

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

CORNING OPTICAL COMMUNICATIONS LLC
Petitioner

v.

DALI WIRELESS, INC.
Patent Owner

Case IPR2021-00492
Patent 9,197,358

**PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 9,197,358**

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EXHIBIT LIST

Exhibit No.	Description
1001	U.S. Patent No. 9,197,358 to Hejazi et al. (“’358 patent”)
1002	Prosecution History of U.S. Patent No. 9,197,358 (Application No. 13/894,309) (“’358 Pros. Hist.”)
1003	Declaration of James A. Proctor, Jr., M.S.E.E. in Support of Petition for <i>Inter Partes</i> Review of U.S. Patent No. 9,197,358
1004	<i>Curriculum Vitae</i> of James A. Proctor, Jr.
1005	Masaaki Fujii, “User Scheduling for Distributed-Antenna Zero-Forcing Beamforming Downlink Multiuser MIMO-OFDM Systems,” IEICE Transactions on Communications, Vol. E93-B, pp. 2370-2380 (September 2010) (“Fujii”)
1006	U.S. Patent Publication No 2010/0177760A1 to Cannon et al. (“Cannon”)
1007	U.S. Patent Publication No 2008/0232305A1 to Oren et al. (“Oren”)
1008	R. Kwan et al., “A Survey of Scheduling and Interference Mitigation in LTE,” Journal of Electrical and Computer Engineering Volume 2010, pp. 1-10 (Hindawi Publishing Corporation 2010)

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Exhibit No.	Description
1009	X. Fan et al., “An Inter-Cell Interference Coordination Technique Based on Users’ Ratio and Multi-Level Frequency Allocations,” 2007 International Conference on Wireless Communications, Networking and Mobile Computing, Sept. 21-25, 2007, Shanghai, China, pp. 799-802 (Date Added to IEEE Xplore: October 8, 2007)
1010	R. Ghaffar et al., “Fractional Frequency Reuse and Interference Suppression for OFDMA Networks,” 8th International Symposium on Modeling and Optimization in Mobile, Ad Hoc, and Wireless Networks, May 31-June 4, 2010, Avignon, France, pp. 273-277 (Date Added to IEEE Xplore: July 23, 2010)
1011	U.S. Patent Publication No 2010/0110996A1 to Tao et al. (“Tao”)
1012	Ericsson, “Inter-cell Interference Handling for E-UTRA” 3GPP TSG-RAN WG1 #42, R1-050764, London, UK (August 29 – September 2, 2005)
1013	Huawei, “Further Analysis of Soft Frequency Reuse Scheme,” 3GPP TSG RAN WG1#42, R1-050841, London, UK (August 29 – September 2, 2005)
1014	W. Choi et al., “Downlink Performance and Capacity of

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Exhibit No.	Description
	Distributed Antenna Systems in a Multicell Environment,” IEEE Transactions on Wireless Communications, Vol. 6, No. 1, pp. 69-73 (January 2007)
1015	Chang et al., “A High Capacity Cell Architecture Based on Distributed Antenna System and Frequency Allocation Scheme,” IEICE Transactions on Communications, Vol. E93-B, pp. 2370-2380 (September 2010) (“Chang”)
1016	U.S. Patent No. 6,141,566 to Gerdisch et al. (“’566 patent”)
1017	Scanferla, D. & Technische Universiteit Eindhoven (TUE). Stan Ackermans Instituut. Information and Communication Technology (ICT), 2012, Eindhoven: Technische Universiteit Eindhoven
1018	Dali Wireless, Inc.’s Disclosure of Asserted Claims and Infringement Contentions in <i>Dali Wireless, Inc. v. Corning Optical Commc’ns LLC</i> , No. 3:20-cv-6469-EMC (N.D. Cal.)
1019	Expert Report of Dr. Sylvia D. Hall-Ellis Regarding Public Availability of a Publication

***Inter Partes* Review of U.S. Patent No. 9,197,358**

Exhibit No.	Description
1020	3GPP TS 36.141 version 10.4.0 (2011-11) titled “LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) conformance testing”

I. INTRODUCTION

Corning Optical Communications LLC (“Petitioner”) petitions for *inter partes* review of claims 1-21 (“challenged claims”) of U.S. Patent No. 9,197,358 (“’358 patent”). The challenged claims are directed to a method and system for implementing frequency reuse techniques, such as fractional frequency reuse (“FFR”) or soft frequency reuse (“SFR”), in wireless communication systems, including distributed antenna systems (“DAS”), to reduce inter-cell interference (“ICI”). But using various frequency reuse schemes, such as FFR or SFR, to mitigate ICI among wireless subscribers in conventional cellular systems having a centrally located antenna within each cell was well-known in the art long before the priority date of the ’358 patent. People skilled in the art also had established that DAS, consisting of geographically distributed antenna modules, to reduce access distance and overall transmit power in communications between the antennas and users, was capable of mitigating ICI.

With the adoption of Orthogonal Frequency Division Multiple Access (“OFDMA”) as the transmission scheme for the next generation wireless communications systems in the mid-to-late 2000s, persons skilled in the art began publishing works specifically recognizing that a frequency reuse scheme, such as FFR or SFR, implemented in a DAS would mitigate ICI and improve cell edge user’s throughput in such systems.

One such publication is a paper titled “User Scheduling for Distributed-Antenna Zero-Forcing Beamforming Downlink Multiuser MIMO-OFDM Systems” by Masaaki Fujii. Fujii describes a user scheduling scheme for use with a DAS, which incorporates FFR to provide high-rate data services to a large number of users in OFDMA systems. Fujii recognized that (1) “DAS possesses a ... higher ICI tolerance than co-located (or centralized) antenna systems (CAS)” and (2) “[f]ractional frequency reuse (FFR) has been investigated as a type of geographical user scheduling to avoid adjacent cell interference for users located within cell boundaries.” EX1005, p. 2370, Introduction, ¶¶ 1 & 3. Fujii then states: “[w]e introduce FFR into DAS to further increase average user throughputs for users located in cell boundaries.” *Id.*, p. 2371, Introduction, ¶ 6.

Fujii describes a well-known frequency reuse scheme for use in a DAS that reuses a single range of frequencies in the inner-cell zone of each cell, while using different frequency ranges in the cell-boundary zones of adjacent cells, as depicted in Figures 9 and 10 from Fujii (shown below).

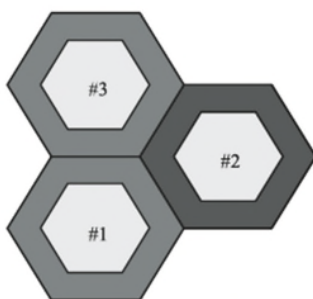


Fig. 9 Cell partitioning into inner-cell and cell-boundary zones for FFR ($FRF = 3$).⁴

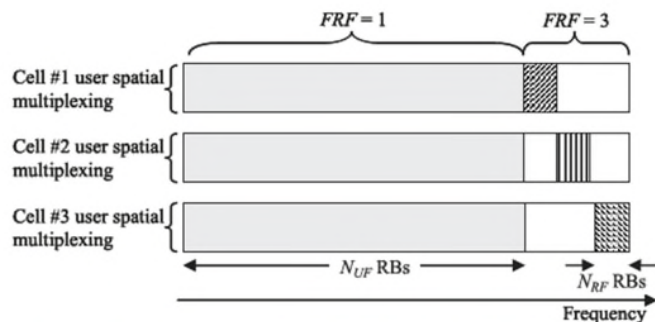


Fig. 10 Allocation of users to RBs with $FRF = 1$ and cell-specific RBs with $FRF = 3$.

Many other prior art references from that time frame compare and contrast various implementations of the FFR and SFR and demonstrate that these schemes were well-known approaches to mitigating ICI in OFDMA systems. A skilled artisan would have recognized that Fujii in combination with prior art depicting a known implementation of a DAS disclosed the methods and systems recited in the challenged claims. Unfortunately, the applicants for the '358 patent cited none of these references or anything like them during prosecution. As demonstrated below, if the references had been before the examiner during prosecution, the '358 patent would not have been allowed. The claims of the '358 patent should therefore be found unpatentable.

II. MANDATORY NOTICES

REAL PARTIES IN INTEREST: The real parties in interest are Corning Optical Communications LLC, Corning Incorporated, and Corning Research & Development Corporation. 37 C.F.R. § 42.8(b)(1).

RELATED MATTERS:

Pursuant to 37 C.F.R. § 42.8(b)(2), Petitioner is aware of the following pending patent infringement lawsuits or related matters involving the '358 patent: *Dali Wireless, Inc. v. Corning Optical Communications LLC*, No. 6:20-cv-06469-EMC (N.D. Cal.-S.F. Div.). The '358 patent was first asserted in the district court case in a First Amended Complaint filed on April 30, 2020.

LEAD AND BACKUP COUNSEL: Petitioner provides the following designation and service information for lead and back-up counsel. 37 C.F.R. § 42.8(b)(3) and (b)(4).

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III. GROUNDS FOR STANDING

Petitioner certifies that the '358 patent is available for *inter partes* review. Petitioner also certifies that it is not barred or estopped from requesting this *inter partes* review on the grounds identified herein.

IV. STATEMENT OF RELIEF REQUESTED

Petitioner requests *inter partes* review and cancellation of challenged claims 1-21 based on the detailed statements presented below.

V. IDENTIFICATION OF CHALLENGE

Petitioner requests *inter partes* review on the below grounds. Per 37 C.F.R. § 42.6(c), copies of the references are filed with this petition. In support of these grounds, this petition is accompanied by a Declaration of James A. Proctor, Jr., M.S.E.E. in Support of Petition for *Inter Partes* Review of U.S. Patent No. 9,197,358 (“Proctor Declaration”) (EX1003), along with his *curriculum vitae* (EX1004). The Proctor Declaration explains what the prior art would have conveyed to a person of ordinary skill in the art (“POSA”).

Inter Partes Review of U.S. Patent No. 9,197,358

Ground	'358 Patent Claims	Basis for Ground
1	1-21	Fujii alone or in view of Cannon
2	4	Fujii in view of Cannon in view of Oren

As noted on the face of the patent, the earliest possible priority date of the '358 patent is May 18, 2012. Each of the references relied on here is prior art to this patent.

Fujii (EX1005), titled “User Scheduling for Distributed-Antenna Zero-Forcing Beamforming Downlink Multiuser MIMO-OFDM Systems” is prior art under at least §102(b) as it was published on or shortly after November 2010, over 17 months before the earliest effective filing date of the '358 patent in the United States.

Fujii bears a copyright date of 2010 and indicates that it was published in the September 2010 issue. See EX1005. The Expert Report of Dr. Sylvia D. Hall-Ellis Regarding Public Availability of a Publication (EX1019) explains that Fujii was published on or shortly after November 1, 2010. EX1019, ¶¶29-41. Moreover, the version of Fujii that was obtained by Dr. Hall-Ellis from the Linda Hall Library includes a date stamp from November 2010. *Id.*, ¶¶35-36; EX1005, 1.

Cannon (EX1006), U.S. Patent Publication No. 2010/0177760A1 to Cannon et al., titled “Systems and Methods for Improved Digital RF Transport in Distributed

Antenna Systems,” is prior art under at least §§102(a), 102(b), and 102(e) [pre-AIA] as it was published on July 15, 2010, based on U.S. Patent Application No. 12/686,488 filed January 13, 2010, more than a year before the earliest possible invention date of the ’358 patent.

Oren (EX1007), U.S. Patent Publication No 2008/0232305A1 to Oren, titled “Distributed Antenna System for MIMO Technologies,” is prior art under at least §102(b) as it was published on September 25, 2008 more than 3 years before the earliest possible priority date of the ’358 patent.

VI. TECHNICAL BACKGROUND

Beginning at least in 2005, industry participants recognized that inter-cell interference was going to be problem in Orthogonal Frequency Division Multiple Access (“OFDMA”) systems in a “same frequency network” (i.e. a cell to cell frequency reuse factor (FRF) of one), such as Wi-Max and LTE. Companies like Ericsson, Siemens, Alcatel and Huawei proposed using various alternative frequency reuse schemes in the developing LTE standard, beyond a reuse factor of one. *See, e.g.*, EX1008, pp. 4-5; EX1009, pp. 799-800. While the literature is not always consistent in its use of the terminology, there were three major frequency reuse schemes described in the prior art for mitigating inter-cell interference: hard frequency reuse, fractional frequency reuse (FFR) and soft frequency reuse (SFR), and variations of these. *See, e.g.*, EX1010, p. 274, Fig. 1; EX1011, FIGS. 2A-2D,

[0053]-[0060], which describe various frequency and power allocation schemes known in the art in 2010.

A traditional FFR scheme is illustrated in Figure 1 of EX1010:

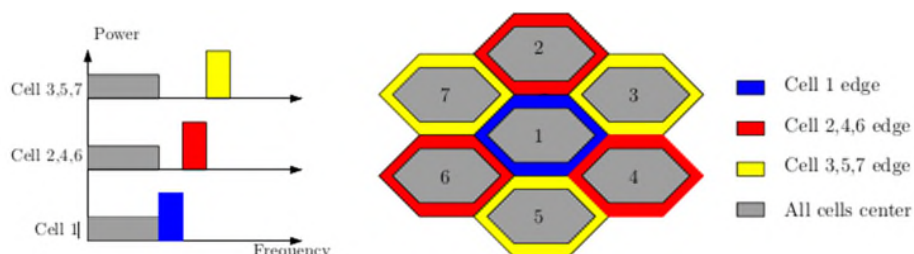


Fig. 1. FFR in LTE. Frequency reuse factor for cell edge users is 3.

In this traditional FFR scheme, users in center cell region use the frequency range shown in gray, and users in the cell edge regions are allocated different frequency bands at higher power.

A so-called hard FFR scheme is illustrated with reference to Figures 2A and 2B from EX1011 (reproduced below). In this scheme, the entire available bandwidth is divided into four segments, B_{e1} , B_{e2} , B_{e3} , B_{c1} . EX1011, FIGS. 2A & 2B. A frequency reuse factor (FRF) of 1 using frequency band B_{c1} is employed for mobile stations (MSs) in the center zones of cells A1-A3, whereas frequency bands B_{e1} , B_{e2} , and B_{e3} are used for an FRF of 3 configuration for MSs in the edge zones of these cells. *Id.*, FIGS. 2A & 2B, [0056]-[0058].

