

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

UBIQUITI INC.
Petitioner

v.

XR COMMUNICATIONS, LLC D/B/A VIVATO TECH.
Patent Owner

IPR2024-00148

U.S. Patent No. 10,594,376

**PETITION FOR *INTER PARTES* REVIEW OF
U.S. PATENT NO. 10,594,376**

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EXHIBIT LIST

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EX-1003	Declaration of Zhi Ding, Ph.D.
EX-1004	Curriculum Vitae of Zhi Ding, Ph.D.
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EX-1007	G. Okamoto et al., “Evaluation of beamforming algorithm effectiveness for the smart wireless LAN system,” <i>VTC '98. 48th IEEE Vehicular Technology Conference. Pathway to Global Wireless Revolution</i> , 1998, pp. 1675-1679 vol.3 (“Okamoto”)
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EX-1012	Plaintiff’s Opening Claim Construction Brief from <i>XR Communications, LLC, dba Vivato Technologies v. D-Link Systems, Inc.</i> , 8:17-cv-596, Dkt. 91 (Feb. 15, 2018)
EX-1013	R.H. Roy, “Application of Smart Antenna Technology in Wireless Communication Systems” in <i>Mobile Networking with WAP</i> . (2000)
EX-1014	Excerpts from Stutzman, Warren and Gary Thiele. <i>Antenna Theory and Design</i> . 2 nd Ed. John Wiley & Sons, Inc., 1998.
EX-1015	Miller, Sandra K., “Facing the Challenge of Wireless Security,” <i>Computer</i> , Vol. 34, July 2001
EX-1016	Saliga, Stephen V., “An Introduction to IEEE 802.11 Wireless LANs,” 2000 IEEE Radio Frequency Integrated Circuits Symposium, pp. 11-14.
EX-1017	802.11-1999 - Standard for Information Technology - Telecommunication and information exchange between systems - Local and Metropolitan Area networks - Specific requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications, November 30, 1998 (“802.11”)

EX-1018	Declaration of Gordon MacPherson regarding 802.11
EX-1019	Excerpts from Gast, Matthew, 802.11 Wireless Networks: The Definitive Guide (Apr. 2002) (“Gast”)
EX-1020	P. Lehne & M. Petterson, “An overview of smart antenna technology for mobile communications systems”, IEEE Communications Surveys, Fourth Quarter 1999, Vol. 2, No. 4 (“Lehne”)
EX-1021	D. Gerlach and Arogyaswami Paulraj, "Base station transmitter antenna arrays with mobile to base feedback," Proceedings of 27th Asilomar Conference on Signals, Systems and Computers, 1993, pp. 1432-1436 vol.2 (“Gerlach 1993”)
EX-1022	A. U. Bhobe and P. L. Perini, “An overview of smart antenna technology for wireless communication,” in Proc. IEEE Aerosp. Conf., Mar. 2001, vol. 2, pp. 875–883. (“Bhobe”)
EX-1023	Excerpts from J. Litva <i>Digital Beamforming in Wireless Communications</i> , Artech House (1996) (“Litva”)
EX-1024	Excerpts from J. Liberti and T. Rappaport, <i>Smart Antennas for Wireless Communications: IS-95 and Third Generation CDMA Applications</i> (1999) (“Liberti”)
EX-1025	Qualcomm MSM6000 Chipset Solution Data Sheet (“Qualcomm”)
EX-1026	U.S. Patent No. 5,371,734 (“Fisher”)
EX-1027	J. Thomson et al., "An integrated 802.11a baseband and MAC processor," 2002 IEEE International Solid-State Circuits Conference, Digest of Technical Papers. (“Thomson”)
EX-1028	Texas Instruments, “TI Extends Wireless LAN Coverage Area by 70 Percent with New IEEE 802.11b Chip and Reference Designs” (June 4, 2001) (https://www.ti.com/sc/docs/news/2001/01112.htm) (“Texas Instruments”)
EX-1029	U.S. Patent Application Publication 2002/0119754 (“Wakutsu”)
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I. INTRODUCTION

Ubiquiti Inc. (“Petitioner”) requests *inter partes* review (“IPR”) of claims 1-34 of U.S. Patent No. 10,594,376 (the “’376 patent”).

II. GROUNDS FOR STANDING

Petitioner certifies that the ’376 patent is available for IPR and Petitioner is not barred or estopped from requesting IPR to challenge the claims on the grounds herein.

III. IDENTIFICATION OF CHALLENGE

A. Prior Art

The ’376 patent was filed on April 12, 2017 and claims priority to Application No. 10/700,329, filed on Nov. 3, 2003, and Provisional Application No. 60/423,660, filed on Nov. 4, 2002.

U.S. Patent No. 5,471,647 (“Gerlach”; EX-1005), issued November 28, 1995, is prior art under at least pre-AIA §§102(a)-(b).

U.S Patent No. 5,592,490 (“Barratt”; EX-1006), issued January 7, 1997, is prior art under at least pre-AIA 35 U.S.C. §§102(a)-(b).

G. Okamoto et al., “Evaluation of beamforming algorithm effectiveness for the smart wireless LAN system,” *VTC '98. 48th IEEE Vehicular*

Technology Conference. Pathway to Global Wireless Revolution, 1998, pp. 1675-1679 vol.3 (“Okamoto”; EX-1007), published May 21, 1998 and available to the public prior to the earliest possible priority date of the ’376 patent. EX-1008, ¶11; EX-1009, 2 (demonstrating public availability by 1998); EX-1008, ¶¶6-7 & Ex. A (demonstrating online availability by August 6, 2002). Okamoto is prior art under at least pre-AIA §§ 102(a)-(b).

B. Grounds for Challenge¹

Ground 1: The combination of Gerlach and Barratt renders claims 1-9, 12-18, and 22-34 obvious.

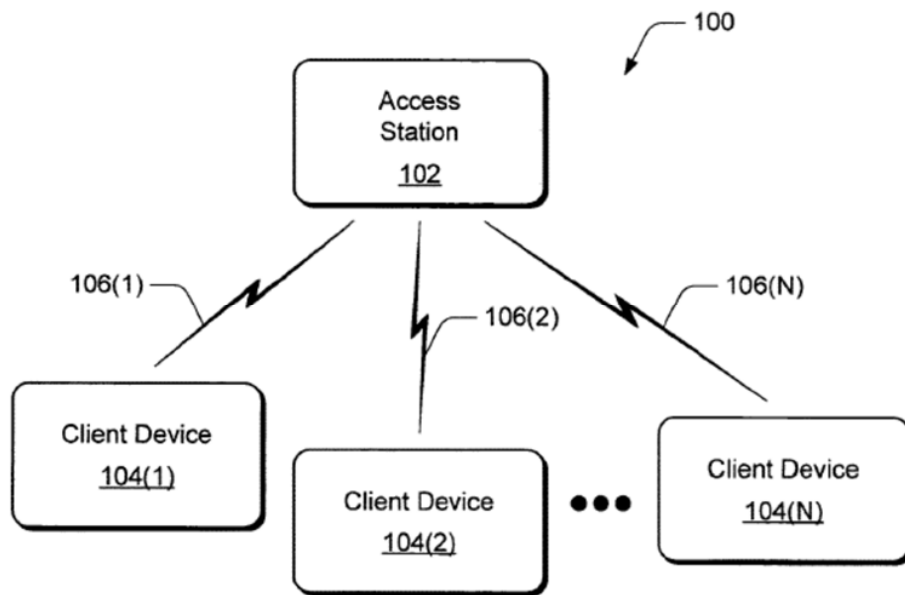
Ground 2: The combination of Gerlach, Barratt, and Okamoto renders claims 10-11 and 19-21 obvious.

IV. ’376 PATENT

A. Overview of ’376 Patent

The ’376 patent relates to “a multi-beam directed signal system [] implemented to communicate over a wireless communication link via an antenna assembly with client devices.” EX-1001, 3:11-15.

¹ Petitioner does not concede that any challenged claims satisfy requirements for patentability that cannot be raised in IPR, including Section 101 and 112.



'376 patent, Fig. 1

The system, illustrated in Figure 2 below, includes access station 102 having a multi-beam directed signal system 206 that “generates a directed wireless communication for transmission to wireless client device 202 via directed communication beam 214(1).” *Id.*, 5:26-29. The access station uses a processor, transceiver, or smart antenna assembly producing a transmission pattern that “selectively places transmission nulls and/or peaks within an applicable coverage area” to “emanate multiple directed communication beams” at client devices. *Id.*, 4:54-58, 5:5-9, 5:59-67.

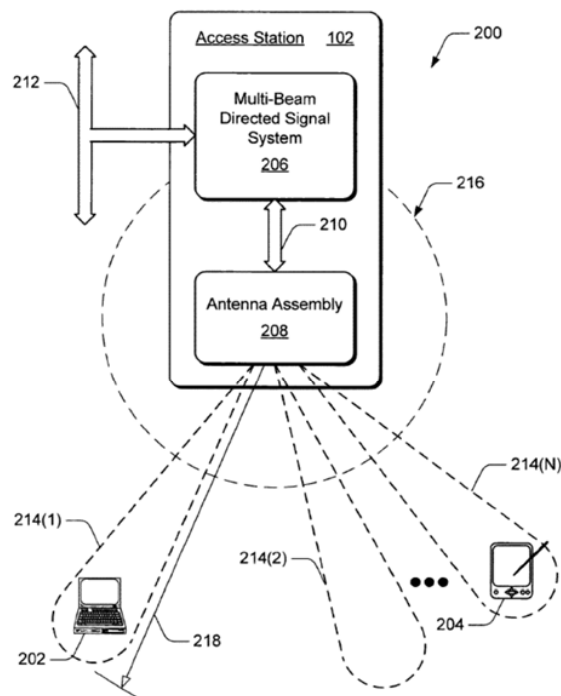


Fig. 2

'376 patent, Fig. 2

The access station can be implemented as “a nexus point, a trunking radio, a base station, a Wi-Fi switch, an access point, [or] some combination and/or derivative thereof.” *Id.*, 4:27-30. Client devices can include “portable computers, computing devices, and” other “communication device[s] that can be configured for wireless communication.” *Id.*, 3:15-20.

B. Prosecution of '376 Patent

The '376 patent was filed as a TrackOne application in April 2017. The 30 originally filed claims were rejected as anticipated over U.S. Patent Publication

2004/0014429 (“Guo”). EX-1002, 183. To overcome Guo, Applicant amended the independent claims to add limitations directed to “generat[ing] a probing signal,” “transmit[ting] the probing signal,” “receiv[ing]” feedback information, and “determin[ing] where to place transmission peaks and transmission nulls” based on feedback information. *Id.*, 254-258. Applicant also added several new independent claims including these same limitations. *Id.*, 261-265. The Examiner subsequently allowed the claims, focusing on two limitations recited in all independent claims:

- determine where to place transmission peaks and transmission nulls within one or more spatially distributed patterns of electromagnetic signals based in part of the first and second feedback information;
- wherein the one or more spatially distributed patterns of electromagnetic signals are configured to exhibit a first transmission peak at a location of the first client device [and] a second transmission peak at a location of the second client device [and a first transmission null at a location of a third device].

Id., 1246-1248.

As demonstrated below, using feedback information to determine where to place transmission peaks and transmission nulls was known for almost a decade before the earliest possible priority date of the ’376 patent.

C. Claim Construction

Petitioner does not believe it necessary for the Board to expressly construe any term for the purpose of this IPR proceeding. *See Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999).² This IPR applies the ordinary and customary meaning as would be understood by one of ordinary skill in the art in view of the specification. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1314–17 (Fed. Cir. 2005).

D. Level of Ordinary Skill in the Art

At the time of the alleged inventions, a Person of Ordinary Skill in the Art (“POSITA”) would have been familiar with wireless communications networks and equipment, and would have had at least a working knowledge of the protocols and architectures of common wireless communications networks at the time; and an understanding of the components and subsystems within available wireless communication equipment. A POSITA would have had at least a Bachelor’s

² Petitioner reserves all rights to raise claim construction arguments in any litigation concerning the ’376 patent. For example, comparing the claims to the accused products may raise controversies that require construction of certain claim terms.

degree in Electrical Engineering or a related field, and three to four years of work experience in wireless communications, or a Master's degree and at least two years of work experience in wireless communications.

V. GROUND 1: GERLACH AND BARRATT RENDER CLAIMS 1-9, 12-18, AND 22-34 OBVIOUS.

A. Overview of the Combination

1. Gerlach

Gerlach relates “to methods for multiplexing signals transmitted from an antenna array to multiple receivers, and in particular to the use of feedback from the receivers to minimize cross-talk among the received signals.” Gerlach, 1:6-9.

a. Conventional Spatial Multiplexing for Multiple Access

Gerlach explains that “[w]ireless communication systems may use spatial multiplexing techniques wherein a single transmitter simultaneously emits multiple information signals, each of which is intended for one of a number of spatially separated receivers.” Gerlach, 1:13-17. Gerlach’s Fig. 1 is a conceptual diagram of a “conventional wireless communication system (30) comprising a transmitting array (12) with transmitting elements (14) and multiple receivers (16)” illustrating this technique. Gerlach, 2:11-14.

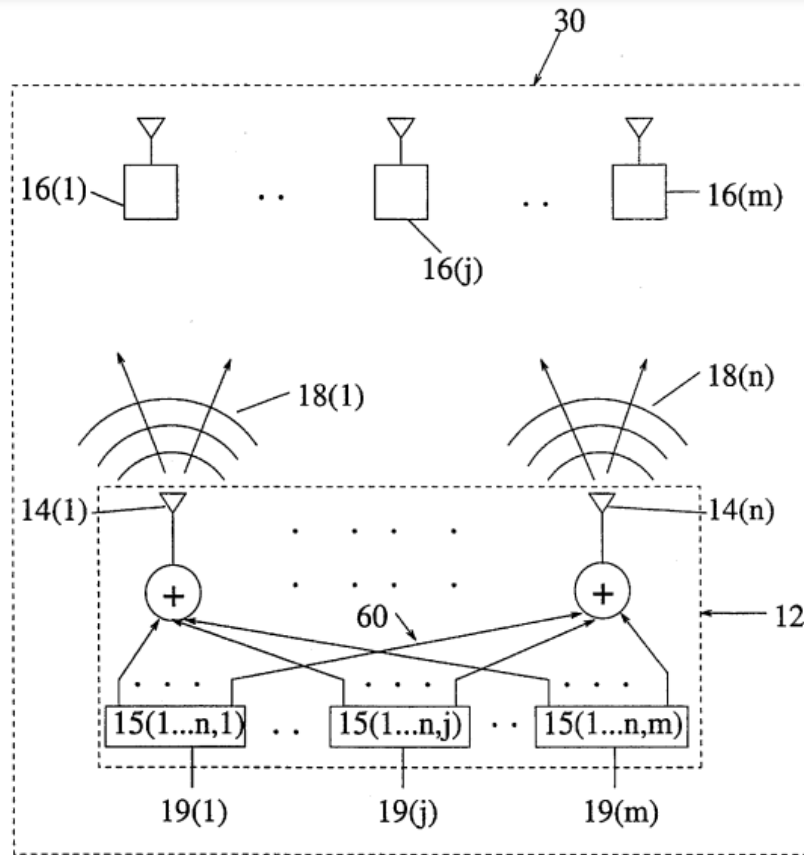


Fig.1

Gerlach, Fig. 1

In this conventional system, “[r]eceptors 16 are located in distinct directions with respect to transmitting array 12, and their angular separation provides a way to multiplex information signals 19.” Gerlach, 2:53-55. This type of multiplexing is referred to as “spatial multiplexing”; and, when applied to separate simultaneously transmitted signals in a multi-user system such as Gerlach, it is referred to as “Spatial Division Multiple Access” or SDMA. Ding, ¶¶48-49, *citing*

EX-1021, 1.

As illustrated in Fig. 1 above, “[i]nformation signals 19(1), 19(2) ... 19(m) excite transmitting elements 14(1)-14(n) collectively, giving rise to transmission signals 18 which are detected by receivers 16(1)-16(m), respectively.” Gerlach, 2:47-50. More specifically, the information signals 19(1)-19(m) are applied “to elements 14(1)-14(n) with selected complex amplitudes 15(1,1), 15(1,2) ... 15(n-1,m) through connections 60.” Gerlach, 2:62-67. Complex amplitudes 15 “form the elements of a $n \times m$ weight matrix W .” Gerlach, 2:67-3:1. The “[i]nteraction among resulting signals 18(1)-18(n) directs information signals 19 to their intended receivers 16.” Gerlach, 3:1-3. This “interaction among signals” is commonly referred to as the antenna’s radiation pattern or “beampattern.” Ding, ¶65.

In conventional SDMA systems, the weight matrix W applied to transmitted signals was not optimized to reflect receiver locations and the propagation environment through which the information signals 19 are transmitted, leading to cross-talk at the receivers from the simultaneously transmitted signals. Gerlach’s Fig. 2a represents a beampattern for an information signal in a spatial multiplexing wireless system without a mechanism to optimize weight matrix W to minimize cross-talk. As shown in this figure, a “primary lobe 23(j) at angle θ is directed toward receiver 16(j) also at angle θ with respect to array 12, and side lobes 22(j)

appear at a series of other angles.” Gerlach, 3:22-25. Because a receiver detects any signal which has a non-zero gain in its direction, the “receiver 16(l) at angle # detects the non-zero amplitude of side lobe 22(j) at angle #.” Gerlach, 3:25-28. That is, receiver 16(l) “detects signal 19(j) through side lobe 22(j), leading to cross-talk.” Gerlach, 3:28-29. Cross-talk is undesirable in wireless systems because it “degrades the quality of the signal at its intended receiver, and in the worst case, may wash it out altogether.” Gerlach, 1:42-44.

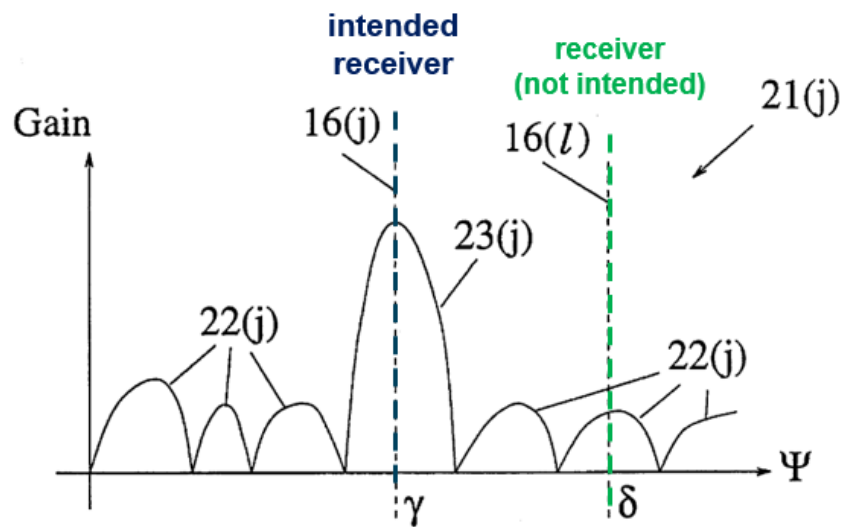


Fig. 2a

Gerlach, Fig. 2a (annotated)

b. Gerlach's Probing/Feedback Technique

Gerlach “uses feedback signals 32 to adjust the amplitudes and phases 15 with which signals 19 are applied to transmitting elements 14 so that cross-talk is

minimized.” Gerlach, 3:30-33. These feedback signals 32 “originate at receivers 16 in response to probing signals 17 applied to transmitting elements 14.” Gerlach, 3:43-46. Probing signals 17 are “transmitted with a selected weight matrix W , and the resulting feedback (32) used to determine the transfer functions a_{kj} for each array-element/receiver pair.” Gerlach, 1:57-60, Fig. 3a. Specifically, using a probing weight matrix W , “each transmitting element 14 of array 12 is successively excited by a single probing signal 17.” Gerlach, 5:23-25.

