IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of:	Xiaodong Li, et al.	
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Title:	METHODS AND APPARATUS FOR MULTI-CARRIER COMMUNICATION SYSTEMS WITH ADAPTIVE TRANSMISSION AND FEEDBACK	

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PETITION FOR *INTER PARTES* REVIEW OF UNITED STATES PATENT NO. 10,075,941 PURSUANT TO 35 U.S.C. §§ 311–319, 37 C.F.R. § 42

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EXHIBIT LIST

Exhibit No.	Description
1001	U.S. Patent No. 10,075,941 B2 to Li et al. ("the '941 patent")
1002	Prosecution File History of U.S. Patent No. 10,075,941 ("Prosecution History")
1003	Declaration of Dr. Wilson in Support of Petition for Inter Partes Review of U.S. Patent No. 10,075,941 ("Wilson Dec.")
1004	*Curriculum Vitae* of Sarah Kate Wilson, PhD
1005	IEEE Std 802.16-2001 "IEEE Standard for Local and metropolitan area networks Part 16: Air Interface for Fixed Broadband Wireless Access Systems" ("802.16a-2001")
1006	IEEE Std 802.16-2003 "IEEE Standard for Local and metropolitan area networks Part 16: Air Interface for Fixed Broadband Wireless Access Systems Amendment 2: Medium Access Control Modifications and Additional Physical Layer Specifications for 2-11 GHz" ("802.16a-2003")
1007	U.S. Patent No. 6,937,592 B1 to Heath, Jr. et al. ("Heath")
1008	U.S. Patent Application Publication 2003/0125040 to Walton et al. ("Walton040")
1009	U.S. Patent Application Publication 2002/0147017 to Li et al. ("Li017")
1010	F. Tufvesson, "Pilot Assisted Channel Estimation for OFDM in Mobile Cellular Systems," 1997 IEEE 47th Vehicular Technology Conference. Technology in Motion, May 4-7, 1997 ("Tufvesson")
1011	Carl Eklund, "IEEE Standard 802.16: A Technical Overview of the WirelessMAN™ Air Interface for Broadband Wireless Access," IEEE Communications Magazine June 2002
1012	E. Lawrey, "Multiuser OFDM," Fifth International Symposium on Signal Processing and its Applications, ISSPA '99, Brisbane, Australia, 22-25 August, 1999. ("Lawrey")

Exhibit No.	Description
1013	Declaration of Gordon MacPherson regarding "802.16-2001 - IEEE Standard for Local and Metropolitan Area Networks - Part 16: Air Interface for Fixed Broadband Wireless Access Systems, April 8, 2002."
1014	Declaration of Gordon MacPherson regarding "802.16a-2003 - Standard for Amendment to IEEE Standard for Local and Metropolitan Area Networks - Part 16: Air Interface for Fixed Broadband Wireless Access Systems - Medium Access Control Modifications and Additional Physical Layer Specifications for 2-11 GHz, April 1, 2003."
1015	U.S. Patent No. 7,436,757 B1 to Wilson ("Wilson")
1016	Petition for *Inter Partes* Review, *Dell Inc. v. Neo Wireless LLC*, Case No. IPR2021-01468 (P.T.A.B.), filed September 1, 2021
1017	U.S. Patent No. 9,473,269 ("Walton269")
1018	U.S. Patent No. 6,947,748 ("Li748")
1019	U.S. Patent Appl. Pub No. 2004/0165683 ("Gupta")
1020	PCT Patent Appl. Pub No. WO 02/093819 ("PCT819")
1021	U.S. Patent No. 6,400,699 ("Airy")
1022	Decision Denying Institution of *Inter Partes* Review, *Dell Inc. v. Neo Wireless LLC*, Case No. IPR2021-01468 (P.T.A.B.), issued March 14, 2021
1023	P. Monsen, "Theoretical and Measured Performance of a DFE Model on a Fading Multipath Channel," *IDDD Transactions on Communications*, Vol. Com-25, No. 10, Oct. 1977, pp. 1144-1153.
1024	B. Salzberg, "Performance of an efficient parallel data transmission system," IEEE Transactions on Communications Technology. Vol. 15, No. 6, 1967 pp. 805-8011.
1025	S. Weinstein, P. Ebert, "Data transmission by frequency-division multiplexing using the discrete Fourier Transform," IEEE Transactions on Communications Technology, Vol. 19, No. 4, 1971, pp. 628-634.

Exhibit No.	Description
1026	L. Cimini, "Analysis and Simulation of a Digital Mobile Channel Using Orthogonal Frequency Division Multiplexing," in IEEE Transactions on Communications, vol. 33, no. 7, July 1985, pp. 665-675.
1027	J. Bingham, Theory and Practice of Modem Design, John Wiley and Sons, 1988.
1028	P. S. Chow, J. C. Tu and J. M. Cioffi, "A multichannel transceiver system for asymmetric digital subscriber line service," IEEE Global Telecommunications Conference GLOBECOM '91: Countdown to the New Millennium. Conference Record, 1991, pp. 1992.
1029	B. LeFloch, R. Halbert-Lassalle, D. Castelain, "Digital sound broadcasting to mobile receivers," IEEE Transactions on Consumer Electronics, Vol. 35, No. 3, 1989, pp. 493-503.
1030	M. Aldinger, "Multicarrier COFDM scheme in high bitrate radio local area networks," 5th IEEE International Symposium on Personal, Indoor and Mobile Radio Communications, Wireless Networks - Catching the Mobile Future., Vol. 3, 1994, pp. 969-973.
1031	C. Reiners and H. Rohling, "Multicarrier transmission technique in cellular mobile communications systems," Proceedings of IEEE Vehicular Technology Conference (VTC), vol.3, 1994, pp. 1645-1649.
1032	M. Wahlqvist, C. Östberg, J. van de Beek, O. Edfors, and P. O. Börjesson, 'A conceptual study of OFDM-based multiple access schemes: Part 1: Air interface requirements', Telia research AB, Luleå, 1996.
1033	Declaration of Gordon MacPherson regarding "F. Tufvesson and T. Maseng; 'Pilot assisted channel estimation for OFDM in mobile cellular systems', 1997 IEEE 47th Vehicular Technology Conference. Technology in Motion, May 4 – 7, 1997."

Exhibit No.	Description
1034	Declaration of LiMin H. Fields regarding "F. Tufvesson and T. Maseng; 'Pilot assisted channel estimation for OFDM in mobile cellular systems', 1997 IEEE 47th Vehicular Technology Conference. Technology in Motion, May 4 – 7, 1997."
1035	Carl Eklund, "WirelessMAN Inside the IEEE 802.16™ Standard for Wireless Metropolitan Networks," 2006
1036	Plaintiff Neo Wireless LLC'S Responsive Claim Construction Brief, *Neo Wireless, LLC v. Dell Technologies Inc. et al.*, Case No. 6:21-cv-00024-ADA (W.D. Tex.), filed November 18, 2021 (ECF No. 45)
1037	Plaintiff Neo Wireless LLC'S Claim Construction Sur Reply Brief, *Neo Wireless, LLC v. Dell Technologies Inc. et al.*, Case No. 6:21-cv-00024-ADA (W.D. Tex.), filed December 16, 2021) (ECF No. 54)
1038	Plaintiff Neo Wireless LLC'S Response to Defendants' Supplemental Claim Construction Brief, *Neo Wireless, LLC v. Dell Technologies Inc. et al.*, Case No. 6:21-cv-00024-ADA (W.D. Tex.), filed June 8, 2022) (ECF No. 54)
1039	Defendants' Opening Claim Construction Brief, *Neo Wireless, LLC v. Dell Technologies Inc. et al.*, Case No. 6:21-cv-00024-ADA (W.D. Tex.), filed October 28, 2021 (ECF No. 44)
1040	Defendants' Reply Claim Construction Brief, *Neo Wireless, LLC v. Dell Technologies Inc. et al.*, Case No. 6:21-cv-00024-ADA (W.D. Tex.), filed December 2, 2021 (ECF No. 48)
1041	Defendants' Supplemental Claim Construction Brief, *Neo Wireless, LLC v. Dell Technologies Inc. et al.*, Case No. 6:21-cv-00024-ADA (W.D. Tex.), filed May 18, 2022 (ECF No. 83)
1042	Joint Claim Construction Statement, *Neo Wireless, LLC v. Dell Technologies Inc. et al.*, Case No. 6:21-cv-00024-ADA (W.D. Tex.), filed December 21, 2021 (ECF No. 56)
1043	Transfer Order, *In re: Neo Wireless, LLC, Patent Litigation*, Case MDL No. 3034, issued June 14, 2022 (ECF No. 50)

Exhibit No.	Description
1044	Docket Sheet, *Neo Wireless, LLC v. Volkswagen Group of America, Inc. et al.*, Case No. 2:22-cv-11404-TGB (E.D. Mich.)
1045	United States District Courts – National Judicial Caseload Profile, June 2022
1046	Docket Navigator, Ohio Southern District Time to Milestones, accessed March 29, 2023
1047	Declaration of Dr. R. Michael Buehrer

I. INTRODUCTION

American Honda Motor Co., Inc. ("Petitioner" or "Honda") petitions for *inter partes* review of claims 1-14 ("challenged claims") of U.S. Patent No. 10,075,941 ("the '941 patent"), titled "Methods and Apparatus for Multi-Carrier Communication Systems with Adaptive Transmission and Feedback."

The '941 patent is the fifth in a series of continuations directed to link adaptation techniques in a generic Orthogonal Frequency Division Multiplexing (OFDM) communication system. According to the '941 patent, the shortcoming of the prior art was that the "subchannel configuration is normally defined and fixed in an operation, and it is usually not considered an adjustable function of the system to be adapted to the user profile and/or operational environment." EX1001, '941 patent, 2:4-7. The '941 patent purports to solve this alleged problem by using a subchannel configuration that "is designed to be configurable so that it can be adjusted statically or dynamically according to the user profiles or environmental conditions." *Id.*, 2:42-45.

But the '941 patent itself admits that this was known—"[t]o improve performance…subchannel configuration can be adjusted in accordance with the state of the communication channel." *Id.*, 1:44-55. This is not surprising given that inventors of the '941 patent disclosed this same concept years earlier. *See* EX1009,

Li017, ¶111. The '941 patent is thus left simply claiming well-known features disclosed in various prior art patents and industry publications.

Petitioner's expert, Dr. Sarah Kate Wilson, who has over 32 years of experience working with wireless communications systems, and over 30 years specifically working with OFDM systems, explains that the claimed link adaptation techniques were indeed well-known before the '941 patent and publicly disclosed by both companies and even the IEEE. For instance, IEEE published the 802.16a standard in 2001, which was amended in 2003, that discloses a link adaptation method for an OFDM communication system that includes transmitting a control message to a mobile station containing specific transmission parameters indicating an antenna transmission scheme and subchannel configuration. *See infra* VIII.A.3. U.S. Patent Application Publication 2003/0125040 to Walton *et al*. ("Walton040")—assigned to Qualcomm—similarly discloses a link adaptation method for an OFDM communication system that includes transmitting a control message to a mobile station that contains specific transmission parameters indicating an antenna transmission scheme. *See infra* VIII.B.2. 802.16a and Walton040 serve as the two primary references in the grounds for rejections.

802.16a and Walton040, used in various combinations, disclose the methods and systems recited in the challenged claims of the '941 patent. Unfortunately however, neither 802.16a nor Walton040—nor any of the other prior-art references

relied on herein—were considered during examination. If they had been, the '941 patent would not have been allowed. Accordingly, the Board should institute this proceeding and find claims 1-13 of the '941 patent unpatentable.

II. MANDATORY NOTICES (37 C.F.R. § 42.8(A)(1))

REAL PARTY IN INTEREST:

American Honda Motor Co., Inc. and Honda Development & Manufacturing of America, LLC (collectively, "Honda") are the real parties-in-interest.

RELATED MATTERS: The '941 patent is the subject of the following civil actions: *Neo Wireless LLC v. Dell Technologies Inc.*, 1-22-cv-00060 (W.D. Tex.), filed January 12, 2021; *Neo Wireless, LLC v. Ford Motor Company*, 4-22-cv-00210 (W.D. Mo.), filed March, 29, 2022; *Neo Wireless, LLC v. American Honda Motor Co., Inc.*, 2-22-cv-01824 (S.D. Ohio), filed March 29, 2022; *NEO Wireless, LLC v. Nissan North America Inc.*, 3-22-cv-00220 (M.D. Tenn.), filed March 29, 2022; *Neo Wireless LLC v. Tesla, Inc.*, 2-22-cv-00095 (E.D. Tex.), filed March 29, 2022; *Neo Wireless LLC v. General Motors Company*, 2-22-cv-00094 (E.D. Tex.), filed March 29, 2022; *Neo Wireless LLC v. Toyota Motor North America, Inc.*, 2-22-cv-00093 (E.D. Tex.), filed March 29, 2022; *Neo Wireless, LLC v. Volkswagen Group of America, Inc.*, 1-22-cv-00076 (E.D. Tenn.), filed March 29, 2022; *In re: Neo Wireless, LLC Patent Litigation*, 2-22-md-03034 (E.D.

Mich.), filed June 23, 2022; *Neo Wireless, LLC v. American Honda Motor Co., Inc.*, 2-22-cv-11403 (E.D. Mich.), filed June 27, 2022; *Neo Wireless, LLC v. Ford Motor Company*, 2-22-cv-11402 (E.D. Mich.), filed June 27, 2022; *Neo Wireless LLC v. Tesla Inc.*, 2-22-cv-11408 (E.D. Mich.), filed June 28, 2022; *Neo Wireless LLC v. General Motors Company*, 2-22-cv-11407 (E.D. Mich.), filed June 28, 2022; *Neo Wireless LLC v. Toyota Motor North America, Inc.*, 2-22-cv-11406 (E.D. Mich.), filed June 28, 2022; *Neo Wireless, LLC v. Volkswagen Group of America, Inc.*, 2-22-cv-11404 (E.D. Mich.), filed June 28, 2022; *Neo Wireless, LLC v. Nissan North America Inc.*, 2-22-cv-11405 (E.D. Mich.), filed June 29, 2022; *Neo Wireless, LLC v. FCA US LLC*, 3-22-cv-01252 (N.D. Ohio), filed July 15, 2022; *Neo Wireless, LLC v. FCA US LLC*, 2-22-cv-11770 (E.D. Mich.), filed August 2, 2022; *Neo Wireless, LLC v. Mercedes-Benz USA, LLC*, 3-22-cv-00780 (M.D. Fla), filed July 15, 2022; and *Neo Wireless, LLC v. Mercedes-Benz USA, LLC*, 2-22-cv-11769 (E.D. Mich.), filed August 2, 2022.

The ’941 patent was also the subject of an IPR in *Dell Inc. v. New Wireless LLC*, IPR2021-01468, filed September 21, 2021, and *Volkswagen Group of America, Inc. v. Neo Wireless, LLC* IPR2022-01537, filed September 15, 2022. Ford filed an identical petition to the Volkswagen petition in *Ford Motor Company v. Neo Wireless, LLC,* IPR2023-00766, filed March 28, 2023.

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III. GROUNDS FOR STANDING (37 C.F.R. § 42.104(A))

The undersigned and Petitioner certify that the '941 patent is available for *inter partes* review. Petitioner is not barred or estopped from requesting this *inter partes* review on the grounds herein with Honda having been served on March 30, 2022.

IV. IDENTIFICATION OF CHALLENGE (37 C.F.R. § 42.104(B))

A. Citation of Prior Art

The '941 patent was filed on March 28, 2016, and claims priority to multiple earlier applications. The earliest effective priority date of the '941 patent is February 13, 2004. Petitioner does not concede that the challenged claims of the '941 patent are entitled to the benefit of this date. Nonetheless, all references relied

upon in this Petition qualify as prior art with respect to the February 13, 2004 priority date.

802.16a-2001 (EX1005) was published by IEEE on April 8, 2002. Therefore, 802.16a-2001 is prior art at least under 35 U.S.C. § 102(b) (pre-AIA). *See* EX1013; EX1003 Wilson Decl., ¶¶119-120, 123.

802.16a-2003 (EX1006) was published by IEEE on April 1, 2003. Therefore, 802.16a-2003 is prior art at least under 35 U.S.C. § 102(a) (pre-AIA). *See* EX1014; EX1003, ¶¶121-123.

U.S. Patent No. 6,937,592 to Heath (EX1007) was filed on September 1, 2000, and issued on August 30, 2005. Therefore, Heath is prior art at least under 35 U.S.C. § 102(e) (pre-AIA).

U.S. Patent Appl. Publ. No. 2003/0125040 to Walton (EX1008) was filed on November 6, 2001, and published on July 3, 2003. Therefore, Walton040 is prior art at least under 35 U.S.C. §§ 102(a) & (e) (pre-AIA).

U.S. Patent Appl. Publ. No. 2002/0147017 to Li (EX1009) was filed on April 17, 2001, and published on October 10, 2002. Thus, Li017 qualifies as prior art under at least 35 U.S.C. § 102(b) (pre-AIA).

Tufvesson (EX1010) was published on the IEEE Xplore website on August 6, 2002 and indexed at the Kurt. F. Wendt Library at University of Wisconsin on July 22, 1997. Therefore, Tufvesson is prior art at least under 35 U.S.C. § 102(b) (pre-AIA). *See* EX1033; EX1034; EX1003, ¶¶164-167.

B. Statutory Grounds for the Challenge

Ground	Basis	Claims	References
1.	§ 103	1-14	802.16a-2001 and 802.16a-2003 (collectively "802.16a") + Heath
2.	§ 103	1, 3-8, 10-14	Walton040 + Li017[1]
3.	§ 103	2, 9	Walton040 + Li017 + Tufvesson

V. TECHNICAL BACKGROUND

The '941 patent is directed to methods and apparatuses for adaptive transmission of wireless communication signals, "where MCS (modulation and coding scheme), coding rates, training pilot patterns, TPC (transmission power control) levels, and subchannel configurations are jointly adjusted to adapt to the channel conditions." EX1001, 2:33-38. But these techniques, and the benefits thereof, were well-known before the '941 patent.

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[1] Petitioner acknowledges that references with similar inventors to Walton040 and Li017 were previously identified in IPR2021-01468. However, Walton040 and Li017 are different references and applied differently, herein. *See infra* VIII.B, IX.A. The Board should institute review on the basis of the grounds presented herein.

A. OFDM communication systems were well-known.

The inventors of the ’941 patent did not invent OFDM. The ’941 patent admits as much, recognizing that OFDM communication systems were known and identifying “conventional OFDM” systems, including IEEE802.11a, 802.11g, 802.16, and DVB-T. EX1001, 1:56-61. This is not surprising because OFDM was first proposed in the 1960’s.

802.16a, Heath, Walton040, and Li017 also describe OFDM communication systems. EX1003, ¶¶60-74.

B. Adapting to channel conditions was well-known.

The inventors of the ’941 patent did not invent adapting to channel conditions in wireless communications system. Indeed, the ’941 patent admits that it was known that “[t]o improve performance, in addition to the MCS, other system functions such as channel estimation, transmission power control (TPC), and subchannel configuration can be adjusted in accordance with the state of the communication channel.” EX1001, 1:44-55.

802.16a, Walton040, Heath, and Li017 also disclose this concept. EX1003, ¶¶75-81.

C. Transmitting a control message over a control channel was well-known.

To effectively adapt to channel conditions, it was well-known to transmit a control message from a base station to a mobile station over a control channel. For

example, 802.16a provides a frame control header (FCH) at the beginning of each frame in the downlink from a base station to provide downlink parameters to a subscriber. EX1006, 802.16a-2003, 184, 67; EX1005, 802.16a-2001, 46.

Walton040, Heath, and Li017 also disclose this concept. EX1003, ¶¶82-88.

D. Transmission diversity and multiple-input multiple-output (MIMO) antenna schemes were well-known.

Antenna schemes, including transmission diversity scheme and multiple-input multiple-output (MIMO) schemes were well-known by February 2004. For example, Walton040 noted that to "provide diversity against deleterious path effects and improve performance, multiple transmit and receive antennas may be used" and that generally, "diversity increases and performance improves as the number of transmit and receive antennas increases." EX1008, Walton040, ¶6. Transmit diversity, in particular, can be used "to achieve highly reliable transmission of a single data stream." *Id*., ¶63.

Or, by "[u]sing MIMO, a transmitter unit may send multiple independent data streams on the same communication channel to a single or multiple receiver units by exploiting the spatial dimensionality of the communication channel coupling the transmit and receive antennas." *Id*., ¶¶55, 64-65.

802.16a and Heath also disclose this concept. EX1003, ¶¶89-102.

E. Distributed and localized subcarrier configurations were well-known.

Subchannel configurations with distributed or localized subcarriers were well-known by February 2004. For example, in 1999, Lawrey explained that "[t]he simplest scheme is to group the carriers allocated to each user." EX1013, Multiuser OFDM, 762. However, grouping carriers "makes the transmission susceptible to fading, as the whole group of carriers can be lost in a null in the spectrum." *Id.* As such, "[c]arriers can be allocated in a comb pattern, spreading them over the entire system bandwidth. This improves the frequency diversity, preventing all the carriers used by a user being lost in a null in the spectrum. However, this allocation scheme may be susceptible to inter-user interference." *Id.*, 763.

802.16a similarly explains that the subcarriers "forming one subchannel may, but need not be adjacent. The concept is shown in Figure 128as." EX1006, 180.

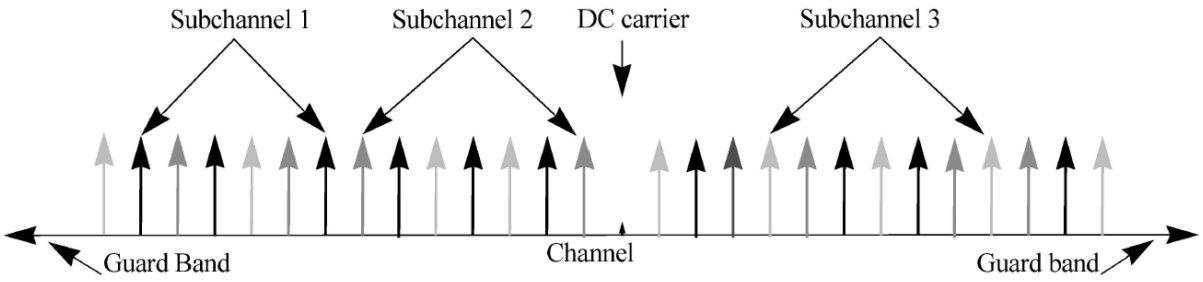


Figure 128as—OFDMA frequency description (3 channel schematic example)

EX1006, FIG. 128as.

Inventors of the ’941 patent even disclosed this concept in Li017 years before the ’941 patent. EX1009, ¶111.

Selecting a subchannel configuration based on a channel condition was also well-known by February 2004. Indeed, the ’941 patent admits that it was known that “[t]o improve performance,” a “subchannel configuration can be adjusted in accordance with the state of the communication channel.” EX1001, 1:44-48. Li017 also discloses this concept. EX1003, ¶¶103-115.

VI. THE ’941 PATENT

A. Overview

Like the prior art, the ’941 patent relates to methods to allegedly improve the performance of a wireless system, such as adaptive modulation and coding, channel estimation, transmission power control, and the adjustment of a subchannel configuration based on the state of a communication channel. EX1001, 1:34–48.

The ’941 patent does not purport to have invented the idea of OFDM systems. *Id.*, 1:56-61. The ’941 patent also does not purport to have invented adapting transmission parameters according to a channel condition. *Id.*, 1:34-2:3. Indeed, the ’941 patent admits that it was known to adjust system functions such as subchannel configuration and transmission power “in accordance with the state of the communication channel.” *Id.*, 1:44-55.

Yet, in a conflicting statement, the '941 patent alleges that the shortcoming of the prior art was that the "subchannel configuration is normally defined and fixed in an operation, and it is usually not considered an adjustable function of the system to be adapted to the user profile and/or operational environment." *Id.*, 2:4-7. The '941 patent purports to solve this alleged problem by using a subchannel configuration that "is designed to be configurable so that it can be adjusted statically or dynamically according to the user profiles or environmental conditions." *Id.*, 2:42-45. According to the '941 patent, "[t]his adaptation maximizes the overall system capacity and spectral efficiency without wasting radio resources or compromising error probability performance." *Id.*, 2:38-41.

As described in detail below, however, the concept of adjusting a subchannel configuration in an OFDM system as a function of a channel condition was not new in February 2004. Rather, this concept was known and even disclosed by the inventors of the '941 patent years earlier. *See generally* EX1009.

B. Prosecution History

The '941 patent was filed on March 28, 2016. EX1002, '941 Prosecution History, 0001. An Office Action was issued on October 12, 2017, rejecting claim 27 under non-statutory double patenting over U.S. Patent No. 9,301,296, rejecting claims 29-32 and 38-41 under § 112, ¶2, and rejecting claims 26-43 as anticipated by Wilson (EX1015). *Id.*, 0077-84.

In response, the applicant amended the independent claims to recite "the antenna transmission scheme comprising a transmission diversity scheme or a multiple-input multiple-output (MIMO) scheme and the corresponding subchannel configuration characterized by distributed subcarriers or localized subcarriers in the frequency domain." *Id.*, 0093-97. The applicant argued that because Wilson limits its teaching to a MIMO system, Wilson did not disclose the claimed antenna transmission scheme. The applicant also amended the claims to overcome the § 112 rejection and traversed the double-patenting rejection. *Id.*, 0093-0102. The Examiner then issued a notice of allowance without providing any reason for allowance. *Id.*, 0109-13.

But the claimed concepts were well-known before the '941 patent. Indeed, had any of the aforementioned references been before the Examiner during prosecution, the '941 patent would not have been allowed.

C. IPR2021-01468

On September 1, 2021, Dell filed an IPR asserting that claims 1-14 of the '941 patent were obvious over various combinations of Walton269, Li748, Gupta, PCT819, and Airy. EX1017, IPR2021-01468 Petition, 3.

On March 14, 2022, the Board issued a decision denying institution. EX1023, IPR2021-01468 DI, 47. Regarding Ground A1, the Board stated that "the record describes no problem in Walton '269 that one of ordinary skill in the art

would have resolved with the techniques used in [Li748] to address intercell interference" and the Petition did not "establish a reason to combine their teachings." *Id.*, 33. Regarding Ground B1, the Board stated that "we agree with Patent Owner that '[b]ecause Airy is not said to use any particular configuration of subcarriers, Petitioner has not shown that the combination of PCT819 and Airy has any need to transmit a subchannel configuration.'" *Id.*, 45.

D. Level of Ordinary Skill in the Art

A person of ordinary skill in the art ("POSITA") would have a bachelor's degree in electrical engineering, computer engineering, computer science, or an equivalent field, or an advanced degree in those fields, as well as least 3-5 years of academic or industry experience in mobile wireless communications, or comparable industry experience. EX1003, ¶¶53-54.

