

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of: Xiaodong Li et al.
U.S. Patent No.: 10,075,941 Attorney Docket No.: 00035-0023IP1
Issue Date: September 11, 2018
Appl. Serial No.: 15/082,878
Filing Date: March 28, 2016
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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EXHIBITS

EX-1001	U.S. Patent No. 10,075,941 to Li et al. (“the ’941 Patent”)
EX-1002	Excerpts from the Prosecution History of the ’941 Patent (“the Prosecution History”)
EX-1003	Declaration and Curriculum Vitae of Dr. Zhi Ding
EX-1004	Complaint, <i>Neo Wireless LLC., v. Dell Technologies Inc.</i> , 6:21-cv-0024, W.D. Tex., Jan. 12, 2021
EX-1005	Stipulation by Petitioner
EX-1006	U.S. Patent No. 9,473,269 (“Walton ’269”)
EX-1007	U.S. Patent No. 6,947,748 (“Li”)
EX-1008	U.S. Patent Apl. Pub No. 2004/0165683 (“Gupta”)
EX-1009	PCT Patent Apl. Pub No. WO 02/093819 (“PCT819”)
EX-1010	U.S. Patent No. 6,400,699 (“Airy”)
EX-1011	U.S. Patent No. 7,110,783 (“Bahl”)
EX-1012	U.S. Patent Apl. Pub No. 2002/0032030 (“Berglund”)
EX-1013	U.S. Patent No. 7,209,459 (“Kangas”)
EX-1014	Joint Proposed Scheduling Order, <i>Neo Wireless LLC., v. Dell Technologies Inc.</i> , 6:21-cv-0024, W.D. Tex., Aug. 6, 2021
EX-1015	Defendants’ Opposed Motion for Intra-District Transfer of Venue, <i>Neo Wireless LLC., v. Dell Technologies Inc.</i> , 6:21-cv-0024, W.D. Tex., May 8, 2021

LISTING OF CHALLENGED CLAIMS

Claim 1	
[1pre-1]	A link adaptation method by a base station serving a plurality of mobile stations in an Orthogonal Frequency Division Multiplexing (OFDM) communication system,
[1pre-2]	the communication system utilizing a transmission structure with time slots in the time domain and frequency subchannels in the frequency domain, the method comprising:
[1a]	transmitting a control message to a mobile station over a control channel,
[1b]	wherein: 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
[1c]	the mobile station-specific transmission parameters indicate an antenna transmission scheme and a corresponding subchannel configuration,
[1c-1]	the antenna transmission scheme comprising a transmission diversity scheme or a multiple-input multiple-output (MIMO) scheme and
[1c-2]	the corresponding subchannel configuration characterized by distributed subcarriers or localized subcarriers in the frequency domain; and
[1d]	transmitting a data packet to the mobile station over the frequency subchannel in accordance with the mobile station-specific transmission parameters.

Claim 2	
[2]	The method in claim 1, wherein the mobile station-specific transmission parameters further indicate a training pilot pattern.
Claim 3	
[3]	The method in claim 1, wherein the mobile station-specific transmission parameters further indicate power control information.
Claim 4	
[4]	The method in claim 1, wherein the antenna transmission scheme is based on a channel condition.
Claim 5	
[5]	The method in claim 1, wherein the corresponding subchannel configuration is selected based on a channel condition.
Claim 6	
[6pre-1]	A base station serving a plurality of mobile stations in an Orthogonal Frequency Division Multiplexing (OFDM) communication system,
[6pre-2]	the communication system utilizing a transmission structure with time slots in the time domain and frequency subchannels in the frequency domain,
[6pre-3]	the base station comprising a transmitter configured to:
[6a]	transmit a control message to a mobile station over a control channel,
[6b]	wherein: 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

[6c]	the mobile station-specific transmission parameters indicate an antenna transmission scheme and a corresponding subchannel configuration,
[6c-1]	the antenna transmission scheme comprising a transmission diversity scheme or a multiple-input multiple-output (MIMO) scheme and
[6c-2]	the corresponding subchannel configuration characterized by distributed subcarriers or localized subcarriers in the frequency domain; and
[6d]	transmitting a data packet to the mobile station over the frequency subchannel in accordance with the mobile station-specific transmission parameters.
Claim 7	
[7]	The base station in claim 6, further comprising a receiver configured to receive channel state information from the mobile station.
Claim 8	
[8pre-1]	A link adaptation method by a mobile station served by a serving base station in an Orthogonal Frequency Division Multiplexing (OFDM) communication system,
[8pre-2]	the communication system utilizing a transmission structure with time slots in the time domain and frequency subchannels in the frequency domain, the method comprising:
[8a]	receiving a control message the serving base station over a control channel,
[8b]	wherein: 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

[8c]	the mobile station-specific transmission parameters indicate an antenna transmission scheme and a corresponding subchannel configuration,
[8c-1]	the antenna transmission scheme comprising a transmission diversity scheme or a multiple-input multiple-output (MIMO) scheme and
[8c-2]	the corresponding subchannel configuration characterized by distributed subcarriers or localized subcarriers in the frequency domain; and
[8d]	receiving a data packet transmitted by the serving base station using the mobile station-specific transmission parameters over the frequency subchannel.
Claim 9	
[9]	The method in claim 8, wherein the mobile station-specific transmission parameters further indicate a training pilot pattern.
Claim 10	
[10]	The method in claim 8, wherein the mobile station-specific transmission parameters further indicate power control information.
Claim 11	
[11]	The method in claim 8, wherein the MIMO scheme is for improving transmission throughput based on a channel condition.
Claim 12	
[12]	The method in claim 8, wherein the corresponding subchannel configuration is selected based on a channel condition.
Claim 13	
[13pre-1]	A mobile station served by a serving base station in an Orthogonal Frequency Division Multiplexing (OFDM) communication system,

[13pre-2]	the communication system utilizing a transmission structure with time slots in the time domain and frequency subchannels in the frequency domain,
[13pre-3]	the mobile station comprising a receiver configured to:
[13a]	receive a control message from the serving base station over a control channel,
[13b]	wherein: 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
[13c]	the mobile station-specific transmission parameters indicate an antenna transmission scheme and a corresponding subchannel configuration,
[13c-1]	the antenna transmission scheme comprising a transmission diversity scheme or a multiple-input multiple-output (MIMO) scheme and
[13c-2]	the corresponding subchannel configuration characterized by distributed subcarriers or localized subcarriers in the frequency domain; and
[13d]	receive a data packet transmitted by the serving base station using the mobile station-specific transmission parameters over the frequency subchannel.
Claim 14	
[14]	The mobile station in claim 13, further comprising a transmitter configured to transmit channel state information to the serving base station.

Dell Inc. and Dell Technologies Inc. (collectively “**Petitioner**”) petition for *Inter Partes* Review (“**IPR**”) of claims 1-14 (“**the Challenged Claims**”) of U.S. Patent No. 10,075,941 (“**the ’941 Patent**”). As explained in this Petition, an IPR should be instituted because there exists a reasonable likelihood that Petitioner will prevail with respect to the Challenged Claims.

The ’941 Patent describes and claims a link adaptation method between a base station and one or more mobile stations using Orthogonal Frequency Division Multiplexing (OFDM). EX-1001, 9:5-11:3. The link adaptation method recited in independent claim 1 (and similarly in independent claims 8, 6, and 13) purports to achieve the link adaptation merely by transmitting a control message and a data packet from a base station to a mobile station. *Id.* While apparently not reciting any type of data processing operation to implement the link adaptation method, the ’941 Patent claims focus on the contents of the control message—in particular that the control message contains transmission parameters that indicate an antenna transmission scheme and a corresponding subchannel configuration. *Id.*

Yet, the claimed link adaptation method and control message were not novel. EX-1003, ¶¶[30], [58], [187]. To the contrary, as demonstrated in the asserted grounds of this Petition and the disclosure in the cited references, the claimed contents of the control message and, moreover, the transmission of the control message and data packet from a base station to the mobile station, were

known in the art and would have been obvious to a person of ordinary skill in the art as of the Priority Date of the '941 Patent (“**POSITA**”). *See infra* Sections I, III. Because Petitioner clearly demonstrates that the '941 Patent claims were obvious and Petitioner was diligent and timely in filing this petition, Petitioner respectfully submits that an IPR should be instituted, and that the Challenged Claims should be canceled as unpatentable.

I. REQUIREMENTS FOR IPR UNDER 37 C.F.R. § 42.104

A. Grounds for Standing

Petitioner certifies that the '941 Patent is available for IPR. Petitioner is not barred or estopped from requesting review. Petitioner was first served with a complaint of infringement of the '941 Patent less than one year prior to the filing of this Petition. EX-1004.

B. Challenge and Relief Requested

Petitioner requests IPR of the Challenged Claims on the obviousness grounds noted below. Dr. Ding provides supporting explanations in his Declaration cited throughout this petition. EX-1003, ¶¶[1]-[187].

Ground	Claim(s)	35 U.S.C. § 103 Combination
A1	1-14	Walton '269 in view of Li
A2	2 and 9	Walton '269 in view of Li and Gupta
B1	1, 3-8, 10-14	PCT819 in view of Airy

The '941 Patent claims priority to US Provisional Application Serial No. 60/544,521, filed on February 13, 2004. Petitioner does not take a position as to whether the '941 Patent is entitled to the priority date of February 13, 2004 (hereinafter "Priority Date"). As shown below, each reference predates the Priority Date and qualifies as prior art.

Reference	Filing Date	Publication Date	Prior Art Under
Walton '269 (USPN 9,473,269)	Dec. 1, 2003	Oct. 18, 2016 (Issue)	102(e)
Li (USPN 6,947,748)	Dec. 15, 2000	Aug. 29, 2002	102(b)
Gupta (US Pub 2004/0165683)	Aug. 28, 2003	Aug. 26, 2004	102(e)
PCT819 (PCT Pub No. WO 02/093819)	May 16, 2001	Nov. 21, 2002	102(b)
Airy (USPN 6,400,699)	Sept. 12, 2000	Jun. 4, 2002	102(b)

Petitioner does not waive any arguments concerning other grounds that can only be raised in district court.

C. Claim Construction

No formal claim constructions are necessary because “claim terms need only be construed to the extent necessary to resolve the controversy.” *Wellman, Inc. v. Eastman Chem. Co.*, 642 F.3d 1355, 1361 (Fed. Cir. 2011).

D. Level of Ordinary Skill in the Art

A POSITA would have had at least a Bachelor’s degree in an academic area emphasizing electrical engineering or a similar discipline, and at least two years of experience in the field working with, teaching, or researching wireless communication networks. EX-1003, ¶¶[32]-[33]. Superior education could compensate for a deficiency in work experience, and *vice-versa*. *Id.*

II. THE ’941 PATENT

A. Brief Description

The ’941 Patent is directed to “[m]ethods and apparatus 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.” EX-1001, 2:33-41, Abstract; EX-1003, ¶[53].

The ’941 Patent’s FIG. 4 (reproduced below) illustrates an AMCTP (adaptive modulation, coding, training and power control) process. EX-1001, 4:5-24. FIG. 4 shows Device A communicating with Device B and is described as

follows:

The transmitter 401 of Device A transmits data 402 and associated control information 404 to Device B, based on an output of the adaptation process 406. After a receiver 408 of Device B receives the transmitted data 402 and control information 404, a measurement process 410 of Device B measures a channel conditions [sic] and feeds a channel quality information (CQI) 412 back to Device A.

EX-1001, 4:13-24. The control information 404 is transmitted in a control message that can include an AMCTP indicator indicative of the type of AMCTP scheme to be implemented for data transmission 402. EX-1001, 7:25-38, 4:39-45, FIG. 6; EX-1003, ¶¶[54]-[55].

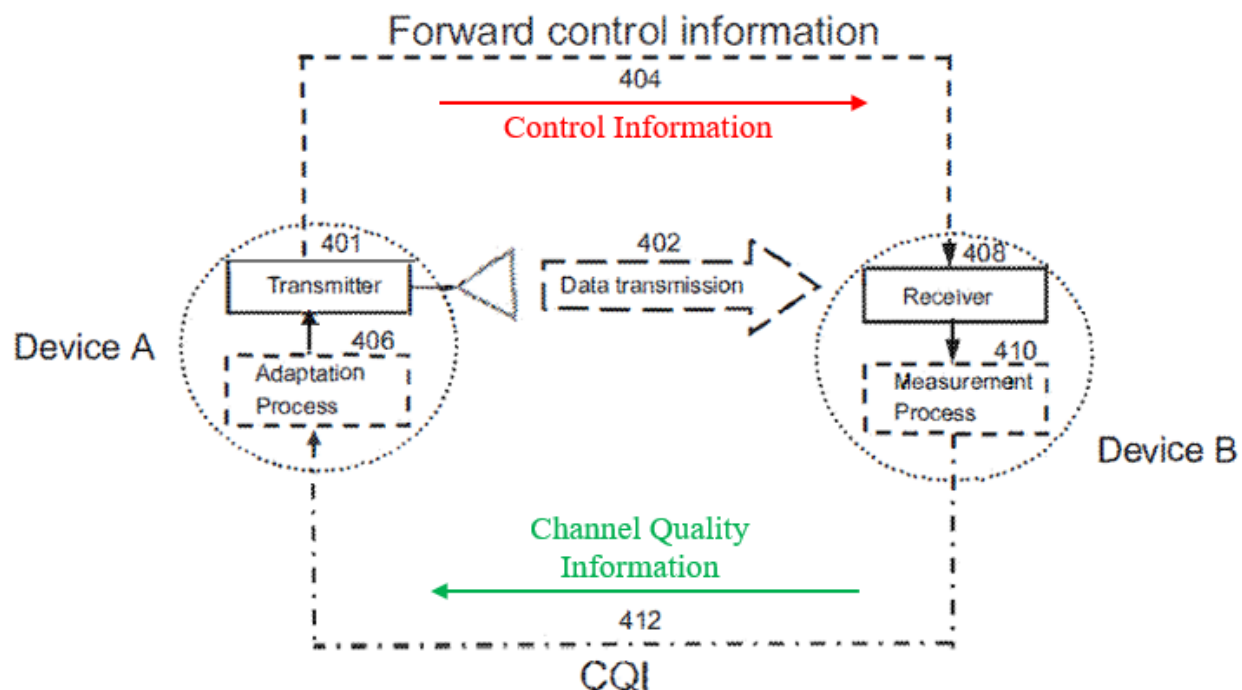


FIG. 4

EX-1001, FIG. 4¹

An adaptation process 406 is then performed at device A to adjust “the allocated modulation schemes, coding rates, pilot patterns, power levels, spatial processing schemes, subchannel configurations, etc. in accordance with the transmission channel state and condition.” EX-1001, 3:66-4:4; EX-1003, ¶[56]. The adaptation process 406 includes features such as “coding 502, modulation 504, training pilot pattern 506, and transmission power for a subchannel 508” as shown in FIG. 5 (reproduced below). EX-1001, 4:32-38.

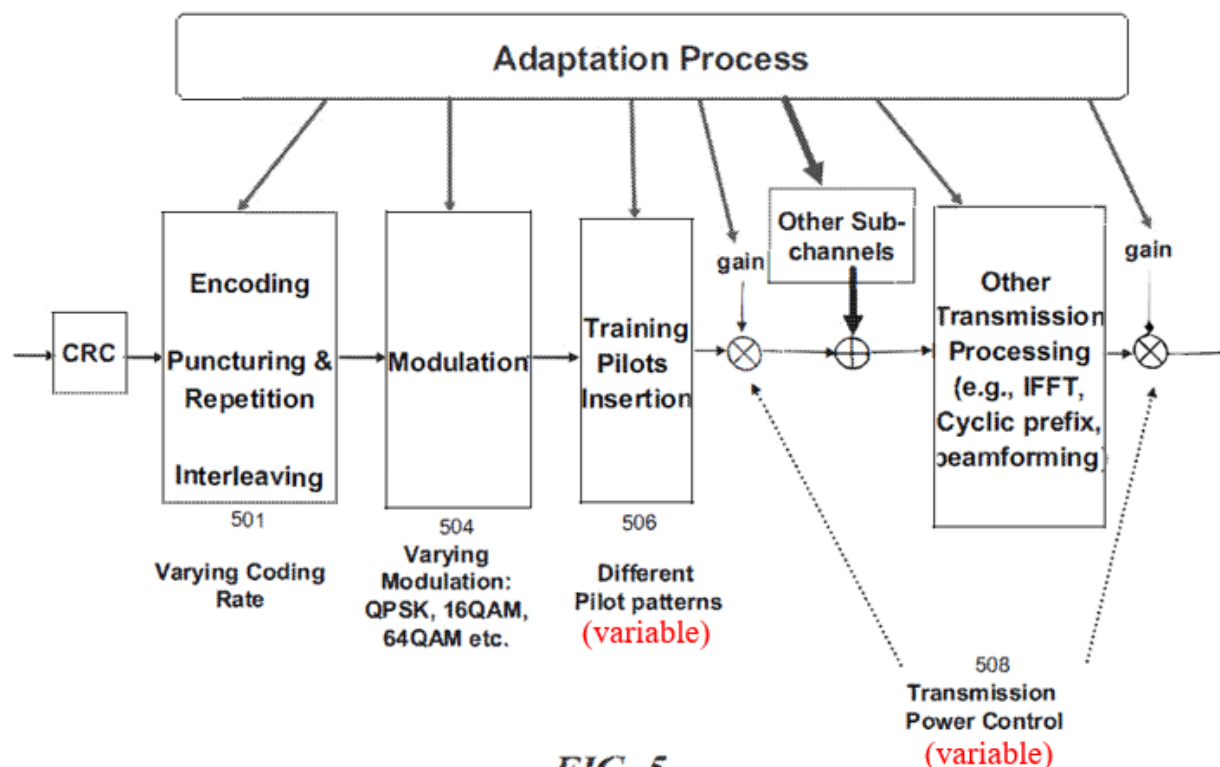


FIG. 5

¹ Annotations to the figures throughout this petition are shown in color.

EX-1001, FIG. 5

B. Prosecution History of the '941 Patent

The '941 Patent issued from U.S. Patent Application No. 15/082,878 (“the '878 application”), which was filed on March 28, 2016. EX-1001, cover. The '941 Patent issued after one Office Action. *See generally* EX-1002. In a response to the Office Action, applicant/Patent Owner responded to a § 112, ¶ 2 rejection for recitation of the term “channel condition” in the claims by explaining that channel conditions are “‘referred to as one or more of the following, for a user or a subchannel signal level, noise level, interference level, SINR[□], fading channel characteristics (Doppler frequency, delay spread, etc.), or channel profile in time or frequency domain.’ In other words, channel conditions refer to any of various characteristics about a telecommunications channel that can be measured or estimated.” EX-1002, 47-48. The term “channel condition” is recited in claims 4, 5, 10, and 11. EX-1003, ¶¶[57]-[58]

This petition demonstrates the existence and obviousness of prior art channel conditions consistent with those listed by Applicant in its office action response and recited by claims 4, 5, 10, and 11 in a manner consistent with Patent Owner’s description of “channel condition.” *See infra* Sections III.A.4.[4]- III.A.4.[5], III.C.4.[4]- III.C.4.[5].

III. THE CHALLENGED CLAIMS ARE UNPATENTABLE

A. GROUND A1: Claims 1-14 are obvious over Walton '269 and Li

1. Walton '269²

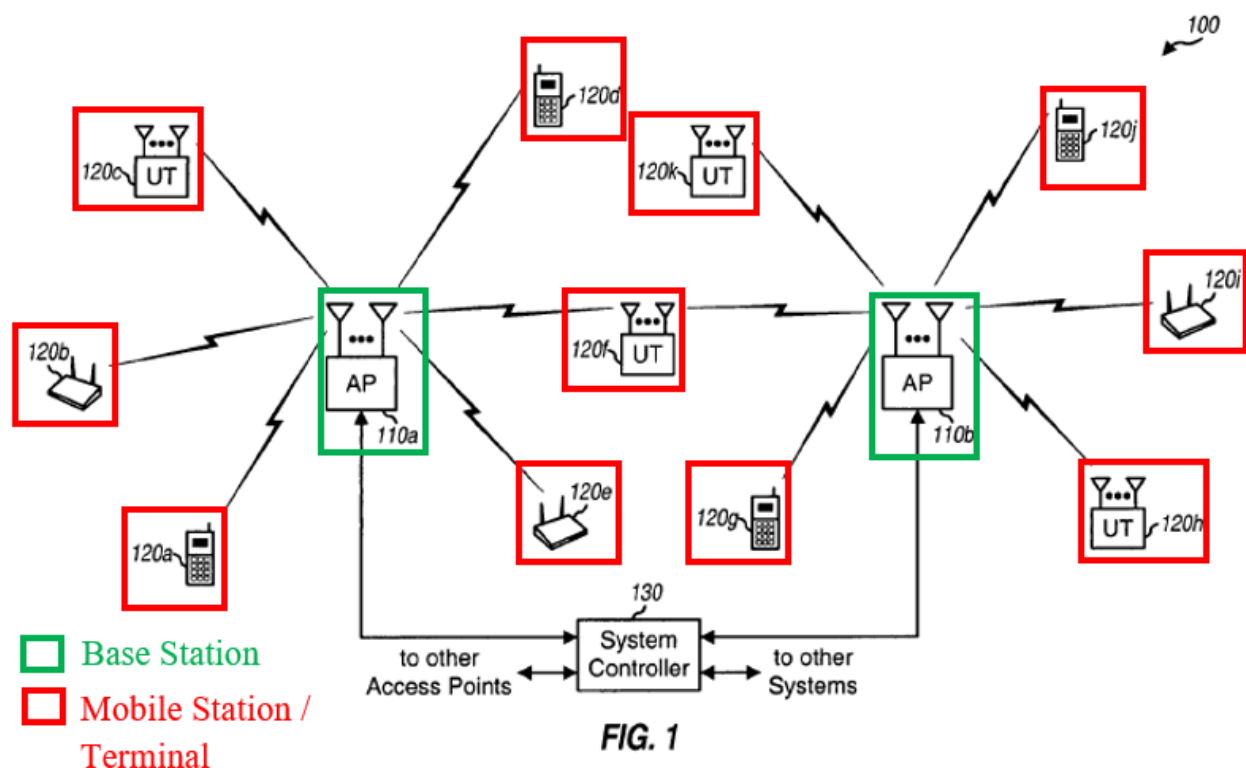
Walton '269 explains that in wireless communication systems, “a radio frequency (RF) modulated signal from a transmitter unit may reach a receiver unit via a number of propagation paths. The characteristics of the propagation paths typically vary over time due to a number of factors, such as fading and multipath. To provide diversity against deleterious path effects and improve performance, multiple transmit and receive antennas may be used.” EX-1006, 1:35-60; EX-1003, ¶[59].