Figure 3a (below left) illustrates application of probing signal 17(1) to transmitting array 12. Ding, ¶69. A POSITA would have understood that a non-zero weight is applied to the probing signal for element 14(1) and a zero weight is applied to the probing signal for every transmission element other than element 14(1). Gerlach, 5:20-22, 3:34-39; Ding, ¶70. The received feedback signals 32 from each receiver (shaded purple) “are conveyed to weight computer 40 in array 12 for processing.” Gerlach, 3:46-48. This process is successively repeated for each element 14(i) of the antenna array. Ding, ¶71. Figure 3a (below right) illustrates the conceptual process for probing signal 17(m). The received feedback signals 32 from each receiver in response to probing signal 17(m) from element 14 (n) (shaded gold) are also conveyed to weight computer 40 for processing. Gerlach, 3:46-48.

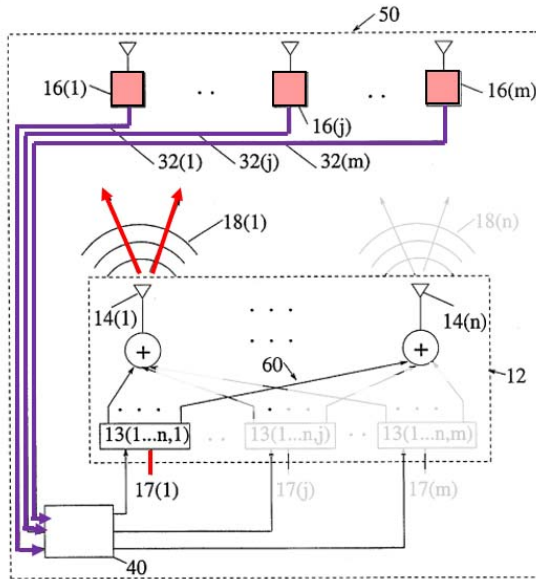


Fig. 3a

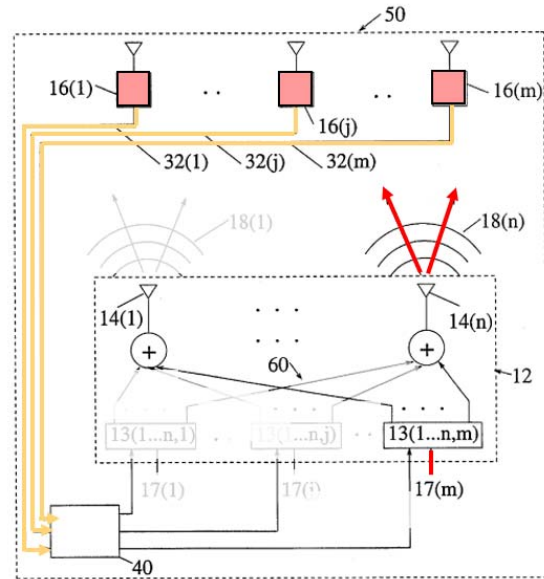


Fig. 3a

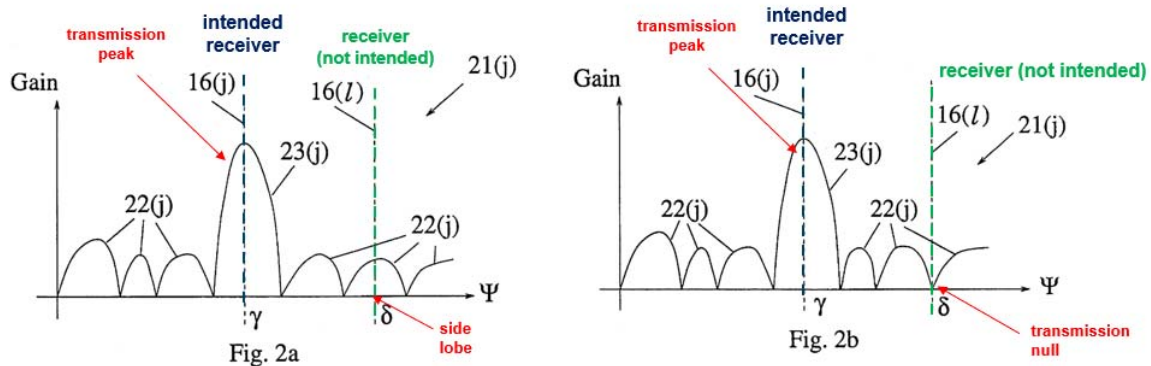
Gerlach, Figure 3a (annotated to show probing signals 17(1) at left and 17(m) at right)

Weight computer 40 “extract[s] information about the propagation environment from feedback signals 32.” Gerlach, 5:4-8. The “[i]nformation conveyed by feedback signals 32 can then be used to determine” a new weight matrix, W . Gerlach, 5:8-10.

Gerlach’s system applies the values of weight matrix W during transmission of information signals. Gerlach, 5:7-10. Using this adjusted weight matrix, transmitting array 12 “generate[s] a complimentary null beam pattern.” Gerlach, 5:20-22. This has a “primary lobe 23(j) with unit gain at angle θ_j , in the direction of intended receiver 16(j), and side lobes 22(j) with nulls in the direction of all

remaining receivers $16(l)$ where $l \neq j$ as illustrated in Fig. 2b (below right).

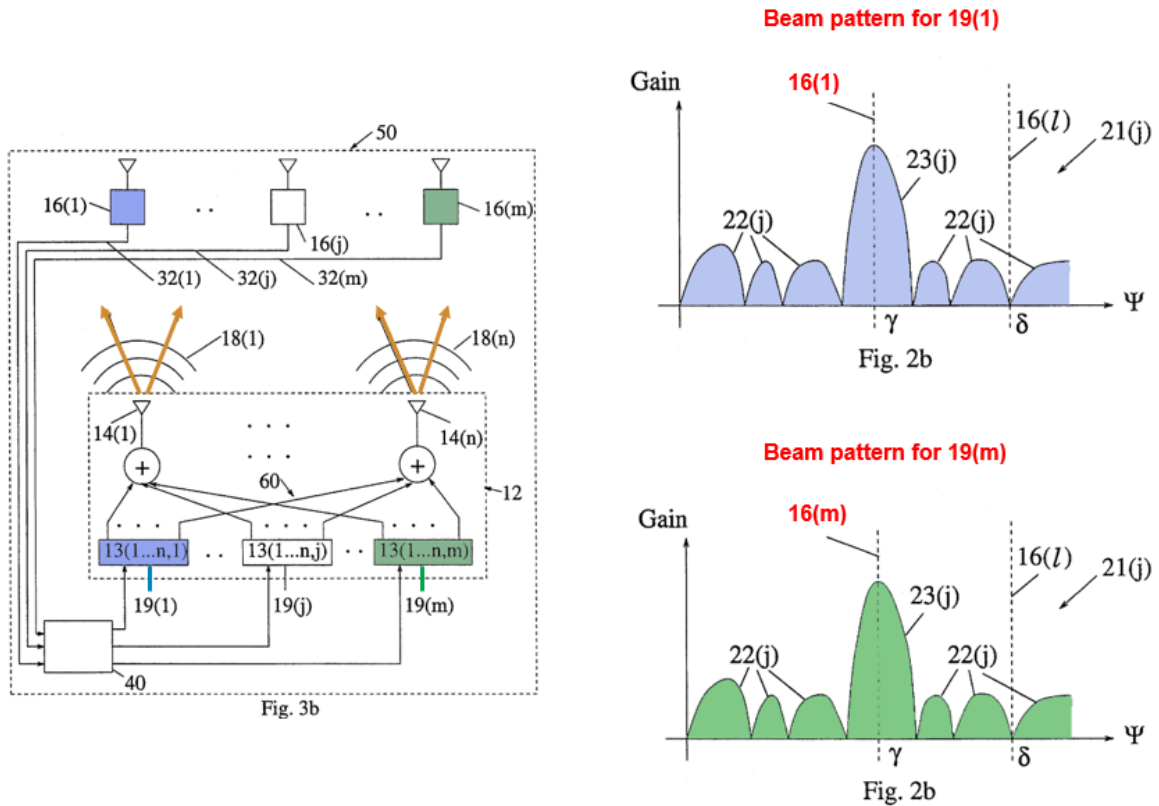
Gerlach, 5:36-39. As highlighted by the side-by-side comparison of Fig. 2a and 2b below, Gerlach's probing/feedback technique places nulls in the direction of non-intended receivers, thereby eliminating (or rendering negligible) signal amplitude at the non-intended receivers. Ding, ¶¶74-75. That is, the generated null beam pattern ideally has no cross-talk. Ding, ¶75; Gerlach, 5:9-10.



Gerlach, Figs. 2a-b (annotated)

Gerlach's probing/feedback technique is integrated with conventional SDMA, described above with respect to Fig. 1. Ding, ¶76; see Sections V.A.1.a, V.A.1.b. For example, weight computer 40 and its associated processing are added to the conventional system. Ding, ¶76. In Gerlach's system, information signal 19(1) is directed to receiver $16(1)$ (shaded blue in Fig. 3b below) and a different information signal $19(m)$ is directed to receiver $16(m)$ (shaded green). Weights for

signal 19(1) are selected for the propagation environment between transmitting array 12 and receiver 16(1) – that is, the column of weight matrix W for receiver 16(1) is provided to transmitting array 12 (e.g., 15(1 ...n,1). Ding, ¶77. The weights for signal 19(m) are similarly selected for the propagation environment between transmitting array 12 and receiver 16(m) – that is, the column of weight matrix W for receiver 16(m) is provided to transmitting array 12 (e.g., 15(1 ...n,m). Ding, ¶78. Information signal 19(1) is applied to elements 14(1)-14(n) with the selected weights highlighted in the blue box and information signal 19(m) is simultaneously applied to elements 14(1)-14(n) with the selected weights highlighted in the green box. *Id.* The components of each weighted information signal are combined at an adder associated with each transmitting element 14 and the resulting signals are transmitted by transmission elements 14. *Id.*



Gerlach, Figs. 3b, 2b (annotated)

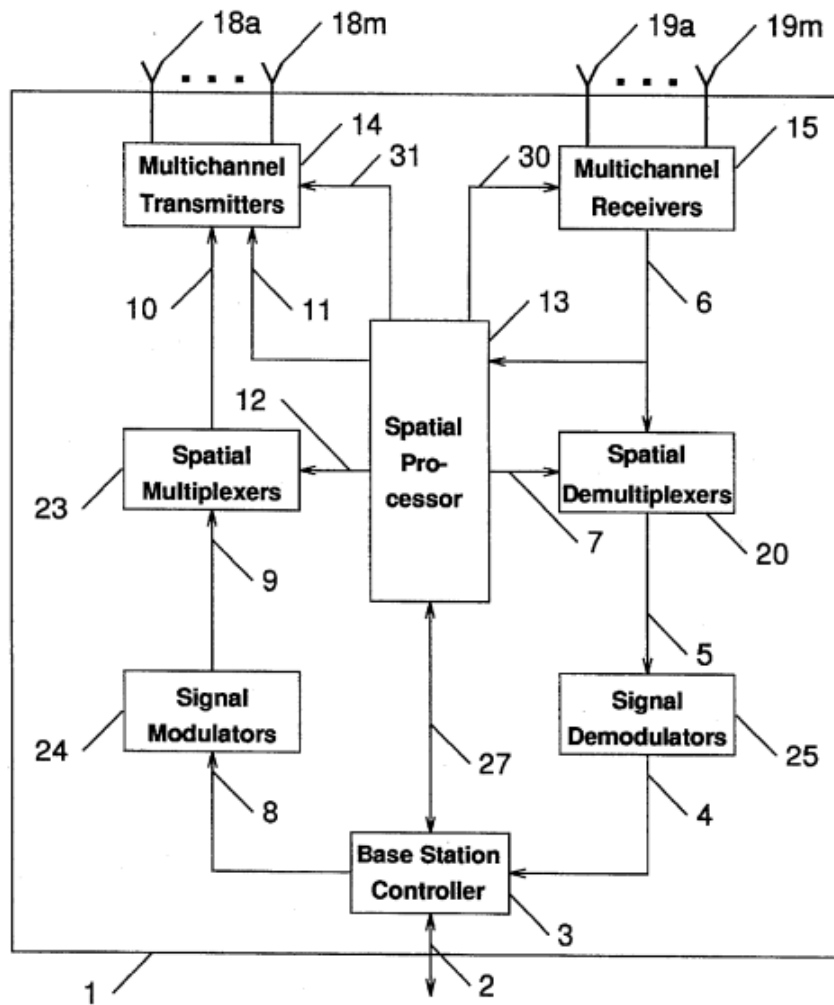
The interaction among the transmitted signals from each element 14 generates an antenna radiation pattern. Gerlach explains that “[e]ach information signal 19 will have its own beampattern 21 generated by interference between transmission signals 18.” Gerlach, 3:20-22. The above figures (at right) annotate Fig. 2b to show “complimentary null beampattern” 21(1) directed to receiver 16(1) carrying information signal 19(1) (top) and “complimentary null beampattern” 21(m) directed to receiver 16(m) carrying information signal 19(m) (bottom).

Ding, ¶79.

Although Gerlach provides conceptual figures illustrating its feedback technique in a wireless system, Gerlach has limited disclosure of the architecture of a network-based wireless apparatus including its transmitting array, and of handling uplink communication between the remote devices and network-based apparatus. Barratt provides these details.

2. Barratt

Barratt relates to “using antenna arrays and signal processing to dramatically increase the capacity and performance of wireless communication systems.” Barratt, 1:15-18. Barratt’s base station, illustrated in Fig. 1 below, includes, on the transmit side, signal modulators 24, spatial multiplexers 23, and multichannel transmitters coupled to transmitting antennas 18a-18n and, on the receive side, multichannel receivers 15 coupled to receive antennas 19a-19n, spatial demultiplexers 20, and signal demodulators 25.



Barratt, Fig. 1

In an embodiment of Barratt, “transmission antennas 18(a, ... , m) and reception antennas 19(a, ... , m) at base station 1 are replaced by a single array of m antennas.” Barratt, 20:30-32. Each antenna element in the array “is attached to both its respective component of multichannel transmitters 14 and its respective component of multichannel receivers 15 by means of a duplexer.” Barratt, 20:32-

35. A POSITA would have been motivated to use a shared antenna array and duplexer to minimize the space and cost taken by the antenna array(s) at a base station which is size constrained and/or to minimize overall base station cost. Ding, ¶82.

For transmission, signal modulators 24 “produce modulated signals 9.” Barratt, 8:60-61. A set of spatial multiplexing weights 12 for each remote terminal is then “applied to the respective modulated signals in spatial multiplexers 23 to produce spatially multiplexed signals to be transmitted 10 for each of the m transmit antennas 18(a, ..., m) and each of the N_{cc} conventional channels.” Barratt, 8:60-67. The “[m]odulated and spatially multiplexed signals 10 are inputs to a bank of m phase coherent multichannel transmitters 14.” Barratt, 9:49-50.

For reception, “[i]ncoming or uplink radio transmissions impinge on an antenna array composed of a number, m , of receive antenna elements 19(a, ... , m) each of whose outputs is connected to one of m multichannel receivers in a bank of phase-coherent multichannel receivers 15.” Barratt, 6:63-67. The multichannel receivers “produce received signal measurements 6 which are supplied to spatial processor 13 and to a set of spatial demultiplexers 20.” Barratt, 7:53-58. The “outputs of spatial demultiplexers 20 are spatially separated uplink signals 5 for each remote terminal communicating with the base station.” Barratt, 8:36-38.

Spatially separated uplink signals 5 are then “demodulated by signal demodulators 25, producing demodulated received signals 4.” Barratt, 8:38-42.

3. Motivation to Combine

A POSITA would have been motivated to combine Barratt’s base station architecture teachings with Gerlach. First, Gerlach describes a wireless system conceptually, but has limited implementation details of a wireless network-based apparatus. A POSITA would have therefore been motivated to find references that provide those details to develop an operational system. Ding, ¶94. A POSITA would have been led to Barratt, which describes a network-based apparatus using spatial multiplexing, but does not describe beamforming. *Id.*

Second, Gerlach provides limited implementation details regarding reception of uplink signals. A POSITA would have therefore been motivated to combine Barratt’s base station architecture teachings with Gerlach to provide techniques for receiving uplink signals. Ding, ¶96. Third, a POSITA would have been motivated to combine Gerlach and Barratt to permit duplexing using a single antenna array, as taught by Barratt. Ding, ¶97. A POSITA would have recognized that use of a single antenna array reduces equipment cost and size of the network-based apparatus. *Id.*

The combination merely combines prior art elements (Gerlach’s feedback

mechanism in an SDMA system and Barratt's base station components) according to known methods to yield predictable results. Ding, ¶98. Gerlach's probing/feedback technique is a software-based process executing, in part, on Gerlach's weight computer, which performs processing equivalent to Barratt's spatial processing. Ding, ¶99. Because Barratt describes how to transmit and receive spatially multiplexed signals using weight patterns, a POSITA would have been able to implement Gerlach's software-based probing/feedback technique which optimizes SDMA beampatterns through adjustable, optimized weights. *Id.* Because the elements of the combined systems perform the same basic functions, the results of the combination would have been predictable to a POSITA. *Id.* For these reasons, a POSITA would have also had a reasonable expectation of success in the combination. *Id.*

B. Independent Claims 1, 12, 22, 32³

The four independent claims have the same basic format – limitations directed to a processor and its functions, limitations directed to a transceiver and its functions, and limitations directed to functions performed in either the processor,

³ A listing of the challenged claims with labels added for ease of discussion is provided in the Appendix.

transceiver, or a smart antenna. Because of the significant overlap among the independent claims, Petitioner addresses them together.

1. Preamble⁴

Gerlach's Figs. 3a and 3b conceptually depict portions of the wireless communication system utilized in Gerlach's probing/feedback technique. Gerlach, 2:39-41. The system includes transmitting array 12 comprising transmitting elements 14(1), 14(2), ... 14(n) and receivers 16(1), 16(2) ... 16(m). *See* Gerlach, 2:44-46. Transmitted signals 18(1) ... 18(n) "are generated at elements 14(1)-14(n), respectively, by applying information signals 19(1)-19(m) to elements 14(1)-14(n) with selected complex amplitudes 15(1,1), 15(1,2) ... 15(n-1,m), 15(n,m)⁵ through connections 60." Gerlach, 2:62-67, 3:51-56.

⁴ Petitioner does not acquiesce that the preamble of any independent claim is limiting.

⁵ Complex amplitudes are identified as 15(1,1)-15(n,m) and 13(1,1)-13(n,m) "merely to distinguish between information transmission and probing modes." Gerlach, 3:51-56.

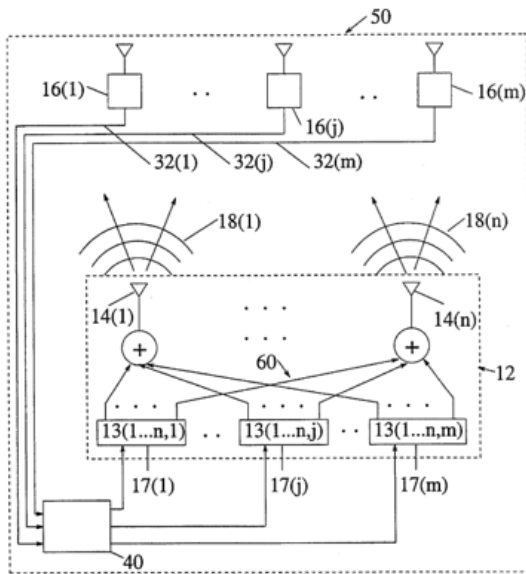


Fig. 3a

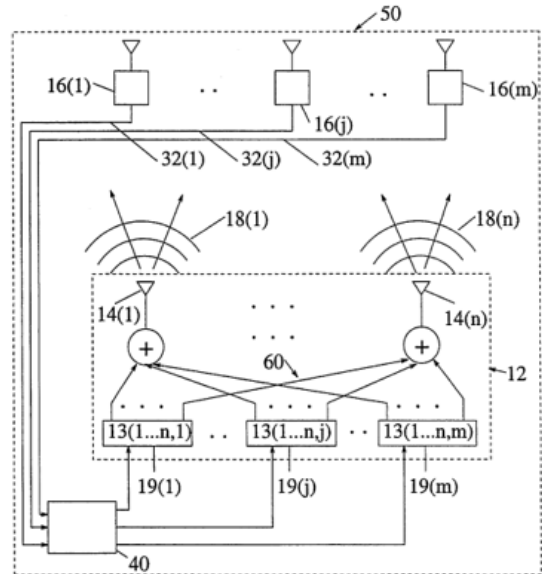


Fig. 3b

Gerlach, Figs. 3a-b

A POSITA would have understood that transmitting array 12 and its associated weight computer 40, shown in Figs. 3a and 3b above, are components of a network-based apparatus such as a base station or access point. Ding, ¶102.