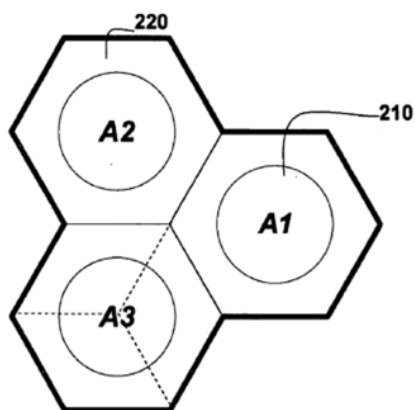


Fig. 2A

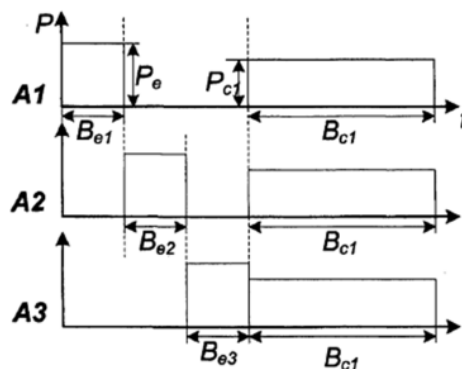
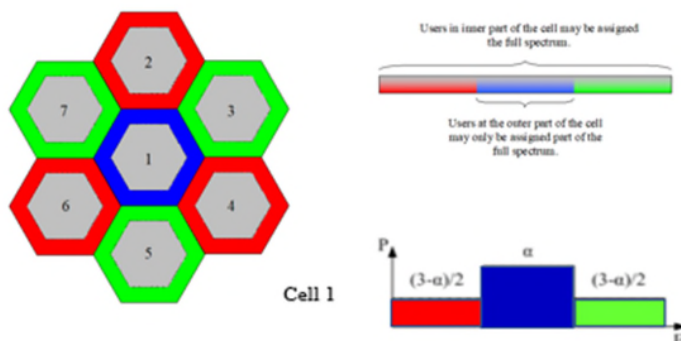


Fig. 2B

In this FFR scheme, the sub-channels allocated for the edge zones are assigned power P_e , which is higher than power P_{c1} assigned to the sub-channels allocated for the center zones.. *Id.*, FIG. 2B, [0058].

Various soft FFR or SFR schemes are described with reference to Figures 2C and 2D of EX1011. In addition, Ericsson (EX1012) and Huawei (EX1013) made proposals to the 3GPP standard organization describing SFR schemes. In the SFR scheme of the Ericsson and Huawei proposals, only a part of the available spectrum is used for cell-edge users in a particular cell, with neighboring cell-edge users using different, orthogonal frequency bands to mitigate interference. Cell-center users, on the other hand, used the full spectrum with reduced transmit/receive power levels for the part of the frequency band not used by the cell-edge users (as depicted in the figure below). EX1012, p. 2; *see also* EX1013, pp. 1-2.



At the same time that skilled artisans were discussing frequency reuse schemes as an effective technique to avoid excessive inter-cell interference in OFDMA systems, they were also discussing distributed antenna systems as a technique for addressing interference in a multicell environment. *See, e.g.*, EX1014. A DAS uses geographically distributed antennas, as opposed to fewer antennas at the center of each cell. The distributed antennas reduce the distances that signals are required to propagate (as well as the signal propagation path loss), and therefore also reduce the required transmission power from each of the distributed antennas. Each distributed antenna module is connected to a home base station (or central unit) via dedicated wires, fiber optics, or an exclusive RF link (as shown in Figure 1 below from EX1014, p. 70).

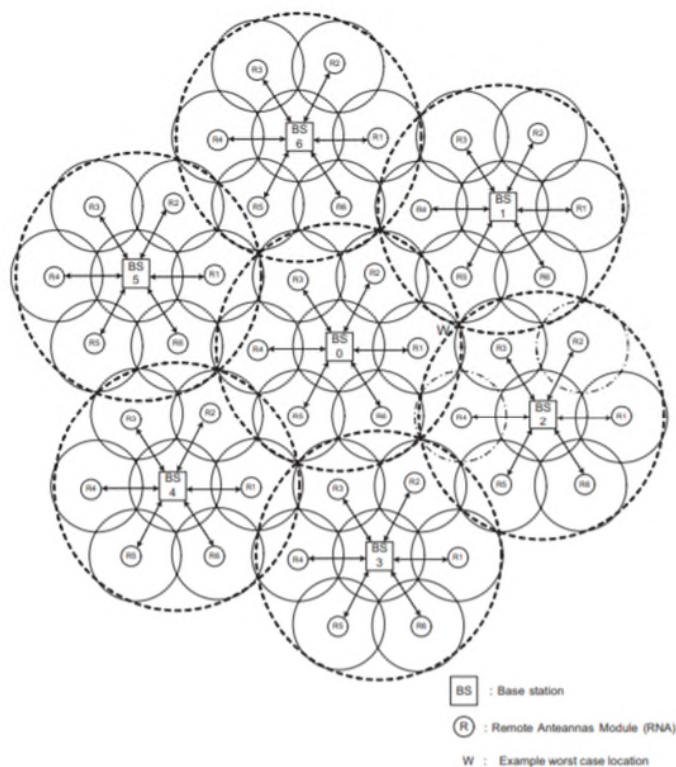


Fig. 1. Structure of a distributed antenna system.

As yet another approach to reducing ICI, in centralized antenna cellular systems, base stations configured to provide coverage to a number of geographic areas radially distributed around the base station were developed as an alternative to base stations providing omnidirectional coverage. See EX1016, 1:11-14, 1:25-28.

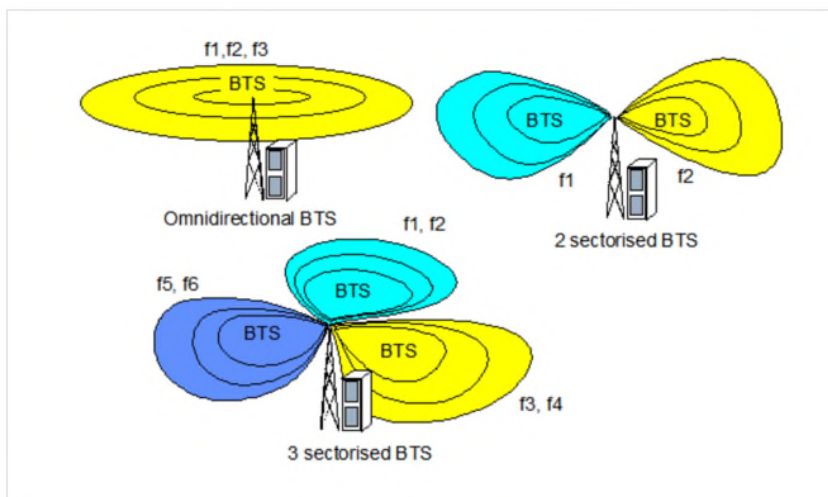
Because the antenna of an omnidirectional base station transmits and receives signals equally well in all directions, signals emanating from the base station may interfere with signals in surrounding cells in all directions. *Id.*, 1:14-18. Thus, frequency reuse within the entire wireless communications network must be limited in order to ensure reliable communications. *Id.*, 1:18-20. Limited frequency reuse

within the cellular system results in decreased system capacity, and thus lower revenues may result. *Id.*, 1:20-23.

To overcome the problem of limited frequency reuse, these base stations (known as sectorized base stations) allot sectors of available RF frequencies to each geographic area in such a way that frequency reuse throughout the cellular network is increased. *Id.*, 1:28-31. Because the coverage area of the base station is subdivided into geographic areas, each of which is supported by a separate directional antenna aligned with it, signal interference with surrounding cells is reduced. *Id.*, 1:31-34.

The figure below compares an omnidirectional base station with different sectorized base station arrangements:¹

¹ Image from: <https://sites.google.com/site/gsmtheory/home/4-2-bearer-independent-circuit-switched-core-network-umts-release-4-/3-base-station-subsystem-bss->.



The sectorization of signals to different regions of a cell served by the same base station was known in 2012. The sectorization was performed in multiple cellular standards. As shown in the figure above, different frequencies were utilized for different regions served by the same base station (for example in the GSM standard, or the IS-136 TDMA standard). In newer standards (using signal processing techniques), the same frequencies could be reused across different sectors, and cells (IS-95, W-CDMA, and LTE), but still allowing for independently manageable radio resources for each sector.

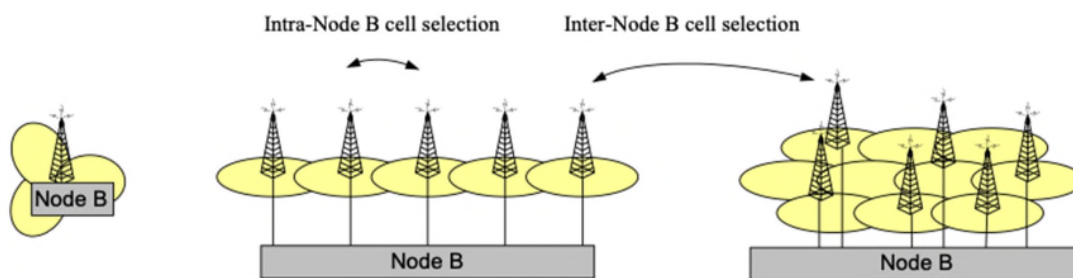


Figure 3: Examples of different deployments.

Ex. 1012, Fig. 3

As can be seen in the above figure, a base station may have different sector radiation patterns. The shape of each sector coverage area of a base station is defined by the type of antenna which is connected to the base station's RF sector ports. These antennas are interchangeable by the use of an antenna connector between the antennas and the base station. For example, the 3GPP LTE standard requires LTE base stations (eNodeBs) to include an "antenna connector" as a "port" to perform conformance testing. See EX1020 (3GPP TS 36.141 version 10.4.0 (2011-11) titled "LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); Base Station (BS) conformance testing"), §4.5.1, Fig. 4.5-1, §4.5.2, Fig. 4.5-2, and §4.5.3.

Unless otherwise stated, the transmitter characteristics in clause 6 are specified at the **BS antenna connector (test port A)** with a full complement of transceivers for the configuration in normal operating conditions. If any external apparatus such as a TX amplifier, a filter or the combination of such devices is used, requirements apply at the **far end antenna connector (test port B)**.

Id., 4.5.1. (emphasis added).

These BTS sector RF ports were known to be used for connecting directly to antennas as discussed above, and were also used for connecting to distributed antenna systems. The RF ports from a BTS were independent of the type of antenna connected to them (directional, distributed, or otherwise), and were an available, known, and common RF interface to a base station (including an LTE eNodeB).

Further prior art approaches combining frequency reuse techniques to cell edge user equipment (UEs) of respective base station sectors were known as well.

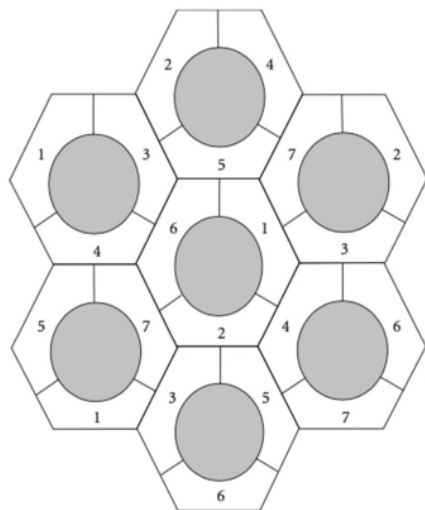


FIGURE 5: Illustration of SFR 3/7 scheme.

Ex. 1008, Figure 5.

Recognizing benefit in using DAS and a frequency reuse technique, the author in Fujii (EX 1005) combined DAS and FFR to mitigate ICI in OFDMA systems.

VII. THE '358 PATENT

A. Description of the '358 Patent's Alleged Invention

The '358 patent is titled “Method and System for Soft Frequency Reuse in a Distributed Antenna System.” EX1001, cover page. The '358 patent describes Digital Remote Units (DRUs) operable to communicate using a first set of frequencies over a first geographic footprint and a second set of frequencies, different from the first set of frequencies, over a second geographic footprint including and surrounding the first geographic footprint. *Id.*, Abstract.

The '358 patent, like other innovators and authors—such as Fujii (EX1005) and Chang (EX1015)—recognized that the downlink performance of cellular networks is known to be strongly limited by inter-cell interference in OFDMA based systems. EX1001, 5:47-49. The '358 patent acknowledges that “[i]n order to mitigate this interference, a number of techniques have recently been proposed,” which include frequency reuse techniques and DAS. *Id.*, 5:49-50, *see also* 6:44-7:67, FIGS. 1A-1F, 12:15-43 (describing three resource allocations scenarios). The '358 patent further notes that “both SFR and FFR have increased (e.g., full) spectral efficiency and are a strong mechanism for inter-cell interference mitigation.” *Id.*, 8:47-49. The '358 patent purports to mitigate ICI by combining DAS with known frequency reuse schemes “in a unique cell architecture....” *Id.*, 5:53-54, *see also* 11:3-5 (“In an embodiment, fractional frequency reuse is implemented in a DAS system with a plurality of adjacent cells, each of the cells including a plurality of remote units.”); 11:16-17 (“In another embodiment, soft frequency reuse is implemented in a DAS system with a plurality of adjacent cells.”).

Figure 2 of the '358 patent shows the general cell architecture of the DAS in a multi-cell environment, where 7 Digital Remote Units (DRUs) are connected to an LTE base station, shown as an “eNB” (eNodeB) via an optical fiber and a central unit, referred to as a Digital Access Unit (DAU) (not shown in the Figure 2). *Id.*, 11:51-55.

