

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

LENOVO (UNITED STATES) INC. and MOTOROLA MOBILITY LLC
Petitioners,

v.

COLLISION COMMUNICATIONS, INC.,
Patent Owner.

Case No. IPR2025-00284

U.S. Patent No. 8,089,946

PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 8,089,946

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EXHIBIT LIST

Ex.	Description
1001	U.S. Patent No. 8,089,946 (“’946 Patent”)
1002	Prosecution History for 8,089,946
1003	Declaration of Dr. Paul S. Min
1004	U.S. Patent Application Publication No. 2003/0235147 A1 (“Walton”)
1005	U.S. Patent No. 7,190,743 (“Learned”)
1006	U.S. Patent No. 7,139,283 (“Quigley”)
1007	U.S. Patent No. 6,826,140 (“Brommer”)
1008	RESERVED
1009	<i>Collision Communications, Inc. v. Samsung Electronics America, Inc. et al.</i> , 2:23-cv-00587-JRG (E.D. Tex.), Plaintiff Collision Communication Inc.’s Preliminary Disclosure of Asserted Claims and Infringement Contentions (served March 25, 2024), and its Exhibit 4 Infringement Chart for U.S. Patent No. 8,089,946
1010	<i>Curriculum Vitae</i> of Dr. Paul S. Min
1011	Verdu, Sergio, “Computational Complexity of Optimum Multiuser Detection,” <i>Algorithmica</i>
1012	Verdu, Sergio, “Multiuser Detection,” Cambridge University Press (1998)
1013	RFC 791 Internet Protocol, IETF, available at https://datatracker.ietf.org/doc/html/rfc791#page-11
1014	RESERVED

Ex.	Description
1015	Federal Court Management Statistics (September 2024).
1016	Memorandum, Interim Procedure for Discretionary Denials in AIA Post-Grant Proceedings with Parallel District Court Litigation (USPTO June 21, 2022) (“Guidance Memo”)
1017	Standing Order Regarding Readiness for Scheduling Conference (Judge Rodney Gilstrap, E.D. Tex., December 20, 2011), <i>available at www.txed.uscourts.gov/sites/default/files/judgeFiles/12-20-11%20Standing%20Order%20%20re%20Readiness%20for%20Scheduling%20Conference.pdf</i>
1018	Docket Control Order, Dkt. No. 44, <i>Collision Communications, Inc. v. Lenovo Group Ltd</i> , 2-23-cv-00594 (E.D. Tex.).
1019	Declaration of Paul S. Min Ph.D.

LIST OF CHALLENGED CLAIMS

Claim	Limitation
1pre	A modem which enables efficient use of bandwidth in a multiuser wireless network including a plurality of modems in the presence of interference and noise, the modem comprising:
1a	a multiuser detection (MUD) module configured to simultaneously demodulate and recover K wirelessly transmitted signals using co-channel demodulation;
1b	a data formatting module operatively coupled to the multiuser detection module, and configured to produce network data packets for at least one of the K recovered signals;
1c	a control processor operatively coupled to the formatting module, and configured to detect with which protocol mode the at least one of the K recovered signals was transmitted, and to enable a corresponding transmission mode including one of a legacy protocol mode and a bandwidth efficient aggressive access protocol mode that exploits co-channel demodulation capabilities of the modem, wherein the signals of the one of a legacy protocol mode can be selected from the group consisting of low data rate BPSK, QPSK, GMSK and OAM; and
1d	a demultiplexer operatively coupled to the data formatting module and the control processor, and configured to select one of the recovered K wirelessly transmitted signals as a target signal intended for a user associated with the modem, where the selection is based on a control input from the control processor, wherein the data formatting module supports multiple types of format modes, and the control processor is configured to select a network data packet formatting mode in which the data formatting operates.
2	The modem of claim 1, further comprising a front end configured to simultaneously receive the K wirelessly transmitted signals, and to provide those signals to the MUD and