In addition, Barratt describes a “wireless system comprising a network of base stations for receiving uplink signals transmitted from a plurality of remote terminals and for transmitting downlink signals to the plurality of remote terminal.” Barratt, Abstract. A base station is a “*data-communication network apparatus.*” Ding, ¶103.

Thus, the combination of Gerlach and Barratt teaches a “*data-*

*communications networking apparatus*⁶ [1P]/[12P]/[22P]/[32P]. Ding, ¶¶100-104, 184-85, 201.

2. “**Processor**” limitations.

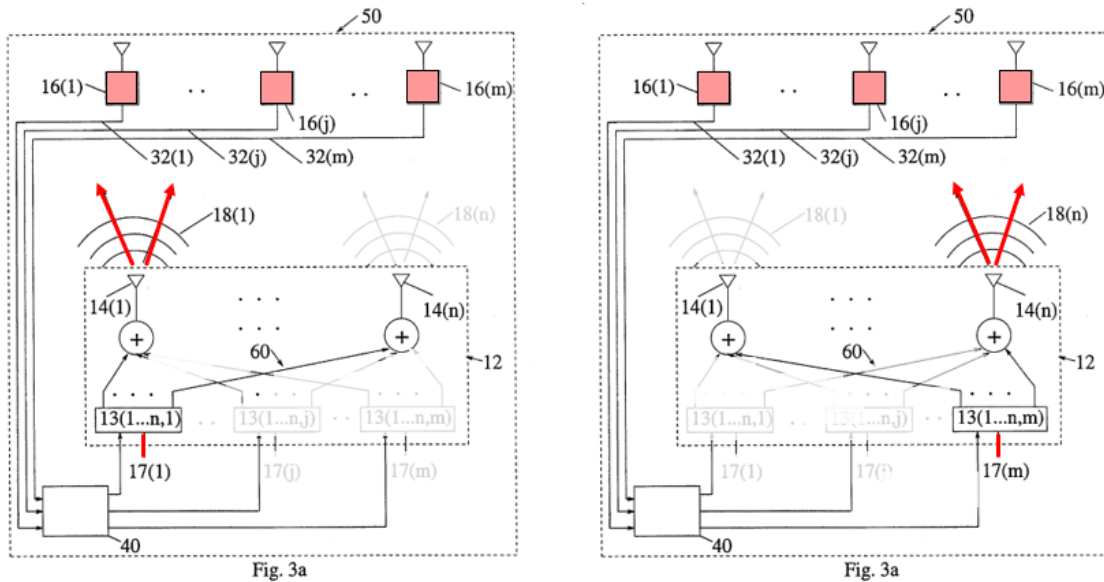
Each claim includes a limitation directed to “*a processor*” and three limitations reciting functions the “*processor is configured to*” perform: “*generat[ing] a probing signal*,” “*generat[ing] a first data stream for transmission*,” and “*generat[ing] a second data stream for transmission*.”

a. “**Probing signal**”

In Gerlach, “each transmitting element 14 of array 12 is successively excited by a single **probing signal** 17” using a probing weight matrix W “having all components zero except for 1s in the diagonal position.” Gerlach, 5:22-30. For example, element 14(1) is first excited by probing signal 17(1) because its associated weight is non-zero and the remaining elements are not excited by probing signal 17(1) because their associated weights are zero. Ding, ¶116; Fig. 3a (below left). Because the resulting antenna pattern is not directed to a single receiver, multiple receivers 16 in communication range of transmitting array 12 (shaded red) receive the transmitted probing signal. Ding, ¶116; Gerlach, 3:43-45

⁶ Challenged claim language is indicated by italics herein.

(“feedback signals 32 originate at receivers 16”). Each receiver 16 receiving the probing signal returns a feedback signal 32 to the wireless communication system. See Gerlach, 3:43-46; Ding, ¶116. This process is repeated for each element 14(i) of the antenna array. See Gerlach, 3:27-29; Ding, ¶116. Annotated Figure 3a below right illustrates the process for probing signal 17(m) and the final transmitting element 14(m)⁷ of the array.



Gerlach, Figure 3a (annotated to show probing signals 17(1) at left and 17(m) at right)

⁷ Because Gerlach assumes a square matrix (having 1s in the diagonal position), a POSITA would have understood that “m” equals “n” in Figure 3a. Ding, ¶116.

Thus, Gerlach's wireless system transmits the same "*probing signal*" (e.g., 17(1)) to "*at least a first client device and a second client device*" (e.g., 16(1)-16(m)) [1A(i)]/[12A(i)]/[22A(i)]/[32A(i)]. Ding, ¶¶116-17, 184-85, 201.

b. First and Second "*Data Stream*" limitations.

In a wireless communications system using spatial multiplexing techniques such as Gerlach, "a single transmitter simultaneously emits multiple information signals, each of which is intended for one of a number of spatially separated receivers." Gerlach, 1:13-16. For example, in the conventional system shown in Gerlach's Fig. 1, "[i]nformation signals 19(1), 19(2) ... 19(m) excite transmitting elements 14(1)-14(n) collectively, giving rise to transmission signals 18 which are detected by receivers 16(1)-16(m), respectively." Gerlach, 2:47-50. More specifically, information signals 19(1)-19(m) are applied "to elements 14(1)-14(n) with selected complex amplitudes 15(1,1), 15(1,2) ... 15(n-1,m) through connections 60." Gerlach, 2:62-67.

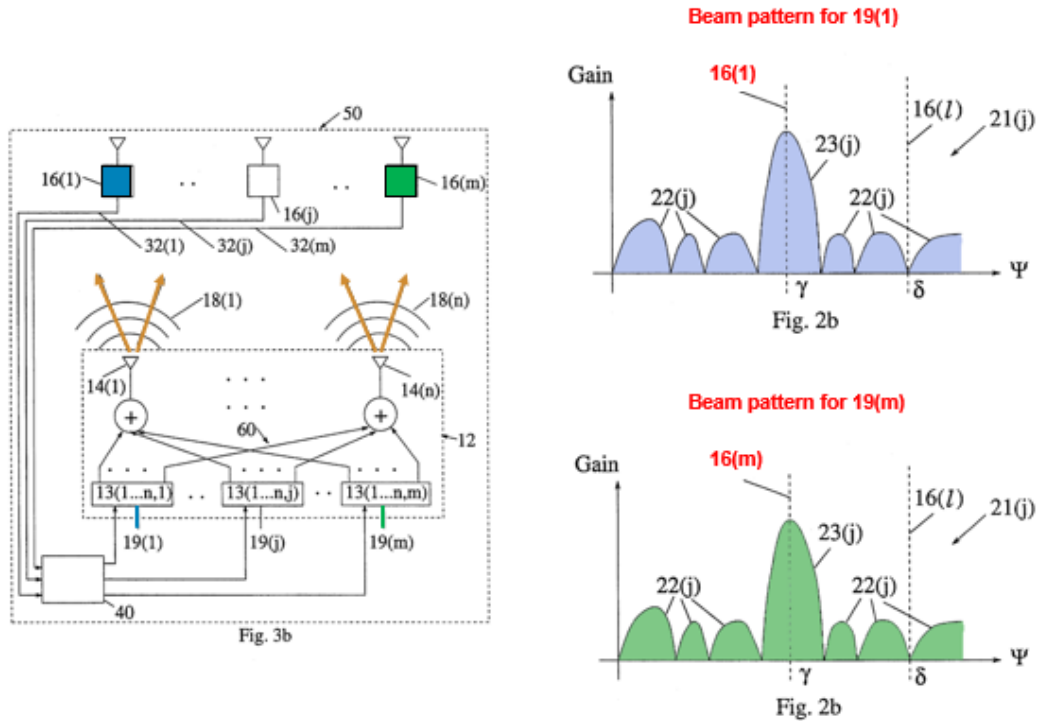
This conventional multi-user spatial multiplexing is used with Gerlach's probing/feedback technique which modifies the weights (complex amplitudes) applied to each information signal, as illustrated in Fig. 3b below left.⁸ Ding, ¶121;

⁸ Although illustrating a feedback embodiment, a POSITA would have understood

see Section V.A.1. As shown in annotated Fig. 3b, information signal 19(1) is directed to receiver 16(1) (shaded blue) and information signal 19(m) is directed to receiver 16(m) (shaded green). Weights for signal 19(1) are selected for the propagation environment between the transmitting array and receiver 16(1) and weights for signal 19(m) are selected for the propagation environment between the transmitting array and receiver 16(m). Ding, ¶121. Information signal 19(1) is applied to elements 14(1)-14(n) with selected weights 15(1,1) used in the highlighted blue box and information signal 19(m) is simultaneously applied to elements 14(1)-14(n) with selected weights 15(1...n,m) used in the highlighted green box. *Id.* The components of each weighted information signal are combined at an adder associated with each transmitting element 14. *Id.* The resulting transmitted signals from each element 14 generate a beampattern directed to 16(1) carrying information signal 19(1) with nulls directed to the other receivers and a

that Gerlach's Fig. 3b system also transmits information signals without feedback using weights 15 instead of weights 13. Ding, ¶121 n.3; see Gerlach, 3:51-56 (discussing use of amplitudes 15 for information signals and amplitudes 13 for probing signals), 5:9-10 (discussing transmitting information signals using weight matrix, W\$).

beam pattern directed to 16(m) carrying information signal 19(m) with nulls directed to other receivers. Ding, ¶122.



Gerlach, Figs. 3b, 2b (annotated)

Thus, Gerlach discloses or suggests “a first data stream [e.g., 19(1)] for transmission to the first client device [e.g., 16(1)]” and “a second data stream [e.g., 19(m)] for transmission to the second client device [16(m)]” [1A(ii)]/[1A(iii)]/[12A(ii)]/[12A(iii)]/[22A(ii)]/[22A(iii)]/[32A(ii)]/[32A(iii)].

Ding, ¶¶118-123, 184-85, 201.

c. ***“Processor configured to: generate” a probing signal, a first data stream, and a second data stream.***

Although Gerlach teaches that the transmitting array receives both probing signals 17 and information signals 19 for transmission, Gerlach does not explicitly describe the component that generates these signals. However, a POSITA would have understood that Gerlach’s system includes a processor for generating probing signals and information signals or that it would have been obvious to utilize a processor in this manner. Ding, ¶¶105-106.

In an RF system, data (bits) to be transmitted must be converted to a signal (e.g., a baseband signal (symbols)) that can be used to modulate a carrier for transmission. Ding, ¶107. A POSITA therefore would have understood that probing signals 17 and information signals 19, provided as input to Gerlach’s transmitting array 12, are baseband modulated symbols to be multiplied with complex weights 13 and 15, respectively. *Id.*; EX-1001, 3:51-56. Prior to 2002, it was well-known to a POSITA that baseband modulation (i.e., bit to symbol mapping) techniques, particularly those used for wireless communication—like quadrature amplitude modulation (QAM)—were performed in software. Ding, ¶107, *citing* EX-1029, ¶10; EX-1030, ¶¶14, 325; EX-1010, 2:37-3:17; EX-1011, 27:60-64, 28:25-28. Moreover, processors capable of performing signal encoding and baseband modulation were widely available by 2002. Ding, ¶107, *citing* EX-

1025, 1; EX-1027, 1; EX-1028, 1; EX-1031, 11:27-33.

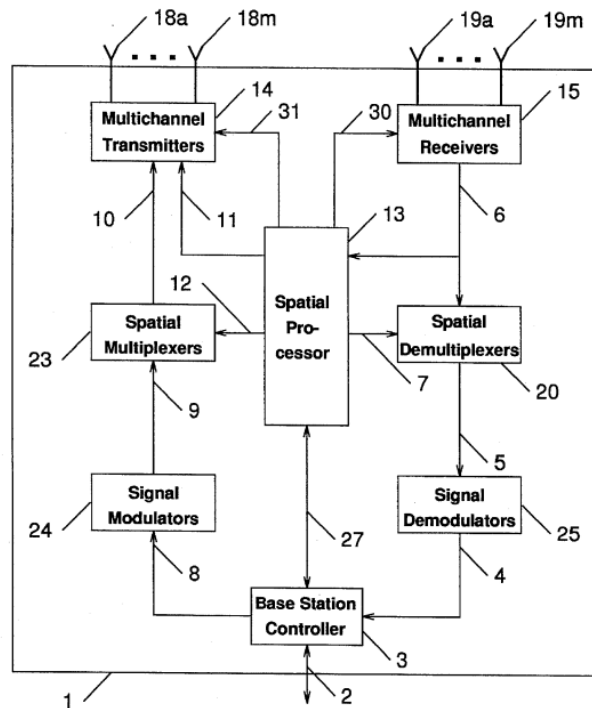
Based on the knowledge of the art at the time, a POSITA would have understood that Gerlach inherently teaches or at a minimum suggests a processor in the network-based apparatus for modulating a data signal onto a carrier to generate a modulated signal. Ding, ¶108. Indeed, Gerlach discloses the usefulness of processors in its network-based apparatus inasmuch as it discloses a weight computer 40 at its centralized apparatus that processes received feedback signals. Gerlach, 3:45-47 (“Feedback signals 32 are conveyed to weight computer 40 in array 12 **for processing.**”). A POSITA would have been motivated to also use a processor—whether the same processor that implements the weight computer or one or more additional processors—to execute software for generating modulating signals because doing so would have obviated the need for specialized hardware and would have simplified the design and development of the network-based apparatus. Ding, ¶108.

Barratt also discloses or suggests “*a processor.*” Barratt’s base station includes a “base station controller 3 [that] acts as an interface between base station i and any external connection via a base station communication link 2, and serves to coordinate the overall operation of base station 1.” Barratt, 6:55-59, Fig. 1 (below). The base station controller 3 “is implemented with a conventional central

processing unit and associated memory and programming.” Barratt, 6:59-62.

Barratt’s base station further includes “signal modulators 24 [that] produce modulated signals 9” and signal demodulators 25. Barratt, 8:60-67. For the reasons discussed above, a POSITA would have found it obvious to implement Barratt’s signal modulators 24 via software executed on a processor—whether using the same CPU as the base station controller or a different one or more additional processors. Ding, ¶111. A POSITA would have found it obvious to incorporate Barratt’s modulators/processor(s) in Gerlach to generate the probing and first/second information signals for the reasons discussed in Section V.B.2.c.

Ding, ¶112.



Barratt, Fig. 1

Accordingly, Gerlach alone or in combination with Barratt teaches “a processor” [1A]/[12A]/[22A]/[32A] configured to “generate a probing signal [e.g., probing signal 17(1)] for transmission to at least a first client device and a second client device” [1A(i)]/[12A(i)]/[22A(i)]/[32A(i)], “generate a first data stream [e.g., information signal 19(1)] for transmission to the first client device” [1A(ii)]/[12A(ii)]/[22A(ii)]/[32A(ii)] and “generate a second data stream [e.g., information signal 19(m)] for transmission to the second client device” [1A(iii)]/[12A(iii)]/[22A(iii)]/[32A(iii)]. Ding, ¶¶105-23, 184-85, 201.

3. “*Transceiver*” limitations.

Each independent claim includes two structural “*transceiver*” limitations (“*transceiver operatively coupled to the processor*” and “*smart antenna [] operatively coupled to the transceiver*”⁹) and a limitation directed to function the transceiver is configured to perform: “*transmit the probing signal to at least the first client device and the second client device via a smart antenna.*”

a. “**Transceiver**”

A “transceiver” is a device that operates to both transmit and receive signals. Ding, ¶124. This understanding of the plain meaning of the term “transceiver” is consistent with the ’376 patent which repeatedly equates “transceive”¹⁰ to “transmit and/or receive.” See EX-1001, 5:5-9 (“[t]he multi-beam directed signal system 206 can **transmit and/or receive (i.e., transceive)** information ... via the antenna assembly 208.”); 5:9-12 (“[W]ireless communication(s) are **transmitted and/or received from (i.e., transceived** with respect to) a remote client device.”).

⁹ Claims 1 and 12 further require that the “*smart antenna*” comprises “*a first antenna element and a second antenna element.*”

¹⁰ The ’376 patent does not use the term “transceiver,” but discloses a separate transmitter and receiver in the same device. EX-1001, 11:13-18, Fig. 8B.

Gerlach's Figures do not explicitly show a transmitter or receiver. However, it would have been obvious to a POSITA that Gerlach's network-based apparatus includes a transmitter and receiver ("*transceiver*"). As discussed in Section V.B.2, Gerlach's network-based apparatus transmits both probing signals and information signals. Specifically, information signals 19 and probing signals 17 excite transmitting elements 14 "giving rise to transmission signals 18." Gerlach, 2:44-49, 3:51-53, Fig. 3a. The transmitting elements 14 in Gerlach's network-based apparatus therefore each must include a transmitter to effectuate the transmission of signals 18 to the remote devices. Ding, ¶126. In addition, "[f]eedback signals 32 originate at receivers 16 in response to probing signals 17" and "are conveyed to weight computer 40 in array 12 for processing." Gerlach, 3:43-48. Fig. 3a of Gerlach illustrates feedback signals being received directly at the weight computer of the network-based device. Although not explicitly depicted, a POSITA would have understood that the feedback signals from the remote devices are transmitted wirelessly and necessarily received by receiving elements at the network-based apparatus before being provided to the weight computer. Ding, ¶126. Therefore, Gerlach's network-based device also includes a receiver. *Id.*.

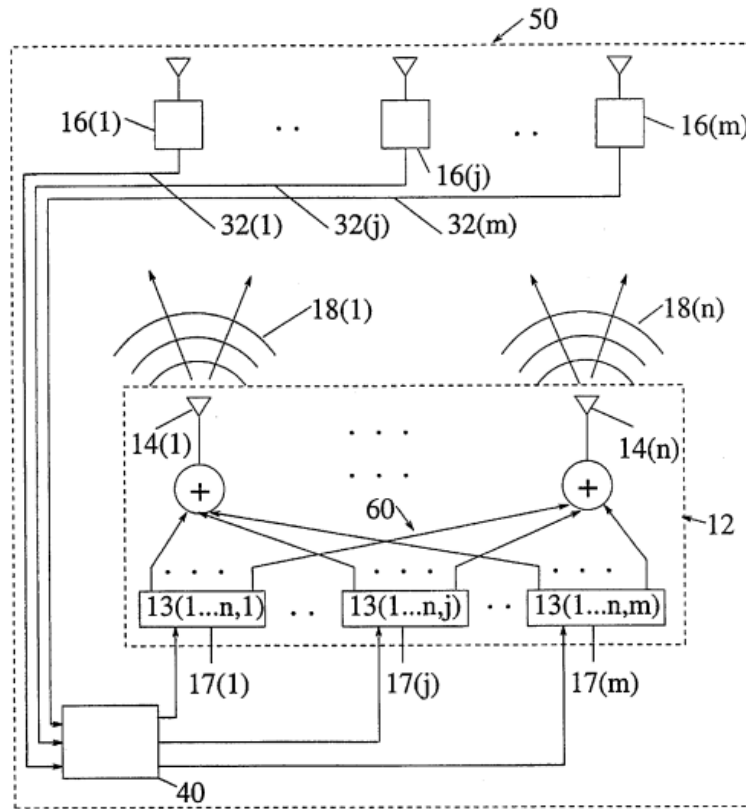
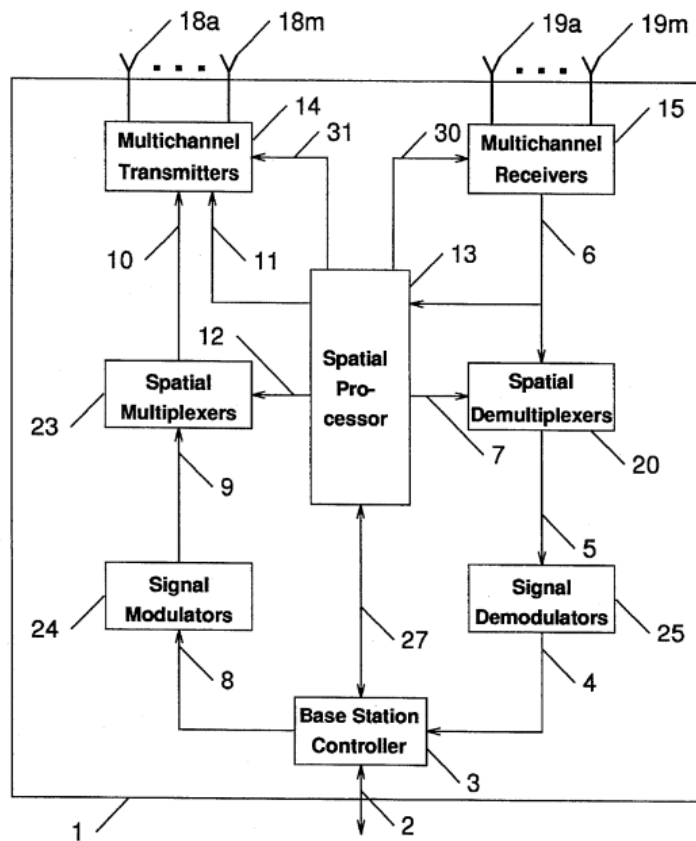


Fig. 3a

Gerlach, Fig. 3a

Barrett explicitly discloses a “*transceiver*.” Ding, ¶127. Barratt’s base station includes multichannel transmitters 14 coupled between transmission antenna elements 18a-18n and spatial multiplexers 23 and also includes multichannel receivers 15 coupled between reception antenna elements 19a-19m. See Barratt, Fig. 1. During transmission, “signal modulators 24 produce modulated signals 9” and during reception, signal demodulators 25 demodulate spatially separated uplink signals 5 from the spatial multiplexers. Barratt, 8:38-42, 8:60-67.