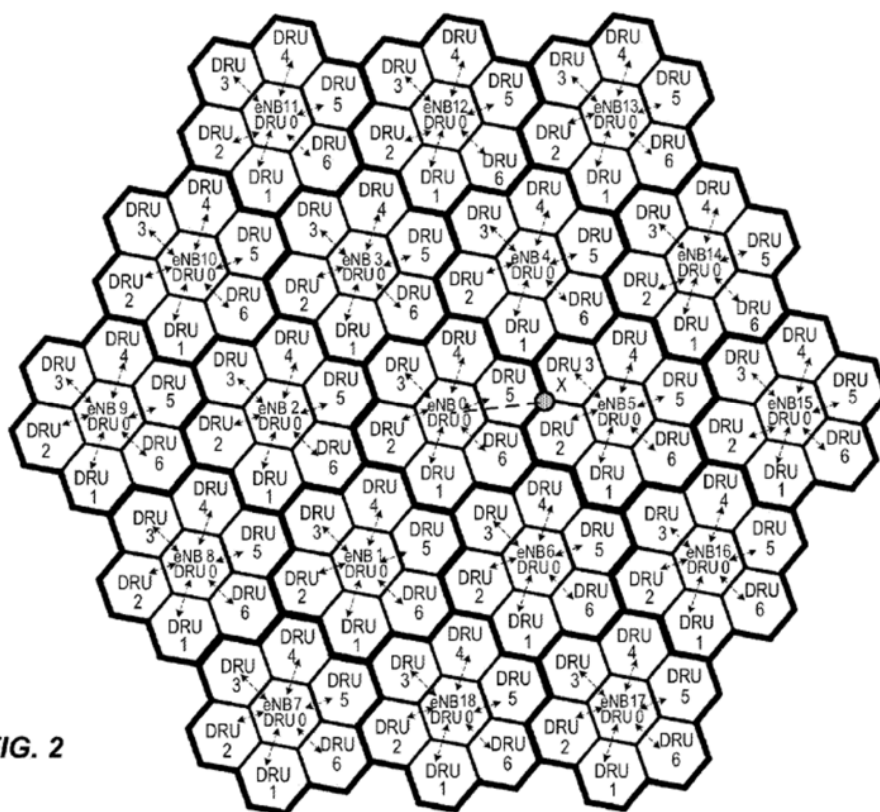


FIG. 2

The proposed architecture divides the entire spectral bandwidth F into 3 parts (F_1 , F_2 , F_3). *Id.*, 11:65-67. In one embodiment, the eNB assigns the full-reused frequency (all 3 parts) to the central DRU and the other 6 edge DRUs work on just 1 part based on a reuse factor in such a way that neighbor cell edge DRUs don't use the same frequency part. *Id.*, 11:67-12:4. In another embodiment, F_1 RBs (Resource Blocks) are solely assigned to the exterior users, whereas the F_2 and F_3 RBs are assigned to the interior users. *Id.*, 12:36-38.

In this architecture with multiple users, the '358 patent considers several possible resource allocation scenarios using multiple DRUs. *Id.*, 12:15-48. Various frequency allocation schemes also are depicted in Figures 1A-1F.

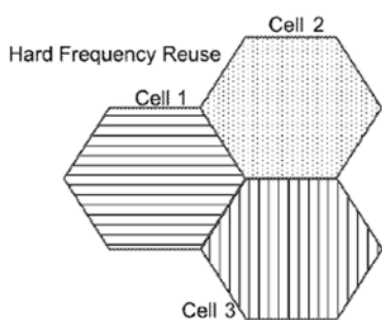


FIG. 1A

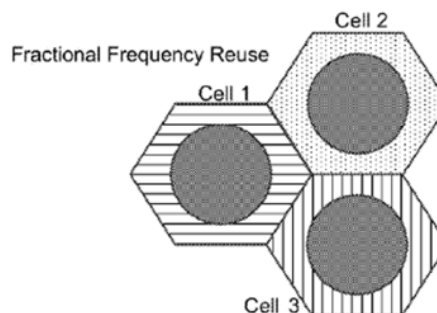


FIG. 1B

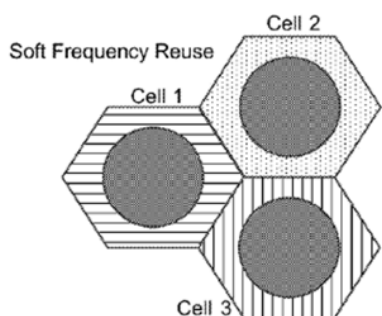


FIG. 1C

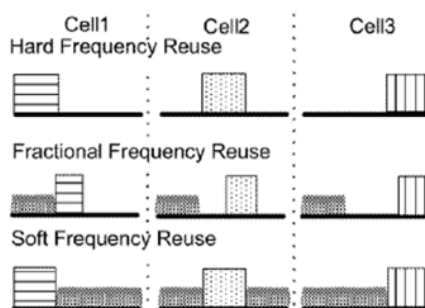


FIG. 1D

FIG. 1E

FIG. 1F

The applicants for the '358 patent did not submit a single prior art reference to the United States Patent and Trademark Office during prosecution, including their own prior art describing known DAS implementations.

B. Summary of the Prosecution History

The prosecution history of the '358 patent is brief. The application that issued as the '358 patent was filed on May 14, 2013. In a non-final office action in a first round of prosecution, the examiner rejected the claims under §102 in view of U.S. Application No. 2005/0239403 ("Karabinis"). Applicant filed an Amendment on May 27, 2015, arguing that Karabinis failed to disclose, among other limitations, "a third set of frequencies characterized by a third frequency band different from the

first frequency band and the second frequency band.” See EX1002, 255.² On July 17, 2015, a Notice of Allowance was mailed. *Id.*, 262-263.

The Examiner did not review or cite any reference relied on in this petition.

C. Level of Ordinary Skill in the Art

Based on the disclosure of the ’358 patent, a POSA at the time of the claimed invention would have: (1) a bachelor’s degree in electrical engineering and (2) a minimum of 3-4 years of industry experience in wireless communications networks and engineering. However, an individual with an advanced degree in electrical engineering would require less industry experience (*e.g.*, 1-2 years). EX1003, ¶28.

D. Claim Construction

In an *inter partes* review, claims are “construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. 282(b).” 37 C.F.R. § 42.100(b). If trial is instituted, all claim terms must be given their ordinary and customary meaning as understood by a POSA during the relevant timeframe in light of the specification and the prosecution history. *Id.*; *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312-1313 (Fed. Cir. 2015) (en banc); see also 83 Fed. Reg. 51340.

² For ease of reference, the pages of Exhibit 1002 have been numbered consecutively from 1 to 339.

Petitioner believes that the terms of the '358 patent, for the purposes of this proceeding, should be given their plain and ordinary meaning under the *Phillips* standard unless stated otherwise in the discussion of particular limitations below.

The plain and ordinary meaning of Digital Remote Unit (DRU) in the '358 patent is “a unit of a Distributed Antenna System (DAS) that supports the transport of radio resource signals between users and a central facility and/or one or more Digital Access Units (DAUs).”

The plain and ordinary meaning of Digital Access Unit '358 patent is “a unit of a Distributed Antenna System (DAS) that supports the transport of radio resource signals between at least one signal source and the one or more Digital Remote (DRUs).”

VIII. GROUNDS OF REJECTION

Claims 1-21 are unpatentable for at least the reasons set forth below.

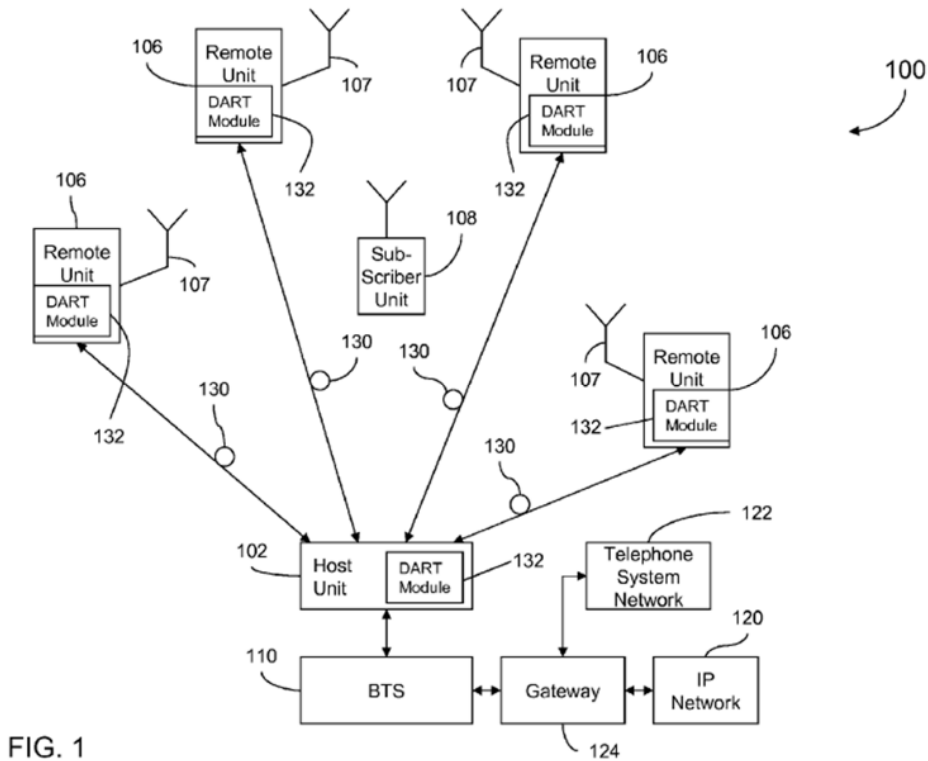
A. Ground 1: Claims 1-21 are obvious over Fujii alone or in combination with Cannon.

1. Overview: Fujii discloses a DAS using FFR to reduce inter-cell interference; Cannon discloses a DAS with DAUs and DRUs.

Fujii describes a user scheduling scheme suitable for use with orthogonal frequency-division multiplexing (OFDM) transmissions in distributed antenna systems. EX1005, p. 2370, SUMMARY. Just like the '358 patent, Fujii recognized and disclosed techniques for inter-cell-interference mitigation by combining DAS with

FFR. *Id.*, p. 2370, Introduction, ¶¶ 1 & 6 (“DAS possesses a larger link budget and higher ICI tolerance than co-located (or centralized) antenna systems (CAS)” and “[t]he novelty of the scheme that we propose is as follows. We introduce FFR into DAS to further increase average user throughputs for users located in cell boundaries”) and SUMMARY (“This user scheduling scheme consists of inter-cell-interference mitigation scheduling by using fractional frequency reuse”). Fujii’s Figures 9 and 10 (reproduced above), illustrate a fractional frequency reuse scheme like that shown in Figures 1B and 1E of the ’358 patent (reproduced above).

Cannon discloses a DAS that employs a host unit, which operates as Digital Access Unit (hereinafter “DAU”). EX1006, [0018]. The host unit 102 serves as an interface between at least one base transceiver station (“BTS”) 110 and a plurality of remote units 106, and receives downlink RF signals from the at least one BTS. *Id.*, [0018]-[0020]. Figure 1 of Cannon is reproduced below.



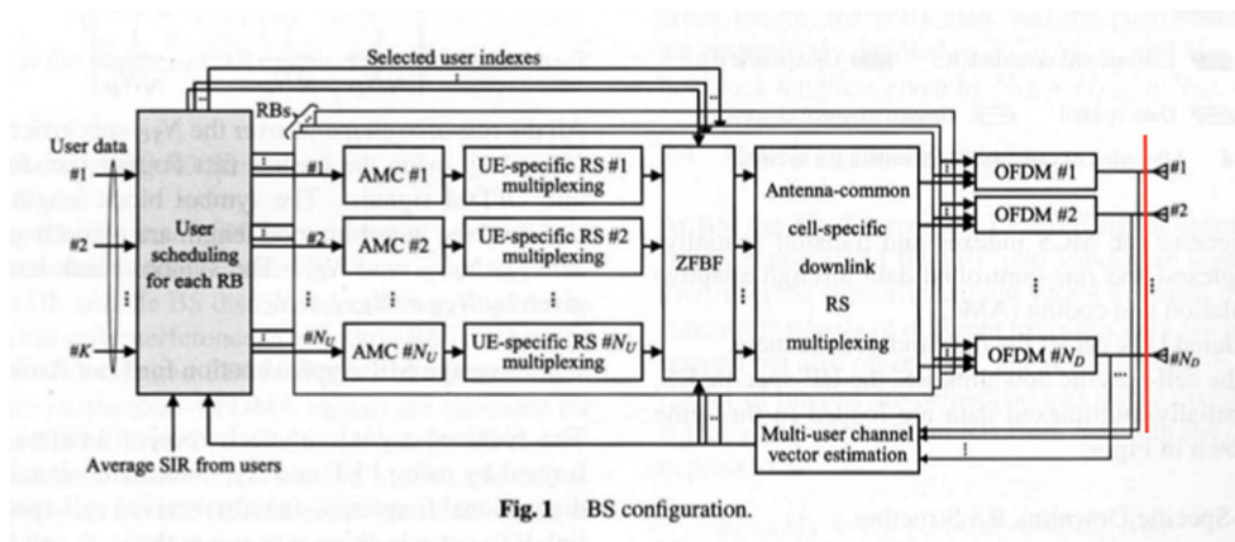
Fujii alone in combination with Cannon teaches or suggests all of the limitations of independent claims 1, 7, and 15, and dependent claims 2-6, 8-14, and 16-21. EX1003, ¶867

2. Motivation to Combine

Fujii describes a user scheduling scheme for use in a DAS with base stations and geographically distributed base station antennas, but does not focus on the specific implementation of the elements of the DAS that process and transport signals from the base stations to the remote antennas. *Id.*, ¶85. Cannon describes a known implementation of a DAS having a host unit (DAU) and one or more remote

units (DRUs) connected thereto, which process and transport RF signals from one or more base stations to the remote antennas. The '358 patent provides little or no description of the internal structure of the DAU and DRUs it discloses, and assumes instead that POSAs are familiar with such devices. *Id.* A POSA would have been familiar with the DAS implementation shown in Cannon and would have been motivated to use such a DAS implementation in Fujii. *Id.*

Fujii discloses an RF interface for each of the transmitted signals, for example in Figure 1, reproduced and annotated in red below. *Id.*, ¶88. The red line depicts the radio frequency interfaces between the BS and each of the antennas #1 through N_D . A POSA would understand that antennas include interfaces using RF Ports, and are analogues interfaces to the inputs/output ports of the DAS of Cannon, as discussed below. *Id.*



EX1005, Fig. 1 (red line added).

Cannon discloses a DAS that:

address[es] the problem of efficiently transporting multiple non-adjacent communications bands within the digital transport of a distributed antenna system. This is accomplished by segregating from a digitized RF spectrum a plurality of smaller spectral regions that include relevant signals of interest, and discarding information not within those spectral regions. This segregation further allows the spectral regions to be processed independently, and each independently re-sampled (at a sampling rate based on their respective bandwidths) so that they can be transmitted over a common serial transport link. Each spectral region is transmitted using a number of timeslots in the serial bit stream that is a function of their respective bandwidths rather than the bandwidth of the entire digitized RF spectrum.

EX1006, [0017].