E. Claim Construction

In *inter partes* review proceedings, a claim of a patent is construed using the same standard used in federal district court. *See* 37 C.F.R. § 42.100(b). Under that standard, claim terms are construed in accordance with their ordinary and customary meaning, as understood by one of ordinary skill in the art, and in view of the patent specification and the relevant prosecution history. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312-1313 (Fed. Cir. 2005) (*en banc*).

Solely for purposes of the present Petition, Petitioner believes that none of the claim terms require explicit constructions. Accordingly, all claim terms have been given their plain and ordinary meaning, in the context of the '941 patent specification, under the *Phillips* standard.

Petitioner notes that the Board has previously declined to construe any claim term of the '941 patent. EX1023, 10-19. Petitioner notes, however, that the Board stated that "while we do not provide an explicit construction of 'the mobile station-specific transmission parameters indicate . . . a corresponding subchannel configuration . . . the corresponding subchannel configuration characterized by distributed subcarriers or localized subcarriers in the frequency domain,' we determine that the correct construction requires, at a minimum, that the mobile station-specific transmission parameters are capable of indicating, as alternatives, both distributed subcarriers and localized subcarriers in the frequency domain as subchannel configurations." *Id.*, 19. Petitioner takes no position on whether a construction is necessary for this term at this time. But regardless, the prior art discussed below discloses this limitation consistent with the Board's interpretation.

Petitioner notes that [8E]/[8G] and [13E]/[13G] are disputed terms in *Neo Wireless LLC v. Dell Technologies Inc.*, 1-22-cv-00060. *See* EX1042, Joint Claim Construction Statement, 7. Petitioner reserves the right to construe these terms if

appropriate/necessary but believes the construction of these terms is not necessary at this state in the proceeding.

VII. OVERVIEW OF THE APPLIED REFERENCES

A. 802.16a

802.16a is a standard that specifies a broadband wireless access system providing multiple services in a wireless metropolitan area network. EX1005, iv. This standard is defined in two documents—802.16a-2001 and 802.16a-2003—and referred to herein simply as "802.16a." EX1006, cover, 1.

802.16a discloses an OFDM communication system having at least one base station serving multiple mobile stations ("subscriber stations"/"subscribers"/"SS"). *See generally* EX1006, Chapter 8.5. Figures 128av and 128ax illustrate frame structures for BS to SS transmissions:

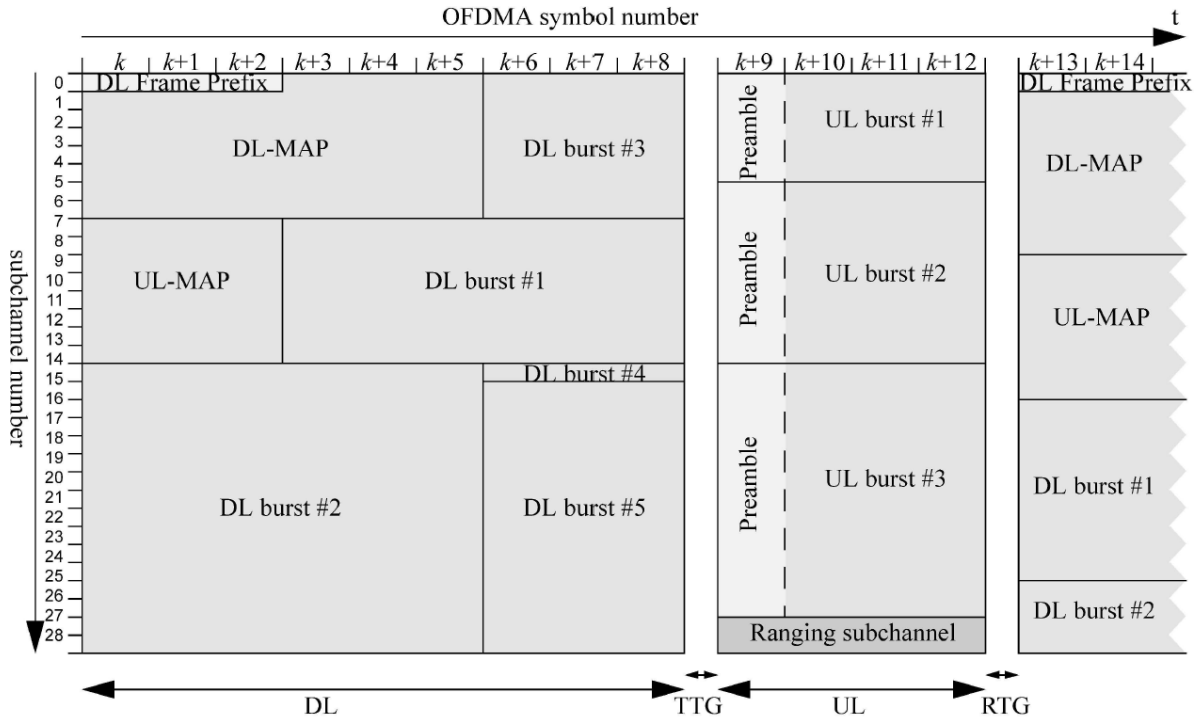


Figure 128av—Time plan - one TDD time frame

EX1006, FIG. 128av.

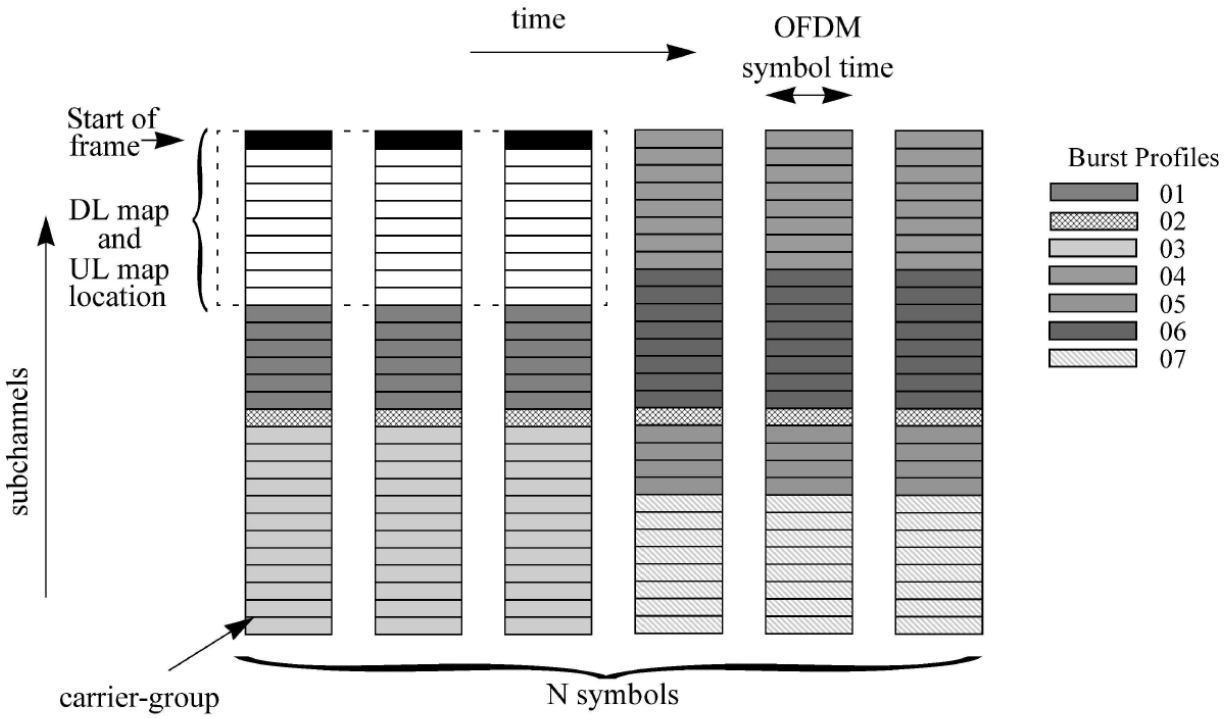


Figure 128ax—Example of OFDMA DL and UL map location

EX1006, FIG. 128ax.

802.16a's communication system adapts its transmission parameters based on the capabilities of the BS and SSs, as well as the channel state. EX1006, 4, 83. Specifically, a frame control header (FCH) is "transmitted at the beginning of each frame" in the downlink and "contains the DL-MAP message and may additionally include the UL-MAP, DCD or UCD messages." EX1006, 184; EX1005, 67. DL-MAP "defines the access to the downlink information" and can include a number of information elements. EX1005, 46.

BSs and SSs communicate using different antenna schemes with multiple antennas, including transmit diversity (space time coding (STC)) and adaptive

antenna systems (AAS). EX1006, 203-205, 66-68. Downlink transmission is performed on subchannels of the OFDMA symbol. *Id.*, 186, 180. Each subchannel is a collection of subcarriers that may or may not be adjacent in the frequency domain. *Id.*

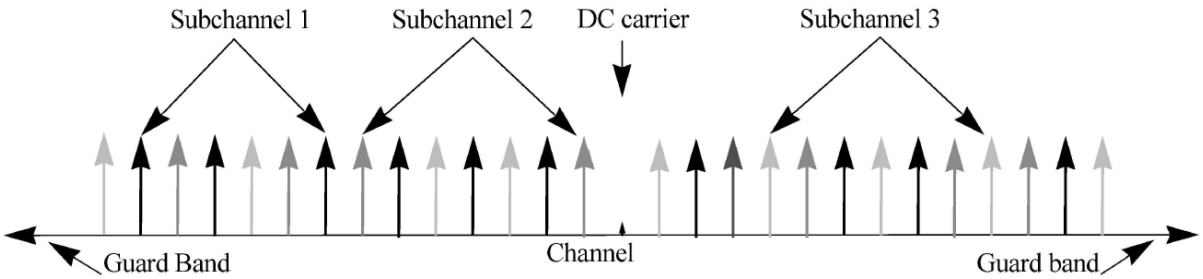


Figure 128as—OFDMA frequency description (3 channel schematic example)

EX1006, FIG. 128as.

For the "distributed carrier permutation," subchannels consist of non-contiguous subcarriers distributed across the OFDM frequency spectrum. EX1006, 199-200. For the "adjacent carrier permutation," "symbol data within a subchannel is assigned to adjacent carriers." *Id.*, 201.

B. Heath

Heath describes an OFDM wireless communication system that supports wireless transmissions with and without spatial multiplexing. EX1007, Heath, Abstract, 5:17-23. Figure 1 illustrates base transceiver station 202 and subscriber unit 208 that support spatial multiplexing. *Id.*, 5:7-15. BS 202 includes antennas 114, spatial multiplexing logic 118, and mode determination logic 122 that enables

the system to adapt its mode of operation between spatial multiplexing and non-spatial multiplexing in response to transmission-specific variables. *Id*.

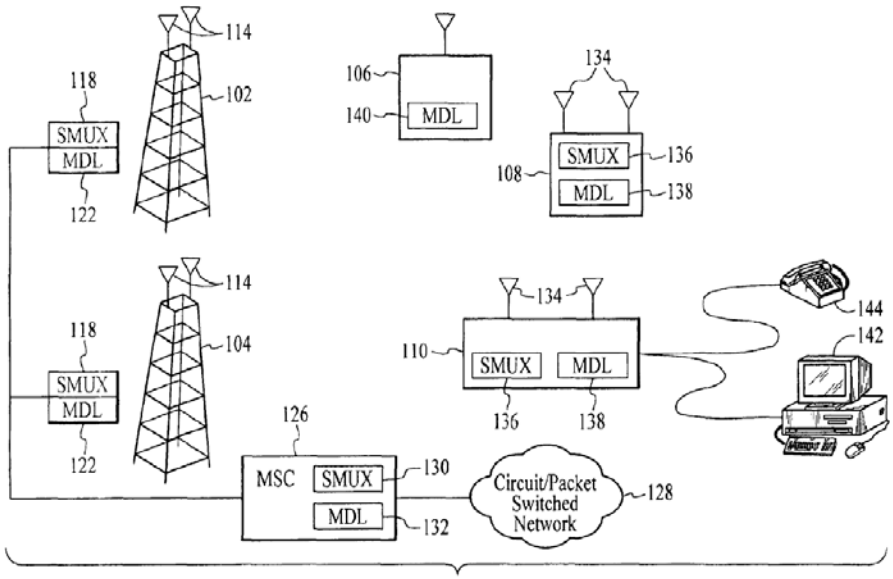


FIG. 1

EX1007, FIG. 1.

Heath explains that transmission diversity (non-spatial multiplexing) involves transmitting a "subscriber datastream over multiple paths, [where] each of the transmitted datastreams carries the same information." EX1007, 1:33-39, 1:44-46. "Because the transmission antennas are spatially separated, the receiving device receives diverse signals that can be processed to reduce multipath fading and to suppress interfering signals." *Id.*, 1:40-43. However, MIMO (spatial multiplexing) "works well to increase the bit rate between base transceiver stations and subscriber units." *Id.*, 1:55-59.

Figure 4 illustrates the transmission characteristics 450 used by Heath's

mode determination logic to determine the appropriate mode for subsequent transmissions—transmission diversity or MIMO. *Id*., 9:15-32, 9:60-10:1.

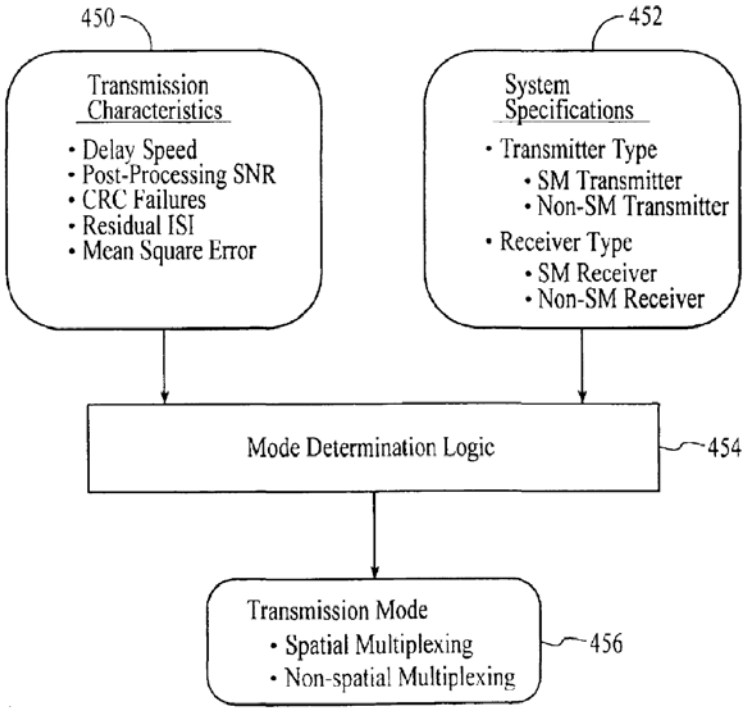


FIG. 4

EX1007, FIG. 4.

C. Walton040

Walton040 is directed to a multi-cell, multiple-access communication system 100 that "provides communication for a number of coverage areas 102a through 102g, each of which is serviced by a corresponding base station 104." EX1008, ¶43. In particular, a multiple-access MIMO system that employs OFDM. *Id.*, ¶10.

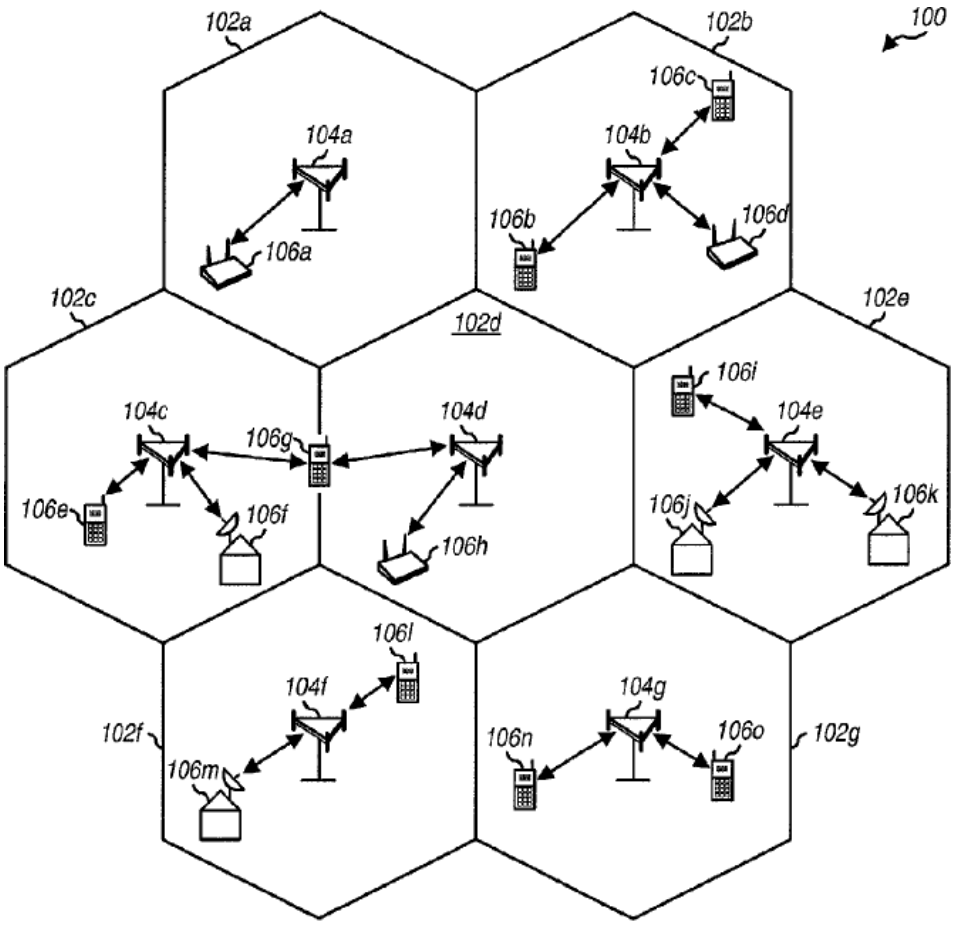


FIG. 1

EX1008, FIG. 1.

Figure 2A illustrates base station 104 and terminals 106 within system 100 for downlink data transmission. *Id.*, ¶76.

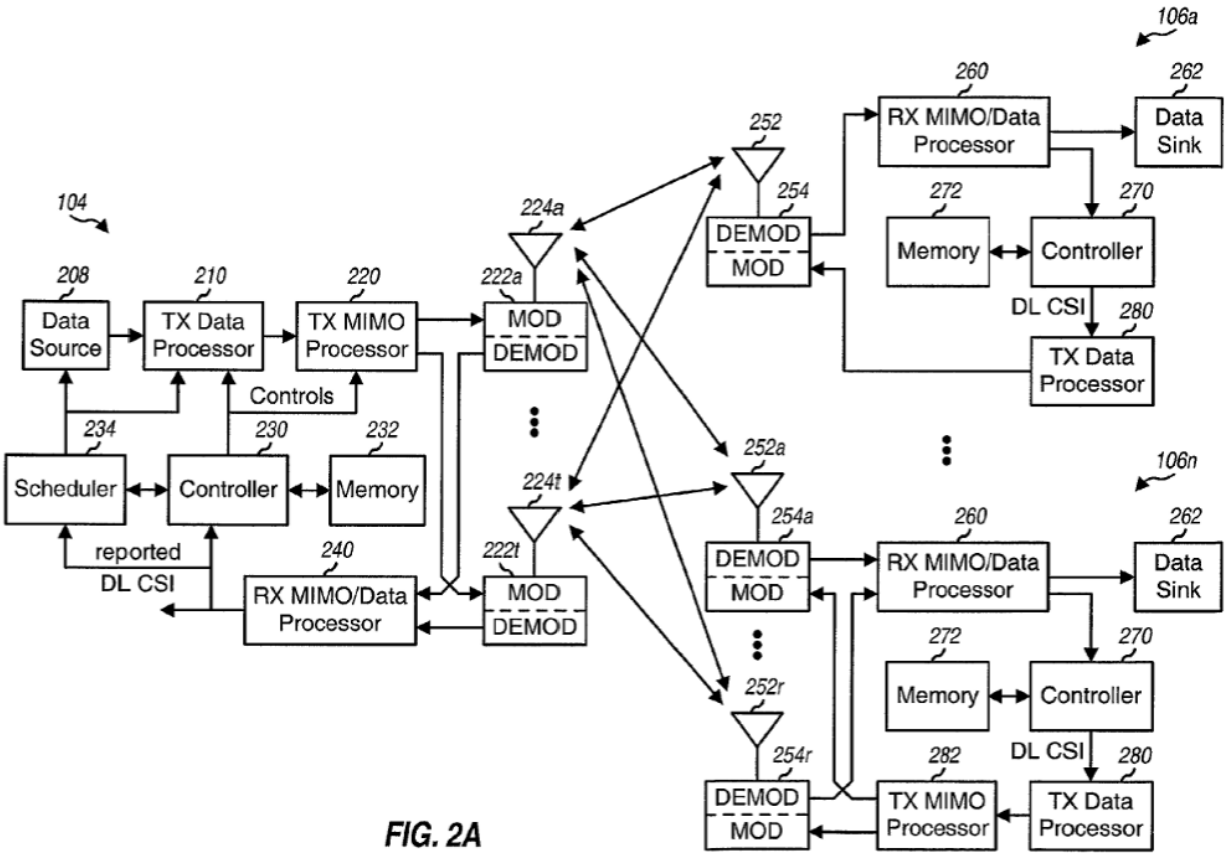


FIG. 2A

EX1008, FIG. 2A.

Walton040 explains that "[t]he use of multiple antennas at both the transmitter unit and receiver unit (i.e., $N_R \times N_T$ MIMO) is an effective technique for enhancing the capacity of multiple-access systems (e.g., cellular, PCS, LAN, and so on). Using MIMO, a transmitter unit may send multiple independent data streams on the same communication channel to a single or multiple receiver units by exploiting the spatial dimensionality of the communication channel coupling the transmit and receive antennas." EX1008, ¶55.

TABLE 1

Transmit Antennas	Receive Antennas: 1	Receive Antennas: N_R
1	SISO	SIMO
N_T	MISO	MIMO

EX1008, Table 1.

Walton040 also describes adaptively processing data prior to transmission based on channel state information (CSI). EX1008, Abstract. Specifically, adjusting operating parameters (e.g., the operating mode, channel, data rate, antenna(s) to transmit from, transmit power, and so on) based on performance metrics, and indicating these parameters to terminals via a control channel. *Id.*, ¶74.

For example, the base station may select and convey "schedule, antenna assignments, coding and modulation schemes, other information, or any combination thereof" to the scheduled terminals via a control channel (step 928). *Id.*, ¶482.

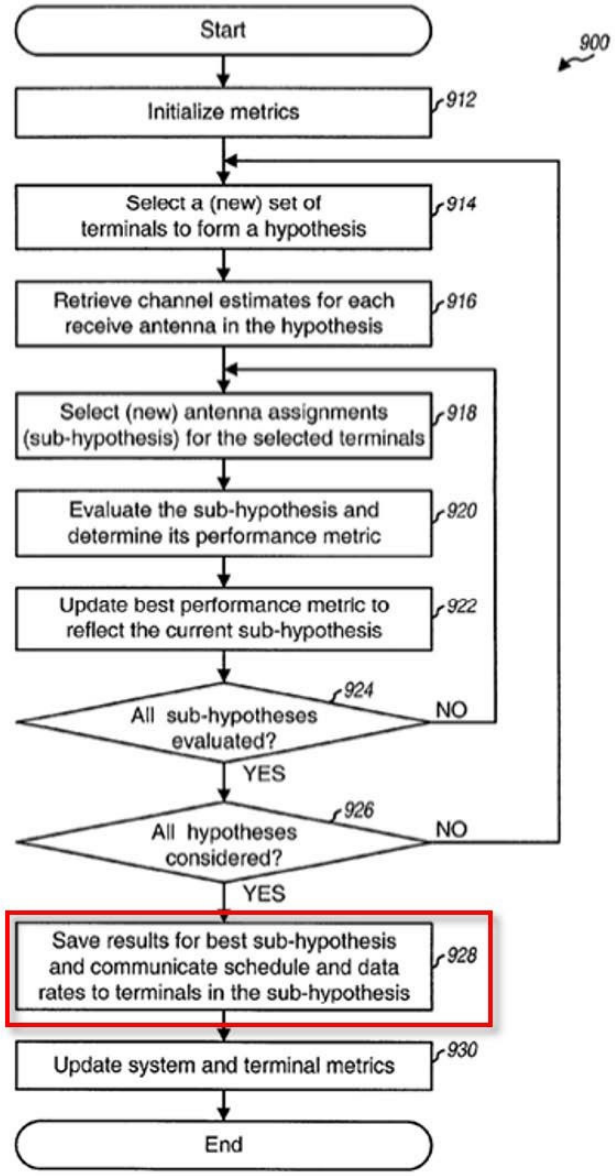


FIG. 9A

EX1008, FIG. 9A (annotated).

D. Li017

Li017 is directed to multi-cell, multi-subscriber wireless systems using OFDM. EX1009, ¶2.

In Li017, "each subscriber measures the SINR of each subcarrier cluster and reports these SINR measurements to their base station." *Id.*, ¶45. Upon receiving feedback, the base station selects one or more clusters for the subscriber. *Id.*, ¶47.

"[T]here are two categories of clusters: coherence clusters, containing multiple subcarriers close to each other and diversity clusters, containing multiple subcarriers with at least some of the subcarriers spread far apart over the spectrum." *Id.*, ¶111. Figure 9 illustrates these clusters. *Id.*, ¶112.