As discussed in Section V.B.2.c, a POSITA would have found it obvious to include signal modulators 24 and demodulators 25 in a “processor.” As illustrated in Barratt’s Fig. 1 (below), multichannel transmitters 14 and multichannel receivers 15 are “operatively coupled to” modulators 24 and demodulators 25 (collectively the “processor”). Ding, ¶127.



Barratt, Fig. 1

A POSITA would have found it obvious to use Barratt’s transceiver to

implement Gerlach's transmit and receive functions for the reasons discussed in Section V.A.3, and also because doing so would have amounted to use of a known technique (Barratt's transceiver) to improve similar devices (Gerlach's network-based apparatus) in the same way (using a transceiver to effectuate Gerlach's transmit and receive functionality). The combination of Gerlach and Barratt, therefore, teaches "*a transceiver operatively coupled to the processor*" [1B]/[12B]/[22B]/[32B]. Ding, ¶¶124-29, 184-185, 201.

Should PO contend that a transceiver requires the transmitter and receiver to share components, the combination of Gerlach and Barratt also teaches the limitation under this overly narrow interpretation. As discussed in Section V.A.2, the transmission and reception elements in Barratt "are replaced by a single array of *m* antennas" where "[e]ach element in this array is attached to both its respective component of multichannel transmitters 14 and its respective component of multichannel receivers 15 **by means of a duplexer.**" Barratt, 20:30-35. Therefore, the transmitters and receivers in the combination of Gerlach and Barratt share at least an antenna array and a duplexer. Ding, ¶130.

b. "Smart antenna"

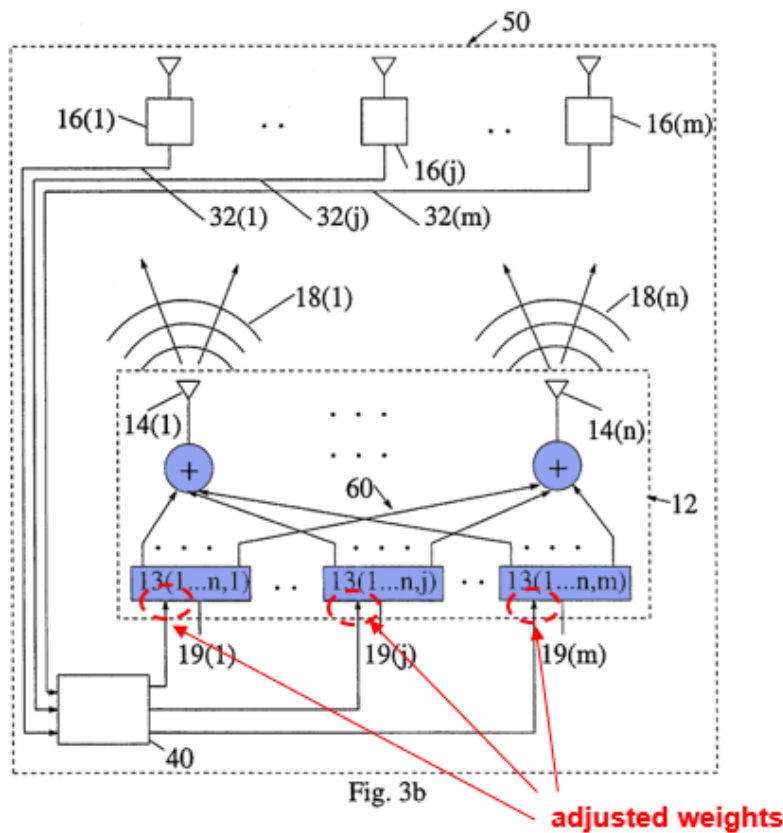
Gerlach's system includes a "transmitting **antenna** array 12" having transmission elements 14(1), 14(2), ... 14(n). See Gerlach, 1:6-9 ("[M]ethods for

multiplexing signals transmitted from **an antenna array** to multiple receivers.”), 2:44-46, Fig. 3b. Gerlach illustrates transmitting elements 14 as including an antenna symbol (inverted triangle) and refers to transmitting elements as “antenna elements.” See Gerlach, Figs. 1, 3a-b, 4:14-17. Barratt also discloses an “array of m antennas” where “[e]ach element in this array is attached to both its respective component of multichannel receivers 15 by means of a duplexer.” Barratt, 20:30-35. The combination of Gerlach and Barratt teaches an antenna array having “*a first antenna element and a second antenna element.*” Ding, ¶134

Gerlach’s transmitting antenna array 12 includes a “*smart antenna.*” Ding, ¶136. In Gerlach, “transmitted signals 18(1) ... 18(n) are generated at elements 14(1)-14(n), respectively, by applying information signals 19(1)-19(m) to elements 14(1)-14(n) with selected complex amplitudes 15(1,1), 15(1,2) ... 15($n-1,m$), 15(n,m) through connections 60.” Gerlach, 2:62-67. These “complex amplitudes 15 form the elements of a $n \times m$ weight matrix W .” Gerlach, 2:67-3:1.

Gerlach’s system “extract[s] information about the propagation environment from feedback signals 32 generated by transmission of selected probing signals 17.” Gerlach, 5:4-8. The information conveyed by these feedback signals 32 is used to determine a new weight matrix W' . Gerlach, 5:8-10. The complex amplitudes making up weight matrix W' (e.g., 15(1... n ,1)-15(1- n , m)) are then

provided by weight computer 40 (as illustrated in Figure 3b below) to transmitting array 12. See Gerlach, Fig. 3b, 3:49-63. The beam pattern created by applying elements of weight matrix W to an information signal “has a primary lobe 23(j) with unit gain at angle θ_j , in the direction of intended receiver 16(j), and side lobes 22(j) with nulls in the direction of all remaining receivers 16(l) where $l \neq j$.” Gerlach, 3:35-39. That is, the beam pattern is “directed” to receiver 16(j).



Gerlach, Fig. 3b (annotated)

Gerlach recognizes that “changes in the location of receivers 16 or changes in the scattering environment will necessitate periodic reoptimization of complex amplitudes 15 comprising weight matrix W .” Gerlach, 3:14-17. For example, Gerlach “monitor[s] cross-talk during transmission of information signals 19” and initiates a “redetermination of weight matrix W ” whenever crosstalk increases above a preselected level” or, alternatively, “weight matrix W can be reoptimized at regular intervals.” Gerlach, 6:27-32. With either technique, Gerlach’s methods “determine the weight matrix W that generates complimentary null beampatterns for all signals 19.” Gerlach, 6:32-35. The updated weight values are provided to the transmitting antenna array 12 and applied to subsequent transmissions of information signals. Ding, ¶138.

Thus, weight computer 40 adjusts the weights (complex amplitudes) used in transmitting array 12 (e.g., parameters used in the blue boxes) which in turn cause the adjustment of the beampattern generated by the transmitting array. Ding, ¶139. For example, the direction of the main lobe and nulls of the beam can be altered based on the intended recipient and current status of the propagation environment. *Id.* Indeed, Gerlach’s method “us[es] feedback to optimize the directional properties.” Gerlach, 1:48-51. Accordingly, weight computer 40, components of transmitting array 12 (shaded blue in Fig. 3b) and the antenna array collectively

comprise “*smart antenna*” because these components allow the directed beam pattern to be adjusted. Ding, ¶139.

Should PO argue that the term “smart antenna” should be construed to be an “antenna that transmits directed beams,”¹¹ Gerlach’s transmitting array 12 generates a null beam pattern directed to the intended recipient device. Gerlach, 3:35-39.

As illustrated in Gerlach’s Fig. 3b, the antenna elements, components of transmission array that adjust the generated beam pattern, and the weight computer (collectively the “*smart antenna*”) are coupled to the transmitter and receiver (“*transceiver*”). Ding, ¶141. Indeed, for transmitting array 12 to operate as intended (i.e., transmit signals), the “*smart antenna*” must be operatively coupled to transmitters (part of the “*transceiver*”). *Id.*

Accordingly, the combination of Gerlach and Barratt teaches “*the smart antenna is operatively coupled to the transceiver and comprises a first antenna element and a second antenna element*” [1B(ii)]/[12B(ii)] and “*the smart antenna is operatively coupled to the transceiver*” [22B(ii)]/[32B(ii)]. Ding, ¶¶134-42, 184-

¹¹ In a co-pending district court litigation involving related U.S. Patent 7,062,296, PO advanced this interpretation. EX-1012, 20.

85, 201.

c. “Transmit the probing signal”

As discussed in Section V.B.2.a, Gerlach discloses transmission of a probing signal “*to at least a first client device and a second client device.*”

Gerlach further teaches that the probing signal is transmitted “*via a smart antenna.*” Ding, ¶132. As discussed in Section V.B.2.a, “each transmitting element 14 of array 12 is successively excited by a single probing signal 17” using a probing weight matrix W. Gerlach, 5:27-30. Probing weight matrix W is provided by weight computer 40 to elements of Gerlach’s “*smart antenna*” (shaded blue in Fig. 3a below) and applied to the probing signal. The resulting signal 18 is transmitted via the transmitting elements 14 which include the recited “*transceiver*” and through the antenna array which is part of the “*smart antenna.*” Ding, ¶132; *see* Section V.B.3.b.

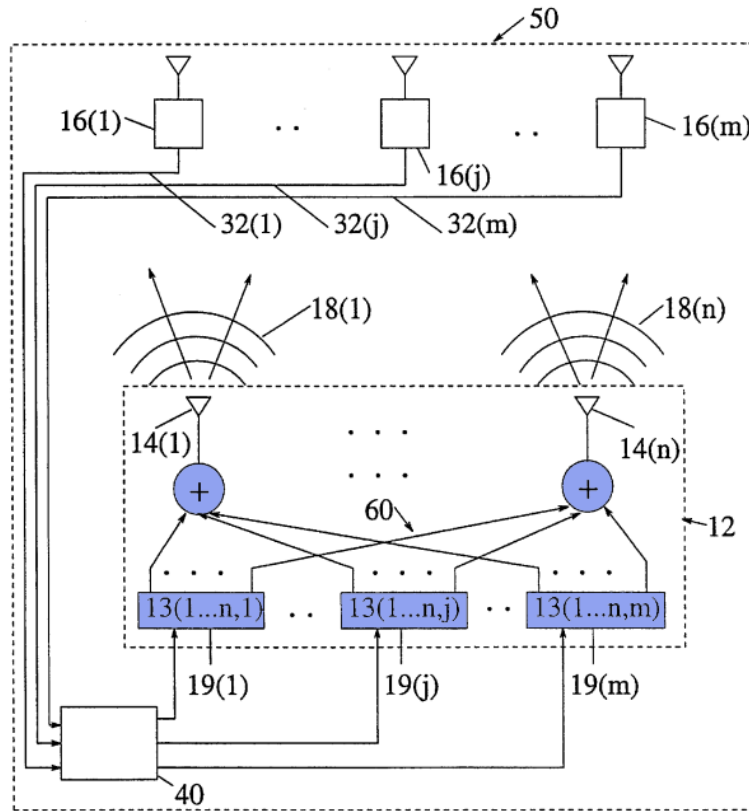


Fig. 3b

Gerlach, Fig. 3a (annotated)

Accordingly, the combination of Gerlach and Barratt teaches the
“transceiver ... configured to: transmit the probing signal to at least the first client device and the second client device via a smart antenna”

[1B(i)]/[12B(i)]/[22B(i)]/[32B(i)]. Ding, ¶¶131-33, 184-85, 201.

4. “Memory” limitations.

Claim 32 recites a *“memory operatively coupled to one or more of the processor or the transceiver”* [32C(i)] and *“a routing table is stored in the*

memory” [32C(ii)]. Independent claims 1, 12, and 22 do not include these limitations.

The ’376 patent describes that “[t]he routing table(s) or similar data structure(s) provide an information basis for each routing decision within the wireless communication system (e.g., multi-beam directed signal system 206).” EX-1001, 15:59-62. The ’376 patent’s routing table includes “identifiers of the desired sources” and “stored weighting values (w) each associated with a particular signal source.” *Id.*, 24:45-49.

Gerlach’s weight matrix, W , is a “*routing table*” because it provides the informational basis for directing a beampattern carrying an information signal to an intended destination (i.e., routing the information signal). Ding, ¶203. As described in Section V.A.1 above and V.B.5 below, Gerlach’s system uses the “[i]nformation conveyed by feedback signals 32” to determine a new weight matrix, W , for application during information signal transmission. Gerlach, 5:8-10. The weight computer provides the appropriate elements of the weight array to components in the transmitting array, based on the information signals to be transmitted and the intended reception. Ding, ¶203; Fig. 3b (below). For example, for information signal 19(1) destined for receiver 16(1), the weight computer provides the weight array column associated with receiver 16(1) (i.e., 15(1 ...n,1) (provided to box

shaded blue)) and for information signal 19(m) destined for receiver 16(m), the weight computer provides the weight array column associated with receiver 16(m) (i.e., 15(1 ..., n,m) (provided to box shaded green)).¹² Using these adjusted weight matrix values, transmitting array 12 “generate[s] a complimentary null beam pattern.” Gerlach, 5:20-22. That is, Gerlach’s system “routes” the directed beam carrying information signal 19(1) to receiver 16(1) and the directed beam carrying information signal 19(m) to receiver 16(m). Ding, ¶203.

¹² Although Figure 3b refers to complex amplitudes as 13(1 ...,n,1) to 13(11 ... n,m), a POSITA would have understood that when referring to information transmission Gerlach designates complex amplitudes as 15(1 ...,n,1) to 15(11 ...n,m). Gerlach, 3:51-56.

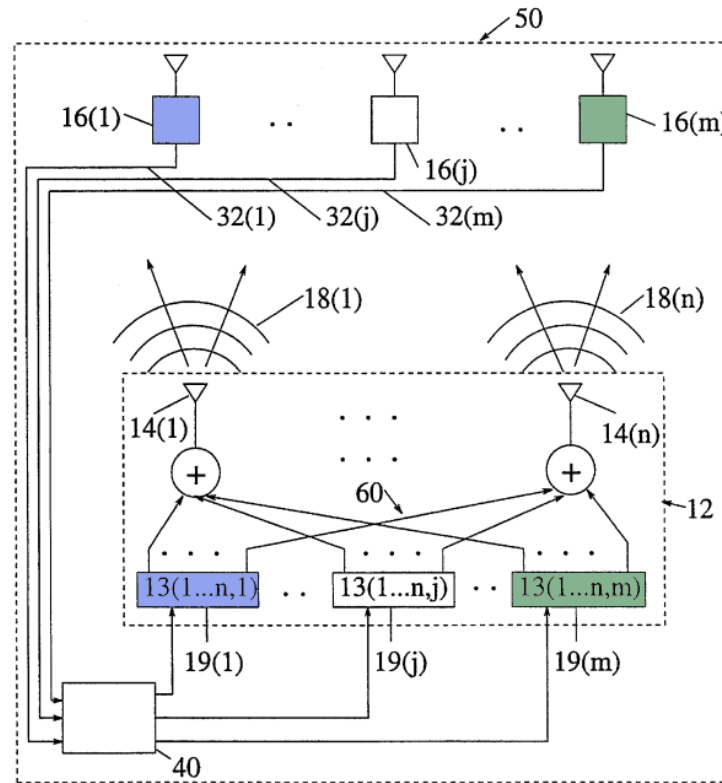


Fig. 3b

Gerlach, Fig. 3b (annotated)

Although Gerlach does not explicitly mention the use of a memory, a POSITA would have understood one would be necessary, or at least obvious, to include in Gerlach's system to store the data including weight matrix W needed to direct transmissions in Gerlach's system. Such a memory would have operated in tandem with the processor to store/retrieve data from memory, and the transceiver to make use of the data stored in memory in directing transmissions. Ding, ¶204. Barratt explicitly discloses that its network-based apparatus (base station 1) has "a

conventional central processing unit and associated **memory** and programming.”

Barratt, 6:59-62.

A POSITA would have found it obvious to incorporate Barratt’s memory into Gerlach to store the weight matrix W for the reasons discussed in Section V.A.3, and also because doing so would have amounted to no more than use of a known technique (Barratt’s memory) to improve similar devices (Gerlach’s network-based apparatus) in the same way (using a memory to store Gerlach’s weight matrix W). Thus, the combination of Gerlach and Barratt discloses or suggests “*a memory operatively coupled to one or more of the processor or the transceiver; wherein a routing table is stored in the memory*” [32C]. Ding, ¶¶201-06.

5. “Feedback information” limitations

Each of the independent claims recites a set of three “*feedback*” functions that “*one or more of the processor, the transceiver, or the smart antenna is [] configured to*” perform and claims 22 and 32 further recite the content of the first and second “*feedback information*.”

a. Transmission/Propagation environment.

i. Transmission functions/gain.

“Signal transmission between each element 14(1)-14(n) and each receiver

16(1)-16(m) is characterized by a transmission function or gain, comprising an amplitude and phase factor.” Gerlach, 3:64-67. The amplitude and phase factor are typically expressed as a complex amplitude at baseband:

$$a_{kj} = |a_{kj}| e^{j\phi_{kj}} \quad (\text{Eq. I})$$

“where a_{kj} is the transmission factor between array element 14(k) and receiver 16(j), and $|a_{kj}|$ and ϕ_{kj} are the corresponding amplitude and phase.” Gerlach, 3:67-4:6; Ding, ¶144. The transmission functions a_{kj} for each array-element/receiver pair “are conveniently represented as the matrix elements of an n by m gain matrix, A , where n is the number of antenna elements 14 and m is the number of receivers 16.” Gerlach, 4:14-17. For example, “the j^{th} column of A contains transfer functions between receiver 16(j) and transmission elements 14(1)-14(n).” Gerlach, 4:18-20.

ii. Properties of a received signal at a receiver.

The amplitude of a received information signal at an individual receiver (e.g., receiver 16(1)) due to all transmitting elements 14 is given by the following equation:

$$r_i = \sum_k c_{ki} a_{ki} \quad (\text{Eq. III})$$

See Gerlach, 4:44-47. In this equation, c_{ji} “is the amplitude of information signal 19(j) at receiver 16(i) and the summation is over all transmitting elements 14(1)-

14(n).” Gerlach, 4:48-50. The c_{ji} “taken together form elements of a signal matrix C.” Gerlach, 4:54-55.

The transmission properties for the wireless system are summarized with the following equation:

$$W^H(A - C) \quad (\text{Eq. IV})$$

Gerlach, 4:56-59. In this equation, A is the gain matrix which “characterizes the geometric properties of wireless system 50.” Gerlach, 4:17-18. And “ W^H is the Hermitian conjugate of the weight matrix W according to which information signals 19 or probing signals 17 are applied to transmitting elements 14, and C is the matrix representation of the resulting probing signals 17 or information 19 at receivers 16.” Gerlach, 4:60-64.

