

Petition for *Inter Partes* Review of
U.S. Patent No. 10,103,845 B2

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

AMERICAN AIRLINES, INC. AND SOUTHWEST AIRLINES CO.
Petitioners

v.

INTELLECTUAL VENTURES I LLC
Patent Owner

U.S. Patent No. 10,103,845
Issue Date: October 16, 2018

Title: DUAL MODE COMMUNICATION SYSTEMS AND METHODS

Inter Partes Review No. 2025-01510

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OF U.S. PATENT NO. 10,103,845 B2**

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LIST OF EXHIBITS

Exhibit No.	Description of Document
1001	U.S. Patent No. 10,103,845 (the “’845 Patent”)
1002	Prosecution History of the ’845 Patent
1003	Declaration of William C. “Chuck” Easttom in Support of Petition for <i>Inter Partes</i> Review of U.S. Patent No. 10,103,845
1004	Curriculum Vitae of William C. “Chuck” Easttom
1005	U.S. Patent Application No. 2002/0154705 (“Walton”)
1006	U.S. Patent No. 7,130,592 (“Ishikawa”)
1007	U.S. Patent No. 7,885,178 (“Maltsev”)
1008	U.S. Patent No. 7,916,803 (“Gardner”)
1009	U.S. Patent No. 7,324,429
1010	International Patent App. No. WO2003003646A2
1011	2003 Texas Instruments White Paper
1012	2009 Cisco Presentation re: 802.11

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Intellectual Ventures (“IV” or “Patent Owner”) is a private equity firm that monetizes patents. On November 2, 2024, it added American Airlines, Inc. and Southwest Airlines Co. (“Petitioners”) to its ever-growing list of targets by suing them for the infringement of six different patents. Over six months later, IV moved for leave to add six more patents, including the ’845 Patent, to its case against Petitioner American. IV’s motion was granted on August 26, 2025—bringing the total number of patents in the case to twelve and the number of asserted claims to over eighty.

The ’845 Patent is related to 802.11 wi-fi technology. The invention it purports to disclose, titled “Dual mode communication systems and methods,” is an orthogonal frequency division multiplexing (OFDM) communications system that is capable of both frequency and spatial multiplexing modes of data transmission. Ex.1001 1:30-32; 3:14-16.

The ’845 Patent’s inventors did not invent MIMO communications systems or spatial or frequency multiplexing—all of these methodologies were well-known in the art at the time of the ’845 Patent’s purported invention due to contemporary efforts to develop the 802.11n standard. Indeed, multiple references discussed in this Petition rendered the ’845 Patent invalid, alone and in combination.

IV’s litigation strategy has been apparent from the beginning. IV asserted a medley of unrelated patents, covering subjects ranging from cloud computing to

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satellite internet to 802.11 data transmission techniques, against defendants whose core businesses are unrelated to the patents' subject matter. IV attempts to bury defendants under an avalanche of low-quality patents in an attempt to reach a quick settlement. IV's strategy should fail—the '845 Patent has clear invalidity issues. Petitioners respectfully request institution of this Petition.

I. MANDATORY NOTICES UNDER 37 C.F.R. § 42.8

A. Real party in interest under § 42.8(b)(1)

Petitioners are the real party in interest to this Petition. No unnamed entity is funding, controlling, or otherwise has an opportunity to control or direct this Petition or Petitioners' participation in any resulting IPR.

B. Related matters under § 42.8(b)(2)

To the best of Petitioners' knowledge, the '845 Patent is or has been involved in these matters:

Name	No.	Court	Filed	Status
<i>Intellectual Ventures I LLC et al. v. American Airlines, Inc.</i>	4:24-cv-980	EDTX	Nov. 2, 2024	Active

C. Lead and backup counsel under § 42.8(b)(3)

Petitioners designate the following counsel:

Lead Counsel	Backup Counsel
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Lead Counsel	Backup Counsel
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D. Service information

USPTO records show the attorneys having power of attorney over the '845 Patent are Foley & Lardner LLP. This Petition is thus being served by USPS Priority Mail Express to the correspondence address for the '845 Patent, FOLEY & LARDNER, LLP, 3000 K Street N.W., Suite 600, Washington, D.C. 20007. Petitioners consent to electronic service at AA_Intellectual_Ventures@mckoolsmith.com.

II. FEE PAYMENT

The Office is allowed to charge the fees specified by 37 C.F.R. §§ 42.103(a) and 42.15(a) to Deposit Account No. 50-5723.

III. GROUNDS FOR STANDING

Petitioners certify the '845 Patent is available for IPR and that Petitioners are not barred or estopped from requesting an IPR challenging the '845 Patent's claims on the grounds identified in this Petition. Petitioners filed this Petition within one year of service of the amended complaint asserting the '845 Patent against Petitioner American.

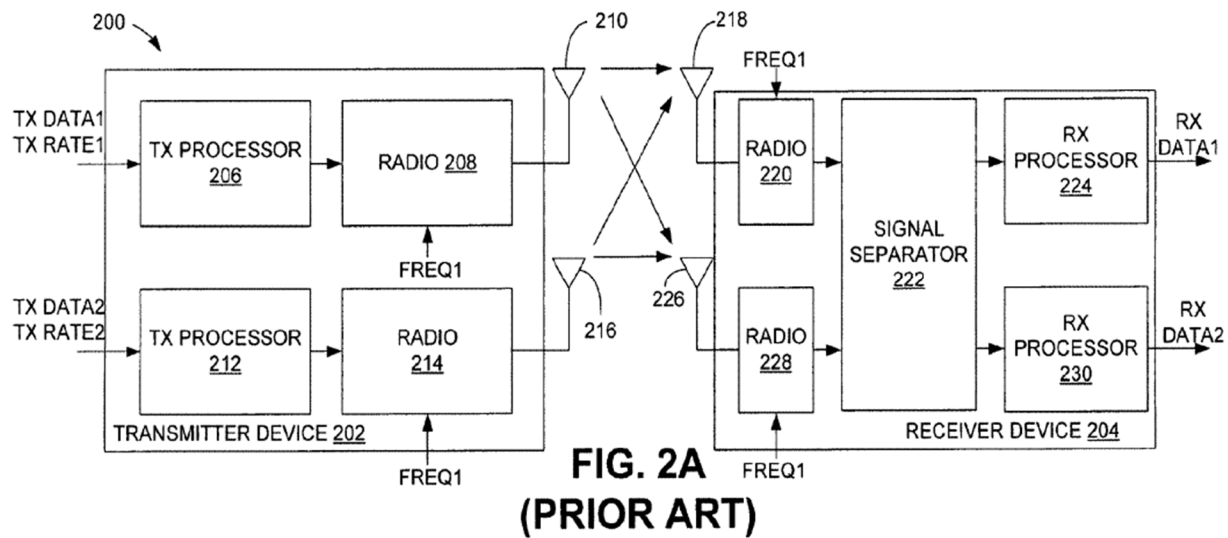
IV. THE '845 PATENT

A. Overview

The '845 Patent describes a dual-mode communications system configured to perform spatial multiplexing and expanded bandwidth data transmission. Ex.1001 4:6-7. As will be seen, both spatial multiplexing and expanded bandwidth data

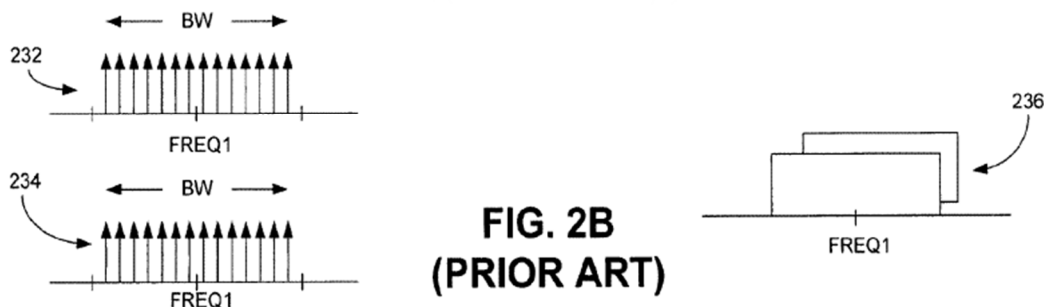
transmission were well known in the art, as was the combination of the two in a single device.

Shown below is a figure from the '845 Patent depicting a “a multiple-input multiple-output (MIMO) OFDM communication system 200” capable of spatial multiplexing. Ex.1001 2:32-38. The '845 Patent describes spatial multiplexing as “a technique where a transmission channel is divided into multiple ‘spatial channels’ through which independent streams can be transmitted and received via multiple transmit and receive antennas, respectively.” Ex.1001 2:27-30.



The MIMO system depicted above, which the '845 Patent acknowledges to be prior art, comprises hardware necessary to transmit and receive data wirelessly. Ex.1001 2:40-62. The system depicted above operates at a single common frequency for each transmitter and receiver. Ex.1001 2:42-49. Figure 2B below depicts the “spectrums of the signals processed in the MIMO system 200,” which are

“comprised of subcarriers centered at the same reference or carrier frequency (FREQ1).” Ex.1001 2:63-67.



An embodiment of the system described in the '845 Patent is shown below in

Figure 3A:

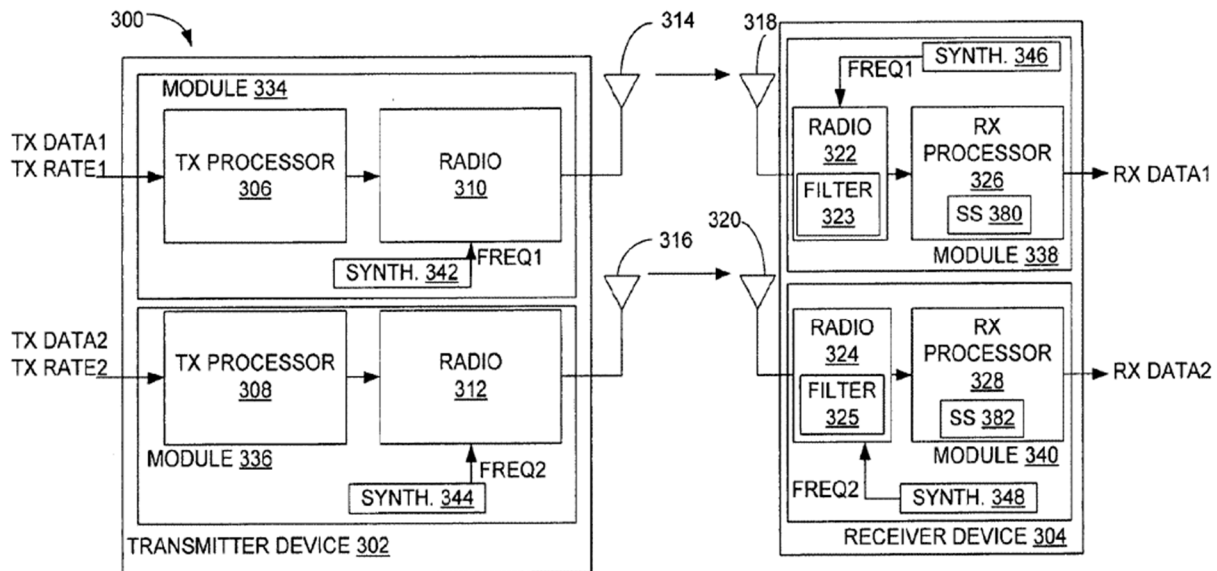


FIG. 3A

Depicted is a “multiple-input multiple-output (MIMO) orthogonal frequency division multiplexing (OFDM) communication system that implements bandwidth expansion and/or spatial multiplexing.” Ex.1001 4:53-57. Bandwidth expansion is enabled if “the synthesizers of the respective transmit/receive chains are tuned to

different, non-overlapping frequencies rather than the same frequency.” Ex.1001 4:32-34. Figures 3B, 3C, and 3D below depict “exemplary spectrums” of the BES system. Ex.1001 5:13-23.

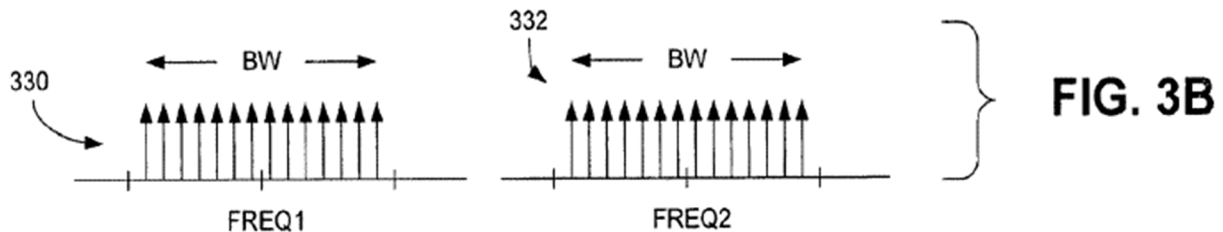


Figure 3B above depicts “subcarriers of equal bandwidth ... but at distinct reference or carrier frequencies (FREQ1 and FREQ 2) as opposed to the conventional mechanisms of using the same reference or carrier frequency.” Ex.1001 6:16-20. Figure 3C depicts “adjacent” spectrums or channels and Figure 3D depicts “non-adjacent” spectrums or channels, both as transmitted/received by the '845 Patent's system. 6:21-29.

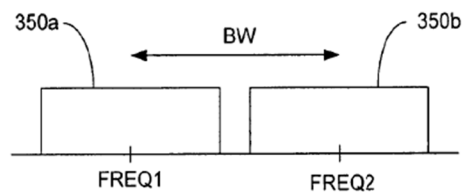


FIG. 3C

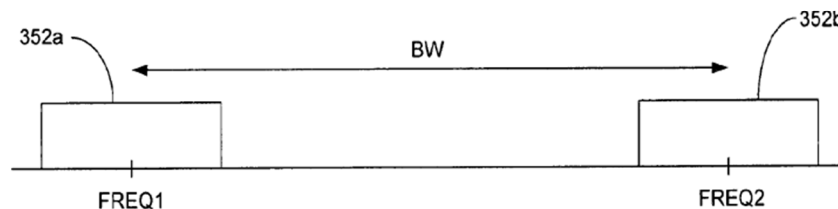


FIG. 3D

Regarding bandwidth expansion, the '845 Patent states that a benefit of non-adjacent channels is “finding a free or available channel.” Ex.1001 6:32. The '845 Patent notes that “the proposed 802.11n standard” contemplated bandwidths of greater than 20 MHz, including 40 MHz. Ex.1001 6:34-35. The '845 Patent further states that its bandwidth expansion and spatial multiplexing modes can be configured either manually or automatically based on operational conditions, such as “signal-to-noise ratio, multipath environment, [or] interference.” Ex.1001 6:57-59. The '845 Patent further notes some embodiments that employ “gap filling,” e.g., “fill[ing] in the gap between spectrums 350*a* and 350*b*” with “extra subcarriers, which may increase the composite data rate.” Ex.1001 7:23-27

B. Prosecution History

The application for the '845 patent was filed on September 27, 2012. the Examiner issued multiple obviousness rejections during prosecution. None of the references forming the grounds presented in this Petition were before the '845 Examiner.

In response to the Examiner's last rejection, dated December 27, 2017, the Applicant stated that the Examiner's reference was overcome because “The Office Action ... explicitly admits that ‘Walton does not elaborate about combining spatial multiplexing with FDD (or bandwidth expansion).’” Ex.1002 at 54. In other words,

the Applicant contended that most of the limitations of the allowed claims were not met because the reference before the Examiner purportedly did not elaborate about combining spatial multiplexing with FDD (or bandwidth expansion). Conversely, every ground in this Petition discusses the combination of spatial multiplexing and bandwidth expansion. *Infra* § IX.

C. Person of Ordinary Skill in the Art (POSITA)

Based on the relevant factors, *In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995), a POSITA would have had at least a bachelor's degree in computer science, electrical engineering, or related field, with at least three to four years of experience in wireless communication technology. Additional education could substitute for professional experience and vice versa. Ex.1003 ¶¶28-29.

V. PRIORITY DATE

For purposes of this Petition, Petitioners assume the earliest effective filing date of the '845 Patent is April 14, 2004. On that date, Provisional Application No. 60/561,877 ('877 provisional) was filed. The '845 Patent claims priority to the '877 provisional. Ex.1001 at 2. Thus, this Petition applies pre-AIA 35 U.S.C. §102 and §103 in showing unpatentability. Petitioners' prior art references qualify as prior art. *Infra* § VIII.A.