To implement its user scheduling scheme, which introduces FFR into DAS, Fujii would find it useful to employ a DAS as shown in Cannon, which allows segregating from a digitized RF spectrum a plurality of smaller spectral regions that include relevant signals of interest, and discarding information not within those spectral regions. EX1003, ¶90.

Such segregation of spectrum is useful when only portions of the available spectrum are being used by different remote units, as is the case in the frequency reuse scheme described in Fujii. *Id.*, ¶90. More specifically, as shown in Figures 9

and 10 of Fujii (below), the portions of the spectrum being used by the remote antenna units in the three adjacent cells are different. Notably, there are different portions of the spectrum that are not being used in each cell, which reduces interference at the edges of each cell. *Id.*; EX1005, Figs. 9 & 10:

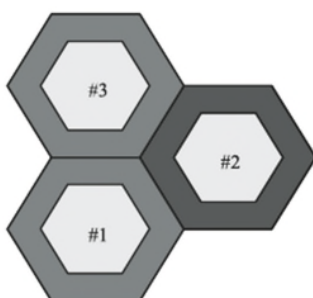


Fig. 9 Cell partitioning into inner-cell and cell-boundary zones for FFR ($FRF = 3$).

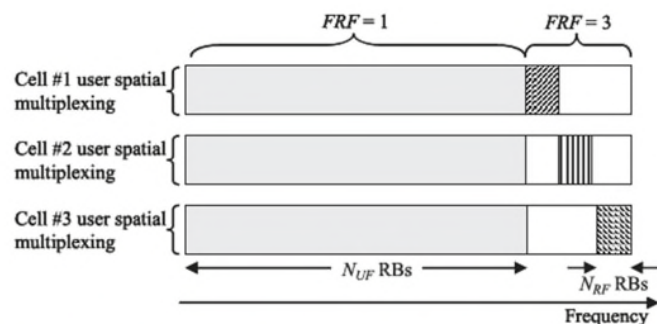


Fig. 10 Allocation of users to RBs with $FRF = 1$ and cell-specific RBs with $FRF = 3$.

While the frequencies used by all three adjacent cells shown in Fujii comprise a single cellular band, the frequencies used in two of the three cells comprise non-adjacent communications/frequency bands, which are sub-bands of the cellular band. EX1003, ¶92.

Therefore, a POSA, realizing that there are portions of the spectrum not being used in each of Fujii's cells, would have been motivated to use Cannon's implementation of a DAS, which discards digitized representations of RF spectrum that is not being used by remote antennas within a particular cell, because Cannon's implementation of a DAS in Fujii would result in a more efficient use of the fiber bandwidth between the host unit and remote units. *Id.*, ¶93.

In addition, the interfaces to the host unit 102 of Cannon are disclosed as being RF signals from one or more base stations. *Id.*, ¶94; EX1006, [0020], [0027]. It would be obvious to a POSA to interface the RF signals input of Cannon with the OFDM transceiver interfaces 1 through N_D of Fujii (depicted in red above). EX1003, ¶94. Both Cannon and Fujii interface RF signals, and comprise conventional and known technologies to transport RF signals between a base station RF transceiver and an antenna interface. *Id.* Moreover, because this combination requires a straightforward connection of base station RF signal inputs to a DAS, a POSA would have had a reasonable expectation of success in combining Fujii with Cannon. *Id.*

3. Independent claim 1

a) Fujii alone in combination with Cannon discloses the preamble of claim 1.

[1.P] A method for routing and switching operator RF signals, the method comprising:

To the extent the preamble is limiting, Fujii in combination with Cannon discloses a *method for routing and switching operator RF signals*.³ Specifically, Fujii's Figures 1 and 2 display "configurations of a BS [base station] equipped with N_D antennas and UE [user equipment] equipped with n_R antennas." EX1005, pp. 2370-71; Figs. 1 and 2 (reproduced below).

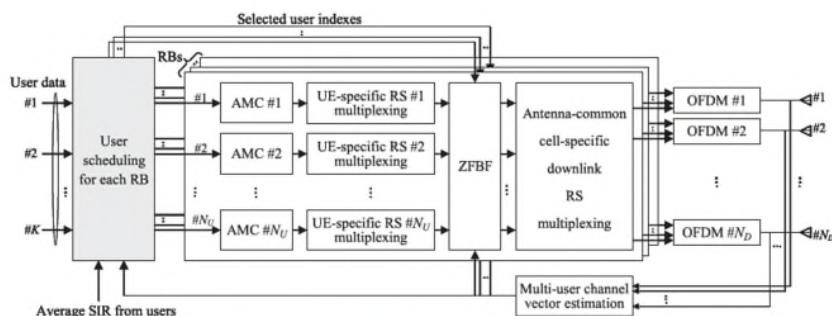


Fig. 1 BS configuration.

³ For ease of reference, Petitioner will identify claim language from the '358 patent using *italics*.

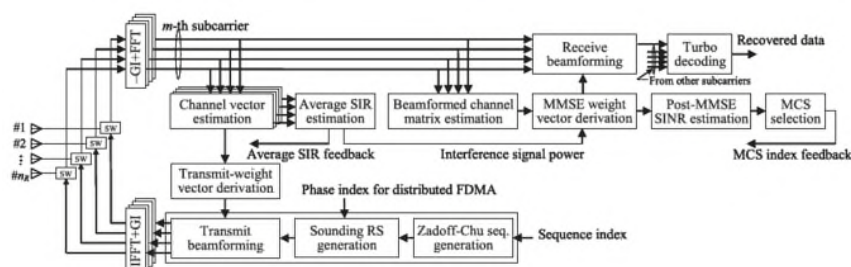


Fig. 2 UE configuration.

The signal-flow procedures of the reference signals and data transmissions (*RF signals*) are as described in section 2 of Fujii (titled “Reference Signal (RS) Structures”) and include “BSs [base stations] transmit[ing] cell-specific downlink RSs ... receiv[ing] the sounding RSs, ... schedule[ing] N_U users per resource block (RB), ... transmit[ing] UE-specific RSs ... transmit[ing] spatially multiplexed and rate-controlled data through adaptive modulation and coding (AMC).” *Id.*, pp. 2370-71. By transmitting and receiving various reference signals (RSs), scheduling users to specific resource blocks (RBs) and transmitting spatially multiplexed and rate-controlled data, Fujii’s system performs a *method for routing and switching operator RF signals*. EX1003, ¶¶95-96.

In addition, the DAS in Cannon discloses a *method for routing and switching operator RF signals*. *Id.*, ¶91. For example, as shown in Figure 1 of Cannon, operator RF signals from at least one base station (BTS 110) are provided to host unit 102 and routed and switched to remote units 106. EX1006, Fig. 1; [0018]-[0021].

Accordingly, the Fujii alone or in combination with Cannon discloses [1.P]. EX1003, ¶¶95-98.

- b) **Fujii alone or in combination with Cannon discloses the “providing one or more DRUs” limitation of claim 1 if this limitation is rewritten.**

[1.1] providing one or more Digital Remote Units (DRUs), each configured to receive one or more downlink radio frequencies and to transmit one or more uplink radio frequencies;
--

Limitation [1.1] is drafted in a manner that does not correlate to the structures described in the specification of the '358 patent. In particular, the DRUs⁴ are not “configured to *receive* one or more downlink radio frequencies and to *transmit* one or more uplink radio frequencies,” as required by this limitation. *Id.*, ¶99. The “downlink” signals “received” by the DRU are digital signals, not “radio frequencies.” *Id.* Likewise, the “uplink” signals “transmitted” by the DRU are digital signals, not “radio frequencies.” *Id.* The DRU is, however, “configured to ~~receive~~ [transmit] one or more downlink radio frequencies and to ~~transmit~~ [receive] one or more uplink radio frequencies.” *Id.* If claim 1 is rewritten so that it is not inconsistent with the specification by transposing the words “transmit” and “receive,” then the combination of Fujii with Cannon discloses [1.1]. *Id.*

⁴ The plain and ordinary meaning of Digital Remote Unit (DRU) in the '358 patent is “a unit of a DAS that supports the transport of the radio resource signals between users and a central facility and/or one or more DAUs.” EX1003, ¶68.

Fujii describes a user scheduling scheme for use in a DAS, while Cannon discloses a known implementation of a DAS. Figure 1 of Cannon illustrates an embodiment of the Distributed Antenna System providing *one or more Digital Remote Units (DRUs)*. Cannon provides that “DAS 100 includes a host unit 102 and a plurality of remote units 106.” EX1006, [0018], FIG. 1.

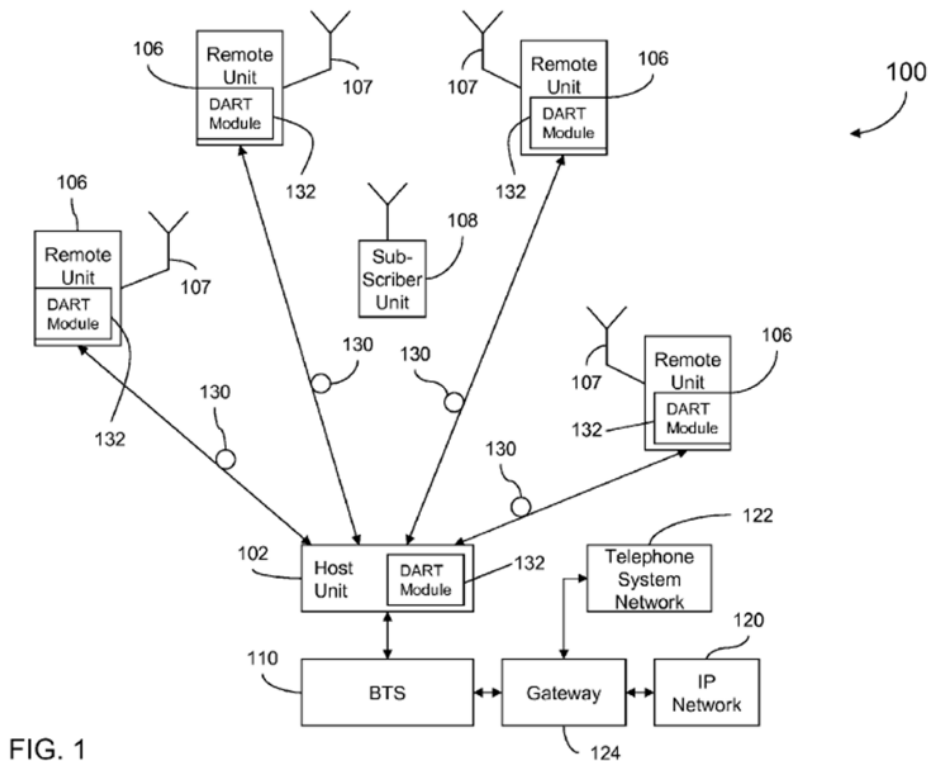


FIG. 1

In the downlink direction (from the base station to the user), Cannon shows that each remote unit (a DRU) is configured to “receive” one or more downlink signals from the host unit (a DAU)⁵ and [transmit] *one or more downlink radio frequencies*:

Downlink RF signals are received from the BTS 110 at the host unit 102, which the host unit 102 uses to generate one or more downlink transport signals for transmitting to one or more of the remote units 106. Each such remote unit 106 receives at least one downlink transport and reconstructs the downlink RF signals from the downlink transport signal and causes the reconstructed downlink RF signals to be radiated from a remote antenna 107 coupled to or included in that remote unit 106.

Id., [0020]; *see also* EX1003, ¶101.

In the uplink direction (from the user to the base station), Cannon shows that *each* [DRU is] *configured to* [receive] *one or more uplink radio frequencies* and to transmit one or more uplink transport signals to the host unit (DAU):

⁵ The plain and ordinary meaning of Digital Access Unit (DAU) in the ’358 patent is “a unit of a Distributed Antenna System (DAS) that supports the transport of radio resource signals between at least one signal source and the one or more Digital Remote Units (DRUs).” EX1003, ¶69.

Uplink RF signals received at one or more remote units 106 from subscriber 108 are used to generate respective uplink transport signals that are transmitted from the respective remote units 106 to the host unit 102.

EX1006, [0020]; *see also* EX1003, ¶102.

Cannon further teaches that the remote units are able to be configured in their operational frequencies, disclosing that DART modules (in both the host and remote units) are programmed to operate on “relevant RF signals” in both the uplink (“uplink analog signal received by a remote unit 106”) and the downlink (“a downlink signal received at a host unit 102 intended for a wireless transmission by a remote unit 106”), and that “the DART module has been programmed to recognize that spectral regions 451 and 452 contain information to be transported over DAS 100.” EX1006, [0029]. The DART is further disclosed as receiving configuration information identifying a plurality of relevant spectral regions within an RF spectrum, and the configuration information may be received by a DART module from a user interface either directly or indirectly. *Id.*, [0047]; EX1003, ¶103.

Accordingly, Fujii alone or in combination with Cannon discloses [1.1] if the claim is rewritten in the manner proposed above. EX1003, ¶104.

c) Fujii in combination with Cannon discloses the “providing at least one Digital Access Unit (DAU)” limitation of claim 1.

[1.2] providing at least one Digital Access Unit (DAU) configured to communicate with at least one of the one or more DRUs;

As discussed in element 1.1, Cannon discloses *at least one Digital Access Unit (DAU) configured to communicate with at least one of the one or more DRUs*. EX1003, ¶105; EX1006, FIG. 1, [0018]-[0021].

Fujii discloses a base station in which its antennas are distributed in a DAS arrangement, while Cannon discloses a DAS (FIG. 1 at DAS 100) composed of a DAU (FIG. 1 at host unit 102), which is used to interface to the RF outputs of at least one base station (FIG. 1 at 110) in order to distribute the base station signals to a plurality of remote units (DRUs) (FIG. 1 at 106). EX1006, FIG. 1, [0018]-[0021].

Fujii discloses a DAS having a base station, interfaced to remote antennas as follows:

In DAS, the base station (BS) antennas of multiple input multiple-output (MIMO) systems are geographically distributed within a cell to reduce the access distance between user equipment (UE) and a distributed antenna subset.

EX1005, p. 2370, Introduction, ¶ 1.

Thus, one implementing the base station arrangement of Fujii, and desiring to distribute the antennas in a DAS arrangement as proposed by Fujii, would look to the arrangement of Cannon to achieve the flexibility in configuration and use of

optical fiber in order to distribute the signals from the base station to the distributed antennas utilizing the detailed DAS teachings of Cannon, by incorporating a host unit (DAU) to interface the base station RF signals to the remote units and antenna of Cannon to achieve the geographically distributed antenna arrangement required by Fujii. EX1003, ¶¶105-108.

