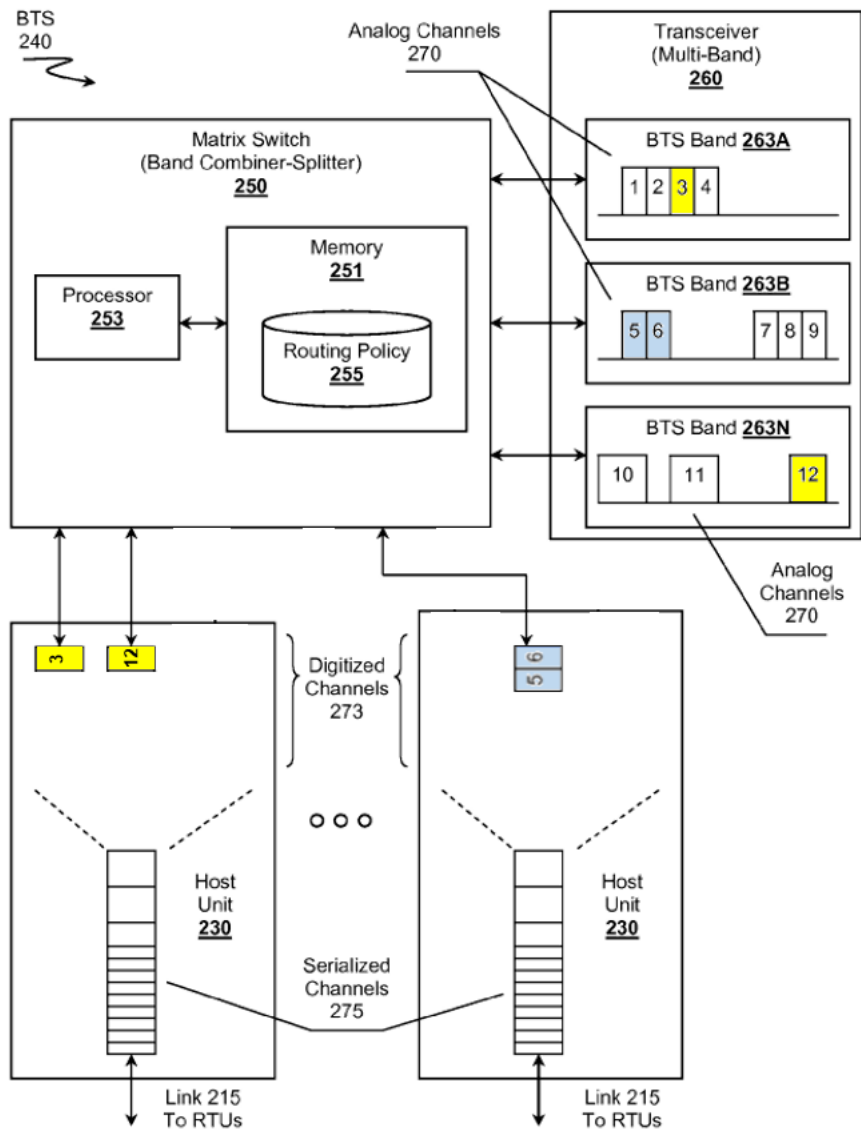
247. The matrix switch (part of the central node) performs this function in Wu. Wu’s disclosure emphasizes that the matrix switch employs a routing policy

that provides fine-grained control to allocate sets of downlink channel signals individually or in arbitrary groups to different RTUs. Ex. 1006 Abstract (“Wireless carrier channels can be split from their respective bands and can be allocated among remote transceiver units to ensure proper coverage for wireless services. Carrier channels can be allocated or routed individually or as a group according to reconfigurable routing policy.”), ¶0009 (“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.”), ¶0011, ¶¶0038-39, ¶0047, ¶0049. Wu’s matrix switch splits each band into individual channels or groups of channels such that different sets of channels can be routed to different RTUs depending on current conditions such as usage, load, weather, or events. Ex. 1006 ¶¶0038-39, ¶¶0040-47. Each of Wu’s channels is a radio resource, and Wu provides examples where different subsets of the radio resources having different numbers of channels are allocated to different RTUs. *See, e.g.*, Ex. 1006, ¶0043 (“The first region could be allocated a large number of channels during business hours while a residential region might have a smaller number of channels during the same time frame.”); ¶0047 (carrier 1 to an RTU while two carriers (carriers 5 and 6) routed together to an RTU); ¶0046 (“allocate

more channels” to increase the bandwidth available to victim or aid workers in a particular region when a disaster occurs).

248. Wu, therefore, has the capability and can be configured to route any or all of the channels received by the system from the multiband transceiver 260 to any RTU. The figures of Wu (e.g., Figures 2, 3, 5, 6) show the example and capability of routing all the channels to every RTU (*Id.*, ¶0049 “channels can be routed...collectively as shown”), but Wu takes pains to point out that the matrix switch provides the capability to route the channels individually or in smaller “arbitrary groups.” *Id.*, ¶ 0049. The examples in paragraphs 0039 and 0047 demonstrate that any channel can be split and separately routed to any of the RTUs.

249. The following figure illustrates a simple example based on paragraph 0047 of Wu, where Wu describes, “Matrix switch 250, based on policy 255, can allocate a different subsets of radio resources (e.g., carrier channels) to different RTUs.” The figure has been annotated to show examples mentioned in paragraph 0047, for example, carrier channels 3 and 12 (highlighted yellow) routed together to an RTU and carrier channels 5-6 routed together (highlighted in blue) to a different RTU.



250. Having shown where Element 1E is taught in Wu, it follows that Elements 12E and 20E in claims 12 and 20 respectively are disclosed by or are obvious in light of Wu for the same reasons.

6. Element 1F (and 12F, 20F):

“wherein, in response to a change in need of a number of wireless subscribers coupled to the second access point and which of the second subset is loaded beyond a threshold, the one or more central nodes assign additional radio resources of the plurality of radio resources to the second access point.”

251. Wu’s matrix switch employs a routing policy that satisfies this limitation. Wu describes that from time to time the number of channels routed to an RTU may change by means of the routing policy that includes rules for reacting to observed or measured metrics, calculated metrics, events, and conditions. Ex. 1006, ¶¶0038-47; ¶0039(...to ensure proper coverage given various conditions...[including] usage, load, weather, events...); ¶0041(“The rules of policy 255 can include one or more criterion representing a trigger ...When the criteria are met, matrix switch 250 can take appropriate routing action.”); ¶0042(“Observed metrics are considered to be those having values that are measured by BTS 240, matrix switch 260, or other device associated with the system.”) The triggered routing actions include, e.g., “to allocate more channels” to a region “to increase the bandwidth available.” *Id.*, ¶0046.