VI. CLAIM CONSTRUCTION

Petitioners apply the claim construction standard established in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005). 83 Fed. Reg. 51,340, 51,340-44 (Oct. 11, 2018). Petitioners do not believe explicit construction is required to resolve this Petition. Petitioners reserve the right to revisit constructions proposed in district court and, in accordance with 37 C.F.R. § 42.100(b), request leave to submit the district court's claim construction order for the Board to consider.

VII. PRECISE RELIEF REQUESTED AND GROUNDS RAISED

Petitioners request cancellation of claims 1-21 on the following grounds, all of which consist of prior art that was not before the '845 Patent Examiner:

Ground	Claims	Basis for Invalidity
1	1-21	§103 Walton
2	1-21	§103 Walton & Maltsev
3	1-21	§103 Ishikawa
4	1-21	§103 Ishikawa & Gardner

In support of the above grounds Petitioners also submit the declaration of Dr. William "Chuck" Easttom (Ex.1003). Dr. Easttom is a qualified expert in the technological field of the '845 Patent and is a POSITA. Ex.1003 ¶¶30; Ex.1004.

VIII. SCOPE AND CONTENT OF THE PRIOR ART

A. Brief Overview of the Prior Art

1. Walton (Ex.1005)

Walton is U.S. Patent Application No. 2002/0154705, filed on March 22, 2000 and published on October 24, 2002. Ex.1005 Cover. Walton thus qualifies as prior art under at least pre-AIA §§ 102(a), (b), and (e).

Walton describes a “High efficiency high performance communications system employing multi-carrier modulation.” Ex.1005 Cover. Walton discloses “Transmitter and receiver units for use in a communications system and configurable to provide antenna, frequency, or temporal diversity, or a combination thereof, for transmitted signals.” Ex.1005 Abstract. Figure 1, a MIMO system capable of embodying the invention described in Walton, is shown below:

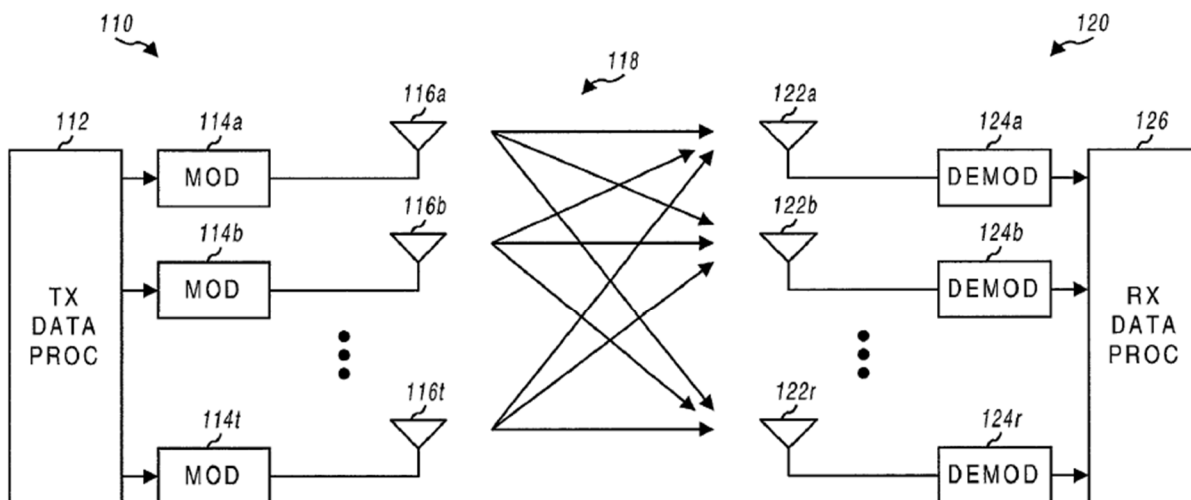


FIG. 1

Antenna diversity “refers to the transmission and/or reception of data over more than one antenna.” Ex.1005 ¶43. It is achieved by employing multiple antennas at the transmitter, the receiver, or both devices. Ex.1005 ¶45. “Spatial diversity” is a subcategory of antenna diversity that “refers to the use of multiple transmit and receive antennas to improve the reliability and/or increase the capacity of the communications link.” Ex.1005 ¶43. Walton also refers to spatial diversity as the “MIMO communications mode.” Ex.1005 ¶56.

Frequency diversity “refers to the transmission of data over more than one sub-band.” Ex.1005 ¶43. It can be achieved by employing a multi-carrier modulation scheme, such as OFDM, wherein the “overall transmission channel is essentially divided into a number of (L) parallel sub-channels that are used to transmit the same or different data.” Ex.1005 ¶48. “The overall transmission channel occupies the total operating bandwidth of W, and each of the sub-channels occupies a sub-band having a bandwidth of W/L and centered at a different center frequency. Each sub-channel has a bandwidth that is a portion of the total operating bandwidth.” Ex.1005 ¶48. “Each of the sub-channels may also be considered an independent data transmission channel that may be associated with a particular (and possibly unique) processing, coding, and modulation scheme.” Ex.1005 ¶48.

Figure 2 from Walton, below, depicts “a specific example of a transmission from a transmit antenna at a transmitter unit.” Ex.1005 ¶25. The horizontal axis

represents time and the vertical axis is frequency, as divided into sub-channels.

Ex.1005 ¶80.

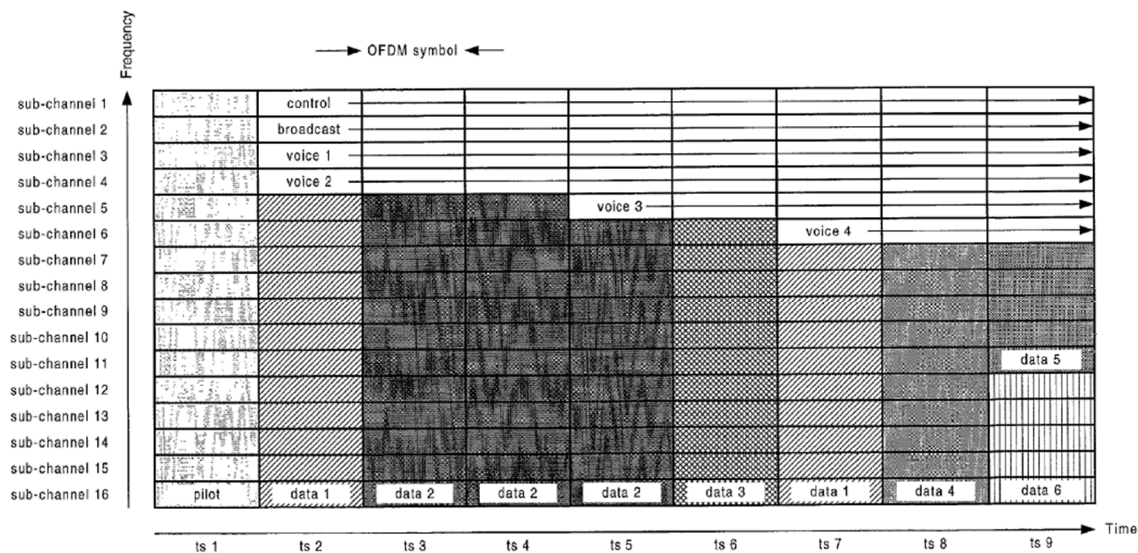


FIG. 2

Walton's antenna, frequency, or temporal diversity modes “can be independently achieved and dynamically selected.” Ex.1005 ¶42. For example, “antenna diversity is dynamically provided based on the characteristics of the communications link to provide the required performance,” including the carrier-to-noise-interference ratio. Ex.1005 ¶46. Walton further notes that “The data may be partitioned and transmitted over any defined set of two or more sub-bands to provide frequency diversity.” Ex.1005 ¶49.

2. Ishikawa (Ex.1006)

Ishikawa is U.S. Patent No. 7,130,592, filed in the U.S. on June 25, 2003. Ex.1006 Cover. Ishikawa thus qualifies as prior art under at least pre-AIA § 102(e).

Ishikawa describes a radio transmission apparatus that can “control each transmission frequency of a plurality of antennas and the number of information transmitted from the plurality of antennas according to circumstances of a propagation path.” Ex.1006 1:64-67. An embodiment of the invention is depicted in Figure 1 below, with two antennas shown “as an example.” Ex.1006 3:16-18.

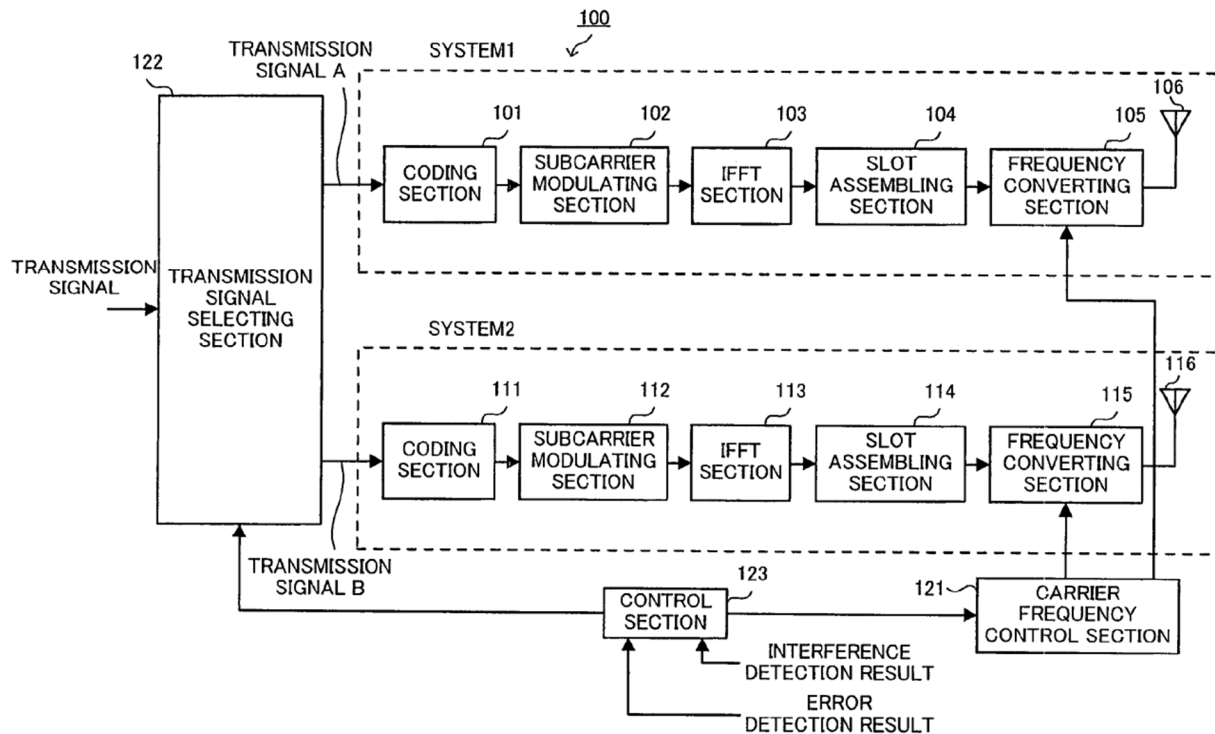


FIG.1

Ishikawa describes the ability to “adaptively select space multiplex where different information is transmitted from the plurality of antennas with the same

frequency [and] frequency multiplex where different information is transmitted from the plurality of antennas with different frequencies.” Ex.1006 2:2-11.

Two example transmissions created by Ishikawa’s system are shown below. Figure 3 depicts a spatial multiplexing transmission where two antennas transmit at the same frequency, and Figure 4 reflects frequency multiplexing where two antennas transmit information on different frequencies. Ex.1006 5:40-43, 6:3-6.

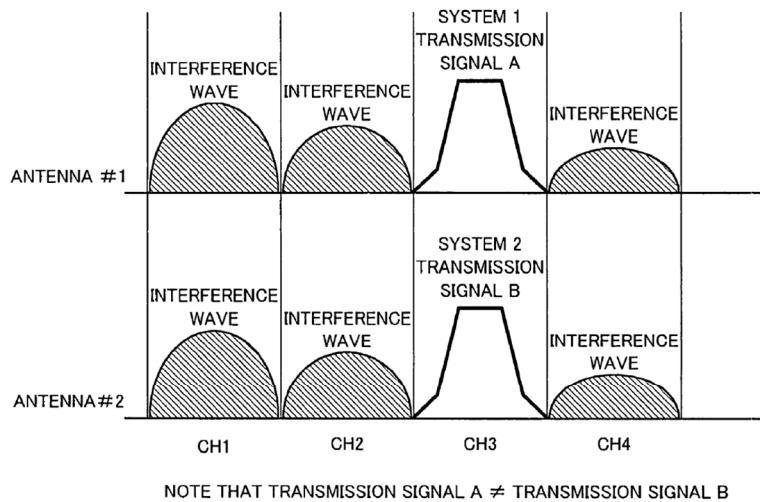


FIG.3

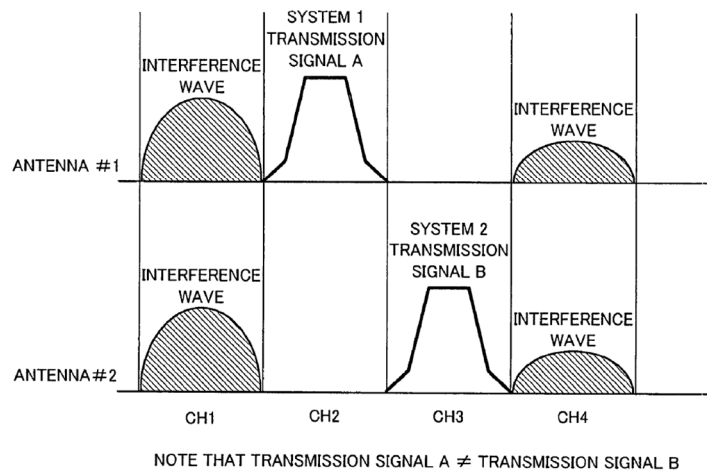


FIG.4

3. Maltsev (Ex.1007)

Maltsev is U.S. Patent No. 7,885,178, filed on December 29, 2003 and issued February 8, 2011. Ex.1007 Cover. Maltsev qualifies as prior art under at least § 102(e).

Maltsev is directed to multichannel receivers for wideband OFDM communications. Ex.1007 Cover. Maltsev describes a receiver that “may receive an OFDM symbol on a wideband communication channel” that may comprise one or more subchannels that are themselves “separated in frequency” and which may comprise OFDM subcarriers. Ex.1007 2:15-22.

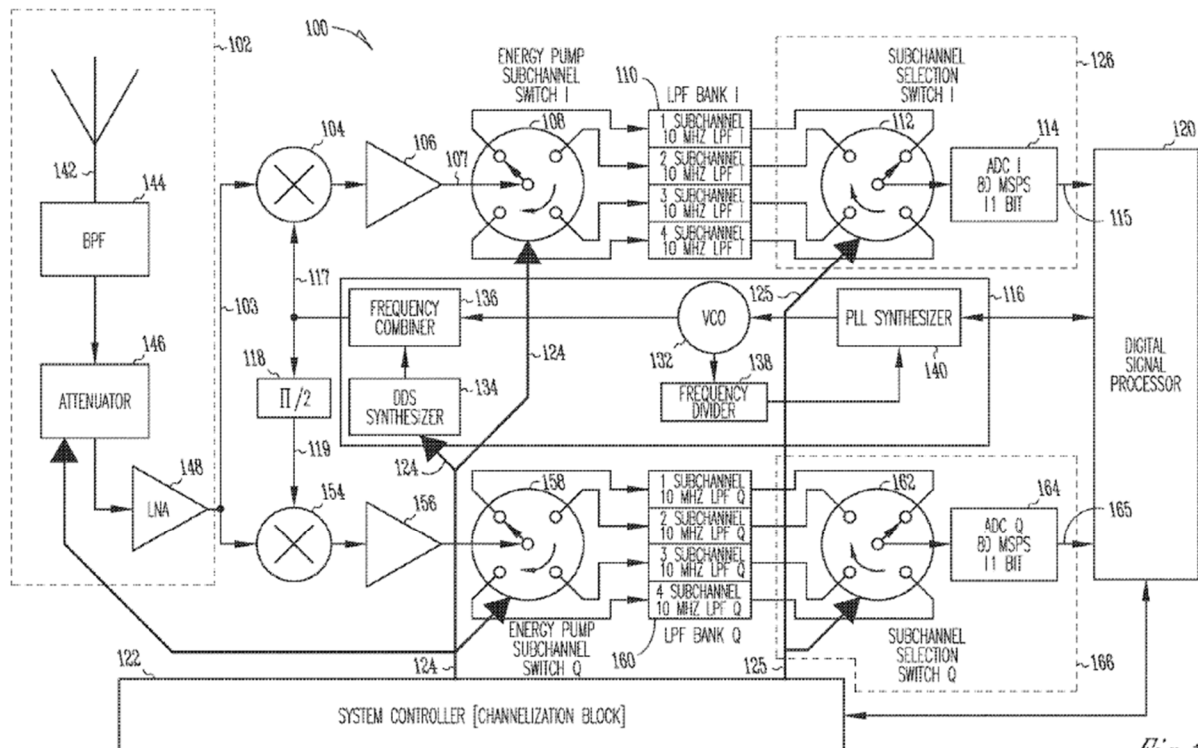


Fig. 1

Figure 1, above, depicts an embodiment in accordance with Maltsev's invention. Maltsev notes that the antenna assembly depicted in Figure 5 below "may be suitable for use as RF and front-end circuitry 102" as seen in Figure 1. Ex.1007 8:32-35.