One example of a wireless communication system disclosed by Walton '269 is a Wireless Local Area Network (WLAN) Multiple-Input, Multiple-Output Orthogonal Frequency Division Multiplexing (MIMO-OFDM) communication system that includes an access point/base station and user terminals. EX-1006, FIG. 1, 1:61-2:7, 1:25-35, 2:64-65; 3:24-58. The base station is configured to support multiple user terminals and can allocate downlink and uplink resources

² General descriptions provided for the references and combinations discussed in Section III are incorporated into each subsection addressing/applying those references, as are the discussions of combinations.

based on factors such as user terminal requirements and channel conditions. EX-1006, 1:61-2:7, 1:25-35; EX-1003, ¶[60]. For the downlink and uplink resources, a configurable channel structure can be used to signal system parameters and allocate resources (e.g., channel assignments). EX-1006, 2:8-36. Walton '269's method is directed to providing "more efficient control channel structure that is able to accommodate different users that may operate at different data rates" relative to earlier resource allocation methods, which tend to be inefficient by limiting the data rate for a forward control channel (FCCH) to the worst case user in the system even though other users could have operate at higher data rates. EX-1006, 2:8-41; EX-1003, ¶[61].

In more detail, Walton '269's FIG. 1 illustrates a MIMO-WLAN system with access points/base stations 110a, 110b in communication with user terminals (UTs) 120a-120k ("also referred to as [] mobile station[s].") EX-1006, 2:64-65; 3:24-58; EX-1003, ¶[62].



EX-1006, FIG. 1

In some implementations, the MIMO-WLAN system employs OFDM, which has the advantage of addressing frequency selective fading and inter-symbol interference (ISI) distortion. EX-1006, 4:55-6:45. The MIMO-WLAN OFDM system is used to perform a link adaptation method as described in more detail below with respect to features [1pre-1]-[1d] in Section III.A.4. EX-1003, ¶[63].

For example, after being alerted to a pending message to be downloaded from the base station, a terminal “estimates the downlink to obtain channel state information (CSI),” and uses the CSI to provide feedback information back to the base station. EX-1006, 8:4-26. The base station “uses the feedback information to

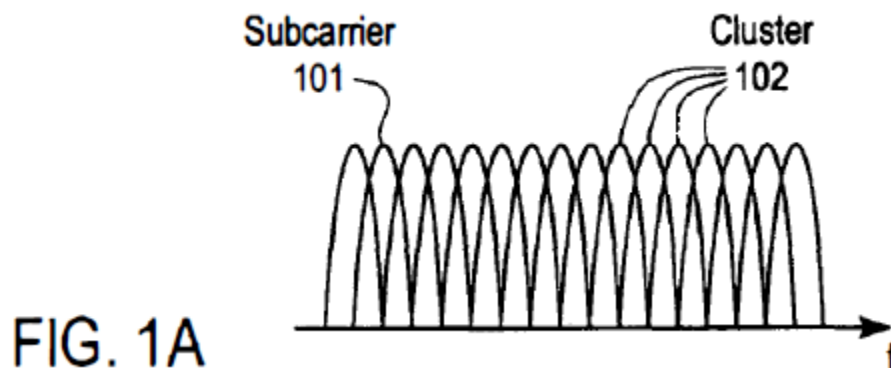
perform a number of functions such as (1) selecting a set of user terminals for data transmission on the downlink and uplink, (2) selecting the transmission rate(s) and the transmission mode for each selected user terminal, and (3) assigning the available FCH/RCH [(Forward Channel/Reverse Channel)] resources to the selected terminals.” EX-1006, 8:14-44. The base station then transmits a FCCH message with resource allocation control information to a mobile station over the FCCH channel. EX-1006, 8:44-9:10, 3:44-58, Abstract, 2:44-5. The base station may then transmit data, e.g., user-specific data, to the selected terminals using the FCH channel. EX-1006, 8:60-66, 10:30-43, 11:51-59; EX-1003, ¶[64].

2. Li

Li discloses that in OFDM communications, “a wide bandwidth is divided into multiple narrow-band subcarriers, which are arranged to be orthogonal with each other. The signals modulated on the subcarriers are transmitted in parallel.” EX-1007, 1:15-18, 1:31-34. Because of frequency-selective fading, uneven gains across subcarriers, and uncorrelated channels and subscribers, Li explains that “it is advantageous in an OFDMA system to adaptively allocate the subcarriers to subscribers so that each subscriber enjoys a high channel gain.” EX-1007, 1:48-50. However, earlier methods of using subcarriers in OFDM systems did not adequately address the problem of intercell interference. EX-1007, 1:54-63. To address this problem, Li discloses a reduced-complexity subcarrier allocation and

selection method. EX-1007, 2:8-18, 2:59-67; EX-1003, ¶[65].

Li's method utilizes a cluster of subcarriers, as shown in Li's FIG. 1A. EX-1007, 5:9-19, FIG. 1A (reproduced below).



EX-1007, FIG. 1A

Li's FIG. 1B illustrates a process for allocating subcarriers that can be integrated in wireless communication systems to effectively utilize subcarriers in the communication link. Li's process begins with a "base station periodically broadcast[ing] pilot OFDM symbols to every subscriber within its cell (or sector) (processing block 101)." EX-1007, 5:19-36, FIG. 1B (reproduced below); EX-1003, ¶¶[66]-[67].

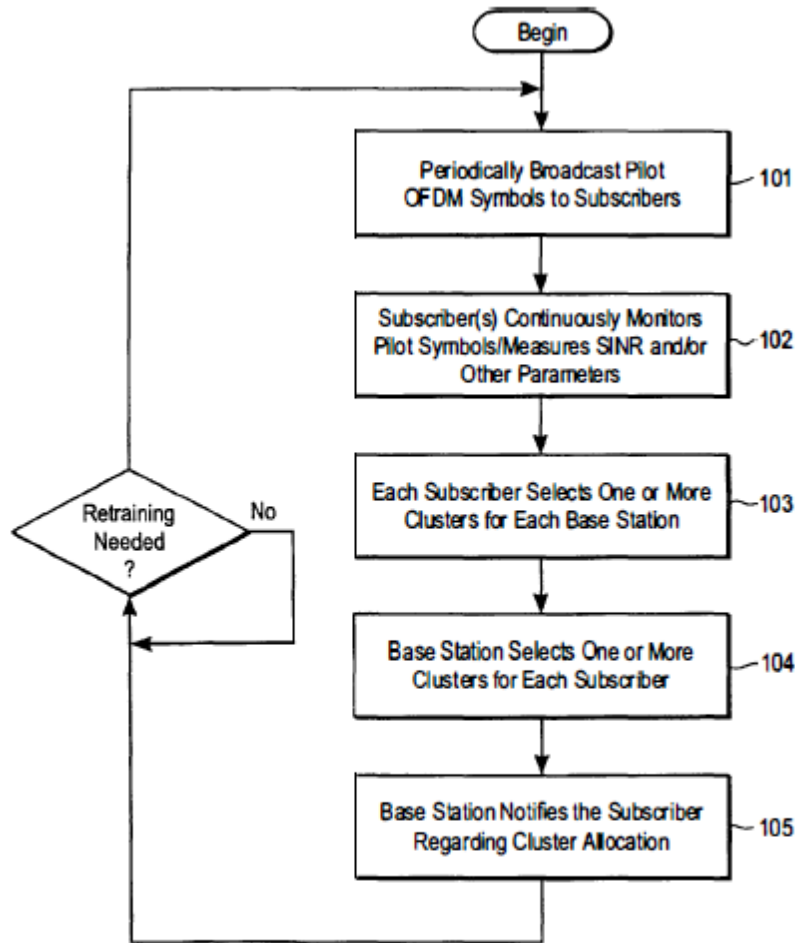


FIG. 1B

EX-1007, FIG. 1B

“[E]ach subscriber continuously monitors the reception of the pilot symbols and measures the SINR [(signal-to-interference plus noise ratio)] and/or other parameters, including inter-cell interference and intra-cell traffic, of each cluster (processing block 102). Based on this information, each subscriber selects one or more clusters with good performance (e.g., high SINR and low traffic loading) relative to each other and feeds back the information on these candidate clusters to

the base station through predefined uplink access channels (processing block 103).” EX-1007, 5:37-51. “Upon receiving the feedback from a subscriber, the base station further selects one or more clusters for the subscriber among the candidates (processing block 104). The base station may utilize additional information available at the base station, e.g., the traffic load information on each subcarrier, amount of traffic requests queued at the base station for each frequency band, whether frequency bands are overused, and how long a subscriber has been waiting to send information. The subcarrier loading information of neighboring cells can also be exchanged between base stations.” EX-1007, 6:9-19. “After cluster selection, the base station notifies the subscriber about the cluster allocation through a downlink common control channel or through a dedicated downlink traffic channel if the connection to the subscriber has already been established (processing block 105).” EX-1007, 6:21-26, 11:10-24, FIG. 13 (reproduced below); EX-1003, ¶[68].

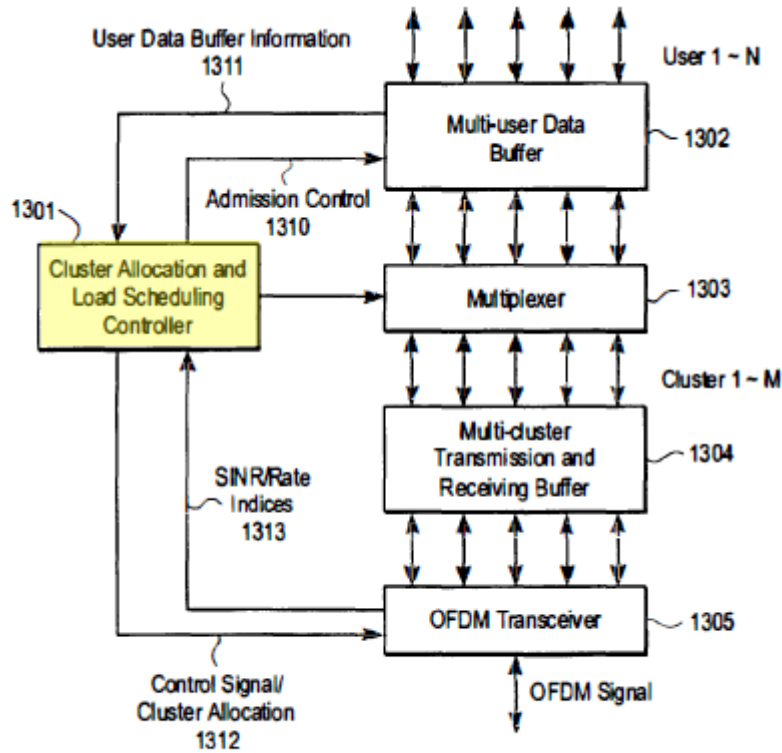


FIG. 13

EX-1007, FIG. 13

Li promotes categorizing the subcarrier clusters into two categories-namely coherence clusters and diversity clusters. EX-1007, 14:14-30. Coherence clusters may contain “multiple subcarriers close to each other” and would have been understood by a POSITA to be “localized subcarriers in the frequency domain.” EX-1007, 14:14-30; EX-1003, ¶[69]. Diversity clusters contain “multiple subcarriers with *at least some* of the subcarriers spread far apart over the spectrum” and would have been understood by a POSITA to be “distributed subcarriers.” EX-1007, 14:14-30. Examples of diversity and coherence clusters are shown in Li’s FIG. 9 (reproduced below) with frequencies labeled 1-8 representing the

diversity clusters, and the frequencies labeled 9-16 representing plain/coherence clusters. EX-1007, 14:31-44, FIG. 9; EX-1003, ¶[69].

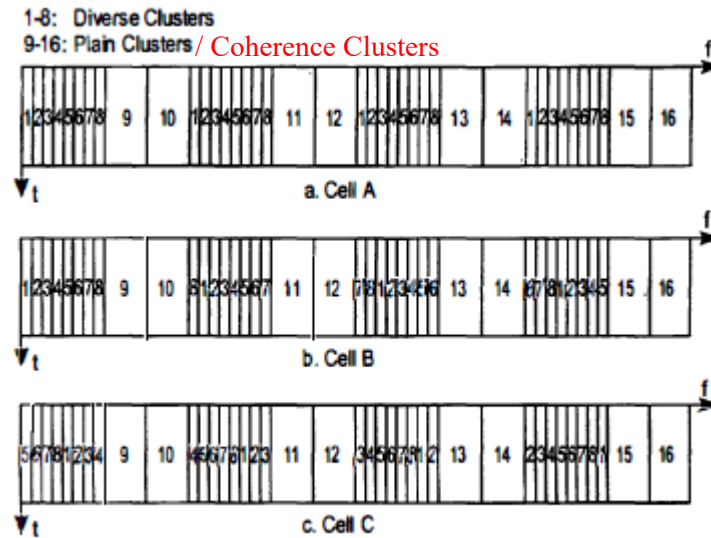


FIG. 9

EX-1007, FIG. 9

Li explains that coherence clusters may be selected by the base station when a mobile station is mobile or is not in a fixed position close to the edge of a cell. EX-1007, 16:8-19. When neither of these conditions is present, the base stations select diversity clusters. EX-1007, 16:8-19, FIG. 11 (reproduced below); EX-1003, ¶[70].

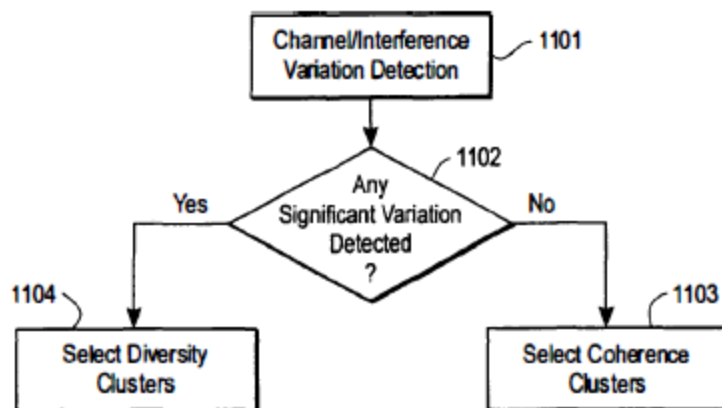


FIG. 11

EX-1007, FIG. 11

3. Combination of Walton '269 and Li

As explained above, Walton '269 discloses a system in which a base station serves a plurality of cells associated with mobile stations. EX-1006, 2:64-65; 3:24-58, FIG. 1. Li is directed to avoiding issues arising from a base station that serves multiple cells. EX-1007, 1:15-63. Specifically, to address intercell interference, for instance, Li encourages “adaptive[] allocat[ion of] the subcarriers to subscribers so that each subscriber enjoys a high channel gain.” EX-1007, 1:48-50. It would have been obvious for a POSITA to combine the teachings of Walton '269 with the teaching of Li to enable Walton '269's system to avoid intercell interference and benefit from higher channel gain. EX-1003, ¶[71].

For example, an obvious integration of Li into Walton '269 would have involved configuring Walton '269's to broadcast pilot OFDM symbols to the

mobile stations, and configuring the mobile stations to measure the SINR and/or other parameters upon receipt of the pilot signals and to select one or more clusters with good performance. EX-1007, 5:19-51, FIG. 1B; EX-1003, ¶[71]. Per Li, the selection information would have been fed back to the base station along with other information such as CSI, enabling Walton '269's base station to select the subcarrier clusters along with the transmission rate(s) and the transmission mode for each selected user terminal, and thus, to control allocation of FCH/RCH resources to selected terminals. EX-1006, 8:14-44, FIG. 3; EX-1003, ¶[71]. Then, per Li, information on the subcarrier selections would have been transmitted in the FCCH message along with other transmission parameters sent by the base station to the terminal. EX-1003, ¶[71]. Subsequently, the base station would be able to communicate with the mobile station using a subchannel configuration characterized by distributed subcarriers (e.g., diversity clusters) or localized subcarriers (e.g., coherence clusters). EX-1007, 14:14-30. As noted above, coherence clusters may be used when a mobile station is mobile or is not in a fixed position close to the edge of a cell. EX-1007, 16:8-19. When neither of these conditions is present, the base stations selects diversity clusters. EX-1007, 16:8-19, FIG. 11. Diversity clusters are also desirable to reduce inter-cell interference through interference averaging. EX-1007, 14:42-44, 5:53-64; EX-1003, ¶[71].

In this manner, the Walton '269-Li combination ("WLC") would have

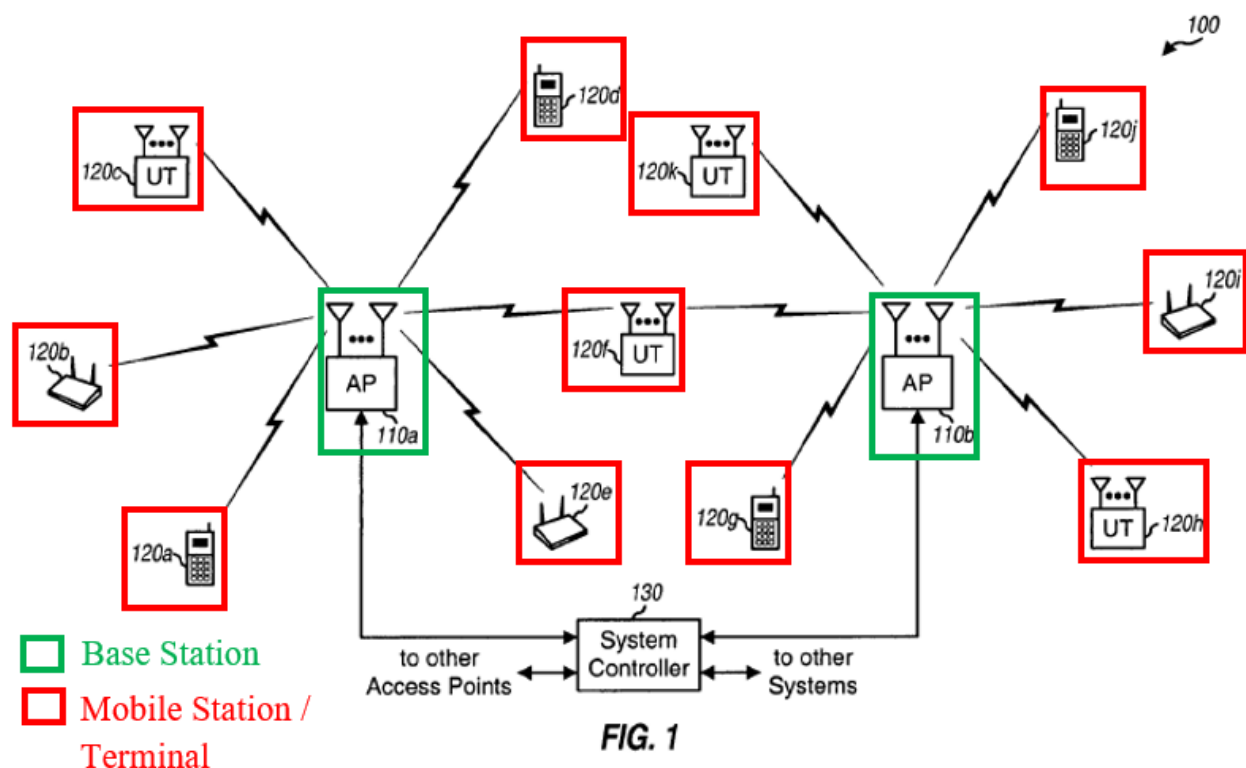
merely involved combining prior art elements (e.g., Li's subchannel configuration of diversity clusters and coherence clusters with Walton '269's system) according to known methods (Li's subcarrier allocation method) to yield predictable and foreseeable results and would have been an application of a known technique to a known system (Walton '269's system) ready for improvement (e.g., less intercell interference, higher channel gain). EX-1003, ¶[72]. A POSITA would have had a reasonable expectation of success in implementing WLC at least because Walton '269 and Li are related to similar methods and systems (i.e., OFDM WLAN communications between a base station and mobile stations using subchannels). EX-1003, ¶[72].

4. Manner in which the Prior Art Renders Claims 1-14 Obvious

The following sections describe how WLC renders claims 1-14 obvious.

[1pre-1]

As noted above in Section III.A.1 and to the extent the preamble is limiting, Walton '269 discloses a communication system that includes an *access point/base station 110a, 110b and user terminals/mobile stations 120a-120k*. EX-1006, 2:64-65; 3:24-58, FIG. 1 (reproduced below); EX-1003, ¶[89].



EX-1006, FIG. 1

The *base stations 110a, 110b serve the plurality of mobile stations 120a-120k* at least because they “act like hubs and/or routers and provide connectivity for” the mobile stations 120a-120k and may also allow the mobile stations 120a-120k access to LAN resources. EX-1006, 1:25-35. Furthermore, the base stations can provide the mobile stations with downlink transmissions including overhead data and user data intended for specific mobile stations. EX-1006, 3:44-58. In some implementations, Walton ’269’s *communication system is a MIMO-WLAN system that employs OFDM*. EX-1006, 4:55-6:45; EX-1003, ¶[90].

As shall become more evident in the subsequent sections (*see e.g.*, Sections

III.A.4.[1pre-2]-[5]), Walton '269's *base station performs a link adaptation method*. EX-1003, ¶[91]. For example, Walton '269's MIMO WLAN system is "configured to support various transmission modes," such as diversity mode and spatial multiplexing mode when communicating data across different types of transport channels. EX-1006, 4:55-5:32, 8:44-50. The transport channels include a Forward Channel (FCH) and a Forward Control Channel (FCCH), which is "[u]sed by the access point to allocate resources on the downlink and uplink." EX-1006, 8:55-66. In particular, a FCCH message "is used by the access point [(base station)] to convey the resource allocation information for the FCH" and "provide information *indicative of the assignment of FCH[] resources* for" a specific mobile station. EX-1006, 14:1-30. As shown below in Walton '269's Table VI, the FCCH message includes several parameters/fields such as an information element (IE) type field. EX-1006, 14:31-55. IE types are "defined for use *to allocate resources for different types of transmissions*." EX-1006, 14:31-55; EX-1003, ¶[91].

TABLE 6

FCCH Message		
Fields/ Parameter Names	Length (bits)	Description
N_IE	6	Number of IEs included in the FCCH message N_IE information elements, each including:
IE Type	4	IE type
MAC ID	10	ID assigned to the user terminal
Control Fields	48 or 72	Control fields for channel assignment
Padding Bits	Variable	Pad bits to achieve even number of OFDM symbols in the FCCH message
CRC	16	CRC value for the FCCH message
Tail Bits	6	Tail bits for convolutional encoder

EX-1006, 14:31-47

A POSITA would have understood that, in this and other processes undertaken to allocate resources for optimizing communications between the base station and mobile stations, the base station is performing a link adaptation method to adapt a communication link between the base station and one or more mobile stations. EX-1003, ¶[92]. The resource allocation is performed after the base station receives feedback information (indicative of channel state information) from the one or more mobile stations, as explained in more detail in [1b]. EX-1006, 8:14-44; EX-1003, ¶[92].

[1pre-2]

To the extent the preamble is limiting, Walton '269's *communication*

system utilizes a transmission structure in which a control channel is partitioned into a number of subchannels “each of which is operated at a specific data rate.” EX-1006, Abstract, 2:44-57, 19:60-21:34. Recall from [1pre-1] that Walton ’269’s system can use multiple channels including FCCH and FCH channels. Frame structures are defined for the transport channels, which can be configured according to different types of multiplexing, e.g., time division multiplexing (TDM), frequency division duplexing (FDD), or frequency division multiplexing (FDM). EX-1006, 9:27-62. Walton ’269’s Table 4 lists examples of different frame structures. EX-1003, ¶[94].