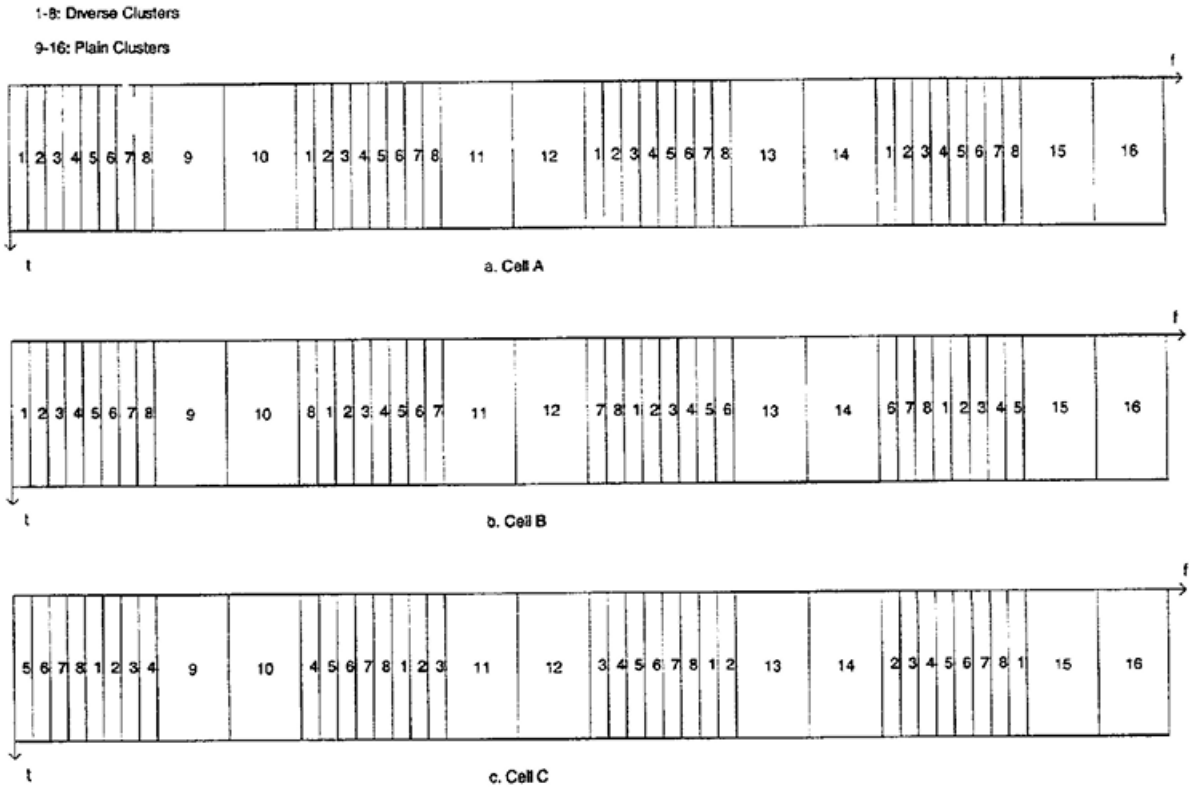


Figure 9

EX1009, FIG. 9.

Figure 11 illustrates the base station determining whether a user is mobile or in a fixed position close to the edge of the cell (block 1102). EX1009, ¶121. If the user is not mobile or is not in a fixed position close to the edge of the cell, the base station selects coherence clusters (1103); otherwise, the base station selects diversity clusters (1104). *Id.*

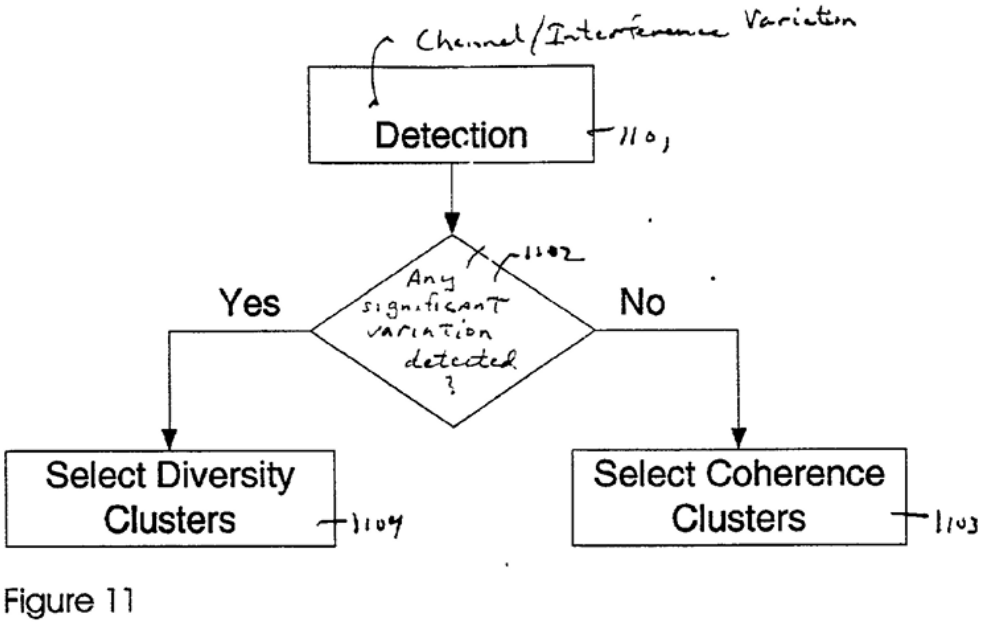


Figure 11

EX1009, FIG. 11.

"After cluster selection, the base station notifies the subscriber about the cluster allocation through a downlink common control channel" (105). *Id.*, ¶48.

E. Tufvesson

Tufvesson is directed to pilot assisted channel estimation for OFDM in mobile cellular systems. EX1010, Tufvesson, 1639.

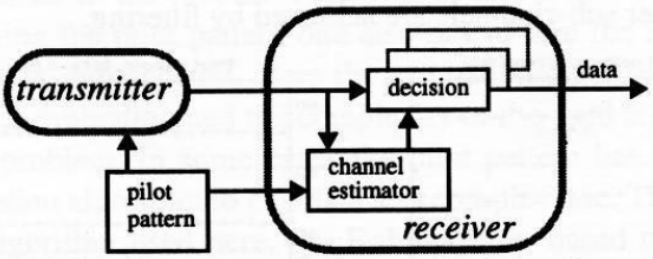


Fig. 1 The pilot pattern is known both by the receiver and the transmitter. The purpose is to minimize the number of transmitted pilot symbols without increasing the bit error rate.

EX1010, Fig. 1.

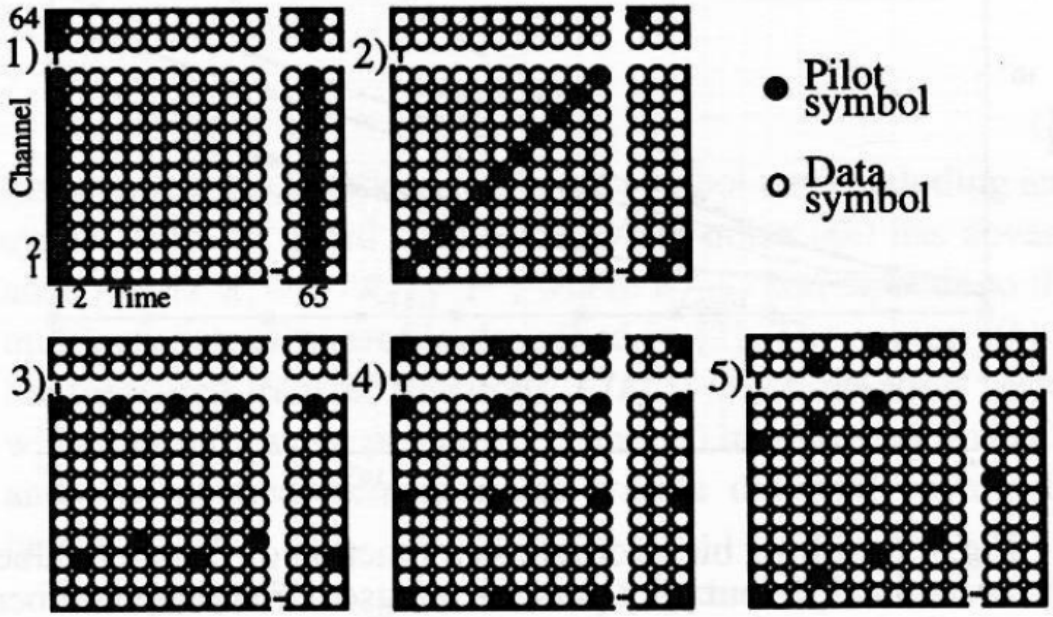


Fig. 2 Examples of pilot patterns analyzed.

EX1010, Fig. 2.

As Tufvesson explained, the pilot pattern used is among the information transferred to a mobile station when it logs into a new cell and then, once known, is used for channel estimation. *Id.*, 1639, 1641.

VIII. GROUNDS OF UNPATENTABILITY

Claims 1-14 are unpatentable for at least the reasons set forth below. EX1003, ¶¶170-341.

A. Ground 1: Claims 1-14 are unpatentable under § 103 as obvious over 802.16a-2001 and 802.16a-2003 (collectively "802.16a"), alone or in combination with Heath.

1. A POSITA would have been motivated to combine 802.16a-2001 and 802.16a-2003.

A POSITA would have found it at least obvious to combine 802.16a-2001 and 802.16a-2003 based on the explicit statements in 802.16a-2003. For example, 802.16a-2003 explains that it "amends IEEE Std 802.16-2001." EX1006, i, iii. 802.16a-2003 also contains editing instructions that "define how to merge the material contained herein into the existing base standard (IEEE Std 802.l6^{TM}-2001) to form the comprehensive standard." *Id.*, 1. These explicit statements would have motivated a POSITA to combine 802.16a-2003 with 802.16-2001 to form a single document/standard, referred to herein as "802.16a." EX100X, ¶¶170-172.

2. A POSITA would have been motivated to combine 802.16a and Heath.

802.16a is directed to an OFDM communication system having a BS and SS with multiple antennas. *See, e.g.*, EX1006, 66-68, 179, 203-205.

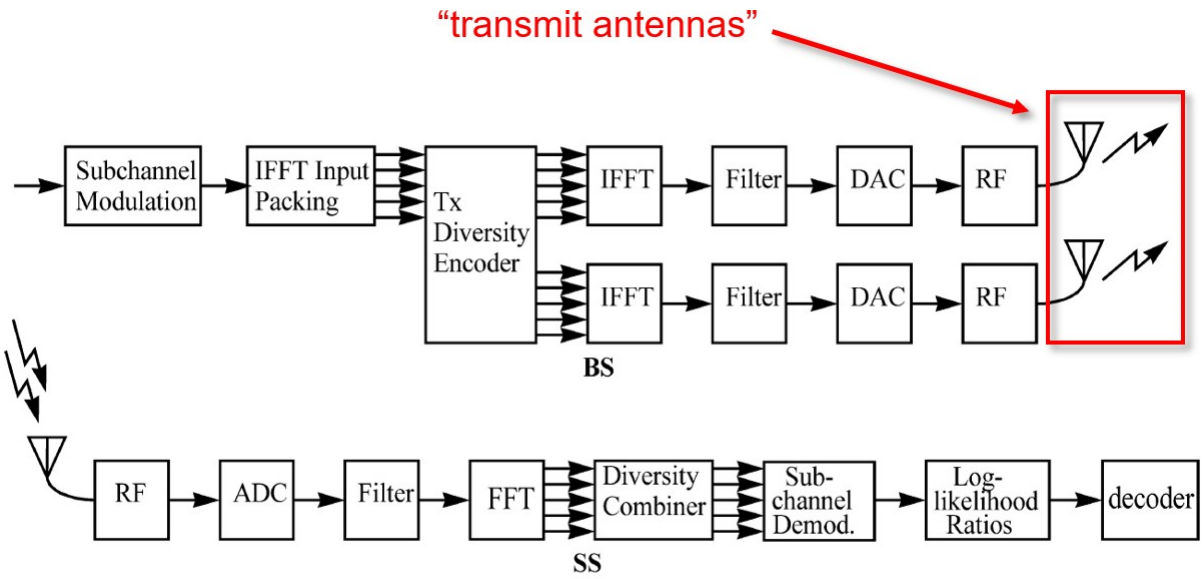


Figure 128bf—Illustration of STC

EX1006, FIG. 128bf (annotated).

Although Figure 128bf illustrates an SS with one antenna, SSs may have multiple antennas. *See id.*, 131 (describing "[r]eceive diversity"), 204 (describing two receive antennas "2Rx"). 802.16a's BS can communicate with SSs with the multiple antennas using different antenna schemes, including transmit diversity (STC) and AAS. EX1006, 203-205, 66-68; EX1003, ¶¶173-175.

AAS uses more than one antenna to "improve range and system capacity, by adapting the antenna pattern and concentrating its radiation to each individual subscriber." EX1006, 66. According to 802.16a, "[t]he spectral efficiency can be increased linearly with the number of antenna elements. This is achieved by steering beams to multiple users simultaneously so as to realize an inter-cell frequency reuse of one and an in-cell reuse factor proportional to the number of

antenna elements." *Id.*; EX1003, ¶176.

A POSITA would have readily understood 802.16a's AAS to be a "multiple-input multiple-output (MIMO) scheme" because it uses multiple transmit antennas to steer different beams to multiple users simultaneously so as to increase spectral efficiency. Indeed, this is consistent with the '941 patent, which does not define or describe the claimed "multiple-input multiple-output (MIMO) scheme" in any detail. Instead, simply stating that "multiple antenna techniques such as multiple-input multiple-output (MIMO) schemes are used to improve transmission throughput in favorable channel conditions." EX1001, 6:60-65. A POSITA would have readily appreciated that 802.16a's AAS scheme is likewise used to improve transmission throughput in favorable channel conditions. EX1003, ¶177.

A POSITA, specifically, would have understood 802.16a's AAS to be a multi-user MIMO scheme. *See, e.g.*, EX1008, ¶61 ("MIMO (Multiple-Input, Multiple-Output)—the RF link is characterized by multiple transmit antennas and multiple receive antennas."); *id.*, ¶65 ("Spatial multiplexing, multi-user (multi-user MIMO mode)—the use of multiple transmit and receive antennas to accommodate communication with multiple terminals concurrently on the same channel."); EX1003, ¶178.

However, 802.16a does not explicitly disclose details of how to select the appropriate antenna scheme. Therefore, a POSITA would have been motivated to

look at the prior art, e.g. Heath, for techniques for selecting the appropriate antenna scheme. EX1007, 1:46-51. EX1003, ¶179.

Like 802.16a, Heath discloses the use of a transmit diversity or MIMO scheme. EX1007, 1:33-43, Abstract, 2:11-22. Heath also emphasizes the importance of selecting the appropriate antenna scheme depending on transmission conditions. EX1007, Abstract. For example, Heath states that "[a]lthough diversity communication may reduce the effects of multipath fading, diversity does not enable the increased bit rates that are enabled by spatial multiplexing." EX1007, 8:18-21. However, using "multiple spatially separated antennas at the base transceiver stations and the subscriber units to multiplex transmissions" "increase[s] the bit rate[s] between the base transceiver stations and subscriber units." *Id.*, 1:46-51, 1:55-59. "Although spatial multiplexing [MIMO] works well to increase the bit rate between base transceiver stations and subscriber units that support spatial multiplexing," "it may not be appropriate to utilize spatial multiplexing for every transmission. For example, transmission conditions may be such that spatial multiplexing provides poor results, thereby eliminating the possibility of an increased bit rate that is provided by spatial multiplexing." *Id.*, 1:55-65; EX1003, ¶¶180-181.

Recognizing this, Heath's mode determination logic 454 utilizes transmission characteristics 450 to determine whether to use transmit diversity

(non-spatial multiplexing) or MIMO (spatial multiplexing). EX1007, 9:60-10:1; EX1003, ¶182.

Figure 4 illustrates "transmission-specific inputs 450 and 452 that are considered by the mode determination logic 454 to determine the appropriate mode of operation" for subsequent transmissions." EX1007, 9:15-18; EX1003, ¶183.

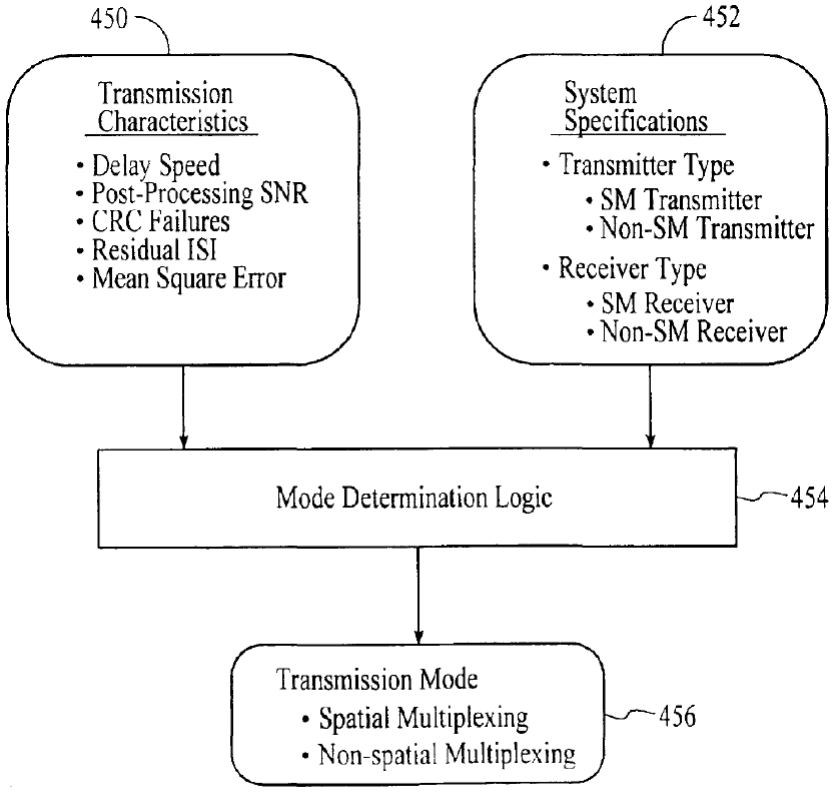


FIG. 4

EX1007, FIG. 4.

Heath's BS also includes a mode switch that dictates the mode of operation for subsequent data transmissions in accordance with the mode determination logic

and conveys the selected transmission mode to the mobile station via the control channel. EX1007, 11:67-12:38, 14:55-63, 2:58-61, 3:60-62, Fig. 8; EX1003, ¶184.

As such, 802.16a and Heath both disclose a BS having multiple antennas that can operate in a transmit diversity or MIMO scheme, and inform the mobile station of the selected scheme via a control channel. Based on the teachings of Heath, a POSITA would have been motivated to modify 802.16a so as to incorporate Heath's mode determination logic. Doing so would have required minimal modifications. Namely, it would have been obvious to modify 802.16a's BS to incorporate the mode determination logic and switch to select the appropriate antenna scheme based on existing CSI, and to inform the SS of the selected antenna transmission scheme in the existing FCH using DL-Map. EX1007, 2:58-61, 3:60-62; EX1003, ¶¶185-186.

Modifying 802.16a with Heath's mode determination logic and communicating the selected mode over the control channel would have required minimal modifications. For example, by incorporating Heath's mode determination logic to select the appropriate antenna transmission scheme already present—STC or AAS—using the existing CSI, and indicating which scheme to use via DL-Map as 802.16a teaches. EX1003, ¶187.

For example, a POSITA would have readily understood that it would have been advantageous to utilize transmit diversity (STC) when the transmission

conditions are susceptible to fading and/or multipath when CSI is not available to the BS. EX1007, 1:33-43. A POSITA would have also known that it would have been advantageous to utilize AAS, for example, when 802.16a's BS is in communication with multiple SSs and CSI is available to the BS. By utilizing AAS, 802.16a's BS is able to "improve range and system capacity." EX1006, 66; EX1003, ¶¶188-189.

To the extent that Patent Owner may argue that the claimed "multiple-input multiple-output (MIMO) scheme" requires something different from 802.16a's AAS MIMO scheme (it does not), Heath discloses this limitation. That is, Heath discloses use of spatial multiplexing—a single-user MIMO scheme. *Id.*, Abstract, 2:11-22; *see* EX1008, ¶64 ("Spatial multiplexing, single-user (single-user MIMO mode)—the use of both multiple transmit and receive antennas to achieve high data rates for a single terminal by creating multiple parallel transmission channels by exploiting the spatial dimensionality of the communication channel."). EX1003, ¶¶190-191.

Heath's Figure 2 illustrates a spatially multiplexed transmission:

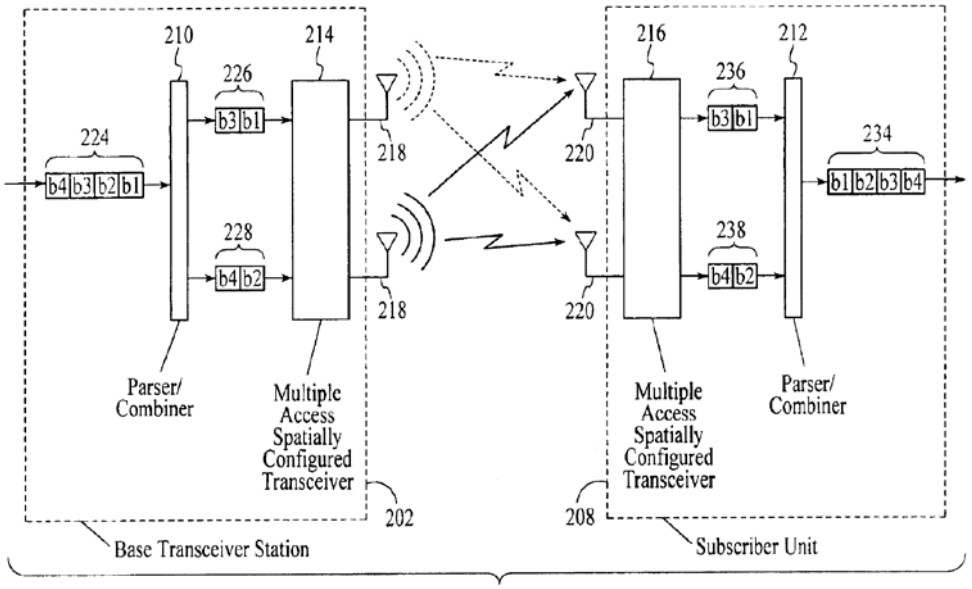


FIG. 2

EX1007, FIG. 2.

Based on the teachings of Heath, a POSITA would have also been motivated to modify 802.16a so as to incorporate Heath's spatial multiplexing, single-user MIMO, scheme at least for the ability to increase the bit rate between a base transceiver station and a single SS. EX1007, 1:55-65. Such a modification would have also incorporated Heath's teaching of informing the SS of the switch to single-user MIMO via the existing FCH using DL-Map so that the SS may properly receive and decode the data. *Id.*, 2:58-61, 3:60-62; EX1003, ¶193.

Modifying 802.16a to also include Heath's spatial multiplexing mode would have required minimal modifications. For example, by incorporating Heath's spatial multiplexing unit to output data for transmission over 802.16a's existing antennas and indicating the use of spatial multiplexing to the SS via DL-Map (e.g.,

with a spatial multiplexing information element). Using the example above, a POSITA would have known that it would have been preferable to utilize a single-user MIMO scheme as taught by Heath when 802.16a's BS is in communication with a single SS and CSI is available to the BS to achieve an increased bit rate. EX1007, 1:46-51; EX1003, ¶184.

In addition to the motivations described above, a POSITA would have been further motivated to combine 802.16a and Heath because both are in the same general field of mobile communications, and address the same problem—improving the performance of wireless communication systems. Further, a POSITA would have combined the system of 802.16a with the teachings of Heath using known methods, and the results of the combination would have been predictable to a POSITA (e.g., by including Heath's antenna transmission scheme selection logic and communication of the selected scheme over the control channel with or without the spatial multiplexing unit). EX1003, ¶195.

Finally, the proposed combination of 802.16a and Heath would involve nothing more than incorporating a well-known concept (i.e., Heath's antenna transmission scheme selection logic and communication of the selected scheme over the control channel with or without the spatial multiplexing unit) into a well-known system (i.e., 802.16a's wireless communication system). EX1003, ¶196; *KSR Int'l Co. v. Teleflex Inc*., 550 U.S. 398, 419-421 (2007).

3. Claim 1

(a) [1A]

802.16a discloses this preamble to the extent the limiting. EX1003, ¶¶199-203.

802.16a's BS serves multiple mobile stations ("SSs") in an OFDM communication system utilizing a transmission structure with time slots (*k*) in the time domain and frequency subchannels in the frequency domain. For example, 802.16a's WirelessMAN-OFDMA is based on OFDM modulation utilizing a transmission structure with time slots in the time domain (TDD) and frequency subchannels in the frequency domain. *See generally* EX1006, 179-226. Figures 128av and 128ax illustrate frame structures for BS to SS transmissions. *Id.*, 183, 185.

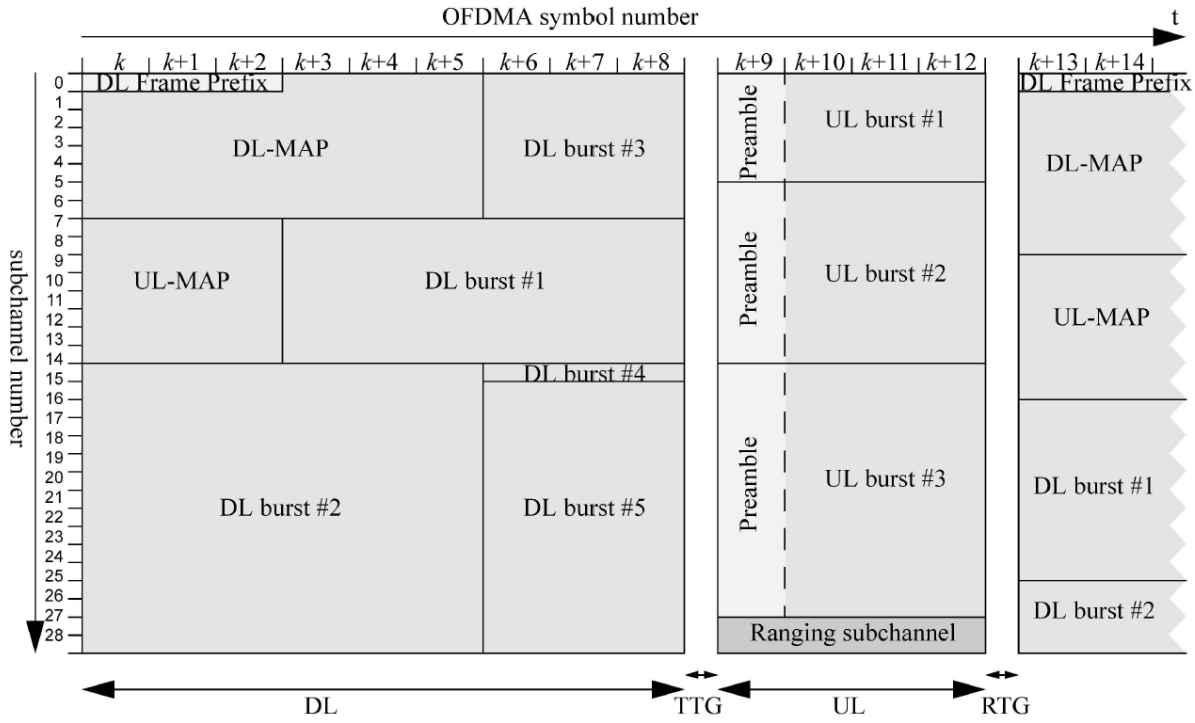


Figure 128av—Time plan - one TDD time frame

EX1006, FIG. 128av.