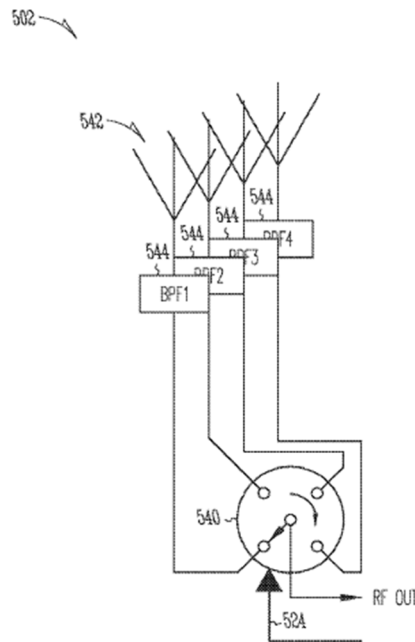


Fig. 5

Maltsev discloses embodiments wherein it acts as a "genuine multichannel receiver," receiving OFDM symbols over more than one subchannel. Ex.1007 3:43-45. In embodiments reflected by Figure 5, a receiver "may utilize more than one of spatially-diverse antennas 542 to "divide" a single subchannel into one or more spatial channels." Ex.1007 8:37-39. Further, "each antenna 542 may receive signals from one spatial channel." Ex.1007 8:39-40. Spatial channels may carry the same

data as other spatial channels or different data, allowing for increased data throughput without an increase in frequency bandwidth. Ex.1007 8:40-47.

4. Gardner (Ex.1008)

Gardner is U.S. Patent No. 7,916,803, filed on April 5, 2004, issued on March 29, 2011, and claiming priority to U.S. Provisional Application No. 60/461,999, which was filed on April 10, 2003. Ex.1008 Cover. Gardner thus qualifies as prior art under at least § 102 (e).

Gardner is directed towards modified preambles for 802.11 devices, and it discloses multi-antenna MIMO devices “where multiple data streams are multiplexed spatially” and “multichannel techniques, where an extended transmitter transmits using more than one 802.11a channel at a time.” Ex.1008 Abstract.

Gardner’s Figure 5 “illustrates the case where out-of-band pilots are attenuated for 20 MHz channels used to transmit a MIMO signal.” Ex.1008 6:29-31.

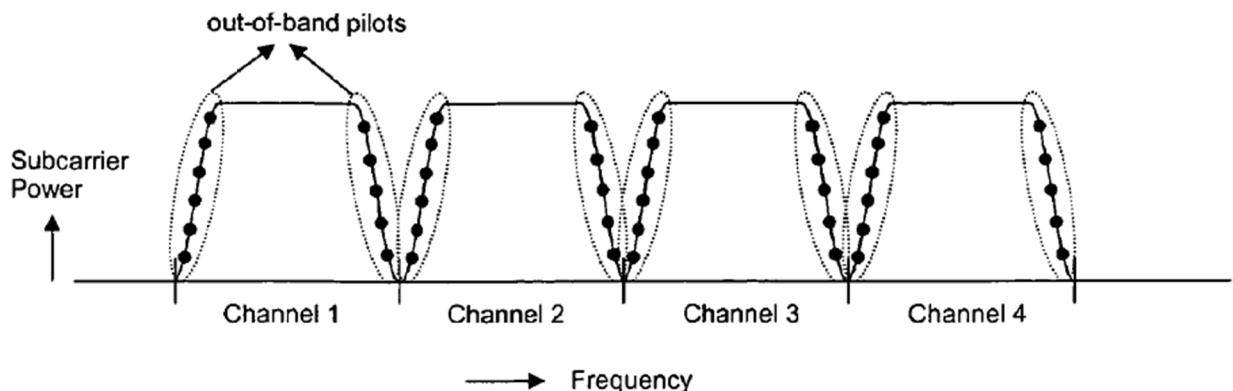


FIG. 5

Gardner further notes that “[s]ome or all of these out-of-band subcarriers may also be used in the data symbols to increase the data rate.” Ex.1008 6:34-35. Gardner explains that it is possible that one device transmits on channels 1 and 4 simultaneously, while channels 2 and 3 are occupied by other devices. Ex.1008 6:38-40.

Gardner also contains Figures 6 and 7, which respectively depict the situations in which a single device transmits using two adjacent 20 MHz channels and four adjacent 20 MHz channels.

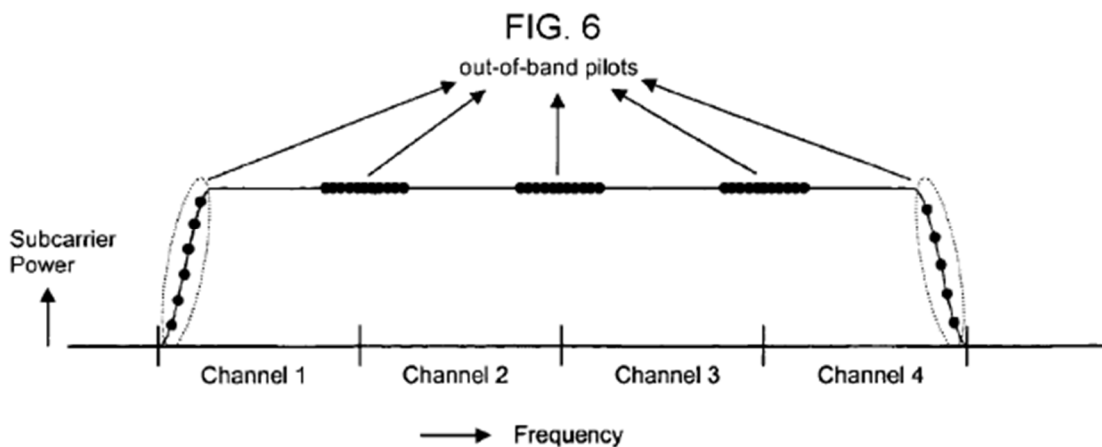
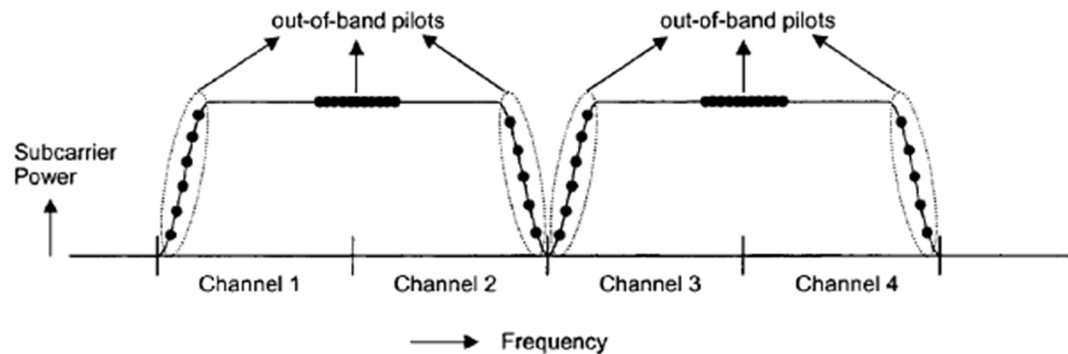


FIG. 7

As depicted, the previously attenuated out-of-band subcarriers/pilots are no longer attenuated, allowing information to be carried on them. Ex.1008 6:57-61.

B. Motivations to Combine

1. Walton & Maltsev

A POSITA would have been motivated to combine the teachings of Walton with those of Maltsev. Ex.1003 ¶61. Both references are analogous: they originate in the same field of endeavor (OFDM-based wireless data transmission) and are directed towards the same problem as the '845 Patent: increasing the throughput and reliability of OFDM data transmissions. *E.g.*, Ex.1005 ¶12 (describing a communications system “capable of providing increased spectral efficiency, improved performance, and enhanced flexibility by employing a combination of antenna, frequency, and temporal diversity”); Ex.1007 1:24-31 (describing a need for an OFDM communications system capable of greater bandwidth).

Moreover, at the time of the '845 Patent's purported invention, it was routine to combine MIMO spatial multiplexing techniques with bandwidth expansion techniques such as frequency division duplexing (FDD). Ex.1009 at 2:53-54 (U.S. Patent No. 7,324,429, filed on October 23, 2003 and disclosing a MIMO system that “may be a time division duplex (TDD) system or a frequency division duplex (FDD) system.”); Ex.1008, Cover (“The extended devices might use multiple antenna techniques (MIMO) ... and/or multi-channel techniques.”). Thus, it would have been

a simple combination of known elements to obtain a predictable result to modify Walton with the MIMO-wideband channel system of Maltsev. Ex.1003 ¶64. A

A POSITA would have been further motivated to combine the references given their mutual relevance to the ongoing development of the 802.11n standard. Ex.1003 ¶63. For example, both are dedicated to enhancing OFDM data transmission via the use of MIMO spatial multiplexing and bandwidth expansion, two central features of the 802.11n standard. Ex.1012 at 3, 7, 19 (2009 Cisco Presentation noting that development of 802.11n began in 2002 and that MIMO and channel-bonded 40 MHz Channels were two of the standard's central advancements).

Thus, combining Walton and Maltsev would have been a predictable, routine step in developing an improved wireless data transmission methodology in line with contemporary developments in the 802.11n standard. The combination would require neither extensive experimentation nor undue burden but would rather reflect the normal course of development in the field given 802.11n's publicly available and collaborative development process and the references' similarity. Ex.1003 ¶¶62-63.

2. Ishikawa & Gardner

A POSITA would have been motivated to combine the teachings of Ishikawa and Gardner. Ex.1003 ¶65. Gardner is analogous to Ishikawa in that it is from the same field of endeavor (OFDM-based wireless communication) and is directed to

the same issue as that of the '845 Patent (increasing OFDM data throughput and reliability). Ex.1006 1:60-2:11 (describing a system capable of improving spectrum efficiency and transmission rate using adaptive selection of frequency/space multiplexing); Ex.1008 2:28-32 (“One approach to obtaining higher data rates is the use of more bandwidth. Another approach, used by itself or as well as the use of more bandwidth, is MIMO ... channels.”).

Moreover, the practices of transmitting in non-adjacent channels and using the “gap” between channels to transmit additional data were both well-known techniques at the time of '845 Patent's filing. *E.g.*, Ex.1010 at 3:20-4:10 (International Patent App. No. WO2003003646A2, filed in July 2002 and published in January 2003 discussing transmitting on non-adjacent channels for greater flexibility and efficiency); Ex.1011 at 4 (2003 Texas Instruments white paper discussing transmitting additional data in the empty guard band between adjacent channels). As noted in the previous section, it was also routine to combine MIMO spatial multiplexing techniques with bandwidth expansion techniques. Thus, it would have been a simple combination of known elements to obtain a predictable result to modify Ishikawa with Gardner's teachings regarding the combination of spatial multiplexing and bandwidth expansion, as well as regarding transmitting on non-adjacent channels and gap filling. Ex.1003 ¶68.

Further, like Ishikawa, Gardner’s subject matter (enabling MIMO devices for bandwidth expansion) and its relevance to the 802.11n standard would have motivated a POSITA to combine the two references. Ex.1003 ¶¶67; Ex.1012 at 3, 7 (2009 Cisco Presentation noting that development of 802.11n began in 2002 and that MIMO is the “heart of 802.11n.”).

Thus, combining Ishikawa and Gardner would have been a predictable, routine step in developing an improved wireless data transmission methodology in line with contemporary developments in the 802.11n standard. Ex.1003 ¶¶66-67.

IX. THE CHALLENGED CLAIMS ARE UNPATENTABLE.

As used herein, the verbs “disclose,” “suggest,” and “teach” reflect the contention that a reference’s disclosure renders a given claim element or concept as obvious to a POSITA.

Claims 1, 7, 11, and 18 are substantially similar except that claims 1 and 7 are method claims, claims 11 and 18 are system claims, claims 1 and 11 are transmitter claims, and claims 7 and 18 are receiver claims. Put differently, the four independent claims of the ’845 Patent consist of two system-and-method pairings of one transmitter and one receiver claim. The ’845 Patent’s independent claims are thus analyzed as one group. Substantially similar dependent claims are likewise analyzed as one group. To the extent a reference discloses only transmission or reception, the

converse receiving/transmitting action would have been rendered obvious to a POSITA. Ex.1003 ¶70.

For ease of review, the analyses of the four independent claims are presented together in three groupings designated by [pre] (the preamble), [a] (the '845 Patent's first mode of operation), and [b] (the '845 Patent's second mode of operation).

A. Grounds 1 & 2: Claims 1-21 are rendered obvious by Walton and/or Walton in view of Maltsev under Section 103.

Walton and/or Walton in view of Maltsev render every claim of the '845 Patent obvious.

1. Independent Claims 1, 7, 11, and 18

a) 1[pre] A method of operation of a transceiver in a plurality of modes including at least a first mode and a second mode, the method comprising:

7[pre] A method of operation of a transceiver in a plurality of modes including at least a first mode and a second mode, the method comprising:

11[pre] An article of manufacture including a non-transitory computer-readable medium having instructions stored thereon that, upon execution by a computing device, cause the computing device to perform operations comprising:

18[pre] An article of manufacture including a non-transitory computer-readable medium having instructions stored thereon that, upon execution by a computing device, cause the computing device to perform operations comprising:

To the extent the preambles are limiting, Walton discloses these limitations. Ex.1003 ¶¶71, 151, 197, 251. Walton discloses: “Transmitter and receiver units for use in a communications system and configurable to provide antenna, frequency, or temporal diversity, or a combination thereof, for transmitted signals.” Ex.1005, Abstract. Walton further discloses an embodiment employing “one or more antennas,” and that “each antenna receives and transmits a respective modulated signal.” Ex.1005 ¶¶ 13-14. Walton also discloses that its communications system may include “a central system ... having a number of antennas that transmit data to, and receive data from, a number of remote systems.” Ex.1005 ¶36.

Walton also discloses Figure 1 below, stating “For the bidirectional communications system, each of systems 110 and 120 may operate as a transmitter unit or a receiver unit, or both concurrently, depending on whether data is being transmitted from, or received at, the unit.” Ex.1005 ¶34.

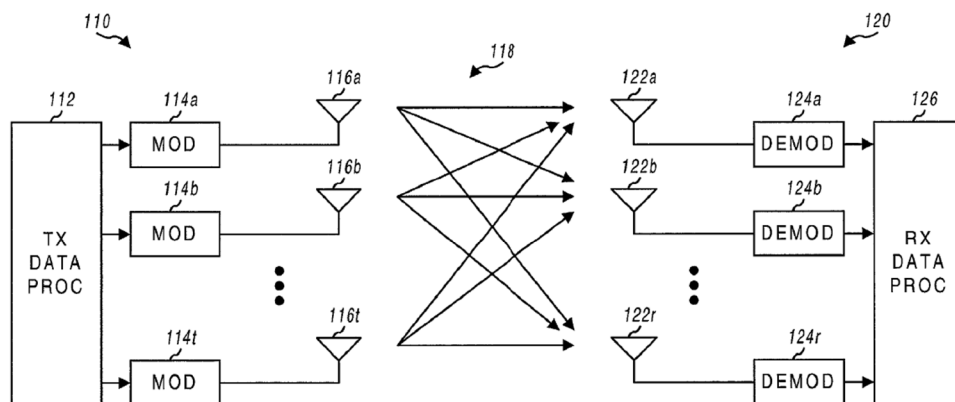


FIG. 1

Walton thus renders obvious all of the above limitations.

b) **1[a][i] in the first mode based on spatial multiplexing:
generating separate first mode transmit symbols by
first transmitters of the transceiver and second
transmitters of the transceiver; and**

7[a][i] in the first mode based on spatial multiplexing:

**11[a][i] generating separate first mode transmit
symbols by first transmitters and second transmitters
of a transceiver;**

**18[a][i] receiving in a first mode based on spatial
multiplexing**

Walton renders these limitations obvious. Ex.1003 ¶83, 88, 156, 202, 256.