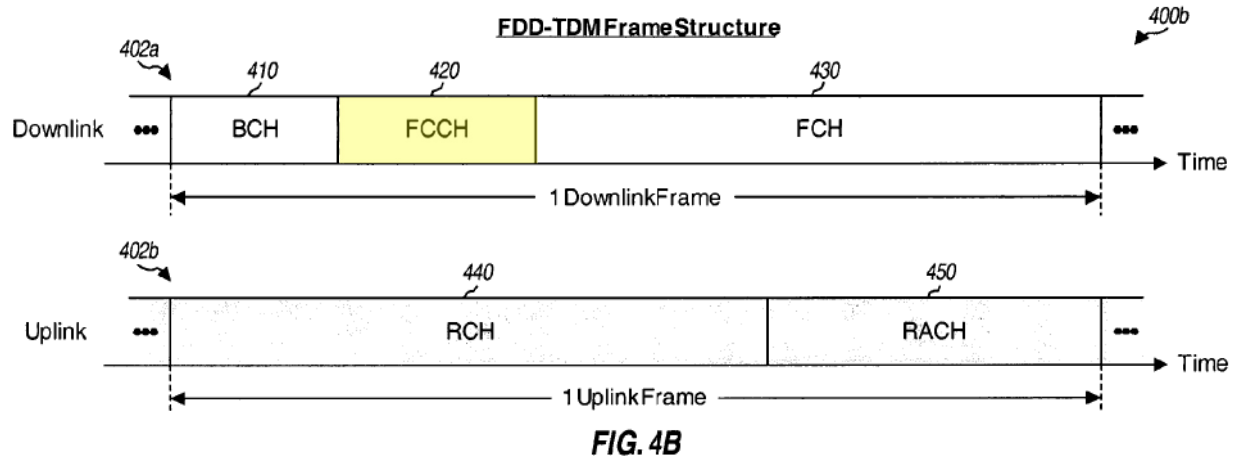
TABLE 4

	Shared frequency band for downlink and uplink	Separate frequency bands for downlink and uplink
Time division	TDD-TDM frame structure	FDD-TDM frame structure
Code division	TDD-CDM frame structure	FDD-CDM frame structure

EX-1006, 9:55-60

As shown below in Walton ’269’s FIG. 4B, when using a FDD-TDM frame structure, *channels are allocated respective time slots* for transmitting data across an uplink or a downlink. EX-1003, ¶[95]. In the FDD-TDM frame structure, *time slots in the time domain are allocated to certain channels and the channels occupy different subbands of the system bandwidth*. EX-1006, 9:27-62, 10:44-11:5, 5:43-6:9, FIG. 4B. In “FDM, each transport channel is assigned a different portion of the frequency band *for the link*.” EX-1006, 9:47-50. Accordingly,

Walton '269 discloses a “communication system utilizing a transmission structure with time slots in the time domain and frequency subchannels in the frequency domain.” EX-1003, ¶[95].



EX-1006, FIG. 4B

Walton '269's disclosure often refers to channels and subchannels in an interchangeable manner. EX-1003, ¶[96]. For instance, Walton '269 explains that a MIMO channel can be divided into multiple spatial channels. EX-1006, 4:21-42. When OFDM is employed, the overall system bandwidth (e.g., MIMO channel) is divided into orthogonal *subbands each of which is associated with a respective subcarrier and channel*. EX-1006, 5:33-6:9, 19:60-20:23. Although the channels associated with each subband would have been understood by a POSITA to be MIMO subchannels, Walton '269 discloses that “each spatial channel of each subband may [also] be viewed as an independent transmission channel.” EX-1006, 5:39-42; EX-1003, ¶[96].

The independent transmission control channels, such as the FCCH channel, can further be divided into subchannels. EX-1006, 8:35-52, FIG. 8. For instance, as shown in FIG. 7 (reproduced below), the FCCH channel can be divided into “4 distinct control channels” and these channels may “also [be] called control subchannel[s] or FCCH subchannel[s].” EX-1006, 19:35-42; EX-1003, ¶[97].

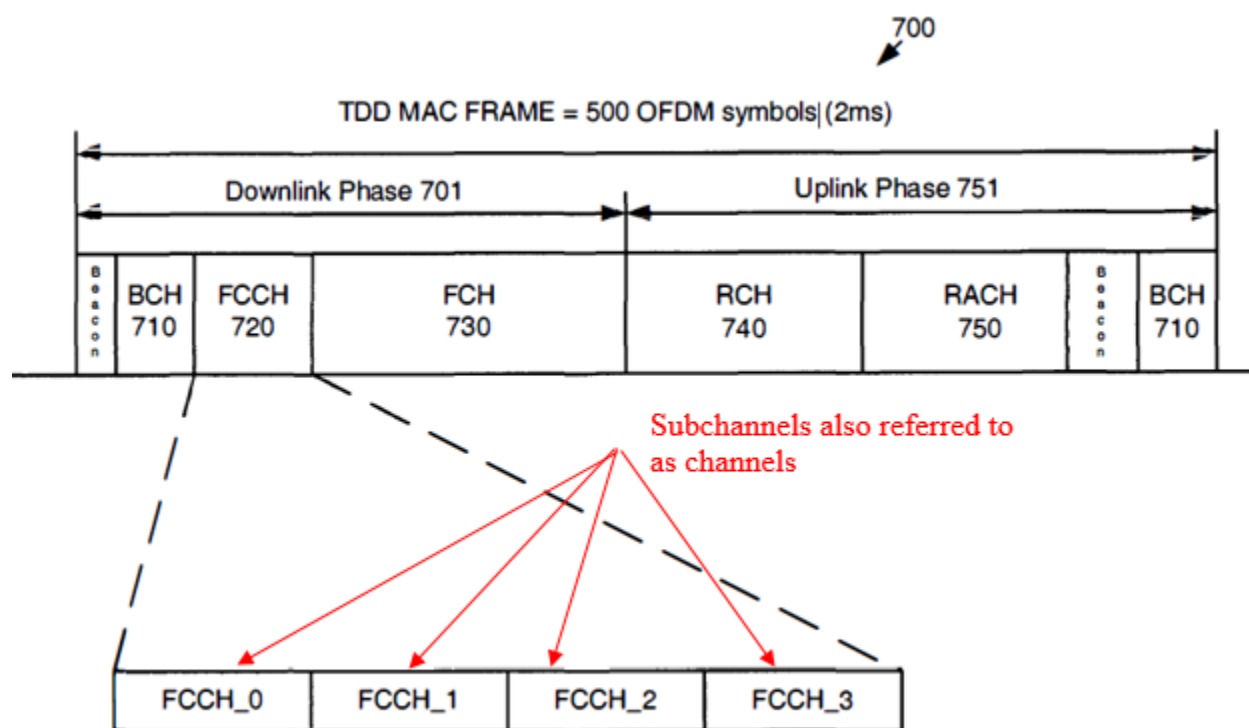


FIG. 7

EX-1006, FIG. 7

[1a]

As explained above in [1pre-1], Walton '269's base station *transmits a FCCH message (“control message”) with resource allocation control information to a mobile station over the FCCH channel (“control channel”).*

EX-1006, 8:44-9:10, 3:44-58. In particular, Walton '269 teaches that the FCCH message “is used by the access point/base station to convey the resource allocation information for the FCH” and “provide information indicative of the assignment of FCH/RCH resources for [a specific] user terminal.” EX-1006, 14:1-30. Table 6 describes the contents of the FCCH message which includes a number of information elements (IEs) and a MAC ID field that identifies the specific user terminal for which the IEs are intended. EX-1006, 14:1-31-61; EX-1003, ¶[101].

TABLE 6

FCCH Message		
Fields/ Parameter Names	Length (bits)	Description
N_IE	6	Number of IEs included in the FCCH message N_IE information elements, each including:
IE Type	4	IE type
MAC ID	10	ID assigned to the user terminal
Control Fields	48 or 72	Control fields for channel assignment
Padding Bits	Variable	Pad bits to achieve even number of OFDM symbols in the FCCH message
CRC	16	CRC value for the FCCH message
Tail Bits	6	Tail bits for convolutional encoder

EX-1006, 14:30-47

[1b]

Walton '269's base station relies on information that is fed back from a user terminal/mobile station to configure a control message that controls how subsequent data is transmitted from the base station to the user terminal/mobile station over a frequency subchannel and in a time slot. In particular, the base

station receives feedback information (indicative of channel state information) from a user terminal/mobile station and then “uses the feedback information to perform a number of functions such as (1) selecting a set of user terminals for data transmission on the downlink and uplink, (2) selecting the transmission rate(s) and the transmission mode for each selected user terminal, and (3) assigning the available FCH/RCH resources to the selected terminals.” EX-1006, 8:14-44.

As explained above in [1a], the assigning/allocation of available FCH/RCH resources (item (3) above) is performed using a FCCH message (“*control message*”) that is transmitted over the FCCH channel. EX-1006, 14:1-15:43.

Walton '269's Table 6 lists the *fields/transmission parameters in a FCCH message* which include, e.g., a user terminal/mobile station ID and control fields for the link between the identified user terminal/mobile station and the base station. EX-1006, 14:30-47. The FCCH message also includes an assignment of a transmission parameter such as the IE type, which indicates a particular type of transmission mode, e.g., Diversity, Spatial, Beam Steering, etc. (*see* Table 7). EX-1006, 15:5-27; EX-1003, ¶¶[104]-[105].

TABLE 6

“control message
contains
transmission
parameters
allocated to the
mobile station”

FCCH Message		
Fields/ Parameter Names	Length (bits)	Description
N_IE	6	Number of IEs included in the FCCH message N_IE information elements, each including:
IE Type	4	IE type
MAC ID	10	ID assigned to the user terminal
Control Fields	48 or 72	Control fields for channel assignment
Padding Bits	Variable	Pad bits to achieve even number of OFDM symbols in the FCCH message
CRC	16	CRC value for the FCCH message
Tail Bits	6	Tail bits for convolutional encoder

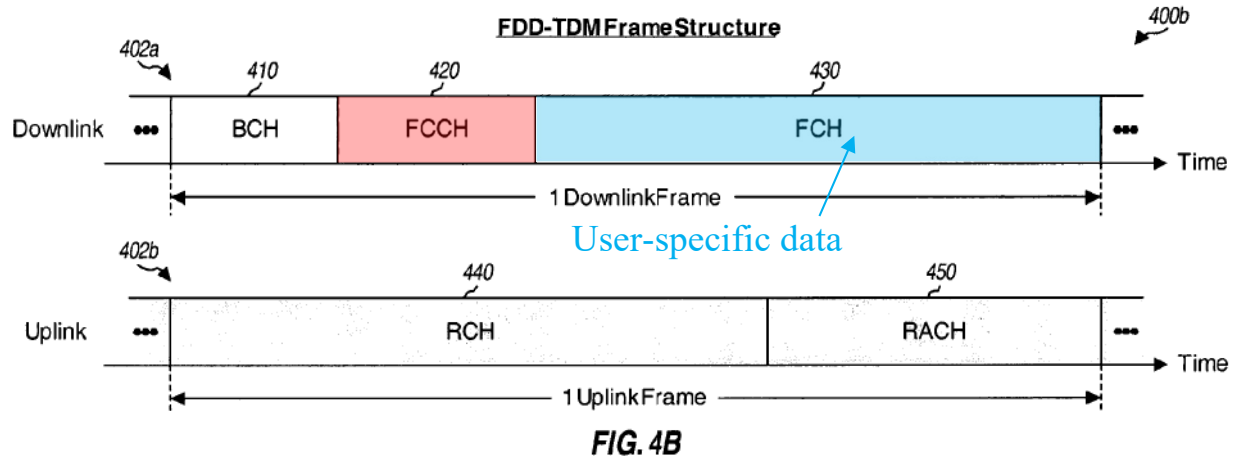
TABLE 7

FCCH IE Types			
IE Type	IE Size (bits)	IE Type	Description
0	48	Diversity Mode	Diversity mode only
1	72	Spatial Multiplexing Mode	Spatial multiplexing mode - variable rate services
2	48	Idle Mode	Idle state - variable rate services
3	48	RACH Acknowledgment	RACH acknowledgment - diversity mode
4		Beam Steering Mode	Beam steering mode
5-15	—	Reserved	Reserved for future use

EX-1006, 14:30-47 (Table 6); 15:13-27 (Table 7)

Walton '269 also explains that *after the FCCH message is sent, user-specific data is transmitted over the FCH channel*. EX-1006, 11:37-60, 10:30-43, 8:60-65. Indeed FIG. 4B (reproduced below) indicates the same and depicts a frame structure in which data transmissions in *the FCH channel are scheduled for a time slot after the FCCH channel time slot* (“for a subsequent transmission of

data by the base station over a frequency subchannel to the mobile station in a time slot"). EX-1003, ¶[106].



EX-1006, FIG. 4B

As explained above in [1pre-2], transport control channels, such as the FCH channel, may also be understood by a POSITA to be *a frequency subchannel* as the FCH channel has its own associated subband and is a subchannel of the overall MIMO channel. EX-1006, 5:33-6:9, 19:60-20:23; EX-1003, ¶[107].

[1c]

Walton '269's *FCCH message includes transmission parameters that specify the transmission modes and other link features* to be used for communications with specific terminals. The transmission modes include an *antenna transmission scheme such as the Diversity mode, Spatial multiplexing mode, and Beam Steering mode*, which involve multiple antennas communicating

in a MIMO WLAN system (“*a MIMO scheme*”). EX-1003, ¶[111]. The *transmission parameters also indicate a corresponding subchannel configuration* by specifying features such as the rate, offset, preamble size for allocating resources and configuring the FCH and RCH channels/subchannels. EX-1006, 15:5-17:67; EX-1003, ¶[111].

In more detail and as explained in [1pre-1]-[1b], Walton ’269’s FCCH message (“*control message*”) includes *mobile station-specific transmission parameters that indicate an antenna transmission scheme and a corresponding subchannel configuration*. EX-1003, ¶[112]. Walton ’269’s Table 6 describes the fields or parameters of a FCCH message, which includes the IE type to be used for the FCCH channel. EX-1006, 14:31-47.

TABLE 6		
FCCH Message		
Fields/ Parameter Names	Length (bits)	Description
N_IE	6	Number of IEs included in the FCCH message N_IE information elements, each including:
IE Type	4	IE type
MAC ID	10	ID assigned to the user terminal
Control Fields	48 or 72	Control fields for channel assignment
Padding Bits	Variable	Pad bits to achieve even number of OFDM symbols in the FCCH message
CRC	16	CRC value for the FCCH message
Tail Bits	6	Tail bits for convolutional encoder

EX-1006, 14:31-47

Table 7 shows that the IE types include a diversity transmission mode, a spatial multiplexing mode, a RACH acknowledgement diversity mode, or a beam steering mode. EX-1006, 15:5-65; EX-1003, ¶[113].

TABLE 7			
FCCH IE Types			
IE Type	IE Size (bits)	IE Type	Description
0	48	Diversity Mode	Diversity mode only
1	72	Spatial Multiplexing Mode	Spatial multiplexing mode - variable rate services
2	48	Idle Mode	Idle state - variable rate services
3	48	RACH Acknowledgment	RACH acknowledgment - diversity mode
4		Beam Steering Mode	Beam steering mode
5-15	—	Reserved	Reserved for future use

EX-1006, 15:13-27

Tables 8 and 12 include different link features (e.g., rate, offset, preamble size) of IE Type 0 (Diversity mode), IE Type 1 (Spatial multiplexing mode), and IE Type 4 (Beam steering mode), respectively. EX-1006, 15:5-65, 17:1-60; EX-1003, ¶[114].

TABLE 8

FCCH IE Type 0 and 4		
Fields/ Parameter Names	Length (bits)	Description
IE Type	4	IE type
MAC ID	10	Temporary ID assigned to the user terminal
FCH Offset	9	FCH offset from start of the TDD frame (in OFDM symbols)
FCH Preamble Type	2	FCH preamble size (in OFDM symbols)
FCH Rate	4	Rate for the FCH
RCH Offset	9	RCH offset from start of the TDD frame (in OFDM symbols)
RCH Preamble Type	2	RCH preamble size (in OFDM symbols)
RCH Rate	4	Rate for the RCH
RCH Timing Adjustment	2	Timing adjustment parameter for RCH
RCH Power Control	2	Power control bits for RCH

TABLE 12

FCCH IE Type 1		
Fields/ Parameter Names	Length (bits)	Description
IE Type	4	IE type
MAC ID	10	Temporary ID assigned to the user terminal
FCH Offset	9	FCH offset from end of FCCH (in OFDM symbols)
FCH Preamble Type	2	FCH preamble size (in OFDM symbols)
FCH Spatial Channel 1 Rate	4	Rate for the FCH for spatial channel 1
FCH Spatial Channel 2 Rate	4	Rate for the FCH for spatial channel 2
FCH Spatial Channel 3 Rate	4	Rate for the FCH for spatial channel 3
FCH Spatial Channel 4 Rate	4	Rate for the FCH for spatial channel 4
RCH Offset	9	RCH offset from end of FCH (in OFDM symbols)
RCH Preamble Type	2	RCH preamble size (in OFDM symbols)

EX-1006, 15:45-65 (Table 8); 17:6-38 (Table 12)

Walton '269's Tables 1 and 2 indicate that the Diversity, Beam-steering, and Spatial Multiplexing modes involve multiple antennas and/or subbands. EX-1006, 4:55-6:9. For example, in the Diversity mode, multiple antennas can be configured to redundantly transmit data. EX-1006, 15:12-65; EX-1003, ¶[115].

TABLE 1

Transmission modes	Description
SIMO	Data is transmitted from a single antenna but may be received by multiple antennas for receive diversity.
Diversity	Data is redundantly transmitted from multiple transmit antennas and/or multiple subbands to provide diversity.
Beam-steering	Data is transmitted on a single (best) spatial channel at full power using phase steering information for the principal eigenmode of the MIMO channel.
Spatial multiplexing	Data is transmitted on multiple spatial channels to achieve higher spectral efficiency.

TABLE 2

Transmission modes	Downlink		Uplink	
	Single-antenna user terminal	Multi-antenna user terminal	Single-antenna user terminal	Multi-antenna user terminal
MISO (on downlink)/SIMO (on uplink)	X	X	X	X
Diversity	X	X		X
Beam-steering	X	X		X
Spatial multiplexing		X		X

EX-1006, 15:12-65

Accordingly, Walton '269's FCCH message includes mobile station-specific transmission parameters that indicate the antenna transmission scheme such as the Diversity mode Spatial multiplexing mode, and Beam Steering mode, and a

corresponding subchannel configuration by specifying features such as the rate, offset, preamble size for allocating resources and configuring the FCH and RCH channels/subchannels. EX-1006, 15:5-17:67; EX-1003, ¶[116].

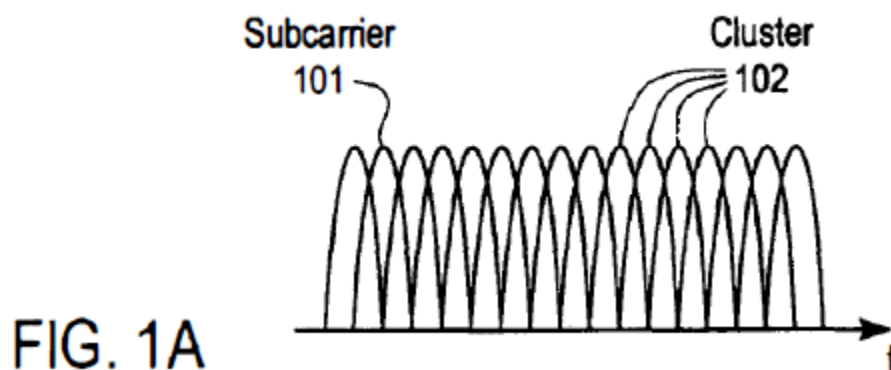
[1c-1]

See supra [1c]; EX-1003, ¶[119].

[1c-2]

Walton '269 teaches that the frequency *channels have subbands* and that “each subband is associated with a *respective subcarrier* that may be modulated with data. For a MIMO system that utilizes OFDM, each spatial channel of each subband may be viewed as an independent transmission channel.” EX-1006, 5:32-43. Li, like Walton '269, teaches that “[i]n OFDM, a wide bandwidth is divided into multiple narrow-band subcarriers, which are arranged to be orthogonal with each other. The signals modulated on the subcarriers are transmitted in parallel.” EX-1007, 1:15-18, 1:31-34. Because of frequency-selective fading, uneven gains across subcarriers, and uncorrelated channels and subscribers, Li explains that “it is advantageous in an OFDMA system to adaptively allocate the subcarriers to subscribers so that each subscriber enjoys a high channel gain.” EX-1007, 1:48-50. A POSITA would have combined the teachings of Walton '269 and Li to obtain the above-noted benefits in the manner described above in Section III.A.3. EX-1003, ¶[125].

As explained above in Section III.A.2, Li discloses using a ***cluster of subcarriers in the frequency domain***. EX-1007, 5:9-19, FIG. 1A (reproduced below).



EX-1007, FIG. 1A

Li's subcarrier clusters can include: 1) coherence clusters, which contain “multiple subcarriers close to each other” and would have been understood by a POSITA to be “***localized subcarriers in the frequency domain***”; and 2) diversity clusters, which contain “multiple subcarriers with at least some of the subcarriers spread far apart over the spectrum” and would have been understood by a POSITA to be “***distributed subcarriers.***” EX-1007, 14:14-30; *see supra* Section III.A. 2; EX-1003, ¶¶[126]-[127]. Examples of diversity and coherence clusters are shown in Li's FIG. 9 (reproduced below) ***with frequencies labeled 1-8 representing the diversity clusters (“distributed subcarriers”), and the frequencies labeled 9-16 representing coherence/plain clusters (“localized subcarriers”).*** EX-1007, 14:31-44, FIG. 9; EX-1003, ¶[127].

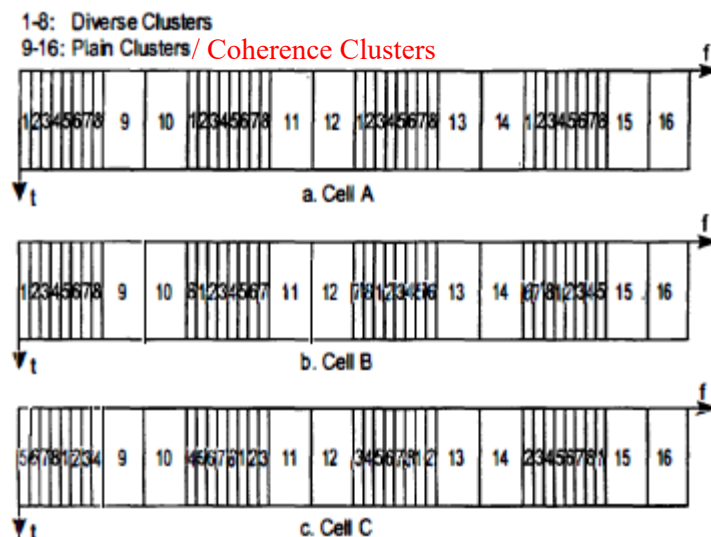


FIG. 9

EX-1007, FIG. 9

Accordingly, it would have been obvious to a POSITA that, in WLC, frequency subbands in Walton '269 can be configured and characterized according to Li's diversity clusters or coherence clusters (*"subchannel configuration characterized by distributed subcarriers or localized subcarriers in the frequency domain"*). EX-1006, 5:32-43; EX-1007, 14:14-44, FIG. 9; EX-1003, ¶[128].