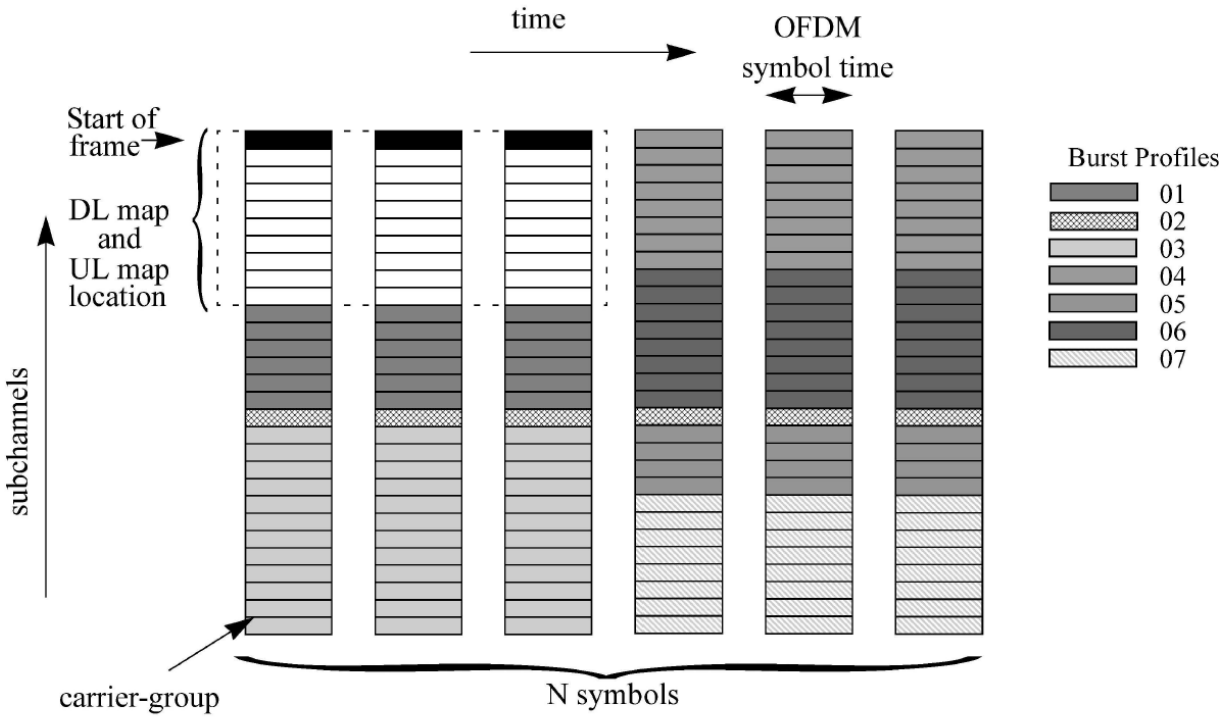


Figure 128ax—Example of OFDMA DL and UL map location

EX1006, FIG. 128ax.

EX1003, ¶¶199-201.

802.16a's BS also performs a link adaptation method according to its capabilities, SS capabilities, and CSI. EX1006, 4, 42, 67, 83, 189, 197, 200-221; EX1003, ¶¶202-203.

(b) [1B]

802.16a discloses transmitting a control message to a mobile station over a control channel. EX1003, ¶¶204-213.

In particular, the downlink from the BS "includes the transmission of a FCH, which is transmitted in the most robust burst profile of the system followed by

transmission using burst profiles as defined in the FCH." EX1006, 183. This FCH is "transmitted at the beginning of each frame" and "contains the DL-MAP message and may additionally include the UL-MAP, DCD or UCD messages." *Id.*, 184; EX1005, 67. DL-MAP "defines the access to the downlink information" as illustrated in Table 15. EX1005, 46; EX1003, ¶¶205-206.

Table 15—DL-MAP message format

Syntax	Size	Notes
DL-MAP_Message_Format() {		
Management Message Type = 2	8 bits	
PHY Synchronization Field	Variable	See appropriate PHY specification.
DCD Count	8 bits	
Base Station ID	48 bits	
Number of DL-MAP Elements *n*	16 bits	
Begin PHY Specific Section {		See applicable PHY section.
for (*i* = 1; *i* <= *n*; *i*++) {		For each DL-MAP element 1 to *n*.
DL_MAP_Information_Element()	Variable	See corresponding PHY specification.
if !(byte boundary) {		
Padding Nibble	4 bits	Padding to reach byte boundary.
}		
}		
}		
}		

EX1005, Table 15.

Figures 128av and 128ax illustrate DL-Map at the start of the frame. EX1003, ¶207.

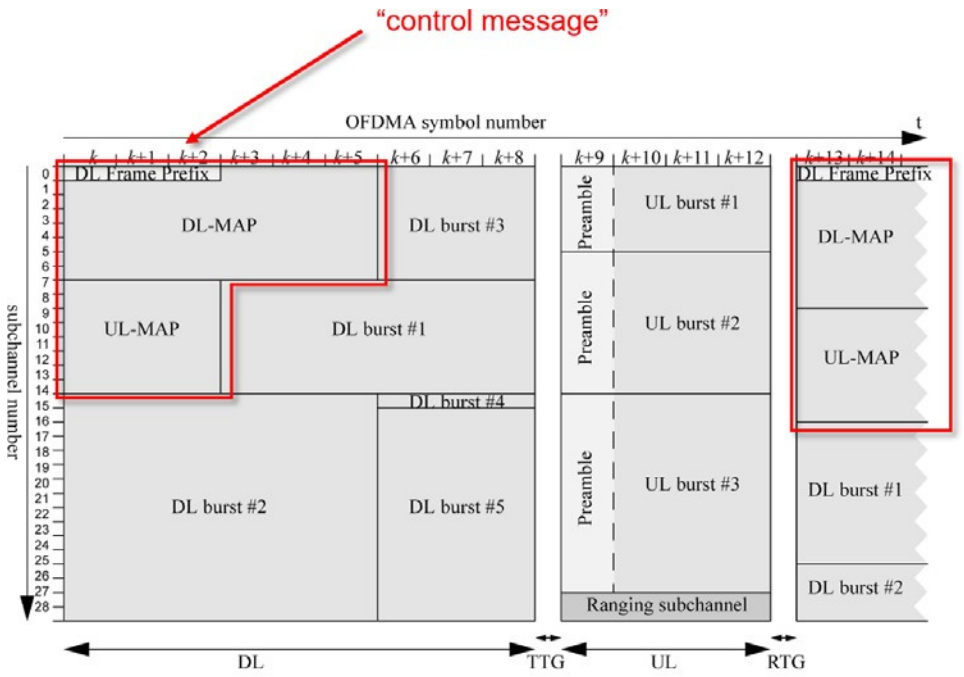


Figure 128av—Time plan - one TDD time frame

EX1006, FIG. 128av (annotated).

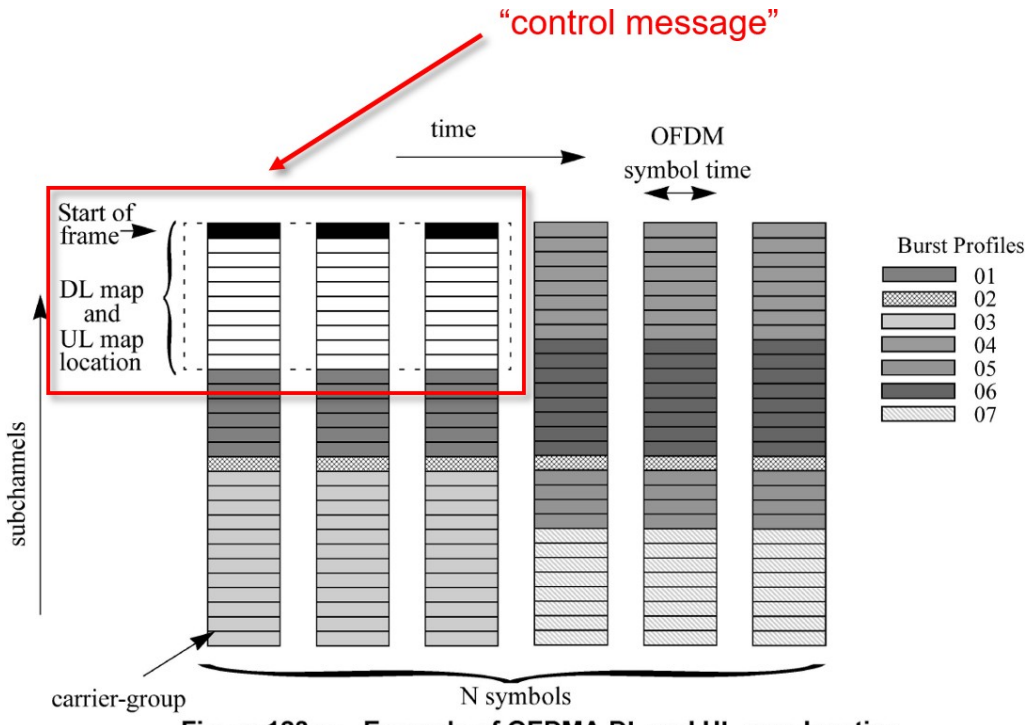


Figure 128ax—Example of OFDMA DL and UL map location

EX1006, FIG. 128ax (annotated).

A POSITA would have understood that 802.16a's FCH is transmitted over a "control channel." The '941 patent does not define the generically claimed "control channel"; instead stating that a "forward control link is defined here as the transmission of the AMCTP indicator from the transmitter to the receiver, and a return control channel is defined as the transmission of CQI, as the feedback information, from the receiver to the transmitter." EX1001, 7:25-38. 802.16a's FCH is transmitted from the transmitter to the receiver, as shown in Figure 40, just like the AMCTP indicator 602 on a forward link, as shown in Figure 6 of the '941 patent. EX1006, 183; EX1003, ¶¶208-211.

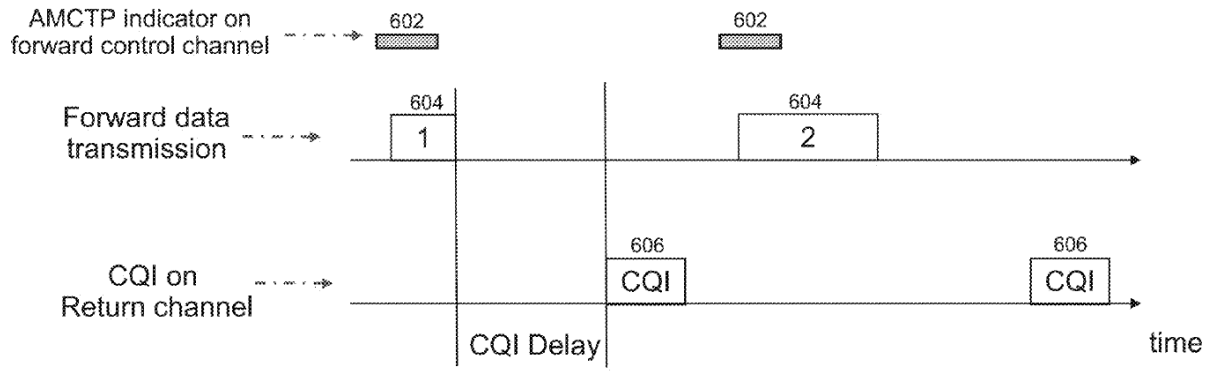


FIG. 6

EX1001, FIG. 6.

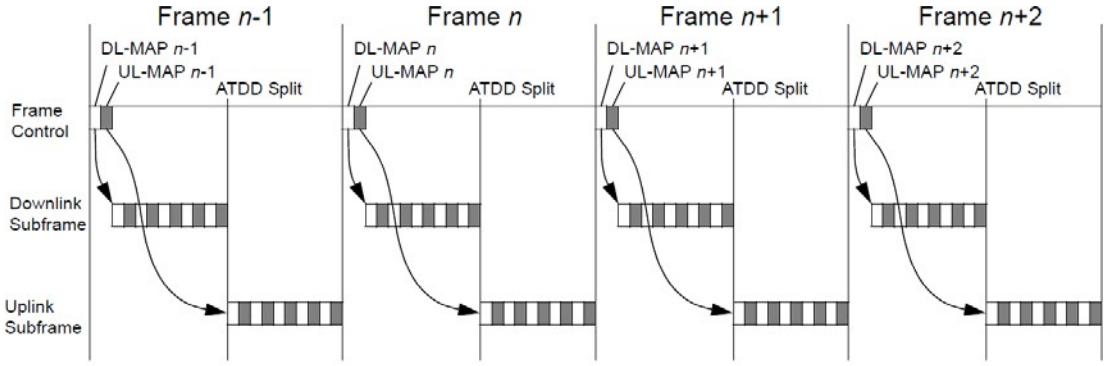


Figure 40—Minimum time relevance of PHY and MAC control information (TDD)

EX1005, FIG. 40.

See EX1005, 97, 239; EX1006, 59.

Heath also confirms that 802.16a discloses this limitation, explaining that a "control channel may be located in the header or the payload portion of each packet" and that the "control channel may involve a dedicated transmission frequency a dedicated time slot." EX1007, 8:60-65; EX1003, ¶212.

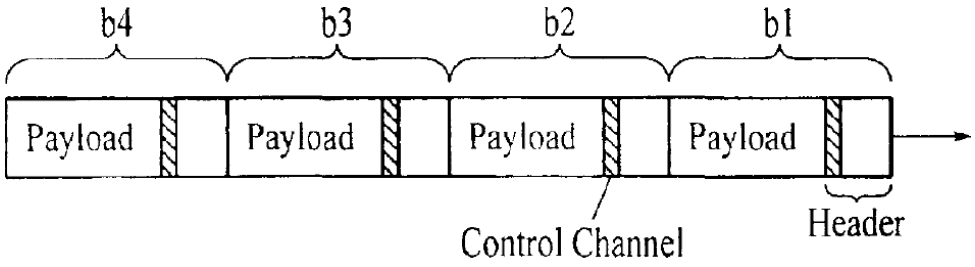


FIG. 3D

EX1007, FIG. 3D.

(c) [1C]

802.16a discloses that the FCH ("control message") contains transmission parameters allocated to the SS ("mobile station") for a subsequent transmission of data (e.g., DL burst 3) by the BS over a frequency subchannel (e.g., subchannel 3) to the SS in a time slot (e.g., *k+6 to k+8*). EX1003, ¶¶214-220.

In 802.16a, DL transmission 'is performed on the subchannels of the OFDMA symbol" and the number of subchannels needed for the different transmissions and their mapping is defined in the DL-MAP message, using "subchannels in the frequency domain and OFDMA symbols in the time domain." EX1006, 186. Specifically, DL-MAP specifies a burst profile (DIUC value), OFDM Symbol offset, subchannel offset, number of OFDM symbols, and number of subchannels for a specific DL burst. *Id.*, 193, 188; EX1005, 5, 46; EX1003, ¶¶216-217.

Table 116bp—OFDMA DL-MAP_Information_Element format

Syntax	Size	Notes
DL-MAP_Information_Element() {		
DIUC	4 bits	
if (UIUC == 15) {		
Extended DIUC dependent IE	variable	AAS_DL_IE()
} else {		
OFDM Symbol offset	10 bits	
Subchannel offset	6 bits	
No. OFDM Symbols	10 bits	
No. Subchannels	6 bits	
}		
}		

EX1006, Table 116bp.

DL-Map's parameters are then used by the BS for a subsequent transmission of data by the BS over a frequency subchannel to the mobile station in a time slot (e.g., DL burst #3 on subchannels 0-6 in time slots *k+6 to k+8*). EX1005, 24, 46, 67, 97, 220; EX1003, ¶¶218-219.

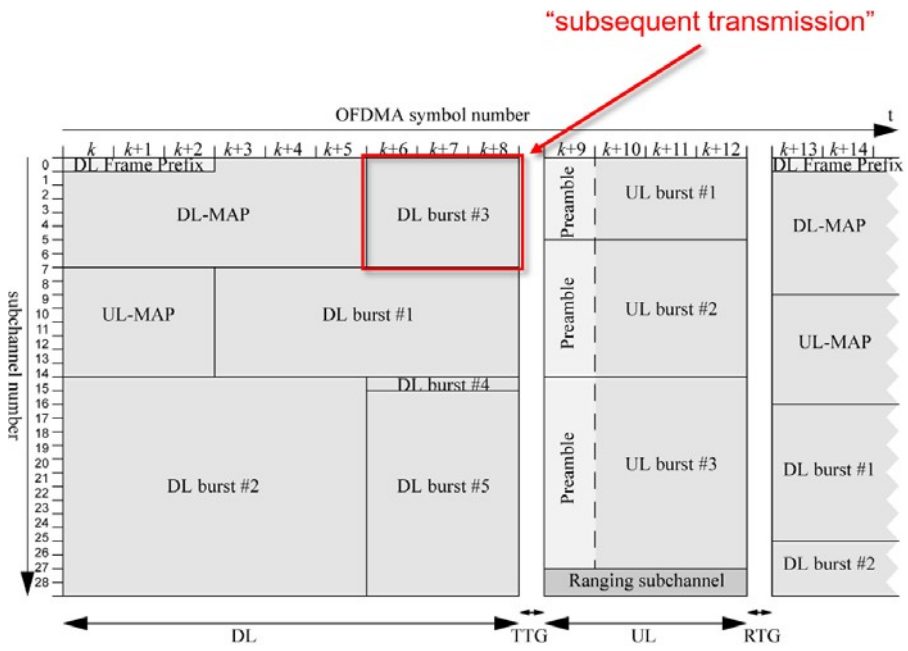


Figure 128av—Time plan - one TDD time frame

EX1006, FIG. 128av (annotated).

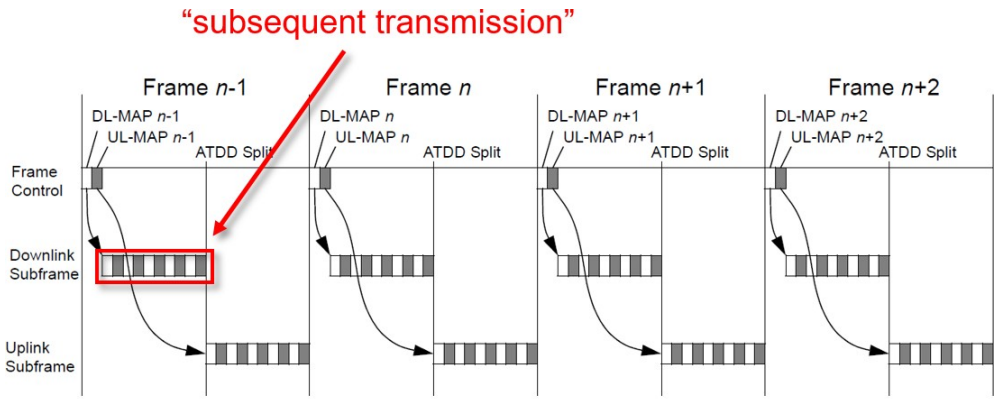


Figure 40—Minimum time relevance of PHY and MAC control information (TDD)

EX1005, FIG. 40 (annotated).

(d) [1D]

802.16a's SS-specific transmission parameters in the FCH indicate an antenna transmission scheme. 802.16a's BS and SS can communicate using

different antenna schemes, including transmit diversity (STC) and MIMO (AAS). EX1006, 203-205, 66-68; EX1003, ¶¶221-229.

STC on the downlink provides "2nd order (Space) transmit diversity" using "two transmit antennas on the BS side." EX1006, 203; EX1003, ¶223.

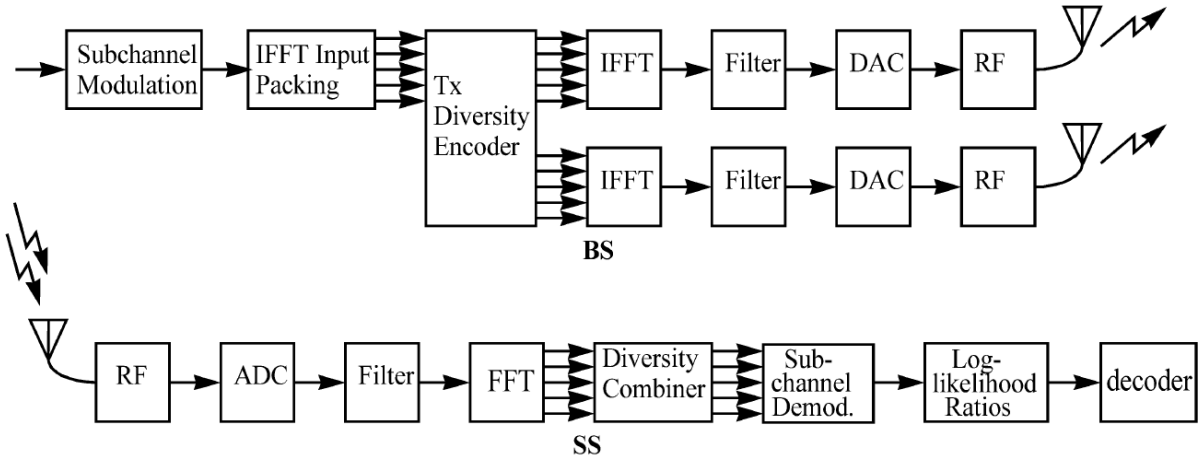


Figure 128bf—Illustration of STC

EX1006, FIG. 128bf.

AAS, "through the use of more than one antenna element, can improve range and system capacity, by adapting the antenna pattern and concentrating its radiation to each individual subscriber. The spectral efficiency can be increased linearly with the number of antenna elements. This is achieved by steering beams to multiple users simultaneously so as to realize an inter-cell frequency reuse of one and an in-cell reuse factor proportional to the number of antenna elements." EX1006, 66; EX1003, ¶224.

Table 0a—Air interface nomenclature

Designation	Applicability	PHY specification	Additional MAC requirements	Options	Duplexing alternative
WirelessMAN-SC	10–66 GHz	8.2			TDD FDD
WirelessMAN-SCa	2–11 GHz licensed bands	8.3		AAS (6.2.7.7) ARQ (6.2.4) STC (8.3.3)	TDD FDD
WirelessMAN-OFDM	2–11 GHz licensed bands	8.4		AAS (6.2.7.7) ARQ (6.2.4) Mesh (6.2.6.7) STC (8.4.7)	TDD FDD
WirelessMAN-OFDMA	2–11 GHz licensed bands	8.5		AAS (6.2.7.7) ARQ (6.2.4) STC (8.5.8)	TDD FDD
WirelessHUMAN	2–11 GHz license-exempt bands	[8.3, 8.4 or 8.5] and 8.6	DFS (6.2.14)	AAS (6.2.7.7) ARQ (6.2.4) Mesh (6.2.6.7) (with 8.4 only) STC (8.3.3/8.4.7/8.5.8)	TDD

EX1006, Table 0a (annotated).

DL-MAP indicates the antenna transmission scheme (STC or AAS) using STC_IE() and AAS_ DL_IE() information elements. EX1006, 188; EX1003, ¶226.

Table 116bp—OFDMA DL-MAP_Information_Element format

Syntax	Size	Notes
DL-MAP_Information_Element() {		
DIUC	4 bits	
if (UIUC == 15) {		
Extended DIUC dependent IE	variable	AAS_DL_IE()
} else {		
OFDM Symbol offset	10 bits	
Subchannel offset	6 bits	
No. OFDM Symbols	10 bits	
No. Subchannels	6 bits	
}		
}		

EX1006, Table 116bp (annotated).

In DL-MAP, an STC enabled BS "may transmit DIUC=15 with the STC_IE() to indicate that the subsequent allocations shall be STC encoded." EX1006, 189.

Table 116bs—OFDMA DL STC Information Element

Syntax	Size	Notes
STC_IE() {		
extended DIUC	4 bits	AAS = 0x01
OFDMA symbol offset	10 bits	
}		

EX1006, Table 116bs.

"[T]he switch from non-AAS to AAS-enabled traffic is marked by using the extended DIUC = 15 with the AAS_ DL_IE() to indicate that the subsequent allocations … shall be for AAS traffic." EX1006, 189; EX1003, ¶¶227-228.

Table 116br—OFDMA DL AAS information element

Syntax	Size	Notes
AAS_DL_IE() {		
extended DIUC	4 bits	AAS = 0x02
Permutation	2 bits	0 = distributed-carrier permutation 1 = adjacent-carrier permutation
OFDMA symbol offset	10 bits	
}		

EX1006, Table 116br.

(e) [1E]

802.16a's SS-specific transmission parameters indicate a corresponding subchannel configuration. DL transmission "is performed on the subchannels" and the "**number of subchannels needed for the different transmissions (modulation and coding) and their mapping is defined in the DL-MAP message**."[2] EX1006, 186, 180; EX1003, ¶¶230-234.

[2] Emphasis added unless otherwise noted.

Table 116bp—OFDMA DL-MAP_Information_Element format

Syntax	Size	Notes
DL-MAP_Information_Element() {		
DIUC	4 bits	
if (UIUC == 15) {		
Extended DIUC dependent IE	variable	AAS_DL_IE()
} else {		
OFDM Symbol offset	10 bits	
Subchannel offset	6 bits	
No. OFDM Symbols	10 bits	
No. Subchannels	6 bits	
}		
}		

EX1006, Table 116bp (annotated).

EX1006, 188 ("**Subchannel offset:** The lowest index OFDM subchannel used for carrying the burst, starting from subchannel 0. … **No. of subchannels:** The number OFDMA subchannels with subsequent indexes, used to carry the burst."); EX1003, ¶232.