The “receiving” element of claim 18[a][i] is addressed in the next section.

Regarding the first mode based on spatial multiplexing, Walton’s “antenna diversity” mode “refers to the transmission and/or reception of data over more than one antenna.” Ex.1005 ¶43. Walton further describes “spatial diversity” as a subcategory of antenna diversity. Ex.1005 ¶43. “[S]patial diversity refers to the use of multiple transmit and receive antennas to improve the reliability and/or increase the capacity of the communications link.” Ex.1005 ¶43. “With spatial diversity, data is demultiplexed and transmitted (concurrently in each of the assigned sub-channels or over different time slots) over multiple antennas.” Ex.1005 ¶119.

Walton also refers to spatial diversity as the “MIMO communications mode.”
Ex.1005 ¶56. “[T]he MIMO communications mode provides greater spectral
efficiency when used.” Ex.1005 ¶57.

Regarding the generation of separate first mode transmit symbols by first and
second transmitters, the transmitter disclosed in Walton “provide[s] antenna,
frequency, or temporal diversity, or a combination thereof, for transmitted signals.”
Ex.1005 ¶13. Transmitter units include “a system data processor,” which
“generate[s] one or more (N_T) modulation symbol vector streams.” Ex.1005 ¶13.
Each vector stream “includes a sequence of modulation symbol vectors
representative of data in one or more channel data streams.” Ex.1005 ¶13.

Walton further discloses:

The system data processor may include one or more channel data
processors, encoders, demultiplexers, and combiners. In a specific
implementation, each encoder encodes a respective channel data stream
to generate an encoded data stream, each channel data processor
processes a respective encoded data stream to generate a stream of
modulation symbols, each demultiplexer demultiplexes the stream of
modulation symbols into one or more symbol sub-streams, and each
combiner selectively combines the symbol sub-streams to generate a
modulation symbol vector stream for an associated antenna.

Ex.1005 ¶15. “The modulation symbol vectors are generated and transmitted in a
manner to provide antenna, frequency, or temporal diversity, or a combination
thereof.” Ex.1005 ¶17.

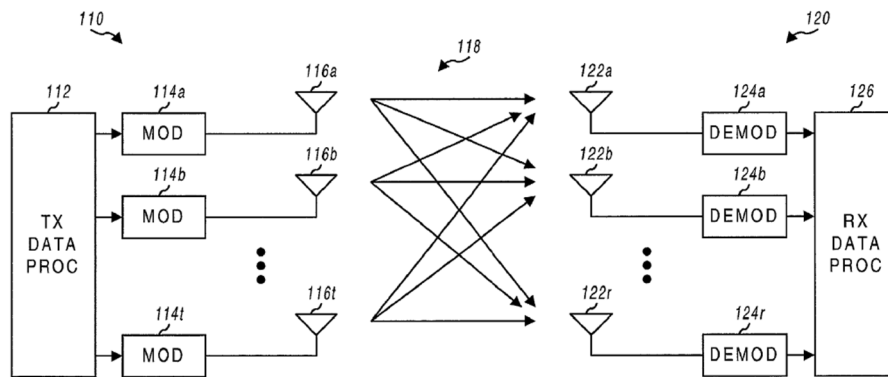


FIG. 1

Walton describes Figure 1, above, as “a diagram of a multiple-input multiple-output (MIMO) communications system 100 ... [that] can be operative to provide a combination of antenna, frequency, and temporal diversity to increase spectral efficiency, improve performance, and enhance flexibility.” Ex.1005 ¶31. “For simplicity, communications system 100 is shown to include one transmitter unit (i.e., system 110) and one receiver unit (i.e., system 120)” but that other configurations of its system are possible, including multiple transmitter units and/or receiver units. Ex.1005 ¶35.

From the above disclosures, a POSITA would have recognized that Walton renders every element of the above limitations obvious based on, for example, Walton’s multiple transmitter units’ generating symbol streams according to its diversity or MIMO modes. *E.g.*, Ex.1003 ¶78.

- c) **1[a][ii] transmitting the separate first mode transmit symbols from the first transmitters and the second transmitters over a first set of antennas and a second set of antennas**

7[a][iii] receiving separate first mode symbols with first receivers of the transceiver and second receivers of the transceiver via a first set of antennas and a second set of antennas

11[b][ii] transmitting in a first mode the separate first mode transmit symbols from the first transmitters and the second transmitters over a first set of antennas and a second set of antennas

18[a][ii] receiving in a first mode based on spatial multiplexing separate first mode symbols with first receivers of a transceiver and second receivers of the transceiver at a mobile station via a first set of antennas and a second set of antennas

Walton renders these limitations obvious. Ex.1003 ¶¶96, 163, 208, 256.

Moreover, Walton discloses that its MIMO communications mode is “characterized by transmission of each of the at least one channel data stream using a plurality of transmit antennas and reception of the transmission using a plurality of receive antennas to improve the reliability of the transmission and increase link capacity. Ex.1005 Claim 18. “The modulation symbol vectors are generated and transmitted in a manner to provide antenna, frequency, or temporal diversity, or a combination thereof. For example, the data for a particular channel data stream may be transmitted from one or more antennas.” Ex.1005 ¶17.

“Each transmitter unit may include a single transmit antenna or a number of transmit antennas, such as that shown in FIG. 1. Similarly, each receiver unit may include a single receive antenna or a number of receive antennas, again such as that

shown in FIG. 1.” Ex.1005 ¶36. Walton also discloses “The MIMO communications mode employs antenna diversity at both ends of the communication link and is generally used to improve both the reliability and increase the capacity of the communications link.” Ex.1005 ¶56.

Walton also discloses:

In a terrestrial communications system (e.g., a cellular system, a broadcast system, an MMDS system, and others), an RF modulated signal from a transmitter unit may reach the receiver unit via a number of transmission paths.

Ex.1005 ¶45. As a further example, Walton further discloses “a number of remote systems (i.e., subscriber units, similar to remote stations in the CDMA system).”

Ex.1005 ¶36.

A POSITA would have found every element of the above limitations obvious based on, for example, Walton’s transmission and reception of modulation symbol vectors. Ex.1003 ¶84. A POSITA would recognize Walton also discloses the mobile station of limitation 18[a][ii] based on its discussion of a cellular system and remote stations in a CDMA system. Ex.1003 ¶255.

d) 1/11[a][iii] across a spectrum of frequencies that is same for each of the first transmitters and the second transmitters; and

7/18[a][iii] across a spectrum of frequencies that is same for each of the first receivers and the second receivers; and

Walton renders obvious every element of the above limitations. Ex.1003 at ¶96, 163, 208, 256. With respect to the modulation symbol vectors, Walton notes that they are “transmitted in a manner to provide antenna, frequency, or temporal diversity, or a combination thereof.” Ex.1005 ¶17. The disjunctive nature of this disclosure confirms that the transmission may or may not provide “frequency diversity,” which Walton defines as “the transmission of data over more than one sub-band.” Ex.1005 ¶43. This understanding is confirmed by, for example, Walton noting that “frequency and temporal diversity *may* be used in conjunction with the different transmit antennas.” Ex.1005 ¶47.

“In the diversity communications mode, data is transmitted on one or more sub-channels, from one or more antennas, and at one or more time periods. The allocated sub-channels may be associated with the same antenna, or may be sub-channels associated with different antennas.” Ex.1005 ¶55. Moreover, “The MIMO communications mode may further employ frequency and/or temporal diversity in combination with the antenna diversity.” Ex.1005 ¶56.

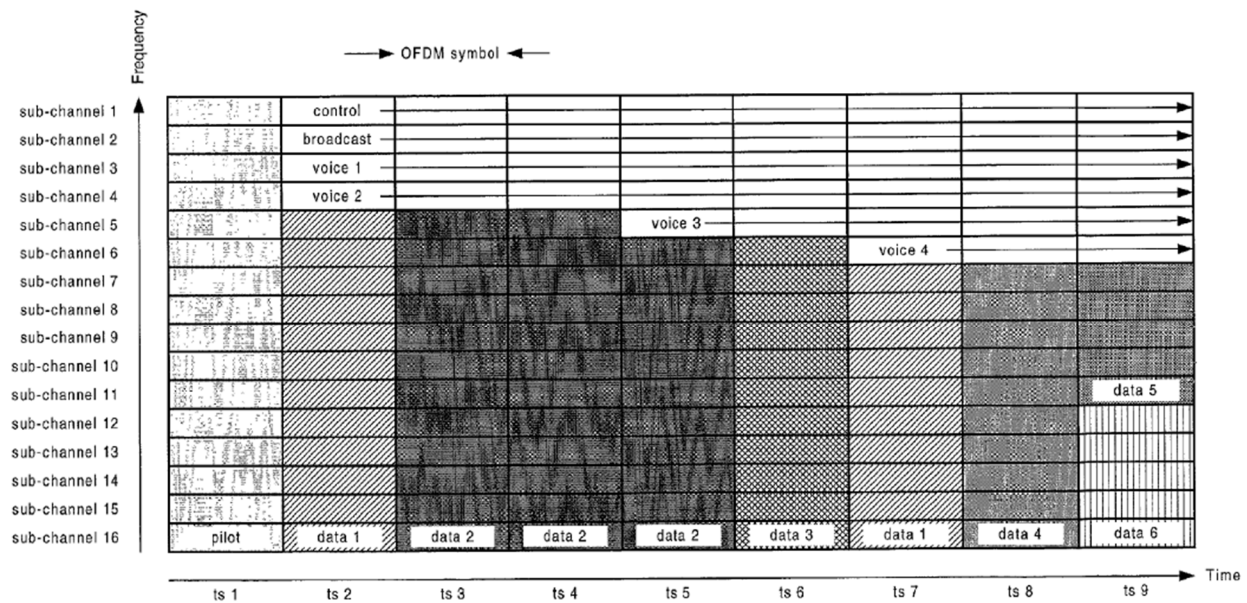


FIG. 2

Walton's Figure 2, above, is "a diagram that graphically illustrates a specific example of a transmission from a transmit antenna at a transmitter unit." Ex.1005 ¶25.

FIG. 2 shows a specific example of a transmission from one of NT transmit antennas at a transmitter unit. ... In this example, the transmission channel includes 16 sub-channels and is used to transmit a sequence of OFDM symbols, with each OFDM symbol covering all 16 sub-channels (one OFDM symbol is indicated at the top of FIG. 2 and includes all 16 sub-bands).

Ex.1005 ¶80. "[A]ntenna diversity for a particular transmission (e.g., voice call 1) may be achieved by transmitting the (voice) data on a particular sub-channel (e.g., sub-channel 1) over two or more antennas." Ex.1005 ¶87. "The overall transmission channel occupies the total operating bandwidth of W , and each of the sub-channels occupies a sub-band having a bandwidth of W/L and centered at a different center frequency." Ex.1005 ¶48.

Moreover:

The same or different data may be transmitted from multiple antennas and/or on multiple sub-bands to obtain the desired diversity. For example, the data may be transmitted on: (1) one sub-channel from one antenna, (2) one sub-channel (e.g., sub-channel 1) from multiple antennas, (3) one sub-channel from all NT antennas, (4) a set of sub-channels (e.g., sub-channels 1 and 2) from one antenna, (5), a set of sub-channels from multiple antennas, (6) a set of sub-channels from all NT antennas, or (7) a set of channels from a set of antennas (e.g., sub-channel 1 from antennas 1 and 2 at one time slot, sub-channels 1 and 2 from antenna 2 at another time slot, and so on). Thus, any combination of sub-channels and antennas may be used to provide antenna and frequency diversity.

Ex.1005 ¶88.

Every element of the above limitations would have been obvious to a POSITA based on, for example, the optionality of whether to provide frequency diversity in combination with other communication modes and the transmission of data on one or multiple of the same sub-channels over multiple antennas. Ex.1003 ¶92.

e) **1[b][i] in the second mode based on the spatial multiplexing and bandwidth expansion: generating separate second mode transmit symbols by the first transmitters and the second transmitters;**

7[b][i] in the second mode based on the spatial multiplexing and bandwidth expansion:

11[b][i] generating separate second mode transmit symbols by the first transmitters and the second transmitters;

18[b][i] receiving in a second mode based on the spatial multiplexing and bandwidth expansion

Walton and Walton in view of Maltsev disclose these limitations. Ex.1003 ¶106, 109. The “receiving” element of claim 18[b][i] is addressed in this and the next section.

Walton’s transmitter and receiver units are “configurable to provide antenna, frequency, or temporal diversity, or a combination thereof, for transmitted signals.” Ex.1005, Abstract. Moreover, Walton’s communication system “can be designed to concurrently support both diversity and MIMO communications modes.” Ex.1005 ¶58. “The MIMO communications mode may further employ frequency and/or temporal diversity in combination with the antenna diversity.” Ex.1005 ¶56.

Regarding its frequency diversity mode, Walton explains that it “refers to the transmission of data over more than one sub-band.” Ex.1005 ¶43. Moreover:

With OFDM modulation, the overall transmission channel is essentially divided into a number of (L) parallel sub-channels that are used to transmit the same or different data. The overall transmission channel occupies the total operating bandwidth of W, and each of the sub-channels occupies a sub-band having a bandwidth of W/L and centered at a different center frequency. Each sub-channel has a bandwidth that is a portion of the total operating bandwidth. Each of the sub-channels may also be considered an independent data transmission channel that may be associated with a particular (and possibly unique) processing, coding, and modulation scheme, as described below.

EXWLA ¶48. “In the diversity communications mode, data is transmitted on one or more sub-channels, from one or more antennas, and at one or more time periods. The allocated sub-channels may be associated with the same antenna, or may be sub-

channels associated with different antennas.” Ex.1005 ¶55. For example, data may be transmitted on “a set of channels from a set of antennas (e.g., sub-channel 1 from antennas 1 and 2 at one time slot, sub-channels 1 and 2 from antenna 2 at another time slot, and so on.” Ex.1005 ¶88.

Walton discloses the symbol generation limitations of the ’845 Patent with its transmitters comprising “system data processor[s]” that “generate one or more (N_T) modulation symbol vector streams,” each including “a sequence of modulation symbol vectors representative of data in one or more channel data streams.” *Supra* § IX.A.1.b (citing Ex.1005). Walton further discloses:

The system data processor may include one or more channel data processors, encoders, demultiplexers, and combiners. In a specific implementation, each encoder encodes a respective channel data stream to generate an encoded data stream, each channel data processor processes a respective encoded data stream to generate a stream of modulation symbols, each demultiplexer demultiplexes the stream of modulation symbols into one or more symbol sub-streams, and each combiner selectively combines the symbol sub-streams to generate a modulation symbol vector stream for an associated antenna.

Ex.1005 ¶15. “The modulation symbol vectors are generated and transmitted in a manner to provide antenna, frequency, or temporal diversity, or a combination thereof.” Ex.1005 ¶17.

A POSITA would thus recognize that Walton renders the above limitation obvious based on, for example, the employment of its frequency diversity mode in

combination with its spatial diversity/MIMO modes in generating modulation symbol vector streams. Ex.1003 ¶¶97-98.

To the extent Walton does not render the above limitations obvious, Walton in view of Maltsev would have done so. Ex.1003 ¶¶99. For example, Maltsev discloses a receiver that “may receive an OFDM symbol on a wideband communication channel.” Ex.1007 2:14-16. The wideband channel may comprise “one or more ... frequency-separated subchannels” with respective bandwidths of 20 MHz. Ex.1007 4:17-23. In embodiments where the receiver “operates as a genuine multichannel receiver, FFTs may be performed for OFDM symbols received over more than one subchannel.” Ex.1007 3:43-45.

Further, regarding spatial multiplexing, Maltsev’s receiver in some embodiments “may utilize more than one of spatially-diverse antennas 542 to “divide” a single subchannel into one or more spatial channels.” Ex.1007 8:36-39. A receiver may “receive an OFDM symbol over a single subchannel comprising a plurality of spatial channels” where “each of a plurality of spatially diverse antennas may receive signals from one spatial channel.” Ex.1007 12:47-50. Spatial channels may either communicate “separate or independent data streams on the same subcarriers as the other spatial channels, allowing the reception of additional data without an increase in frequency bandwidth” or “may be used to communicate the same data as the other spatial channels.” Ex.1007 12:52-57.