252. Wu describes that the channel assignments can be distributed in response to government/police requests (¶0046) or based on events such as weather events or disasters that create special needs to support wireless service to aid workers or victims. *Id.*, ¶0046; Ex. 1003, ¶69. Wu also describes that the channel allocations can be triggered based on a “threshold” relating to measured or

calculated metrics such as current traffic load. Ex. 1006, ¶¶0041-42 (“one or more criterion representing a trigger for an action...a time...a rate, a threshold, a quantity, a count, or other type of data that is measurable.”)(emphasis added); ¶0044 (policy 255 “routes, allocates, or distributes channels based on a current traffic load”); ¶0045 (“threshold criteria” may establish a triggering criteria); ¶¶0046-47. Wu explains that the processor 253 within the matrix switch can be configured to analyze the traffic metrics to determine whether a triggering condition relating to current traffic load has been satisfied. *Id.*, ¶0044:

[0044] Another example includes a policy 255 that routes, allocates, or distributes channels based on a current traffic load. Processor 253 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. If the current or recent historical traffic metric have a profile that satisfies criteria of a signature for a triggering condition, switch 250 can route, allocate, or distribute channels as defined by policy 255 to balance traffic load.

253. Load balancing refers to the concept of matching resources to load. In other words, (a) where load is high, the system uses a higher number of resources and (b) where load is low, the system uses a lower number of resources.

254. Observing and measuring network conditions such as usage, traffic rate, and consumed bandwidth are each different ways to measure or determine subscriber needs or load on the system in the coverage area of an RTU. For example, consumed bandwidth is a measure of the amount of radio resources assigned to an RTU that are actually in use, i.e., carrying traffic. Triggering an

allocation of more channels to an RTU based on a threshold criteria relating to current traffic load (such as by determining whether the consumed bandwidth of the carrier channels currently assigned to an RTU have exceeded a threshold) as disclosed in Wu's routing policy satisfies this limitation.

255. Having shown where Element 1F is taught in Wu, it follows that Elements 12F and 20F in claims 12 and 20 respectively are disclosed by Wu for the same reasons.

D. Independent Claim 12

256. As discussed above, all of the limitations of claim 12 are included in claim 1, except that Claim 12 is written as a method claim. Having shown how the elements of Claim 1 are obvious based on Wu alone or in combination with Sabat, Claim 12 is invalid for the same reasons. Wu teaches to use his disclosed system in a method to route carrier channels in a wireless communication system. *See, e.g.,* Ex. 1006, ¶0011 (“The inventive subject matter provides ... methods in which a carrier channel distribution system can route individual carrier channels to Remote Transceiver Units (RTUs).”).

E. Independent Claim 20

257. Claim 20 is an independent claim that includes the same method steps recited in independent claim 12, except the preamble of claim 20 recites “One or more non-transitory computer readable storage media storing instructions that,

when executed by one or more processors, cause the one or more processors to perform the steps of:” The limitations relating to the method steps that follow after the preamble that are recited in the body of claim 20 are obvious based on Wu alone or in combination with Sabat for the same reasons that the corresponding elements of Claims 1 and 12 are invalid as discussed above. The further limitations added by the preamble of claim 20 are also disclosed and obvious based on Wu alone or Wu in combination with Sabat. Wu, for example, discloses that his carrier channel distribution system includes “software instructions stored on a computer readable media” and “at least one processor configured to execute” the software instructions. Ex. 1006, ¶0029. Wu discloses both a memory 251 and a processor 253 in Figure 2. Wu further explains that the routing policy that the governs the behavior of the switch “is considered to include programmatic instructions stored on a computer readable memory 251 that can be executed within processor 253 that configures switch 250 to properly route the channels.” Ex. 1006 ¶0040. Wu identifies examples of non-transitory memory storage media such as “flash card, hard drive, solid state driver.” Ex. 1006, ¶0048. Wu, therefore, discloses the additional limitations recited in claim 20 that were not already recited in claims 1 or 12.

F. Dependent Claims

1. Claims 2 and 13

“2. The wireless system of claim 1, wherein the change in need is determined based on a change in capacity needed by the number of wireless subscribers coupled to the second access point or a change in throughput needed by the number of wireless subscribers coupled to the second access point.”

“13. The method of claim 12, wherein the change in need is determined based on a change in capacity needed by the number of wireless subscribers coupled to the second access point or a change in throughput needed by the number of wireless subscribers coupled to the second access point.”

258. Wu discloses this limitation by disclosing that the routing policy changes allocations in response to government/police requests (¶0046) or events such as weather events or disasters that create special needs to support wireless service to aid workers or victims or using threshold criteria based on observed or calculated traffic load metrics. Ex. 1006, ¶0046; ¶¶0042-44 (“calculated metrics can include a traffic rate, a consumed bandwidth, an aggregated count, or other derived metrics”). A police request for more bandwidth or responding to a weather disaster or a change based on a traffic load threshold or consumed bandwidth as discussed above for claim 1 are examples where the change in need is determined as recited in this limitation. These are examples of ways, taught by Wu, to determine when there is a change in capacity needed or throughput needed by subscribers in the region serviced by a particular RTU.

259. In addition, Wu also discloses that the routing policy makes allocation decisions based on a schedule or events that coincide with increased need for capacity or throughput which also satisfies this limitation. For example, at paragraphs 0043 and 0046 Wu discloses allocating additional bandwidth (capacity and throughput) during business hours where there are a significant number of commercial businesses or to locations of a pre-scheduled sporting event. Ex. 1006, ¶0043. Wu's disclosure here closely aligns with the very similar example used in the specification of the '232 patent. At 1:46-58 and 6:54-60, the '232 patent describes a "lunchtime scenario" where the need for capacity near a business cafeteria increases during the lunch hour. Ex. 1001, 1:46-58; 6:54-60.

260. Having shown where Claim 2 is taught in Wu, it follows that Claim 13 is disclosed by Wu for the same reasons.

2. Claims 3 and 14

"3. The wireless system of claim 1, wherein the additional resources are included in the first subset prior to being assigned to the second access point, and wherein the one or more central nodes assign the additional radio resources of the plurality of radio resources to the second access point comprises removing the additional resources from the first subset assigned to the first access point."

"14. The method of claim 12, wherein the one or more additional resources are included in the first subset prior to being assigned to the second access point, and wherein assigning the one or more additional radio resources comprises removing the one or more additional resources from the first subset assigned to the first access point."

261. Wu teaches in response to various events or conditions the system can allocate carrier channels “from” one cell region “to” another. Ex. 1006, ¶0005. This is a disclosure of not only adding new radio resources where needed, but taking those resources “from” other regions, i.e., “removing the additional resources from the first subset”. Wu gives a specific example of this. In paragraph 0043 Wu discloses that during business hours a region with commercial businesses is allocated additional bandwidth, while “during the same time frame” a smaller number of channels is allocated to a residential region. Altering the number of resources allocated to the residential region to make it a “smaller number of channels” is a disclosure of “removing resources” from the second access point, when adding resources to the business district. In addition, Wu discloses programming the routing policy to perform “load balancing” which was known to include de-allocating resources by transferring any load that those resources were previously carrying to other resources at a first location so that when these resources are activated at the new second location, they will provide their complete capacity in to that second location. Ex. 1006, ¶0044, ¶0005.