[1d]

As noted above in [1b], the transmission parameters included in Walton '269's FCCH message indicate a corresponding subchannel configuration for communication with a particular mobile station by allocating resources and features such as the rate, offset, preamble size and configuring the FCH and RCH subchannels/channels. EX-1006, 15:5-17:67. In particular, the FCCH message "carries resource allocation (e.g., channel assignment) information indicative of

which user terminal(s) are designated to receive downlink data on the FCH and which user terminal(s) are designated to transmit uplink data on the RCH within the current TDD frame.” EX-1006, 8:55-60, 10:30-43, 14:24-21:33. The FCH subchannel/channel allocated to a specific user terminal can then be used to transmit user-specific data to the specific user terminal. EX-1006, 11:33-60. Indeed, as shown in Walton ’269’s FIG. 4B and FIG. 5 below, data is sent in the FCH after any FCCH data transmission. EX-1003, ¶[133].

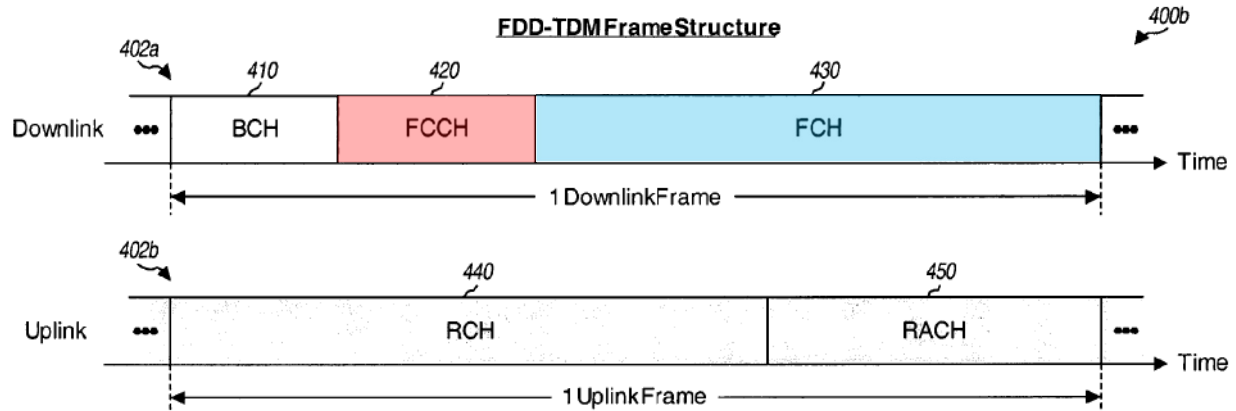


FIG. 4B

EX-1006, FIG. 4B

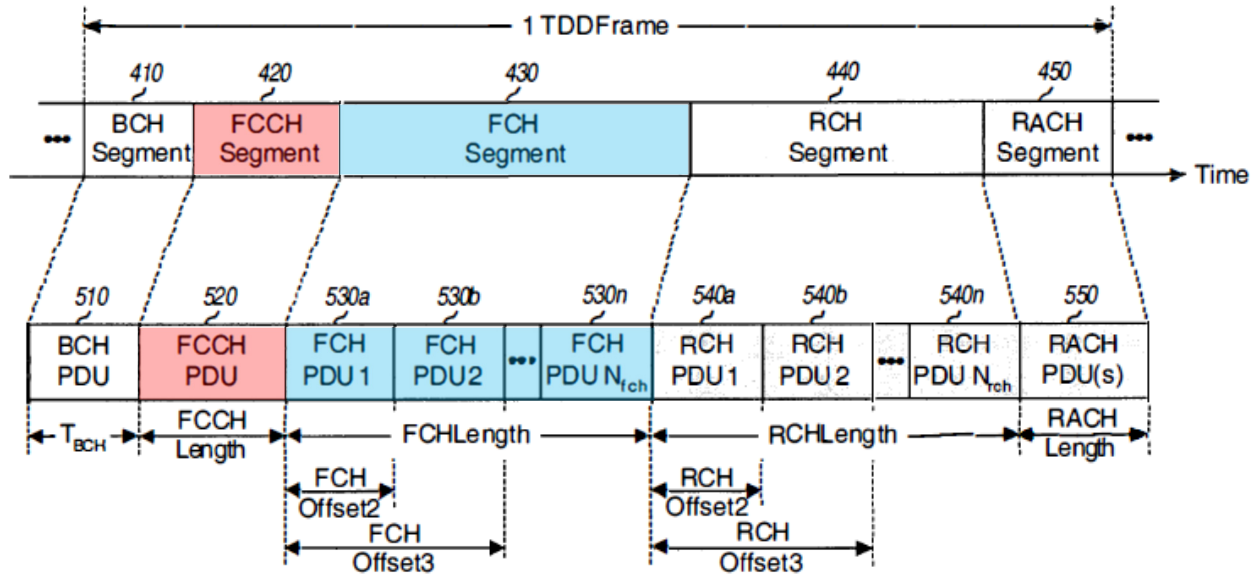


FIG. 5

EX-1006, FIG. 5

Accordingly, it would have been obvious to a POSITA that WLC renders obvious “*transmitting a data packet [(such as a FCH PDU including user-specific data)] to the mobile station over the frequency subchannel [(FCH channel)] in accordance with the mobile station-specific transmission parameters.*” EX-1003, ¶[134].

[2]

As shown in Li’s FIG. 1B (reproduced below), pilot OFDM symbols are broadcast to subscribers for training purposes when training is needed. EX-1007, FIG. 1B, 6:55-67; EX-1003, ¶[136].

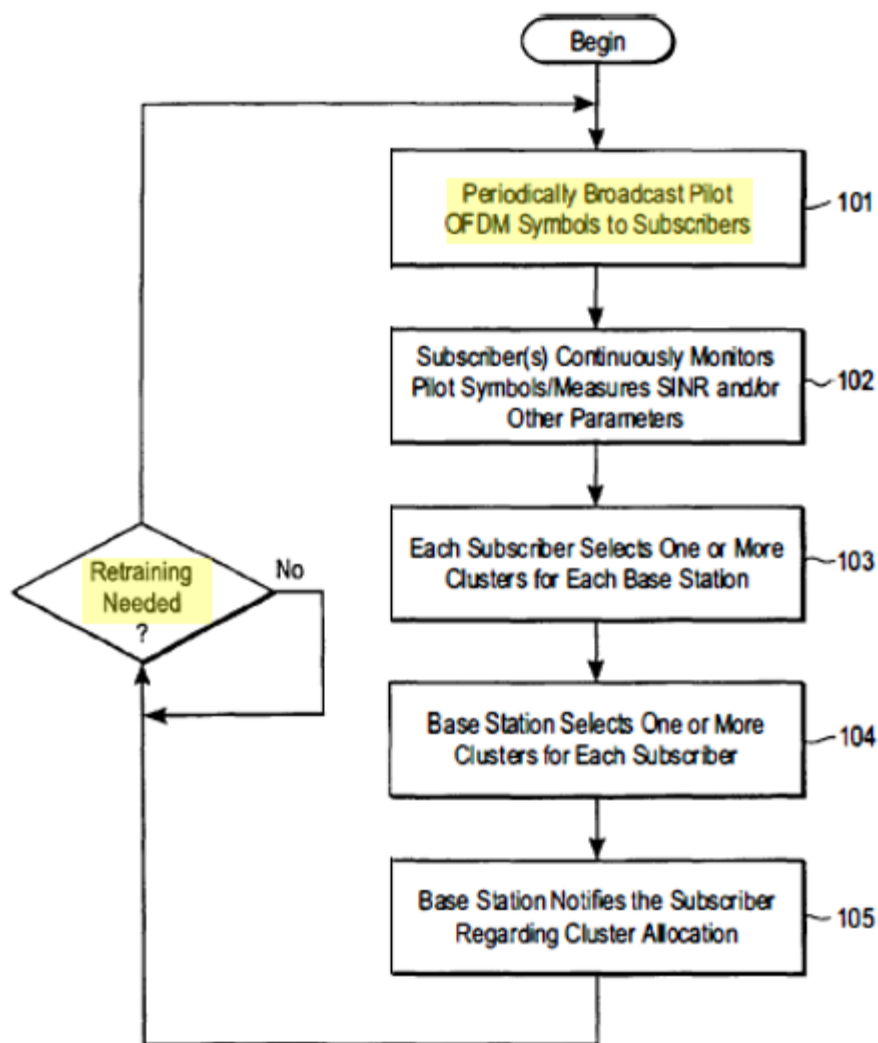


FIG. 1B

EX-1007, FIG. 1B

“The pilot symbols can serve multiple purposes: time and frequency synchronization, channel estimation and signal-to-interference/noise (SINR) ratio measurement for cluster allocation.” EX-1007, 5:32-36. “The pilot symbols may be different for different cells (or sectors).” EX-1007, 5:32-34. A POSITA would have understood that Li’s broadcast pilot symbols would have had a “pilot pattern”

and that the patterns could be adjusted based on the purpose of the pilot symbols, e.g., time and frequency synchronization for a particular mobile station in a cell. (note: the claims do not recite/require any specific pattern associated with the “training pilot pattern”). EX-1003, ¶[137]. Moreover, as indicated in Section III.A.3, it would have been obvious to a POSITA that Li’s training pilot pattern would have been included as part of the mobile station-specific transmission parameters in the control message that is sent to a subscriber/mobile station. EX-1003, ¶[137]. A receiving subscriber/mobile station would have demodulated the received signals with training pilot patterns and performed channel estimation based on the training pilot patterns. EX-1007, 5:26-6:21; EX-1003, ¶[137].

[3]

Walton ‘269 explicitly discloses an indication of “power control information.” As noted above in [1a] and [1b], Table 6 describes the contents of the FCCH message (“*control message*”), which includes a number of information elements (IEs) that identify various transmission modes, e.g., Diversity, Spatial, etc. (*see* Table 7). EX-1006, 14:1-55, 15:5-27. TABLE 1 reveals that when the transmission mode noted in the FCCH message is “Beam-steering,” data is to be transmitted at full power. EX-1006, 5:1-10; EX-1003, ¶[139].

5

TABLE 1-continued

Transmission modes	Description
Beam-steering	Data is transmitted on a single (best) spatial channel at full power using phase steering information for the principal eigenmode of the MIMO channel.
Spatial multi-plexing	Data is transmitted on multiple spatial channels to achieve higher spectral efficiency.

EX-1006, 5:1-10

With respect to the types of information elements (IEs) included in a FCCH message, TABLE 8 reveals that the 48 bits of FCCH IE Type 0 and IE Type 4 include power control bits for the uplink RCH Power Control. EX-1006, 14:24-16:4. The mapping of the values of the RCH power control bits is explained in TABLE 11. EX-1006, 16:45-55. For example, the “00” value for the RCH power control bits indicates that the current transmit power should be maintained. EX-1006, 16:45-55; EX-1003, ¶[140].

TABLE 8

FCCH IE Type 0 and 4		
Fields/ Parameter Names	Length (bits)	Description
IE Type	4	IE type
MAC ID	10	Temporary ID assigned to the user terminal
FCH Offset	9	FCH offset from start of the TDD frame (in OFDM symbols)
FCH Preamble Type	2	FCH preamble size (in OFDM symbols)
FCH Rate	4	Rate for the FCH
RCH Offset	9	RCH offset from start of the TDD frame (in OFDM symbols)
RCH Preamble Type	2	RCH preamble size (in OFDM symbols)
RCH Rate	4	Rate for the RCH
RCH Timing Adjustment	2	Timing adjustment parameter for RCH
RCH Power Control	2	Power control bits for RCH

The RCH Power Control field includes two bits used to adjust the transmit power of the uplink transmission from the identified user terminal. This power control is used to reduce interference on the uplink. Table 11 lists the values for the RCH Power Control field the associated actions.

TABLE 11

RCH Power Control		
Bits	Description	
00	Maintain current transmit power	
01	Increase uplink transmit power by δ dB, where δ is a system parameter.	
10	Decrease uplink transmit power by δ dB, where δ is a system parameter.	
11	Not used	

EX-1006, 15:45-16:55

Accordingly, it would have been obvious to a POSITA that the mobile station-specific transmission parameters, such as the transmission modes and FCCH IE Type 0 and 4, in Walton '269's FCCH message ("***control message***") indicate power control information. EX-1003, ¶[141].

[4]

As explained above in [1b], Walton '269's base station receives feedback information (indicative of channel state information) from a user terminal/mobile station and then "assign[s] the available FCH/RCH resources to the selected terminals." EX-1006, 8:14-44, FIG. 3. As explained above in [1c], the allocation of FCH/RCH resources includes allocating the antenna transmission scheme. *See supra* [1c] (citing to EX-1006, 15:5-17:67, 4:55-6:9).

It would have been obvious to or understood by a POSITA that channel station information includes channel condition. EX-1003, ¶[145]. Indeed, Walton '269 explicitly discloses that "[t]he allocation of downlink and uplink resources **may be dependent on** the requirements of the user terminals, **the channel conditions**, and other factors." (Emphasis added). EX-1006, 2:4-7; EX-1003, ¶[145].

[5]

Walton '269 explicitly discloses that “[t]he allocation of downlink and uplink resources may be dependent on the requirements of the user terminals, the channel conditions, and other factors.” EX-1006, 2:4-7. As explained above in [1b], Walton '269's base station receives feedback information (indicative of channel state information) from a user terminal/mobile station and then “assign[s] the available FCH/RCH resources to the selected terminals.” EX-1006, 8:14-44, FIG. 3. As explained above in [1c], the allocation of resources and configuring of FCH/RCH channels/subchannels includes subchannel configuration. *See supra* [1c], [1c-2] (citing to EX-1006, 5:32-43; Li at 1:13-63, 2:8-18, 5:9-27, 11:10-24, 14:14-44, 16:8-19, and FIGS. 1A, 1B, 9, 13). It would have been obvious to or understood by a POSITA that channel state information includes channel condition. EX-1003, ¶[147]. Indeed, as noted above, Walton '269 discloses that “[t]he allocation of downlink and uplink resources may be dependent on the requirements of the user terminals, the channel conditions, and other factors.” (Emphasis added). EX-1006, 2:4-7; EX-1003, ¶[147].

[6pre-1]

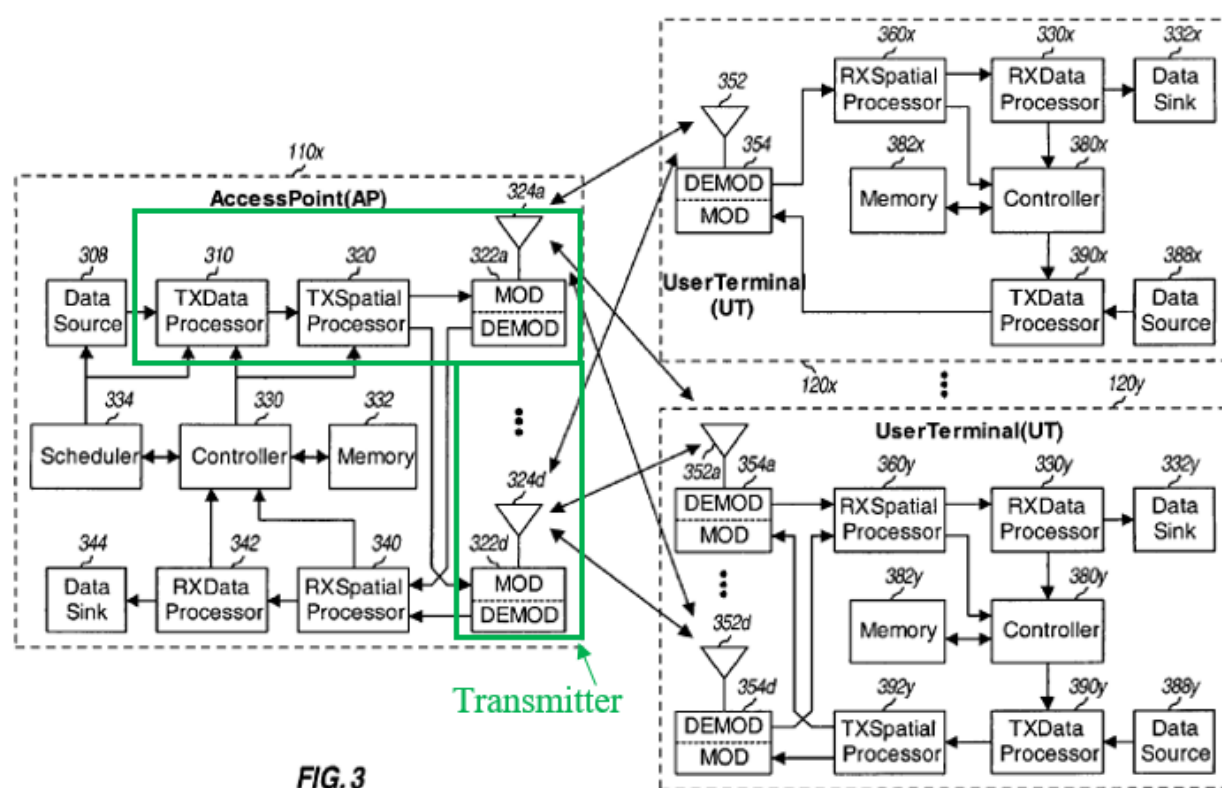
See supra [1pre-1]; EX-1003, ¶[150].

[6pre-2]

See supra [1pre-1] ; EX-1003, ¶[151].

[6pre-3]

To the extent the preamble is limiting, Walton '269 discloses that its base station includes a **transmitter** that includes various components such as processors 310, 320, and antennas 324a-324d. EX-1006, 7:49-60, FIG. 3 (reproduced below). The antennas are used to send downlink data using the BCH, FCCH, and FCH channels to mobile stations. EX-1006, 9:12-14; EX-1003, ¶[152].



EX-1006, FIG. 3³

³ For ease of understanding, green rectangles have been used to depict some transmitter components. Certain components, such as the demodulator, are located

[6a]

See supra [1a]; EX-1003, ¶[154].

[6b]

See supra [1b]; EX-1003, ¶[155].

[6c]

See supra [1c]; EX-1003, ¶[156].

[6c-1]

See supra [1c-1]; EX-1003, ¶[157].

[6c-2]

See supra [1c-2]; EX-1003, ¶[158].

[6d]

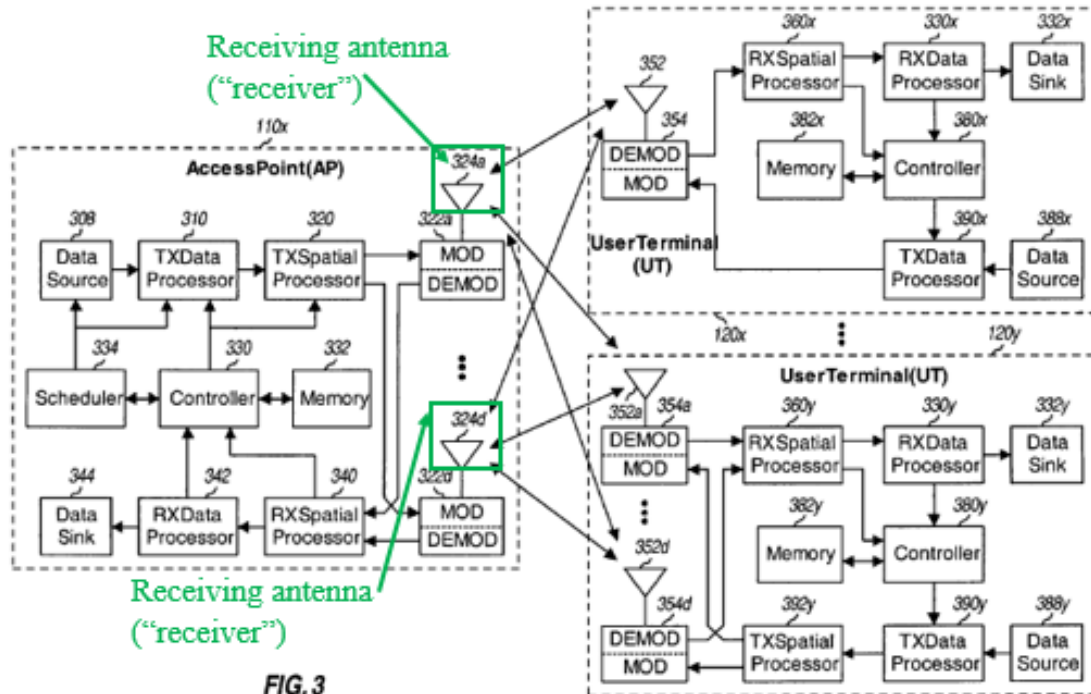
See supra [1d]; EX-1003, ¶[159].

[7]

Walton '269 teaches that each mobile station “estimates the downlink to ***obtain channel state information (CSI). The CSI*** may include channel response estimates, [and] received SNRs.” EX-1006, 8:13-27. ***Feedback information is generated based on the CSI and sent to the base station.*** EX-1006, 8:13-27.

within the green rectangles but are not part of the transmitter. These components operate as part of the receiver.

Although Walton '269 does not explicitly state that the CSI is part of the feedback information transmitted to the base station, a POSITA would have understood that CSI is part of the feedback information transmitted to and received by the base station. EX-1003, ¶[160]. This *feedback information is received by one or more antenna(s) 324 ("receiver") at the base station* and used to “perform a number of functions such as (1) selecting a set of user terminals for data transmission on the downlink and uplink, (2) selecting the transmission rate(s) and the transmission mode for each selected user terminal, and (3) assigning the available FCH/RCH resources to the selected terminals.” EX-1006, 8:27-44, FIG. 3 (reproduced below); EX-1003, ¶[160].



EX-1006, FIG. 3

[8pre-1]

See supra [1pre-1].

[8pre-2]

See supra [1pre-2].

[8a]

See supra [1a] EX-1003, ¶[164].

[8b]

See supra [1b]; EX-1003, ¶[165].

[8c]

See supra [1c]; EX-1003, ¶[166].

[8c-1]

See supra [1c-1]; EX-1003, ¶[167].

[8c-2]

See supra [1c-2]; EX-1003, ¶[168].

[8d]

See supra [1d]; EX-1003, ¶[169].

[9]

See supra [2]; EX-1003, ¶[170].

[10]

See supra [3]; EX-1003, ¶[171].

[11]

As a preliminary matter, the features recited in claim 11 (e.g., “the MIMO scheme *is for* improving transmission throughput”) are directed to an intended use of the MIMO scheme and therefore should not have any patentable weight.

Boehringer Ingelheim Vetmedica, Inc. v. Schering-Plough Corp., 320 F.3d 1339, 1345 (Fed. Cir. 2003) (intended use will not limit the scope of the claim because it merely defines a context in which the invention operates). However, even if claim 11 is given patentable weight, the prior art references render it obvious.