A POSITA would have thus found the above obvious over Walton in view of Maltsev, as Maltsev discloses a second mode of simultaneous spatial multiplexing and bandwidth expansion using multiple antennas. Ex.1003 ¶106.

- f) **1[b][ii] transmitting the separate second mode transmit symbols from the first transmitters over the first set of antennas across a first spectrum of frequencies;
and transmitting the separate second mode transmit symbols from the second transmitters over the second set of antennas across a second spectrum of frequencies,**
- 7[b][ii] receiving separate second mode symbols with the first receivers of the transceiver via the first set of antennas across a first spectrum of frequencies;
and receiving the separate second mode symbols with the second receivers of the transceiver via the second set of antennas across a second spectrum of frequencies,**
- 11[b][ii] transmitting in a second mode the separate second mode transmit symbols from the first transmitters over the first set of antennas across a first spectrum of frequencies;
and transmitting in the second mode the separate second mode transmit symbols from the second transmitters over the second set of antennas across a second spectrum of frequencies,**

18[b][ii] receiving in a second mode based on the spatial multiplexing and bandwidth expansion separate second mode symbols with the first receivers of the transceiver at the mobile station via the first set of antennas across a first spectrum of frequencies; and receiving in the second mode the separate second mode symbols with the second receivers of the transceiver at the mobile station via the second set of antennas across a second spectrum of frequencies,

Walton and Walton in view of Maltsev render these limitations obvious.

Ex.1003 ¶¶ 114, 119, 174, 214, 217, 260-61, 266.

As discussed in the previous section, Walton discloses generating separate second mode transmit symbols by first and second transmitters in a second mode based on spatial multiplexing and bandwidth expansion.

Walton further discloses “The same or different data may be transmitted from multiple antennas and/or on multiple sub-bands to obtain the desired diversity.”

Ex.1005 ¶88. “Antenna, frequency, and temporal diversity may be respectively achieved by transmitting data from multiple antennas, on multiple sub-channels in different sub-bands, and over multiple time slots.” Ex.1005 ¶87. “A combination of antenna and frequency diversity may be obtained by transmitting data from two or more antennas and on two or more sub-channels.” Ex.1005 ¶87.

“The same or different data may be transmitted from multiple antennas and/or on multiple sub-bands to obtain the desired diversity.” Ex.1005 ¶88. Furthermore, “In accordance with certain embodiments of the invention that provide the most

flexibility and are capable of achieving high performance and efficiency, each sub-channel at each time slot for each transmit antenna may be viewed as an independent unit of transmission (i.e., a modulation symbol) that can be used to transmit any type of data such as pilot, signaling, broadcast, voice, traffic data, and others, or a combination thereof (e.g., multiplexed voice and traffic data).” Ex.1005 ¶89.

Moreover:

The modulation symbol vectors are generated and transmitted in a manner to provide antenna, frequency, or temporal diversity, or a combination thereof. For example, the data for a particular channel data stream may be transmitted from one or more antennas, on one or more sub-bands of the system operating bandwidth, and at one or more time periods to respectively provide antenna, frequency, and temporal diversity.

Ex.1005 ¶17. “[A]ntenna diversity includes transmit diversity and receive diversity. For transmit diversity, data is transmitted over multiple transmit antennas. ... For receive diversity, modulated signals are received on multiple receive antennas, and diversity is achieved by simply receiving the signals via different transmission paths.” Ex.1005 ¶47.

All elements of the above claim limitations would have been obvious to a POSITA based on, for example, the transmission and reception of data using multiple transmitters, receivers, and antennas while operating in frequency diversity and spatial diversity/MIMO modes over multiple subchannels/sub-bands of the system’s operating bandwidth. Ex.1003 ¶ 110. A POSITA would recognize Walton

also discloses the mobile station of limitation 18[b][ii] based on its discussion of a cellular system and remote stations in a CDMA system, as noted above in section IX.A.1.c. Ex.1003 ¶255.

Moreover, Walton in view of Maltsev would have rendered the above limitations obvious. Ex.1003 ¶119. In addition to the previous section's disclosures wherein Maltsev discloses a receiver capable of simultaneous spatial multiplexing and bandwidth expansion using multiple antennas, Maltsev discloses that its receiver "may be part of a ... device that may receive and/or transmit information wirelessly." Ex.1007 6:3-8. Thus, in addition to Walton's disclosure of the above limitations, a POSITA would have found them obvious over Walton in view of Maltsev, as the combination discloses every element of the above limitations. Ex.1003 ¶119.

g) 1/7/11/18[b][iii] wherein the first spectrum of frequencies does not overlap with the second spectrum of frequencies.

Walton discloses these limitations. Ex.1003 ¶119, 174, 217, 266.

As previously explained in Section IX.A.1.e, Walton's frequency diversity mode corresponds to the '845 Patent's expanded bandwidth mode, as Walton discloses "the transmission of data over more than one sub-band," and "[e]ach of the sub-channels may also be considered an independent data transmission channel that may be associated with a particular (and possibly unique) processing, coding, and modulation scheme. Ex.1005 ¶43, 48. Data "may be partitioned and transmitted over

any defined set of two or more sub-bands to provide frequency diversity.” Ex.1005 ¶49.

A POSITA would have found all elements of the above claim limitation obvious based on, for example, Walton’s discussion of transmitting data simultaneously over multiple independent and non-overlapping sub-channels representing portions of the system’s total operating bandwidth. Ex.1003 ¶ 119.

To the extent Walton does not render the above limitations obvious, Walton in view of Maltsev would have done so. Ex.1003 ¶119, 174, 217, 266. For example, Maltsev discloses a receiver that may receive an OFDM on a wideband communication channel comprising subchannels that “may be frequency-division multiplexed (i.e., separated in frequency).” Ex.1007 2:16-18. A POSITA would have found the above limitations obvious over Walton in view of Maltsev, as Maltsev discloses first and second frequency spectrums that are non-overlapping. Ex.1003 ¶167.

2. Dependent Claims

- a) [2] The method of claim 1, further comprising switching between the first mode and the second mode based on operating conditions.**

[15] The article of manufacture of claim 11, wherein the instructions, upon execution by the computing device, cause the computing device to perform automatically switching between the first mode and the second mode based on operating conditions.

Walton discloses these limitations. Ex.1003 ¶123, 238.

Walton discloses first and second modes in that its system “can be designed to concurrently support both diversity and MIMO communications modes.” Ex.1005

¶58. Further:

Communications system 100 can be operative to provide a combination of antenna, frequency, and temporal diversity to increase spectral efficiency, improve performance, and enhance flexibility. Increased spectral efficiency is characterized by the ability to transmit more bits per second per Hertz (bps/Hz) when and where possible to better utilize the available system bandwidth. ... Improved performance may be quantified, for example, by a lower bit-error-rate (BER) or frame-error-rate (FER) for a given link carrier-to-noise-interference ratio (C/I).

Ex.1005 ¶31.

Walton also discloses that “antenna, frequency, or temporal diversity can be independently achieved and dynamically selected.” Ex.1005 ¶42. For example, “antenna diversity is dynamically provided based on the characteristics of the communications link to provide the required performance.” Ex.1005 ¶46. And “The combination of antenna, frequency, and temporal diversity also allows the communications system to concurrently accommodate different types of services

having disparate data rate, processing delay, and quality of service requirements.”

Ex.1005 ¶52.

Every element of the above limitations would have been obvious to a POSITA because Walton teaches dynamically switching and combining its modes based on characteristics of the communications link. Ex.1003 ¶123, 238.

b) **[3] The method of claim 2, wherein the switching between the first mode and the second mode is performed automatically based on the operating conditions including a signal to noise ratio and an interference.**

[16] The article of manufacture of claim 15, wherein the instructions, upon execution by the computing device, cause the computing device to automatically switch between the first mode and the second mode based on the operating conditions including a signal to noise ratio and an interference.

Walton discloses these limitations. Ex.1003 ¶127, 240.

As noted above with respect to claim 2, Walton discloses switching between diversity/MIMO modes to provide improved performance, which “may be quantified, for example, by a lower bit-error-rate (BER) or frame-error-rate (FER) for a given link carrier-to-noise-interference ratio (C/I).” Ex.1005 ¶31. Further:

In some embodiments of the invention, antenna diversity is dynamically provided based on the characteristics of the communications link to provide the required performance. For example, higher degree of antenna diversity can be provided ... for some communications link characteristics (e.g., low C/I), or for some other conditions or considerations.

Ex.1005 ¶46. Walton further discloses “use of the diversity communications mode is based, in part, on a quality of one or more communications links used for a particular channel data stream transmission.” Ex.1005 Claim 17.

Every element of the above limitation would have been obvious to a POSITA because Walton teaches dynamically selecting modes based on communications link characteristics such as the carrier-to-noise interference ratio. Ex.1003 ¶127, 240.

- c) **[4] The method of claim 1, wherein, in the first mode, the first transmitters and the second transmitters modulate and transmit the separate first mode transmit symbols during a same period of time.**
[9] The method of claim 7, wherein, in the first mode, the first receivers and the second receivers receive the separate first mode symbols during a same period of time.
[13] The article of manufacture of claim 11, wherein the instructions, upon execution by the computing device, cause the computing device to perform transmitting the separate first mode transmit symbols from the first transmitters and the second transmitters during a same period of time in the first mode.
[20] The article of manufacture of claim 18, wherein the instructions, upon execution by the computing device, cause the computing device to perform receiving the separate first mode symbols with the first receivers and the second receivers during a same period of time.

Walton and Walton in view of Maltsev disclose these limitations. Ex.1003 ¶133, 185, 228, 276.

Walton’s “diversity communications mode employs transmit and/or receive diversity, frequency, or temporal diversity, or a combination thereof.” Ex.1005 ¶54. “[T]emporal diversity refers to the transmission of data over more than one time period.” Ex.1005 ¶43.

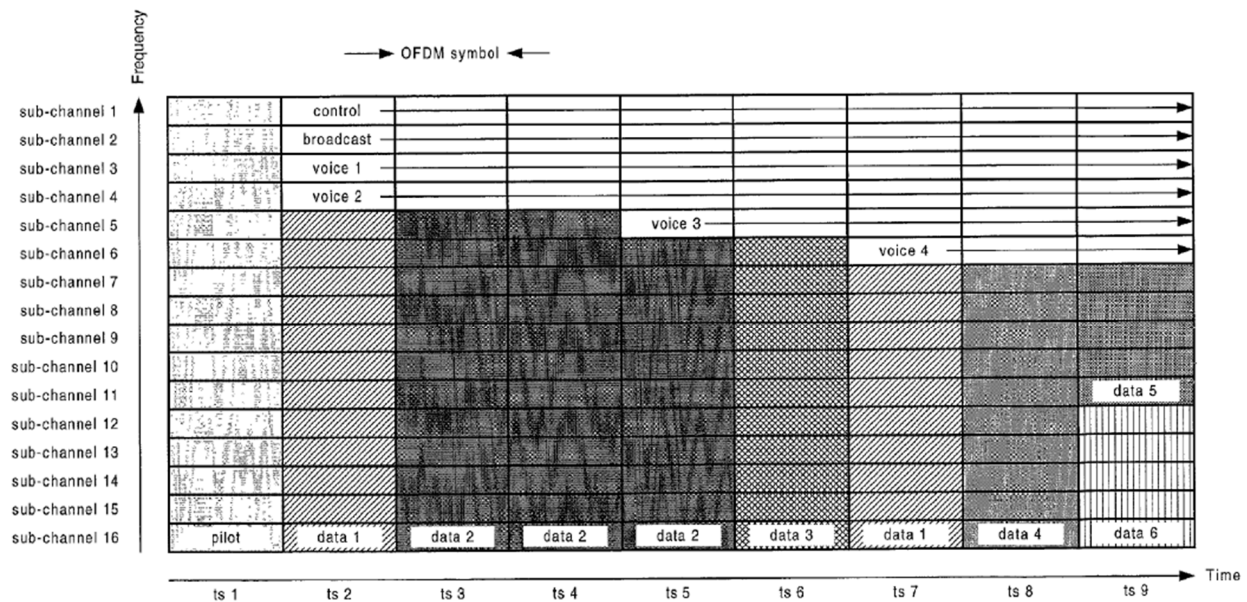


FIG. 2

With respect to Figure 2, above, Walton discloses: “Antenna, frequency, and temporal diversity may be respectively achieved by transmitting data from multiple antennas, on multiple sub-channels in different sub-bands, and over multiple time slots.” Ex.1005 ¶87. “[A]ntenna diversity for a particular transmission (e.g., voice call 1) may be achieved by transmitting the (voice) data on a particular sub-channel (e.g., sub-channel 1) over two or more antennas.” Ex.1005 ¶87. “Data 1 through 6 transmissions can represent transmissions of traffic data to one or more receiver

units.” Ex.1005 ¶84. “Temporal diversity may be achieved by transmitting data over multiple time slots.” Ex.1005 ¶87.

A POSITA would thus find every element of the above limitations obvious because Walton teaches frequency division multiplexing. *E.g.*, Ex.1003 ¶129.

To the extent Walton does not render the above limitations obvious, Walton in view of Maltsev would have done so, as a POSITA would have found it obvious to combine Walton’s system with Maltsev’s teachings that a receiver “may simultaneously receive RF signals over one or more subchannels,” Ex.1007 11:30-31, and that subchannels may comprise “a plurality of spatial channels.” Ex.1007 12:48. Ex.1003 ¶133, 185, 228, 276.

d) **[5] The method of claim 1, wherein when transmitting in the second mode the first spectrum of frequencies and the second spectrum of frequencies are non-adjacent.**

[10] The method of claim 7, wherein the first spectrum of frequencies and the second spectrum of frequencies are non-adjacent.

[14] The article of manufacture of claim 11, wherein the first spectrum of frequencies and the second spectrum of frequencies are non-adjacent.

[21] The article of manufacture of claim 18, wherein the first spectrum of frequencies and the second spectrum of frequencies are non-adjacent.

Walton and Walton in view of Maltsev disclose these limitations. Ex.1003 ¶140, 191, 234, 282.

Walton discloses:

The data may be partitioned and transmitted over any defined set of two or more sub-bands to provide frequency diversity. ... As another example, data for a particular subscriber unit may be transmitted over sub-channels 1 and 2 at time slot 1 (e.g., with the same data being transmitted on both sub-channels), sub-channels 4 and 6 at time slot 2, only sub-channel 2 at time slot 3, and so on.

Ex.1005 ¶49. As previously noted, “each of the sub-channels occupies a sub-band having a bandwidth of W/L and centered at a different center frequency.” Ex.1005 ¶48.

Every element of the above limitation would have been obvious to a POSITA because Walton teaches transmitting data in its frequency diversity mode over non-adjacent sub-channels (e.g., sub-channels 4 and 6) which can represent non-adjacent spectrums of frequencies. To the extent Walton does not render the above limitations obvious, Walton in view of Maltsev would have done so, as a POSITA would have found it obvious to combine the transmitting in non-adjacent sub-bands disclosed by Walton with the “wideband channel comprising one or more ... frequency-separated subchannels” disclosed by Maltsev. Ex.1007 4:16-18; Ex.1003 ¶140, 191, 234, 282

- e) **[6] The method of claim 1, further comprising:
performing a gap filling between the first spectrum of
frequencies and the second spectrum of frequencies.**

[17] The article of manufacture of claim 11, wherein the instructions, upon execution by the computing device, cause the computing device to perform a gap filling between the first spectrum of frequencies and the second spectrum of frequencies.

Walton and Walton in view of Maltsev disclose these limitations. Ex.1003

¶146, 245.