Claim	Limitation
	a parameter estimator in a form that facilitates their subsequent processing by the multiuser detection module.
3	The modem of claim 1, wherein in response to the control processor knowing that a modem with which it is communicating does not support the bandwidth efficient aggressive access protocol mode, the control processor is further adapted to enable a legacy protocol mode.
4	The modem of claim 1, further comprising a parameter estimator module receiving D diversity inputs from D analog to digital (A/D) converters, the parameter estimator module outputting an S matrix to the MUD module, wherein the S matrix comprises estimated composite signature waveforms.
5	The modem of claim 1, further comprising a bank of K decoders communicating with the K MUD module outputs, the bank of K decoders producing a matrix b_n output to the MUD module from the input of K MUD module recovered signals, wherein the matrix b_n is a matrix of symbol estimates.
7	The modem of claim 1, wherein the control processor detects which of the received data signals 1-K is the intended data signal m, based on packet header information provided by the data formatting module.
9	The modem of claim 1, wherein the data formatting module provides packet header information to the control processor for each of the received signals 1-K, whereby a data signal intended

Claim	Limitation
	for a particular modem can be identified, while other received data signals can be ignored.
10pre	A modem which enables efficient use of bandwidth in a multiuser wireless network including a plurality of modems in the presence of interference and noise, the modem comprising:
10a	a multiuser detection (MUD) module receiving D inputs from D analog to digital (A/D) converters configured to simultaneously demodulate and recover K wirelessly transmitted signals using co-channel demodulation, simultaneously outputting K recovered signals;
10b	a parameter estimator module receiving the D inputs from the D A/D converters;
10c	a bank of K decoders communicating with the K MUD module outputs, the bank of K decoders producing a bn output to the MUD module from the input of K MUD module recovered signals;
10d	a data formatting module operatively coupled to the parallel K MUD module outputs of the MUD module, and configured to produce network data packets of the parallel K recovered signals, the parallel K recovered signal data packets communicated to a demultiplexer, wherein the data formatting module supports multiple types of network packet format modes;
10e	the demultiplexer operatively coupled to the data formatting module, receiving the parallel K recovered signal data packets, and configured to select one of the recovered K wirelessly transmitted signals as a target signal intended for a user, m, associated with the modem, and to communicate m data packets of the K recovered signal data packets to a recipient, where the selection is based on a control input from a control processor;
10f	the control processor operatively coupled to the demultiplexer and the data formatting module, and configured to detect with

Claim	Limitation
	which protocol mode the at least one of the K recovered signals was transmitted, based on input from the data formatting module, and to enable a corresponding transmission mode including one of a legacy protocol mode and a bandwidth efficient aggressive access protocol mode that exploits co-channel demodulation capabilities of the modem, the control processor also configured to select a network data packet formatting mode in which the data formatting operates
10g	a modulator operatively coupled to the control processor, the control processor enabling the transmission mode of the modulator, the transmission mode corresponding to the protocol mode in which the at least one of the K recovered signals was transmitted; and
10h	an amplifier operatively coupled to the modulator, the amplifier in communication with at least one antenna output port.
11a	The modem of claim 10, further comprising: a front end receiver block comprising a plurality, D, of antenna diversity ports, a plurality of D tuners, and the plurality of D A/D converters;
11b	the plurality, D, of antenna diversity ports communicating, respectively, with D antennas;
11c	the plurality of D tuners communicating, respectively, with the D antenna diversity ports;
11d	the plurality of D A/D converters communicating, respectively, with the D tuners, each outputting a baseband waveform, respectively corresponding to each of the D antenna diversity ports.
12	The modem of claim 10, wherein the m data packets of the K recovered signal data packets are formatted for and provided to a

Claim	Limitation
	network, where the selection is based on a control input from the control processor.
13	The modem of claim 10, wherein the m data packets of the K recovered signal data packets are formatted for and provided to a backbone, where the selection is based on a control input from the control processor.
14	The modem of claim 10, wherein the m data packets of the K recovered signal data packets are formatted for and provided to a local host, where the selection is based on a control input from the control processor.
15	The modem of claim 10, wherein the data formatting module provides packet header information to the control processor for each of received signals 1-K.
16	The modem of claim 15, wherein the packet header information of a data signal comprises intended destination of that data signal, whereby the data signal intended for a particular modem can be identified, while other received data signals are ignored.
20pre	A modem which enables efficient use of bandwidth in a multiuser wireless network including a plurality of modems in the presence of interference and noise, the modem comprising:
20a	a front end receiver block comprising a plurality, D, of antenna diversity ports, a plurality of D tuners, and a plurality of D analog to digital (A/D) converters;