Accordingly, Fujii alone or in combination with Cannon discloses [1.2]. *Id.*, ¶109.

d) Fujii alone or in combination with Cannon discloses a first DRU communicating using first and second sets of frequencies over first and second geographic footprints.

[1.3] wherein a first DRU in a first cell is operable to communicate using:
a first set of frequencies characterized by a first frequency band over a first geographic footprint; and
a second set of frequencies characterized by a second frequency band different from the first frequency band over a second geographic footprint including and surrounding the first geographic footprint;

Fujii alone or in combination with Cannon discloses element 1.3. *Id.*, ¶110.

Fujii discloses multiple cells in Figure 3, each cell having a distributed antenna geometry as shown in Figure 5. EX1005, p. 2372, Figs. 3 & 5:

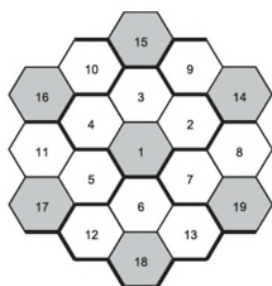


Fig. 3 Multi-cell layout with cell clusters consisting of $N_F (= 4)$ cells.

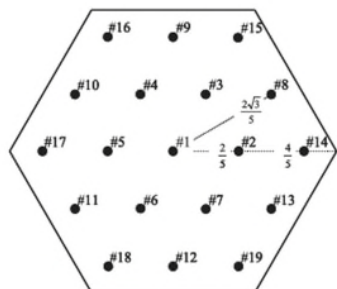


Fig. 5 Distributed antenna geometry.

See also *id.*, p. 2370, Introduction, ¶ 3 (“Fractional frequency reuse (FFR) has been investigated as a type of geographical user scheduling to avoid adjacent cell interference for users located within cell boundaries. ... In FFR, the entire bandwidth is divided into a subchannel with a frequency reuse factor (FRF) equal to one and a subchannel with a higher FRF. Resource blocks (RBs) in a subchannel with FRF equal to one are allocated to users located in inner-cell zones, whereas RBs in a subchannel with a higher FRF are allocated to users located in cell-boundary zones.”); p. 2372, Section 2.1, ¶ 1 (“Figure 3 shows cell clusters consisting of N_F cells in a multicell layout consisting of N_C cells. ... Identical cell specific downlink RSs are allocated for all the distributed antennas shown in Fig. 5 as antenna-common cell-specific downlink RS.”).

Cannon discloses a DAS in which the distributed antennas of Fujii could be implemented as DRUs. EX1003, ¶111; EX1006, FIG. 1.

In Fujii, a traditional fractional frequency reuse (FFR) scheme is used to partition each cell into inner-cell and cell-boundary zones as shown in Figure 9, with

an allocation of frequency resources to users within the inner-cell and cell boundary zones being shown in Fig. 10. *Id.*, p. 2375, Figs. 9 & 10:

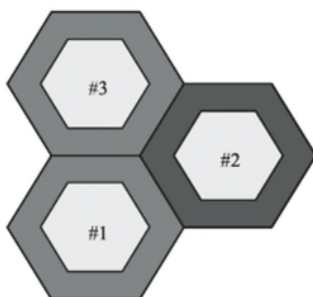


Fig. 9 Cell partitioning into inner-cell and cell-boundary zones for FFR ($FRF = 3$).

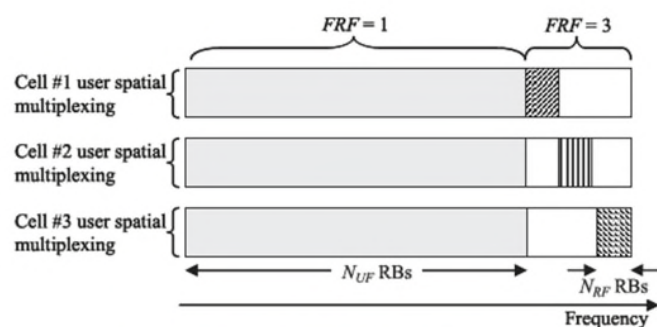


Fig. 10 Allocation of users to RBs with $FRF = 1$ and cell-specific RBs with $FRF = 3$.

See also *id.*, p. 2374, Section 3, ¶ 1 (“Figure 9 shows a multi-cell structure where FFR is equal to one and three, respectively, in the inner-cell and cell-boundary zones. The number of RBs allocated for the inner-cell and cell-boundary users is respectively N_{UF} and N_{RF} as illustrated in Fig. 10.”); p. 2374, Section 3.1 (“... *The* users in the high- and low-SIR groups are thus respectively regarded as inner-cell and cell-boundary users. The inner-cell users are allocated to RBs with FFR equal to one,

whereas the cell-boundary users are allocated to cell specific RBs with FRF equal to three.”)

As shown in these figures and discussions, *a first DRU in a first cell (e.g., a remote unit (DRU) associated with distributed antenna #1 in cell #1) is operable to communicate using:*

*a first set of frequencies characterized by a first frequency band—*This is shown as the set of frequencies in the frequency band N_{UF} RBs for cell #1 in Fig. 10.

*over a first geographic footprint—*This is shown as the inner-cell zone of cell #1 in Fig. 9.

Id., p. 2374, Section 3, ¶ 1 and Section 3.1; p. 2375, Figs. 9 & 10; EX1003, ¶113.

In addition, the same remote unit (DRU) (the remote unit associated with distributed antenna #1) *is operable to communicate using:*

[3] *a second set of frequencies characterized by a second frequency band different from the first frequency band* (shown as N_{RF} RBs for cell #1 in Fig. 10)

over a second geographic footprint including and surrounding the first geographic footprint (shown as the inner-cell and cell-boundary zones for cell #1 in Fig. 9). EX1005, p. 2374, Section 3, ¶ 1 and Section 3.1; p. 2375, Figs. 9 & 10; EX1003, ¶114.

As noted in the '358 patent, when a DRU transmits/receives frequencies at a higher power level for the cell edge than for the central portion of the cell, it “provides coverage over both the central portion ... as well as the peripheral portions” of the cell because “the higher power level results in a larger coverage area.” EX1001, 8:1-22; *see also* EX1003, ¶115.

In Fujii, as described in Section 4.2, the average power is set at $1/N_U$ for inner-cell region where FRF=1 and it is adjusted to a higher level of $3/N_U$ in the cell-boundary zone, where FRF=3. EX1005, p. 2376, Section 4.2. In view of this difference in power levels in Fujii, the *second geographic footprint include[es] and surround[s] the first geographic footprint*. EX1003, ¶116.

e) Fujii alone or in combination with Cannon discloses a second DRU communicating using first and third sets of frequencies over third and fourth geographic footprints.

[1.4] wherein a second DRU in a second cell is operable to communicate using:

the first set of frequencies over a third geographical footprint; and
a third set of frequencies characterized by a third frequency band different from the first frequency band and the second frequency band over a fourth geographic footprint including and surrounding the third geographic footprint.

Fujii alone or in combination with Cannon discloses element 1.4. *Id.*, ¶117.

As discussed with respect to limitation 1.3, Fujii discloses multiple cells in Figure 3, each cell having a distributed antenna geometry as shown in Figure 5 (EX1005, p.

2372, Figs. 3 & 5), while Cannon discloses a DAS in which the distributed antennas of Fujii could be implemented as DRUs. EX1006, FIG. 1.

Fujii's FFR scheme partitions each cell into inner-cell and cell-boundary zones as shown in Figure 9 and allocates frequency resources to users within the inner-cell and cell boundary zones as shown in Figure 10. EX1005, p. 2375, Figs. 9 & 10. As can be seen from these figures and the discussion above, *a second DRU in a second cell (e.g., distributed antenna #1 in cell #2) is operable to communicate using: the same first set of frequencies as the first DRU (distributed antenna #1) in cell #1 uses to communicate with users in the inner-cell zone of cell #1 (shown as N_{RF} RBs for cell #2 in Fig. 10) over a third geographical footprint (shown as the inner zone of cell #2 in Fig. 9).* EX1003, ¶118.

Similarly, the *second DRU (distributed antenna #1 in cell #2) is operable to communicate using: a third set of frequencies characterized by a third frequency band (shown as the set of frequencies in frequency band N_{RF} RBs for cell #2 in Fig. 10) that is different from the first frequency band and second frequency band used by users in the inner-cell and cell-boundary zones of cell #1.* EX1005, p. 2374, Section 3, first paragraph, Section 3.1, p. 2375, Figs. 9 & 10. In addition, the third set of frequencies are used *over a fourth geographic footprint including and surrounding the third geographic footprint (shown as the inner-cell and cell-boundary zones of cell #2 in Fig. 9),* Again, because the frequencies used in the cell-boundary use a

higher average power signal, the *fourth geographic footprint* corresponding to the third set of frequencies *include[es] and surround[s] the third geographic footprint*. EX1003, ¶¶119-120.

Accordingly, claim 1 is obvious over Fujii alone or in combination with Cannon. *Id.*, ¶121.

4. Dependent claim 2 - Fujii combined with Cannon discloses the limitation of claim 2.

[2] 2. The method of claim 1 wherein the DRUs comprise remote radio units.
--

The specification of the '358 patent (excluding the claims) uses the term remote radio units once: "The DRUs can comprise remote radio units." EX1001, 2:59. There is no further description of the specific structure of a remote radio unit or how it is a species of the genus, DRU, or a subcomponent of a DRU.

Cannon discloses that its remote units (*DRUs*) *comprise remote radio units*:

FIG. 2 is a block diagram of one embodiment of a remote unit 106. Remote unit 106 includes a serial radio frequency (SeRF) module 220, a digital to analog radio frequency transceiver (DART) module 208, a remote DART interface board (RDI) 224, and wireless RF components 250 that include electronics such as power amplifier, a duplexer, a low noise amplifier and other RF electronics coupled to an antenna 212.

EX1006, [0022]; FIG. 2 (shown below).

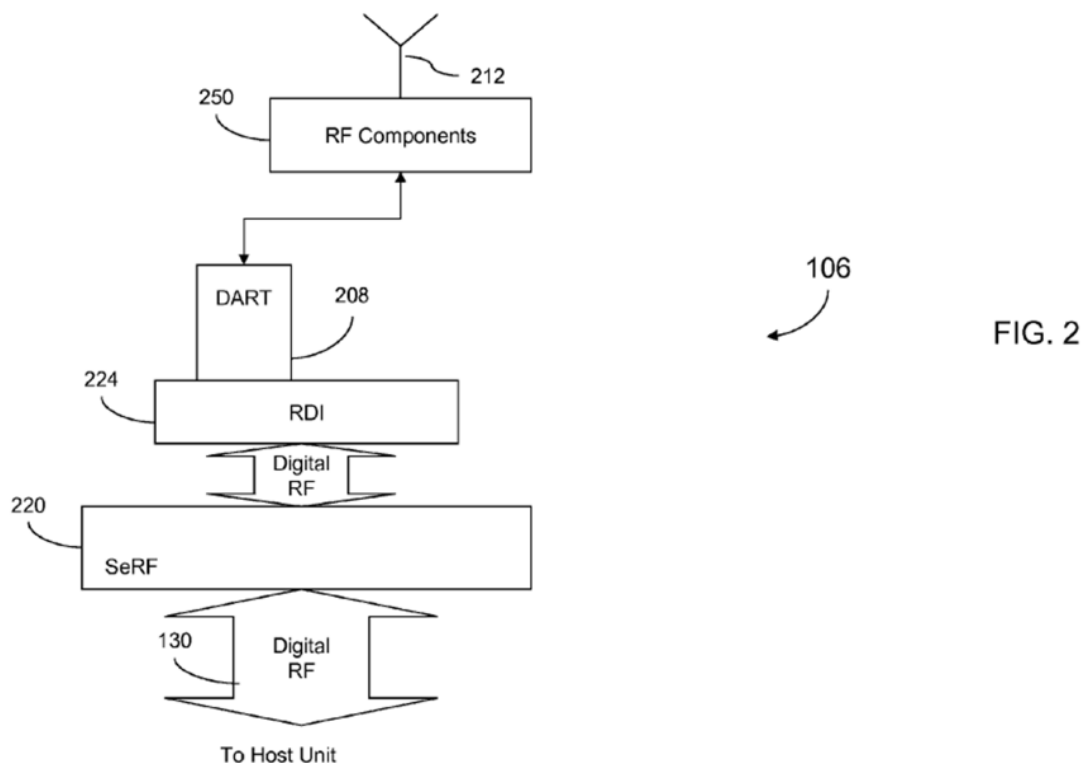


FIG. 2

The RF components 250 in the remote units 106 comprise remote radio units.

EX1003, ¶124. Accordingly, Fujii in combination with Cannon discloses [2]. *Id.*

5. Dependent claim 3 - Fujii combined with Cannon discloses the limitation of claim 3.

[3] 3. The method of claim 1 further comprising communicating between a plurality of Base Transceiver Stations (BTS) coupled to the at least one DAU.

Cannon discloses *communicating between a plurality of Base Transceiver Stations (BTS) coupled to the at least one DAU*. EX1006, FIG. 1 & 3; [0027]. For example, Cannon provides:

FIG. 3 is a block diagram illustrating one embodiment of a host unit 102. ... Host unit 102 includes a host unit digital to analog radio frequency transceiver (DART) module 308 and a host unit serial radio frequency (SeRF) module 320. ... DART module 308 provides a bi-directional interface between SeRF module 320 and one or more base stations, such as BTS 110. As with remote units 106, when host unit 320 operates over multiple bands with multiple base stations, a separate DART module 308 is provided for each frequency band.

Id., [0027].

Accordingly, Fujii in combination with Cannon discloses [3]. EX1003, ¶¶125-126.

6. Dependent claim 4

[4] The method of claim 3 wherein one or more of the plurality of BTSs are coupled to the at least one DAU using BTS sector RF connections.

Claim 4 depends from claim 3 and adds the limitation that *one or more of the plurality of BTSs are coupled to the at least one DAU using BTS sector RF connections*.

For the reasons set forth above for claims 1 and 3, Fujii alone in combination with Cannon discloses the method of claim 3. EX1003, ¶128.

In addition, because sectorized base stations were well-known to POSAs by 2012 (*see, e.g.*, EX1012, 7-14), having the inputs to the DAU be BTS sector RF

connections would have been obvious in view of the combination of Fujii and Cannon. EX1003, ¶129. Accordingly, Fujii in combination with Cannon discloses [4].