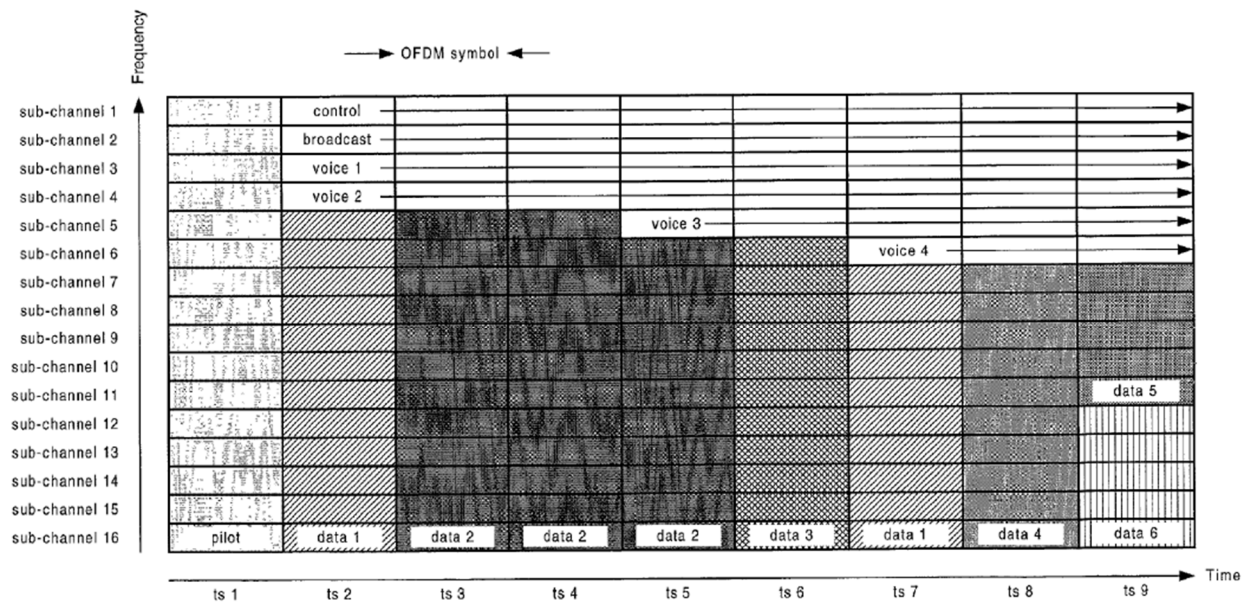


FIG. 2

With respect to Figure 2, above, Walton teaches that “The available sub-channels can be used to transmit signaling, voice, traffic data, and others.” Ex.1005

¶81. “[D]ata 5 transmission uses sub-channels 7 through 11 at time slot 9, and data 6 transmission uses sub-channels 12 through 16 at time slot 9.” Ex.1005 ¶84.

Moreover:

The communications system of the invention flexibly supports the transmissions of traffic data. ... [M]ultiple data transmissions (e.g., data 5 and 6) may occur at one time slot. ... The system can also be designed to support multiple data transmissions on one sub-channel. For

example, voice data may be multiplexed with traffic data and transmitted on a single sub-channel.

Ex.1005 ¶85.

Walton further notes that “The same or different data may be transmitted from multiple antennas and/or on multiple sub-bands to obtain the desired diversity.”

Ex.1005 ¶88. This includes, for example, “a set of channels from a set of antennas (e.g., sub-channel 1 from antennas 1 and 2 at one time slot, sub-channels 1 and 2 from antenna 2 at another time slot, and so on).” Ex.1005 ¶88. “Thus, any combination of sub-channels and antennas may be used to provide antenna and frequency diversity.” Ex.1005 ¶88. Further, “each sub-channel at each time slot for each transmit antenna may be viewed as an independent unit of transmission (i.e., a modulation symbol) that can be used to transmit any type of data such as pilot, signaling, broadcast, voice, traffic data, and others, or a combination thereof.”

Ex.1005 ¶89.

Moreover:

In a design that provides the most flexibility, best performance, and highest efficiency, the modulation symbol to be transmitted at each time slot, on each sub-channel, can be individually and independently selected. This feature allows for the best use of the available resource over all three dimensions—time, frequency, and space. The number of data bits transmitted by each modulation symbol may thus differ.

Ex.1005 ¶108. Finally, Walton notes that “power control can be performed on each channel data stream [or] on each sub-channel” to “minimize interference and maximize system capacity.” Ex.1005 ¶137.

A POSITA would find every element of the above limitations obvious based on Walton. Ex.1003 ¶146, 245. Walton’s Figure 2 demonstrates gap-filling with, for example, its depiction of data 5, which occupies sub-channels 7 through 11—i.e., the frequency band between the two frequency bands represented by sub-channels 1 through 6 and 12 through 16. Ex.1005 Fig. 2. Walton also recognizes that every such-channel in a bandwidth can be independently selected to transmit data and contemplates whether sub-channels should be powered or unpowered to minimize interference. Ex.1005 ¶89. It would have been obvious to a POSITA to “perform[] a gap filling between the first spectrum of frequencies and the second spectrum of frequencies” given Walton’s teachings that each sub-channel at each time slot may be viewed as an independent unit of transmission, that any combination of sub-channels and antennas may be used to provide antenna/frequency diversity, and that each sub-channel’s modulation symbol can be individually selected to allow for the best use of available resources over time, frequency, and space. Ex.1003 ¶146, 245.

To the extent Walton alone does not render the above limitations obvious, Walton in view of Maltsev would have done so, as a POSITA would have found it obvious to combine the “gap filling” disclosed by Walton with the “wideband

channel comprising one or more ... frequency-separated subchannels” disclosed by
Maltsev. Ex.1007 4:16-18; Ex.1003 ¶146, 245

f) [8] The method of claim 7, wherein each of the first spectrum of frequencies and the second spectrum of frequencies comprises a plurality of frequency subbands.

[12] The article of manufacture of claim 11, wherein each of the first spectrum of frequencies and the second spectrum of frequencies comprises a plurality of frequency subbands.

[19] The article of manufacture of claim 18, wherein each of the first spectrum of frequencies and the second spectrum of frequencies comprises a plurality of frequency subbands.

Walton and Walton in view of Maltsev disclose these limitations. Ex.1003 ¶180, 222, 270. For example: “The overall transmission channel occupies the total operating bandwidth of W , and each of the sub-channels occupies a sub-band having a bandwidth of W/L and centered at a different center frequency. Each sub-channel has a bandwidth that is a portion of the total operating bandwidth.” Ex.1005 ¶48. Moreover, “the data for a particular channel data stream may be transmitted from one or more antennas, on one or more sub-bands of the system operating bandwidth, and at one or more time periods to respectively provide antenna, frequency, and temporal diversity.” Ex.1005 ¶17.

A POSITA would find every element of the above limitations obvious based on, for example, Walton's division of the system's operating bandwidth into a series of sub-bands. Ex.1003 ¶180, 222, 270.

To the extent Walton does not render the above limitations obvious, Walton in view of Maltsev would have done so, as a POSITA would have found it obvious to combine Walton's system with the "wideband channel comprising one or more ... frequency-separated subchannels" disclosed by Maltsev. Ex.1007 4:16-18; Ex.1003 ¶180, 222, 270.

B. Grounds 3 & 4: Claims 1-21 are rendered obvious by Ishikawa and/or Ishikawa in view of Gardner

Ishikawa and/or Ishikawa in view of Gardner render every claim of the '845 Patent obvious.

1. Independent Claims 1, 7, 11, and 18

a) **1[pre] A method of operation of a transceiver in a plurality of modes including at least a first mode and a second mode, the method comprising:**

7[pre] A method of operation of a transceiver in a plurality of modes including at least a first mode and a second mode, the method comprising:

11[pre] An article of manufacture including a non-transitory computer-readable medium having instructions stored thereon that, upon execution by a computing device, cause the computing device to perform operations comprising:

18[pre] An article of manufacture including a non-transitory computer-readable medium having instructions stored thereon that, upon execution by a computing device, cause the computing device to perform operations comprising:

To the extent the preambles are limiting, Ishikawa discloses these limitations.

Ex.1003 ¶¶77, 152, 198, 252. For example, Ishikawa discloses Figure 1:

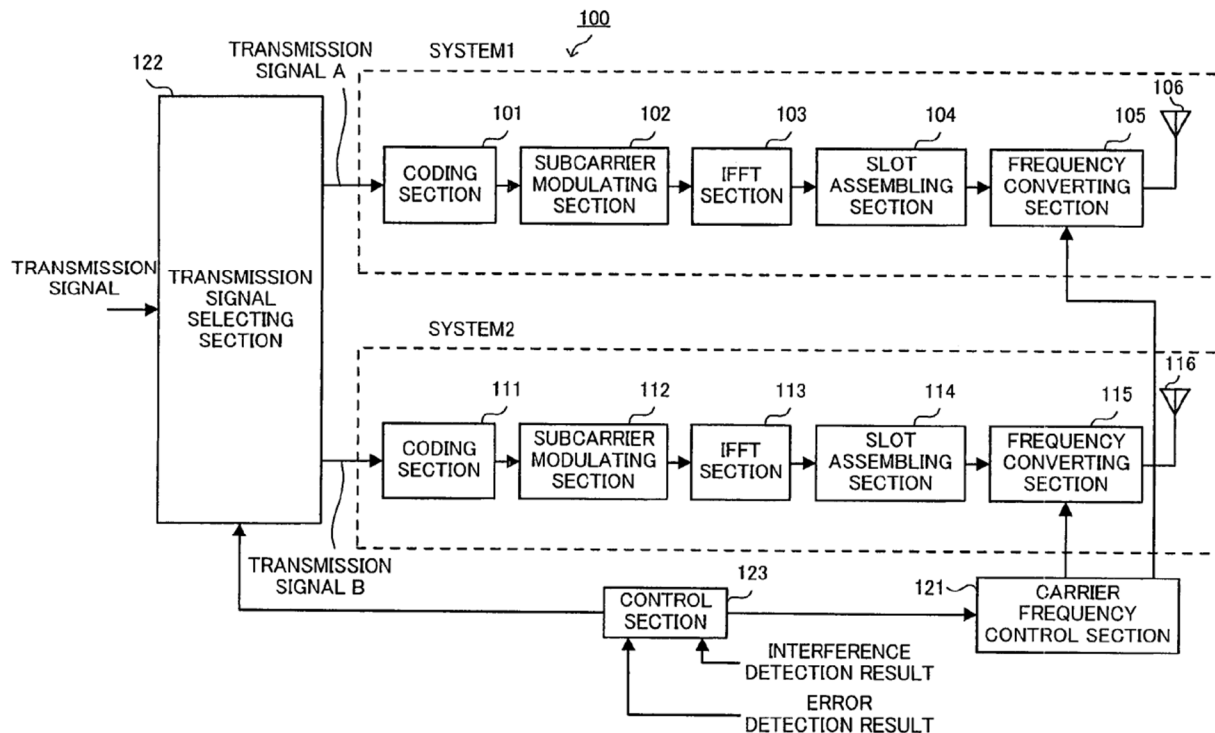


FIG.1

With respect to Figure 1, Ishikawa states “FIG. 1 is a block diagram illustrating the configuration of a radio transmitting apparatus according to one embodiment of the present invention.” Ex.1006 2:56-58. “The radio transmitting apparatus (transmitter) 100 illustrated in FIG. 1 includes a system 1 that transmits a transmission signal A and a system 2 that transmits a transmission signal B.” Ex.1006 3:19-22. “[W]hen the radio transmitting apparatus 100 and the radio

receiving apparatus 200 are installed on the same radio communication apparatus, the antennas 106 and 116 for transmitter 100 and the antennas 201 and 211 for receiver 200 may be a transmission and reception sharing type.” Ex.1006 3:52-57.

Moreover:

The essence of the present invention is to control each transmission frequency of a plurality of antennas and the number of information transmitted from the plurality of antennas according to circumstances of a propagation path when the same or different information is transmitted using a plurality of antennas, namely, to adaptively select space multiplex where different information is transmitted from the plurality of antennas with the same frequency, frequency multiplex where different information is transmitted from the plurality of antennas with different frequencies, space diversity where the same information is transmitted from the plurality of antennas with the same frequency, and frequency diversity where the same information is transmitted from the plurality of antennas with the different frequencies according to the circumstances of the propagation path.

Ex.1006 1:64-2:11.

All elements of the above limitations, including the transceiver, the article of manufacture, and the plurality of modes would have been obvious to a POSITA based on the teachings described above. Ex.1003 ¶¶77, 152, 198, 252.

**b) 1[a][i] in the first mode based on spatial multiplexing:
generating separate first mode transmit symbols by
first transmitters of the transceiver and second
transmitters of the transceiver; and**

7[a][i] in the first mode based on spatial multiplexing:

**11[a][i] generating separate first mode transmit
symbols by first transmitters and second transmitters
of a transceiver;**

18[a][i] receiving in a first mode based on spatial multiplexing

Ishikawa discloses these limitations. Ex.1003 ¶83, 88, 157, 203, 257. The “receiving” element of claim 18[a][i] is addressed in the section below.

Regarding spatial multiplexing, Ishikawa discloses: “In this embodiment, the transmitter 100 can use four radio communication systems. The first case is a space multiplex case, namely, a case in which different information (transmission signal A≠transmission signal B) is transmitted from two antennas 106 and 116 with the same frequency (for example, FIG. 3).” Ex.1006 5:14-19. Figure 3 of Ishikawa is shown below:

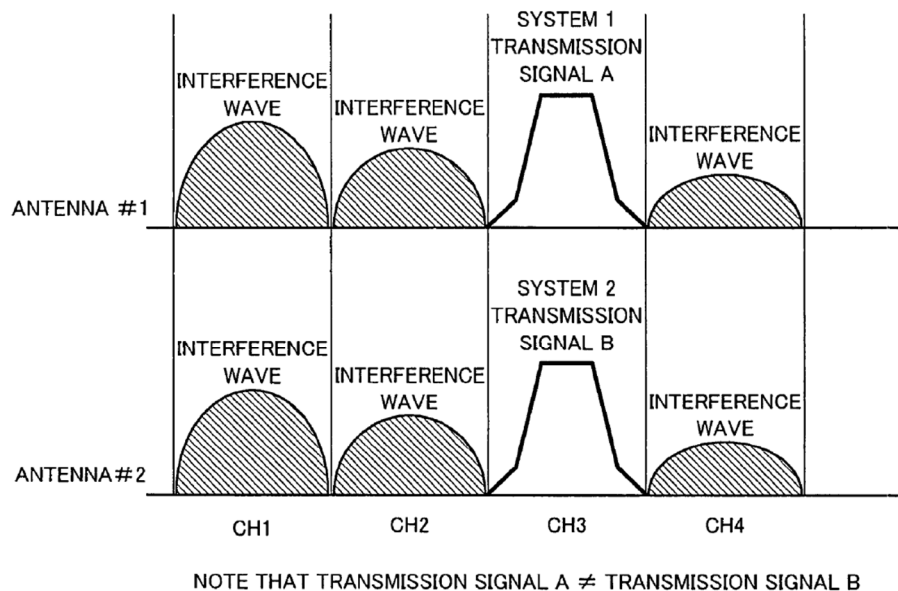


FIG.3

Further: “In this type of method, the modulation is the same as the conventional case, but different information is transmitted from the plurality of antennas with the same frequency to perform space multiplex.” Ex.1006 1:38-41.

Regarding the generation of transmit symbols, Ishikawa discloses with respect to Figure 1:

The transmission signal A of the system 1 is, for example, convolutionally coded by the coding section 101. The coded signal is modulated for each subcarrier by the subcarrier modulating section 102, and thereafter the resultant is outputted to the IFFT section 103. The IFFT section 103 provides inverse fast Fourier transform (IFFT) to an output signal of the subcarrier modulating section 103 to generate an OFDM signal. A guard interval and a preamble are inserted to the generated OFDM signal by the slot assembling section 104, and thereafter the resultant is output to the frequency converting section 105. The frequency converting section 105 upconverts an output signal of the slot assembling section 104 to a radio frequency (transmission frequency), which is independently controlled by the carrier frequency control section 121. The upconverted transmission signal is transmitted via the antenna 106.

Ex.1006 3:62-4:10. Ishikawa further notes that “the same processing as the transmission signal A of the system 1 is provided to the transmission signal B of the system 2.” Ex.1006 4:10-12.

The above limitations would have been obvious to a POSITA based on Ishikawa’s teachings described above. Ex.1003 ¶¶83, 88, 157, 203, 257.

- c) **1[a][ii] transmitting the separate first mode transmit symbols from the first transmitters and the second transmitters over a first set of antennas and a second set of antennas**

7[a][iii] receiving separate first mode symbols with first receivers of the transceiver and second receivers of the transceiver via a first set of antennas and a second set of antennas

11[b][ii] transmitting in a first mode the separate first mode transmit symbols from the first transmitters and the second transmitters over a first set of antennas and a second set of antennas

18[a][ii] receiving in a first mode based on spatial multiplexing separate first mode symbols with first receivers of a transceiver and second receivers of the transceiver at a mobile station via a first set of antennas and a second set of antennas

Ishikawa renders these limitations obvious. Ex.1003 ¶¶96, 164, 208, 257.

Ishikawa discloses the ability to “adaptively select space multiplex where different information is transmitted from the plurality of antennas with the same frequency” and/or “space diversity where the same information is transmitted from the plurality of antennas with the same frequency.” Ex.1006 2:2-8.