Claim	Limitation
20b	the plurality, D, of antenna diversity ports communicating, respectively, with D antennas;
20c	the plurality of D tuners communicating, respectively, with the D antenna diversity ports;
20d	the plurality of D A/D converters communicating, respectively, with the D tuners, each outputting a baseband waveform, respectively corresponding to each of the D antenna diversity ports;
20e	a multiuser detection (MUD) module receiving D inputs from the D A/D converters, wherein the MUD module is configured to simultaneously demodulate and recover K wirelessly transmitted signals using co-channel demodulation, simultaneously outputting K recovered signals;
20f	a parameter estimator module receiving the D inputs from the D A/D converters, wherein the parameter estimator estimates the relative received timing offsets, phases, received amplitudes, and multipath structure for each of the interfering signals present in the received signal, outputting parameter estimation matrix S to the MUD module;
20g	a bank of K decoders communicating with the K MUD module outputs, the bank of K decoders producing a bn output to the MUD module from the input of K MUD module recovered signals;
20h	a data formatting module operatively coupled to the parallel K MUD module outputs of the MUD module, and configured to produce network data packets of the parallel K recovered signals, the parallel K recovered signal network data packets communicated to a demultiplexer, wherein the data formatting module supports multiple types of network data packet format modes;
20i	the demultiplexer operatively coupled to the data formatting module, receiving the parallel K recovered signal network data

Claim	Limitation
	packets, and configured to select one of the recovered K wirelessly transmitted signals as a target signal intended for a user, m, associated with the modem, and to communicate m data packets of the K recovered signal data packets to a recipient, where the selection is based on a control input from a control processor;
20j	the control processor operatively coupled to the demultiplexer and the data formatting module, and configured to detect with which protocol mode the at least one of the K recovered signals was transmitted, based on input from the data formatting module, and to enable a corresponding transmission mode including one of a legacy protocol mode and a bandwidth efficient aggressive access protocol mode that exploits co-channel demodulation capabilities of the modem, wherein the signals of the one of a legacy protocol mode comprise low data rate BPSK or QPSK, or BPSK and QPSK, the control processor also configured to select a network data packet formatting mode in which the data formatting operates;
20k	a modulator operatively coupled to the control processor, the control processor providing a burst control input, enabling a transmission mode of the modulator, the transmission mode corresponding to the protocol mode in which the at least one of the K recovered signals was transmitted, and an input of data from the user m from the demultiplexer; and
20l	an amplifier operatively coupled to the modulator, the amplifier in communication with at least one antenna output port.

I. INTRODUCTION

Petitioners Lenovo (United States) Inc. and Motorola Mobility LLC (collectively “Petitioners”) requests *Inter Partes* Review (“IPR”) of claims 1-5, 7, 9-16, and 20 of U.S. Patent No. 8,089,946 (“the ’946 patent”). Petitioners also file a contingent motion to join the IPR in *Samsung Electronics America, Inc., et al v. Collision Communications, Inc.*, Case No. IPR2024-01250 (“the Samsung IPR”), in which Samsung is challenging the same claims on the same grounds.¹ Petitioners submit this petition to preserve their motion for joinder or to allow for timely consideration of the prior art presented herein if the Samsung Petition is denied for reasons other than the likelihood of prevailing at trial.

The ’946 Patent relates to a narrow aspect in the field of “multi-user detection” (“MUD”). At its simplest, MUD is a technique used to mitigate interference created when multiple users transmit simultaneously over a shared channel. MUD techniques separate out and decode individual user signals from a combined, received signal.

¹ Petitioners have retained Paul Min, Ph.D. in this proceeding. EX1019. Dr. Min has adopted his prior opinions set forth in EX1003 (submitted in IPR2024-01250) and, for expediency, this Petition cites to Dr. Min’s previously submitted declaration, also presented herein as EX1003.