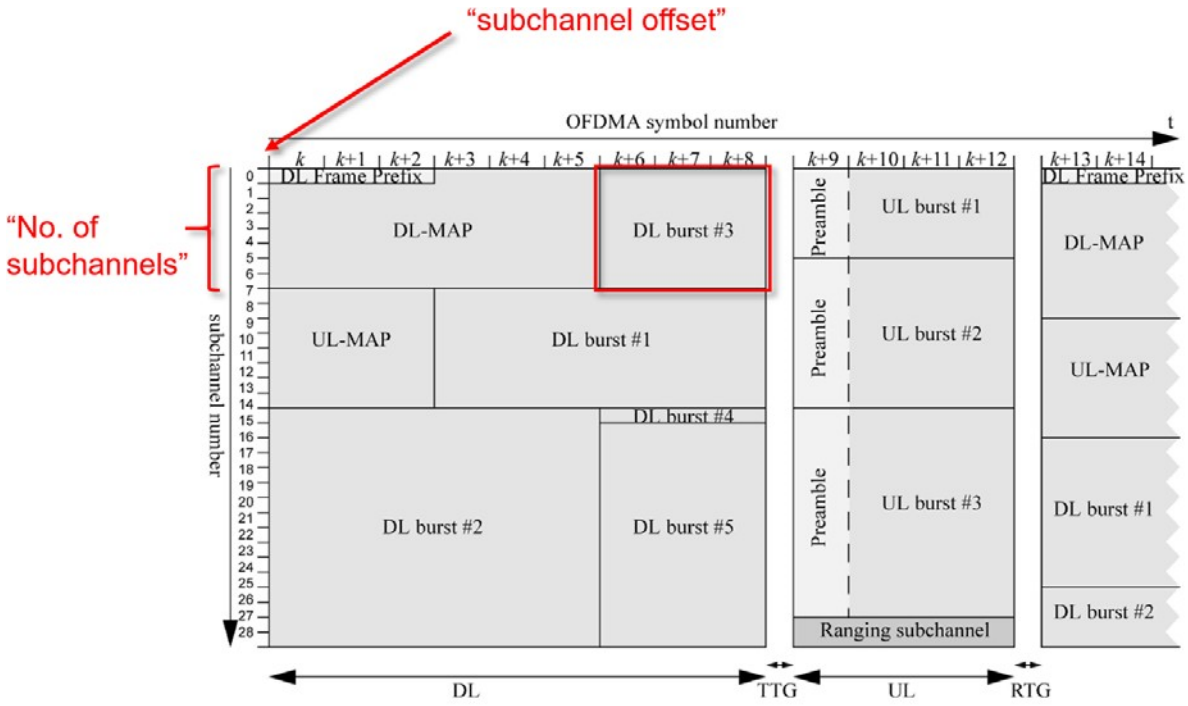


Figure 128av—Time plan - one TDD time frame

EX1006, FIG. 128av (annotated).

At least the "subchannel offset" and "[n]o. of subchannels" in DL-Map "*indicate … a corresponding subchannel configuration*." 802.16a also discloses that the transmission parameters "*indicate … a corresponding subchannel configuration*," as explained below. *See infra* VIII.A.3(g); EX1003, ¶233.

(f) [1F]

As explained above, 802.16a discloses the "antenna transmission scheme." Specifically, 802.16a's antenna transmission schemes indicated in the FCH include a transmission diversity (STC) and MIMO (AAS) scheme. EX1006, 203, 66; *see supra* VIII.A.2, VIII.A.3(d); EX1003, ¶¶235-248.

802.16a's AAS "**through the use of more than one antenna element**, **can improve** range and **system capacity**, by adapting the antenna pattern and concentrating its radiation to each individual subscriber. **The spectral efficiency can be increased linearly with the number of antenna elements**. **This is achieved by steering beams to multiple users simultaneously so as to realize an inter-cell frequency reuse of one** and an in-cell reuse factor **proportional to the number of antenna elements**." EX1006, 66. Because AAS uses multiple transmit antennas to steer different beams to multiple users simultaneously so as to increase spectral efficiency, a POSITA would have readily understood AAS to be the "*multiple-input multiple-output (MIMO) scheme*." Specifically, a POSITA would have understood 802.16a's AAS to be a multi-user MIMO mode. *See, e.g.*, EX1008, ¶61, ¶65; *see supra* VIII.A.2; EX1003, ¶¶238-240.

As such, 802.16a's "*antenna transmission scheme*" indicated in DL-MAP comprises STC ("*a transmission diversity scheme*") or AAS ("*a multiple-input multiple-output (MIMO) scheme*"). EX1003, ¶241.

To the extent that Patent Owner may contend that the "multiple-input multiple-output (MIMO) scheme" requires something different from multi-user MIMO (it does not), this is taught by Heath. For example, Heath describes using "multiple spatially separated antennas at the base transceiver stations and the subscriber units to multiplex transmissions in order to increase the bit rates

between the base transceiver stations and the subscriber units." EX1007, 1:46-51. A POSITA would have thus understood that Heath utilizes a specific type of MIMO—single-user MIMO. *See* EX1008, ¶64; *see supra* VIII.A.2; EX1003, ¶¶242-244.

As discussed above, a POSITA would have been motivated to employ Heath's spatial multiplexing—single-user MIMO scheme—utilizing the existing transmit antennas of 802.16a's BS. When combined, 802.16a's two transmit antennas would transmit different data streams to the SS when transmission conditions were favorable (e.g., BS is in communication with a single SS and CSI is available to the BS), resulting in "increased bit rates." EX1007, 8:18-21. And DL-Map would indicate the multiple-input multiple-output (MIMO) scheme (spatial multiplexing). This would have also resulted in 802.16a's FCH indicating "*the antenna transmission scheme comprising a transmission diversity scheme or a multiple-input multiple-output (MIMO) scheme*." *See supra* VIII.A.2; EX1003, ¶¶247-248.

(g) [1G]

As explained above, 802.16a discloses "*the corresponding subchannel configuration*." *See supra* VIII.A.3(e). 802.16a further discloses that the corresponding subchannel configuration is characterized by distributed subcarriers

(distributed-carrier permutation) or localized subcarriers (adjacent-carrier permutation) in the frequency domain. EX1003, ¶¶249-263.

802.16a explains that the "carriers forming one subchannel may, but need not be adjacent," as shown Figure 128as:

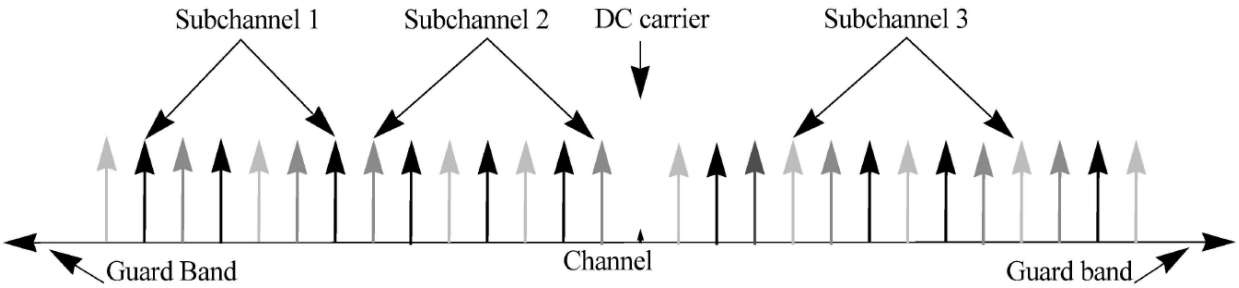


Figure 128as—OFDMA frequency description (3 channel schematic example)

EX1006, Figure 128as.

EX1006, 180. For the "distributed carrier permutation," **each subchannel consists of one subcarrier from each group of** contiguous subcarriers according to Equation (69). *Id.*, 196-197. Table 116ca illustrates the subcarrier allocations and variables for Equation (69).

Table 116ca—OFDMA DL carrier allocations

Parameter	Value
Number of dc carriers	1
Number of guard carriers, left	173
Number of guard carriers, right	172
N_{used}, Number of used carriers	1702
Total number of carriers	2048
$N_{varLocPilots}$	142
Number of fixed-location pilots	32
Number of variable-location pilots which coincide with fixed-location pilots	8
Total number of pilots[a]	166
Number of data carriers	1536
$N_{subchannels}$	32
$N_{subcarriers}$	48
Number of data carriers per subchannel	48
BasicFixedLocationPilots	{0,39, 261, 330, 342, 351, 522, 636, 645, 651, 708, 726, 756, 792, 849, 855, 918, 1017, 1143, 1155, 1158, 1185, 1206, 1260, 1407, 1419,1428, 1461, 1530,1545, 1572, 1701}
$\{PermutationBase_0\}$	{3, 18, 2, 8, 16, 10, 11, 15, 26, 22, 6, 9, 27, 20, 25, 1, 29, 7, 21, 5, 28, 31, 23, 17, 4, 24, 0, 13, 12, 19, 14, 30}

[a]Variable Location Pilots which coincide with Fixed-location Pilots are counted only once in this value.

EX1006, Table 116ca.

802.16a also provides an example of using Equation (69) in section 8.5.6.2.1 demonstrating that the subcarriers are distributed in the frequency domain. *Compare* EX1006, 199-200, *with* EX1001, 7:5-9; EX1003, ¶¶251-256.

For the "adjacent carrier permutation," "symbol data within a subchannel is assigned to adjacent carriers." *Compare* EX1006, 201, *with* EX1001, 7:1-5. Table 116cc illustrates these subcarrier allocations. EX1003, ¶¶257-258.

Table 116cc—OFDMA AAS carrier allocations

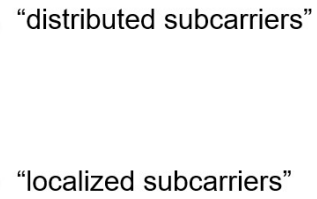
Parameter	Value
Number of dc carriers	1
Number of guard carriers, left	176
Number of guard carriers, right	175
N_{used}, Number of used carriers	1696
Total number of carriers	2048
$N_{varLocPilots}$	0
Number of fixed-location pilots	160
Number of variable-location pilots which coincide with fixed-location pilots	0
Total number of pilots (*)	160
Number of data carriers	1536
$N_{subchannels}$	32
$N_{subcarriers}$	48
Number of data carriers per subchannel	48
BasicFixedLocationPilots	{5,16,27,38,49}within each subchannel

EX1006, Table 116cc.

802.16a's BS may change from the "distributed carrier permutation" to the "adjacent carrier permutation," and indicate the switch to the SS in AAS_DL_IE() in DL-MAP. EX1006, 188-189, 200-201. "After this change, the BS shall only transmit/receive AAS-enabled traffic using the **adjacent carrier permutation** until the end of the frame." *Id.*, 200. Table 116br illustrates AAS_DL_IE() indicating the subchannel configuration. EX1003, ¶¶259-261.

Table 116br—OFDMA DL AAS information element

Syntax	Size	Notes
AAS_DL_IE() {		
extended DIUC	4 bits	AAS = 0x02
Permutation	2 bits	0 = distributed-carrier permutation 1 = adjacent-carrier permutation
OFDMA symbol offset	10 bits	
}		



EX1006, Table 116br (annotated).

That is, 802.16a discloses a mobile station-specific transmission parameter capable of indicating, as alternatives, both distributed subcarriers and localized subcarriers in the frequency domain as subchannel configurations. EX1003, ¶262.

(h) [1H]

802.16a, alone or in combination with Heath, discloses transmitting a DL burst (data packet) to the SS over the frequency subchannel in accordance with the mobile station-specific transmission parameters (e.g., burst profile, subchannel offset, no. of subchannels) in DL-MAP. EX1006, 188; *see also* EX1005, 15-24 (describing data packet format); *see supra* VIII.3.(c); EX1003, ¶¶264-267.

Table 116bp—OFDMA DL-MAP_Information_Element format

Syntax	Size	Notes
DL-MAP_Information_Element() {		
DIUC	4 bits	
if (UIUC == 15) {		
Extended DIUC dependent IE	variable	AAS_DL_IE()
} else {		
OFDM Symbol offset	10 bits	
Subchannel offset	6 bits	
No. OFDM Symbols	10 bits	
No. Subchannels	6 bits	
}		
}		

EX1006, Table 116bp.

Moreover, 802.16a's BS transmits traffic "using the adjacent carrier permutation until the end of the frame" after informing the mobile station of the switch in DL-MAP using AAS_DL_IE(). EX1006, 200; EX1003, ¶265.

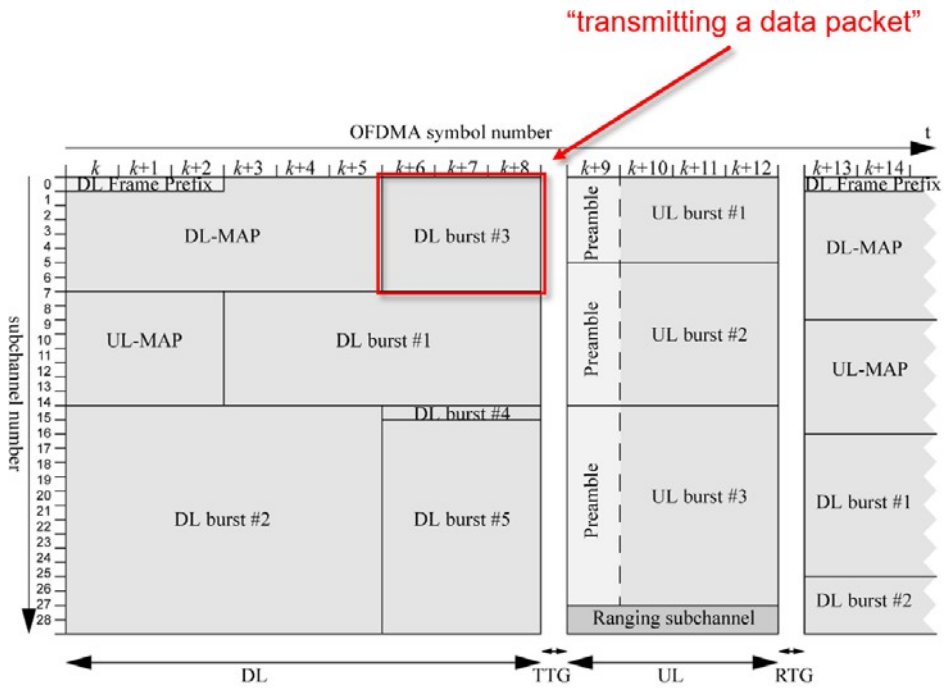


Figure 128av—Time plan - one TDD time frame

EX1006, FIG. 128av (annotated).

802.16a in view of Heath would have also taught this limitation by transmitting data using Heath's spatial multiplexing scheme as described above. *See supra* VIII.A.2; EX1003, ¶266.

4. Claim 6

Claim 6 recites essentially identical limitations to method claim 1 in the form of an apparatus claim—a "*base station serving a plurality of mobile stations*." Thus for similar reasons as claims 1 and 8, 802.16a and Heath disclose claim 6. *See supra* VIII.A.3; EX1003, ¶¶268-278.

(a) [6A]

For similar reasons as [1A], 802.16a discloses [6A]. *See supra* VIII.A.3(a); EX1003, ¶271.

(b) [6B]

For similar reasons as [1B], 802.16a discloses [6B]. *See supra* VIII.A.3(b); EX1003, ¶272.

(c) [6C]

For similar reasons as [1C], 802.16a discloses [6C]. *See supra* VIII.A.3(c); EX1003, ¶273.

(d) [6D]

For similar reasons as [1D], 802.16a discloses [6D]. *See supra* VIII.A.3(d); EX1003, ¶274.

(e) [6E]

For similar reasons as [1E], 802.16a discloses [6E]. *See supra* VIII.A.3(e); EX1003, ¶275.

(f) [6F]

For similar reasons as [1F], 802.16a, alone or in combination with Heath, discloses [6F]. *See supra* VIII.A.3(f); EX1003, ¶276.

(g) [6G]

For similar reasons as [1G], 802.16a discloses [6G]. *See supra* VIII.A.3(g); EX1003, ¶277.

(h) [6H]

For similar reasons as [1H], 802.16a, alone or in combination with Heath, discloses [6H]. *See supra* VIII.A.3(h); EX1003, ¶278.

5. Claim 8

Claim 8 recites essentially identical limitations to method claim 1 in the form of a method from the prospective of a "*mobile station served by a base station*." Thus for similar reasons as claims 1 and 6, 802.16a, alone or in combination with Heath, discloses claim 8. *See supra* VIII.A.3, VIII.A.4; EX1003, ¶¶279-291.

(a) [8A]

For similar reasons as [1A], 802.16a discloses [8A]. *See supra* VIII.A.3(a). In particular, 802.16a discloses a link adaption method in an OFDM communication system having at least one mobile station (SS) served by a base station (BS). *See supra* VIII.A.3(a); EX1003, ¶¶282-283.

(b) [8B]

For similar reasons as [1B], 802.16a discloses [8B]. *See supra* VIII.A.3(b). In particular, 802.16a discloses the SS receiving the FCH from the serving BS over a control channel. *See* EX1006, 184.

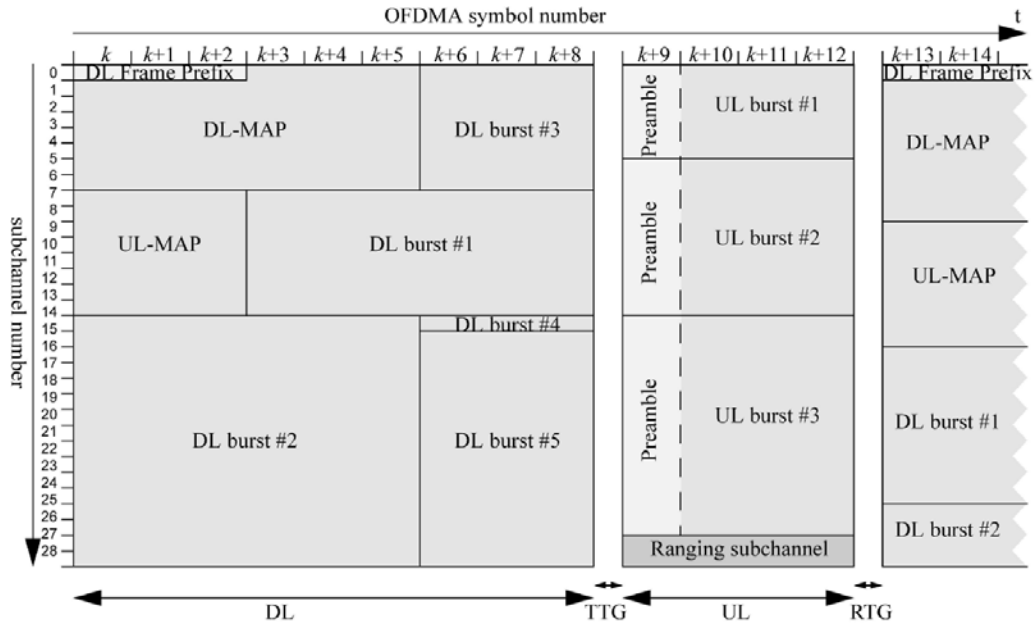


Figure 128av—Time plan - one TDD time frame

EX1006, FIG. 128av.

EX1005, 24, 46, 67, 97, 220; EX1006, 67, 183; EX1003, ¶¶284-285.

(c) [8C]

For similar reasons as [1C], 802.16a discloses [8C]. *See supra* VIII.A.3(c); EX1003, ¶286.

(d) [8D]

For similar reasons as [1D], 802.16a discloses [8D]. *See supra* VIII.A.3(d); EX1003, ¶287.

(e) [8E]

For similar reasons as [1E], 802.16a discloses [8E]. *See supra* VIII.A.3(e); EX1003, ¶288.

(f) [8F]

For similar reasons as [1F], 802.16a, alone or in combination with Heath, discloses [8F]. *See supra* VIII.A.3(f); EX1003, ¶289.

(g) [8G]

For similar reasons as [1G], 802.16a discloses [8G]. *See supra* VIII.A.3(g); EX1003, ¶290.

(h) [8H]

For similar reasons as [1H], 802.16a, alone or in combination with Heath, discloses [8H]. *See supra* VIII.A.3(h); EX1003, ¶291.

6. Claim 13

Claim 13 recites essentially identical limitations to claims 1 and 8 in the form of an apparatus claims—a "*mobile station served by a base station*." Thus for similar reasons as claims 1 and 8, 802.16a, alone or in combination with Heath, discloses claim 13. *See supra* VIII.A.3, VIII.A.5; EX1003, ¶¶295-302.

(a) [13A]

For similar reasons as [1A] and [8A], 802.16a renders discloses [13A]. *See supra* VIII.A.3(a), VIII.A.5(a); EX1003, ¶295.

(b) [13B]

For similar reasons as [1B] and [8B], 802.16a renders discloses [13B]. *See supra* VIII.A.3(b), VIII.A.5(b); EX1003, ¶296.

(c) [13C]

For similar reasons as [1C] and [8C], 802.16a renders discloses [13C]. *See supra* VIII.A.3(c), VIII.A.5(c); EX1003, ¶297.

(d) [13D]

For similar reasons as [1D] and [8D], 802.16a renders discloses [13D]. *See supra* VIII.A.3(d), VIII.A.5(d); EX1003, ¶298.

(e) [13E]

For similar reasons as [1E] and [8E], 802.16a discloses [13E]. *See supra* VIII.A.3(e), VIII.A.5(e); EX1003, ¶299.

(f) [13F]

For similar reasons as [1F] and [8F], 802.16a, alone or in combination with Heath, renders discloses [13F]. *See supra* VIII.A.3(f), VIII.A.5(f); EX1003, ¶300.

(g) [13G]

For similar reasons as [1G] and [8G], 802.16a renders discloses [13G]. *See supra* VIII.A.3(g), VIII.A.5(g); EX1003, ¶301.

(h) [13H]

For similar reasons as [1H] and [8H], 802.16a, alone or in combination with Heath, renders discloses [13A]. *See supra* VIII.A.3(h), VIII.A.5(h); EX1003, ¶302.

7. Claims 2 and 9

802.16a's SS-specific transmission parameters also indicate a training pilot pattern. For both the uplink and downlink, carriers are either pilot or data carriers.

EX1006, 194. For the distributed carrier permutation, pilots are in fixed and variable locations. The subcarrier indices of the fixed-location pilots never change and are indicated in BasicFixedLocationPilots (below). The variable-location pilots shift their location every symbol repeating every 4 symbols, according to the formula: $varLocPilot_k = 3L+12P_k$. *Id.*, 194-195; EX1003, ¶303-309.

This is illustrated in Figure 128ba:

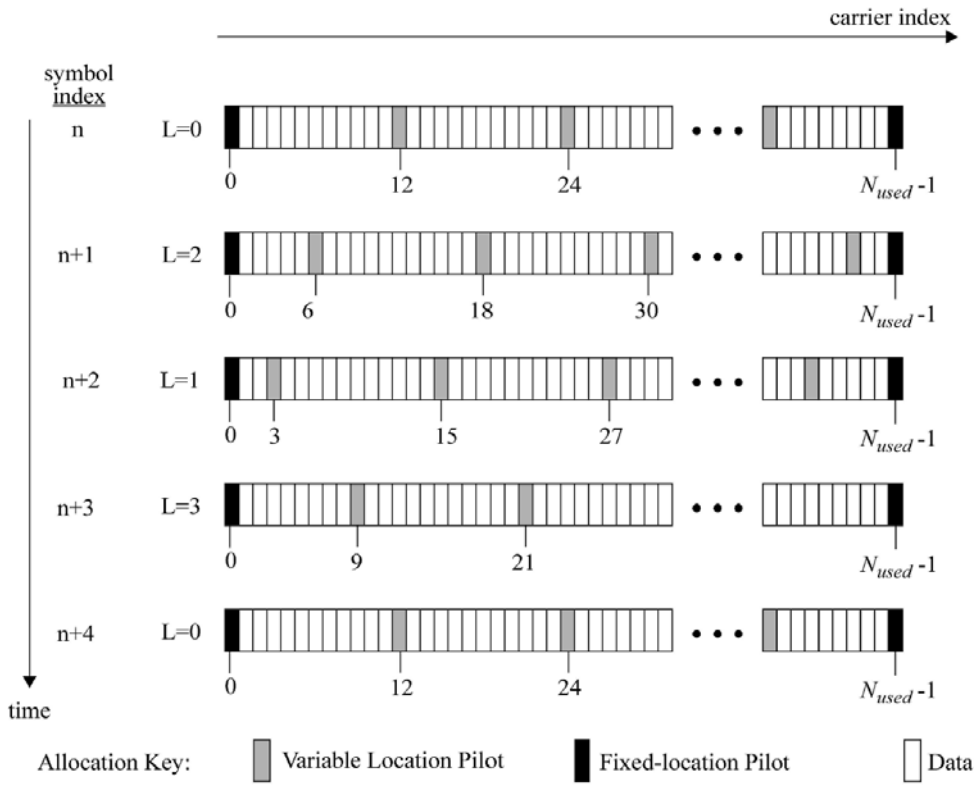


Figure 128ba—Carrier Allocations in the OFDMA DL

EX1006, FIG. 128ba.

Table 116ca illustrates the fixed-pilot pattern for the distributed carrier permutation. EX1003, ¶305.

Table 116ca—OFDMA DL carrier allocations

Parameter	Value
Number of dc carriers	1
Number of guard carriers, left	173
Number of guard carriers, right	172
N_{used}, Number of used carriers	1702
Total number of carriers	2048
$N_{varLocPilots}$	142
Number of fixed-location pilots	32
Number of variable-location pilots which coincide with fixed-location pilots	8
Total number of pilots[a]	166
Number of data carriers	1536
$N_{subchannels}$	32
$N_{subcarriers}$	48
Number of data carriers per subchannel	48
BasicFixedLocationPilots	{0,39, 261, 330, 342, 351, 522, 636, 645, 651, 708, 726, 756, 792, 849, 855, 918, 1017, 1143, 1155, 1158, 1185, 1206, 1260, 1407, 1419,1428, 1461, 1530,1545, 1572, 1701}
$\{PermutationBase_0\}$	{3, 18, 2, 8, 16, 10, 11, 15, 26, 22, 6, 9, 27, 20, 25, 1, 29, 7, 21, 5, 28, 31, 23, 17, 4, 24, 0, 13, 12, 19, 14, 30}

[a]Variable Location Pilots which coincide with Fixed-location Pilots are counted only once in this value.

EX1006, Table 116ca (annotated).

With the adjacent carrier permutation used for AAS traffic, the training pilot pattern is different—the pilot carriers are only assigned to fixed positions in the frequency domain. EX1006, 200-201. Table 116cc illustrates this fixed-pilot pattern. EX1003, ¶¶306-307.

Table 116cc—OFDMA AAS carrier allocations

Parameter	Value
Number of dc carriers	1
Number of guard carriers, left	176
Number of guard carriers, right	175
N_{used}, Number of used carriers	1696
Total number of carriers	2048
$N_{varLocPilots}$	0
Number of fixed-location pilots	160
Number of variable-location pilots which coincide with fixed-location pilots	0
Total number of pilots (*)	160
Number of data carriers	1536
$N_{subchannels}$	32
$N_{subcarriers}$	48
Number of data carriers per subchannel	48
BasicFixedLocationPilots	{5,16,27,38,49} within each subchannel

EX1006, Table 116cc (annotated).

Thus, because 802.16a's SS-specific transmission parameters indicate whether to use AAS or STC, the SS-specific transmission parameters also indicate the appropriate training-pilot pattern specified in BasicFixedLocationPilots. EX1003, ¶308.

For similar reasons, 802.16a discloses claim 9. EX1003, ¶¶332-333.

8. Claims 3 and 10

802.16a's SS-specific parameters indicate power-control information in two ways. EX1003, ¶¶310-314.

First, the DCD message in the FCH indicates the BS transmit power (to be used by the SS to validate radio-link conditions). EX1005, 224; EX1006, 184; EX1003, ¶312.