For example, Walton '269's MIMO WLAN system is “employed to attain high throughput and combat deleterious path effects.” EX-1006, 1:61-2:7. As explained above in [1b], Walton '269's base station receives feedback information (indicative of channel state information) from a user terminal/mobile station and then “assign[s] the available FCH/RCH resources to the selected terminals.” EX-1006, 8:14-44, FIG. 3. As explained above in [1c], the allocation of FCH/RCH resources includes allocating the spatial multiplexing mode. EX-1006, 17:1-60. A POSITA would have understood that the spatial multiplexing mode can be used to improve transmission throughput and that channel station information includes channel condition. EX-1003, ¶[172]. Indeed, Walton '269 explicitly discloses that “[t]he allocation of downlink and uplink resources may be dependent on the requirements of the user terminals, *the channel conditions*, and other factors.”

(Emphasis added). EX-1006, 2:4-7. For at least these reasons, it would have been obvious to a POSITA that Walton '269 teaches that it's "MIMO scheme is for improving transmission throughput based on a channel condition." EX-1003, ¶[172].

[12]

See supra [5]; EX-1003, ¶[174].

[13pre-1]

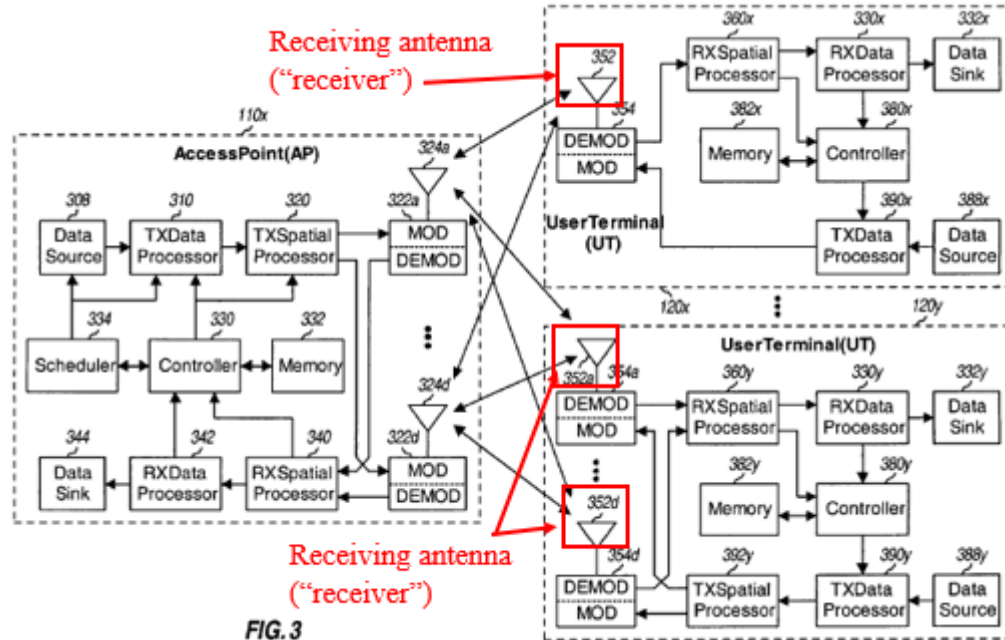
See supra [1pre-1]; EX-1003, ¶[175].

[13pre-2]

See supra [1pre-2]; EX-1003, ¶[176].

[13pre-3]

To the extent the preamble is limiting, Walton '269 discloses that each mobile station includes a receiver that includes various components such as **receivers 352-352d**. EX-1006, 7:61-8:3, FIG. 3. These receivers receive control messages and downlink data sent using the BCH, FCCH, and FCH channels from the base station. EX-1006, 9:12-14; EX-1003, ¶[177].



EX-1006, FIG. 3

[13a]

See *supra* [1a]; EX-1003, ¶[179].

[13b]

See *supra* [1b]; EX-1003, ¶[180].

[13c]

See *supra* [1c]; EX-1003, ¶[181].

[13c-1]

See *supra* [1c-1]; EX-1003, ¶[182].

[13c-2]

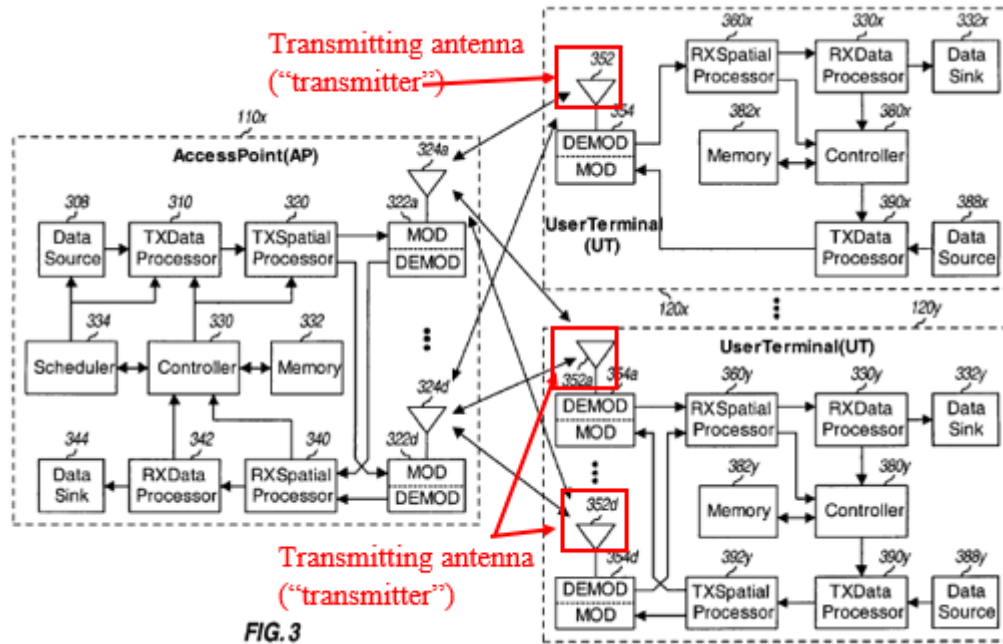
See *supra* [1c-2]; EX-1003, ¶[183].

[13d]

See supra [1d]; EX-1003, ¶[184].

[14]

Walton '269 teaches that each user terminal/mobile station “estimates the downlink to ***obtain channel state information (CSI). The CSI*** may include channel response estimates, [and] received SNRs.” EX-1006, 8:13-27. ***Feedback information is generated based on the CSI and sent to the base station.*** EX-1006, 8:13-27. Although Walton '269 does not explicitly state that the CSI is part of the feedback information transmitted to the base station, a POSITA would have understood that ***CSI is part of the feedback information transmitted to the base station.*** EX-1003, ¶[185]. This information is then used by the base station to “perform a number of functions such as (1) selecting a set of user terminals for data transmission on the downlink and uplink, (2) selecting the transmission rate(s) and the transmission mode for each selected user terminal, and (3) assigning the available FCH/RCH resources to the selected terminals.” EX-1006, 8:34-44. ***One or more antennas 352 are used as a transmitter to transmit the information to the base station.*** EX-1006, 8:13-27, FIG. 3 (reproduced below); EX-1003, ¶[185].



EX-1006, FIG. 3

B. GROUND A2: Claims 2 and 9 are obvious over Walton '269, Li, and Gupta

1. Gupta

Gupta explains that:

Channel estimation is one technique used to compensate for the distortion introduced in data during its transmission. Channel characteristics are obtained at the receiver and are used to compensate for the distortion during demodulation. More particularly, a channel response of the communication channel is estimated based on transmissions of a known pattern called training sequences. Training sequences having constant data are used.

EX-1008, ¶[0007]. In an OFDM system, Gupta teaches that “training

sequences known as pilot symbol **patterns** or training symbols are transmitted by the transmitter. The training symbols are known to the receiver such that the receiver is able to perform channel estimation.” EX-1008, ¶[0028]; EX-1003, ¶¶[73]-[74].

2. Combination of Walton ’269, Li, and Gupta renders obvious claims 2 and 9

As noted above in Section III.A.4.[2], Li discloses broadcasting pilot OFDM symbols to subscribers for training purposes. EX-1007, FIG. 1B, 6:55-67, 7:30-8:41, 5:26-36. To the extent that Patent Owner argues that Li’s disclosure is not sufficient because it does not explicitly teach that the pilot symbols have a training pilot *pattern*, Gupta provides such disclosure or, at a minimum, renders training pilot patterns obvious. EX-1003, ¶¶[75], [138], [170].

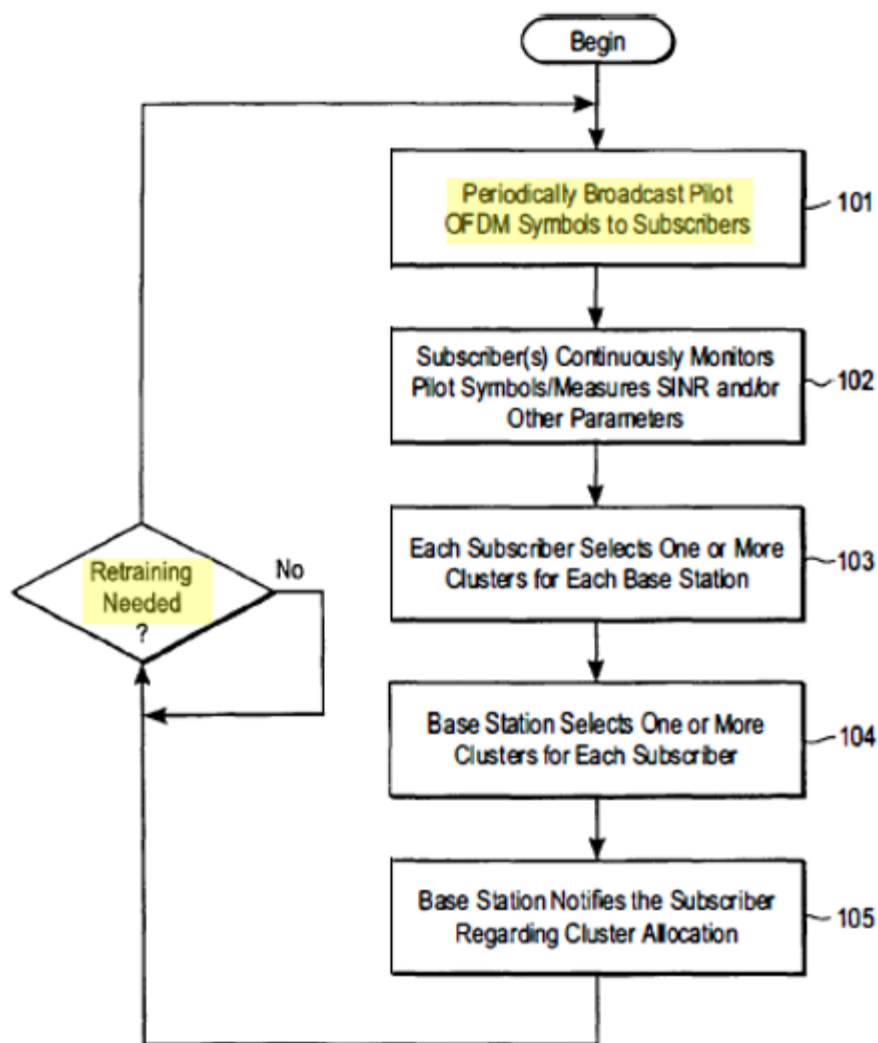


FIG. 1B

EX-1007, FIG. 1B

In particular, Gupta discloses or renders obvious that training pilot *patterns* are used for channel estimation purposes. EX-1008, ¶¶[0007], [0028]. It would have been obvious to a POSITA to combine the teachings of Walton '269, Li, and Gupta as doing so would merely involve combining prior art elements according to known methods to yield predictable results. EX-1003, ¶[76]. In particular, Li

teaches that “pilot symbols can serve multiple purposes: time and frequency synchronization, *channel estimation*, ... signal-to-interference/noise (SINR) ratio measurement for cluster allocation,” and training. EX-1007, 5:26-36, 7:30-8:41, FIG. 1B, 6:55-67. Gupta teaches that the training pilots used for channel estimation have patterns. EX-1008, ¶¶[0007], [0028]. Accordingly, the known method of using training pilot patterns for performing channel estimation would have been incorporated into the WLC system to yield the predictable result of using training pilot *patterns*. Indeed, Walton ’269, Li, and Gupta all relate to OFDM communication systems and a POSITA would have turned to Gupta’s teachings to predictably implement training pilot patterns in Walton ’269 and Li’s OFDM communication system. EX-1003, ¶[76].

In combining the teachings of Walton ’269, Li, and Gupta, Gupta’s training pilot patterns would have been included as part of the transmission parameters in the control message that is sent to the subscribers/mobile stations. EX-1003, ¶[77]. A receiving subscriber/mobile station would have demodulated the received signals with training pilot patterns and performed channel estimation based on the training pilot patterns. EX-1008, ¶[0007].

C. GROUND B1: Claims 1, 3-8, and 10-14 are obvious over PCT819 and Airy

1. PCT819

PCT819 is directed to “allocating downlink resources in a multiple-input

multiple-output (MIMO) communication system.” EX-1009, ¶[1001]. PCT819 states that “[e]ach MIMO channel between a base station and a terminal typically experiences difficult link characteristics and is associated with different transmission capability, so the spatial subchannels available to each terminal have different effective capacities. Efficient use of the available downlink resources (and higher throughput) may be achieved if the N available spatial subchannels are effectively allocated such that data is transmitted on these subchannels to a ‘proper’ set of terminals in the MIMO system. There is therefore a need in the art for techniques to allocate downlink resources in a MIMO system to provide improved system performance.” EX-1009, ¶¶[1005]-[1006]; EX-1003, ¶¶[78]-[79].

To increase the downlink performance and transmission capacity of a wireless communication system, PCT819 discloses link adaptation methods and systems in which data can be transmitted from a base station to one or more terminals using a number of different operating modes (e.g., MIMO or mixed MIMO & N-SIMO). EX-1009, ¶[1007]. PCT819’s FIG. 1 (reproduced below) illustrates an example of a MIMO system in which a base station 104 serves a plurality of terminals 106. EX-1009, FIG. 1, ¶¶[1023]-[1026]; EX-1003, ¶[80]. The “base station 104 employs multiple antennas and represents the multiple-input (MI) for downlink transmissions from the base station to the terminals.” EX-1009,

¶[1023]. In some implementations, PCT819's link adaptation method can be performed in a MIMO system that uses OFDM. EX-1009, ¶¶[1026], [1124].

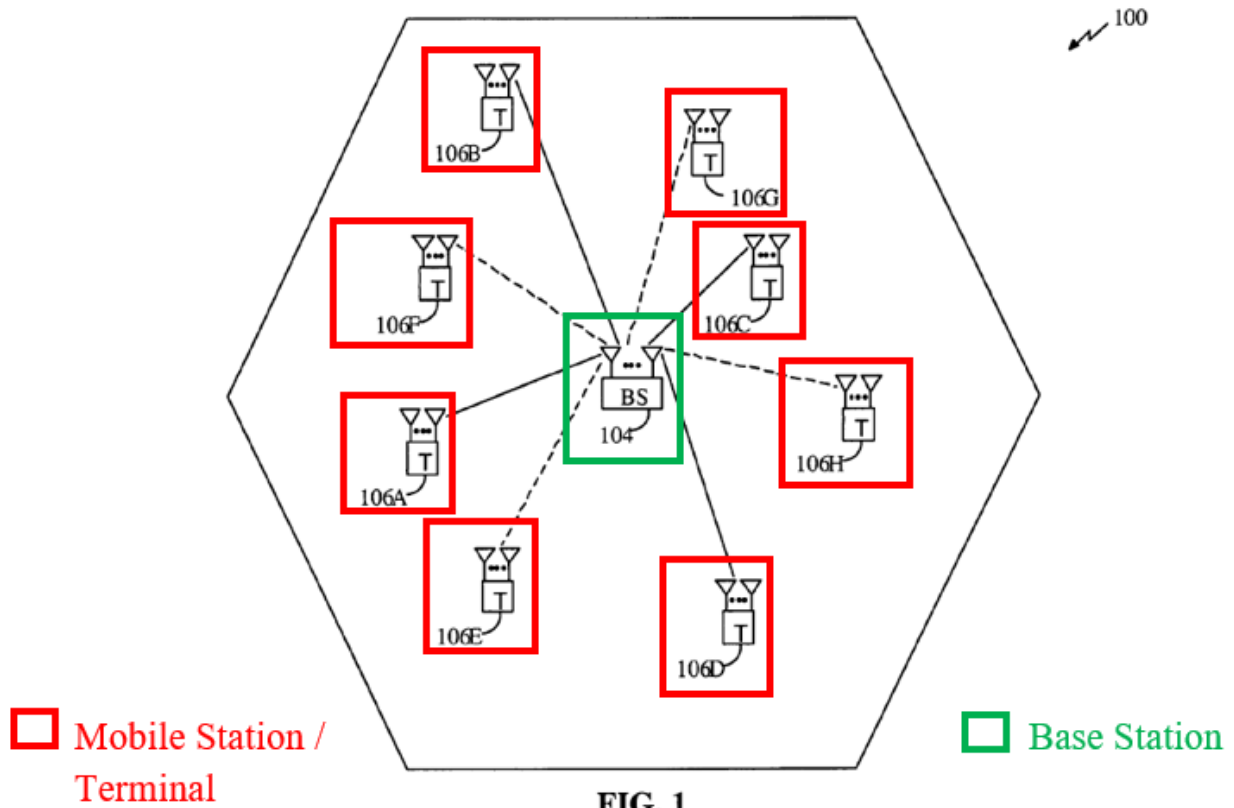


FIG. 1

EX-1009, FIG. 1

PCT819's method includes configuring scheduling schemes to perform link adaptation. EX-1009, ¶¶[1037]-[1038]; EX-1003, ¶[81]. For example, data rates may be adapted for links to one or more terminals/mobile stations and terminals that have similar link margins can be grouped together. EX-1009, ¶¶[1119]-[1120]. In addition to data rates, link adaptation may include assigning scheduled transmission intervals, antenna assignments, and coding and modulation schemes

to be used for communicating with one or more terminals/mobile stations. EX-1009, ¶¶[1054], [1074]. Information on the assigned link adaptation configuration is then transmitted to the respective terminals. EX-1009, ¶¶[1054], [1074]; EX-1003, ¶[81].

2. Airy

Airy is directed to “scheduling of data wirelessly transmitted between a base control station having multiple antennas, and subscriber units.” EX-1010, 1:7-10. The scheduling is “adaptive to the quality of transmission links between the base station transceiver antennas and each of the subscribers (subscriber) units” and can allow for spatial multiplexing and communication diversity to “improve the capacity of the communication system and reduce the effects of fading and multipath resulting in increased capacity.” EX-1010, 2:47-55, 6:50-56. A POSITA would have understood that Airy’s subscriber units, like PCT819’s terminals, are mobile stations. EX-1003, ¶[82].

Airy’s scheduling “generally includes assigning frequency blocks and time slots to each of the subscriber units for receiving or transmitting data blocks.” EX-1010, 2:65-67. After “generating [the] schedule that designates time slots and pre-defined frequency blocks,” the schedule is transmitted to the subscriber units. EX-1010, 3:1-15, 5:56-59. The schedule indicates to each subscriber unit “when (that is, which time slot) and at what frequency data blocks requested by the subscriber

unit will be transmitted.” EX-1010, 5:65-6:2. The base station includes multi-carrier modulation units 350, 360, 370 that can generate a plurality of multiple-carrier modulated signals. EX-1010, 6:14-40, FIG. 3 (reproduced below); EX-1003, ¶[83].

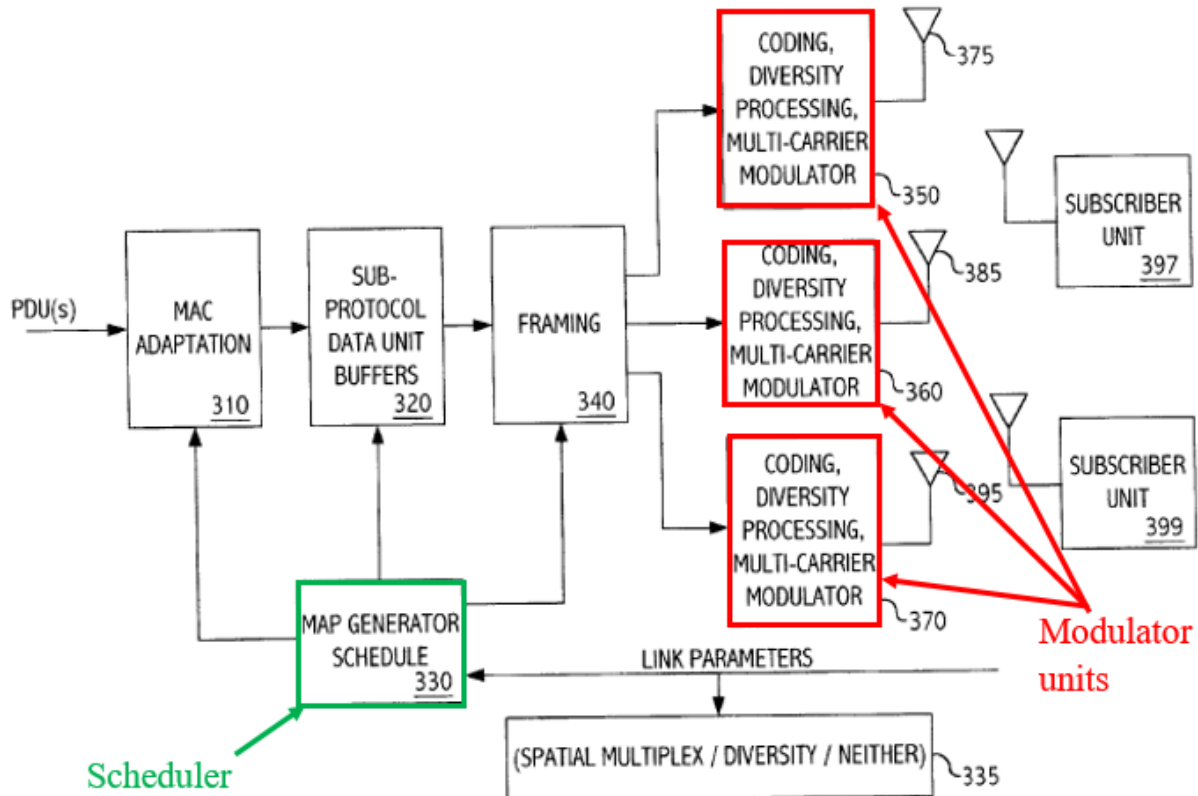


FIGURE 3

EX-1010, FIG. 3

In implementations involving OFDM, the available frequency bandwidth can be divided into multiple data carriers. EX-1010, 9:1-14. For example, “FIG. 6 shows a frequency spectrum of OFDM sub-carrier signals 610, 620, 630, 640, 650, 660.” EX-1010, 9:15-17. “An example OFDM signal occupying 6 MHz is made up of

1024 individual carriers (or tones), each carrying a single QAM symbol per burst.”