The '946 patent does not purport to invent MUD. Indeed, the patent's purported improvement over the prior art is simple: the ability to support a "legacy" protocol (having a low data rate) in a multi-user environment. Patentee's arguments in the file history confirm that this *legacy mode support is the only alleged point of novelty recited in the claims.*

But support for fallback legacy protocol modes is ubiquitous in the prior art and necessary for backwards compatibility support with older protocols, which was well-known. This was, in fact, pioneered by Qualcomm years before the '946 patent. This work is embodied in Walton (EX1004), and describes support for numerous "diversity transmission modes" (*e.g.*, single-antenna or multiple-antenna diversity schemes) used "to achieve higher reliability for certain data transmissions." EX1004, ¶¶72-75. These "diversity transmission modes" directly map onto the claimed "legacy" protocol mode—indeed, these diversity transmission modes correspond precisely to the same transmission modes relied upon by Patentee in its infringement contentions in the underlying district court litigation.

II. STANDING

Petitioners certify the '946 patent is available for *inter partes* review and they are not estopped.

III. GROUNDS

Petitioners present three Grounds based on Walton (Ground 1), Walton in

view of Learned (Ground 2), and Walton in view of Learned and Quigley (Ground 3).

Ground 1 is based on Patent Owner's infringement contentions in district court litigation against Samsung ("the Samsung district court litigation"), where the claimed "MUD module" is generally mapped to multiple- input multiple-output (MIMO) receivers in a wireless network. *See* EX1009, 2-14. Under this broad interpretation of a "MUD module," Walton's MIMO receiver renders every challenged claim obvious.

Ground 2 is based on the plain meaning of "MUD module," which is a component that detects, separates, and decodes signals from multiple users transmitting simultaneously over the same frequency band. Applying the correct meaning of the term, Walton's MIMO receiver does not necessarily comprise a MUD module. Accordingly, Ground 2 combines Walton with Learned, which expressly discloses multi-user detector, and thus renders every challenged claim obvious in combination with Walton.

Ground 3 further combines Walton and Learned with Quigley, to the extent Patent Owner argues Walton does not disclose providing a burst control input.

Ground	Basis	Reference(s)	Claims
1	§ 103	Walton	1-5, 7, 9-16, and 20
2	§ 103	Walton in view of Learned	1-5, 7, 9-16, and 20
3	§ 103	Walton in view of Learned and Quigley	20

IV. POSITA

A POSITA at the time of the '946 patent had at least a bachelor's in EE/CE/CS, physics, or equivalent, and two years of experience with cellular telecommunications, radio-access network architectures, protocols and signal propagation in wireless networks. EX1003, ¶59. Petitioners' expert exceeded this level of experience by the priority date. EX1010.

V. BACKGROUND

A. Technical Background

MUD techniques have been known for decades, and documented since at least the 1980s. EX1003, ¶¶33-46. Generally speaking, a MUD system allows users to transmit information over a shared communication path or channel. The users' information is transmitted as interfering signals² over the shared communication path or channel. As these signals are interfering, the receiver of the signals must differentiate the signals to correlate them with each user. MUD detects the signals for each user by demodulating the interfering signals using signal parameters (*e.g.*, signal phase, power, time delay, frequency, or code) related to each user.

The '946 patent also deals with legacy and bandwidth efficient modes. Legacy protocol modes for backwards compatibility in wireless networks have been used for decades. For example, stereo FM radio broadcasting was introduced in the

² Interfering signals are signals that suffer from interference from another signal that overlaps in phase, frequency, time, or power. Interfering signals may include unwanted noise or intentionally overlapping signals from multiple sources.

Interference in a received signal causes the primary signal's parameters to be obscured by the interfering signals.

1960s. Stereo FM radios, however, were still made to be backwards compatible with a legacy mode—mono FM radio. EX1003, ¶46.

B. '946 Patent

The '946 patent deals with a modem for multi-user detection. It recognizes that multi-user detection techniques are well known and conventional. Rather, the invention of the '946 patent is directed to the need for a bandwidth efficient wireless network modem capable of exploiting the channel densities of multiuser receivers. The asserted claims relate to the ability to support a “legacy” protocol (having a low data rate) in a multi-user environment, when a high data rate protocol is not available.