In Gerlach, “[f]or a given gain matrix A, a new weight matrix W\$ can be found that eliminates the off-diagonal elements of signal matrix C.” Gerlach, 4:64-66. In the signal matrix, for $i=j$, “ c_{ji} represents the amplitude of information signal 19(j) at its intended receiver 16(j), while for $(i \neq j)$ c_{ji} represents cross-talk due to information signal 19(j) at the receiver 16(i).” Gerlach, 4:50-53. The off-diagonal components therefore represent “cross-talk” i.e., non-zero amplitude of an information signal not intended for the recipient. Ding, ¶148. Gerlach’s system makes these elements zero, thereby eliminating the element of the signal matrix.

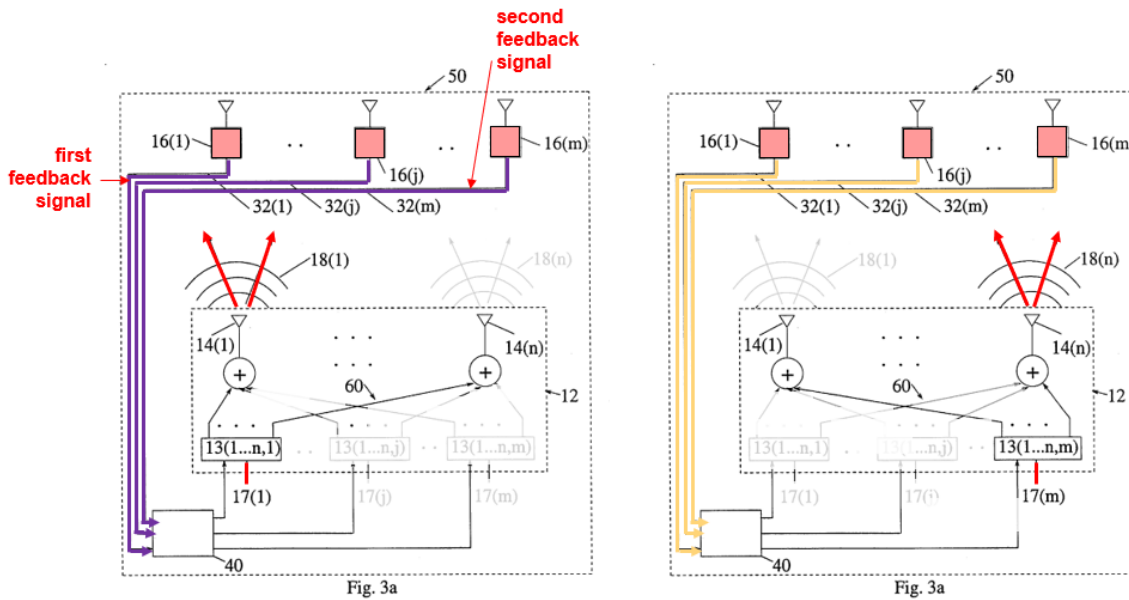
Id. Equation IV above therefore becomes:

$$W \cdot (A - I) \quad (\text{Eq. V})$$

“where, I is the identity matrix.” Gerlach, 4:67-5:3. A POSITA would have understood that this calculation requires each column of W to be matched with a column A (i.e., the column index of W matches the receiver providing feedback for the column). Ding, ¶148.

b. “Receive a [first/second] feedback information” limitations.

Gerlach’s system “facilitates diagonalization of signal matrix C by **extracting information about the propagation environment from feedback signals 32** generated by transmission of selected probing signals 17 in accordance with weight matrices W.” Gerlach, 5:4-8. The information extracted from each feedback signal is “*feedback information*.” Ding, ¶149. Specifically, as illustrated in Fig. 3a below, “each transmitting element 14 of array 12 is successively excited by a single probing signal 17, and the **response at all receivers is measured and fed back for each excitation**.” Gerlach, 5:27-30. Each transmission of a probing signal results in feedback signals from each client device in communication range of the transmitting array. Ding, ¶150. That is, probing signal 17(1) causes generation of first and second feedback signals (at left) and probing signal 17(m) causes generation of first and second feedback signals (at right). Ding, ¶¶150-151.



Gerlach, Figure 3a (annotated to show a first probing signal 17(1) and associated feedback at left and a second probing signal 17(m) and associated feedback at right)

Thus, the combination of Gerlach and Barratt teaches “*receiv[ing] a first feedback information [e.g., information in feedback signal 32(1)] from the first client device [e.g., 16(1)] in response to the transmission of the probing signal [e.g., probing signal 17(1)]*” and “*receiv[ing] a second feedback information [e.g., information in feedback signal 32(m)] from the second client device [e.g., 16(m)] in response to the transmission of the probing signal [e.g., probing signal 17(1)]*” [1C(i)] and [1C(ii)]. Ding, ¶¶143-151.

The combination of Gerlach and Barratt also teaches “*receiv[ing] a first feedback information from the first client device*” and “*receiv[ing] a second*”

feedback information from the second client device”

[12C(i)]/[22C(i)(a)]/[32D(i)(a)] and [12C(ii)]/[22C(ii)(a)]/[32D(ii)(a)]. *Id.*; *see id.*, ¶¶184-85, 201.

The received feedback signals 32 “are conveyed to weight computer 40 in array 12 for processing.” Gerlach, 3:45-47. Although not explicitly depicted in Gerlach’s Fig. 3a, a POSITA would have understood that the feedback signals are necessarily received by a receiver and provided to the weight computer after appropriate signal processing. Ding, ¶153. Barratt explicitly discloses receivers and the general process of receiving an uplink signal at the base station’s antenna array. *See* Section V.A.2; Barratt, 6:63-67, 7:53-58. Accordingly, in the combination of Gerlach and Barratt, each of the feedback signals is received by “*the transceiver*” and the “*smart antenna.*” Ding, ¶153.

In addition, a POSITA would have understood that a received signal must be demodulated before the information carried in the signal is useable by a processor. Ding, ¶154. Moreover, as discussed in Section V.B.2.c, a POSITA would have been motivated to use a processor for signal modulation and demodulation as well as for the weight computer processes. *Id.* Because the feedback information is demodulated and provided to the weight computer, the “*processor*” in the

combination of Gerlach and Barratt also receives the feedback information. *Id.*

Thus, the combination of Gerlach and Barratt teaches “*the processor, the transceiver [and] the smart antenna*” are each “*configured to*” perform the functions of “*receiv[ing] the first feedback information*” and “*receiv[ing] the second feedback information*” [1C]/[12C]/[22C]/[32D]. Ding, ¶¶152-55, 185, 201.

c. Content of “*feedback information*” limitations.

Claims 22 and 32 recite that the first and second “*feedback information*” includes “*one or more of: a first amplitude information, a first phase information, a first routing information, or a first index to a routing table*” [22C(i)(b)]/[22C(ii)(b)]/[32D(i)(b)]/[32D(ii)(b)].

i. “*Feedback information*” includes “*amplitude information*” and “*phase information*.”

The feedback information received in Gerlach’s network-based apparatus includes “*amplitude information*” and “*phase information*.” Ding, ¶187. As discussed in Section V.A.1.b, probing signals 17 are “transmitted with a selected weight matrix W , and the resulting feedback (32) is used to determine the transfer functions a_{kj} for each array-element/receiver pair.” Gerlach, 1:57-60, 5:11-14 (“Information conveyed by feedback signals 32 can then be used to determine weight matrix W of equation V”). The transmission functions a_{kj} “are conveniently represented as the matrix elements of an n by m gain matrix, A .” Gerlach, 4:14-17.

The determination of gain matrix A from feedback signals 32 “is facilitated by using a probing weight matrix W with elements $13(1,1) \dots 13(n,m)$ having all components zero except for 1s in the diagonal position.” Gerlach, 5:22-25. In this manner, “[e]ach column of W is a weight vector w_j which picks out a corresponding row of gain matrix.” Gerlach, 5:27-30. In Gerlach’s method, the “**response** at all receivers 16” to probing signals “is measured **and fed back** for each excitation.” Gerlach, 5:29-30. The “[s]equential application of each weight vector w_j allows sequential measurement of each row of gain matrix A , because signal matrix C equals gain matrix A in this case.” Gerlach, 5:30-33. That is, $c_{ji} = a_{ji}$. Ding, ¶188. Thus, Gerlach teaches that the probing signal response (the measured amplitude of information 19(j) at receiver (i) due to all transmitting elements) is provided in the feedback signal. *Id.* The “transmission function or gain” comprises both “an amplitude and phase factor” that are “typically expressed as a complex amplitude.” Gerlach, 3:67-4:6. Because the complex amplitude a_{ji} includes an “amplitude and phase factor,” the received “*feedback information*” from each remote device comprises “*amplitude information*” and “*phase information*.” Ding, ¶188.

ii. “***Feedback information***” includes an “***index to a routing table***.”

As discussed in Section V.B.4, Gerlach’s weight matrix, W , is a “*routing*

table” because it provides the informational basis for directing a beam pattern carrying an information signal to an intended destination (i.e., routing the information signal). *Id.* As discussed in Sections V.A.1.b and V.B.5.a.ii, Gerlach’s weight matrix W is determined from gain matrix A which is determined based on the feedback information received from receivers 16 in response to probing signals 17. A POSITA would have understood that received signals include an indication of the device that transmitted the signal to permit placement in a matrix A column and correctly maintain calculated weights in the corresponding column of matrix W . Ding, ¶192. Gerlach explains matrix W is determined from gain Matrix A , which in turn is determined based on feedback information from receivers 16 in response to probing signals 17. Gerlach, 5:11-14, 5:33-35; Ding, ¶193.

Specifically, Gerlach teaches that “the j^{th} column of A contains transfer functions between receiver 16(j) and transmission elements 14(1)-14(n).” Gerlach, 4:18-20. And the j^{th} column of matrix W (determined from gain matrix A) “corresponds to weight vector w_j , which characterizes the complex amplitudes with which probing signal 17(j) or information signal 19(j) is applied to transmitting elements 14.” Gerlach, 4:35-39; see 4:67-5:3 (discussing calculation of W from A). Thus, to populate columns of matrix A with information received in the feedback signals and to generate the columns of W from matrix A as discussed in

Section V.B.5.c.i, Gerlach's weight computer 40 requires knowledge of which receiver 16 the feedback information originated. Ding, ¶195. Specifically, a POSITA would have understood the weights for receiver 16(j) in W must be placed in the column corresponding to the column of matrix A containing receiver 16(j)'s feedback. Ding, ¶¶196-197; see Section V.B.5.c.i.

Additionally, as shown in Fig. 3b, Gerlach's weight computer 40 selects a particular column from weight matrix W to apply to an information signal destined for a specific receiver. Ding, ¶198. For example, weights for signal 19(1) are selected for the propagation environment between transmitting array 12 and receiver 16(1) – that is, the column of weight matrix W for receiver 16(1) is provided to transmitting array 12 (e.g., 15(1 ...n,1). *Id.* The weights for signal 19(m) are similarly selected for the propagation environment between transmitting array 12 and receiver 16(m) – that is, the column of weight matrix W for receiver 16(m) is provided to transmitting array 12 (e.g., 15(1 ...n,m)). *Id.* Thus, Gerlach's weight computer 40 uses receiver identification (e.g., 16(1) or 16(m)) as an index to the weight matrix W .

Gerlach, therefore, discloses or suggests that the “*feedback information*” includes an “*index to a routing table* [identification of the receiver 16].” Ding, ¶199.

The combination of Gerlach and Barratt teaches that “*the first feedback information comprises one or more of: a first amplitude information, a first phase information, a first routing information, or a first index to a routing table*” [22C(i)(b)]/[32D(i)(b)]. Ding, ¶¶186-201.

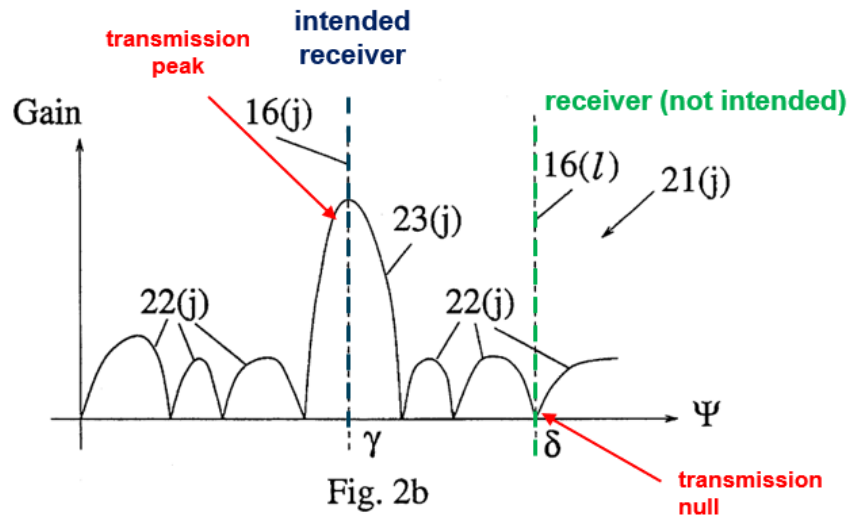
The combination of Gerlach and Barratt teaches that “*the second feedback information comprises one or more of: a first amplitude information, a first phase information, a first routing information, or a first index to a routing table*” [22C(ii)(b)]/[32D(ii)(b)]. *Id.*

d. “Determine where to place transmission peaks and transmission nulls”

Gerlach “us[es] feedback signals 32 to adjust the amplitudes and phases 15 with which signals 19 are applied to transmitting elements 14 so that cross-talk is minimized.” Gerlach, 3:30-34. Weight matrix W , determined by weight computer 40, causes transmitting array 12 to “generate a complimentary null beampattern” when the values of the weight matrix W are applied to the information signals to be transmitted. Gerlach, 5:19-21; Ding, ¶159. Thus, Gerlach’s weight computer determines the weight matrix values necessary to generate a complimentary null beampattern to transmit an information signal to an intended recipient. Ding, ¶158.

A complimentary null beampattern includes “*transmission peaks*” and

“*transmission nulls*.” Ding, ¶159. A beampattern is the “graphical representation of the radiation (far-field) properties of an antenna.” EX-1014, 33; Ding, ¶159. Each beampattern produced by the transmitting elements of Gerlach’s array is therefore the “*spatially distributed pattern[] of electromagnetic signals*.” *Id.* The primary lobe (main lobe) of the beampattern is the lobe containing the direction of maximum radiation, i.e., the “*transmission peak*.” *Id.*, citing EX-1014, 44. A null is the direction in which the pattern assumes very small values, ideally zero, i.e., a “*transmission null*.” Ding, ¶159. The generated complimentary null beampattern, illustrated in Figure 2b below for an information signal having elements of weight matrix W applied, “has a primary lobe 23(j) with unit gain at angle θ_j , in the direction of intended receiver 16(j), and side lobes 22(j) with nulls in the direction of all remaining receivers 16(l) where $l \neq j$.” Gerlach, 3:35-38.



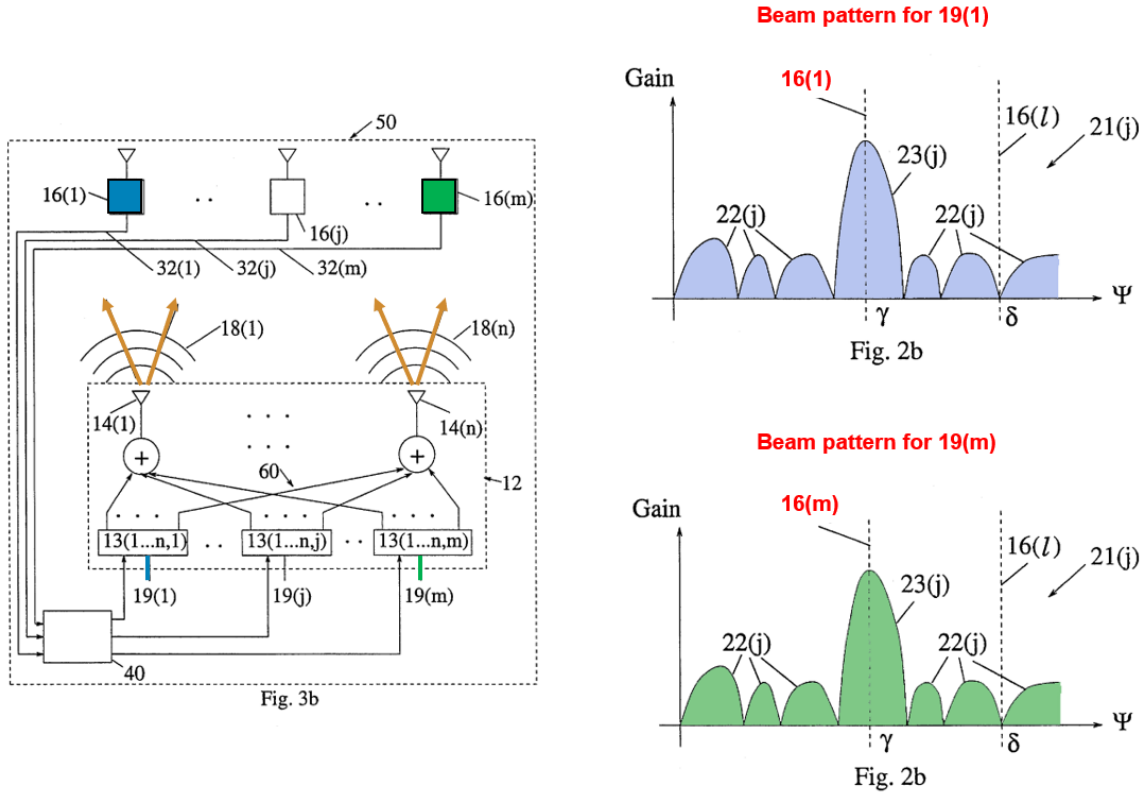
Gerlach, Fig. 2b (annotated)

Gerlach teaches that the “directional properties of transmitting antenna arrays are exploited in” systems using spatial multiplexing techniques “to generate a beampattern for each signal which is directed towards its intended receiver.”

Gerlach, 1:13-19, 3:20-22 (“Each information signal 19 will have its own beampattern 21 generated by interference between transmission signals 18.”). That is, a null beampattern is generated for a first information signal directed to a first receiver (e.g., signal 19(1) directed to receiver 16(1) shown in Fig. 2b top below, top right) that has a primary lobe in the direction of the first receiver and nulls directed to other receivers. Ding, ¶163. A separate null beampattern is generated for a second information signal directed to a second receiver (e.g., signal 19(m)

directed to receiver 16(m) shown in Fig. 2b below, bottom right) that has a primary lobe in the direction of the second receiver and nulls directed to all other receivers.

Id.



Gerlach, Annotated Figures 3b, 2b

As discussed in Section V.B.3.b, the weight computer is part of the “*smart antenna*.”

The combination of Gerlach and Barratt therefore teaches that the “*smart antenna*” is configured to “*determine where to place transmission peaks and transmission nulls within one or more spatially distributed patterns of*

electromagnetic signals based in part on the first and the second feedback information” [1C(iii)]/[12C(iii)]/[22C(iii)]/[32D(iii)]. Ding, ¶¶156-65, 184-85, 201.

6. “Transmit” first and second data stream limitations.

Each independent claim recites the same two “*transmit*” functions for the first and second “*data stream*” that “*one or more of the processor, the transceiver, or the smart antenna is [] configured to*” perform.

Gerlach discloses “methods for multiplexing signals transmitted from an antenna array to multiple receivers.” Gerlach, 1:6-7. In a wireless communications system using spatial multiplexing techniques such as Gerlach, “a single transmitter **simultaneously** emits multiple information signals, each of which is intended for one of a number of spatially separated receivers.” Gerlach, 1:13-16. As described in Section V.A.1, Gerlach’s probing/feedback technique is integrated with conventional SDMA, described above with respect to Fig. 1. Ding, ¶175. In an SDMA system, “[i]nformation signals 19(1), 19(2) ... 19(m) excite transmitting elements 14(1)-14(n) **collectively**, giving rise to transmission signals 18 which are detected by receivers 16(1)-16(m), respectively.” Gerlach, 2:47-50. Indeed, Gerlach’s system is directed to “multiplexing signals from an antenna array to multiple receivers, and in particular to the use of feedback from the receivers to

minimize **cross-talk among the received signals.**” Gerlach, 1:8-9. Thus, Gerlach’s system transmits multiple information signals “*simultaneously*”/“*at the same time.*” Ding, ¶175.