EX-1010, 9:19-22. Airy’s FIG. 7A also reveals “a frame structure depicting blocks of transmission data defined by transmission time slots and transmission frequency blocks” having different frequency ranges. EX-1010, 9:31-44. Airy’s FIGS. 6 and 7A illustrate an example of an OFDM channel being divided into subbands associated with subcarriers that are equally distributed across the channel bandwidth. EX-1003, ¶[84].

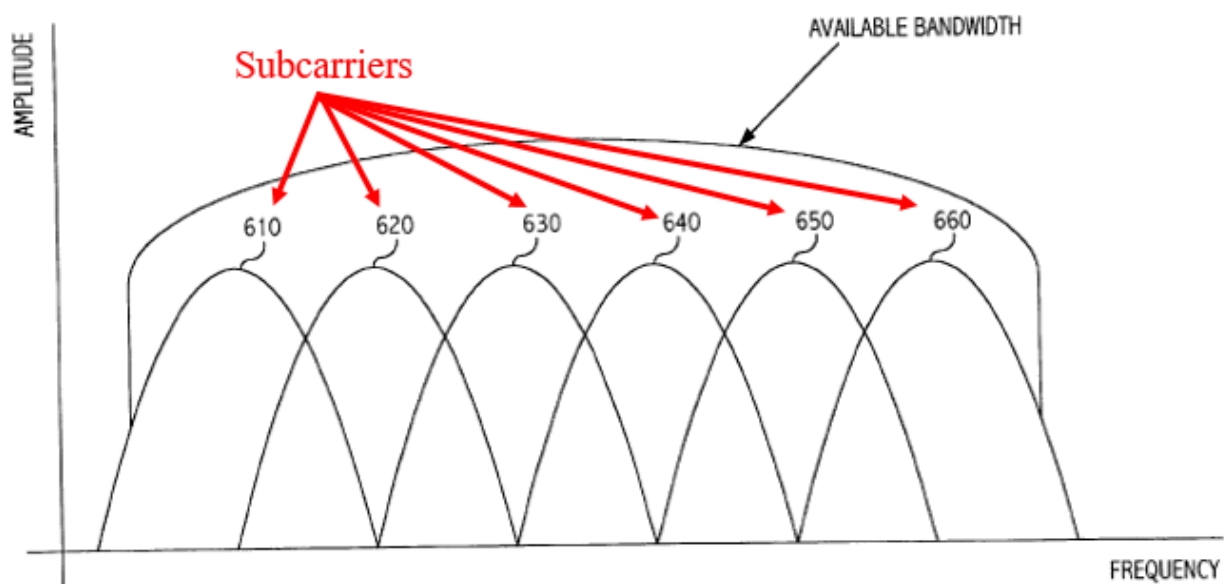


FIGURE 6

EX-1010, FIG. 6

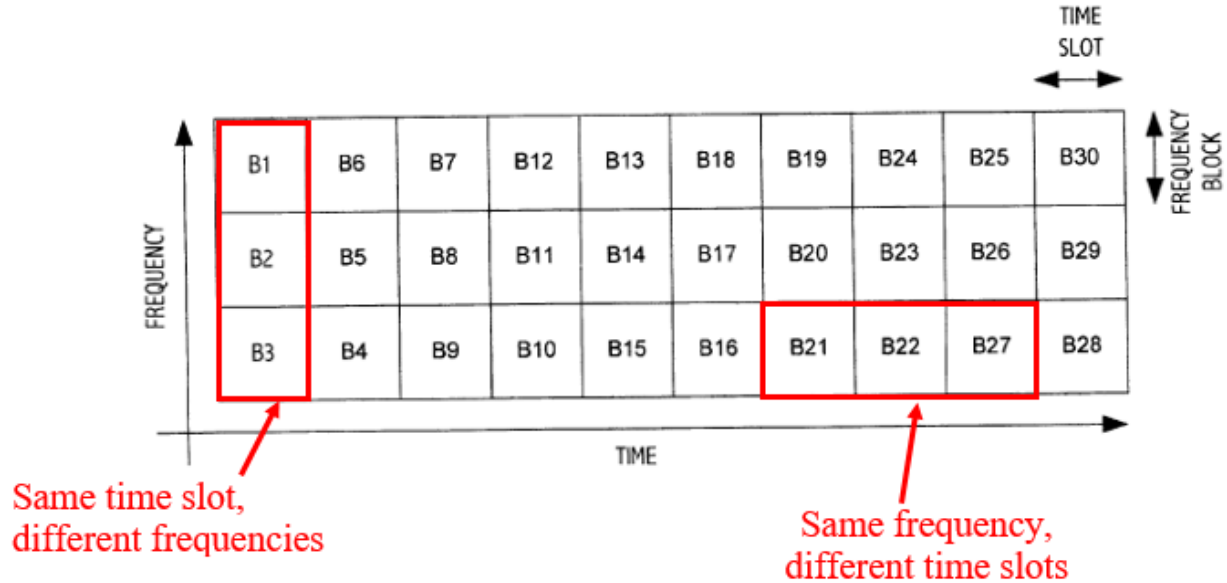


FIGURE 7A

EX-1010, FIG. 7A

3. Combination of PCT819 and Airy

It would have been obvious to a POSITA to combine the teachings of PCT819 and Airy to reduce the effects of fading and multi-path to improve system capacity. EX-1003, ¶[85]; EX-1010, 2:47-55, 6:50-56. As noted above, PCT819 discloses a link adaptation method implemented in a system in which a base station serves a plurality of cells associated with mobile stations. EX-1009, FIG. 1, ¶¶[1023]-[1026]. PCT819's method includes configuring scheduling schemes to perform link adaptation and improve system performance. EX-1009, ¶¶[1005]-[1006].

Airy's system similarly includes a base station serving a plurality of subscriber units. EX-1010, 2:47-55, 6:50-56, FIG. 3. Like PCT819, Airy teaches performing scheduling that is adaptive to link characteristics and allocates time slots and subcarrier frequencies to subchannels for implementing spatial multiplexing or communication diversity. EX-1010, 2:47-55; EX-1003, ¶[86].

To implement the subcarrier-related teachings of Airy in PCT819, PCT819's base station would have assigned time slots and subcarrier frequencies to PCT819's subchannels when performing OFDM modulation. EX-1003, ¶[87]. This can be done, for example, by incorporating software instructions for dividing a channel using, e.g., FDD, FDM, or TDM techniques, and assigning the subchannels subcarrier frequencies, as disclosed by Airy. EX-1010, 9:15-44, FIGS. 6 and 7A; EX-1003, ¶[87]. In this manner, combining such Airy's teachings with PCT819's system (which also utilizes OFDM – *see* EX-1009, ¶¶[1026], [1124]) would have been predictable and foreseeable. EX-1003, ¶[87].

A POSITA would have had a reasonable expectation of success in implementing the PCT819-Airy combination (“WAC”) at least because PCT819 and Airy are related to similar methods and systems (i.e., link adaptation in OFDM WLAN communications between a base station and mobile stations using subchannels). EX-1003, ¶[88]. Indeed, WAC would have been obvious to a POSITA because it would have involved combining prior art elements (e.g., Airy's

subcarrier frequency allocation to subchannels in PCT819's system) according to known methods (Airy's subcarrier allocation) to yield predictable and foreseeable results and would have been an application of a known technique (Airy's subcarrier allocation) to a known system (PCT819's MIMO OFDM system) ready for improvement. EX-1003, ¶[88].

4. Manner in which the Prior Art Renders Claims 1, 3-8, and 10-14 Obvious

The following sections describe how WAC renders claims 1, 3-8, and 10-14 obvious.

[1pre-1]

As explained above in Section III.C.1 and III.C.3, PCT819 discloses ***a link adaptation method performed by a base station (e.g., base station 104) serving a plurality of terminals 106 ("mobile stations")***. EX-1009, ¶¶[1023]-[1026], FIG. 1 (reproduced below). EX-1003, ¶[93]. PCT819's ***link adaptation method is performed in an OFDM communication system***, and involves the base station assigning scheduled transmission intervals, antenna assignments, and coding and modulation schemes to the terminals/mobile stations via a control channel. EX-1009, ¶¶[1026]-[1034], [1124], [1033], [1054], [1074]; EX-1003, ¶[93]. The base station serves the mobile stations at least by providing them with user-specific data, signaling information, and scheduling data/transmission parameters for communicating with the base station. EX-1009, ¶¶[1024]-[1027], [1032]-[1033];

EX-1003, ¶[93].

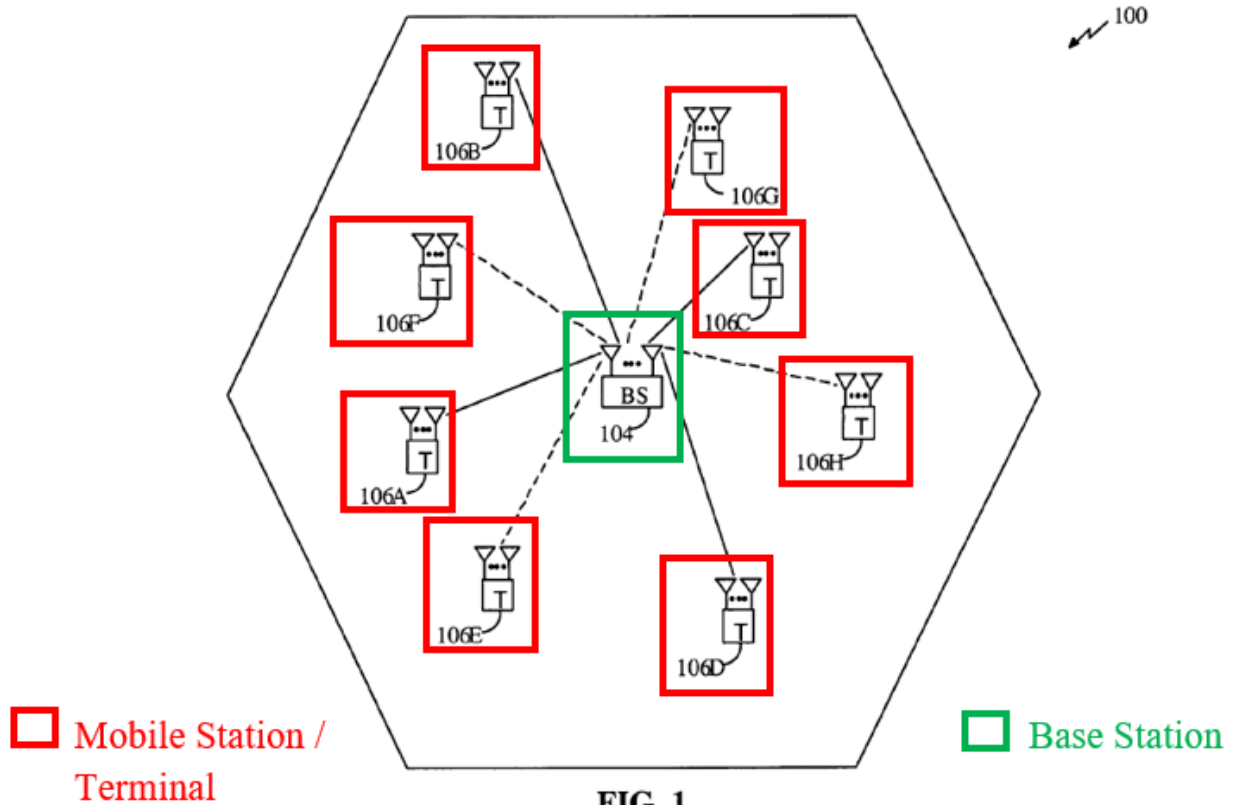


FIG. 1

EX-1009, FIG. 1

[1pre-2]

To the extent the preamble is limiting, PCT819 discloses *a communication system that utilizes a transmission structure* in which several multiplexing schemes can be used for communications between the base station and mobile stations/terminals including “time division multiplexing (e.g., *assigning different fractions of a transmission interval to different terminals*), frequency division

multiplexing (e.g., *assigning different frequency subchannels to different terminals*) ... or any combination of these schemes.” EX-1009, ¶¶[1112]-[1114], [1132], [1164]. A “data stream may be transmitted over multiple transmit antennas, *frequency subchannels, and/or time intervals to provide spatial, frequency, and time diversity*, respectively.” EX-1009, ¶[1142]. A POSITA would have understood that by using a combination of time and frequency division multiplexing, and using spatial, frequency, and time diversity, PCT819’s transmission structure would have included time slots in the time domain and frequency subchannels in the frequency domain. EX-1003, ¶[98]; EX-1009, ¶¶[1131]-[1132].

For example, PCT819 reveals that “[e]ach terminal 106 communicates with base station 104 via a MIMO channel. A MIMO channel may be decomposed into N_c independent channels ... Each of the N_c independent channels is also referred to as a spatial subchannel of the MIMO channel.” EX-1009, ¶[1026]. In “a MIMO system utilizing OFDM, each spatial subchannel of each frequency subchannel may be referred to as a transmission channel.” EX-1009, ¶¶[1026], [1112].

Furthermore, in some implementations, PCT819’s system can utilize a transmission structure compatible with various operating modes including a MIMO mode and a mixed mode (MIMO & N-SIMO). EX-1009, ¶[1031]. In the mixed

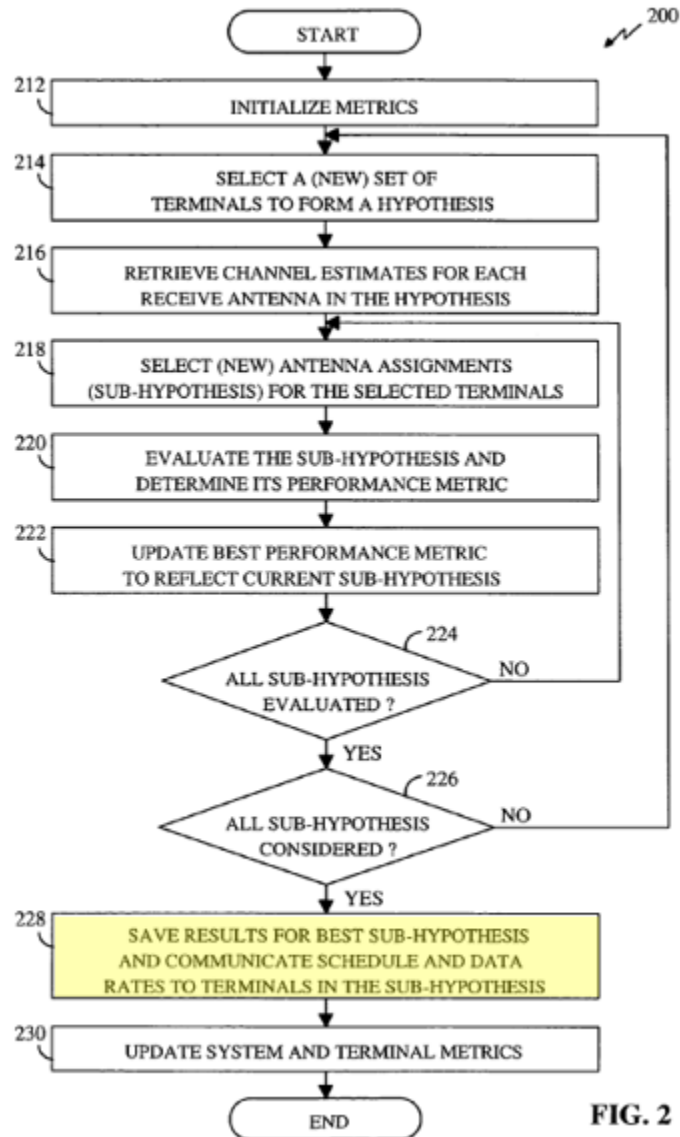
mode, downlink resources can be allocated to terminals supported “on the same *channel, which may be a time slot, a code channel, a frequency subchannel.*”

EX-1009, ¶[1031]. Accordingly, PCT819 discloses or renders obvious “the communication system utilizing a transmission structure with time slots in the time domain and frequency subchannels in the frequency domain.” EX-1003, ¶¶[99]-[100].

[1a]

PCT819 teaches that after a base station receives channel state information (CSI) from the terminals served by the base station, the CSI is aggregated and used by the base station to “(1) select a ‘best’ set of one or more terminals for data transmission, (2) assign the available transmit antennas to the selected terminals in the set, and (3) select the proper coding and modulation scheme for each transmit antenna.” EX-1009, ¶¶[1037]-[1038], [1164], [1132]. These selections are used to configure scheduling schemes that are “designed to maximize the downlink performance by evaluating which specific combination of terminals and antenna assignments provide the best system performance (e.g., the highest throughput) subject to any system constraints and requirements.” EX-1009, ¶[1037]. The information describing the scheduling schemes and transmission parameters such as the “scheduled transmission interval, antenna assignments, coding and modulation schemes, other information, or any combination thereof, *may be*

conveyed to the scheduled terminals (e.g., via a control channel)." (Emphasis added). EX-1009, ¶¶[1054], [1074], FIG. 2.



EX-1009, FIG. 2

A POSITA would have understood that the information conveyed to one or more mobile stations using a control channel is conveyed using a control message. EX-1003, ¶¶[102]-[103]. This is obvious because sending a message to convey

information is a well-known electronic communication technique. EX-1012, Abstract, ¶¶[0003]-[0006], [0033], [0053]; EX-1013, Abstract, 1:64-2:7, 2:40-54, 6:62-7:13; EX-1011, Abstract, FIGS. 5, 7, 9:17-67; EX-1003, ¶[103].

Accordingly, it would have been obvious to a POSITA that to transmit the scheduling scheme information to the one or more terminals/mobile stations over a control channel, the base station would have transmitted a control message using the control channel. EX-1003, ¶[103].

[1b]

As noted above in [1a], it would have been obvious to a POSITA that PCT819 discloses a base station transmitting a control message. The ***control message contains transmission parameters allocated for communications with one or more mobile stations***. These transmission parameters include, for example, the “scheduled transmission interval, antenna assignments, coding and modulation schemes, other information, or any combination thereof.” EX-1009, ¶¶[1054], [1064]-[1068], [1073]-[1075], [1084], [1096]-[1099], [1113], FIGS. 2-4; *see also supra* [1a]. The transmission parameters are used to configure communication for an upcoming transmission interval (“subsequent transmission of data”) by the base station to a mobile station. EX-1009, ¶¶[1041]-[1043], [1024], [1054], [1070]; EX-1003, ¶[108].

Furthermore, as explained above in [1pre-2], PCT819 teaches that when

using time division multiplexing (TDM) and frequency division multiplexing (FDM) for communications between the base station and mobile stations, different frequency subchannels are assigned to different mobile stations and different fractions of a transmission interval are assigned to different mobile stations. EX-1009, ¶¶[1113], [1026]. Since the data to be subsequently transmitted is controlled by a multiplexing scheme that includes time division multiplexing (TDM) and frequency division multiplexing (FDM) and a frequency subchannel is assigned to a particular mobile station, it would have been obvious to a POSITA that PCT819's "subsequent transmission of data" is transmitted, *the "subsequent transmission of data" is transmitted "over a frequency subchannel to the mobile station in a time slot"* for which the data is designated. EX-1003, ¶[109].

Moreover, PCT819 explains that the mobile stations include active terminals which "desire data transmission in an upcoming or future transmission interval." EX-1009, ¶[1024]. Accordingly, at least when the base station schedules schemes for configuring communications with an active terminal/mobile station, a POSITA would have understood from the use of the term "upcoming or future transmission *interval*" (emphasis added) that the "subsequent transmission of data" (described in the previous paragraph) is to be transmitted to the active mobile station "over a frequency subchannel to the mobile station *in a time slot*" when using FDM-TDM multiplexing. EX-1003, ¶[110].

[1c]

As noted above in [1a] and [1b], PCT819 discloses a control message that contains transmission parameters and scheduling schemes, which include, for example, the “scheduled transmission interval, antenna assignments, coding and modulation schemes, other information, or any combination thereof.” EX-1009, ¶¶[1054], [1064]-[1068], [1073]-[1075], [1084], [1096]-[1099], [1113], FIGS. 2-4; *see supra* [1a], [1b]. As part of scheduling active terminals/mobile stations for optimization, “the available transmit antennas can be assigned to the terminals ... based on any one of a number of antenna assignment schemes.” EX-1009, ¶¶[1041], [1032], [1054]-[1073]. An example of an antenna assignment scheme (“***antenna transmission scheme***”) that optimized signal-to-noise-ratio (SNR) performance is shown in PCT819’s Table 2 below. EX-1009, ¶[1067]; EX-1003, ¶[117].

Table 2

Terminal	Transmit Antenna	SNR (dB)
1	3	16
2	4	14
3	1	14
4	2	10

In addition, PCT819 teaches that “scheduling schemes can be designed to select the best set of terminals for simultaneous data transmission *on the available transmission channels* such that system performance is maximized while conforming to the system constraints and requirements.” EX-1009, ¶[1039]. For example, PCT819 teaches that “[a] MIMO channel formed by these N_T transmit and N_R receive antennas may be decomposed into N_C independent channels, with $N_C \leq \min \{N_T, N_R\}$. Each of the N_C independent channels is also referred to as a spatial subchannel of the MIMO channel and corresponds to a dimension.” EX-1009, ¶¶[1004], [1026]. “For a MIMO system that utilize OFDM, multiple frequency subchannels may be associated with each spatial subchannel, and these frequency subchannels may be assigned to terminals.” EX-1009, ¶[1112]. In other words, “different frequency subchannels [are assigned] to different terminals” (“*subchannel configuration*”). EX-1009, ¶¶[1113]-[1114]. As explained above in [1a] and [1b], information regarding the scheduling schemes and transmission parameters, such as the subchannel configuration and antenna transmission scheme, is sent to the scheduled mobile stations in a control message via the control channel. EX-1009, ¶¶[1054], [1074], FIG. 2; EX-1003, ¶[118].

[1c-1]

PCT819 discloses [1c-1]. PCT819 and Airy also render [1c-1] obvious. EX-1003, ¶¶[120]-[124].

PCT819 describes its communication system as a ***MIMO communication system*** configurable for multiple operation modes that can provide communications across ***MIMO channels*** between devices using ***MIMO terminals*** having ***MIMO receivers***. EX-1009, ¶¶[1001], [1033], [1089], [1100]-[1101], [1109], [1121]. For example, “[i]n a ***MIMO mode***, all available downlink data streams are allocated to a single terminal that employs multiple antennas (i.e., a MIMO terminal). ... And in a mixed-mode, the downlink resources may be allocated to a combination of SIMO [(single-input, multiple-output)] and ***MIMO terminals***, with both types of terminals being simultaneously supported. By transmitting data simultaneously to multiple SIMO terminals, ***one or more MIMO terminals***, or a combination thereof, the transmission capacity of the system is increased.” EX-1009, ¶[1007]. For example, FIG. 9 (reproduced below) shows the average throughput for a MIMO communication system with four transmit antennas (i.e., $N_T = 4$) and four receive antennas per terminal (i.e., $N_R = 4$) for the MIMO and N-SIMO modes.” EX-1009, ¶[1109]; EX-1003, ¶[120].