262. Even if this limitation were not taught by Wu, it would have been obvious in light of Wu. Wu’s system includes a flexible routing policy that is intended to enable allocating resources in response to variable conditions such as load, weather, events, or other circumstances. Ex. 1006, ¶0039. It would have

been obvious, once the system detected a triggering event requiring additional resources at a needy location, to take a radio resource from (i.e., de-allocate or remove from) an access point at a location having less need of it so that the resource could be less burdened for use in the more needy region. A person of skill would have been motivated to do so by the fact that adding to a needy region a radio resource that is already fully burdened by other use would not address the need. One of skill in the art would have known that removing the resource from an RTU in the region that is not as needy can increase the amount of available capacity on that resource that will be available for use by a different RTU in the needy region that has a high load. For example, where the new resource to be allocated to the needy RTU is already being simulcast to four different RTUs, before assigning the new resource to the needy RTU, it would have been obvious to remove it from one or more of the simulcasting RTUs so decrease the amount of consumed bandwidth on that resource.

263. Having shown where Claim 3 is disclosed or obvious in light of Wu, it follows that Claim 14 is invalid for the same reasons.

3. Claims 4 and 15

“4. The wireless system of claim 1, wherein the one or more central nodes analyze one or more transmission parameters associated with the second access point to determine the change in need.”

“15. The method of claim 12, further comprising analyzing one or more transmission parameters associated with the second access point to determine the change in need.”

264. Wu discloses that the routing policy being executed by the matrix switch (central node) includes rules based on metrics such as observed metrics measured by the matrix switch or calculated metrics that satisfy this limitation. Ex. 1006, ¶¶0042, ¶¶0044-0045. For example, Wu discloses “Processor 253 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.” *Id.*, ¶¶0044. The metrics are associated with RTUs or with remote regions associated with one or more RTUs. Ex. 1006, ¶¶0042-0043 (metric values “of BTS 240 or RTUs”), ¶¶0051 (“a single RTU 410 at a remote location” or “multiple RTUs 410 could be in the same remote region or in different remote regions”), ¶¶0031-0032 (“the number of RTUs 110 within a remote region can vary”), ¶¶0038 (“matrix switch 250 routes analog channels 270 ... for distribution to remote regions or RTUs.”). Traffic metrics are examples of transmission parameters associated with an RTU (*access point*) that are used by the routing policy to determine a change in need. Therefore, this limitation is disclosed by Wu.

265. Having shown where Claim 4 is taught in Wu, it follows that Claim 15 is disclosed by Wu for the same reasons.

4. Claim 5

“5. The wireless system of claim 1, wherein the one or more central nodes determines the change in need by determining that at least one transmission parameter associated with the second access point is greater than a threshold.”

266. Wu discloses that the routing policy executed by the matrix switch (which corresponds to the central node) can define triggers to change channel allocations using metrics including a “threshold” or “threshold criteria.” Ex. 1006, ¶¶0045, ¶¶0042. Wu teaches that such a “threshold” can be applied to any of the disclosed metrics used by the routing policy, which includes a metric for current traffic load. Ex. 1005, ¶¶0045, ¶¶0042, ¶¶0044. Wu teaches examples of transmission parameters for determining the current traffic load could be a “data rate, call rate, consumed traffic bandwidth, etc.” *Id.*, ¶¶0044. Therefore, this limitation is disclosed by Wu.

5. Claims 6 and 16:

“6. The wireless system of claim 1, wherein the first access point belongs to a first sector and the second access point belongs to a second sector.”

“16. The method of claim 12, where the first access point belongs to a first sector and the second access point belongs to a second sector.”

267. The development and use of the term “sector” was discussed above in Ground 1. Whether the patentee is using the term in claims 6 and 16 to refer to distinct coverage areas or to distinct radio resources does not matter because both

are disclosed in Wu and in the combination of Wu and Sabat. Therefore, these claims are obvious in light of Wu alone or based on Wu in combination with Sabat.

268. Wu discloses that each RTU can be located in a different coverage area and can receive different radio resources than the RTUs in adjacent coverage areas. Figure 1 of Wu for example shows multiple remote cellular regions 120. The examples shown include three RTUs having adjacent coverage areas within each region. The regions shown convey sectorization first in that they are shown in groups of three adjacent RTU areas. (Set of three at top of Figure 1 and set of three at the bottom of Fig. 1.) In addition, the RTUs can be supplied with either the same (simulcast) or independent radio resources from the base transceiver station via the operation of the matrix switch implementing the routing policy to route carrier channels independently or in arbitrary groups to each RTU. Ex. 1006, ¶0047. The carrier channels can come from the same or different bands and can even come from different base transceiver stations where the switch is coupled to multiple transceivers. *Id.*, ¶0034. Wu, therefore, also discloses the limitation of claim 6 that the first access point belongs to a first sector (e.g., uppermost RTU in Figure 1 of Wu) and the second access point belongs to a second sector (e.g., lowermost RTU in Figure 1 of Wu or the lowermost RTU in upper cellular region 120 both of which are in a different coverage area and are supplied with independent radio resources from a different transceiver than is the uppermost

RTU in Figure 1). Wu also discloses this limitation by its use of groupings of three adjacent RTU coverage areas.

269. Furthermore, Sabat expressly discloses that the hub of a digital distributed antenna system can, like the matrix switch of Wu, be coupled to multiple base stations. The signals from each base station are described by Sabat as defining a different “sector.” Ex. 1010, Figs. 5 and 6 (Sectors 1...K); ¶¶0027-0028. Each different base station sector, which Sabat describes as a group of RF carriers (Ex. 1010, ¶0010), is presented to the switched hub of Sabat for distribution to a different group of remote digital radio units. *See, e.g.*, Ex. 1010 ¶¶0044-0046 (“In Fig. 5, each sector is treated as a separate grouping of remote units with their associated base station sector.”) (“Fig. 6 shows an expansion of the multi-sector DDR Hub 510...Any single DDR 504 can be connected to any base station sector 502 with the only constraint being the maximum simulcast per sector that is supported by the switched DDR Hub 510.”). Therefore, even if Wu did not disclose that the RTUs could belong to groups of RTUs within a particular area that receive independent radio resources, e.g., from different base stations, Sabat discloses these features, and one of skill in the art would have been motivated to use Wu’s system to deliver multiple sector signals, as shown to be desirable in Sabat, each to a different group of RTUs. Incorporating this feature from Sabat into Wu would make Wu capable of implementing frequency reuse schemes to

most efficiently utilize limited radio spectrum resources. Therefore, it would have been obvious for a first of Wu's RTUs to belong to a first sector and a second of Wu's RTU's to belong to a second sector.