With respect to Figure 1, Ishikawa discloses “The upconverted transmission signal is transmitted via antenna 106,” and that “the same processing as the transmission signal A of the system 1 is provided to the transmission signal B of the system 2. Ex.1006 4:9-12.

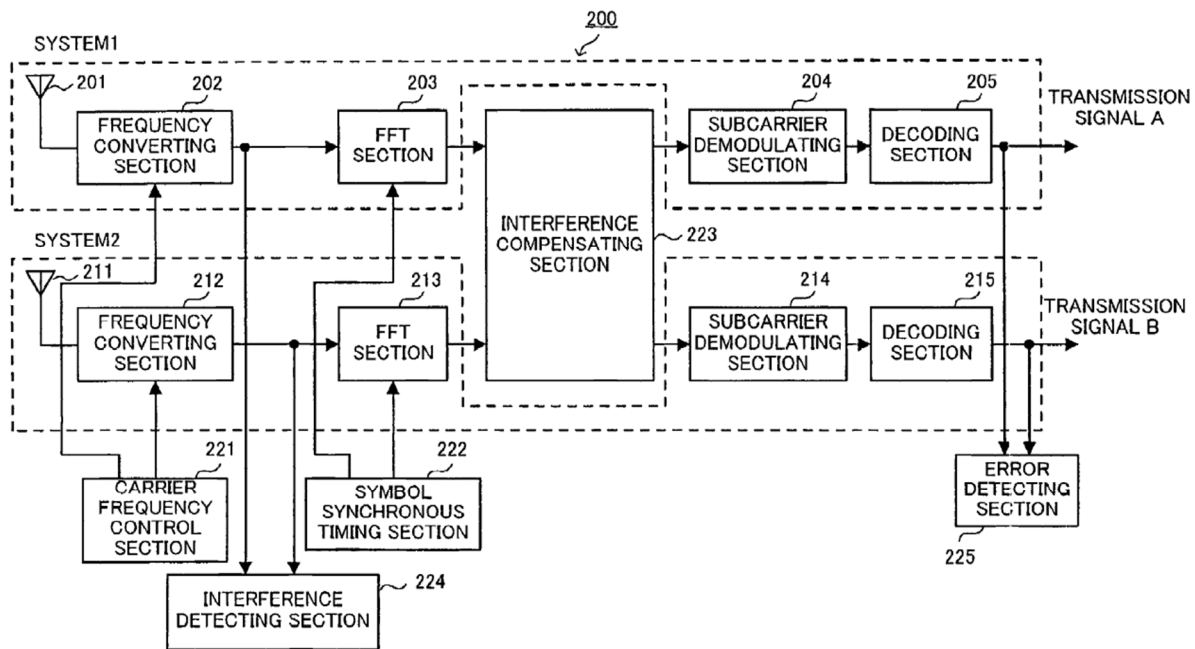


FIG.2

Ishikawa's Figure 2, above, "is a block diagram illustrating the configuration of a radio receiving apparatus that performs radio communication with the radio transmitting apparatus illustrated in FIG. 1." Ex.1006 2:33-36. After describing the system's transmission capability as depicted in Figure 1, Ishikawa explains its receiving functionality as depicted in Figure 2:

The OFDM signal received via antenna 201 of the system 1 is downconverted by the frequency converting section 202 using a radio frequency (the same frequency as the transmission frequency of the antenna 106 from which the transmission signal A is transmitted). ... The same processing is provided to the OFDM signal received via the antenna 211 of the system 2.

Ex.1006 4:28-40.

Moreover, Ishikawa also discloses the following: "the radio transmitting apparatus of the present invention can be installed on the radio communication

apparatus, for example, a radio base station apparatus and a radio terminal apparatus in the mobile communication system.” Ex.1006 7:60-64.

A POSITA would find all elements of the above claim limitations obvious based on, for example, Ishikawa’s transmission and reception of OFDM signals via the multiple antenna elements associated with systems 1 and 2, and its capability to do so in a spatial multiplexing mode. Ex.1003 ¶¶96, 164, 208, 257.

- d) **1/11[a][iii] across a spectrum of frequencies that is same for each of the first transmitters and the second transmitters; and**
7/18[a][iii] across a spectrum of frequencies that is same for each of the first receivers and the second receivers; and

Ishikawa discloses the above limitations. Ex.1003 ¶¶96, 164, 208, 257. As noted previously in Section IX.B.1.b(1), Ishikawa discloses that, in its spatial multiplexing mode, “different information (transmission signal A≠transmission signal B) is transmitted from two antennas 106 and 116 with the same frequency (for example, FIG. 3).” Ex.1006 5:14-19. Figure 3 of Ishikawa is shown below:

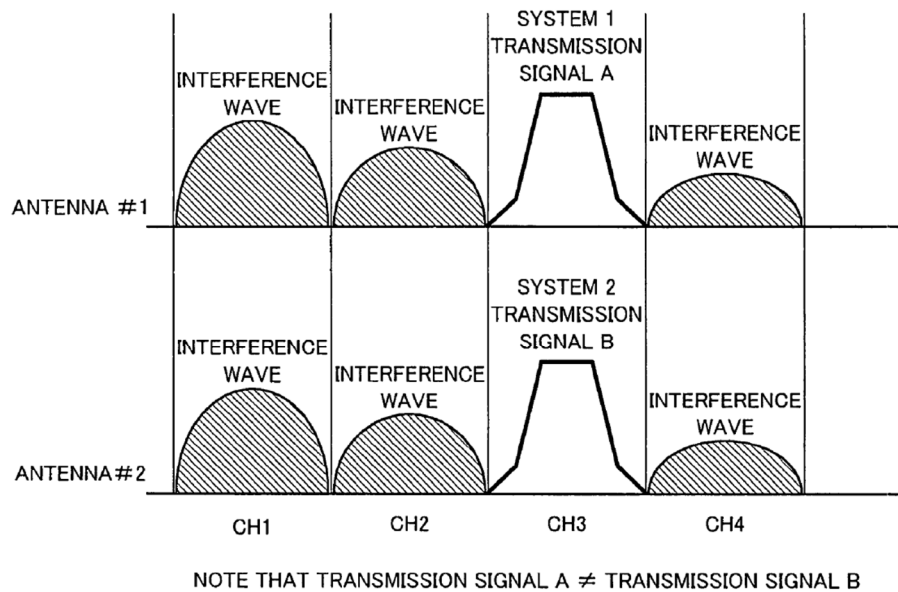


FIG.3

With respect to Figure 3, Ishikawa explains that “a case in which four channels (frequency bands) including channel 1 (CH1) to channel 4 (CH4) are used is hereinafter explained as an example. Moreover, in FIGS. 3 to 6, antenna #1 denotes the antenna 106 of the system 1, and antenna #2 denotes the antenna 116 of the system 2.” Ex.1006 5:8-13.

A POSITA would find every element of the above limitations obvious based on Ishikawa’s teaching of a spatial multiplexing mode involving multiple antennas that transmit and receive information at the same frequency. Ex.1003 ¶¶96, 164, 208, 257.

- e) **1[b][i] in the second mode based on the spatial multiplexing and bandwidth expansion: generating separate second mode transmit symbols by the first transmitters and the second transmitters;**

7[b][i] in the second mode based on the spatial multiplexing and bandwidth expansion:

11[b][i] generating separate second mode transmit symbols by the first transmitters and the second transmitters;

18[b][i] receiving in a second mode based on the spatial multiplexing and bandwidth expansion

Ishikawa discloses these limitations. Ex.1003 ¶106, 109, 169, 212, 259. The “receiving” element of claim 18[b][i] is addressed below in the next section.

Ishikawa discloses:

The essence of the present invention is to control each transmission frequency of a plurality of antennas and the number of information transmitted from the plurality of antennas according to circumstances of a propagation path when the same or different information is transmitted using a plurality of antennas, namely, to adaptively select ... frequency multiplex where different information is transmitted from the plurality of antennas with different frequencies ... and frequency diversity where the same information is transmitted from the plurality of antennas with the different frequencies according to the circumstances of the propagation path.

Ex.1006 1:64-2:6. Figures 4 and 6, below, respectively represent frequency multiplexing and frequency diversity.

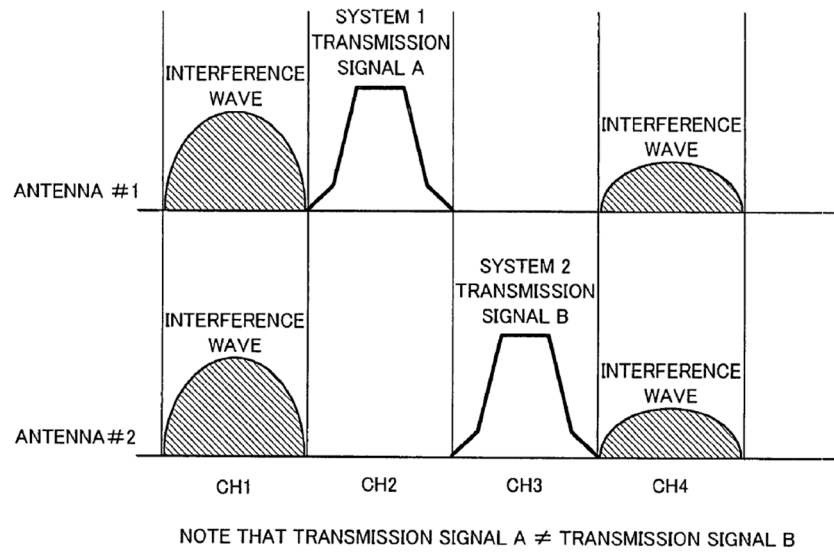


FIG.4

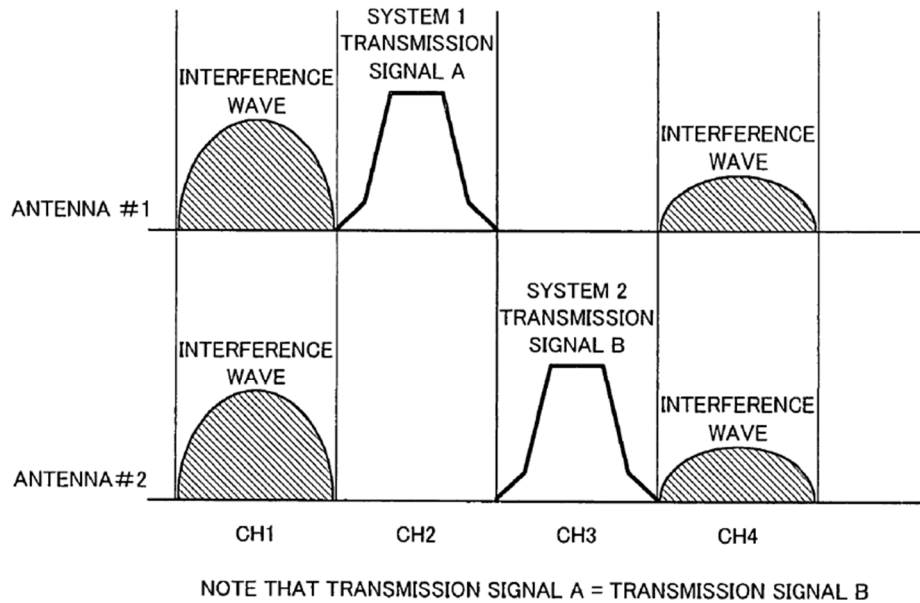


FIG.6

Ishikawa teaches transmitting in the frequency multiplex mode “when the circumstances of the propagation path are good” and in the frequency diversity mode “when the error detection result is extremely poor.” Ex.1006 6:22-38.

Additionally, Ishikawa's teachings regarding the generation of transmit symbols were previously discussed above. *Supra* § IX.B.1.b (discussing Ex.1006 3:62-4:10).

The above limitations would have been obvious to a POSITA based on Ishikawa's capability to generate symbols and its ability to transmit in its frequency multiplexing and diversity modes, and its selection between the two based on propagation path characteristics. Ex.1003 ¶106, 109, 169, 212, 259.

To the extent Ishikawa does not render the above limitations obvious, Ishikawa in view of Gardner would have done so. Ex.1003 ¶106, 109, 169, 212, 259. For example, Gardner discloses 802.11 devices that "might use one or more of multiple antenna techniques (MIMO), where multiple data streams are multiplexed spatially and multi-channel techniques, where an extended transmitter transmits using more than one 802.11a channel at a time." Ex.1008 2:41-46. A POSITA would have found the above obvious given Ishikawa's system and Gardner's disclosure of combined spatial multiplexing and multi-channel techniques. Ex.1003 ¶106, 109, 169, 212, 259.

f) **1[b][ii] transmitting the separate second mode transmit symbols from the first transmitters over the first set of antennas across a first spectrum of frequencies;
and transmitting the separate second mode transmit symbols from the second transmitters over the second set of antennas across a second spectrum of frequencies,**

**7[b][ii] receiving separate second mode symbols with the first receivers of the transceiver via the first set of antennas across a first spectrum of frequencies;
and receiving the separate second mode symbols with the second receivers of the transceiver via the second set of antennas across a second spectrum of frequencies,**

**11[b][ii] transmitting in a second mode the separate second mode transmit symbols from the first transmitters over the first set of antennas across a first spectrum of frequencies;
and transmitting in the second mode the separate second mode transmit symbols from the second transmitters over the second set of antennas across a second spectrum of frequencies,**

**18[b][ii] receiving in a second mode based on the spatial multiplexing and bandwidth expansion separate second mode symbols with the first receivers of the transceiver at the mobile station via the first set of antennas across a first spectrum of frequencies;
and receiving in the second mode the separate second mode symbols with the second receivers of the transceiver at the mobile station via the second set of antennas across a second spectrum of frequencies,**

Ishikawa and Ishikawa in view of Gardner discloses these limitations.

Ex.1003 ¶114, 119, 172, 175, 215, 218, 259, 265.

Ishikawa defines frequency multiplexing as a mode where “where different information is transmitted from the plurality of antennas with different frequencies.” Ex.1006 2:5-6. In Figure 1, Ishikawa depicts “a system 1 that transmits a transmission signal A and a system 2 that transmits a transmission signal B.” Ex.1006 3:20-22.

As previously discussed in Section IX.B.1.c, Ishikawa teaches that signals A and B are separately encoded by systems 1 and 2, transmitted over antennas 106 and 116, received by antennas 201 and 211, and separately decoded. Ex.1006 2:2-8, 2:33-36, 4:9-12, 4:28-40. Ishikawa notes that “the transmitter 100 can use four radio communication systems. ... The second case is a frequency multiplex case, namely, a case in which different information (transmission signal A≠transmission signal B) is transmitted from two antennas 106 and 116 with the different frequencies.” Ex.1006 5:14-23.

A POSITA would thus recognize that Ishikawa renders the above claim limitations obvious based on, for example, Ishikawa’s transmission and reception of OFDM signals via the multiple antenna elements associated with systems 1 and 2, and its capability to do so in a frequency multiplexing mode. Ex.1003 ¶114, 119, 172, 175, 215, 218, 259, 265.

To the extent Ishikawa does not render the above limitations obvious, Ishikawa in view of Gardner would have done so. Ex.1003 ¶114, 119, 172, 175, 215,

218, 259, 265. For example, Gardner discloses increasing data rates “using multiple transmit antennas or multiple channels or a combination of both.” Ex.1008 4:16-17.

A POSITA would have found the above limitations obvious given Ishikawa’s system and Gardner’s disclosure of combined spatial multiplexing and multi-channel techniques. Ex.1003 ¶114, 119, 172, 175, 215, 218, 259, 265.

g) 1/7/11/18[b][iii] wherein the first spectrum of frequencies does not overlap with the second spectrum of frequencies.

Ishikawa discloses these limitations. Ex.1003 ¶119, 175, 218, 265.

As previously noted, Ishikawa teaches transmitting in a frequency multiplexing mode, “a case in which different information (transmission signal A≠transmission signal B) is transmitted from two antennas 106 and 116 with the different frequencies (for example, FIG. 4).” Ex.1006 5:14-23. As can be seen in Figure 4 (shown above in Section IX.B.1.e), the transmission spectrums of signals A and B, transmitting in channels 2 and 3, do not overlap.

The above limitations would have been obvious to a POSTIA based on Ishikawa’s teaching of a frequency multiplexing mode involving multiple antennas that transmit and receive information at different frequencies. Ex.1003 ¶119, 175, 218, 265. To the extent Ishikawa does not render the above obvious, Ishikawa in view of Gardner would have done so, as Gardner discloses, for example, Figure 6 below, which depicts non-overlapping spectrums of frequencies as transmitted by a

device capable of spatial multiplexing and multi-channel techniques. Ex.1003 ¶119, 175, 218, 265.