Table 124—DCD channel encodings

Name	Type (1 byte)	Length	Value (variable-length)
Downlink_Burst_Profile	1		May appear more than once; described below. The length is the number of bytes in the overall object, including embedded TLV items.
BS Transmit Power (average)	2	1	Signed in units of 1 dBm.
Burst FDD/TDD frame duration	4	4	The number of PSs contained in a Burst FDD or TDD frame. Required only for framed downlinks
PHY Type	5	1	The PHY Type to be used.
power adjustment rule	9	1	0=Preserve Peak Power 1=Preserve Mean Power Describes the power adjustment rule when performing a transition from one burst profile to another.

EX1005, Table 124 (annotated).

Second, the BS may transmit a Power Control Information Element (Power_Control_IE) in the UL-Map in the FCH to instruct the SS to change its transmission power. EX1006, 184, 190, 192-193, 219, 256; EX1003, ¶313.

Table 116bw—OFDMA Power Control Information Element

Syntax	Size	Notes
Power_Control_IE() {		
extended UIUC	4 bits	Fast power control = 0x00
Power control	8 bits	Signed integer, which expresses the change in power level (in 0.25 dB units) that the SS should apply to correct its current transmission power.
}		

EX1006, Table 116bw.

For similar reasons, 802.16a discloses claim 10. EX1003, ¶¶334-335.

9. Claims 4 and 11

802.16a's AAS uses CSI "in the PHY at both downlink and uplink." EX1006, 67. 802.16a's BS has two ways to obtain CSI: "[b]y relying on reciprocity, thus using the uplink channel state estimation as the downlink channel state" or "[b]y using feedback, thus transmitting the estimated channel state from the SS to BS." *Id.*; *see also id.*, 42-44. STC also requires channel estimation using pilots. *Id.*, 203-205, 220-221.

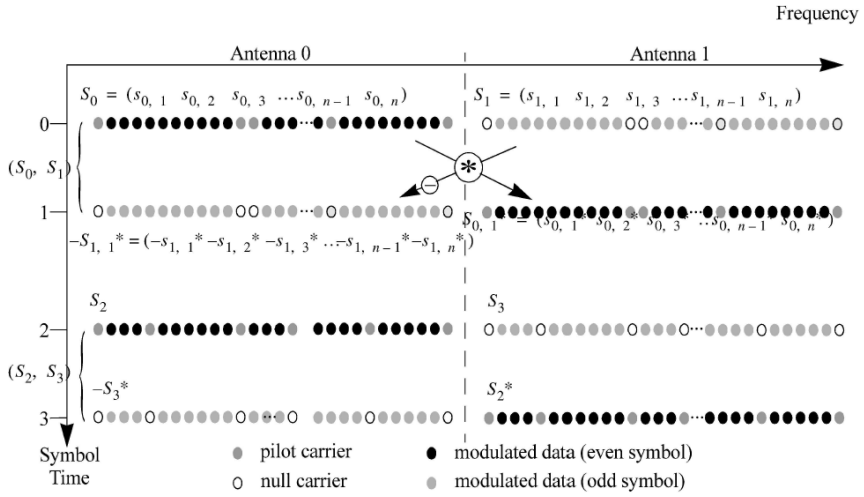


Figure 128bg— STC usage with OFDMA

EX1006, FIG. 128bg.

A POSITA would have thus understood that 802.16a's AAS and STC schemes are "*based on a channel condition*." EX1003, ¶¶315-319.

Heath also discloses that the antenna transmission scheme is based on transmission characteristics 450 (channel condition). EX1007, 9:15-18-11:50.

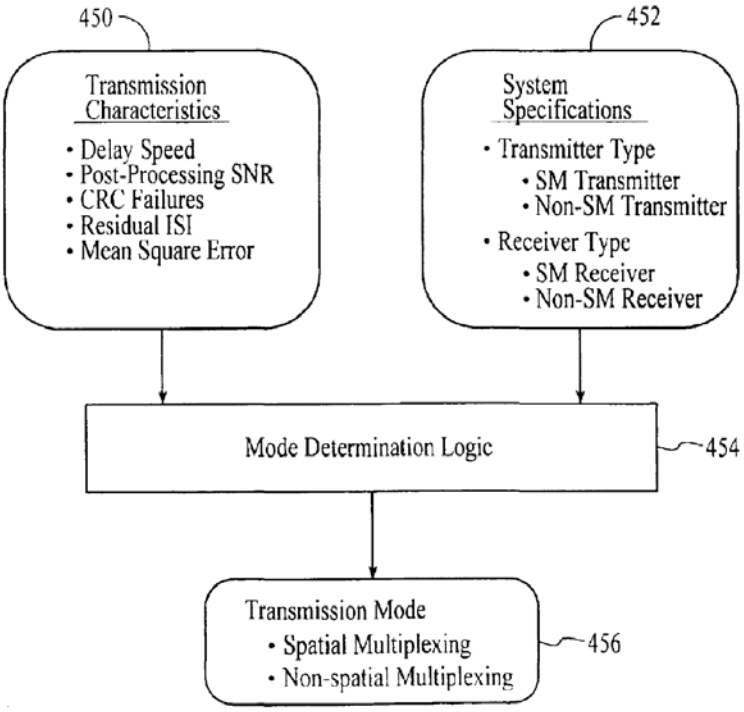


FIG. 4

EX1007, FIG. 4.

As discussed above, a POSITA would have been motivated to incorporate Heath's mode determination logic into 802.16a's BS to select the appropriate antenna transmission scheme based on the CSI already available to the BS. When combined, 802.16a's BS would utilize Heath's mode determination logic to determine the appropriate antenna transmission scheme for subsequent data transmissions based on a channel condition. This would have resulted in a "wireless communications [system] that adapts its mode of operation" "in response to [various] transmission-specific variables." EX1007, 4:61-5:1; *see supra* VIII.A.2; EX1003, ¶¶320-322.

For similar reasons, 802.16a, alone or in combination with Heath, discloses claim 11. EX1003, ¶¶336-337.

10. Claims 5 and 12

802.16a's BS uses the distributed carrier permutation for STC traffic and the adjacent carrier permutation for AAS traffic. *See supra* VIII.A.3.(g); *see also* EX1006, 200. 802.16a's BS also utilizes CSI to determine the appropriate transmission parameters. *See supra* VIII.A.9; *see also* EX1006, 23, 42-44, 67, 88-89, 220-221. While 802.16a does not explicitly state that the BS utilizes the existing CSI to select the appropriate antenna transmission scheme (and corresponding carrier permutation), doing so would have been obvious to a POSITA. EX1003, ¶¶323-325.

For example, a POSITA would have known that if the channel condition is changing quickly due to movement of the SS, STC (and the distributed carrier permutation) would improve performance through diverse signals. *See* EX1007, 1:33-43, 7:47-49, 8:13-18. Alternatively, if the channel condition is relatively fixed due to lack of movement of the SS, it would have been obvious to implement AAS (and the adjacent carrier permutation) to improve overall performance of the system. *See* EX1006, 66; EX1003, ¶¶326-327.

Moreover, it would have been obvious to utilize Heath's mode determination logic 454 in 802.16a's BS to determine the appropriate mode of operation for

subsequent data transmissions—transmission diversity or MIMO—based on a channel condition (transmission characteristics 450). *See supra* VIII.A.2; *see also* EX1007, 9:15-11:50; EX1003, ¶328.

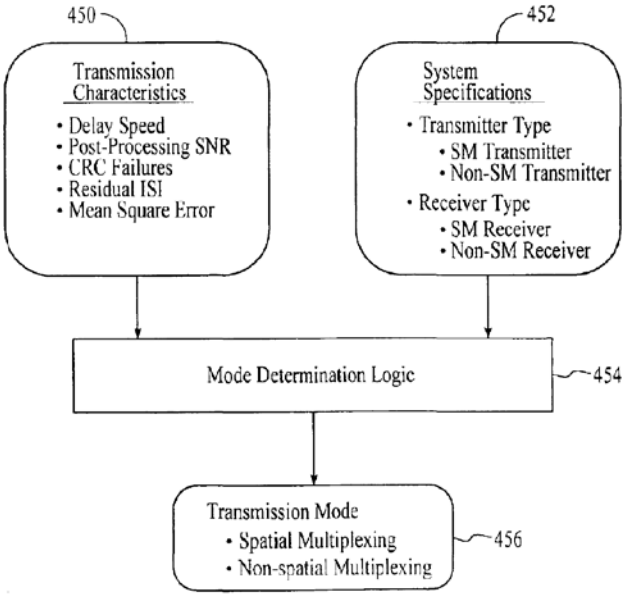


FIG. 4

EX1007, FIG. 4.

Thus, in 802.16a, alone or in combination with Heath, the corresponding subchannel configuration—adjacent carriers for AAS traffic or distributed carriers for STC traffic—would have been based on a channel condition. EX1003, ¶329.

For similar reasons, 802.16a, alone or in combination with Heath, discloses claim 12. EX1003, ¶¶338-339.

11. Claim 7

For similar reasons as discussed with respect to claims 5 and 6, 802.16a, alone or in combination with Heath, discloses claim 7. In particular, 802.16a

discloses the BS receiving channel state information from the mobile station. *See supra* VIII.A.10, VIII.A.4; *see also* EX1006, 23, 89, 220-221; EX1003, ¶¶330-331.

12. Claim 14

For similar reasons as discussed with respect to claims 5-7, 802.16a, alone or in combination with Heath, claim 14. *See supra* VIII.A.10-VIII.A.11; EX1003, ¶¶340-341.

B. Ground 2: Claims 1, 3-8, 10-14 are unpatentable under § 103 as obvious over Walton040 in view of Li017.

Walton040 and Li017 teach or suggest every limitation of claims 1, 3-8, 10-14. EX1003, ¶¶342-498.

1. A POSITA would have been motivated to combine Walton040 in view of Li017.

Walton040's multi-cell, multiple-access communication system 100 supports a number of mobile terminals 106a-o in coverage areas 102a-g, each serviced by a corresponding base station 104. EX1008, ¶¶43-44. Walton040's terminals may be mobile and communicate with different base stations. *Id*.; *see also id.*, ¶¶45, 55. A POSITA would have thus understood that Walton040's terminals may move within a cell (e.g., 106b within 102b (blue)), from cell to cell (e.g., 106b moving from 102b to 102e (green)), be close to cell boundaries (e.g., 106g (red)), or relatively fixed (e.g., 106k (purple)). EX1003, ¶¶342-344.

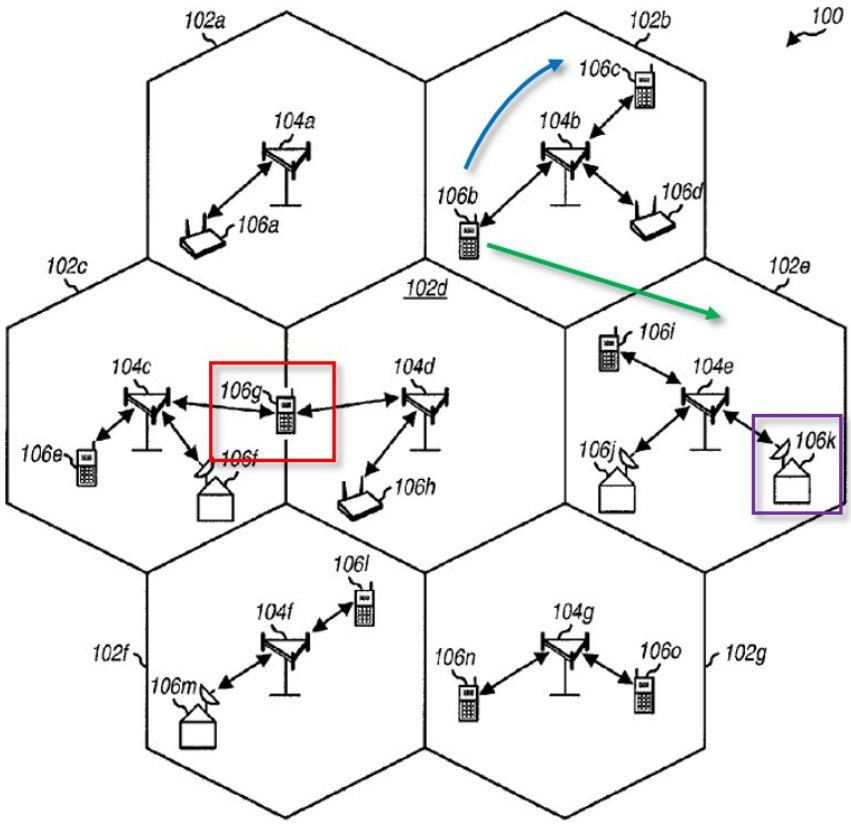


FIG. 1

EX1008, FIG. 1 (annotated).

Walton040's system utilizes OFDM, which "partitions the operating frequency band into a number of (N_F) frequency subchannels (i.e., frequency bins). At each time slot (which is a particular time interval that may be dependent on the bandwidth of the frequency subchannel), a modulation symbol may be transmitted

on each of the N_F frequency subchannels."[3] EX1008, ¶47; EX1003, ¶345.

For "a MIMO system utilizing OFDM, the modulation symbols may be transmitted on multiple frequency subchannels and from multiple transmit antennas." EX1008, ¶131. Also for "a MIMO system utilizing OFDM, the full-CSI processing (i.e., preconditioning) may be performed for each frequency subchannel." *Id*. Specifically, "[t]he adjustment of the processing for each transmission channel based on the determined SNR for the channel allows the MIMO system to achieve high performance (i.e., high throughput or bit rate for a particular level of performance." EX1008, ¶328; EX1003, 351.

While Walton040 describes transmitting OFDM symbols on any number of subcarriers N_F to different terminals, Walton040 does not explicitly describe how to assign or group subcarriers for use in the MIMO system utilizing OFDM. *See* EX1008, ¶¶47-48, 52, 71, 76, 91, 129-135, 140, 170-71, 283, 293, 323, 325, 332-33. A POSITA would have therefore looked to the prior art, e.g. Li017, for determining how to assign or group subcarriers and how to inform a mobile station

[3] While Walton040 refers to "frequency subchannels," a POSITA would have understood that these correspond to the claimed "subcarriers." *Compare* EX1008, ¶54, ¶134, FIG. 3E, *with* EX1001, 5:35-37, FIG. 8; EX1003, ¶¶346-350.

of the subcarriers it should use to receive information. EX1003, ¶¶352-353.

Like Walton040, Li017 is directed to multi-cell, multi-subscriber wireless systems using OFDM with mobile stations. EX1009, ¶¶24-25. Li017 also recognized that "[m]ultipath causes frequency-selective fading" and if "the same spectrum is used for multiple neighboring cells, the problem of intercell interference arises." *Id.*, ¶¶5-6, 64. Thus, "it is advantageous to adaptively allocate the subcarriers so as to mitigate the effect of intercell interference." *Id.*, ¶6; EX1003, ¶¶354-355.

Specifically, Li017 explains that there are two categories: "coherence clusters, containing multiple subcarriers close to each other and diversity clusters, containing multiple subcarriers with at least some of the subcarriers spread far apart over the spectrum."[4] EX1009, ¶111. Each subcarrier configuration—diversity clusters ("distributed subcarriers") and coherence clusters ("localized subcarriers")—provides different advantages. *See supra* V.E; EX1003, ¶356.

Diversity clusters provide interference diversity gain—"[t]herefore, it is advantageous to assign diversity clusters to subscribers that are close (e.g., within

[4] While Li017 refers to a "cluster" of subcarriers, this corresponds to the claimed "subchannel." EX1003, ¶356.

the coherent bandwidth) to the cell boundaries and are more subject to inter-cell interference." EX1009, ¶113. Diversity clusters can also "be used to provide extra robustness and to alleviate the overhead of frequent cluster reallocation" for mobile subscribers having large "channel time variance." *Id.*, ¶118. However, for "static subscribers, such as in fixed wireless access, the channels change very little over time. Selective cluster allocation using the coherence clusters achieves good performance." *Id.*; *see also id.*, ¶114; EX1003, ¶¶357-359.

To select the appropriate cluster type, "each subscriber measures the SINR of each subcarrier cluster and reports these SINR measurements to their base station through an access channel." EX1009, ¶45. Upon receiving that feedback, the BS "selects one or more clusters for the subscriber among the candidates," *id.*, ¶47, and "notifies the subscriber about the cluster allocation through a downlink common control channel," *id.*, ¶48. EX1003, ¶360.

In particular, the BS uses the feedback to determine "which clusters have the best performance relative to each other for the subscriber." EX1009, ¶46. As an example, "for cells containing mixed mobile and fixed subscribers, a channel/interference variation detector can be implemented at either the subscriber or the base station, or both," and using the detection results, "the base station intelligently selects diversity clusters to mobile subscribers or fixed subscribers at cell boundaries, and coherence clusters to fixed subscribers close to the base

station." *Id.*, ¶119; EX1003, ¶¶361-362.

Figure 11 illustrates selecting diversity or coherence clusters "depending on subscribers mobility." EX1009, ¶120. Logic in the BS "performs channel/interference variation detection" (1101) and "tests whether the results of the channel/interference variation detection indicate that the user is mobile or in a fixed position close to the edge of the cell" (1102). *Id.*, ¶121. "If the user is not mobile or is not in a fixed position close to the edge of the cell," the BS selects "coherence clusters" (1103); otherwise, the BS "selects diversity clusters" (1104). *Id.*; *see also id.*, ¶¶122-125.

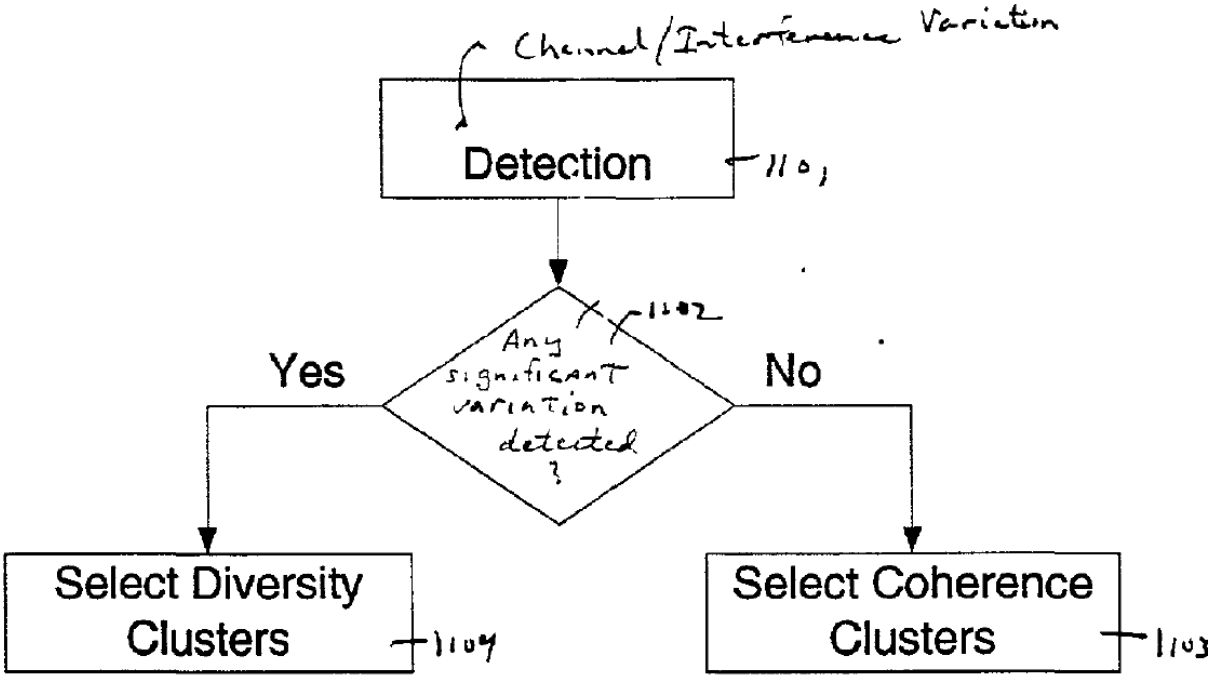


Figure 11

EX1009, FIG. 11.

The BS then "notifies the subscriber about the cluster allocation through a downlink common control channel." EX1009, ¶48; EX1003, ¶¶363-366.

Based on the teachings of Li017, a POSITA would have been motivated to modify Walton040 so as to incorporate Li017's "process for intelligent selection between diversity clusters and coherence clusters depending on subscribers mobility" and informing the subscriber of the selected subchannel configuration via the existing control channel. *Id.*, ¶120. A POSITA would have understood that the scenarios Li017 contemplates (e.g., mobile stations that are mobile, fixed position, or close to the edge of a cell) would have regularly occurred in Walton040's system. As such, a POSITA would have recognized that Li017's process for intelligent selection between diversity and coherence clusters, depending on Walton040's subscriber's mobility and location, would have improved performance and mitigated the effect of intercell interference. EX1009, ¶¶113-114, 118-119. Indeed, the '941 patent admits that it was known that adjusting the subchannel configuration "in accordance with the state of the communication channel" improves performance. EX1001, 1:33-48; EX1003, ¶¶367-369.

For example, a POSITA would have understood that Li017's diversity cluster ("distributed subcarriers") would "provide interference diversity gain" for a mobile station close to a cell boundary or moving quickly through a cell (red/blue),

and the coherence cluster ("localized subcarriers") would "achieve[] good performance" for a stationary mobile station located away from a cell boundary (purple). EX1009, ¶¶113-114, 118-119.

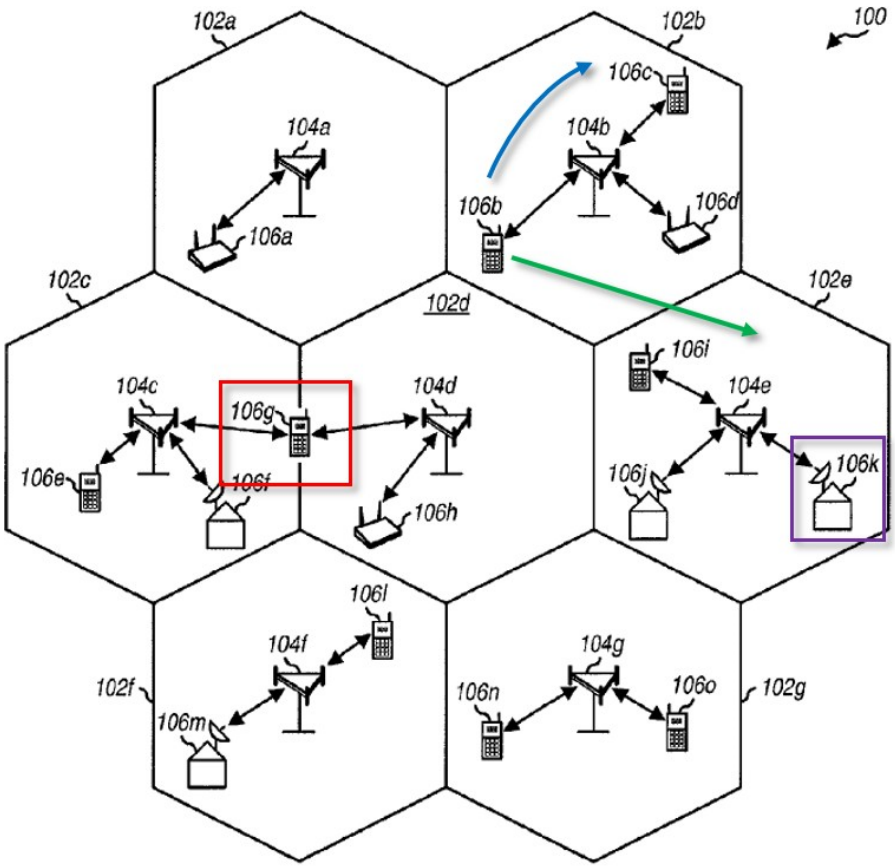


FIG. 1

EX1008, FIG. 1 (annotated).

Moreover, modifying Walton040's BS to incorporate Li017's cluster selection process and informing the subscriber of the selected subchannel configuration would have required minimal modifications (e.g., providing logic in Walton040's BS to select the configuration based on existing CSI and inform the terminal).

EX1003, ¶¶370-371.

In addition to the motivations described above, a POSITA would have been further motivated to combine Walton040 and Li017 because both are in the same general field of mobile communications, and address the same problem—improving the performance of wireless communication systems. In particular, they are both directed to multi-cell cellular communication systems using OFDM to achieve flexible operation and improved system performance. *Id.*, ¶372.

Further, a POSITA would have combined the system of Walton040 with the teachings of Li017 by known methods, and the results of the combination would have been predictable to a POSITA (e.g., by intelligently selecting between diversity and coherence clusters depending on subscribers mobility using existing CSI and informing the subscriber of the selected subchannel configuration using the existing control channel). As discussed above, the advantages of using different subchannel configurations were well known. *See supra* V.E; EX1003, ¶373;

Finally, the proposed combination of Walton040 and Li017 would involve nothing more than incorporating a well-known concept (i.e., Li017's process for intelligent selection between diversity and coherence clusters depending on subscribers' mobility and informing the subscriber of the selected subchannel configuration) into a well-known system (i.e., Walton040's wireless communication system). *Id.*, ¶374; *KSR*, 550 U.S. at 419-421.

2. Claim 1

(a) [1A]

Walton040 discloses this preamble to the extent it is limiting. EX1003, ¶¶376-382.

Walton040's system 100 supports multiple mobile stations (106a-o) in various coverage areas 102a-g, each of which is serviced by a corresponding BS 104. EX1008, ¶¶43-44. System 100 utilizes OFDM, which partitions the "frequency band into a number of (N_F) frequency subchannels" (i.e., "subcarriers"). *Id.*, ¶47. At each time slot, data "may be transmitted on each of the N_F frequency subchannels." *Id.*; *see also id.*, ¶¶48, 52, 71, 76, 91, 129-135, 140, 170-71, 283, 293, 323, 325, 332-33; Figure 1 illustrates system 100. *Id*, ¶44; EX1003, ¶¶377-379.

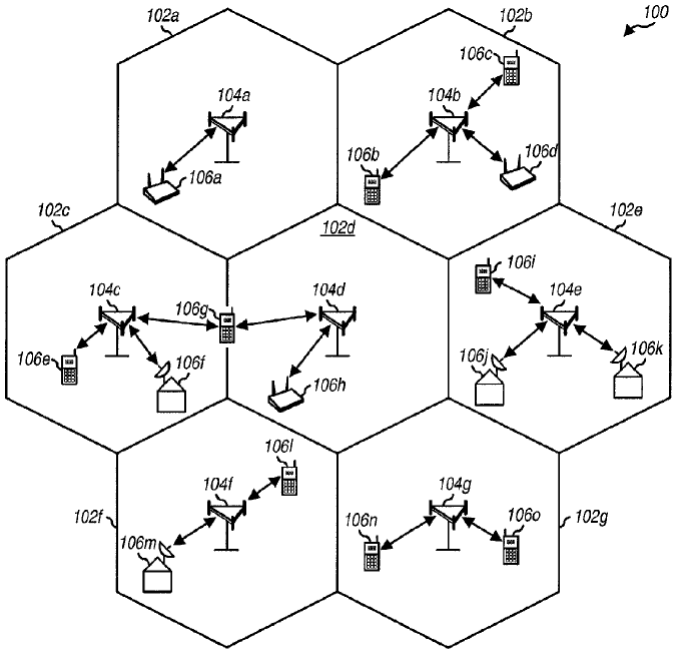


FIG. 1

EX1008, FIG. 1.