270. Having shown where Claim 6 is obvious based on Wu alone or in combination with Sabat, it follows that Claim 16 is invalid for the same reasons.

6. Claims 7 and 17

“7. The wireless system of claim 1, wherein the first access point belongs to a first building and the second access point belongs to a second building.”

“17. The method of claim 12, where the first access point belongs to a first building and the second access point belongs to a second building.”

271. Wu discloses the added limitation in claims 7 and 17 because it teaches RTUs are deployed in “indoor or outdoor environments.” Ex. 1006, ¶0050. Indoor environments include buildings. Wu further teaches that each RTUs may be deployed in a different location. Therefore, reading these teaching together, Wu disclose that a first RTU belongs to a first indoor environment (i.e., first building) and a second RTU belongs to a second indoor environment (i.e., second building).

272. In addition, it was well-known that carrier transport systems such as distributed antenna systems were used to deliver coverage in hard to reach areas such as inside buildings by placing the access points inside buildings. Wu did not need to re-state this well-known application for these systems. For example, Wu

discusses multiple references that disclose systems for carrier channel distribution (see Ex. 1006, ¶¶0006-0008), and each of these references already disclosed that remote antenna units of a carrier transport system can be distributed within buildings to improve wireless coverage inside the buildings:

“[Remote microcell antenna] units may be deployed on the roof of a building or within a building, or on or in other structures. For example, a microcell antenna unit 102 may be deployed on each floor of a building on or adjacent an antenna tower, or along a highway corridor.”

“Moreover, the coverage of urban cellular phone systems is limited by blockage, attenuation and shadowing of the RF signals by high rises and other structures. This can also be a problem with respect to suburban office buildings and complexes. ...Subdivision can be accomplished by dividing the geographic territory of a cell, or for example by assigning cells to buildings or floors within a building”

Ex. 1043, 10:2-6; 2:27-30; 26:22-25; *see also* Ex. 1044, ¶0018 (“Usually the antenna's 6 of the network 4 will be distributed over the premises of a company or institution. The antenna's may be distributed inside or outside several buildings.”).

It would have been obvious based on Wu alone that the access points (RTUs) could be located inside different buildings. In fact, Wu suggests this very implementation at paragraph 0043 where Wu describes locating RTUs at the location of commercial businesses and other RTUs in a residential region. It would have been obvious that these could have been, for example, inside a shopping mall (location of commercial businesses) and inside an apartment complex (a residential region).

273. Even if not obvious based on Wu alone, Sabat discloses using the distributed antenna system inside buildings. Ex. 1010 ¶0005 (“Distributed Antenna Systems are used to provide wireless communications coverage where it is impractical to install a conventional base station. An example is in-building coverage where low cost radiating antennas are desired and base stations represent either too large or too expensive a solution.”). It would have been obvious to locate the RTUs of Wu within buildings as taught by Sabat. Wu teaches to use the system to reach areas that lack line of sight to the base station due to, for example, geography. Sabat teaches that the remote units of a distributed antenna system can be located within buildings because it avoids the cost of placing a base station within the building and avoids needing to find space for the base station within the building. Ex. 1010 ¶0005. One of skill in the art would have been motivated to place the RTUs of Wu within buildings to obtain the same advantages taught by Sabat, i.e., it avoids the cost of placing a base station within each building and avoids needing to find space for the base station within the building.

274. Having shown where Claim 7 is obvious based on Wu alone or in combination with Sabat, it follows that Claim 17 is invalid for the same reasons.

7. Claims 9 and 19:

“9. The wireless system of claim 1, wherein at least two of the plurality of wireless access points are connected in a daisy chain manner to relay communications between at least a subset of the plurality of wireless access points.”

“19. The method of claim 12, wherein at least two of the plurality of wireless access points are connected in a daisy chain manner to relay communications between at least a subset of the plurality of wireless access points.”

275. Wu discloses that the RTUs can be in a “cascade configuration,” which is just another name for a daisy-chain configuration that relays communications between the RTUs. See Ex. 1006 at Fig. 1; Fig. 4 (“cascade configuration”); Fig. 5-1; ¶0012 (“RTUs can be configured into a cascade configuration where a host unit distributes a carrier channel to a first RTU, which then forwards the carrier channel to another RTU.”); ¶0051 (“Cascade configuration...where a host unit 430 couples to an RTU 410, which in turn cascades the serialized carrier channels to another RTU 410, preferably over another optic link.”). Figures 1, 4, and 5-1 illustrate configuring some RTUs in a cascade configuration. When configured as a cascade configuration, the remote units (RTUs) include an optical link interface to communicatively couple a first RTU with another RTU over an optical link so that the first RTU can forward carrier channels to the other RTU.

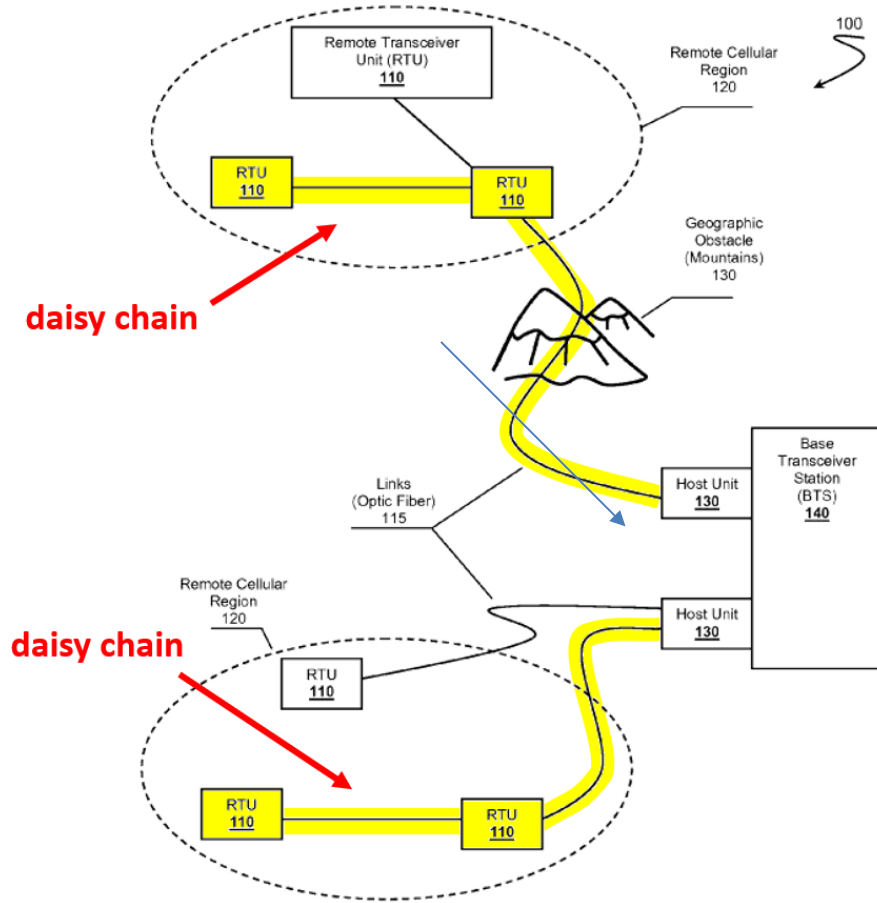


Figure 1

Ex. 1006, Fig. 1 (annotated).