Specifically, information signals 19(1)-19(m) are applied “to elements 14(1)-14(n) with selected complex amplitudes 15(1,1), 15(1,2) ... 15(n-1,m) through connections 60.” Gerlach, 2:62-67. The “[i]nteraction among resulting signals 18(1)-18(n) directs information signals 19 to their intended receivers 16.” Gerlach, 3:1-3. The “interaction among resulting signals 18(1)-18(n)” results in the beampattern associated with the signal. Ding, ¶168. As discussed above, a beampattern is a “*spatially distributed pattern[] of electromagnetic signals.*”

Each information signal has “its own beampattern 21 generated by interference between transmission signals 18.” Gerlach, 3:20-22. For example, during signal transmission, information signal 19(1) is directed to receiver 16(1) (shaded blue in Fig. 3b below) and a different information signal 19(m) is simultaneously directed to receiver 16(m) (shaded green). Weights for signal 19(1) are selected for the propagation environment between transmitting array 12 and receiver 16(1) – that is, the column of weight matrix W for receiver 16(1) is provided to transmitting array 12 (e.g., 15(1 ... n, 1)). Ding, ¶170. The weights for signal 19(m) are similarly selected for the propagation environment between

transmitting array 12 and receiver 16(m) that is, the column of weight matrix W for receiver 16(m) is provided to transmitting array 12 (e.g., $15(1 \dots n, \underline{m})$). *Id.* Information signal 19(1) is applied to elements 14(1)-14(n) with the selected weights provided to the highlighted blue box and information signal 19(m) is simultaneously applied to elements 14(1)-14(n) with the selected weights provided to the highlighted green box. *Id.* The components of each weighted information signal are combined at an adder associated with each transmitting element 14 and the resulting signals are transmitted by transmission elements 14. Ding, ¶171.

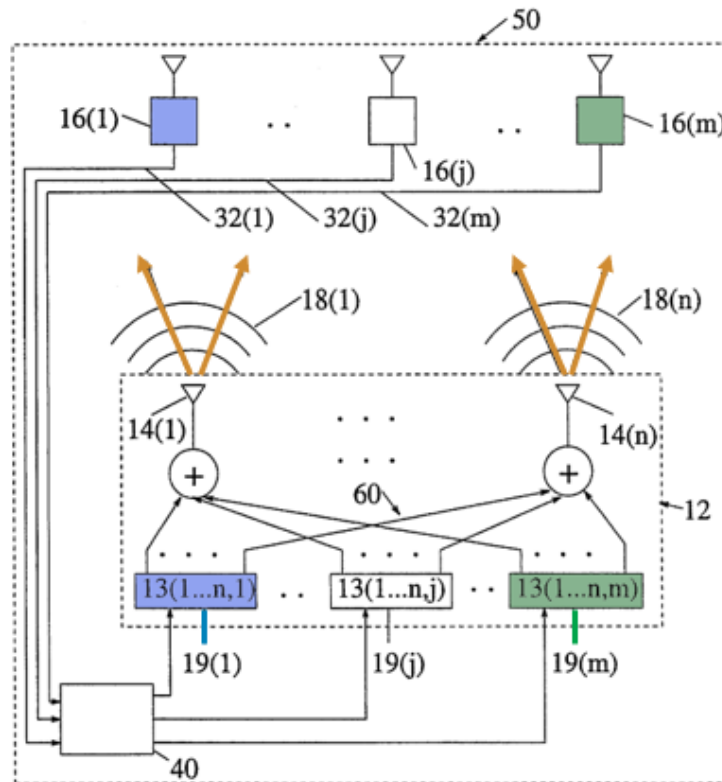


Fig. 3b

Gerlach, Fig. 3b (annotated)

As discussed in Section V.B.2.c, the “*processor*” in the combination of Gerlach and Barratt generates the modulated information signals. And, as discussed in Sections V.B.3.b and V.B.3.a, the “*smart antenna*” and “*transceiver*” are used to “*transmit*” each information signal 19.

Accordingly, the combination of Gerlach and Barratt teaches each of “*the transceiver [and] the smart antenna are configured to ... transmit the first data stream [e.g., information signal 19(1)] to the first client device [receiver 16(1)] via the one or more spatially distributed patterns of electromagnetic signals [beam pattern 21(1)]*” [1C(iv)]/[12C(iv)]/[22C(iv)]/[32D(iv)] and “*transmit the second data stream [e.g., information signal 19(m)] to the second client device [receiver 16(m)] via the one or more spatially distributed patterns of electromagnetic signals [beam pattern 21(m)]*” [1C(v)]/[12C(v)]/[22C(v)]/[32D(v)].
Ding, ¶¶166-73, 184-85, 201.

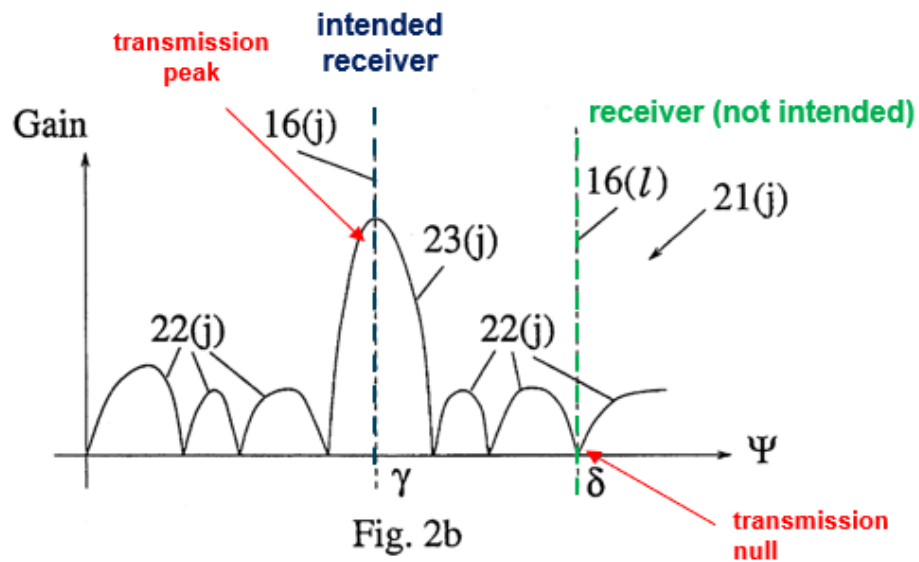
The combination of Gerlach and Barratt also teaches the “*transmission of the first data stream and transmission of at least part of the second data stream occur at the same time*” [1D]/[12D] and discloses that “*transmission of the first data stream and transmission of at least part of the second data stream occur*

simultaneously” [22D]/[32E].¹³ Ding, ¶¶174-76, 184-85, 201.

7. “Patterns ... configured to exhibit” limitations.

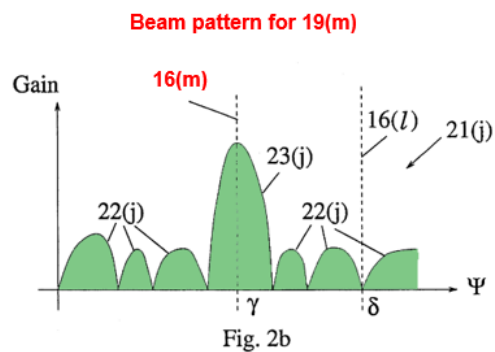
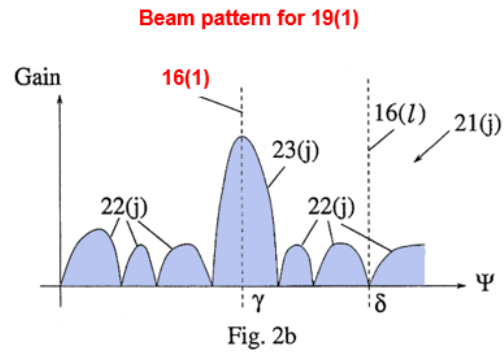
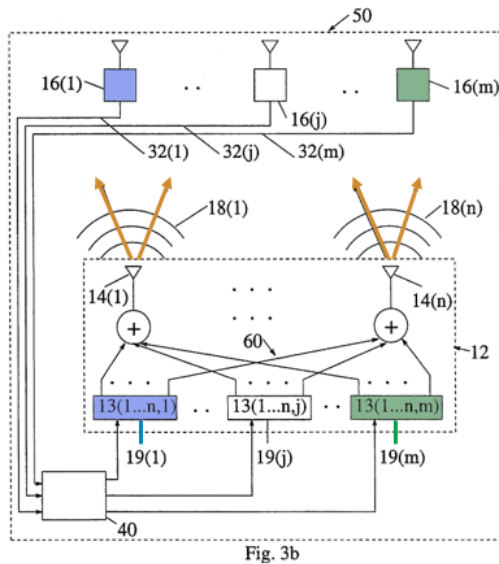
As discussed in Section V.B.5, using the adjusted weight matrix W , transmitting array 12 “generate[s] a complimentary null beam pattern.” Gerlach, 5:20-22. A complimentary null beampattern 21 has a “primary lobe 23(j) with unit gain at angle θ_j , in the direction of intended receiver 16(j), and side lobes 22(j) with nulls in the direction of all remaining receivers 16(l) where $l \neq j$ ” as illustrated in Fig. 2b. Gerlach, 5:36-39. That is, the beampattern 21 for an information signal 19 “*exhibit[s] a first transmission peak at a location of the first client device*” and “*a transmission null*” at all other receivers (i.e., “*a location of a third device*”). Ding, ¶182.

¹³ There is no material difference between the terms “*simultaneously*” and “*at the same time.*”



Gerlach, Fig. 2b (annotated)

Gerlach explains that “[e]ach information signal 19 will have its own beam pattern 21 generated by interference between transmission signals 18.” Gerlach, 3:20-22. The below figures (at right) annotate Fig. 2b to show “complimentary null beam pattern” 21(1) directed to receiver 16(1) carrying information signal 19(1) (top) and “complimentary null beam pattern’ 21(m) directed to receiver 16(m) carrying information signal 19(m) (bottom). Both beam patterns exist when information signal 19(1) and 19(m) are transmitted simultaneously. Ding, ¶179.



Gerlach, Annotated Figures 3b, 2b

Thus, the combination of Gerlach and Barratt teaches “one or more spatially distributed patterns of electromagnetic signals are configured to exhibit a first transmission peak at a location of the first client device [e.g., peak 23 for information signal 19(1) at receiver 16(1)] and a second transmission peak at a location of the second client device [e.g., peak 23 for information signal 19(m) at receiver 16(m)]” [1E]/[12E]/[22E]/[32F]. Ding, ¶¶177-80, 184-85, 201.

The combination of Gerlach and Barratt further teaches “configured to exhibit ... a first transmission null at a location of a third device [e.g., location of

receiver 16(l)]” [12E]/[32F]. Ding, ¶¶182-84, 201.

C. Dependent Claims

1. Claims 2, 13, 23, 33

As discussed in Section V.B.5, Gerlach’s system “extract[s] information about the propagation environment from feedback signals 32.” Gerlach, 5:4-8. The information conveyed by feedback signals 32 is used to determine a new weight matrix W . Gerlach, 5:8-10. The complex amplitudes making up weight matrix W (e.g., w_{11} – w_{nm}) are provided by weight computer 40 (as illustrated in Figure 3b below) to transmitting array 12. See Gerlach, 3:49-63, 4:24-28 (“This distribution is specified by the set of complex amplitudes $w_{11} \dots w_{nm}$ discussed previously, where for example w_{kj} represents the amplitude and phase with which information signal 19(j) is applied to transmitting element 14(k)”). For example, for information signal 19(1), weight computer 40 provides weights w_{11} – w_{n1} to transmitting array and for information signal 19(m), weight computer 40 provides weights w_{1m} – w_{nm} . Ding, ¶209. The beampattern created by applying elements of weight matrix W to an information signal is a “complementary null beampattern.” Gerlach, 5:20-22.

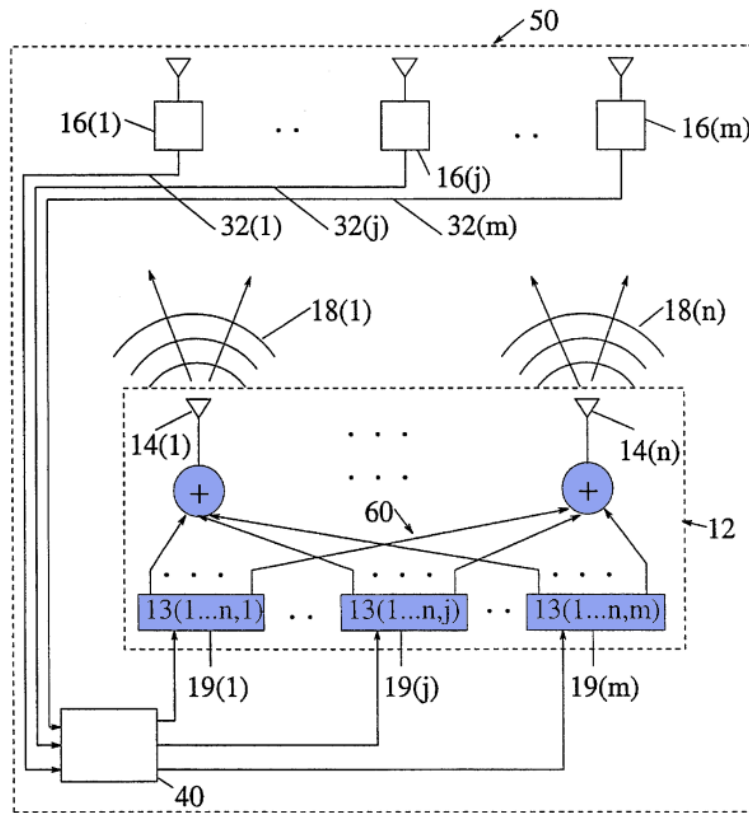


Fig. 3b

Gerlach, Fig. 3b (annotated)

The combination of Gerlach and Barratt, therefore, teaches “*the smart antenna is further configured to: determine a first set of weights to apply to the one or more spatially distributed patterns of electromagnetic signals*”¹⁴

¹⁴ Petitioner reserves the right to raise §112 challenges in district court and, solely for purposes of this IPR, interpret this claim as “weights” to apply to an

[2]/[13]/[23]/[33]. Ding, ¶¶207-210.

2. Claims 3, 14, 25, 34

Gerlach recognizes that “changes in the location of receivers 16 or changes in the scattering environment will necessitate periodic reoptimization of complex amplitudes 15 comprising weight matrix W.” Gerlach, 3:14-17. For example, Gerlach “monitor[s] cross-talk during transmission of information signals 19” and initiates a “**redetermination** of weight matrix W” whenever crosstalk increases above a preselected level.” Gerlach, 6:27-31. Alternatively, “weight matrix W can be reoptimized at regular intervals.” Gerlach, 6:31-32. With either reoptimization technique, Gerlach’s methods “**determine the weight matrix W** that generates complimentary null beampatterns for all signals 19.” Gerlach, 6:32-35. The updated weight values (15(1,1)-15(n,m)) are provided to the transmitting antenna array 12 and applied to subsequent transmissions of information signals. Ding, ¶212. Thus, weight computer 40 adjusts the weights (complex amplitudes) used in transmitting array 12 which in turn cause modifications to the beampattern generated by the transmitting array. *Id.*

information signal to generate a “*spatially distributed pattern of electromagnetic signals.*”

The combination of Gerlach and Barratt, therefore, teaches “*the smart antenna*” “*is further configured to: modify the one or more spatially distributed patterns of electromagnetic signals based on adjustment of a first set of weights to manipulate the one or more spatially distributed patterns of electromagnetic signals*” [3]/[14]/[25]/[34]. Ding, ¶¶211-213.

3. Claims 4, 15, 26

As discussed in Section V.C.2, Gerlach’s system adjusts weight matrix, W, “to reoptimize” its directed transmission. Accordingly, the adjusted weights are applied to a new information signal 19 to be transmitted to a receiver in the same manner described above in Section V.B.6. Ding, ¶215. For example, new information signal 19(1)§ (“*a third data stream*”) intended for receiver 16 is carried by the “*modified one or more spatially distributed patterns of electromagnetic signals.*” *Id.*

For these reasons and the reasons discussed in Section V.B.6, the combination of Gerlach and Barratt teaches each of “*the transceiver [and] the smart antenna is further configured to: transmit a third data stream to the first client device via the modified one or more spatially distributed patterns of electromagnetic signals*” [4]/[15]/[26]. Ding, ¶¶214-216.

4. Claims 5, 16, 24, 27

As discussed in Section V.C.2, Gerlach’s methods “**determine the weight matrix W** that generates complimentary null beampatterns for all signals 19.” Gerlach, 6:32-35. The adjusted weight matrix W includes an updated set of weights to reoptimize the directed beams of the system. Ding, ¶218. The updated set of weights in the adjusted weight matrix (“*second set of weights*”) differs from the original set of weights in weight matrix W as needed to re-optimize the directed beams. *Id.* A POSITA would have understood that the propagation environment changes regularly based on a variety of factors including outside interference, movement of receivers, and changes in topography which can lead to increases in cross-talk. Ding, ¶219. A POSITA would have understood that each time matrix W is calculated because of these propagation environment changes, different weights result. *Id.*

The combination of Gerlach and Barratt therefore teaches that “*the smart antenna*” “*is further configured to: determine a second set of weights to apply to the one or more spatially distributed patterns of electromagnetic signals*”¹⁵, wherein

¹⁵ Petitioner reserves the right to raise §112 challenges in district court and, solely for purposes of this IPR, interprets this claim as the “*weights*” to apply to a data

the first set of weights and the second set of weights are different”

[5]/[16]/[24]/[27]. Ding, ¶¶217-220.

5. Claims 6, 17, 28, 29

As discussed in Section V.C.2, Gerlach’s system continually adjusts the set of weights in the weight matrix W applied to information signals to be transmitted. The adjusted weights are applied to the new information signal 19 in the same manner described above in Section V.B.6. Ding, ¶220. For example, subsequent information signals 19(1)§ (“*a third data stream*”) and 19(1)§§ (“*a fourth data stream*”) intended for receiver 16 are carried by the modified “*spatially distributed pattern[] of electromagnetic signals.*” *Id.* As also discussed in Sections V.B.2 and V.B.3.b, the calculations to redetermine the weight matrix W are performed by weight computer 40 which is part of the “*smart antenna.*”

The combination of Gerlach and Barratt, therefore, teaches “*the smart antenna*” “*modif[ies] the one or more spatially distributed patterns of electromagnetic signals based on adjustment of a second set of weights to manipulate the one or more spatially distributed patters of electromagnetic signals*” [6A]/[17A]/[28A]/[29A]. Ding, ¶¶221-223

stream to generate a “*spatially distributed pattern of electromagnetic signals.*”

For these reasons and the reasons discussed in Section V.B.6, the combination of Gerlach and Barratt also teaches that each of “*the transceiver [and] the smart antenna*” are configured to “*transmit a third data stream via the modified one or more spatially distributed patterns of electromagnetic signals*” [6B]/[17B]/[29B] and “*a fourth data stream via the modified one or more spatially distributed patterns of electromagnetic signals*” [28B]. Ding, ¶¶221-225.