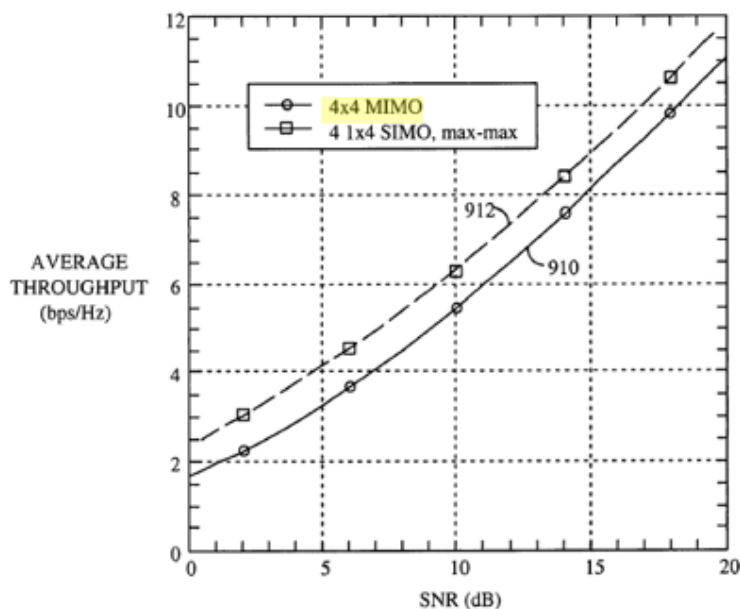


FIG. 9

EX-1009, FIG. 9

Based on the desired performance (e.g., desired SNRs), system goals, and selected coding and modulation schemes, the base station's scheduler assigns MIMO mobile stations and their antennas in an antenna transmission scheme, as described above in [1c]. See also EX-1009, ¶¶[1089], [1100]-[1101]; EX-1003, ¶[121].

PCT819's antenna transmission scheme also includes *transmission diversity schemes such as time diversity, frequency diversity, and spatial diversity*. EX-1009, ¶¶[1121], [1131], [1142]. For example, data can be interleaved to provide time diversity and frequency diversity. EX-1009, ¶[1121]; EX-1003, ¶[122].

Alternatively, Airy discloses *an antenna transmission scheme comprising a transmission diversity scheme*. For details of the combination of PCT819 and Airy and a detailed description of Airy, *see infra* [1c-2].

Airy explains that a base station can use spatial multiplexing (e.g., MIMO) or *communication diversity (“transmission diversity scheme”)* to communicate with the subscriber units. EX-1010, 6:50-56, 5:43-50, 7:2-5, 11:22-27.

Communication diversity involves antenna diversity performed to reduce the effects of multipath fading in systems in which a transmitter and/or a subscriber have two or more antennae. EX-1010, 2:9-12, 6:50-56. Airy explains that “[d]iversity communications and processing is well known in the field of communications.” EX-1010, 6:12-14. For example, in communication diversity, “the transmission between multiple transceiver stations and subscriber units generally requires time, frequency, or some other type of multiplexing” and “[o]ptimally, the base transceiver station can schedule data transmission according to the transmission link quality between each base transceiver station antenna the subscriber unit.” EX-1010, 2:20-46, 5:29-42, 5:51-59; EX-1003, ¶¶[122]-[124].

[1c-2]

PCT819 teaches that in “a MIMO system utilizing OFDM, each spatial subchannel of each frequency subchannel may be referred to as a transmission channel.” While PCT819 does not explicitly reveal that the “subchannel configuration [is] characterized by distributed subcarriers or localized subcarriers in the frequency domain,” Airy does describe this feature. EX-1003, ¶[129].

As noted above in Sections III.C.2-III.C.3, to “improve the capacity of the communication system and reduce the effects of fading and multi-path resulting in increased capacity,” Airy discloses that the available frequency bandwidth can be divided into multiple data carriers in implementations involving OFDM. EX-1010, 9:1-14, 2:47-55, 6:50-56. Airy’s “FIG. 6 shows a frequency spectrum of OFDM sub-carrier signals 610, 620, 630, 640, 650, 660.” EX-1010, 9:15-17. “An example OFDM signal occupying 6 MHz is made up of 1024 individual carriers (or tones), each carrying a single QAM symbol per burst.” EX-1010, 9:19-22. Airy’s FIG. 7A depicts “a frame structure depicting blocks of transmission data defined by transmission time slots and transmission frequency blocks” having different frequency ranges. EX-1010, 9:31-44; EX-1003, ¶[130].

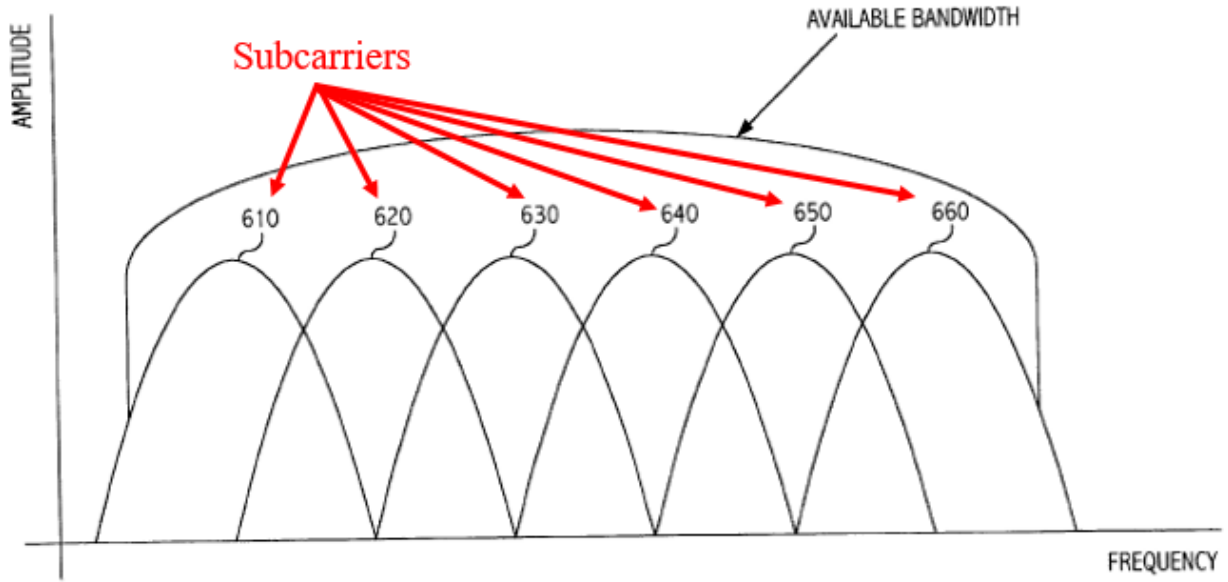


FIGURE 6
EX-1010, FIG. 6

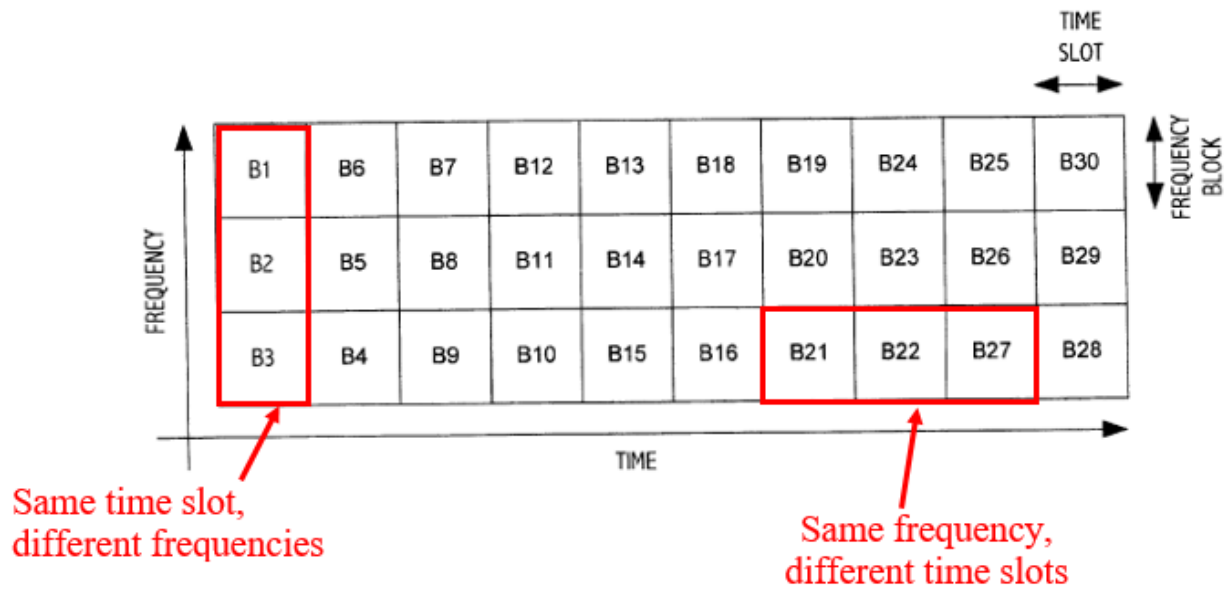


FIGURE 7A
EX-1010, FIG. 7A

As shown in Airy's FIGS. 6 and 7A, Airy discloses dividing an OFDM channel band into subbands that are characterized by subcarriers that are equally distributed across the channel bandwidth. Airy therefore discloses a "subchannel configuration characterized by distributed subcarriers or localized subcarriers in the frequency domain." EX-1003, ¶[131].

For the reasons explained above in Section III.C.3, it would have been obvious to a POSITA to implement the above teachings of Airy in PCT819's system such that the combined system would have included subchannel configuration characterized by distributed subcarriers or localized subcarriers in the frequency domain, to reduce the effects of fading and multi-path to improve system capacity. EX-1010, 2:47-55, 6:50-56; EX-1003, ¶[132].

[1d]

As explained above in [1b], PCT819 discloses a base station that schedules schemes for configuring communications with an active terminal/mobile station for a "*subsequent transmission of data*" in an upcoming or future transmission interval. EX-1009, ¶[1024]. Furthermore, as noted above in [1b], the "subsequent transmission of data" is transmitted to the mobile station/terminal "*over a frequency subchannel* to the mobile station in a time slot." See also EX-1009, ¶[1024]. This data transmission is performed *according to the scheduled schemes*

and transmission parameters sent by the base station. EX-1009, ¶¶[1041]-[1043], [1024], [1054], [1070]; EX-1003, ¶[135].

[3]

PCT819 discloses controlling power transmission levels along with scheduling schemes for performing link adaptation and controlling communications with mobile stations/terminals. In particular, PCT819's "base station may make use of the *power control information* fed back from the terminals to adjust the data processing and/or the transmit power." EX-1009, ¶¶[1159], [1114], [1120]. PCT819 teaches that "power control may also be used in conjunction with the scheduling schemes." EX-1009, ¶¶[1114], [1120]. Recall from [1a] and [1b] that PCT819 teaches conveying scheduling schemes, transmission parameters, and "other information" via a control message(s) to scheduled terminals. EX-1009, ¶¶[1054], [1074], FIG. 2; *see supra* [1a], [1b]. It would have been obvious to a POSITA that power control information would have been the "other information" that was also transmitted along with the scheduling schemes and transmission parameters (or alternatively would have been obvious to include in the "other information") so that the receiver terminal can optimize its power settings to receive data from the base station and to optimize the power consumption of the system. EX-1003, ¶[142]. This would have been obvious particularly because PCT819 is directed to allocating downlink resources in a

MIMO system to provide improved system performance, and the conveyance of power information is consistent with the objectives and teachings of PCT819. EX-1009, ¶¶[1005]-[1006]; *see supra* [1pre-1]; EX-1003, ¶[142].

The obviousness of conveying power information is corroborated by Airy. In particular, Airy discloses that “[b]ased on the quality of the link between a base station transceiver and a subscriber unit, a transmission mode is assigned to the subscriber unit.” EX-1010, 10:54-56. “The mode assignment can also determinations of [*sic*] other transmission characteristics. For example, the mode assignment can also be used *for specifying* transmission frequency bandwidth or *transmission power*.” EX-1010, 11:6-9. A transmission schedule for transmissions between the base station and the subscriber unit is generated based, in part, on the assigned transmission mode. EX-1010, 10:21-29. The generated schedule is transmitted to the subscriber unit. EX-1010, 3:11-15, 13:58-64. Thus, Airy corroborates the obviousness of sending power control information, as part of scheduling information, to a receiver terminal. EX-1003, ¶[143].

Alternatively, it would have been obvious to combine the teachings of PCT819 and Airy so that power control information is conveyed as part of the mobile station-specific transmission parameters in the control message for the reasons noted above. EX-1003, ¶[144]. And doing so, as described above, would have merely involved combining prior art elements according to known methods to

yield predictable and foreseeable results and would have been an application of a known technique to a known system (PCT819's MIMO OFDM system) ready for improvement. EX-1003, ¶[144].

[4]

PCT819 teaches that “transmit *antennas are ... assigned* to the selected terminals *based on the channel estimates* and using any one of a number of antenna assignment schemes.” EX-1009, ¶[1073]. In particular, the base station receives channel state information (CSI) from a terminal and uses the CSI to “perform a number of functions such as (1) selecting the set of best terminals for data transmission, (2) *assigning the available transmit antennas to the selected terminals [(“antenna transmission scheme”)]*, and (3) determining the coding and modulation scheme to be used for each assigned transmit antenna.” EX-1009, ¶¶[1126]-[1129]. A POSITA would have understood that *CSI includes channel condition information*. EX-1003, ¶[146]. Indeed, PCT819 provides a lengthy description in ¶¶[1152]-[1167] of the various types of CSI/channel conditions (e.g., SNR, noise power, signal power, interference power, data rate, power control information, channel quality) and generally describes CSI as being “any type of information that is indicative of the characteristics of the communication link.” EX-1009, ¶¶[1152]-[1167]. These examples are consistent with the

characterization of “channel condition” that the Patent Owner asserted during prosecution. *See supra* Section II.B; EX-1003, ¶[146].

[5]

As noted above in [4], PCT819 teaches that the base station receives CSI from a terminal and uses the CSI to “perform a number of functions such as (1) selecting the set of best terminals for data transmission, (2) assigning the available transmit antennas to the selected terminal[], and (3) determining the coding and modulation scheme to be used for each assigned transmit antenna.” (Emphasis added). EX-1009, ¶¶[1126]-[1129]. As explained in [1c] and [1pre-2], [1pre-2], “multiple frequency subchannels may be associated with each spatial subchannel, and these frequency subchannels may be assigned to terminals.” EX-1009, ¶¶[1112]-[1114], [1132], [1164]. In other words, “different frequency subchannels [are assigned] to different terminals” (“***subchannel configuration***”). EX-1009, ¶¶[1113]-[1114].

Moreover, a POSITA would have understood that ***subchannel configuration*** includes a coding scheme and a modulation scheme, that are ***selected based on the received CSI*** that includes channel condition information such as, e.g., “a differential indicator for a particular measure of quality for a transmission channel,” data rate, and SNR. EX-1009, ¶¶[1152]-[1161], claim 7; ; EX-1003, ¶¶[148]-[149].

[6pre-1]

See supra [1pre-1] ; EX-1003, ¶[150].

[6pre-2]

See supra [1pre-2] ; EX-1003, ¶[151].

[6pre-3]

PCT819 discloses a *base station 104 comprising a transmitter that includes, amongst various components, a transmit data processor 514, modulators 522, and antennas 524*. EX-1009, ¶¶[1121], [1129], [1124], FIGS. 5, 6 (reproduced below) ; EX-1003, ¶[153].

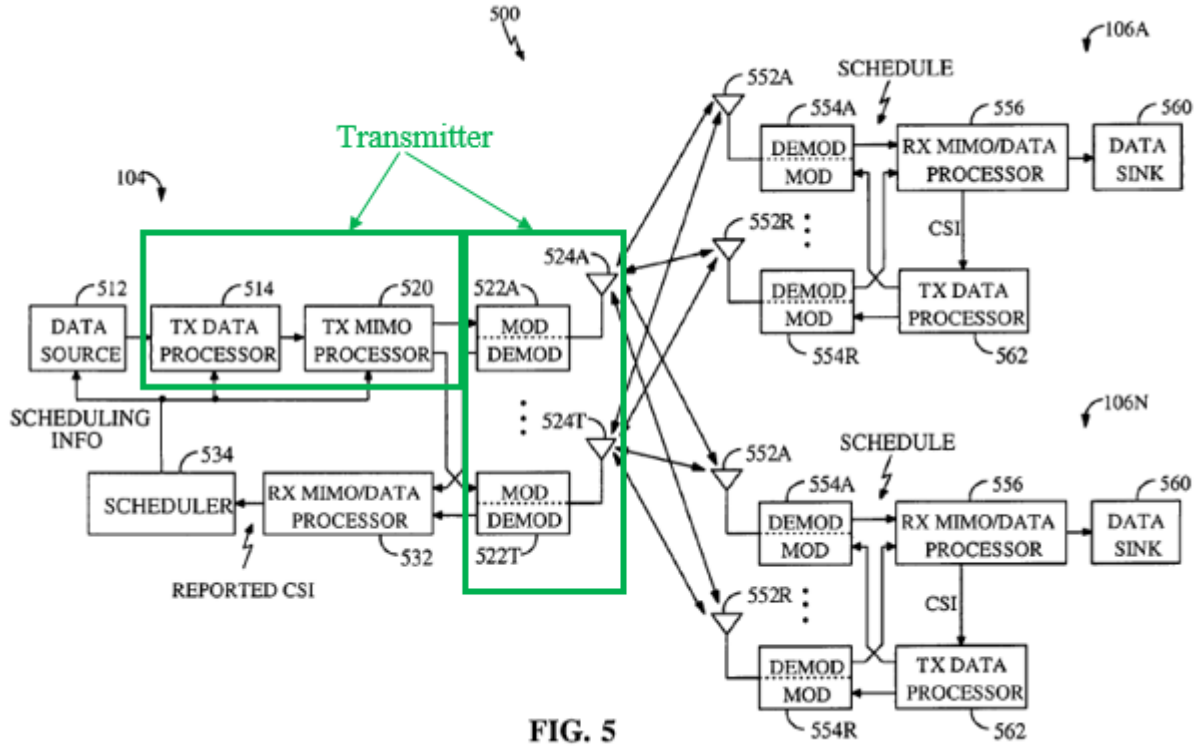


FIG. 5

EX-1009, FIG. 5⁴

⁴ For ease of understanding, green rectangles have been used to depict some transmitter components. Certain components, such as the demodulator, are located within the green rectangles but are not part of the transmitter. These components operate as part of the receiver.

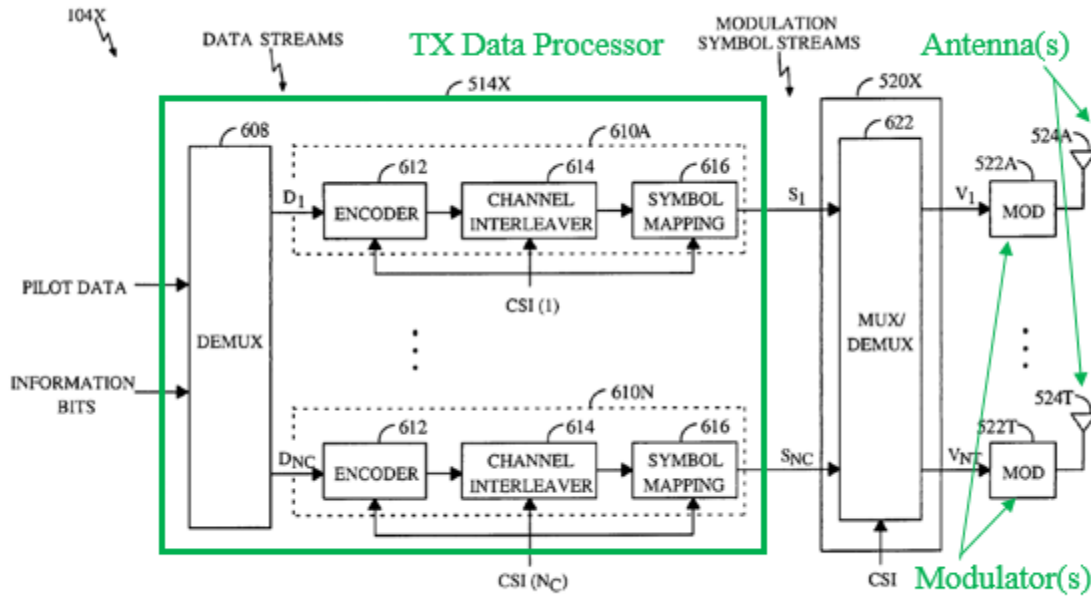


FIG. 6

EX-1009, FIG. 6

[6a]

See *supra* [1a]; EX-1003, ¶[154].

[6b]

See *supra* [1b]; EX-1003, ¶[155].

[6c]

See *supra* [1c]; EX-1003, ¶[156].

[6c-1]

See *supra* [1c-1]; EX-1003, ¶[157].

[6c-2]

See *supra* [1c-2]; EX-1003, ¶[158].

[6d]

See supra [1d]; EX-1003, ¶[159].

[7]

As noted above in [4], PCT819 teaches that the base station receives channel state information (CSI) from a terminal and uses the CSI to “perform a number of functions such as (1) selecting the set of best terminals for data transmission, (2) assigning the available transmit antennas to the selected terminal[], and (3) determining the coding and modulation scheme to be used for each assigned transmit antenna.” EX-1009, ¶¶[1126]-[1129], [1036]-[1037], [1167]. ***The base station’s receiver includes several components such as an antenna 524 for receiving the CSI information, demodulators 522, and a RX processor 532.*** EX-1009, ¶¶[1126]-[1129], FIG. 5 (reproduced below); EX-1003, ¶[161].