Figure 2 illustrates BS 104 and mobile stations 106 for downlink data transmission. EX1008, ¶¶5, 55, 76, 462; EX1003, ¶380.

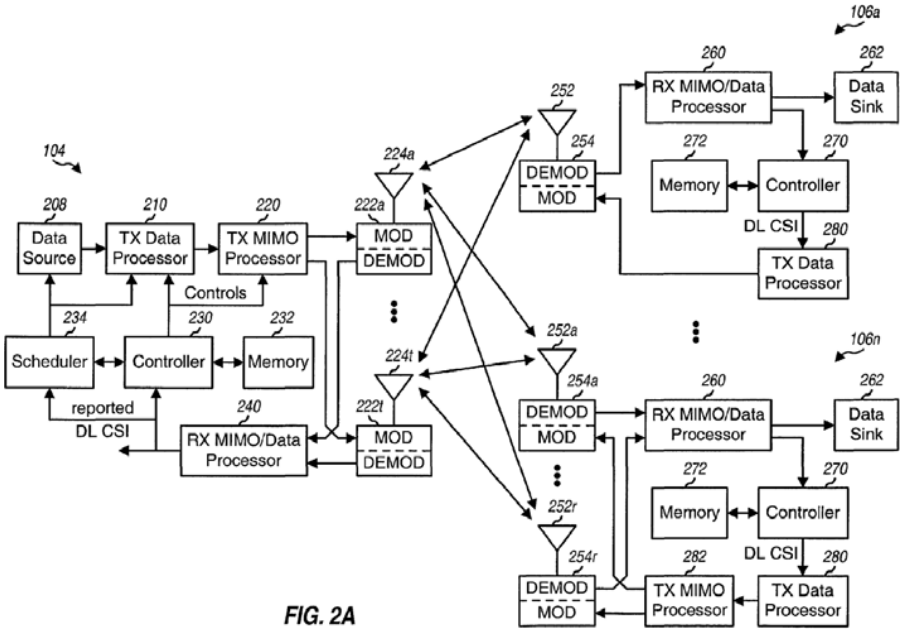


FIG. 2A

EX1008, FIG. 2A.

Walton040 further discloses techniques "to adaptively process data prior to transmission, based on channel state information, to more closely match the data transmission to the capacity of the channel." EX1008, Abstract. Specifically, "the system may adjust various operating parameters (e.g., the operating mode, channel, data rate, antenna(s) to transmit from, transmit power, and so on) in an adaptive manner based on system loading and/or some combination of performance metrics." *Id.*, ¶74; EX1003, ¶¶381-383.

(b) [1B]

Walton040 discloses that for the downlink, the BS allocates resources to mobile stations and provides information via a control channel to indicate the particular operating mode to use. EX1008, ¶74. Specifically, the "pertinent information (e.g., schedule, data rate, coding and modulation scheme, transmit power, and so on) may be communicated to the affected terminals via a control channel on the downlink." *Id.*, ¶¶93, 482; EX1003, ¶¶383-387.

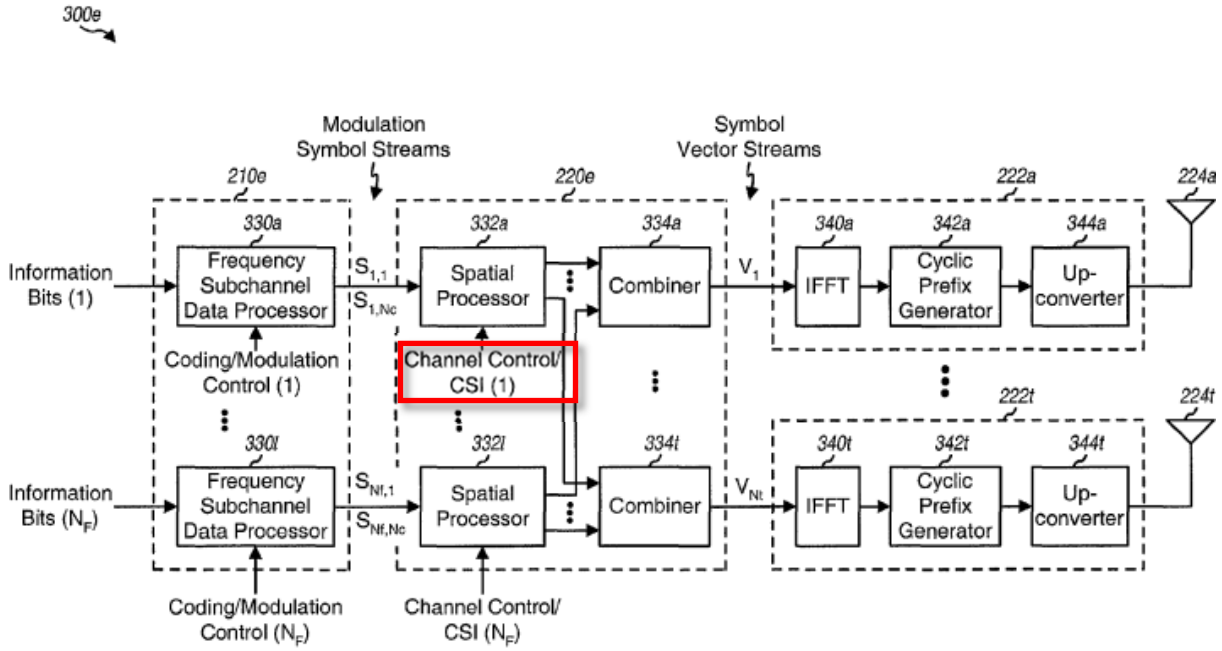


FIG. 3E

EX1008, FIG. 3E (annotated).

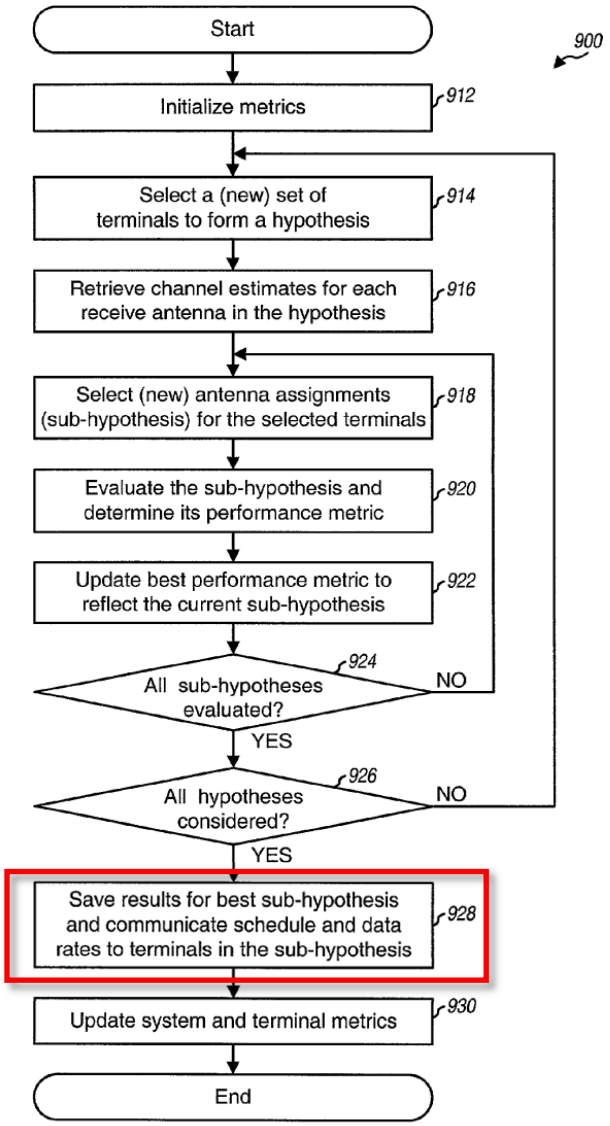


FIG. 9A

EX1008, FIG. 9A (annotated).

Like Walton040, Li017 also discloses "*transmitting a control message to a mobile station over a control channel*." *See* EX1009, ¶¶39, 48, 89; EX1003, ¶388.

(c) [1C]

Walton040 discloses that the information transmitted over the control channel contains transmission parameters allocated to the mobile station for a

subsequent transmission of data by the BS over a frequency subchannel to the mobile station in a time slot. Specifically, Walton040 provides information to "users via a control channel to indicate the particular operating mode to use." EX1008, ¶¶74, 93, 462, 482; EX1003, ¶¶389-393.

That information provided to the mobile station is for a "*subsequent transmission of data*." For example, the "coding and modulation for each frequency subchannel data stream … may be adjusted **based on the coding and modulation control signals**." EX1008, ¶¶130, 82, 100, 367. "Within a TX MIMO processor 220e, the up to N_C modulation symbol streams from each data processor 330 are provided to a respective spatial processor 332, which processes the received modulation symbols **based on the channel control** and/or the available CSI." *Id.*, ¶131; *see also id.*, ¶¶328, 462. Figure 3E illustrates the BS using the transmission parameters for the transmission of data:

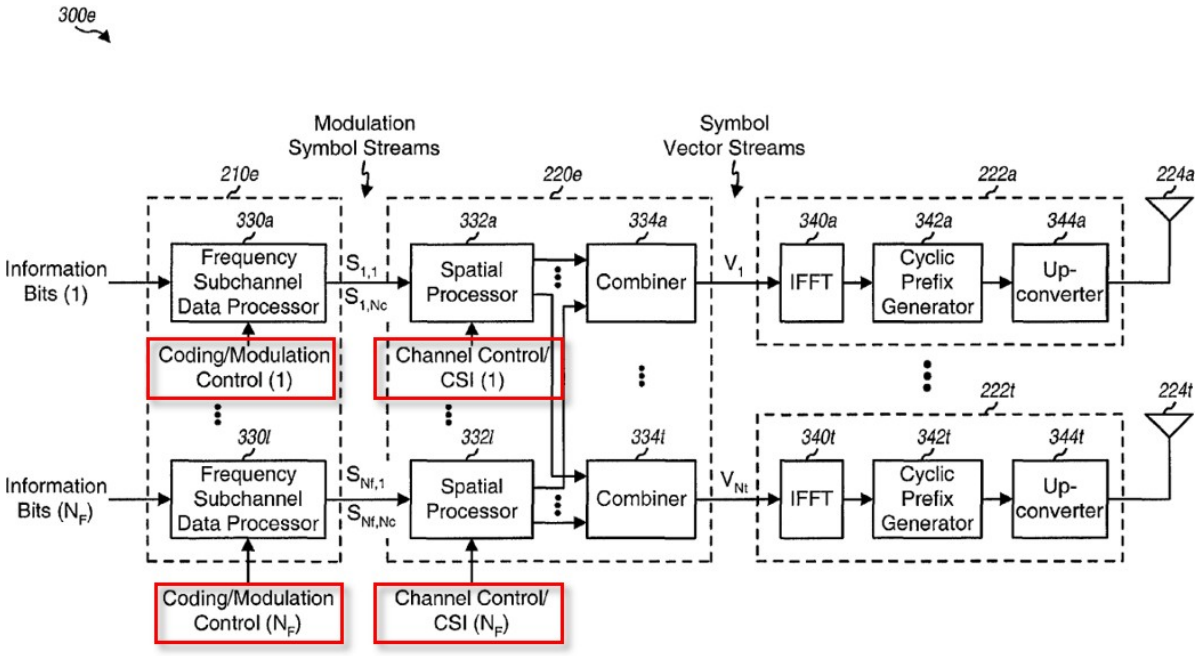


FIG. 3E

EX1008, FIG. 3E (annotated).

EX1003, ¶¶394-400.

(d) [1D]

Walton040 discloses that the information provided to the mobile station—the mobile station-specific transmission parameters—indicates an antenna transmission scheme. EX1003, ¶¶401-405.

Walton040's BS uses CSI "to schedule downlink transmission to the terminals, and to **determine the channel and antenna assignments**, **the operating mode**." EX1008, ¶93; *see also id.*, ¶82. These operating modes include the following antenna transmission schemes:

TABLE 1

Transmit Antennas	Receive Antennas: 1	Receive Antennas: N_R
1	SISO	SIMO
N_T	MISO	MIMO

EX1008, Table 1.

EX1008, ¶93; *see also id.*, ¶¶57-68. After the antenna transmission scheme has been determined, it is communicated to the mobile station via the control channel. EX1008, ¶¶74, 82, 93, 148, 482; EX1003, ¶¶402-405.

Walton040 also discloses this limitation for the reasons explained below with respect to [1F]. *See infra* Section VIII.B.2(f); EX1003, ¶406.

(e) [1E]

The combination of Walton040 and Li017 discloses that the mobile station-specific transmission parameters indicate a corresponding subchannel configuration. Walton040's BS transmits the control message containing transmission parameters to the mobile station and transmits data to the mobile station over "subcarriers" but does not explicitly disclose that the control information includes an indication of a corresponding subchannel configuration for these "subcarriers." *See supra* VIII.B.2(a), VIII.B.2(d). However, Li017 teaches this limitation. *See supra* VIII.B.1; EX1003, ¶¶407-409.

For example, Li017 explains that each subscriber measures the SINR and reports these SINR measurements to their BS through an access channel. EX1009, ¶45. Upon receiving the feedback, the BS further selects one or more clusters.[5] EX1009, ¶47. As Li017 explains, "coherence clusters" contain "multiple subcarriers close to each other" and "diversity clusters" contain "multiple subcarriers with at least some of the subcarriers spread far apart over the spectrum." *Id*., ¶111. A POSITA would have thus readily understood that Li017's coherence cluster of subcarriers corresponds to the claimed "*subchannel configuration characterized by … localized subcarriers in the frequency domain*" and diversity cluster of subcarriers corresponds to the claimed "*subchannel configuration characterized by distributed subcarriers … in the frequency domain*" of [1G]. *Compare id.*, ¶111, *with* EX1001, 7:1-9; EX1003, ¶¶410-413.

Li017's Figure 9 illustrates the "coherence clusters and diversity clusters for Cells A-C." EX1009, ¶112.

[5] Li017's "cluster" corresponds to the claimed "subchannel." EX1003, ¶412.

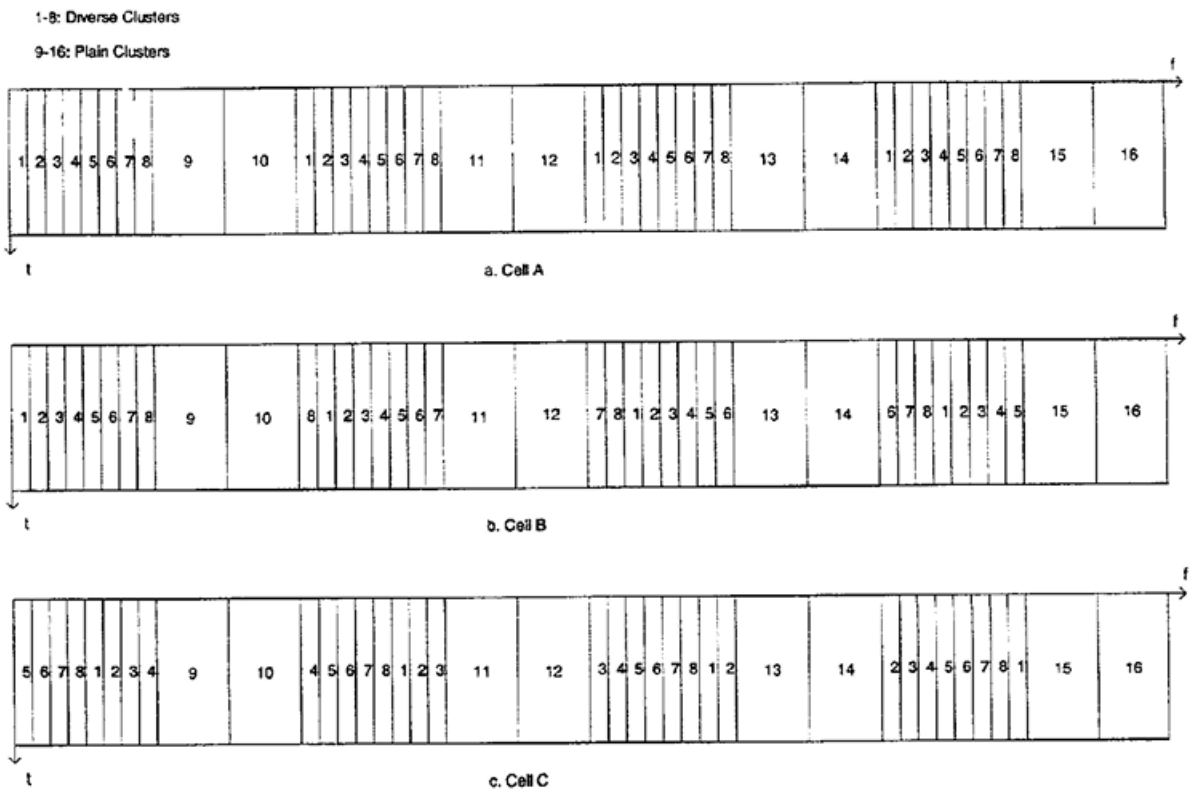


Figure 9

EX1009, FIG. 9.

Li017's Figure 11 illustrates selecting diversity or coherence clusters depending on subscribers' mobility. EX1009, ¶120.

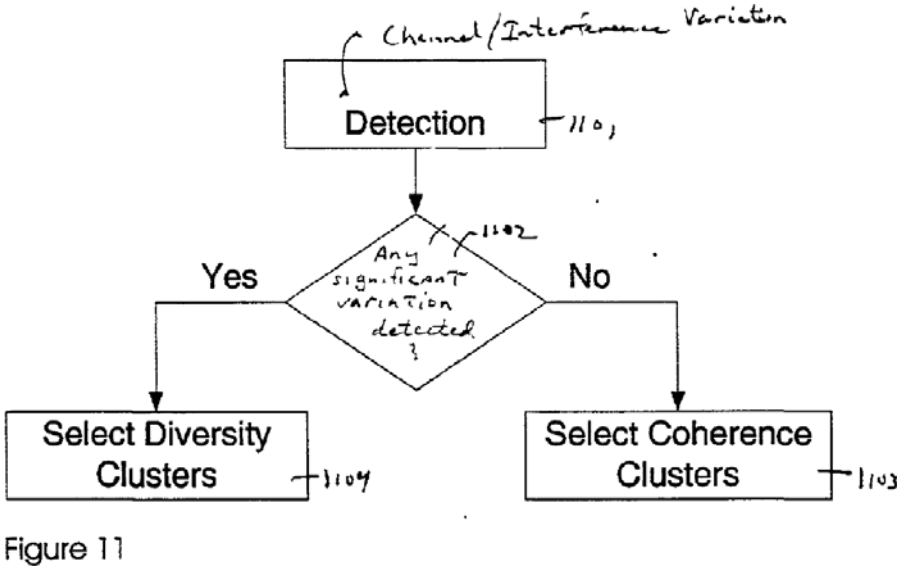


Figure 11

EX1009, FIG. 11.

EX1003, ¶¶414-415.

In particular, Li017 tests whether the results of the channel/interference variation detection that indicate that the user is mobile or in a fixed position close to the edge of the cell (1102). If the user is not mobile or is not in a fixed position close to the edge of the cell, the BS selects coherence clusters (1103). Otherwise, the BS selects diversity clusters (1104). EX1009, ¶121; *see also id.*, ¶¶118-119. Indeed, Li017's process for selecting the subchannel configuration based on user/mobile station movement is just like the '941 patent. EX1009, ¶¶120-121; EX1001, 7:1-9 (allocating subcarriers adjacent or close to each other when the user/mobile station is "either fixed in location or are mov[ing] slowly" and subcarriers scattered in the frequency domain for "fast moving users"); EX1003, ¶¶416-420.

Li017's BS then notifies the subscriber of the cluster allocation (and appropriate modulation/coding rates) through a control channel (block 105). EX1009, ¶48; EX1003, ¶421.

As discussed above, a POSITA would have been motivated to employ Li017's method for subcarrier allocation in Walton040's BS. When combined, Walton040's BS would use the existing CSI to determine the mobility of the mobile station, select the appropriate subchannel configuration to achieve good performance, and inform the mobile station of the selected subchannel configuration—coherence cluster or diversity cluster. *See supra* VIII.B.1; EX1003, ¶422.

The combination of Walton040 and Li017 thus discloses a mobile station-specific transmission parameter capable of indicating, as alternatives, both distributed subcarriers and localized subcarriers in the frequency domain as subchannel configurations. EX1003, ¶423.

(f) [1F]

As explained above, Walton040 discloses the claimed "*antenna transmission scheme*." *See supra* VIII.B.2(d).

In particular, system 100 "support[s] a number of operating modes." EX1008, ¶56. Each BS and terminal "may be equipped with both multiple transmit and receive antennas" and Table 1 summarizes these operating modes. *Id.*, *see also*

id., ¶68; EX1003, ¶424-427.

TABLE 1

Transmit Antennas	Receive Antennas: 1	Receive Antennas: N_R
1	SISO	SIMO
N_T	MISO	MIMO

EX1008, Table 1.

MISO is "characterized by multiple transmit antennas and a single receive antenna. This operating mode may be used for **transmit diversity**." EX1008, ¶60. "Diversity only—the use of both multiple transmit and receive antennas (i.e., both transmit and receive diversity) **to achieve highly reliable transmission of a single data stream**." *Id.*, ¶63; EX1003, ¶428.

MIMO is "characterized by multiple transmit antennas and multiple receive antennas." EX1008, ¶61. Single-user MIMO uses "both multiple transmit and receive antennas **to achieve high data rates** for a single terminal by creating multiple parallel transmission channels by exploiting the spatial dimensionality of the communication channel." *Id.*, ¶64; EX1003, ¶429.

Multi-user MIMO uses "multiple transmit and receive antennas to accommodate communication with multiple terminals concurrently on the same channel." EX1008, ¶65. "In the multi-user MIMO mode (which is also referred to as the N-SIMO mode), the downlink resources may be allocated to a number of

(N) distinct SIMO terminals, with each terminal demodulating a single data stream." *Id.*, ¶462; EX1003, ¶430.

Furthermore, Walton040's BS provides information about the allocated resources to the mobile station "**via a control channel to indicate the particular operating mode to use**." EX1008, ¶¶74, 82, 93, 482, claims 1-5, 8-9.

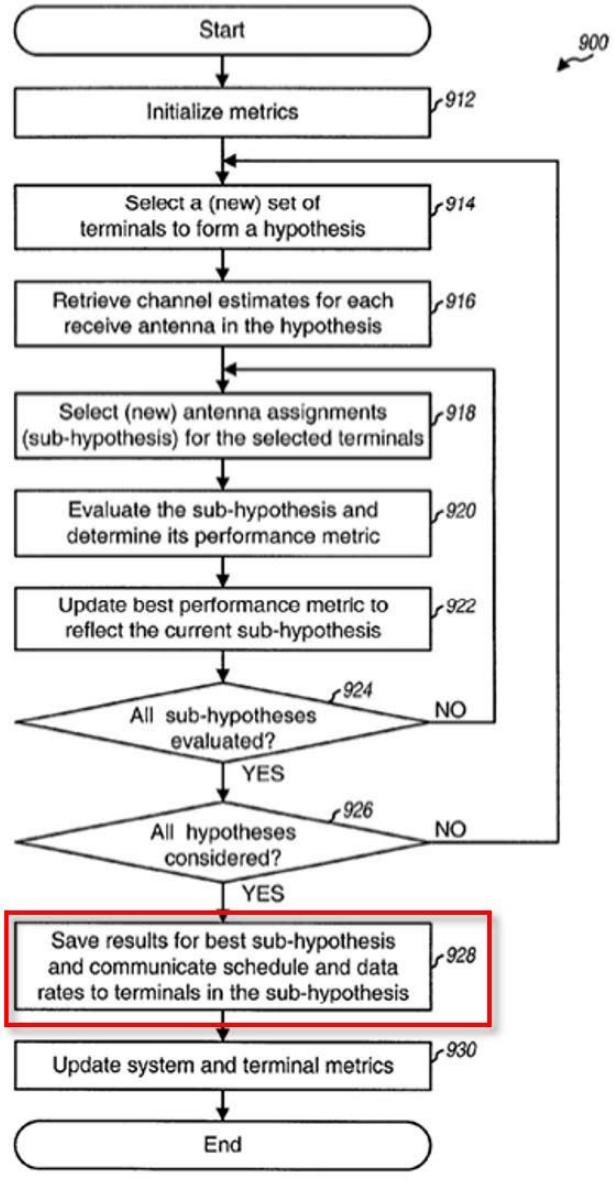


FIG. 9A

EX1008, FIG. 9A (annotated).

As such, Walton040's operating mode and antenna scheme transmitted to a mobile station via the control channel indicate an antenna transmission scheme comprising a transmission diversity scheme or a multiple-input multiple-output (MIMO) scheme. *See* EX1008, claims 1-5, 8-9; EX1003, ¶¶431-434.

(g) [1G]

As explained above, the combination of Walton040 and Li017 discloses the corresponding subchannel configuration characterized by distributed subcarriers or localized subcarriers in the frequency domain. *See supra* VIII.B.2(g); EX1003, ¶¶435-436.

(h) [1H]

As an initial matter, Walton040's BS transmits data packets to the mobile station. *See* EX1008, ¶100 (describing packet error rates); EX1003, ¶438.

Walton040's BS transmits these data packet to the mobile station over the frequency subchannel in accordance with the mobile station-specific transmission parameters (e.g., the coding, modulation, antenna assignments, and operating mode). *See supra* VIII.B.2(c). For example, in Walton040's transmitter unit 300e, the "coding and modulation for each frequency subchannel data stream … may be adjusted based on the coding and modulation control signals." EX1008, ¶130. And within TX MIMO processor 220e, the received modulation symbols are processed

based on the channel control and/or the available CSI. *Id.*, ¶131; *see also id.*, ¶482, claims 1-6, 8-9; EX1003, ¶¶437, 439-443.