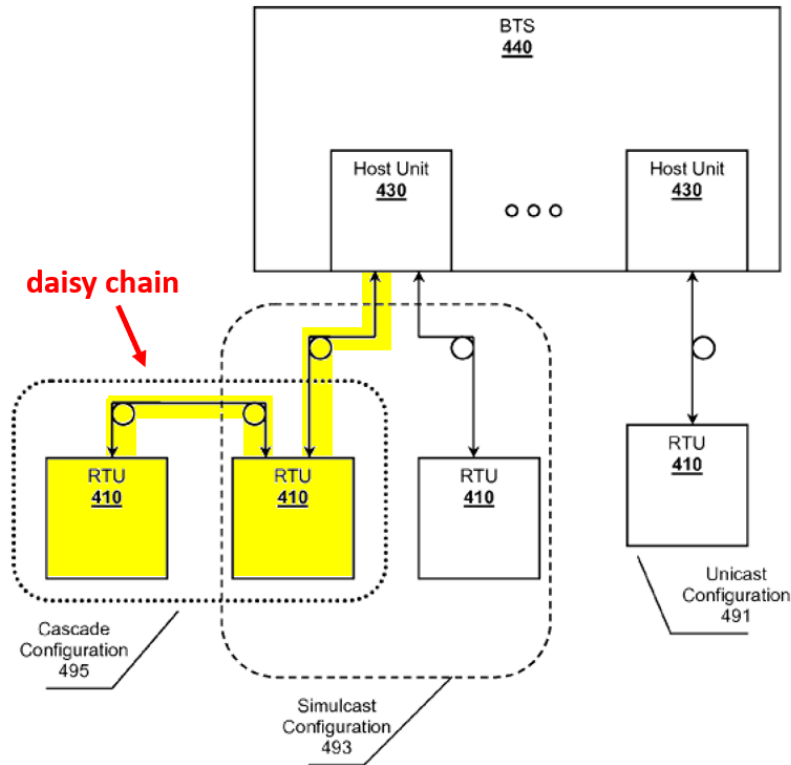


Figure 4

Ex. 1006, Fig. 4 (annotated).

276. Having shown where Claim 9 is disclosed in Wu and therefore that claim 9 is invalid as obvious in light of Wu alone or in combination with Sabat, it follows that Claim 19 is invalid for the same reasons.

XI. Ground 5: Claims 8 and 18 are obvious in further view of Fischer

“8. The wireless system of claim 1, wherein at least one of the plurality of wireless access points enables communication between an IP device and the one or more central nodes.”

“18. The method of claim 12, wherein at least one of the plurality of wireless access points enables communication between an IP device and one or more central nodes.”

277. The limitations of independent claims 1 and 12 are disclosed as discussed above in Grounds 1-4. Dependent claims 8 and 18 are also invalid as obvious based on any of Grounds 1-4 when further combined with U.S. Patent App. Pub. No. 2010/0177759 (Ex. 1008) (“Fischer”) entitled “System and Methods **for IP Communication** over a Distributed Antenna System Transport” (emphasis added).

278. The ‘232 Patent mentions IP in one paragraph that occurs at column 4 lines 62-column 5, line 27:

It is a further object of the present invention to enhance GSM and LTE indoor location accuracy. In another aspect, an embodiment of the present invention provides localization of a user based on the radio signature of the mobile device. FIG. 4 depicts a typical indoor system employing multiple Remote Radio Head Units (RRUs) and a central Digital Access Unit (DAU). In accordance with the invention, each Remote Radio Head provides unique header information on data received by that Remote Radio Head. The system of the invention uses this header information in conjunction with the mobile user's radio signature to localize the user to a particular cell. It is a further object of the present invention to re-route local traffic to Internet VOIP, Wi-Fi or WiMAX. In this aspect of the invention, an embodiment determines the radio signatures of the individual users within a DAU or Island of DAUs and uses this information to identify if the users are located within the coverage area associated with a specific DAU or Island of DAUs. The DAUs track the radio signatures of all the active users within its network and record a running data base containing information pertaining to them. One embodiment of the present invention is for the Network Operations Center (NOC) to inform the DAU that, e.g., two specific users are collocated within the same DAU or Island of DAUs, as depicted in FIG. 6. The DAUs then reroute the users to Internet VOIP, Wi-Fi or WiMAX as appropriate. Another embodiment of the present invention is to determine the Internet Protocol (IP) addresses of the individual

users' Wi-Fi connections. If the individual users' IP addresses are within the same DAU or Island of DAUs, the data call for these users is rerouted over the internal network.

Ex. 1001. The paragraph refers to Figure 6 which indicates that the DAU includes “Local connectivity routed to Internet VOIP”:

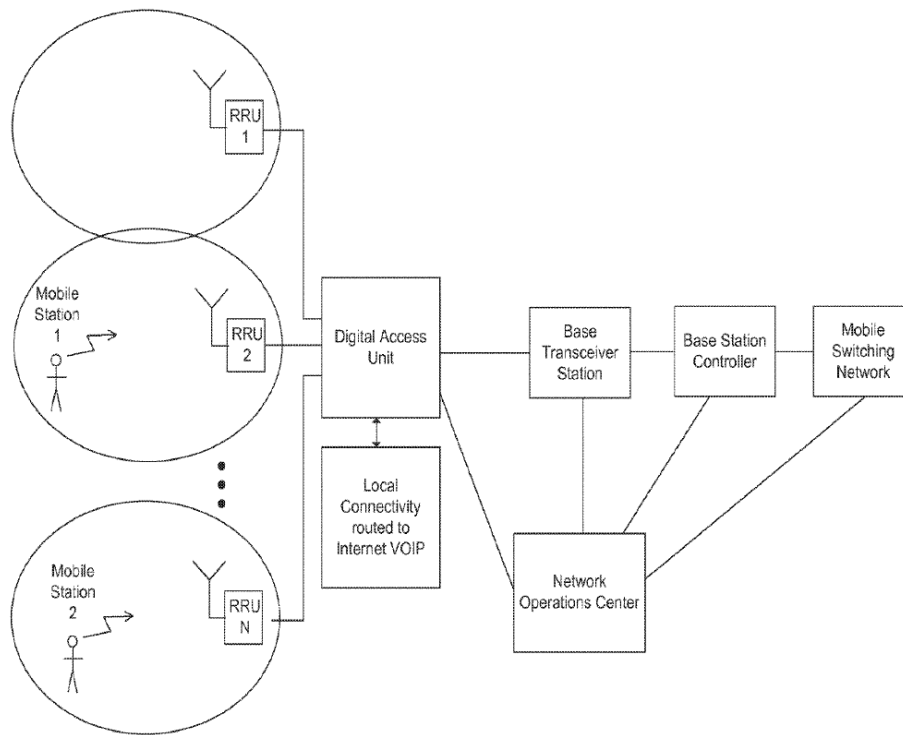


Figure 6 Local Connectivity

279. As shown in Fischer, however, it was already known that a distributed antenna system could have local IP connectivity to be used to transport IP communications, not merely cellular telephony RF traffic. For example, Fischer had already disclosed this idea. Fischer recognized that, in addition to transporting digitized RF signals from base stations, it would be desirable for a DAS also simultaneously to transport internet protocol (IP) communications from