6. Claims 7, 18

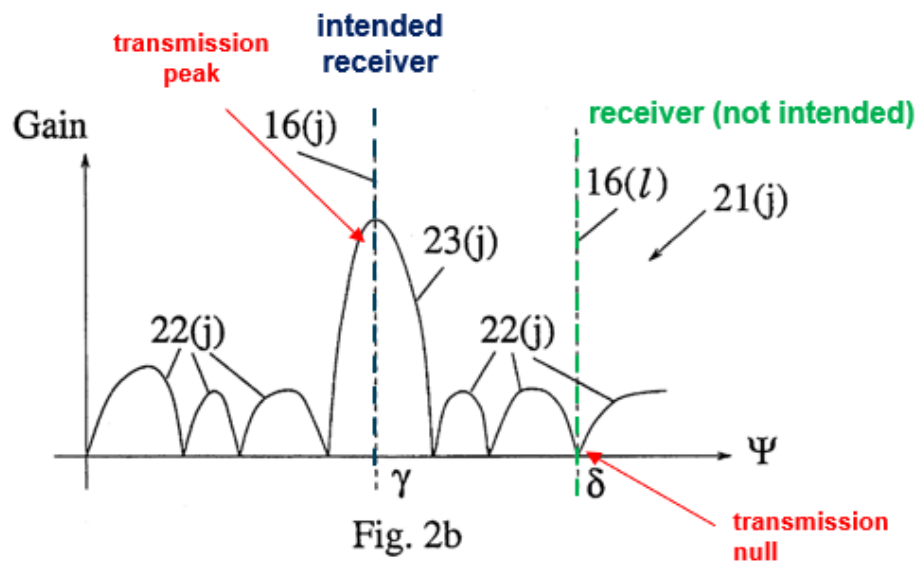
As discussed in Section V.B.5.c.ii, the combination of Gerlach and Barratt teaches that the received “*feedback information*” includes “*amplitude information,*” “*phase information,*” and an “*index to a routing table.*”

For the same reasons, the combination of Gerlach and Barratt teaches that “*the first feedback information and the second feedback information comprise[] at least one of:*” “*a phase value, an amplitude value,... or an index to a routing table*” [7]/[18]. Ding, ¶¶186-200; 226.

7. Claims 8, 9

As discussed in Section V.B.5, using the adjusted weight matrix W , transmitting array 12 “generate[s] a complimentary null beam pattern.” Gerlach, 5:20-22. A complimentary null beam pattern 21 has a “primary lobe 23(j) with unit gain at angle θ , in the direction of intended receiver 16(j), and side lobes 22(j) with

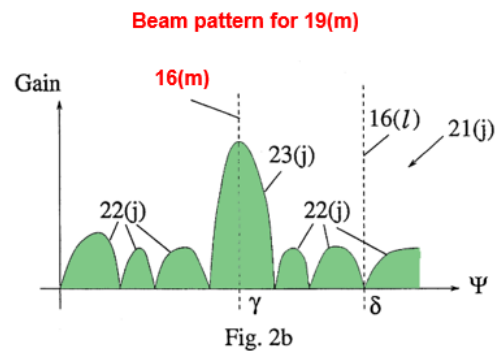
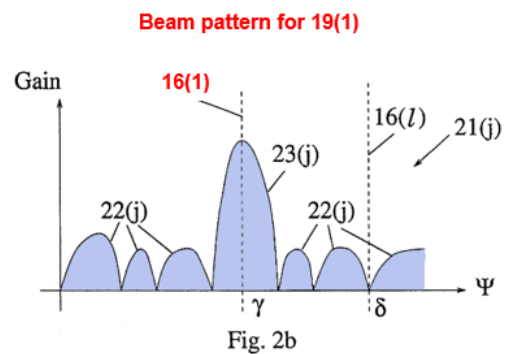
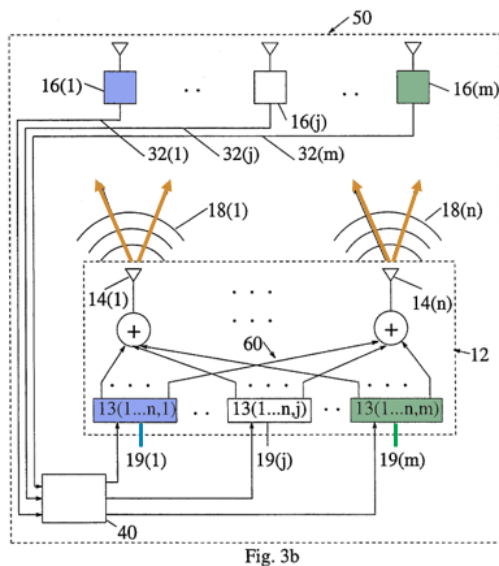
nulls in the direction of all remaining receivers 16(l) where $l \neq j$ ” as illustrated in Fig. 2b. Gerlach, 5:36-39. That is, the beampattern 21 for information signal 19 “exhibit[s] a first transmission peak at a location of the first client device” and “a transmission null” at all other receivers (i.e., “a location of a third device” and “a location of a fourth device”). Ding, ¶228.



Gerlach, Fig. 2b (annotated)

Gerlach explains that “[e]ach information signal 19 will have its own beampattern 21 generated by interference between transmission signals 18.” Gerlach, 3:20-22. That is, multiple beampatterns (such as shown in Fig. 2b) exist for the simultaneous communication of multiple information signals. The below

figures (at right) annotate Fig. 2b to show “complimentary null beampattern” 21(1) directed to receiver 16(1) carrying information signal 19(1) (top) and “complimentary null beampattern” 21(m) directed to receiver 16(m) carrying information signal 19(m) (bottom). Both beampatterns exist when information signal 19(1) and 19(m) are transmitted simultaneously.



Gerlach, Figs. 3b, 2b (annotated)

Thus, the combination of Barratt and Gerlach teaches that “the one or more spatially distributed patterns of electromagnetic signals are further configured to exhibit a first transmission null at a location of a third device” [8] and “the one or

more spatially distributed patterns of electromagnetic signals are further configured to exhibit a second transmission null at a location of a fourth device”

[9]. Ding, ¶¶227-232.

8. Claims 30, 31

Claim 30 has substantially overlapping subject matter with limitation [32C]. As discussed in Section V.B.5.b, the combination of Gerlach and Barratt discloses a “memory” storing a “routing table” (Gerlach’s weight matrix, W).

In Gerlach, determination of the complimentary null beampattern for an information signal 19 to be transmitted to an intended receiver 16 uses the weight matrix. Ding, ¶234. As described above in Section V.B.4, Gerlach’s system “routes” the directed beam carrying information signal 19(1) to receiver 16(1) and the directed beam carrying information signal 19(m) to receiver 16(m) based on the weights contained in matrix W\$ (the “routing table”). *Id.*

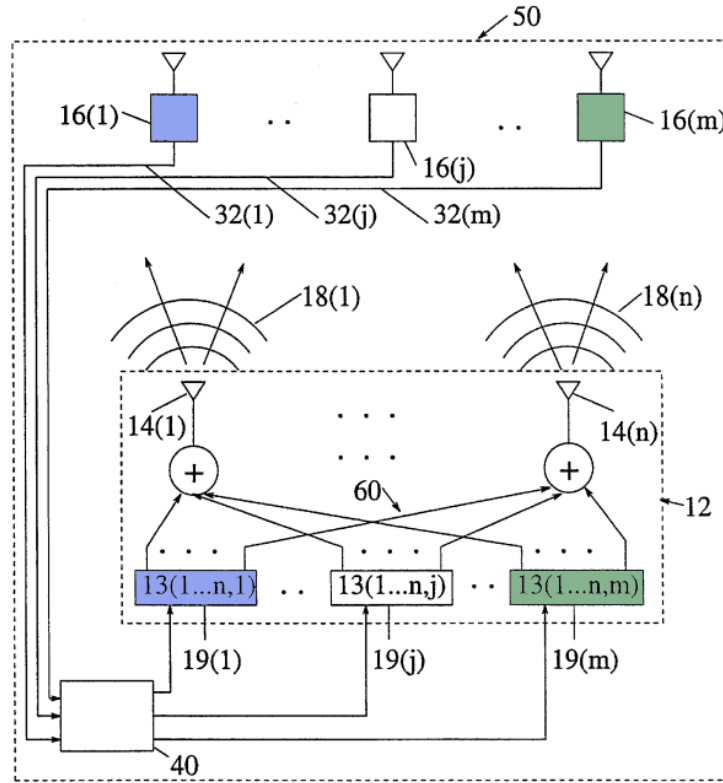


Fig. 3b

Gerlach, Fig. 3b (annotated)

Accordingly, the combination of Gerlach and Barratt teaches “a memory, wherein the determination of where to place the transmission peaks and the transmission nulls within one or more spatially distributed patterns of electromagnetic signals is further based partly on information contained in the routing table, wherein the routing table is stored in the memory” [30]. Ding, ¶¶233-235.

The combination of Gerlach and Barratt therefore also teaches that “the

routing table comprises weighting values” [31]. Ding, ¶¶233-236; see Section V.B.5.c.ii.

VI. GROUND 2: GERLACH, BARRATT AND OKAMOTO RENDER CLAIMS 10-11 AND 19-21 OBVIOUS.

A. Overview of the Combination

The combination of Gerlach and Barratt renders independent claims 1 and 12 obvious. However, the combination does not explicitly disclose IEEE 802.11 or wireless local area networks as recited in claims 10, 19 and 21. Okamoto discloses these limitations.

1. Okamoto

Okamoto describes a “Smart Wireless LAN (SWL) system” that “integrates the Space-Division Multiple-Access (SDMA) technique with the IEEE 802.11 wireless standard.” Okamoto, 1. Okamoto explains that “[c]ertain features of the 802.11 specifications aid the implementation of an SDMA system.” *Id.*, 2. These include 802.11’s “regularly broadcast frame by the base station,” “power control,” a “frame structure with contention and contention free periods,” and “terminal identification fields in each header.” *Id.* By implementing SDMA, Okamoto’s SWL “achieve[s] through-put multiplication by exploiting the rich spatial diversity existing among spatially separate users” on a network. *Id.*, 1.

2. Motivation to Combine

A POSITA would have been motivated to combine Gerlach with Barratt for the reasons described in Section V.A.3 and as further discussed in this petition. A POSITA would have been further motivated to implement the Gerlach-Barratt SDMA capable network-based apparatus in an 802.11 (WiFi) network as a base station (access point) as taught by Okamoto.

Gerlach's disclosure is applicable to general "wireless communication systems." Gerlach, 1:13, 2:11-12. Moreover, Gerlach teaches transmission of "information signals" throughout, which a POSITA would have understood to include data communications signals transmitted over a LAN. Ding, ¶238. Gerlach however does not disclose or limit the type of wireless network (e.g., cellular or WiFi network) in which its system is deployed. *Id.* A POSITA would have therefore been motivated to search for references describing network deployment options for data communications transmissions and would have been led to Okamoto, which discusses the use of SDMA for medium access by an access point in a 802.11 (WiFi) network. *Id.* Okamoto further discloses that 802.11 was a known standard for implementing LANs. *Id.* A POSITA would have recognized the benefits of using Gerlach's system in a WiFi network as taught by Okamoto because, well before the earliest possible priority date of the '376 patent, 802.11-

compliant networks were rapidly growing in popularity. *Id.*, citing EX-1015, 1; EX-1016, 1. Indeed, the original version of the 802.11 standard was released in 1997, years before the earliest possible priority date of the '376 patent. EX-1017, 6.

A POSITA would have been further motivated to deploy Gerlach in a WiFi (802.11 network) access point to take advantage of the increased capacity and power reduction offered by Gerlach's system. Ding, ¶239. As discussed in Section V.A.1, Gerlach's network-based apparatus has the capability to simultaneously transmit information signals to multiple receivers, which results in an increase to the capacity of the system (number of devices that can be serviced in a coverage area). *Id.* A POSITA would have understood that increased capacity was highly beneficial for WiFi networks, due to their increasing popularity prior to the '376 patent. *Id.* Additionally, by reducing crosstalk, Gerlach's probing/feedback technique allows the system to transmit information signals with a sharper beam at a higher gain. *Id.* A POSITA would therefore have recognized that Gerlach's system increases the range of the network-based apparatus, allowing the system to reach user devices that are at a farther distance from the apparatus without requiring an increase in transmission power. *Id.* Because of the FCC, Part 15 rules, a POSITA would have been highly motivated to implement techniques such as

Gerlach's technique which improve the reach, capacity, and transmission quality of an access point while maintaining power within the requirements of the relevant FCC rules. *Id.*

Additionally, Okamoto suggests the combination, describing the use of SDMA techniques in 802.11 networks. Okamoto specifically teaches that 802.11 provides features that “aid the implementation of an SDMA system.” Okamoto, 2; Ding, ¶240. A POSITA would have further recognized that the use of Gerlach's probing/feedback technique would not have required changes to the 802.11 protocol. *Id.* For example, a version of the 802.11 standard available prior to the '376 patent defined a format for MAC frames transmitted over the network for purposes of management or control, or for transmitting data. EX-1017, 50-52. This included a number of “Reserved” frame subtypes, which a POSITA would have recognized could be used for probing/feedback messages. *Id.*, 52; Ding, ¶240. Harnessing the existing frame formats of 802.11 would have been largely, if not entirely, implemented in software and so would not have required substantial circuitry adjustments or hardware alterations. Ding, ¶240. Such an implementation of 802.11 would have been routine for a POSITA. *Id.* For these reasons a POSITA would have had a reasonable expectation of success in the combination. *Id.*

A POSITA would have further been motivated to use the Gerlach-Barratt SDMA capable wireless network-based apparatus as a base station (access point) in an 802.11-compliant wireless network because the combination merely applied a known technique (802.11's network protocols) to a known device (the Gerlach-Barratt SDMA capable network-based apparatus) ready for improvement to yield predictable results (enabling the Gerlach-Barratt SDMA capable network-based apparatus to be implemented in the increasingly popular and widely deployed 802.11-compliant networks). Ding, ¶241.

B. Dependent claims

1. Claims 10, 21

Okamoto describes a Smart Wireless LAN (SWL) system that “integrates the Space-Division-Multiple-Access (SDMA) technique with the IEEE 802.11 wireless LAN standard.” Okamoto, 1. Okamoto uses a “base station” having an “M-element uniform linear antenna array.” *Id.*

A POSITA would understand that Okamoto's “base station” is an 802.11 “access point.” See Ding, ¶244, *citing* EX-1017, 19 (describing an “access point” as “[a]ny entity that has station functionality and provides access to the distribution services, via the wireless medium (WM) for associated stations.”); EX-1019, 13-16 (describing 802.11 system as including a centralized “access point”). Thus, the

network-based apparatus of Gerlach and Barratt, utilized as an access point as taught by Okamoto, “*support[s] the first and second client devices in accordance with an 802.11 standard.*” Ding, ¶244.

The combination of Gerlach, Barratt, and Okamoto teaches or suggests that the “*position of the access point is fixed.*” The specification of the ’376 patent does not disclose or describe that an access point is in a fixed position. In the single mention of fixed components, the ’376 patent states: “Although not required, **access station 102 is typically fixed**, and remote client devices 104 may be fixed or mobile.” EX-1001, 4:11-13.

Gerlach discusses that “[u]ncertainties in the response of the transmitting antenna array, **the locations of the intended receivers**, and the nature and location of scatterers in the vicinity of the array, limit the information available about the transmission channel.” Gerlach, 1:36-39. Gerlach also mentions that in its probing/feedback technique the “**location of receivers 16** or changes in the scattering environment will necessitate periodic reoptimization of complex amplitudes 15 comprising weight matrix W.” Gerlach, 3:14-17; *see* V.B.3.b. Because Gerlach takes into account receiver location but not network-based apparatus location, a POSITA would have understood that the position/location of Gerlach’s network-based apparatus was fixed. Ding, ¶246. Indeed, it was well-

known, even to a lay person, by 2002, that network-based apparatuses in wireless systems were fixed in location. *Id.* Okamoto discloses an access point implementing 802.11, “[a] specification for wireless connectivity for **fixed**, portable, and moving stations within a local area.” EX-1017, 17; Ding, ¶247 (explaining that an “access point” is a type of 802.11 station).

Thus, the combination of Gerlach, Barratt, and Okamoto teaches “*the processor, transceiver and smart antenna are part of an access point configured to support the first and second client devices in accordance with an 802.11 standard, and wherein a position of the access point is fixed*” [10] and “*the data-communications networking apparatus as recited in claim 20, configured to support the first and second client devices in accordance with an IEEE 802.11 standard*” [21]. Ding, ¶¶242-248, 261.

2. Claim 11

Gerlach discloses that “the propagation environment includes any scattering bodies located between transmitting elements 14 and receivers 16, as well as any properties of the ambient environment that affect signal transmission.” Gerlach, 4:10-13; see Section V.A.1.b. A POSITA would have understood that the presence of “scattering bodies” between the transmission array 12 and the receiver encompass situations where the line of sight is blocked. Ding, ¶251.

Similarly, Okamoto describes use of the network “[w]hen one user was blocked from the base station while the other user had LOS,” or line of sight. Okamoto, 3. That is, the user device is not within a “*line of sight of the smart antenna*” [11]. Ding, ¶252.

Thus, the combination of Gerlach, Barratt, and Okamoto teaches that “*the location of the first client device is not within a line of sight of the smart antenna.*” Ding, ¶¶249-253.

3. Claim 19

Gerlach’s probing/feedback technique is applicable to general “wireless communication systems.” Gerlach, 1:13, 2:11-12. Nowhere does Gerlach suggest that its system is limited to a specific use case. Ding, ¶255. Additionally, Gerlach discloses the transmission of “information signals” throughout, which a POSITA would have understood to include data communications signals transmitted over a LAN. *Id.*

Moreover, Okamoto describes a “technique with the IEEE 802.11 wireless **LAN** standard to enable multiple users to transmit on a wireless **LAN** at the same time in the same frequency bank.” Okamoto, 1. As a POSITA would have understood, a wireless LAN is a wireless local area network. Ding, ¶256.

The combination of Gerlach, Barratt, and Okamoto therefore discloses or

suggests that “*the data communications networking apparatus as recited in claim 12, configured for a wireless local area network.*” Ding, ¶¶254-257.

4. Claim 20

As discussed above in Section V.B.3.b, the “*smart antenna*” is a component of the transmitting array. As an integral part of the transmitting array, it is not moveable from the other components of the transmitting array. Thus, the “*position of the smart antenna*” in the network-based apparatus “*is fixed.*” Ding, ¶259.

The combination of Gerlach, Barratt, and Okamoto also teaches that the position of the apparatus (e.g., 802.11 access point) containing the “*smart antenna is fixed*” for the reasons discussed in Section VI.B.1. *See* Ding, ¶¶259-260

VII. DISCRETIONARY DENIAL IS NOT APPROPRIATE IN THIS PROCEEDING.

A. 35 U.S.C. § 325(d)

The Board should not exercise its discretion under § 325(d) to deny institution of this petition. *See Becton, Dickinson & Co. v. B. Braun Melsungen AG*, IPR2017-01586, Paper 8, 17-18 (PTAB Dec. 15, 2017) (precedential); *Advanced Bionic, LLC v. MED-EL Elektromedizinische Gerate GmbH*, IPR2019-01469, Paper 6, at 9-11 (PTAB Feb. 13, 2020) (precedential). Gerlach and Barratt were cited during prosecution. However, evaluation of *Becton* factors (c), (e), and (f) strongly weighs against discretionary denial. *Advanced Bionic*, Paper 6, at 10–

11.

Okamoto was never cited or considered. While both Gerlach and Barratt were identified by applicant on a November 29, 2017 Information Disclosure Statement (“IDS”) and Barratt again on a July 6, 2018 IDS, Gerlach was listed as one of 155 references. EX-1002, 282-289, 1040. The Examiner signed off on the cited references, but stressed that “it is impractical for the examiner to review the references thoroughly with the number of references cited in this case....the examiner is merely acknowledging the submission and ‘consideration’ of the cited references.” *Id.*, 934-935 (noting “that an applicant’ duty of disclosure ... is not satisfied by presenting a patent examiner with ‘a mountain of largely irrelevant [material] from which the examiner is presumed to have been able ... to have found the critical [material]. It ignores the real world conditions under which examiners work.” (citing *Rohm & Haas CO. v. Crystal Chemical Co.*, 722 F.2d 1556, 1573 (Fed. Cir. 1983))). Thus, the Examiner never acknowledged actually considering Gerlach’s disclosure and, indeed, never evaluated it on the record. *Becton* factor (c) strongly favors not exercising discretion to deny this Petition. *SolarEdge Techs. LTD v. SMA Solar*, IPR2020-00021, Paper 8, at 12 (PTAB Apr. 10, 2020) (“Because the Examiner did not rely on [the cited references] to reject a claim, *Becton* factor (c) weighs strongly against exercising our discretion to deny

institution.”).

Because the record is devoid of any evaluation by the Examiner, the Examiner never identified the teachings in Gerlach or Barratt on which Petitioner relies. And the limitations on which the Examiner relied for allowance (EX-1002, 1246-48), are the focus of Gerlach as detailed in this Petition. See Sections V.B.5.d and V.B.7; *see also* Gerlach, Figs. 2a-2b. Thus, to the extent the Examiner substantively reviewed Gerlach, the Examiner erred in overlooking this disclosure. *Becton* factor (e) weighs against discretionary denial.