1. Prosecution History

The '946 patent's application was filed on August 27, 2009 and claimed priority as a division of patent application number 10/529,019 filed March 24, 2005. It further claimed priority as a divisional of U.S. National Phase of PCT Application No. PCT/US03/17377 filed on June 2, 2003. It claimed the benefit of U.S. Provisional Application No. 60/427,495 filed November 19, 2002, and claimed to be related to PCT Application No. PCT/US03/17449 filed June 2, 2003.

Collision has asserted that each of the at-issue claims are entitled to the March 24, 2005 priority date based on U.S. Pat. Appl. No. 10/529,019.

(a) April 3, 2010 Non-Final Rejection

The examiner issued a non-final rejection on April 3, 2010 under § 103 over

Reznik in view of U.S. Patent No. 6,529,488 (Urs). The examiner rejected all claims, finding Reznik discloses every element of the claims except a control processor that enables a transmission mode including one of a legacy protocol mode and a bandwidth efficient aggressive access protocol mode. EX1002, 139-141. The examiner relied on Urs's disclosure of "legacy subscriber equipment" to reject the claims because it would have been obvious to a POSITA to modify Reznik with Urs's teaching that such a modification would allow a system to transmit and receive radio communication using various frequencies and protocols based on a subscriber unit capability.

(b) October 13, 2010 Applicant Remarks

Applicant did not dispute Reznik discloses every limitation other than the "legacy protocol mode" element. Applicant's only argument was that Reznik and Urs apply to CDMA modulations, and that it is "not obvious that a multiuser detection (MUD) system that works on CDMA waveforms will work on legacy modulations." EX1002, 130. Specifically, Applicant argued that "CDMA is modulated through chipping to attain *a high bandwidth*," and the present invention applies to legacy signals including "*low data rate* BPSK, QPSK, GMSK, and QAM." *Id.*

(c) December 27, 2010 Final Rejection

Examiner found Applicant's arguments unpersuasive and noted the

Applicant's argument regarding low data rate were not recited in the claims.

**(d) February 10, 2011 Applicant Amendments and
Remarks with Request for Continued Examination**

Applicant amended the claims to include recitation of "low data rate BPSK, QPSK, GMSK, and QAM." EX1002, 114. Applicant reiterated its argument that Reznik and Urs were limited to the CDMA context, and thus fail to render the claims obvious. EX1002, 106.

(e) April 14, 2011 Non-Final Rejection

Examiner rejected the claims under § 103 over Reznik, in view of Urs, and further in view of U.S. Patent Appl. Publ. No. 2003/0048834 (Feher), which discloses a data formatting module supporting multiple types of format modes, and the control processor configured to select a formatting mode in which the data formatting operates, and wherein the signals of the one of a legacy protocol mode can be selected from the group consisting of low data rate BPSK, QPSK, GMSK, and QAM. EX1002, 85-88.

**(f) August 12, 2011 Applicant Amendment and
Remarks**

Applicant made minor edits to the claims that were not central to its argument, and added new claims. EX1002, 57. Applicant argued that there was no motivation to combine the prior art because none of them have any "suggestion of or capability to distinguish a bandwidth efficient aggressive access protocol mode." EX1002, 66-67. Applicant also argued that the prior art was not enabling because "the limited

description for *low data rate protocol modes* in Feher is lacking in specificity and detail such that one skilled in the art would not readily comprehend any form of *legacy protocol modes* as a fallback to bandwidth efficient aggressive access protocol modes without undue experimentation.” EX1002, 67 (emphasis added).

A Notice of Allowability issued on November 14, 2011. EX1002, 21.