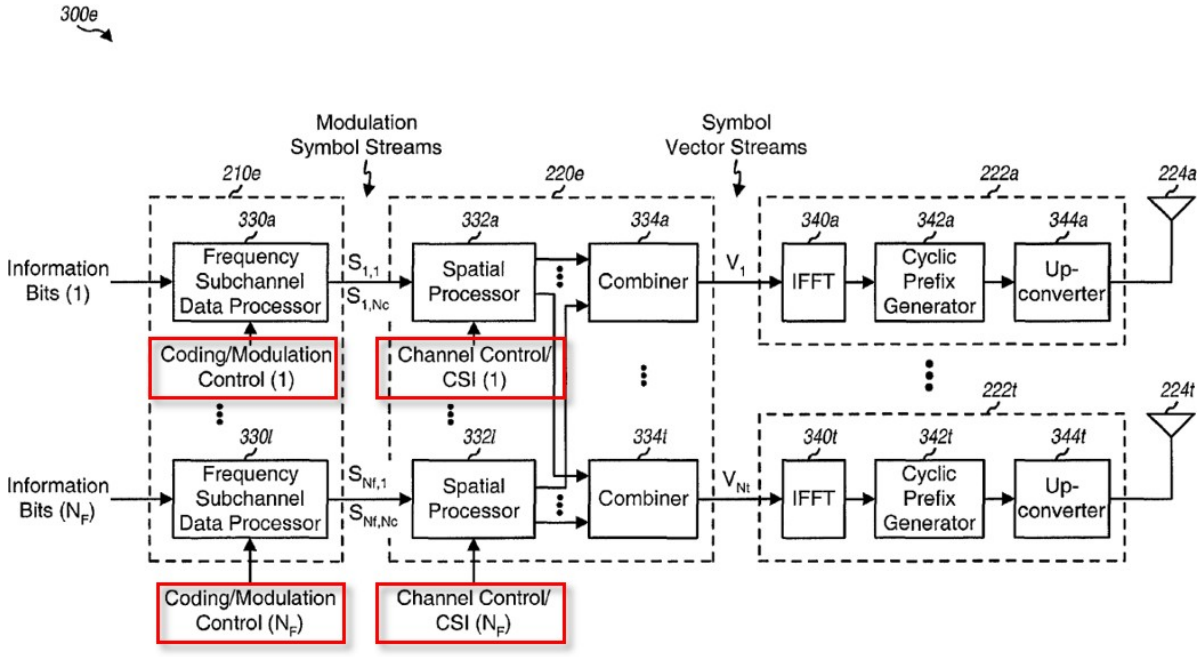


FIG. 3E

EX1008, FIG. 3E (annotated).

3. Claim 6

For similar reasons as discussed with respect to claim 1, Walton040 in view of Li017 discloses claim 6. *See supra* VIII.B.2; EX1003, ¶¶444-452.

(a) [6A]

For similar reasons as [1A], Walton040 discloses element [6A]. *See supra* VIII.B.2(a); EX1003, ¶445.

(b) [6B]

For similar reasons as [1B], Walton040 in view of Li017 discloses element [6B]. *See supra* VIII.B.2(b); EX1003, ¶446.

(c) [6C]

For similar reasons as [1C], Walton040 discloses [6C]. *See supra* VIII.B.2(c); EX1003, ¶447.

(d) [6D]

For similar reasons as [1D], Walton040 discloses [6D]. *See supra* VIII.B.2(d); EX1003, ¶448.

(e) [6E]

For similar reasons as [1E], Walton040 in view of Li017 discloses [6E]. *See supra* VIII.B.2(e); EX1003, ¶449.

(f) [6F]

For similar reasons as [1F], Walton040 discloses [6F]. *See supra* S VIII.B.2(f); EX1003, ¶450.

(g) [6G]

For similar reasons as [1G], Walton040 in view of Li017 discloses [6G]. *See supra* VIII.B.2(g); EX1003, ¶451.

(h) [6H]

For similar reasons as [1H], Walton040 in view of Li017 discloses [6H]. *See supra* VIII.B.2(h); EX1003, ¶452.

4. Claim 8

For similar reasons as discussed with respect to claims 1 and 6, Walton040 in view of Li017 discloses claim 8. *See supra* VIII.B.2, VIII.B.3; EX1003, ¶¶453-463.

(a) [8A]

For similar reasons as [1A], Walton040 discloses [8A]. *See supra* VIII.B.2(a). In particular, Walton040 discloses a link adaptation method in an OFDM communication system having at least one mobile station served by a base station (BS). *See* EX1008, Abstract, ¶44; EX1003, ¶454.

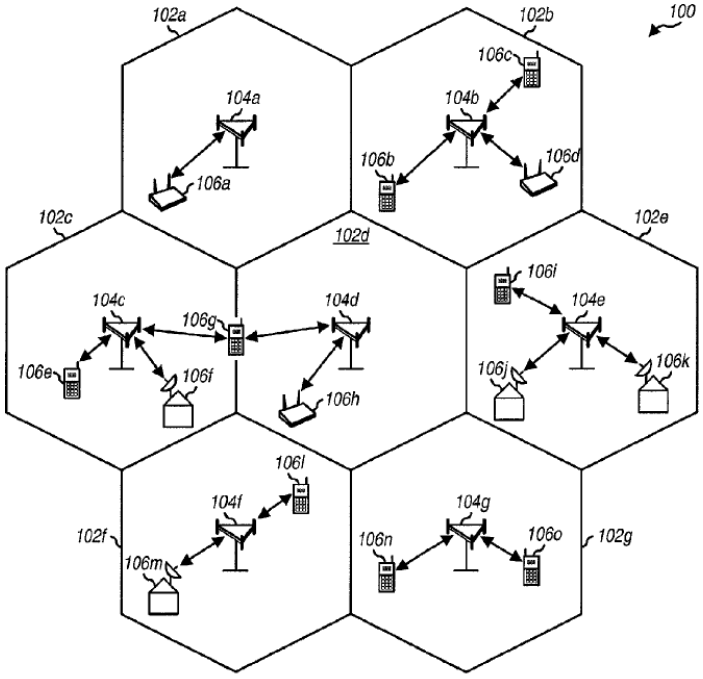


FIG. 1

EX1008, FIG. 1.

(b) [8B]

For similar reasons as [1B], Walton040 discloses [8B]. *See supra* VIII.B.2(b). In particular, Walton040's mobile station receives a control message from the serving BS over a control channel. *See* EX1008, ¶93; EX1003, ¶¶456-457.

(c) [8C]

For similar reasons as [1C], Walton040 discloses [8C]. *See supra* VIII.B.2(c); EX1003, ¶458.

(d) [8D]

For similar reasons as [1D], Walton040 discloses [8D]. *See supra* VIII.B.2(d); EX1003, ¶459.

(e) [8E]

For similar reasons as [1E], Walton040 in view of Li017 discloses [8E]. *See supra* VIII.B.2(e); EX1003, ¶460.

(f) [8F]

For similar reasons as [1F], Walton040 discloses [8F]. *See supra* VIII.B.2(f); EX1003, ¶461.

(g) [8G]

For similar reasons as [1G], Walton040 in view of Li017 discloses [8G]. *See supra* VIII.B.2(g); EX1003, ¶462.

(h) [8H]

For similar reasons as [1H], Walton040 in view of Li017 discloses [8H]. *See supra* VIII.B.2(h); EX1003, ¶463.

5. Claim 13

For similar reasons as discussed with respect to claims 1 and 8, Walton040 in view of Li017 discloses claim 13. *See supra* VIII.B.2, VIII.B.4; EX1003, ¶¶464-472.

(a) [13A]

For similar reasons as [1A] and [8A], Walton040 discloses [13A]. *See supra* VIII.B.2(a), VIII.B.4(a); EX1003, ¶465.

(b) [13B]

For similar reasons as [1B] and [8B], Walton040 discloses [13B]. *See supra* VIII.B.2(b), VIII.B.4(b); EX1003, ¶466.

***(c)* [13C]**

For similar reasons as [1C] and [8C], Walton040 discloses [13C]. *See supra* VIII.B.2(c), VIII.B.4(c); EX1003, ¶467.

(d) [13D]

For similar reasons as [1D] and [8D], Walton040 discloses [13D]. *See supra* VIII.B.2(d), VIII.B.4(d); EX1003, ¶468.

(e) **[13E]**

For similar reasons as [1E] and [8E], Walton040 in view of Li017 discloses [13E]. *See supra* VIII.B.2(e), VIII.B.4(e); EX1003, ¶469.

(a) **[13F]**

For similar reasons as [1F] and [8F], Walton040 discloses [13F]. *See supra* VIII.B.2(f), VIII.B.4(f); EX1003, ¶470.

(a) **[13G]**

For similar reasons as [1G] and [8G], Walton040 in view of Li017 discloses [13G]. *See supra* VIII.B.2(g), VIII.B.4(g); EX1003, ¶371.

(a) **[13H]**

For similar reasons as [1H] and [8H], Walton040 in view of Li017 discloses [13H]. *See supra* VIII.B.2(h), VIII.B.4(h); EX1003, ¶372.

6. Claims 3 and 10

Walton040 discloses claims 3 and 10. EX1003, ¶¶473-477, 491-492.

Walton040 explains that the system is designed to use power control and that in "allocating resources, the scheduling schemes may determine the minimum transmit power required to support a given data rate and operating mode." EX1008, ¶427. "The pertinent information (e.g., … **transmit power**, …) may be communicated to the affected terminals via a control channel on the downlink." EX1008, ¶¶93, 74, 512, claim 26; *see also* EX1001, 1:44-48, 1:64-2:3; EX1003, ¶¶474-477.

7. Claims 4 and 11

Walton040 discloses claims 4 and 11. EX1003, ¶¶478-481, 493-494.

Walton040's BS uses CSI "to determine the channel and antenna assignments, the operating mode." EX1008, ¶93; *see also id.*, ¶¶82, 482; *supra* VIII.B.2(d). Moreover, Walton040 explains that the "flexibility in both selecting the best set of terminals for data transmission and assigning the transmit antennas to the selected terminals allows the scheduler to optimize performance by exploiting multi-user diversity environment" using SNRs for each terminal. EX1008, ¶¶469-470; *see also id.*, claims 1, 14; EX1003, ¶479-481.

8. Claims 5 and 12

The combination of Walton040 and Li017 discloses claims 5 and 12. As noted above, Walton040 in view of Li017 discloses the claimed "corresponding subchannel configuration." *See supra* VIII.B.12.e; EX1003, ¶¶482-488, 495-496.

Moreover, it would have been obvious to a POSITA to modify Walton040 to select the corresponding subchannel configuration based on a channel condition in view of Li017. Each subscriber in Li017 "measures the channel and interference information for all the subcarriers" and feeds that information back to the base station." EX1009, ¶26. The BS then notifies the subscriber of the selected subcarrier configuration. *Id.*, ¶27; *see supra* VIII.B.1; EX1003, ¶¶484-485.

Specifically, the BS performs channel/interference variation detection

(1101), tests whether "the user is mobile or in a fixed position close to the edge of the cell" (1102), and then selects coherence clusters if "the user is not mobile or is not in a fixed position close to the edge of the cell" (1103), or otherwise selects diversity clusters (1104). EX1009, ¶121.

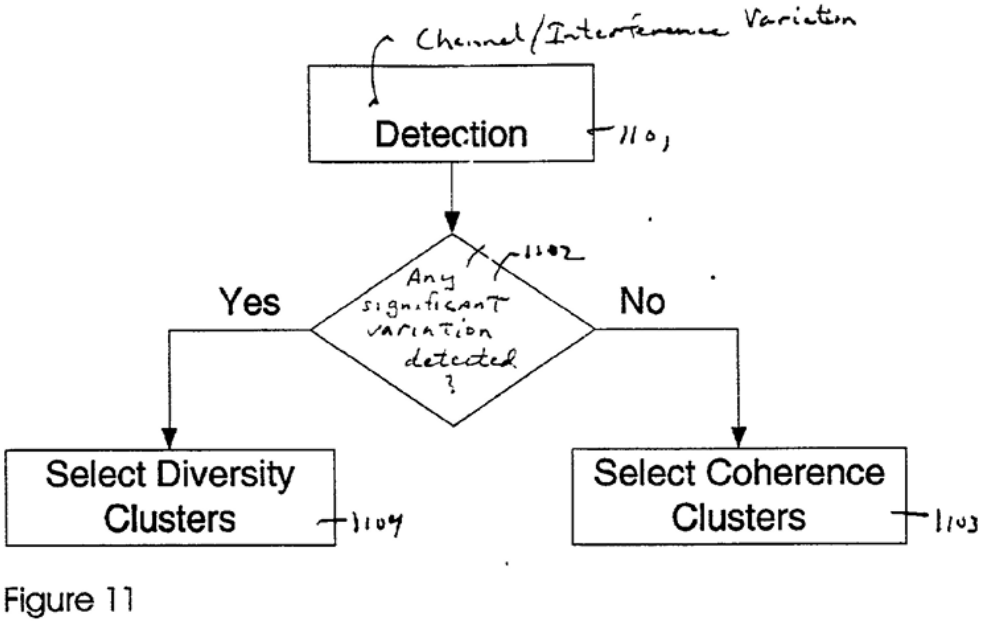


Figure 11

EX1009, FIG. 11.

EX1003, ¶486.

As explained above, a POSITA would have been motivated to employ Li017's method for subcarrier allocation in Walton040's BS. When combined, Walton040's BS would use the existing CSI to determine the mobility/location of the mobile station (fixed/mobile or near cell edge) and select the appropriate subchannel configuration (localized or distributed subcarriers) to achieve improved performance. *See supra* VIII.B.1; EX1003, ¶¶487-488.

9. Claim 7

For similar reasons as discussed with respect to claims 5 and 6, Walton040 in view of Li017 discloses claim 7. *See supra* VIII.8, VIII.3. In particular, Walton040 and Li017 both disclose the BS receiving CSI from the mobile station. *See* EX1008, ¶¶11, 80-82, claim 1; EX1009, 44-47; EX1003, ¶¶489-490.

10. Claim 14

For similar reasons as discussed with respect to claims 5-7, Walton040 in view of Li017 discloses claim 14. *See supra* VIII.B.7-VIII.B.3. In particular, Walton040 and Li017 both disclose the mobile station having a transmitter configured to transmit CSI to the BS. *See* EX1008, ¶¶11, 80-82, claim 1; EX1009, 44-47; EX1003, ¶¶497-498.

C. Ground 3: Claims 2 and 9 are unpatentable under § 103 as obvious over Walton040 in view of Li017 and Tufvesson.

1. A POSITA would have been motivated to combine Walton040 in view of Li017 and Tufvesson.

Walton040 explains that pilot data (e.g., **data of a known pattern**) may be encoded and multiplexed with the processed information bits. EX1008, ¶97; *see also id.*, ¶177. "The pilot data may be used at the receiver to perform channel estimation, frequency and timing estimation, coherent data demodulation, and so on." *Id.*, ¶97. Specifically, CSI "is derived based on a pilot included in the transmitted signals." *Id.*, ¶316; EX1003, ¶¶499-501.

Similarly, Li017's base stations "periodically broadcast[] pilot OFDM

symbols to every subscriber within its cell (or sector) (processing block 101). **The pilot symbols, often referred to as a sounding sequence or signal, are known to both the base station and the subscribers.** … The pilot symbols can serve multiple purposes: time and frequency synchronization, channel estimation and signal-to-interference/noise (SINR) ratio measurement for cluster allocation." EX1009, ¶¶43-44; EX1003, ¶¶502-503.

While Walton040 and Li017 do not explicitly state that the mobile station-specific transmission parameters indicate a training pilot pattern, Walton040 and Li017 both explain that the pattern of the pilots to be used for CSI/channel estimation must be known to the mobile station/subscriber. EX1008, ¶97; EX1009, ¶43; EX1003, ¶504.

A POSITA would have thus looked to the prior art, e.g. Tufvesson, for how to communicate the pilot pattern such that it is known to the mobile station. Tufvesson, like Walton040 and Li017, is directed to pilot assisted channel estimation for OFDM in mobile cellular systems. EX1010, 1639. Tufvesson also explained that the pilot pattern must be known to the mobile stations and is among the information transferred to a mobile station when it logs into a new cell, and once known is used for channel estimation. EX1010, 1639, 1641; EX1003, ¶¶505-507.

Based on the teaching of Tufvesson, a POSITA would have been motivated to modify Walton040 to include the training pilot pattern as part of the information communicated via the control channel to also indicate the forthcoming pilot pattern such that the mobile station may properly determine the SNR. EX1010, ¶97; EX1008, ¶¶74, 93, 462, 482. Otherwise, the mobile station would not be able to properly measure the CSI because the location of the pilots would not be known. EX1003, ¶508.

A POSITA would have been further motivated to combine Walton040 and Tufvesson because both are in the same general field of mobile communications, and address the same problem—improving the performance of wireless communication systems. In particular, they are both directed to cellular communication systems using OFDM. EX1003, ¶509.

A POSITA would have combined the system of Walton040 with the teachings of Tufvesson by known methods, and the results of the combination would have been predictable to a POSITA (e.g., by providing the training pilot pattern in the information transmitted via the control channel). The proposed combination would also involve nothing more than incorporating a well-known concept into a well-known system. EX1003, ¶510; *KSR*, 550 U.S. at 419-421.

2. Claims 2 and 9

The combination of Walton040, Li017, and Tufvesson discloses claim 2.

As discussed above, a POSITA would have been motivated to incorporate a training pilot pattern in the information transmitted via Walton040's control channel. When combined, Walton040 would utilize Tufvesson's teachings such that the mobile station may identify and utilize subsequent pilot data to perform channel estimation, frequency and timing estimation, coherent data demodulation, etc. *See supra* VIII.C.1; EX1008, ¶97; EX1009, ¶43; EX1003, ¶¶511-514.

For similar reasons, Walton040 in view of Li017 discloses claim 9. EX1003, ¶¶515-516.

IX. DISCRETIONARY CONSIDERATIONS UNDER SECTIONS 314(A) AND 325(D) STRONGLY FAVOR INSTITUTION.

A. The *Fintiv* factors strongly favor institution.

Should Patent Owner seek denial under *Fintiv*, Honda will seek permission to reply to address the facts and law as they stand at that time. Under the current facts, *Fintiv* is not applicable. There is no trial scheduled. In fact, there is not even a scheduled date for remand from the MDL court to Honda's trial court (in the Southern District of Ohio) that will, upon that remand, schedule a trial date. And the median time to trial for civil actions in the Eastern District of Michigan (where the nine parties' cases have been consolidated for pretrial proceedings) is nearly four years. *See* Ex. 1045 at 40. For the Southern District of Ohio, there is only one data point for a bench trial (104.8 months) and one for a jury trial (35.1 months). Both dates would occur well after any Final Written Decision. *See*

EX1046.

B. *General Plastic* and *Valve Corp.* strongly favor institution.

Serial petitioning concerns addressed in *General Plastic Industrial Co., Ltd. v. Canon Kabushiki Kaisha*, IPR2016-01357, Paper 19 (P.T.A.B. Sept. 6, 2017) (§ II.B.4.i precedential), and *Valve Corp. v. Electronic Scripting Products, Inc.*, IPR2019-00062, Paper 11 (P.T.A.B. April 2, 2019) (precedential), are not at play here. Petitioner has not previously petitioned for IPR of the '941 patent. Non-parties Dell Inc. and Dell Technologies Inc. ("Dell") previously sought IPR of the '941 patent in IPR2022-00277 based on different prior art and arguments, and a different technical expert. *See* EX1020, 7.

Petitioner has not previously petitioned for *Inter Partes* Review of the '941 patent and has not coordinated with and has no relationship with Dell, who is not a co-defendant in the MDL centralized in the Eastern District of Michigan. EX1024. Nor has Petitioner used the Dell IPR as a "roadmap" to craft invalidity positions. Rather, Petitioner's review and consideration of the record in IPR2021-001468 is no different than review of the '941 patent's file history—routine diligence to understand the patent's history before the Office. Moreover, the deficiencies in Dell's prior-art combinations that led the Board to deny Dell's petition are not present here. Finally, the concerns for fundamental fairness undergirding *General Plastic* and *Valve Corp*. confirm that institution is warranted here. Patent Owner sued Dell in January 2021, more than a year before filing suit against Petitioner. That the Petition here comes

after the Dell IPR is the result of Patent Owner's own actions, not any nefarious serial-petitioning strategy to harass Patent Owner.

C. The *Advanced Bionics* two-part framework strongly favors institution.

Applying the two-part framework from *Advanced Bionics, LLC v. MED-EL Elektromedizinische Geräte GmbH*, IPR2019-01469, Paper 6 at 8-9 (P.T.A.B. February 13, 2020) (precedential), demonstrates that denial under § 325(d) is not appropriate. Under part one, the same or substantially the same art or arguments were *not* previously presented to the Office, ending the inquiry in favor of institution. The "new, noncumulative prior art asserted in the Petition" Petition for *Inter Partes* Review of USP 10,075,94` strongly favors IPR. *Oticon Medical AB v. Cochlear Ltd*., IPR2019-00975, Paper 15 at 20 (P.T.A.B. October 16, 2019) (§§ II.B and II.C precedential).

X. CONCLUSION

For the reasons above, *inter partes* review of claims 1-14 of the '941 patent is requested.

Respectfully submitted,

Dated 3/30/2023

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XI. APPENDIX A: CHALLENGED CLAIMS

1. [1A] A link adaptation method by a base station serving a plurality of mobile stations in an Orthogonal Frequency Division Multiplexing (OFDM) communication system, the communication system utilizing a transmission structure with time slots in the time domain and frequency subchannels in the frequency domain, the method comprising:

[1B] transmitting a control message to a mobile station over a control channel, wherein:

[1C] the control message contains transmission parameters allocated to the mobile station for a subsequent transmission of data by the base station over a frequency subchannel to the mobile station in a time slot; and

[1D] the mobile station-specific transmission parameters indicate an antenna transmission scheme and

[1E] [*the mobile station-specific transmission parameters indicate …*] a corresponding subchannel configuration,

[1F] the antenna transmission scheme comprising a transmission diversity scheme or a multiple-input multiple-output (MIMO) scheme and

[1G] the corresponding subchannel configuration characterized by distributed subcarriers or localized subcarriers in the frequency domain; and

[1H] transmitting a data packet to the mobile station over the frequency subchannel in accordance with the mobile station-specific transmission parameters.

2. The method in claim 1, wherein the mobile station-specific transmission parameters further indicate a training pilot pattern.

3. The method in claim 1, wherein the mobile station-specific transmission parameters further indicate power control information.

4. The method in claim 1, wherein the antenna transmission scheme is based on a channel condition.

5. The method in claim 1, wherein the corresponding subchannel configuration is selected based on a channel condition.

6. [6A] A base station serving a plurality of mobile stations in an Orthogonal Frequency Division Multiplexing (OFDM) communication system, the communication system utilizing a transmission structure with time slots in the time domain and frequency subchannels in the frequency domain, the base station comprising a transmitter configured to:

[6B] transmit a control message to a mobile station over a control channel, wherein:

[6C] the control message contains transmission parameters allocated to the mobile station for a subsequent transmission of data by the base station over a frequency subchannel to the mobile station in a time slot; and

[6D] the mobile station-specific transmission parameters indicate an antenna transmission scheme and

[6E] [*the mobile station-specific transmission parameters indicate …*] a corresponding subchannel configuration,

[6F] the antenna transmission scheme comprising a transmission diversity scheme or a multiple-input multiple-output (MIMO) scheme and

[6G] the corresponding subchannel configuration characterized by distributed subcarriers or localized subcarriers in the frequency domain; and

[6H] transmitting a data packet to the mobile station over the frequency subchannel in accordance with the mobile station-specific transmission parameters.

7. The base station in claim 6, further comprising a receiver configured to receive channel state information from the mobile station.

8. [8A] A link adaptation method by a mobile station served by a serving base station in an Orthogonal Frequency Division Multiplexing (OFDM) communication system, the communication system utilizing a transmission structure with time slots in the time domain and frequency subchannels in the frequency domain, the method comprising:

[8B] receiving a control message from the serving base station over a control channel, wherein

[8C] the control message contains transmission parameters specific to the mobile station for a subsequent transmission by the serving base station over a frequency subchannel to the mobile station in a time slot; and

[8D] the mobile station-specific transmission parameters indicate an antenna transmission scheme and

[8E] [*the mobile station-specific transmission parameters indicate* …] a corresponding subchannel configuration,

[8F] the antenna transmission scheme comprising a transmission diversity scheme or a multiple-input multiple-output (MIMO) scheme and

[8G] the corresponding subchannel configuration characterized by distributed subcarriers or localized subcarriers in the frequency domain; and

[8H] receiving a data packet transmitted by the serving base station using the mobile station-specific transmission parameters over the frequency subchannel.

9. The method in claim 8, wherein the mobile station-specific transmission parameters further indicate a training pilot pattern.

10. The method in claim 8, wherein the mobile station-specific transmission parameters further indicate power control information.

11. The method in claim 8, wherein the MIMO scheme is for improving transmission throughput based on a channel condition.

12. The method in claim 8, wherein the corresponding subchannel configuration is selected based on a channel condition.

13. [13A] A mobile station served by a serving base station in an Orthogonal Frequency Division Multiplexing (OFDM) communication system, the communication system utilizing a transmission structure with time slots in the time domain and frequency subchannels in the frequency domain, the mobile station comprising a receiver configured to:

[13B] receive a control message from the serving base station over a control channel, wherein

[13C] the control message contains transmission parameters specific to the mobile station for a subsequent transmission by the serving base station over a frequency subchannel to the mobile station in a time slot; and

[13D] the mobile station-specific transmission parameters indicate an antenna transmission scheme and

[13E] [*the mobile station-specific transmission parameters indicate* …] a corresponding subchannel configuration,

[13F] the antenna transmission scheme comprising a transmission diversity scheme or a multiple-input multiple-output (MIMO) scheme and

[13G] the corresponding subchannel configuration characterized by distributed subcarriers or localized subcarriers in the frequency domain; and

[13H] receive a data packet transmitted by the serving base station using the mobile station-specific transmission parameters over the frequency subchannel.

14. The mobile station in claim 13, further comprising a transmitter configured to transmit channel state information to the serving base station.

CERTIFICATION UNDER 37 CFR § 42.24

Under the provisions of 37 CFR § 42.24(d), the undersigned hereby certifies that the word count for the foregoing Petition for *Inter Partes* Review totals 13,422 words, which is less than the 14,000 allowed under 37 CFR § 42.24.

Dated 3/30/2023

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CERTIFICATE OF SERVICE

Pursuant to 37 CFR §§ 42.6(e)(4)(i) *et seq.* and 42.105(b), the undersigned certifies that on March 30, 2023, a complete and entire copy of this Petition for *Inter Partes* Review and all supporting exhibits were provided by Federal Express, to the Patent Owner, by serving the correspondence address of record as follows:

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