7. Dependent claim 5 - Fujii combined with Cannon discloses the limitation of claim 5.

[5] 5. The method of claim 1 further comprising transporting signals between the one or more DRUs and the at least one DAU.

Cannon discloses *transporting signals between the one or more DRUs and the at least one DAU*. More specifically, uplink and downlink signals are transported between the one or more remote units 106 and the at least one host unit 102. EX1006, FIG. 1 (shown above); [0018]-[0021]. Accordingly, Fujii in combination with Cannon discloses [5]. EX1003, ¶130.

8. Dependent claim 6 - Fujii alone or in combination with Cannon discloses the limitation of claim 6.

[6] 6. The method of claim 1 wherein a power level associated with the first set of frequencies is less than power levels associated with the second set of frequencies and the third set of frequencies.

Fujii discloses *a power level associated with the first set of frequencies is less than power levels associated with the second set of frequencies and the third set of frequencies*. EX1003, ¶131. Specifically, Fujii at Section 4.2 shows that the average power level is set at $1/N_U$ for inner zone region where $FRF=1$ and it is adjusted to a higher power level of $3/N_U$ in the cell boundary zone, where $FRF=3$. EX1005, p.

2376, Section 4.2. In view of this difference in power levels in the inner and cell boundary zones, Fujii alone or in combination with Cannon discloses [6].

9. Independent claim 7

a) Fujii alone or in combination with Cannon discloses the preamble of claim 7.

Claim 7 is not limited to a DAS. As discussed below, claim 7 is obvious in view of Fujii alone or in combination with Cannon.

[7.P] 7. A method of distributing communications frequencies, the method providing:

To the extent the preamble is limiting, for the reasons described above regarding limitations [1.P], [1.1], [3], and [5], Fujii alone or in combination with Cannon discloses *a method of distributing communications frequencies*. Accordingly, Fujii alone or in combination with Cannon discloses [7.P]. EX1003, ¶133.

b) Fujii alone or in combination with Cannon discloses the “providing a set of communications units” limitation.

[7.1] providing a set of communications units;
--

Fujii alone or in combination with Cannon discloses *a set of communications units*. For example, Cannon discloses a set of remote units (*communications units*) communicating with one or more base stations through a host unit and with subscriber units. EX1006, [0018]-[0021], FIG. 1.

Thus, Fujii alone or in combination with Cannon discloses [7.1]. EX1003, ¶¶134-135.

c) Fujii alone in combination with Cannon discloses this limitation.

[7.2] transmitting, and receiving, from a first communications unit of the set of communications units:

a first set of frequencies characterized by a first frequency band and a first geographic footprint; and

a second set of frequencies characterized by a second frequency band different from the first frequency band and a second geographic footprint larger than and at least partially surrounding the first geographic footprint; and

For at least the reasons discussed above regarding claim elements [1.1], [1.3], and [1.4], a remote unit in cell #1 specified in the analysis of claim 1 above is *a first communications unit of the set of communications units that transmit[s] and receive[s] the frequencies set forth in [7.2]*. Specifically, when Fujii alone is combined with the knowledge of a POSA or when Fujii and Cannon are combined, the frequency and power assignments to the inner-cell and cell-boundary users would be as shown in the Fujii's Figures 9 and 10 (below) and as described in Section 4.2:

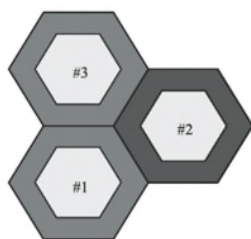


Fig. 9 Cell partitioning into inner-cell and cell-boundary zones for FFR ($FRF = 3$)

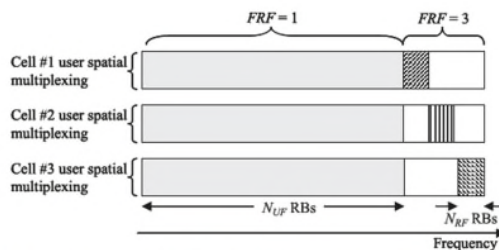


Fig. 10 Allocation of users to RBs with $FRF = 1$ and cell-specific RBs with $FRF = 3$.

In such a combination, a remote unit in cell #1 would transmit and receive frequencies in the lower portion of the total available frequency spectrum (shown as N_{UF} RBs for cell #1 in Fig. 10) at a first power level ($=1/N_U$) to provide coverage for the inner-cell zone of cell #1. EX1005, pp. 2375-76, Fig. 10 & Section 4.2; EX1003, ¶136.

The remote unit in cell #1 would also transmit and receive a different set of frequencies in a frequency band in the upper portion of the total available spectrum (shown as N_{RF} RBs for cell #1 in Fig. 10) at a second power level $= 3/N_U$ (which is higher than the first power level $= 1/N_U$) to provide coverage over both the inner-cell zone and the cell-boundary zone of cell #1. EX1005, pp. 2375-76, Fig. 10 & Section 4.2; EX1003, ¶137.

Therefore, when Fujii alone is combined with the knowledge of a POSA or when Fujii is combined with Cannon, *a first communications unit* (a remote unit in cell #1) *transmit[s] and receiv[es]* (1) *a first set of frequencies characterized by a first frequency band* (the set of frequencies shown as N_{UF} RBs for cell #1 in Fig. 10)

and a first geographic footprint (the inner-cell region in cell #1); and (2) a second set of frequencies characterized by a second frequency band different from the first frequency band (shown as N_{RF} RBs for cell #1 in Fig. 10) and a second geographic footprint (the entire area of cell #1), which is larger than and at least partially surrounding the first geographic footprint (the inner-cell region in cell #1), as can be seen from the figures above. Thus, Fujii alone or in combination with Cannon discloses [7.2]. EX1003, ¶138.

d) Fujii alone or in combination with Cannon discloses this limitation.

[7.3] transmitting, and receiving, from a second communications unit of the set of communications units:

a third set of frequencies including one or more frequencies in the first frequency band and a third geographical footprint; and

a fourth set of frequencies including one or more frequencies in a third frequency band and a fourth geographical footprint larger than and at least partially surrounding the third geographical footprint.

For at least the reasons discussed above regarding claim elements [1.1], [1.3] and [1.4], a remote unit in cell #2 specified in the analysis of claim 1 above is *a second communications unit of the set of communications units that transmit[s] and receiv[es] the frequencies set forth in [7.3]. Specifically, when Fujii alone is combined with the knowledge of a POSA or when Fujii and Cannon are combined, the*

frequency and power assignments to the inner-cell and cell-boundary users would be as shown in Fujii's Figures 9 and 10 and as described in Section 4.2:

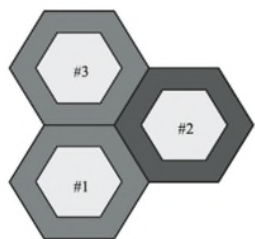


Fig. 9 Cell partitioning into inner-cell and cell-boundary zones for FFR ($FRF = 3$)

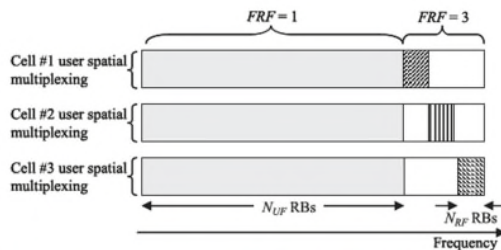


Fig. 10 Allocation of users to RBs with $FRF = 1$ and cell-specific RBs with $FRF = 3$.

In such a combination, a remote unit in cell #2 would transmit and receive frequencies in the lower portion of the total available frequency spectrum (shown as N_{UF} RBs for cell #2 in Fig. 10) at a first power level ($=1/N_U$) to provide coverage for the inner-cell zone of cell #2. EX1005, pp. 2375-76, Fig. 10 & Section 4.2; EX1003, ¶139.

The remote unit in cell #2 would also transmit and receive a different set of frequencies in a frequency band in the upper portion of the total available spectrum (shown as N_{RF} RBs for cell #2 in Fig. 10) at a second power level $= 3/N_U$ (which is higher than the first power level $= 1/N_U$) to provide coverage over both the inner-cell zone and the cell-boundary zone of cell #2. EX1005, pp. 2375-76, Fig. 10 & Section 4.2; EX1003, ¶140.

Therefore, in the combination of Fujii with the knowledge of a POSA or Fujii with Cannon, *a second communications unit* (a remote unit in cell #2) *transmit[s] and receiv[es]*:

(1) *a third set of frequencies including one or more of the frequencies in the first frequency band* (the set of frequencies shown as N_{UF} RBs for cell #2 in Fig. 10) *and a third geographic footprint* (the inner-cell region in cell #2); *and*

(2) *a fourth set of frequencies including one or more frequencies in a third frequency band* (shown as N_{RF} RBs for cell #2 in Fig. 10, which is different than the first set of frequencies characterized by the first frequency band [N_{UF} RBs for cell #1 in Fig. 10] and different than the second set of frequencies characterized by the second frequency band [N_{RF} RBs for cell #1 in Fig. 10]) *and*

(3) *a fourth geographic footprint* (the entire area of cell #2), which is *larger than and at least partially surrounding the third geographic footprint* (the inner-cell region in cell #2), as can be seen from Figure 9 above. EX1003, ¶141. Therefore, Fujii alone or in combination with Cannon discloses [7.3]. *Id.*, ¶144.

Accordingly, claim 7 is obvious over Fujii alone or in combination with Cannon. *Id.*, ¶143.

10. Dependent claim 8

[8] The method of claim 7 wherein the set of communications units includes a plurality of remote units in communication with a host unit.

For the reasons discussed above regarding claim 7 and limitations [1.1], [1.2], and [2], Fujii alone in combination with Cannon discloses *the set of communications units includes a plurality of remote units in communication with a host unit*. The remote units in cell #1 and cell #2 are a *plurality remote units* and they are in *communication with a host unit*, namely, the host unit 102 in Figure 1 of Cannon. Accordingly, claim 8 is obvious over Fujii alone in combination with Cannon. EX1003, ¶144.

11. Dependent claims 9 and 11

[9] The method of claim 7 wherein the first geographic footprint includes a location of the first communications unit.

[11] The method of claim 7 wherein the third geographical footprint includes a location of the second communications unit.

Fujii alone in combination with Cannon discloses that *the first geographical footprint* (inner-cell region of cell #1) *includes a location of the first communications unit* and the third geographical footprint (inner-cell region of cell #2) *includes a location of the second communications unit*. As can be seen by comparing Figures 5 and 9 of Fujii, the inner-cell regions of cell #1 and cell #2 will have at least one distributed antenna in each these regions, with each distributed antenna comprising

a communications unit. EX1003, ¶145. If the DAS of Fujii is implemented using the DAS structure disclosed in Cannon, the first and second communications units may comprise the remote units located in the center of cell #1 and cell #2, respectively. *Id.*

Accordingly, claims 9 and 11 are obvious over Fujii alone in combination with Cannon. EX1003, ¶146.

12. Dependent claims 10 and 12

[10] The method of claim 9 wherein the second geographic footprint covers the first geographic footprint and further extends over a peripheral footprint adjacent the first geographical footprint.

[12] The method of claim 11 wherein the fourth geographical footprint covers the third geographical footprint and extends over a peripheral footprint adjacent the third geographical footprint.

For at least the reasons discussed above regarding claims [7.2] and [7.3], Fujii alone in combination with Cannon discloses these limitations because *the second geographic footprint* (the entire area of cell #1) *covers the first geographic footprint* (the inner-cell region of cell #1) *and further extends over a peripheral footprint adjacent the first geographical footprint*, as can be seen from the Figure 9 of Fujii above. Similarly, as can be seen from the same figure, *the fourth geographic footprint* (the entire area of cell #2) *covers the third geographic footprint* (the inner-

cell region of cell #2) *and further extends over a peripheral footprint adjacent the third geographical footprint*, as can be seen from Figure 9. EX1003, ¶147.

Accordingly, claims 10 and 12 are obvious over Fujii alone in combination with Cannon. *Id.*, ¶148.

13. Dependent claim 13

[13] The method of claim 7 wherein the second geographical footprint abuts the fourth geographical footprint.

For at least the reasons discussed above regarding claims [7.2] and [7.3], Fujii alone or in combination with Cannon discloses that *the second geographical footprint* (entire area of cell #1) *abuts the fourth geographical footprint* (entire area of cell #2), as can be seen from Fujii's Figure 9. Accordingly, Fujii alone or in combination with Cannon discloses claim 13. EX1003, ¶149.

14. Dependent claim 14

[14] The method of claim 7 further comprising transmitting, and receiving, from a third communications unit of the set of communications units: a fifth set of frequencies including one or more frequencies in the first frequency band and a fifth geographical footprint; and a sixth set of frequencies in a fourth frequency band and a sixth geographical footprint larger than and at least partially surrounding the fifth geographical footprint.
--

For at least the reasons similar to those discussed above regarding claims [7.2] and [7.3], Fujii alone in combination with Cannon discloses this limitation. *Id.*, ¶150.

For example, a remote unit in cell #3 is *a third communications unit of the set of communications units that transmit[s] and receiv[es] the frequencies set forth in [14]. Specifically, when Fujii alone is combined with the knowledge of a POSA or when Fujii and Cannon are combined, the frequency and power assignments to the inner-cell and cell-boundary users would be as shown in Fujii's Figures 9 and 10 and as described in Section 4.2:*

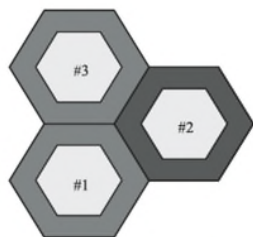


Fig. 9 Cell partitioning into inner-cell and cell-boundary zones for FFR ($FRF = 3$)

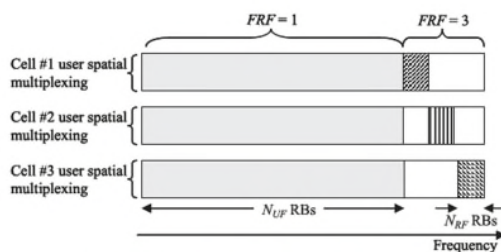


Fig. 10 Allocation of users to RBs with $FRF = 1$ and cell-specific RBs with $FRF = 3$.

In such a combination, a remote unit in cell #3 would transmit and receive frequencies in the lower portion of the total available frequency spectrum (shown as N_{UF} RBs for cell #3 in Fig. 10) at a first power level ($=1/N_U$) to provide coverage for the inner-cell zone of cell #3. EX1005, pp. 2375-76, Fig. 10 & Section 4.2; EX1003, ¶151.