2. Claim Construction

For purposes of this Petition only, Petitioners do not believe any terms require a formal construction. As noted above, the prior art renders the claims unpatentable under both Patent Owner’s interpretation of “MUD module” (Ground 1)³ and under the plain meaning of “MUD module” (Grounds 2 and 3). Every other term carries its “ordinary and customary meaning,” which is “the meaning that the term would have to a person of ordinary skill in the art in question” at the time of

³ Petitioners may rely on Patent Owner’s interpretation of the claims in an IPR, even if they disagree with that interpretation. *See, e.g., Philip Morris Products, S.A. v. Rai Strategic Holdings, Inc.*, IPR2020-00921, Paper 13 at 42-44 (Aug. 5, 2021) (petitioner can “rely[] on claim constructions that it believes are incorrect”); *Lewis Machine & Tool Co. v. WHG Properties, LLC*, IPR2020-00373, Paper 6 at 33-34 (July 27, 2020) (“[W]e are not persuaded that our rules prohibit Petitioner from relying on a claim construction it believes is incorrect.”).

the invention. *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007)

(citation omitted); EX1003, ¶¶62-63.

C. Prior Art

1. Walton (EX1004)

Walton is directed to techniques for transmitting data using a number of diversity transmission modes to improve reliability. It teaches a multiuser network wherein each terminal in the network “receives and processes the streams of samples from all receivers to provide recovered (i.e., demodulated data),” and then “demaps, deinterleaves, and decodes the recovered symbols to obtain the user-specific data.” EX1004, ¶¶42-43. Walton expressly teaches providing multiple modulation schemes, including legacy protocol modes (low code rate BPSK, QPSK, and 16-QAM, annotated in blue) and bandwidth efficient aggressive access protocol modes

(high code rate QPSK, 16-QAM, and 64-QAM, annotated in red). EX1004, ¶¶56-

58, Table 1:

TABLE 1

Convolutional Code			Turbo Code		
Efficiency (bps/Hz)	Code rate	Modulation	Efficiency (bps/Hz)	Code rate	Modulation
0.5	1/2	BPSK	0.5	1/2	BPSK
1.0	1/2	QPSK	1.0	1/2	QPSK
1.5	3/4	QPSK	1.5	3/4	QPSK
2.0	1/2	16-QAM	2.0	1/2	16-QAM
2.67	2/3	16-QAM	2.5	5/8	16-QAM
3.0	3/4	16-QAM	3.0	3/4	16-QAM
3.5	7/8	16-QAM	3.5	7/12	64-QAM
4.0	2/3	64-QAM	4.0	2/3	64-QAM
4.5	3/4	64-QAM	4.5	3/4	64-QAM
5.0	5/6	64-QAM	5.0	5/6	64-QAM

2. Learned (EX1005)

Learned is directed to an efficient multi-user detector in which “interfering users are assigned to levels of a decoding tree constructed in the decoder dependent on the power levels of the user's received signals and for each symbol interval.”

EX1005, Abstract. Learned discloses that its multi-user detector allows for a “reduced complexity search” with an increased likelihood of determining “the correct value for channel symbols.” *Id.*

3. Quigley (EX1006)

Quigley is directed to techniques for data transmission to enhance performance of the transmission system and permit multiple access from cable modems. EX1006, Abstract. It teaches a modem capable of burst transmissions.