IP devices. Ex. 1008 FIGS. 1-5, Title, Abstract (“Systems and methods for IP communication over a distributed antenna system transport are provided.”),

¶¶0004-0005, ¶¶0014-0021:

Embodiments of the present invention provide point-to-point Ethernet connections (100 Base-T, for example) between elements of a distributed antenna system by adapting the digital radio frequency (RF) transport medium to further carry internet protocol data traffic simultaneously with the RF traffic. Embodiments of the present invention enable installation of internet protocol devices at remote locations (for example, to extend a Local Area Network (LAN)/IP network into remote areas, or establish various services at remote locations that benefit from having IP network connectivity). Internet protocol devices may thus include networking devices such as switches, routers, and wireless access points (for WiFi, WiMAX, LTE, for example) or cameras, sensors, audio and/or video devices for security, distributing announcements, warnings or advertising. ...One of ordinary skill in the art after reading this specification would thus realize that such internet connectivity allows utilization of the remote facilities of a distributed antenna system to provide functions beyond that related to the principal RF functions of the system.

See also Ex. 1008 ¶¶0023-0025 (“Remote unit 200 further includes an internet protocol device (IPD) 216. ...IPD 216 may include any device designed to network using an Ethernet connection. For example, IPD 216 may comprise a networking devices such a switch, router, and/or wireless access point (for WiFi or WiMAX, for example).”); Ex. 1008 ¶¶0027-0033. In connection with doing so, Fischer discloses the host and remote units of the DAS have Ethernet interfaces coupled to internet protocol devices (IPDs) or networks. Ex. 1008 FIGS. 2-3, ¶¶0024-0025, ¶¶0028. These IP interfaces enable an IP device near the DAS remote unit to communicate its IP signals through the remote unit to the DAS host unit which can

then forward them via its IP interface to an IP network. Just like the '232 patent

Figure 6, the local IP connectivity of Fischer's host unit to an IP network such as a LAN, IP router, IP switch (see Ex. 1008 at ¶0028), is shown in Figure 3 at 325 and ("Ethernet Link") and 330 ("Internet Protocol Device").

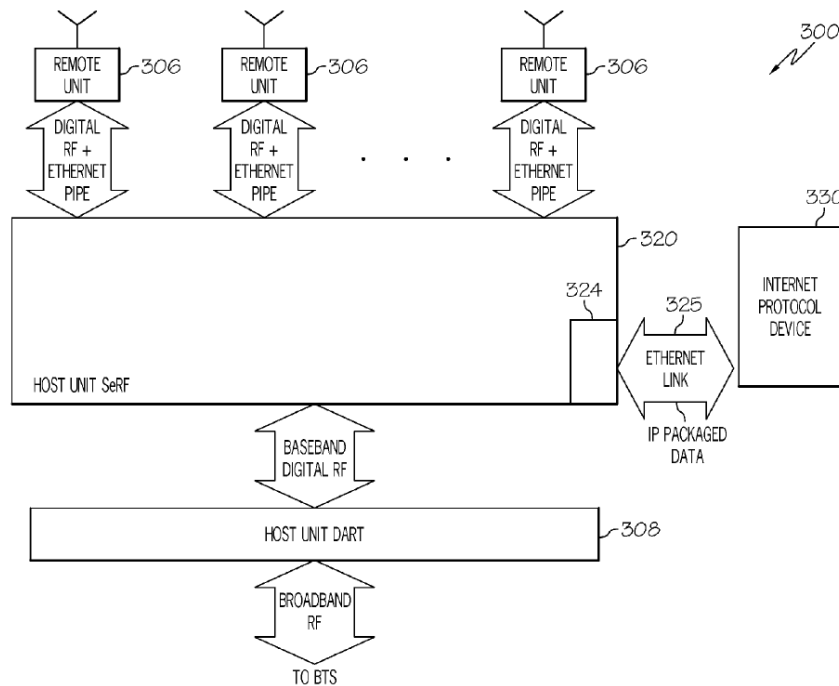


FIG. 3

Ex. 1008, Fig. 3.

280. It would have been obvious to combine Fischer's teaching for a distributed antenna system to multiplex IP communications with digitized RF communications in Wu's distributed antenna system or in Hettstedt's cellular communication system with distributed radio heads. One of skill in the art would have been motivated to make either of these combinations for the reasons given in Fischer which include capitalizing on the inherent infrastructure already present in

a system having distributed remote units (including distributed remote antenna units placed throughout a desired geographic area providing wireless services which are coupled by fiber links to a central location). That is, Fischer teaches that this same architecture can then also be used simultaneously to transport IP communications such as Wi-Fi services. Ex. 1008 ¶¶0004, ¶0014. Using the same architecture to carry two different services saves considerable resources by eliminating the cost of building a parallel Wi-Fi or other IP cabling infrastructure and can link the IP traffic to the broader IP network at a single central location, i.e., at the central unit of the DAS. See, e.g., Ex. 1008 ¶¶0004-0005.

281. Furthermore, because IP communication protocols and interfaces were well-known and even standardized and multiplexing different types of digital data over a digital communication link is a routine operation, a POSITA would have had a reasonable expectation of success modifying Wu or Hettstedt as taught by Fischer to carry IP traffic as well as cellular telephony traffic.

282. Claim 18 is invalid for the same reasons as claim 8 given above.

XII. Ground 6: Claim 10 is obvious in further view of Conyers

“10. The wireless system of claim 1, wherein a transmission power provided by at least one of the plurality of wireless access points is configurable via software.”

The limitations of independent claim 1 are disclosed or obvious for the reasons discussed above in Grounds 1-4. Claim 10 is obvious based on any of Grounds 1-4 as described above in further light of U.S. Patent No. 7,398,106 (“Conyers”) (Ex. 1009). As to the limitation added by claim 10,

multiple references had previously disclosed that remote radio units could have their transmission power configurable via software. See, e.g., Ex. 1009 (Conyers discussed below); Ex. 1030 at ¶0044; Ex. 1031 at 6:25-32; 6:66-7:3, 10:63-11:2.