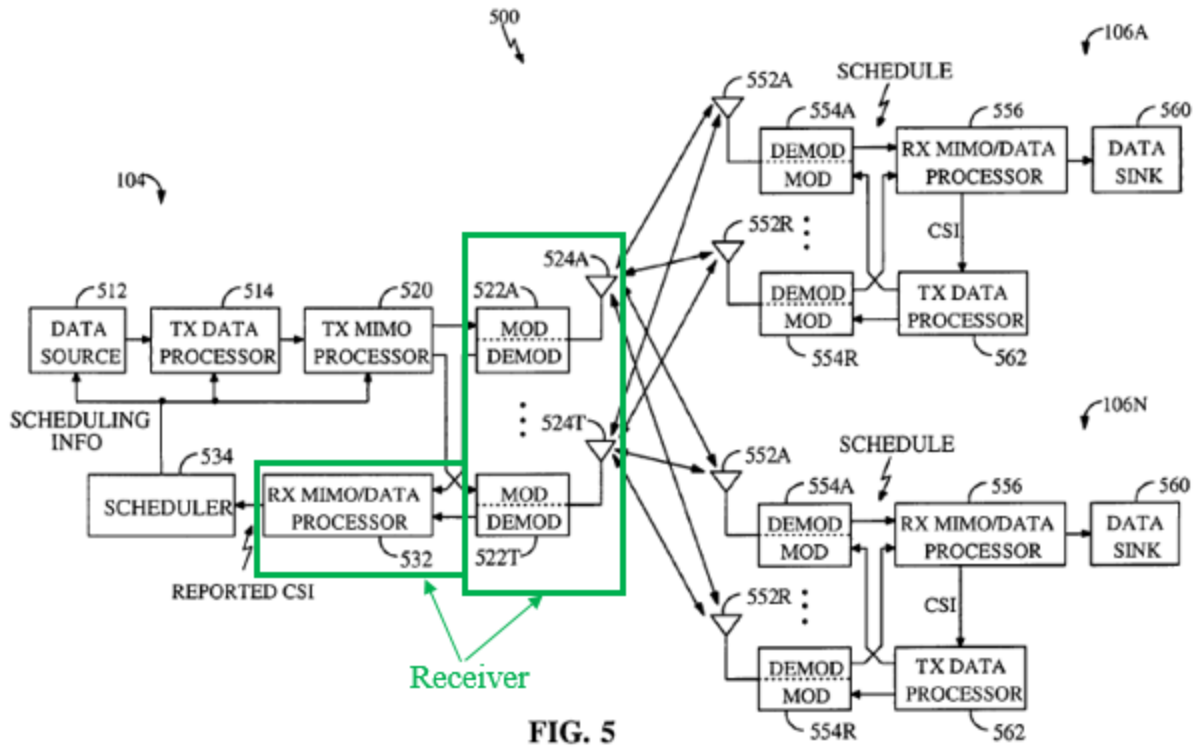


FIG. 5

EX-1009, FIG. 5⁵

[8pre-1]

See *supra* [1pre-1]; EX-1003, ¶[162].

[8pre-2]

See *supra* [1pre-2]; EX-1003, ¶[163].

⁵ For ease of understanding, green rectangles have been used to depict some receiver components. Certain components, such as the modulator, are located within the green rectangles but are not part of the receiver. These components operate as part of the transmitter.

[8a]

See supra [1a]; EX-1003, ¶[164].

[8b]

See supra [1b]; EX-1003, ¶[165].

[8c]

See supra [1c]; EX-1003, ¶[166].

[8c-1]

See supra [1c-1]; EX-1003, ¶[167].

[8c-2]

See supra [1c-2]; EX-1003, ¶[168].

[8d]

See supra [1d]; EX-1003, ¶[169].

[10]

See supra [3]; EX-1003, ¶[171].

[11]

PCT819 teaches that by efficiently allocating subchannels and utilizing downlink resources in MIMO channels, an improved transmission can be achieved. EX-1009, ¶¶[1005]-[1006]. As explained above in Section III.C.4.[4], an antenna transmission scheme can be assigned based on CSI that includes channel condition

information received from a mobile station. EX-1009, ¶¶[1126]-[1129]; EX-1003, ¶[173].

[12]

See supra [5]; EX-1003, ¶[174].

[13pre-1]

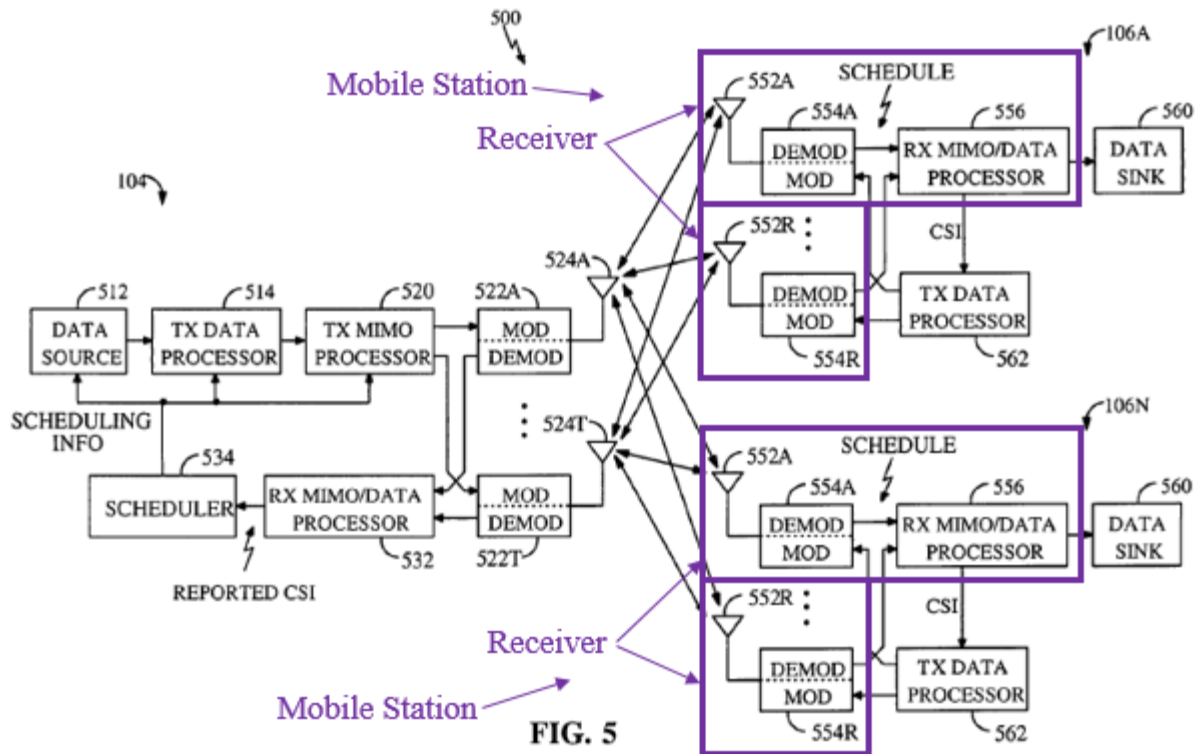
See supra [1pre-1]; EX-1003, ¶[175].

[13pre-2]

See supra [1pre-2]; EX-1003, ¶[176].

[13pre-3]

PCT819 discloses that a terminal 106 comprises a receiver that includes various components such as receive antennas 552, demodulators 554, and RX processor 556. EX-1009, ¶¶[1125], [1137], FIGS. 5, 7 (reproduced below); EX-1003, ¶[178].



EX-1009, FIG. 5⁶

⁶ For ease of understanding, purple rectangles have been used to depict some receiver components. Certain components, such as the modulator, are located within the purple rectangles but are not part of the receiver. These components operate as part of the transmitter.

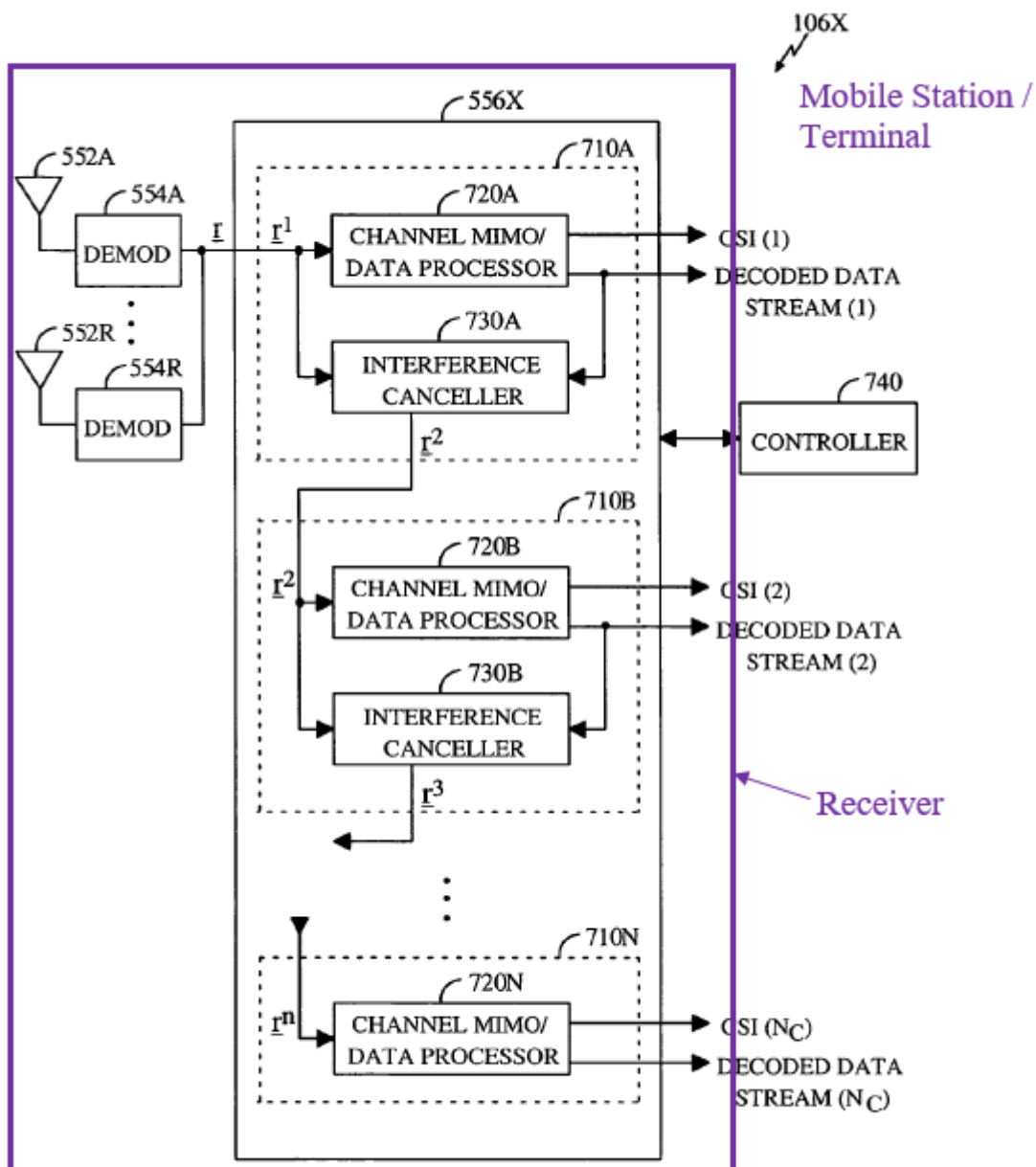


FIG. 7

EX-1009, FIG. 7

[13a]

See supra [1a]; EX-1003, ¶[179].

[13b]

See supra [1b]; EX-1003, ¶[180].

[13c]

See supra [1c]; EX-1003, ¶[181].

[13c-1]

See supra [1c-1]; EX-1003, ¶[182].

[13c-2]

See supra [1c-2]; EX-1003, ¶[183].

[13d]

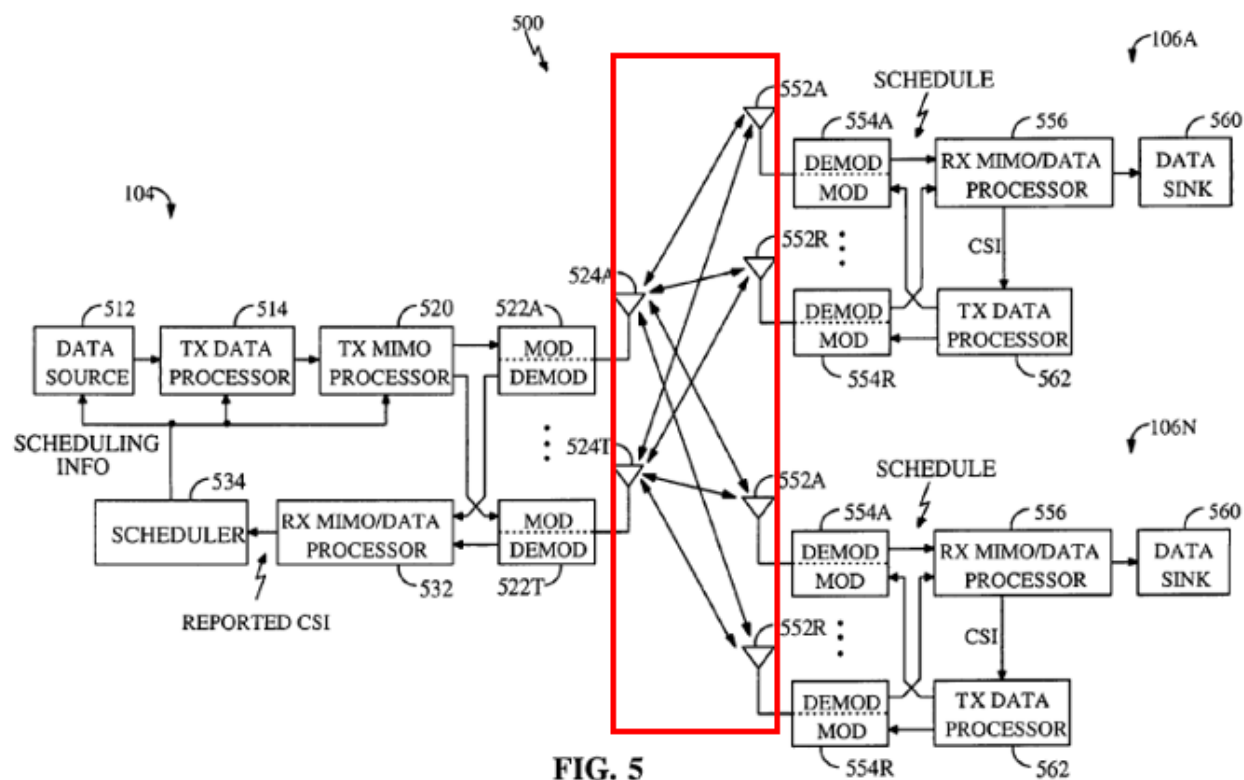
See supra [1d]; EX-1003, ¶[184].

[14]

As noted above in [4] and [7], PCT819 teaches that the base station receives channel state information (CSI) from a terminal. EX-1009, ¶¶[1126]-[1129], [1036]-[1037], [1167]. The base station's receiver includes an antenna 524 for receiving the CSI. EX-1009, ¶¶[1126]-[1129], FIG. 5. It would have been obvious to a POSITA that to send the CSI to the base station, the mobile station would include a transmitter that includes components such as antenna(s) 552 to transmit CSI to the base station, as indicated by the bi-directional arrows between the base

station antenna(s) 524 and mobile station antenna(s) 552 shown in PCT819's FIG.

5 below. EX-1003, ¶[186].



EX-1009, FIG. 5

IV. PTAB DISCRETION SHOULD NOT PRECLUDE INSTITUTION

Consistent with Congressional intent and goals of *NHK/Fintiv*, Petitioner asks the Board alone to consider challenges raised in this Petition. *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 at 6 (PTAB Mar. 20, 2020) (precedential) (“*Fintiv*”). For this and other reasons addressed below, *Fintiv* favors institution. *Id.*; *Sotera Wireless, Inc. v. Masimo Corp.*, IPR2020-01019 Paper 12 at 20-21 (PTAB Dec. 1, 2020) (precedential); *Snap, Inc. v. SRK Technology LLC*, IPR2020-

00820 Paper 15 at 19 (PTAB Oct. 21, 2020) (precedential).

1. Factor 1: Either Party May Request Stay

Factor 1 is neutral because neither party in the co-pending litigation has, as of yet, requested a stay pending the result of IPR. *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 15 at 12 (PTAB May 13, 2020); *Sand Revolution II, LLC v. Cont'l Intermodal Group – Trucking LLC*, IPR2019-01393, Paper 24 at 7 (PTAB June 16, 2020) (“*Sand Revolution*”) (informative).

2. Factor 2: Proximity of the Trial Date

The parties submitted a joint proposed scheduling order on August 6, 2021, asking the court to begin jury selection on January 17, 2023. EX-1014, 5. In the proposal, referencing, among others, the trial date, the parties jointly note that the “Court expects to set these dates at the conclusion of the *Markman* Hearing,” which, according to the proposed schedule, is set for January 13, 2022. EX-1014, 3 (emphasis added). Petitioner has filed a motion for intra-district transfer. Ex. 1015. In this motion, Petitioner moves that the case be transferred from the Waco Division to the Austin Division. The Court has granted a similar motion filed by Petitioner to transfer an action from the Waco Division to the Austin Division in the past. *See Datascape, Ltd. v. Dell Techs., Inc., et al.*, No. 6:19-CV-00129-ADA, 2019 WL 4254069 *2-3 (W.D. Tex. June 7, 2019) (transferring case involving Petitioner as a defendant from the Waco Division to the Austin Division, holding

that “the relevant convenience weighs heavily in favor of transfer” and that Dell (Petitioner) demonstrated that “the transferee venue is *clearly more convenient*” (emphasis in original).

Moreover, even if a trial occurs in January 2023, such a trial date would precede the Final Written Decision (FWD) date by at most two months. The Board has previously granted institution in cases in which a FWD was issued three to five months after the scheduled trial date. *See e.g., Sand Revolution*, IPR2019-01393, Paper 24 at 8-10. The Board has relied on various justifications when granting institution, e.g., Petitioners exercised diligence in filing the petition, the petition was accompanied with a stipulation not to pursue IPR grounds in litigation, minimal investment had been made in litigation (fact and expert discovery not started, petition was filed even before the serving of preliminary invalidity contentions), and the merits of the invalidity challenge were strong. *Verizon Business Network Services, Inc. v. Huawei Techs. Co.*, IPR2020-01141, Paper 12 (Jan. 14, 2021); *HP Inc. v. Slingshot Printing LLC*, IPR2020-01084, Paper 13 (Jan. 14, 2021). The same factors weigh even more heavily in favor of institution here. For instance, Petitioner has exercised diligence and filed this petition well in advance of the one-year bar date. As noted under Factor 4 below, Petitioner has additionally served Patent Owner’s counsel a conditional stipulation (EX-1005) broader than the stipulation accepted by the Board in *Sand Revolution* and *HP Inc.*

v. Slingshot and has stipulated not to assert any of the primary or secondary references used in the IPR grounds in litigation. *See Tide International (USA), Inv. V. UPL NA, Inc. case (IPR2020-01113)*. Moreover, fact and expert discovery have not started and no depositions have occurred. The *Markman* hearing has not yet been held. And, in view of the grounds asserted in this petition, the merits of the invalidity challenge are strong.

Therefore, *Fintiv* Factor 2 weighs against discretionary denial.

3. Factor 3: Petitioner’s Diligence and Investment in the IPR Outweighs the Parties’ Minimal Investment in Litigation

This petition was filed more than four months before the one-year statutory bar date. *Mylan*, IPR2018-01680, Paper 22 at 18 (finding that petition filed two months before bar date is “well within the timeframe allowed by statute, weighing heavily in [petitioner’s] favor”).

Moreover, Petitioner filed this petition at a very early stage of the litigation—a fact that “has weighed against exercising the authority to deny institution under *NHK*.” *Seven Networks*, IPR2020-00156, Paper 10 at 11-12 (June 15, 2020). In particular, Petitioner filed this petition even before a schedule has been issued for litigation. No substantive orders have been issued by the court, no depositions have been taken, and fact and expert discovery have not begun.

Overall, Factor 3 weighs against discretionary denial.

4. Factor 4: The Petition's Grounds Are Materially Different From Any That Might Be Raised in Litigation

As noted above, the co-pending litigation is in an early stage. At present, there is no overlap in issues between the litigation and any IPR resulting from this petition.

Moreover, consistent with *Fintiv*, Petitioner asks the Board alone to consider the unique challenges raised in the Petition. Petitioner has further eliminated any risk of duplicated effort by voluntarily stipulating to counsel for Patent Owner that, if the Board institutes an IPR based on this Petition, Petitioner will not pursue district court invalidity challenges based on the primary or secondary references asserted in this Petition. EX-1005; *see Tide International (USA), Inv. V. UPL NA, Inc. case (IPR2020-01113)*. A lack of overlap between the petition and the district court proceeding “has tended to weigh against exercising discretion to deny institution.” *Fintiv*, IPR2020-00019, Paper 11 at 12-14.

For at least these reasons, Factor 4 weighs against discretionary denial. *See, e.g., Fintiv* at 12-13; *Snap* at 13-16; *Sand Revolution* at 11-12.

5. Factor 5: Institution Would Promote Judicial Efficiency

Petitioner and Patent Owner are parties to the co-pending litigation. Petitioner has stipulated not to assert any of the primary or secondary references in this petition (and therefore any instituted grounds) in the co-pending litigation if

the PTAB institutes an IPR, a fact that favors institution and promotes judicial efficiency. *See Sand Revolution* at 11-12. At worst, where the parties are the same such as in this case, Factor 5 is neutral. *Cisco Sys., Inc. v. Ramot at Tel Aviv Univ. Ltd.*, IPR2020-00122, Paper 15 at *10 (PTAB May 15, 2020) (APJ Crumbley, dissenting).

6. Factor 6: The Merits of this Petition Strongly Favor Institution

The merits of this Petition are particularly strong. As demonstrated in the Petition with reference to Dr. Ding's testimony and additional evidence, institution would result in a finding of unpatentability of the Challenged Claims, which are obvious based on prior art references that materially differ from those considered by the Examiner during prosecution. The strength of the merits alone is enough to outweigh any inefficiencies born of parallel litigation (and as explained above, institution of this petition would actually *promote* efficiency). *See Fintiv* at 14-15. Accordingly, *Fintiv* Factor 6 favors institution. *See Snap* at 16-19.

V. CONCLUSION

Petitioner respectfully requests institution of the IPR and requests that the Board ultimately find the challenged claims unpatentable. EX-1003, ¶¶[30], [187].

VI. PAYMENT OF FEES

Petitioner authorizes charge of fees to Deposit Account 06-1050.

VII. MANDATORY NOTICES UNDER 37 C.F.R § 42.8(a)(1)

A. Real Party-In-Interest Under 37 C.F.R. § 42.8(b)(1)

Dell Inc. and Dell Technologies Inc. (collectively “Petitioner”) are the real parties-in-interest.

B. Related Matters Under 37 C.F.R. § 42.8(b)(2)

Petitioner is not aware of any disclaimers, reexamination certificates, or IPR petitions for the '941 Patent. The '941 Patent is the subject of the following civil action *Neo Wireless LLC v. Dell Technologies Inc. and Dell Inc.*, Case No. 6:21-cv-0024 (W.D. Tex.) (EX-1004).

C. Lead And Back-Up Counsel Under 37 C.F.R. § 42.8(b)(3)

Petitioner provides the following designation of counsel.

Lead Counsel	Backup counsel
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D. Service Information

Please address all correspondence and service to the address listed above.

Petitioner consents to electronic service by email at IPR00035-0023IP1@fr.com

(referencing No. 00035-0023IP1 and cc'ing PTABInbound@fr.com , axf-ptab@fr.com , riffe@fr.com , and khan@fr.com).

Respectfully submitted,

Dated: September 1, 2021

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(Control No. IPR2021-01468)

Attorneys for Petitioner

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 12,902 words, which is less than the 14,000 allowed under 37 CFR § 42.24.

Dated: September 1, 2021

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Attorneys for Petitioner

CERTIFICATE OF SERVICE

Pursuant to 37 CFR §§ 42.6(e)(4)(i) *et seq.* and 42.105(b), the undersigned certifies that on September 1, 2021, a complete and entire copy of this Petition for *Inter Partes* Review and all supporting exhibits were provided via Federal Express, to the Patent Owner by serving the correspondence address of record as follows:

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