The Examiner never identified any combination with Barratt (or Okamoto) during prosecution, and thus Gerlach is presented in a different context than the Examiner viewed it during prosecution, to the extent that Gerlach was substantively considered at all. Moreover, the Petition presents detailed expert evidence which shows how the references disclose every limitation of the challenged claims, as well as the reasons that a POSITA would pursue such a combination. Thus, Petitioner's challenges are based on additional evidence and arguments that the Examiner did not consider, or that if he did consider, as to which he clearly erred. *See Mylan Pharms. Inc. v. Merck Sharp & Dohme Corp.*, IPR2020-00040, Paper 21, at 20 (PTAB May 12, 2020) (new expert testimony weighs against exercising discretion under § 325(d)). *Becton* factor (f) also weighs

against discretionary denial.

B. 35 U.S.C. § 314(a)

The weight of the factors articulated in *Apple, Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 (Mar. 20, 2020) (precedential) favors institution.

A stay has been granted in the CDCA Case 8:17-cv-00596 DOC-JDE (EX-1034). Thus, factors 1, 2, and 3 strongly weigh against exercising discretion to deny institution.

Additionally, there will not be any duplication, even if the district court case is subsequently tried as the Petitioner makes a *Sotera*-style stipulation not to pursue, in any further proceedings at the district court, any ground that was raised or could have been reasonably raised in an IPR. Thus, Factor 4 weighs against exercising discretion to deny institution.

The merits of the instant Petition are especially strong given the Board granted institution in IPR2022-00613, which shares the identical grounds with the present Petition. All the limitations of the challenged claims were known for nearly a decade before the earliest possible priority date of the alleged invention. *See, e.g., Seven Networks*, IPR2020- 00156, Paper 10, at 20-21 (finding this factor weighs strongly in favor of Petition based on Petitioner's "strong showing on the merits"). Thus, Factor 6 weighs against exercising discretion to deny institution.

VIII. MANDATORY NOTICES UNDER 37 C.F.R. § 42.8(B)

A. *Real Parties-in-Interest*

Ubiquiti Inc. is the real parties-in-interest. No other parties have directed, funded, or controlled the filing of this IPR, and this IPR was not filed at the behest of any other party.

B. *Related Matters*

To the best of Petitioner's knowledge, the 376 patent has been involved in the following district court litigation:

Parties	Docket	District	Filing Date
<i>XR Communications, LLC v. Aruba Networks, LLC</i>	2:21-cv-04912	CDCA ¹⁶	June 16, 2021
<i>XR Communications, LLC v. Belkin International, Inc.</i>	2:21-cv-4914	CDCA	June 16, 2021
<i>XR Communications, LLC v. Netgear, Inc.</i>	2:21-cv-4942	CDCA	June 16, 2021
<i>XR Communications, LLC v. D-Link Systems, Inc.</i>	8:21-cv-4942	CDCA	June 16, 2021
<i>XR Communications, LLC v. Netgear, Inc.</i>	8:21-cv-1064	CDCA	June 16, 2021

¹⁶ All listed cases in CDCA were consolidated with an earlier case, *XR Communications, LLC v. D-Link Systems, Inc.*, 8:17-cv-596 (CDCA) (filed April 3, 2017).

<i>XR Communications, LLC v. Ubiquiti Networks, Inc.</i>	8:21-cv-1065	CDCA	June 16, 2021
<i>XR Communications, LLC v. Amazon.com, Inc. et al.</i>	6:21-cv-619	WDTX	June 16, 2021
<i>XR Communications, LLC v. ASUSTeK Computer Inc.</i>	6:21-cv-622	WDTX	June 16, 2021
<i>XR Communications, LLC v. Cisco Systems, Inc. et al.</i>	6:21-cv-622	WDTX	June 16, 2021
<i>XR Communications, LLC v. Google LLC</i>	6:21-cv-625	WDTX	June 16, 2021
<i>XR Communications, LLC v. Samsung Elecs. Co., Ltd. et al.</i>	6:21-cv-626	WDTX	June 16, 2021

To the best of Petitioner's knowledge, the '376 patent was challenged in the following IPR Proceeding:

IPR2022-00613-Samsung Electronics Co., Ltd., Samsung Electronics America, Inc., Google LLC, and Cisco Systems, Inc., v. XR Communications, LLC D/B/A Vivato Tech. (Instituted 10/20/2022)

IPR2023-00174-EERO LLC v XR Communications, LLC D/B/A Vivato Tech. (Filed 11/17/2022)

IPR2023-00174-Netgear, Inc. and Aruba Network LLC v XR Communications, LLC D/B/A Vivato Tech. (Filed 11/18/2022)

Certain claims of a patent that claims priority to the same parent as the '376 patent, U.S. Patent No. 10,715,235, were challenged by Apple Inc. and HP Inc. in IPR2022-00367 (filed January 7, 2022).

C. *Lead and Backup Counsel*

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D. *Service Information*

Please address all correspondence to counsel at the addresses shown above. Petitioner consents to electronic service by e-mail.

IX. FEES

Petitioner concurrently electronically submits the required fees for this Petition. The Board is authorized to charge Simpson Thacher & Bartlett LLP’s deposit account, No. 505546 for any fee deficiency.

X. APPENDIX: LISTING OF CHALLENGED CLAIMS

Reference	Claim Limitation
Claim 1	
[1P]	A data-communications networking apparatus, comprising:
[1A]	a processor configured to:

[1A(i)]	generate a probing signal for transmission to at least a first client device and a second client device;
[1A(ii)]	generate a first data stream for transmission to the first client device; and
[1A(iii)]	generate a second data stream for transmission to the second client device; and
[1B]	a transceiver operatively coupled to the processor and configured to:
[1B(i)]	transmit the probing signal to at least the first client device and the second client device via a smart antenna;
[1B(ii)]	wherein the smart antenna is operatively coupled to the transceiver and comprises a first antenna element and a second antenna element;
[1C]	wherein one or more of the processor, the transceiver, or the smart antenna is further configured to:
[1C(i)]	receive a first feedback information from the first client device in response to the transmission of the probing signal;
[1C(ii)]	receive a second feedback information from the second client device in response to the transmission of the probing signal;
[1C(iii)]	determine where to place transmission peaks and transmission nulls within one or more spatially distributed patterns of electromagnetic signals based in part on the first and the second feedback information;
[1C(iv)]	transmit the first data stream to the first client device via the one or more spatially distributed patterns of electromagnetic signals; and

[1C(v)]	transmit the second data stream to the second client device via the one or more spatially distributed patterns of electromagnetic signals;
[1D]	wherein transmission of the first data stream and transmission of at least part of the second data stream occur at the same time; and
[1E]	wherein the one or more spatially distributed patterns of electromagnetic signals are configured to exhibit a first transmission peak at a location of the first client device and a second transmission peak at a location of the second client device.

Claim 2

2	The data-communications networking apparatus as recited in claim 1, wherein one or more of the processor, the transceiver, or the smart antenna is further configured to: determine a first set of weights to apply to the one or more spatially distributed patterns of electromagnetic signals.
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Claim 3

3	The data-communications networking apparatus as recited in claim 1, wherein one or more of the processor, the transceiver, or the smart antenna is further configured to: modify the one or more spatially distributed patterns of electromagnetic signals based on adjustment of a first set of weights to manipulate the one or more spatially distributed patterns of electromagnetic signals.
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Claim 4

4	The data-communications networking apparatus as recited in claim 3, wherein one or more of the processor, the transceiver, or the smart antenna is further configured to: transmit a third data
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	stream to the first client device via the modified one or more spatially distributed patterns of electromagnetic signals.
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Claim 5	
5	The data-communications networking apparatus as recited in claim 3, wherein one or more of the processor, the transceiver, or the smart antenna is further configured to: determine a second set of weights to apply to the one or more spatially distributed patterns of electromagnetic signals, wherein the first set of weights and the second set of weights are different.

Claim 6	
[6A]	The data-communications networking apparatus as recited in claim 3, wherein one or more of the processor, the transceiver, or the smart antenna is further configured to: modify the one or more spatially distributed patterns of electromagnetic signals based on adjustment of a second set of weights to manipulate the one or more spatially distributed patterns of electromagnetic signals; and
[6B]	transmit a third data stream to the second client device via the modified one or more spatially distributed patterns of electromagnetic signals.

Claim 7	
7	The data-communications networking apparatus as recited in claim 1, wherein the first feedback information and the second feedback information comprise at least one of: a transmit power level, a data receive rate, an antenna direction, quality of service data, a signal to noise ratio, a phase value, an amplitude value, a frequency value, timing data, or an index to a routing table.

Claim 8	
8	The data-communications networking apparatus as recited in claim 1, wherein the one or more spatially distributed patterns of electromagnetic signals are further configured to exhibit a first transmission null at a location of a third device.

Claim 9	
9	The data-communications networking apparatus as recited in claim 8, wherein the one or more spatially distributed patterns of electromagnetic signals are further configured to exhibit a second transmission null at a location of a fourth device.

Claim 10	
10	The data-communications networking apparatus as recited in claim 1, wherein the processor, transceiver and smart antenna are part of an access point configured to support the first and second client devices in accordance with an 802.11 standard, and wherein a position of the access point is fixed.

Claim 11	
11	The data-communications networking apparatus as recited in claim 10, wherein the location of the first client device is not within a line of sight of the smart antenna.

Claim 12	
[12P]	A data-communications networking apparatus, comprising:
[12A]	a processor configured to:

[12A(i)]	generate a probing signal for transmission to at least a first client device and a second client device;
[12A(ii)]	generate a first data stream for transmission to the first client device; and
[12A(iii)]	generate a second data stream for transmission to the second client device; and
[12B]	a transceiver operatively coupled to the processor and configured to:
[12B(i)]	transmit the probing signal to at least the first client device and the second client device via a smart antenna;
[12B(ii)]	wherein the smart antenna is operatively coupled to the transceiver and comprises a first antenna element and a second antenna element;
[12C]	wherein one or more of the processor, the transceiver, or the smart antenna is further configured to:
[12C(i)]	receive a first feedback information from the first client device;
[12C(ii)]	receive a second feedback information from the second client device;
[12C(iii)]	determine where to place transmission peaks and transmission nulls within one or more spatially distributed patterns of electromagnetic signals based in part on the first and the second feedback information;
[12C(iv)]	transmit the first data stream to the first client device via the one or more spatially distributed patterns of electromagnetic signals; and
[12C(v)]	transmit the second data stream to the second client device via the one or more spatially distributed patterns of electromagnetic signals;

[12D]	wherein transmission of the first data stream and transmission of at least part of the second data stream occur at the same time; and
[12E]	wherein the one or more spatially distributed patterns of electromagnetic signals are configured to exhibit a first transmission peak at a location of the first client device, a second transmission peak at a location of the second client device, and a first transmission null at a location of a third device.

Claim 13

13	The data-communications networking apparatus as recited in claim 12, wherein one or more of the processor, the transceiver, or the smart antenna is further configured to: determine a first set of weights to apply to the one or more spatially distributed patterns of electromagnetic signals.
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Claim 14

14	The data-communications networking apparatus as recited in claim 12, wherein one or more of the processor, the transceiver, or the smart antenna is further configured to: modify the one or more spatially distributed patterns of electromagnetic signals based on adjustment of a first set of weights to manipulate the one or more spatially distributed patterns of electromagnetic signals.
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Claim 15

15	15. The data-communications networking apparatus as recited in claim 14, wherein one or more of the processor, the transceiver, or the smart antenna is further configured to: transmit a third data stream to the first client device via the modified one or more spatially distributed patterns of electromagnetic signals.
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Claim 16	
16	The data-communications networking apparatus as recited in claim 14, wherein one or more of the processor, the transceiver, or the smart antenna is further configured to: determine a second set of weights to apply to the one or more spatially distributed patterns of electromagnetic signals, wherein the first set of weights and the second set of weights are different.

Claim 17	
[17A]	The data-communication networking apparatus as recited in claim 14, wherein one or more of the processor, the transceiver, or the smart antenna is further configured to: modify the one or more spatially distributed patterns of electromagnetic signals based on adjustment of a second set of weights to manipulate the one or more spatially distributed patterns of electromagnetic signals; and
[17B]	transmit a third data stream to the second client device via the modified one or more spatially distributed patterns of electromagnetic signals.

Claim 18	
18	The data-communications networking apparatus as recited in claim 12, wherein the first feedback information and the second feedback information comprises at least one of: a transmit power level, a data receive rate, an antenna direction, quality of service data, a signal to noise ratio, a phase value, an amplitude value, a frequency value, timing data, or an index to a routing table.

Claim 19	
19	The data-communications networking apparatus as recited in claim 12, configured for a wireless local area network.

Claim 20	
20	The data-communications networking apparatus as recited in claim 19, wherein a position of the smart antenna is fixed.

Claim 21	
21	The data-communications networking apparatus as recited in claim 20, configured to support the first and second client devices in accordance with an IEEE 802.11 standard.

Claim 22	
[22P]	A data-communications networking apparatus, comprising:
[22A]	a processor configured to:
[22A(i)]	generate a probing signal for transmission to at least a first client device and a second client device;
[22A(ii)]	generate a first data stream for transmission to the first client device; and
[22A(iii)]	generate a second data stream for transmission to the second client device; and
[22B]	a transceiver operatively coupled to the processor and configured to:
[22B(i)]	transmit the probing signal to at least the first client device and the second client device via a smart antenna;

[22B(ii)]	wherein the smart antenna is operatively coupled to the transceiver;
[22C]	wherein one or more of the processor, the transceiver, or the smart antenna is further configured to:
[22C(i)(a)]	receive a first feedback information from the first client device;
[22C(i)(b)]	wherein the first feedback information comprises one or more of: a first amplitude information, a first phase information, a first routing information, or a first index to a routing table;
[22C(ii)(a)]	receive a second feedback information from the second client device;
[22C(ii)(b)]	wherein the second feedback information comprises one or more of: a second amplitude information, a second phase information, a second routing information, or a second index to a routing table;
[22C(iii)]	determine where to place transmission peaks and transmission nulls within one or more spatially distributed patterns of electromagnetic signals based in part on the first and the second feedback information;
[22C(iv)]	transmit the first data stream to the first client device via the one or more spatially distributed patterns of electromagnetic signals; and
[22C(v)]	transmit the second data stream to the second client device via the one or more spatially distributed patterns of electromagnetic signals;
[22D]	wherein transmission of the first data stream and transmission of at least part of the second data stream occur simultaneously; and
[22E]	wherein the one or more spatially distributed patterns of electromagnetic signals are configured to exhibit a first transmission peak at a location of the first client device and a

	second transmission peak at a location of the second client device.
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Claim 23

23	The data-communications networking apparatus as recited in claim 22, wherein one or more of the processor, the transceiver, or the smart antenna is further configured to: determine a first set of weights to apply to the one or more spatially distributed patterns of electromagnetic signals.
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Claim 24

24	The data-communications networking apparatus as recited in claim 23, wherein one or more of the processor, the transceiver, or the smart antenna is further configured to: determine a second set of weights to apply to the one or more spatially distributed patterns of electromagnetic signals, wherein the first set of weights and the second set of weights are different.
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Claim 25

25	The data-communications networking apparatus as recited in claim 22, wherein one or more of the processor, the transceiver, or the smart antenna is further configured to: modify the one or more spatially distributed patterns of electromagnetic signals based on adjustment of a first set of weights to manipulate the one or more spatially distributed patterns of electromagnetic signals.
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Claim 26

26	The data-communications networking apparatus as recited in claim 25, wherein one or more of the processor, the transceiver,
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	or the smart antenna is further configured to: transmit a third data stream to the first client device via the modified one or more spatially distributed patterns of electromagnetic signals.
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Claim 27	
27	The data-communications networking apparatus as recited in claim 26, wherein one or more of the processor, the transceiver, or the smart antenna is further configured to: determine a second set of weights to apply to the one or more spatially distributed patterns of electromagnetic signals, wherein the first set of weights and the second set of weights are different.

Claim 28	
[28A]	The data-communications networking apparatus as recited in claim 27, wherein one or more of the processor, the transceiver, or the smart antenna is further configured to: modify the one or more spatially distributed patterns of electromagnetic signals based on adjustment of the second set of weights to the one or more spatially distributed patterns of electromagnetic signals; and
[28B]	transmit a fourth data stream to the second client device via the modified one or more spatially distributed patterns of electromagnetic signals.

Claim 29	
[29A]	The data-communications networking apparatus as recited in claim 25, wherein one or more of the processor, the transceiver, or the smart antenna is further configured to: modify the one or more spatially distributed patterns of electromagnetic signals based on adjustment of a second set of weights to manipulate the

	one or more spatially distributed patterns of electromagnetic signals; and
[29B]	transmit a third data stream to the second client device via the modified one or more spatially distributed patterns of electromagnetic signals.

Claim 30	
30	The data-communications networking apparatus as recited in claim 22, further comprising a memory, wherein the determination of where to place the transmission peaks and the transmission nulls within one or more spatially distributed patterns of electromagnetic signals is further based partly on information contained within the routing table, wherein the routing table is stored in the memory.

Claim 31	
31	The data-communications networking apparatus as recited in claim 30, wherein the routing table comprises weighting values.

Claim 32	
[32P]	A data-communications networking apparatus, comprising:
[32A]	a processor configured to:
[32A(i)]	generate a probing signal for transmission to at least a first client device and a second client device;
[32A(ii)]	generate a first data stream for transmission to the first client device; and

[32A(iii)]	generate a second data stream for transmission to the second client device; and
[32B]	a transceiver operatively coupled to the processor and configured to:
[32B(i)]	transmit the probing signal to at least the first client device and the second client device via a smart antenna;
[32B(ii)]	wherein the smart antenna is operatively coupled to the transceiver;
[32C]	a memory operatively coupled to one or more of the processor or the transceiver; wherein a routing table is stored in the memory;
[32D]	wherein one or more of the processor, the transceiver, or the smart antenna is further configured to:
[32D(i)(a)]	receive a first feedback information from the first client device;
[32D(i)(b)]	wherein the first feedback information comprises one or more of: a first amplitude information, a first phase information, a first routing information, or a first index to a routing table;
[32D(ii)(a)]	receive a second feedback information from the second client device;
[32D(ii)(b)]	wherein the second feedback information comprises one or more of: a second amplitude information, a second phase information, a second routing information, or a second index to a routing table;
[32D(iii)]	determine where to place transmission peaks and transmission nulls within one or more spatially distributed patterns of electromagnetic signals based in part on the first and the second feedback information;

[32D(iv)]	transmit the first data stream to the first client device via the one or more spatially distributed patterns of electromagnetic signals; and
[32D(v)]	transmit the second data stream to the second client device via the one or more spatially distributed patterns of electromagnetic signals;
[32E]	wherein transmission of the first data stream and transmission of at least part of the second data stream occur simultaneously; and
[32F]	wherein the one or more spatially distributed patterns of electromagnetic signals are configured to exhibit a first transmission peak at a location of the first client device, a second transmission peak at a location of the second client device, and a first transmission null at a location of a third device.

Claim 33	
33	The data-communications networking apparatus as recited in claim 32, wherein one or more of the processor, the transceiver, or the smart antenna is further configured to: determine a first set of weights to apply to the one or more spatially distributed patterns of electromagnetic signals.

Claim 34	
34	The data-communications networking apparatus as recited in claim 32, wherein one or more of the processor, the transceiver, or the smart antenna is further configured to: modify the one or more spatially distributed patterns of electromagnetic signals based on adjustment of a first set of weights to manipulate the

	one or more spatially distributed patterns of electromagnetic signals.
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Respectfully submitted,

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CERTIFICATE OF COMPLIANCE

The undersigned hereby certifies that the foregoing Petition for *Inter Partes* Review contains 13,895 words, excluding those portions identified in 37 C.F.R. § 42.24(a), as measured by the word-processing system used to prepare this paper.

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CERTIFICATE OF SERVICE

I certify that on November 10, 2023, I caused a true and correct copy of the foregoing Petition for *Inter Partes* Review of U.S. Patent No. 10,594,376 and supporting exhibits to be served via overnight delivery on the Patent Owner at the following correspondence address of record as listed on PAIR:

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