283. Conyers (Ex. 1009) disclosed that using software defined radio components in a radio communications system having distributed radio heads, software modules could issue power level adjustment parameters that reconfigured the signal gain and resulting power level of one or more communication channels being used by remote radio head antenna units to communicate with wireless subscriber units. Ex. 1009 at 2:63-3:3:

The radio head unit communicates with one or more subscriber units using the one or more air interface protocols. **The radio head interface module receives power level adjustment parameters from the call processing software module for one or more logical channels and reconfigures the signal gain of one or more communications channels based on the power level adjustment parameters.**

Ex. 1009 at Figs. 2, 1A, 1B; Ex. 1009 at 6:45-53:

Embodiments of the present invention provide for dynamic readjustment of the signal power level (i.e. the signal gain) of the signal broadcasted by radio head unit 104 by reconfiguring DUC 122-1 with filter parameters that either increase or decrease the signal amplitudes of the complex RF data samples processed by DUC 122-1. Increased signal amplitude results in higher power output from 104's RF transmitter while decreased signal amplitudes result in lower power output.

See also 6:13-17 (“Embodiments of the present invention enable radio head interface 106 to adjust the signal gain (i.e. the signal power level) of RF signals transmitted by radio head unit 104.”).

284. Conyers achieves this by including a call processing software module that specifies the desired signal power level to the system, e.g., by delivering power level adjustment information to a management unit which causes different filter coefficients and amplification settings and to be used in the digital up converters associated with the corresponding logical channel. Ex. 1009 at 6:60-7:12:

In one embodiment, radio head interface 106 is dynamically reconfigured to adjust the signal power level of data signals transmitted through forward logical channel 130-1. In operation, in one embodiment, configuration management unit 132 **receives information from call processing software module 114 to adjust the signal power level of logical channel 130-1.** Configuration management unit 132 looks up the associated parameters for the desired signal gain from the table located in memory 136. Through control channel 134, **configuration management unit 132 loads appropriate filter coefficients to DUC 122-1.** In one embodiment, DUC 122-1 is adapted with a buffer memory which holds the parameters received from configuration management unit 132. In one embodiment, transmit engine 126-1 sends a synchronization signal to DUC 122-1 to load the parameters from buffer memory into DUC 122-1's active registers. **Once the parameters are loaded into the active registers, logical channel 130-1 amplifies forward link data samples based on the signal power level specified by call processing software module 114.**

285. Conyers provides motivations why this ability to control power levels using software is desired. Signal power level adjustments are needed in wireless communications systems to maintain acceptable signal quality, minimize co-channel interference, and to conserve power. Ex. 1009 2:32-38. Using software components rather than dedicated hardware components (a) eliminates the need for

hardware designed to operate with only a signal standard that might be idle when network demand for that standard is low, (b) makes the system independent of the modulation standard (i.e. not limited to one specific standard), (c) allows for dynamic reconfiguration based on current demands, and (d) makes the system capable of operating with multiple standards simultaneously. Ex. 1009 at 2:22-31; 1:59-2:21.

286. For the reasons identified by Conyers, it would have been obvious to make the transmission power of Wu's RTUs or Hettstedt's RRHs (*access points*) configurable by software as taught by Conyers. One would be motivated to add this feature from Conyers to Wu's or Hettstedt's system (1) to enable dynamic reconfiguration of the power levels, (2) to maintain acceptable signal quality, minimize co-channel interference, conserve power at the RTUs and radio heads as taught by Conyers. Further, one would be motivated to add this feature from Conyers to Wu's or Hettstedt's system to further enable the system to be standard independent (useable with more than one standard). A POSITA would also have been motivated to include software reconfigurable transmit power so that the coverage radius of the remote unit could be changed dynamically. See Ex. 1030 at ¶0019 ("...the transmitter/receiver (e.g. Wi-fi access point) must be permitted to dynamically control the coverage radius around the associated antenna by increasing or decreasing the downlink transmission power."), Ex. 1030 ¶0044

(“The invention can use software in its implementation and the method according to the invention can be software controlled and completely automated.”).

287. Further, one would have a reasonable expectation of success in making this combination because Wu and Hettstedt both describe systems that include digital components for digitally manipulating and digitally transporting the RF channels. Ex. 1006 ¶¶0029-31, ¶¶0049-0050; Ex. 1005 ¶0040, ¶0042. Because these systems already manipulate and distribute the signals digitally, one would have a reasonable expectation of success implementing additional software on the already-present digital components for configuring the transmit power of the downlink signals as taught by Conyers.

288. Therefore, claim 10 is obvious based on any of Grounds 1-4 in further view of Conyers .

XIII. Ground 7: Wu and Sabat in light of Hettstedt renders claim 11 obvious

“11. The wireless system of claim 1, wherein the one or more one or more central nodes are coupled to a plurality of operator networks via the operator hub.”

289. It is unclear what “the one or more one or more” means in this claim. Assuming it means merely “one or more” this limitation is either disclosed by Wu or obvious in light of Hettstedt.

290. The limitations of independent claim 1 are obvious based on Wu alone or in combination with Sabat for the reasons discussed above in Grounds 3

and 4. Wu further discloses that the matrix switch can be coupled to multiple transceivers. Ex. 1006 ¶0034 (“more than one multi-band transceiver 260”). But Wu does not state that the multiple transceivers might be part of different operator networks. It was already well-known that when multiple base stations could be coupled to a distributed antenna system, the base stations could be operated by different operators (i.e. each would be part of and coupled to a different operator network). Ex. 1005 Fig. 6, ¶0054 (“The eight BS can cover different services of different operators.”), ¶¶0026-0027 (providing for “multi-operator functions...”); see also Ex. 1035 (6,963,552) at Abstract (“...a wireless infrastructure network that may be easily shared among multiple wireless service providers in a given community. The open access system provides the ability for such operators and service providers to share the infrastructure...”); Ex. 1035 2:60-64 (“base station interface located at a central hub location converts radio frequency signals associated with multiple base stations, of the same or even different wireless service providers, to and from a transport signaling format.”)(emphasis added), Ex. 1035 5:40-43 (“Hub 35 can be expanded to connect to multiple base stations 20 (one or multiple wireless carriers) and their associated RAN Units 50.”); Ex. 1035 5:54-58 (“...to or from individual wireless carriers or tenants. By ‘tenant’ it is meant to refer to the wireless carrier, Wireless Service Provider (WSP), or other business entity that desires to provide wireless service to end customers.”).