The remote unit in cell #3 would also transmit and receive a different set of frequencies in a frequency band in the upper portion of the total available spectrum (shown as N_{RF} RBs for cell #3 in Fig. 10) at a second power level $= 3/N_U$ (which is higher than the first power level $= 1/N_U$) to provide coverage over both the inner-

cell zone and the cell-boundary zone of cell #3. EX1005, pp. 2375-76, Fig. 10 & Section 4.2; EX1003, ¶152.

Therefore, in the combination of Fujii alone with the knowledge of a POSA or Fujii with Cannon, *a second communications unit* (a remote unit in cell #3) *transmit[s] and receiv[es]*:

(1) *a fifth set of frequencies including one or more of the frequencies in the first frequency band* (the set of frequencies shown as N_{UF} RBs for cell #3 in Fig. 10, which includes the same frequencies as the first frequency band [N_{UF} RBs for cell #1 in Fig. 10]) *and a fifth geographic footprint* (the inner-cell region in cell #3); *and*

(2) *a sixth set of frequencies in a fourth frequency band* (shown as N_{RF} RBs for cell #3 in Fig. 10, which is different than the first set of frequencies characterized by the first frequency band [N_{UF} RBs for cell #1 in Fig. 10], different than the second set of frequencies characterized by the second frequency band [N_{RF} RBs for cell #1 in Fig. 10], and different than the fourth set of frequencies including one or more frequencies in the third frequency band [N_{RF} RBs for cell #2 in Fig. 10]) *and*

(3) *a sixth geographic footprint* (the entire area of cell #3), which is *larger than and at least partially surrounding the fifth geographic footprint* (the inner-cell region in cell #3), as can be seen from Figure 9 above. EX1003, ¶153. Therefore, Fujii alone or in combination with Cannon discloses [14]. *Id.*

15. Independent claim 15

- a) Fujii alone or in combination with Cannon discloses the preamble of claim 15.**

[15.P] 15. A communications system comprising:

To the extent the preamble is limiting, for the reasons described above regarding limitations [1.P], [1.1], [1.2], [3] and [5], Fujii alone in combination with Cannon discloses a *communications system*. Accordingly, Fujii alone or in combination with Cannon discloses [15.P]. *Id.*, ¶154.

- b) Fujii alone or in combination with Cannon discloses “a host unit.”**

[15.1] a host unit;

Fujii alone or in combination with Cannon discloses *a host unit*. For example, Cannon discloses a host unit that communicates with base stations and remote units. EX1006, [0018]-[0021], FIG. 1. Thus, Fujii alone or in combination with Cannon discloses [15.1]. EX1003, ¶155.

c) **Fujii alone or in combination with Cannon discloses this limitation.**

[15.2] a first communications unit coupled to the host unit and operable to transmit and receive communications using a first set of frequencies in a first frequency range and associated with a first geographical footprint and a second set of frequencies in a second frequency range and associated with a second geographical footprint larger than the first geographical footprint; and

For at least the reasons discussed above regarding claim elements [1.1], [1.2] and [7.2], a remote unit in cell #1 specified in the analysis of claim 7 above is *a first communications unit coupled to the host unit that is operable to transmit and receive communications using the frequencies set forth in [15.2]*. Specifically, when Fujii alone is combined with the knowledge of a POSA or when Fujii and Cannon are combined, the frequency and power assignments to the inner-cell and cell-boundary users would be as shown in the Fujii's Figures 9 and 10 (below) and as described in Section 4.2:

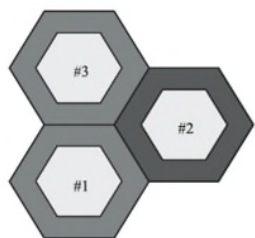


Fig. 9 Cell partitioning into inner-cell and cell-boundary zones for FFR ($FRF = 3$).

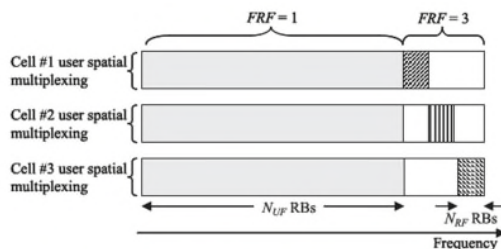


Fig. 10 Allocation of users to RBs with $FRF = 1$ and cell-specific RBs with $FRF = 3$.

In such a combination, a remote unit in cell #1 would transmit and receive frequencies in the lower portion of the total available frequency spectrum (shown as N_{UF} RBs for cell #1 in Fig. 10) at a first power level ($=1/N_U$) to provide coverage for the inner-cell zone of cell #1. EX1005, pp. 2375-76, Fig. 10 & Section 4.2; EX1003, ¶156.

The remote unit in cell #1 would also transmit and receive a different set of frequencies in a frequency range in the upper portion of the total available spectrum (shown as N_{RF} RBs for cell #1 in Fig. 10) at a second power level $= 3/N_U$ (which is higher than the first power level $= 1/N_U$) to provide coverage over both the inner-cell zone and the cell-boundary zone of cell #1. EX1005, pp. 2375-76, Fig. 10 & Section 4.2; EX1003, ¶157.

Therefore, in the combination of Fujii with the knowledge of a POSA or Fujii with Cannon, *a first communications unit* (a remote unit in cell #1) is *coupled to the host unit* (the host unit 102) *and is operable to transmit and receive communications using:*

a first set of frequencies in a first frequency range (the set of frequencies shown as N_{UF} RBs for cell #1 in Fig. 10) *and associated a first geographic footprint* (the inner-cell region in cell #1) *and*

a second set of frequencies in a second frequency range (shown as N_{RF} RBs for cell #1 in Fig. 10) *and associated with a second geographic footprint* (the entire

area of cell #1), which is *larger than the first geographic footprint* (the inner-cell region in cell #1), as can be seen from the figures above. EX1003, ¶158. Hence, Fujii alone in combination with Cannon discloses [15.2]. *Id.*

d) Fujii alone in combination with Cannon discloses this limitation.

[15.3] a second communications unit coupled to the host unit and operable to transmit and receive communications using one or more of the first set of frequencies in a region associated with a third geographical footprint and a third set of frequencies in a third frequency range and associated with a fourth geographical footprint larger than the third geographical footprint

For at least the reasons discussed above regarding claim elements [1.1], [1.2] and [7.3], a remote unit in cell #2 specified in the analysis of claim 7 above is *a second communications unit coupled to the host unit that is operable to transmit and receive communications using the frequencies set forth in [15.3]*. Specifically, when Fujii alone is combined with the knowledge of a POSA or when Fujii and Cannon are combined, the frequency and power assignments to the inner-cell and cell-boundary users would be as shown in Fujii's Figures 9 and 10 and as described in Section 4.2:

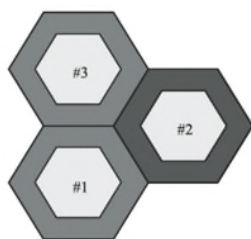


Fig. 9 Cell partitioning into inner-cell and cell-boundary zones for FFR ($FRF = 3$)

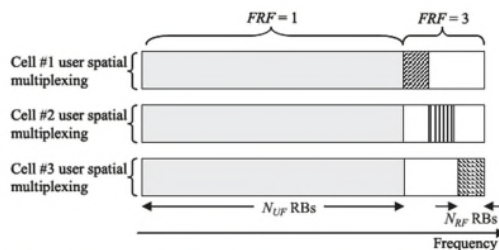


Fig. 10 Allocation of users to RBs with $FRF = 1$ and cell-specific RBs with $FRF = 3$.

In such a combination, a remote unit in cell #2 would transmit and receive frequencies in the lower portion of the total available frequency spectrum (shown as N_{UF} RBs for cell #2 in Fig. 10) at a first power level ($=1/N_U$) to provide coverage for the inner-cell zone of cell #2. EX1005, pp. 2375-76, Fig. 10 & Section 4.2; EX1003, ¶159.

The remote unit in cell #2 would also transmit and receive a different set of frequencies in a frequency range in the upper portion of the total available spectrum (shown as N_{RF} RBs for cell #2 in Fig. 10) at a second power level $= 3/N_U$ (which is higher than the first power level $= 1/N_U$) to provide coverage over both the inner-cell zone and the cell-boundary zone of cell #2. EX1005, pp. 2375-76, Fig. 10 & Section 4.2; EX1003, ¶160.

Therefore, in the combination of Fujii with the knowledge of a POSA or Fujii with Cannon, *a second communications unit* (a remote unit in cell #2) is *coupled to a host unit* (the host unit 102) *and is operable to transmit and receives communications using*:

one or more of the first set of frequencies (the set of frequencies shown as N_{UF} RBs for cell #2 in Fig. 10) in a region associated with a third geographic footprint (the inner-cell region in cell #2) and

a third set of frequencies in a third frequency range (shown as N_{RF} RBs for cell #2 in Fig. 10) and associated with a fourth geographic footprint (the entire area of cell #2), which is larger than the third geographic footprint (the inner-cell region in cell #2), as can be seen from Figure 9 above. EX1003, ¶161. Hence, Fujii alone or in combination with Cannon discloses [15.3].

Accordingly, claim 15 is obvious over Fujii alone or in combination with Cannon. *Id.*, ¶162.

16. Dependent claim 16

[16] The communications system of claim 15 wherein the host unit comprises a DAU, the first communications unit comprises a first DRU, and the second communication unit comprises a second DRU.

For the reasons discussed above regarding claim 15 and limitations [1.1] and [1.2], Fujii in combination with Cannon discloses *the host unit comprises a DAU, the first communications unit comprises a first DRU, and the second communication unit comprises a second DRU*. As stated above, the plain and ordinary meaning of Digital Remote Unit (DRU) in the '358 patent is “a unit of a DAS that supports the transport of the radio resource signals between users and a central facility and/or one or more DAUs,” and the plain and ordinary meaning of Digital Access Unit (DAU)

in the '358 patent is “a unit of a DAS that supports the transport of the radio resource signals between users and a central facility and/or one or more DAUs.” *Id.*, ¶164. Under these definitions, the host unit is a DAU and the remote units comprise DRUs. *Id.*

Accordingly, claim 16 is obvious over Fujii in combination with Cannon. *Id.*, ¶165.

17. Dependent claims 17 and 18

[17] The communications system of claim 15 wherein the communications using the first set of frequencies in the first frequency range are associated with a first power level and the communications using the second set of frequencies in the second frequency range are associated with a second power level greater than the first power level.

[18] The communications system of claim 15 wherein the communications using one or more of the first set of frequencies in the region associated with a third geographical footprint are associated with a first power level and the communications using the third set of frequencies in the third frequency range are associated with a second power level greater than the first power level.

For the reasons discussed above regarding limitations [15.2] and [15.3], Fujii alone or in combination with Cannon discloses that *the first set of frequencies in the first frequency range are associated with a first power level and the communications using the second set of frequencies in the second frequency range are associated with*

a second power level greater than the first power level as required by [17]. EX1003, ¶166. Likewise, Fujii alone or in combination with Cannon discloses that one or more of frequencies in the region associated with a third geographical footprint are associated with a first power level and the communications using the third set of frequencies in the third frequency range are associated with a second power level greater than the first power level as required by [18]. Id.

Accordingly, claims 17 and 18 are obvious over Fujii alone or in combination with Cannon. *Id.*, ¶167.

18. Dependent claim 19

[19] The communications system of claim 15 wherein the first geographic footprint is characterized by a first border and the second geographic footprint is characterized by a second border, wherein a predetermined distance separates the first border and the second border.

The '358 patent discloses that the “distance” of a user device is not physically measured, but is instead based upon the strength of the received signal from that device. EX1001, 7:40-42 (“The spectrum allocated to the inner region is assigned to the nearby users (located close to the eNodeB in terms of path loss) ...”), 16:35-40 (“In LTE systems, eNB distinguishes between the interior and exterior users based on their corresponding uplink power received at the central DRU. To implement this technique, we propose a threshold T_p as a parameter in eNB such that users with uplink power higher than T_p are assigned as interior users, and vice versa.”). The

number of interior and exterior users, $N_{interior}$ and $N_{exterior}$, respectively, are correlated with a defined parameter α ($0 < \alpha < 1$) such that the interior area is located in the $(0, \alpha R)$ region (where R = cell radius) and the exterior area is located in the $(\alpha R, R)$ region:

$$N_{interior} = \alpha^2 N_{users},$$

$$N_{exterior} = (1 - \alpha^2) N_{users}$$

Id., 16:31-34, 16:42-44; EX1003, ¶168.

Fujii discloses a similar approach to defining interior and exterior users. EX1005, p. 2374, Section 3.1 (“Note that the users are not classified here based on their distance from the center of a cell because the received signal power is not always attenuated proportional to the distance due to shadowing and instantaneous fading. ... The users in the high- and low-SIR groups are thus respectively regarded as inner-cell and cell-boundary users.”). EX1003, ¶169.

In Fujii, once the number of users assigned to the inner-cell and cell-boundary regions (K_H and K_L , respectively) is set, then *the first geographic footprint is characterized by a first border and the second geographic footprint is characterized by a second border, wherein a predetermined distance separates the first border and the second border*. Specifically, using the terminology of the '358 patent, the first border of the first geographic footprint will be at a radius of αR , where R is the radius of the cell and $\alpha = [(K_H + K_L)/K_H]^{1/2}$, and the second border of the second geographic

footprint will be at a radius of R , with a predetermined distance of $(1 - \alpha)R$ separating the first border and the second border. *Id.*, ¶170.

Accordingly, claim 19 is obvious over Fujii alone in combination with Cannon. *Id.*, ¶171.

19. Dependent claim 20

[20] The communications system of claim 15 wherein the first frequency band and the second frequency band are contiguous frequency bands.

Claim 15 does not refer to frequency “bands,” but instead refers to frequency “ranges.” Construing the term “band” to mean “range,” then for at least the reasons discussed above regarding limitation [15.2], Fujii alone or in combination with Cannon discloses that *the first frequency band and the second frequency band are contiguous frequency bands*. As can be seen from Fujii’s Figure 10, *the first frequency band* (shown as N_{UF} RBs for cell #1 in Fig. 10) *and the second frequency band* (shown as N_{RF} RBs for cell #1 in Fig. 10) *are contiguous frequency bands*. *Id.*, ¶172.