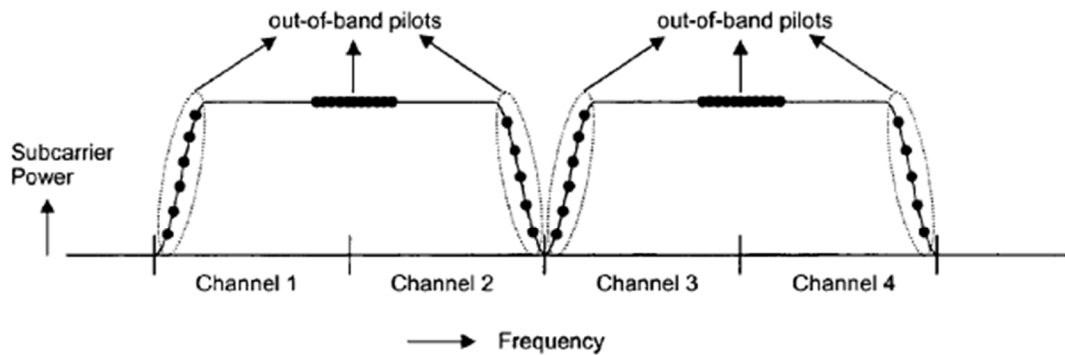


FIG. 6

2. Dependent Claims

- a) [2] The method of claim 1, further comprising switching between the first mode and the second mode based on operating conditions.

[15] The article of manufacture of claim 11, wherein the instructions, upon execution by the computing device, cause the computing device to perform automatically switching between the first mode and the second mode based on operating conditions.

Ishikawa discloses the above limitation. Ex.1003 ¶124, 238.

Ishikawa discloses

The essence of the present invention is to control each transmission frequency of a plurality of antennas and the number of information transmitted from the plurality of antennas according to circumstances of a propagation path when the same or different information is transmitted using a plurality of antennas, namely, to adaptively select space multiplex where different information is transmitted from the plurality of antennas with the same frequency [or] frequency multiplex where different information is transmitted from the plurality of antennas with different frequencies.

Ex.1006 1:64-2:6. Ishikawa elaborates:

[T]he transmitter 100 can use four radio communication systems. The first case is a space multiplex case, namely, a case in which different information (transmission signal A≠transmission signal B) is transmitted from two antennas 106 and 116 with the same frequency (for example, FIG. 3). The second case is a frequency multiplex case, namely, a case in which different information (transmission signal A≠transmission signal B) is transmitted from two antennas 106 and 116 with the different frequencies (for example, FIG. 4). ... The control section 123 adaptively switches among these four radio communication methods based on the interference detection result (presence or absence of the interference wave of each system) from the receiver 200 installed on the same radio communication apparatus and the error detection result (error rate of each system).

Ex.1006 5:14-37.

A POSITA would have found the above limitations obvious based on Ishikawa's teachings of a system that can adaptively switch between its spatial and frequency multiplexing modes according to interference/error detection, i.e., operating conditions. Ex.1003 ¶124, 238.

b) [3] The method of claim 2, wherein the switching between the first mode and the second mode is performed automatically based on the operating conditions including a signal to noise ratio and an interference.

[16] The article of manufacture of claim 15, wherein the instructions, upon execution by the computing device, cause the computing device to automatically switch between the first mode and the second mode based on the operating conditions including a signal to noise ratio and an interference.

Ishikawa discloses the above limitations. Ex.1003 ¶127, 241.

As previously discussed in the previous section, Ishikawa discloses

The control section 123 adaptively switches among these four radio communication methods based on the interference detection result (presence or absence of the interference wave of each system) from the receiver 200 installed on the same radio communication apparatus and the error detection result (error rate of each system).

Ex.1006 5:31-37. Further:

[T]he interference detecting section 224 measures an interference level for each system and detects the presence or absence of an interference wave, thereby detecting a frequency which is not assigned to the other user from a plurality of usable frequencies. Moreover, the error detecting section 225 detects an error rate (for example, BER (Bit Error Rate) and the like) as a reference that indicates the circumstances of the propagation path, the interference detection result (presence or absence of the interference wave of each system) performed by the interference detecting section 224 and the error detection result (error rate of each system) performed by the error detecting section 225 are transmitted to the control section 123 of the transmitter 100.

Ex.1006 4:55-5:1.

A POSITA would have found the above limitations obvious based on Ishikawa's disclosing adaptively switching between its spatial and frequency multiplexing modes based on the detection of interference and/or error rate. Ex.1003 ¶127, 241.

- c) **[4] The method of claim 1, wherein, in the first mode, the first transmitters and the second transmitters modulate and transmit the separate first mode transmit symbols during a same period of time.**

[9] The method of claim 7, wherein, in the first mode, the first receivers and the second receivers receive the separate first mode symbols during a same period of time.

[13] The article of manufacture of claim 11, wherein the instructions, upon execution by the computing device, cause the computing device to perform transmitting the separate first mode transmit symbols from the first transmitters and the second transmitters during a same period of time in the first mode.

[20] The article of manufacture of claim 18, wherein the instructions, upon execution by the computing device, cause the computing device to perform receiving the separate first mode symbols with the first receivers and the second receivers during a same period of time.

Ishikawa discloses the above limitations. Ex.1003 ¶132, 186, 229, 277.

Ishikawa discloses:

[A]s illustrated in FIG. 3, different information (transmission signal A≠ transmission signal B) is transmitted from two antennas 106 and 116 with the same frequency and the space multiplex is thereby performed. In the example illustrated in FIG. 3, CH1, CH2, CH4 where interference waves are present, namely, frequencies (channels) that are assigned to the other users are avoided, and different transmission signals A and B are multiplexed and transmitted from the antenna 106 of the system 1 and the antenna 116 of the system 2 using the vacant same channel (CH3), respectively. Additionally, at this time, the receiver 200 performs the receiving operation using the frequency used by the transmitter 100 (frequency of CH3 in the example of FIG. 3).

Ex.1006 5:40-53. Further, “when the circumstances of the propagation path are good, the space multiplex is performed so that the spectrum efficiency and the

transmission rate can be further improved to the maximum without increasing the frequencies to be used, namely, while maintaining the frequency band to be used.”

Ex.1006 5:54-59.

A POSITA would have thus found the above limitations obvious based on Ishikawa’s spatial multiplexing mode wherein it transmits two signals from two antennas on the same frequency and the signals are received at the same time at the receiver. Ex.1003 ¶¶132, 186, 229, 277. Moreover, a POSITA would recognize that the transmission/reception of the first mode transmit symbols at the same time was inherently disclosed in Ishikawa based on the improvement in frequency utilization and transmission speed accompanying its spatial multiplexing mode. Ex.1003 ¶¶132, 186, 229, 277.

d) **[5] The method of claim 1, wherein when transmitting in the second mode the first spectrum of frequencies and the second spectrum of frequencies are non-adjacent.**

[10] The method of claim 7, wherein the first spectrum of frequencies and the second spectrum of frequencies are non-adjacent.

[14] The article of manufacture of claim 11, wherein the first spectrum of frequencies and the second spectrum of frequencies are non-adjacent.

[21] The article of manufacture of claim 18, wherein the first spectrum of frequencies and the second spectrum of frequencies are non-adjacent.

Ishikawa in view of Gardner renders these limitations obvious. Ex.1003 ¶139, 192, 235, 265.

Gardner discloses devices that “might use one or more of multiple antenna techniques (MIMO), where multiple data streams are multiplexed spatially and multi-channel techniques, where an extended transmitter transmits using more than one 802.11a channel at a time.” Ex.1008 2:41-46. Gardner discloses Figure 5 (shown below), where “different channels may be used by different devices, but it is also possible that the same device transmits on several channels simultaneously. For instance, one device may transmit on channels 1 and 4 simultaneously, while channels 2 and 3 are used by other devices.” Ex.1008 3:36-40.

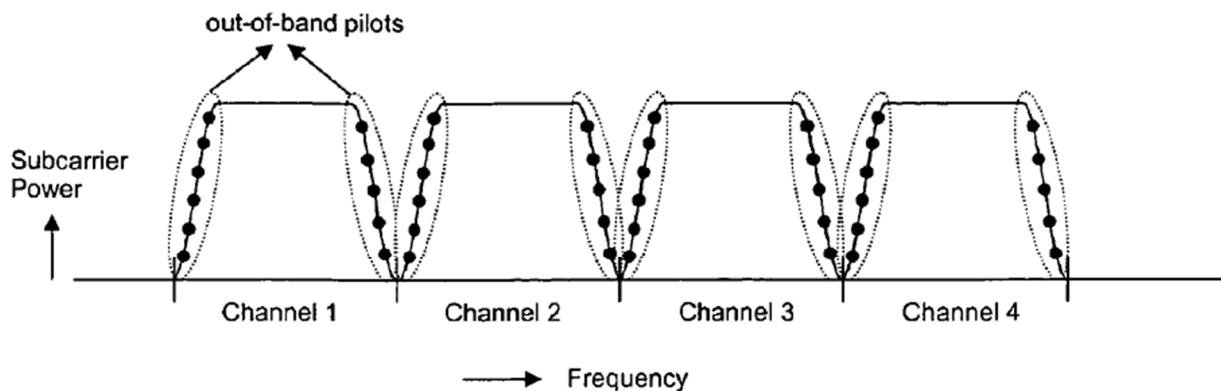


FIG. 5

Thus, in addition to Ishikawa’s disclosure of the above limitations, a POSITA would find the above limitations obvious over Ishikawa in view of Gardner, as Gardner discloses transmitting over non-adjacent frequency spectrums (channels 1

and 4) in a combined spatial multiplexing and multi-channel mode. Ex.1003 ¶139, 192, 235, 265.

a) [6] The method of claim 1, further comprising:
performing a gap filling between the first spectrum of frequencies and the second spectrum of frequencies.

[17] The article of manufacture of claim 11, wherein the instructions, upon execution by the computing device, cause the computing device to perform a gap filling between the first spectrum of frequencies and the second spectrum of frequencies.

Ishikawa in view of Gardner renders the above limitations obvious. Ex.1003 ¶145, 246.

Referring to Figure 6 (shown below), Gardner notes that “If two adjacent channels are used simultaneously by one device, then there is no need to attenuate the “out-of-band subcarriers” in the middle of this 40 MHz band.” Ex.1008 ¶ 6:41-43. “[A]dditional data can be carried on [unattenuated out-of-band subcarriers] to increase the datarate.” Ex.1008 ¶ 6:60-61.

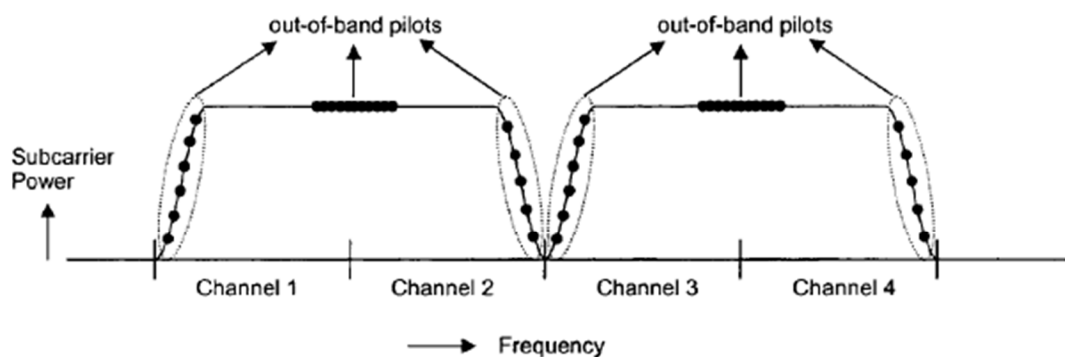


FIG. 6

Gardner further discloses “the case of four 20 MHz channels” in Figure 7:

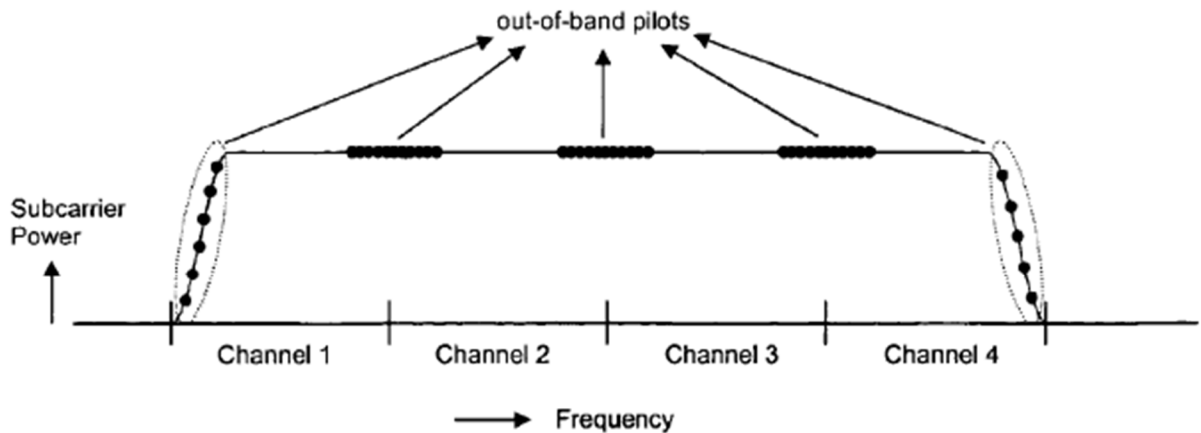


FIG. 7

Ishikawa in view of Gardner thus renders every element of the above claims obvious, as Gardner discloses “gap filling” between first and second spectrums of frequencies by transmitting data on extra subcarriers between two spectrums. Ex.1003 ¶145, 246.

- b) [8] The method of claim 7, wherein each of the first spectrum of frequencies and the second spectrum of frequencies comprises a plurality of frequency subbands.
- [12] The article of manufacture of claim 11, wherein each of the first spectrum of frequencies and the second spectrum of frequencies comprises a plurality of frequency subbands.
- [19] The article of manufacture of claim 18, wherein each of the first spectrum of frequencies and the second spectrum of frequencies comprises a plurality of frequency subbands.

Ishikawa discloses these limitations. Ex.1003 ¶180, 223, 271.

Ishikawa discloses:

As the current broadband radio access system, there is used one in which a modulation method is orthogonal frequency division multiplex (OFDM) using a frequency band of 5 GHz under the world-wide unified standard and a modulation multiple value number corresponding to each subcarrier is adaptively controlled according to the circumstances of a propagation path. According to this method, a large modulation multiple value number can be obtained under good circumstances of the propagation path. For this reason, a transmission rate of 54 Mbps using 64-value QAM in, for example, a frequency band of 20 MHz can be attained.

Ex.1006 1:18-29.

A POSITA would recognize that the limitations of the above claims are inherently rendered obvious by Ishikawa based on its disclosure of attaining greater transmission rates using larger frequency bands (e.g., 20 MHz bands) as opposed to smaller frequency bands (e.g., 5 MHz bands). A POSITA would recognize that frequency spectrums such as those disclosed by Ishikawa are inherently composed of a plurality of smaller sub-bands, as a “spectrum” is a continuous range of frequencies that can be subdivided into smaller continuous ranges of frequencies.

Ex.1003 ¶180, 223, 271.

X. CONCLUSION

Petitioners respectfully request institution of this Petition and cancellation of the '845 Patent based on the grounds set forth above.

Petition for *Inter Partes* Review of
U.S. Patent No. 10,103,845 B2

Dated: October 7, 2025

Respectfully submitted,

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CERTIFICATE OF COMPLIANCE WITH WORD COUNT

Pursuant to 37 C.F.R. § 42.24(a)(i), the undersigned certifies that this Paper—exclusive of the table of contents, table of authorities, table of exhibits, grounds for standing under § 42.104, mandatory notices under § 42.8, certificate of service, and this certificate of word count—includes 13,271 words.

/ John Campbell/
John Campbell (Reg. No. 54,665)

CERTIFICATE OF SERVICE

I hereby certify, pursuant to 37 C.F.R. Sections 42.6 and 42.106, that a complete copy of the attached **PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 10,103,845**, including all exhibits (**Nos.1001-1012**) and related documents, are being served by Federal Express on 7th day of October, 2025, the same day as the filing of the above-identified document in the United States Patent and Trademark Office/Patent Trial and Appeal Board, upon Patent Owner by serving the correspondence address of record with the USPTO as follows:

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