291. It would have been obvious based on Wu's disclosure of coupling the system to multiple transceivers that the transceivers could be part of different operator networks so that the operators could share Wu's system for distributing wireless communications. One would have been motivated to do so, as taught in the art, to reduce the cost to any one operator of acquiring, installing, and deploying the system. One would also be particularly motivated to do so where the cost of real estate to house infrastructure components was particularly high or where there was insufficient zoned space to accommodate multiple, completely separate systems. See also Ex. 1035 at 1:54-2:8:

These market realities have placed continuing pressure on system designers to provide system infrastructure at minimum cost. Radio tower construction companies continue to employ several business strategies to serve their target market. One approach, their historical business strategy, is build-to-suit (i.e., at the specific request and location as specified by a wireless operator). But some have now taken speculation approach, where they build a tower and then work with local government authorities to force new service providers to use the already existing towers. This speculation build approach, spawned by the zoning by-law backlash, is actually encouraged by communities to mitigate the "unsightly ugliness" of cellular phone towers. This is seemingly the best alternative, since Federal laws no longer permit local zoning authorities to completely ban the deployment of wireless infrastructure in a community. Often the shared tower facility is zoned far removed from residential areas, in more commercialized areas of town, along heavily traveled roads, or in more sparsely populated rural sections. But providing such out of the way locations for towers often does not fully address each and every wireless operator's capacity or coverage need.

292. Claim 11 would have been obvious not only based on Wu and Sabat (because of Wu's teaching that the system couple to multiple transceivers), but also

Claim 11 is obvious in further view of Hettstedt. Hettstedt teaches that where the central node of a wireless distribution system is coupled to multiple base stations, those base stations could be from multiple operator networks. Hettstedt Ex. 1005 Fig. 6, ¶0054 (“The eight BS can cover different services of different operators.”), ¶¶0026-0027 (providing for “multi-operator functions...”). A POSITA would have been motivated to make this modification to Wu’s disclosed system for the same reasons discussed above. In addition, since this limitation relates to who operates the transceivers (i.e., the operators), and not to a physical change to the transceivers themselves, a POSITA would have had a reasonable expectation of success when allowing different operators to share the system.

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XIV. Claims Listing Appendix

U.S. Patent No. 11,026,232

Claims 1-20

Designation	Claim 1
Element 1A	1. A wireless system comprising:
Element 1B	one or more central nodes that receive a number of a plurality of radio resources from an operator hub that enables wireless communications and that provides the plurality of radio resources to a radio access network
Element 1C	using the Common Public Radio Interface (CPRI) protocol; and
Element 1D	a plurality of wireless access points that is coupled to the one or more central nodes and distributes one or more wireless signals to one or more wireless subscribers, the plurality of wireless access points including at least a first access point and a second access point,
Element 1E	wherein one or more central nodes assigns a first subset of the number of the plurality of radio resources to the first access point and a second subset of the number of the plurality of radio resources to the second access point, the first subset including more radio resources than the second subset, and
Element 1F	wherein, in response to a change in need of a number of wireless subscribers coupled to the second access point and which of the second subset is loaded beyond a threshold, the one or more central nodes assign additional radio resources of the plurality of radio resources to the second access point.
Claim 2	2. The wireless system of claim 1, wherein the change in need is determined based on a change in capacity needed by the number of wireless subscribers coupled to the second access point or a change in

	throughput needed by the number of wireless subscribers coupled to the second access point.
Claim 3	3. The wireless system of claim 1, wherein the additional resources are included in the first subset prior to being assigned to the second access point, and wherein the one or more central nodes assign the additional radio resources of the plurality of radio resources to the second access point comprises removing the additional resources from the first subset assigned to the first access point.
Claim 4	4. The wireless system of claim 1, wherein the one or more central nodes analyze one or more transmission parameters associated with the second access point to determine the change in need.
Claim 5	5. The wireless system of claim 1, wherein the one or more central nodes determines the change in need by determining that at least one transmission parameter associated with the second access point is greater than a threshold.
Claim 6	6. The wireless system of claim 1, wherein the first access point belongs to a first sector and the second access point belongs to a second sector.
Claim 7	7. The wireless system of claim 1, wherein the first access point belongs to a first building and the second access point belongs to a second building.
Claim 8	8. The wireless system of claim 1, wherein at least one of the plurality of wireless access points enables communication between an IP device and the one or more central nodes.
Claim 9	9. The wireless system of claim 1, wherein at least two of the plurality of wireless access points are connected in a daisy chain manner to relay communications between at least a subset of the plurality of wireless access points.
Claim 10	10. The wireless system of claim 1, wherein a transmission power provided by at least one of the plurality of wireless access points is configurable via software.

Claim 11	11. The wireless system of claim 1, wherein the one or more one or more central nodes are coupled to a plurality of operator networks via the operator hub.
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Designation	Claim 12
Element 12A	12. A method comprising:
Element 12B	receiving a plurality of radio resources from an operator hub
Element 12C	that operates using a Common Public Radio Interface (CPRI) protocol;
Element 12E	assigning a first subset of the plurality of radio resources to a first access point included in a plurality of wireless access points and a second subset of the plurality of radio resources to a second access point included in the plurality of wireless access points, the first subset including more radio resources than the second subset; and
Element 12F	in response to a change in need of a number of wireless subscribers coupled to the second access point and which of the second subset is loaded beyond a threshold, assigning one or more additional radio resources of the plurality of radio resources to the second access point.
Claim 13	13. The method of claim 12, wherein the change in need is determined based on a change in capacity needed by the number of wireless subscribers coupled to the second access point or a change in throughput needed by the number of wireless subscribers coupled to the second access point.
Claim 14	14. The method of claim 12, wherein the one or more additional resources are included in the first subset prior to being assigned to the second access point, and wherein assigning the one or more additional radio resources comprises removing the one or more additional resources from the first subset assigned to the first access point.
Claim 15	15. The method of claim 12, further comprising analyzing one or more transmission parameters associated with the second access point to determine the change in need.

Claim 16	16. The method of claim 12, where the first access point belongs to a first sector and the second access point belongs to a second sector.
Claim 17	17. The method of claim 12, where the first access point belongs to a first building and the second access point belongs to a second building.
Claim 18	18. The method of claim 12, wherein at least one of the plurality of wireless access points enables communication between an IP device and one or more central nodes.
Claim 19	19. The method of claim 12, wherein at least two of the plurality of wireless access points are connected in a daisy chain manner to relay communications between at least a subset of the plurality of wireless access points.

Designation	Claim 20
Element 20A	20. One or more non-transitory computer readable storage media storing instructions that, when executed by one or more processors, cause the one or more processors to perform the steps of:
Element 20B	receiving a plurality of radio resources from an operator hub
Element 20C	that operates using a Common Public Radio Interface (CPRI) protocol;
Element 20E	assigning a first subset of the plurality of radio resources to a first access point included in a plurality of wireless access points and a second subset of the plurality of radio resources to a second access point included in the plurality of wireless access points, the first subset including more radio resources than the second subset; and
Element 20F	in response to a change in need by a number of wireless subscribers coupled to the second access point and which of the second subset is loaded beyond a threshold, assigning one or more additional radio resources of the plurality of radio resources to the second access point.