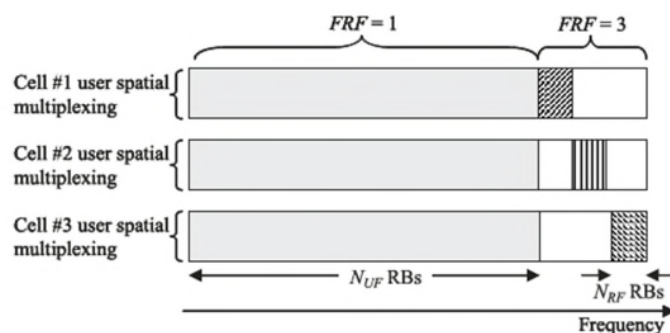


Fig. 10 Allocation of users to RBs with $FRF = 1$ and cell-specific RBs with $FRF = 3$.

Accordingly, Fujii alone or in combination with Cannon discloses [20]. *Id.*,

¶173.

20. Dependent claim 21

[21] The communications system of claim 15 wherein the first frequency range, the second frequency range, and the third frequency range include distinct frequencies.

Fujii alone or in combination with Cannon discloses that *the first frequency range, the second frequency range, and the third frequency range include distinct frequencies*. From the analysis of limitations [15.2] and [15.3], and as can be seen from the Fujii Figure 10 above, *the first frequency range* (shown as N_{UF} RBs for cell #1 in Fig. 10), *the second frequency band* (shown as N_{RF} RBs for cell #1 in Fig. 10), *and the third frequency range* (shown as N_{RF} RBs for cell #2 in Fig. 10) *include distinct frequencies*. *Id.*, ¶174. Accordingly, Fujii alone or in combination with Cannon discloses [21]. *Id.*

B. Ground 2: Dependent claim 4 is obvious over Fujii in combination with Cannon in view of Oren.

1. Dependent claim 4

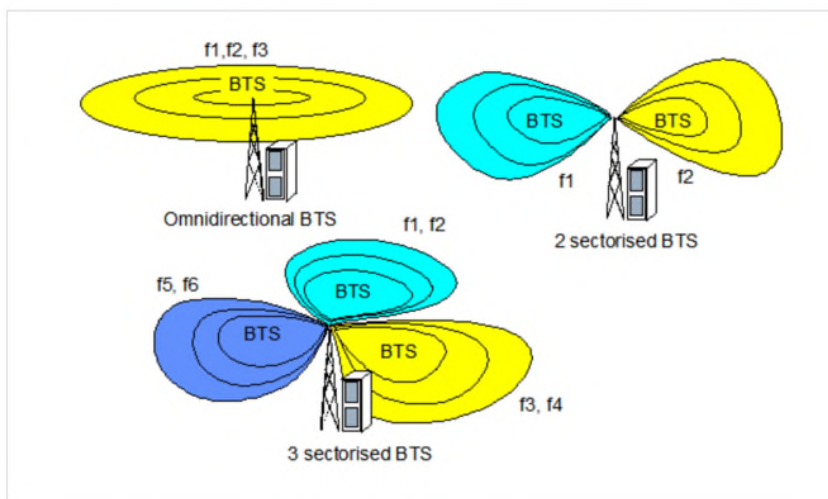
[4] The method of claim 3 wherein one or more of the plurality of BTSs are coupled to the at least one DAU using BTS sector RF connections.

Claim 4 depends from claim 3 and adds the limitation that *one or more of the plurality of BTSs are coupled to the at least one DAU using BTS sector RF*

connections. In centralized antenna cellular systems, a base station is used in each cell to provide the link between subscriber units within the cell and the rest of the communications network. *See* EX1016, 1:11-13. One type of base station provides omnidirectional coverage. *Id.*, 1:13-14. Because the antenna of an omnidirectional base station transmits and receives signals equally well in all directions, signals emanating from the base station may interfere with signals in surrounding cells in all directions. *Id.*, 1:14-18. Thus, frequency reuse within the entire wireless communications network must be limited in order to ensure reliable communications. *Id.*, 1:18-20. Limited frequency reuse within the cellular system results in decreased system capacity, and thus lower revenues may result. *Id.*, 1:20-23.

To overcome the problem of limited frequency reuse, base stations configured to provide coverage to a number of sectors radially distributed around the base station were developed. *Id.*, 1:25-28. These base stations (known as sectorized base stations) allot available RF frequencies to each sector in such a way that frequency reuse throughout the cellular network is increased. *Id.*, 1:28-31. Because the coverage area of the base station is subdivided into sectors, each of which is supported by a separate directional antenna aligned with it, signal interference with surrounding cells is reduced. *Id.*, 1:31-34.

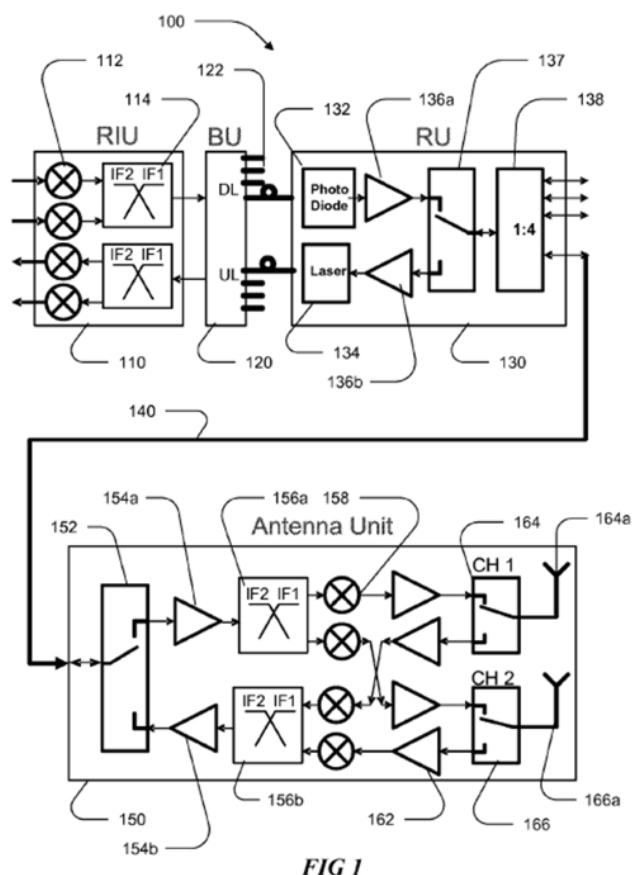
The figure below compares an omnidirectional base station with different sectorized base station arrangements:



2. **Overview:** Fujii alone or in combination with Cannon discloses the method of claim 3, and Oren discloses a base station having sector RF connections connected to a DAS.

For the reasons set forth above for claims 1 and 3, Fujii in combination with Cannon discloses the method of claim 3.

FIG. 1 of Oren shows an example of a DAS that includes a Radio Interface Unit (RIU) 110, a Base Unit (BU) 120, a Remote Unit (RU) 130 and an Antenna Unit (AU) 150. EX1007, [0017].



The RIU 110 provides the interface to the Base station (BTS, not shown). *Id.*, [0018]. In this embodiment, the RIU has two down link (DL) connections from the BTS and two up link (UL) connections to the BTS. *Id.* The RIU 110 and BU 120 can be co-located and, optionally, can be combined into a single physical element or component. *Id.*, [0021]. The DL connections from the BTS to the RIU are RF connections, which receive RF signals in the WiMAX 2.5 GHz-2.7 GHz frequency bands, for example. *Id.*, [0018].

In cases where significant capacity is required in a facility covered by a DAS, multiple base-stations (or multiple sectors on a single base station) can be used to

“feed” the DAS, where each segment of the DAS can be associated with one of the base stations/sectors. *Id.*, [0036]. The RIU can have multiple, separate interfaces for each base station/sector. *Id.*, [0037]. The RIU can map each pair of signals from each base station/sector to a different pair of bands, non-overlapping with the bands assigned to other base stations/sectors. *Id.*

Accordingly, Oren discloses providing *one or more ... BTSs ... coupled to a DAS using BTS sector RF connections*. EX1003, ¶¶177-180.

3. Motivation to Combine

Because the three sectorized configuration was adopted as a standard configuration in WCDMA macro-cell deployments and three and six sector configuration were being considered for LTE (*see* EX1017, 7-14), a POSA would have been motivated to use base stations with sectorized RF connections. EX1003, ¶181. In addition, Oren provides an explicit suggestion to use sectorized RF connections from a base station as inputs to a DAS. *Id.* Thus, a POSA would have had a reasonable expectation of success in using sectorized RF connections from a base station as inputs to a DAS such as the one disclosed in Cannon.

Accordingly, a POSA would have been motivated to combine the combination of Fujii and Cannon with Oren. *Id.*, ¶182. Therefore, Fujii in combination with Cannon and in view of Oren teaches or suggests all of the limitations of dependent claim 4. *Id.*

IX. THIS PETITION CONTAINS NEW ARGUMENTS AND PRIOR ART NOT PREVIOUSLY PRESENTED TO THE OFFICE

The prior art cited in the instant petition was not cited and is different from the prior art considered by the Examiner during original prosecution of the '358 patent. Accordingly, this petition is not redundant to the original examination for purposes § 325(d).

X. THE *NHK SPRING* DECISION IS INAPPLICABLE.

The Board should not deny institution based on the pendency of Dali Wireless district-court case in the Northern District of California. In *NHK Spring*, the Board denied institution in-part because the district-court case was nearing its final stages and would resolve all the issues before the Board. *NHK Spring Co. v. Intri-Plex Techs., Inc.*, IPR2018-00752, Paper 8 at 20 (PTAB Sept. 12, 2018) (precedential). That is not the case here.

The Board has since provided six factors to weigh when considering discretionary denial under *NHK Spring*:

1. whether the court granted a stay or evidence exists that one may be granted if a proceeding is instituted;
2. proximity of the court's trial date to the Board's projected statutory deadline for a final written decision;
3. investment in the parallel proceeding by the court and the parties;
4. overlap between issues raised in the petition and in the parallel proceeding;
5. whether the petitioner and the defendant in the parallel proceeding are the same party; and

6. other circumstances that impact the Board's exercise of discretion, including the merits.

Apple v. Fintiv, Inc., IPR2020-00019, Paper 11 at 13-14 (PTAB Mar. 20, 2020) (precedential). Here, these factors favor institution.

Factor 1 favors institution because Judge Chen will likely grant a stay in this case. Judge Chen has previously granted stays after institution of an IPR where doing so “is likely to assist the court in determining patent validity or eliminate the need to try infringement issues.” *Trusted Knight Corp. v. IBM*, No. 19-cv-01206-EMC, 2020 U.S. Dist. LEXIS 158218, at *3 (N.D. Cal. Aug. 31, 2020); *see also Capella Photonics, Inc. v. Cisco Sys.*, No. C-14-3348 EMC, 2015 U.S. Dist. LEXIS 27953, at *6 (N.D. Cal. Mar. 6, 2015). When granting a stay, Judge Chen has considered factors including: “(1) whether discovery is complete and whether a trial date has been set; (2) whether a stay will simplify the issues in question and trial of the case; and (3) whether a stay would unduly prejudice or present a clear tactical disadvantage to the non-moving party.” *Trusted Knight*, 2020 U.S. Dist. LEXIS 158218, at *4. Here, discovery is in its early stages, and neither a discovery deadline nor a trial date has been set. Thus, Patent Owner would not be prejudiced by a stay. Further, this petition addresses all claims of the '358 Patent, not just those asserted in district court, and would thus simplify the issues if granted. Petitioner may file a motion to stay upon filing the petition for *inter partes* review, and given the facts, Judge Chen is likely to grant the motion.

Factor 2 favors institution. No trial date is set in the co-pending district court case.

Factor 3 favors institution because the district court case remains in its early stages. The case was only recently transferred to the Northern District of California from the Western District of North Carolina. Judge Chen entered a partial case schedule on October 23, 2020, that does not set a date beyond the *Markman* hearing. Discovery is also in its early stages and no depositions have been taken. The Patent Owner served its infringement contentions on October 29, 2020 and invalidity contentions were served on December 14, 2020. The parties Joint Claim Construction Statement was filed on February 12, 2020.

Factor 4 favors institution because this petition challenges all claims 1-21 in the '358 Patent whereas the district court will (at most) decide the patentability of only a subset of the challenged claims (i.e., claims 7-13, 15, and 17-21). EX1018, 2. Even if the district court reaches validity, the claims at issue will have been narrowed further, and the district court will leave the patentability of numerous claims unanswered. The prior-art grounds at issue in the district court remain uncertain, and the district court might not decide any issues in the petition. Accordingly, unlike *NHK Spring*, the district court will not resolve all the issues in the petition.

Factor 5 favors institution because Petitioner is the defendant in the parallel district court proceeding. *Id.*, 1.

***Inter Partes* Review of U.S. Patent No. 9,197,358**

Factor 6 favors institution because the grounds herein provide a strong showing of obviousness. “[I]f the merits of a ground raised in the petition seem particularly strong on the preliminary record, this fact has favored institution.” *Apple*, Paper 11 at 14-15.

XI. SECONDARY CONSIDERATIONS

Petitioner is not aware of any secondary considerations that would overcome the showing of obviousness set forth herein. If the Patent Owner Preliminary Response includes evidence of secondary considerations, Petitioner requests an opportunity to file a reply.

XII. CONCLUSION

For the reasons provided above, *inter partes* review of claims 1-21 of U.S. Patent No. 9,197,358 is requested.

Dated: February 22, 2021

Respectfully submitted, ,

By: /Christopher TL Douglas/
Christopher TL Douglas, Reg. No. 56,950

COUNSEL FOR PETITIONER

CERTIFICATE OF WORD COUNT

The undersigned hereby certifies that the portions of the above-captioned Petition for *Inter Partes* Review of U.S. Patent No. 9,197,358 specified in 37 C.F.R. § 42.24 have 13,353 words, in compliance with the 14,000 word limit set forth in 37 C.F.R. § 42.24(a)(1)(i). This word count was prepared using Microsoft Word 2010.

Dated: February 22, 2021

Respectfully submitted,

By: /Christopher TL Douglas/
Christopher TL Douglas, Reg. No. 56,950

COUNSEL FOR PETITIONER

CERTIFICATION OF SERVICE (37 C.F.R. §§ 42.6(e), 42.105(a))

The undersigned hereby certifies that true and correct copies of the above-captioned **PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 9,197,358**, all associated exhibits, and Petitioner's Power of Attorney were served in their entireties on February 22, 2021, upon the following parties via UPS Next Day Air®:

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Denver, CO 80202

Dated: February 22, 2021

Respectfully submitted,

By: /Christopher TL Douglas/
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