VI. GROUNDS OF REJECTION⁴

A. Ground 1: Claims 1-5, 7, 9-16, and 20 are obvious over Walton

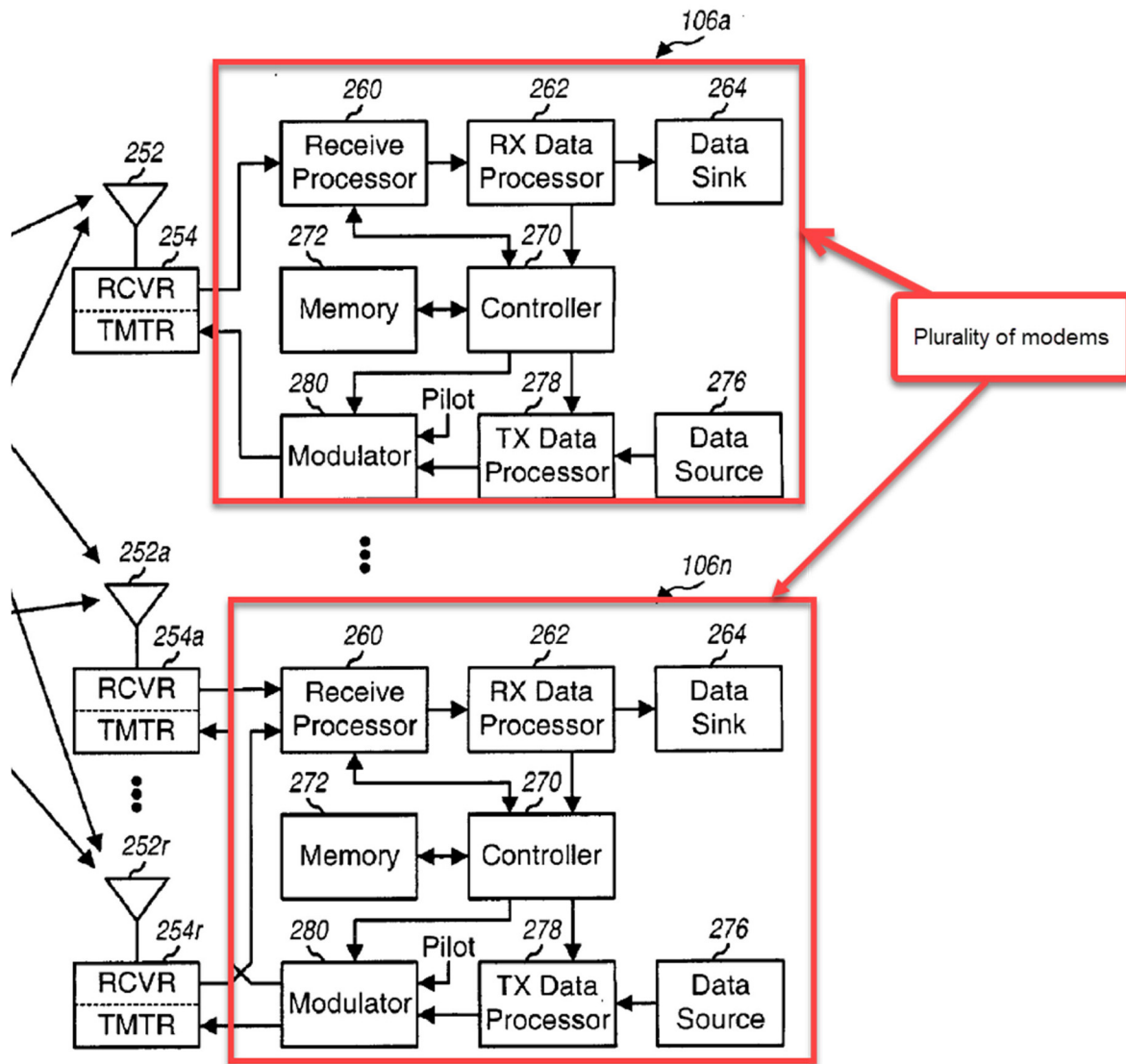
1. Claim 1

(a) 1pre

A modem: Walton discloses a multiple-input and multiple-output (MIMO)

⁴ Petitioners are not aware of any secondary considerations of non-obviousness identified by Patent Owner, though none would rise to the level of overcoming the invalidity opinions of Dr. Min. EX1003, ¶¶264-268. Petitioners reserve the right to address any secondary considerations if raised by Patent Owner.

system, comprising *multiple terminals containing modems*, using techniques for transmitting data involving diversity transmission modes to improve efficiency and reliability. EX1004, Abstract. Specifically, the terminals disclosed in Walton comprise “receive processors 260 [that] receives and processes the streams of samples from all receivers 254 to provide recovered symbols (i.e., demodulated data).” EX1004, ¶42. Additionally, the terminals disclosed in Walton comprise a “modulator 280 [that] symbol maps the interleaved data to provide modulated data, which is provided to one or more transmitters 254.” Accordingly, the portions of the mobile terminals in Figure 2 identified in red below are *modems*. EX1003, ¶ 71.



In a multiuser wireless network including a plurality of modems: As shown in Figure 2, Walton's network includes *multiple user terminals*. EX1003, ¶72. These terminals operate in a *multi-user wireless network* because they are “multiple-access systems capable of supporting communication with *multiple users* either sequentially or simultaneously.” EX1004, ¶4. Figure 1 below additionally shows that Walton's system comprises multiple user terminals 106a-n, each

containing a modem.

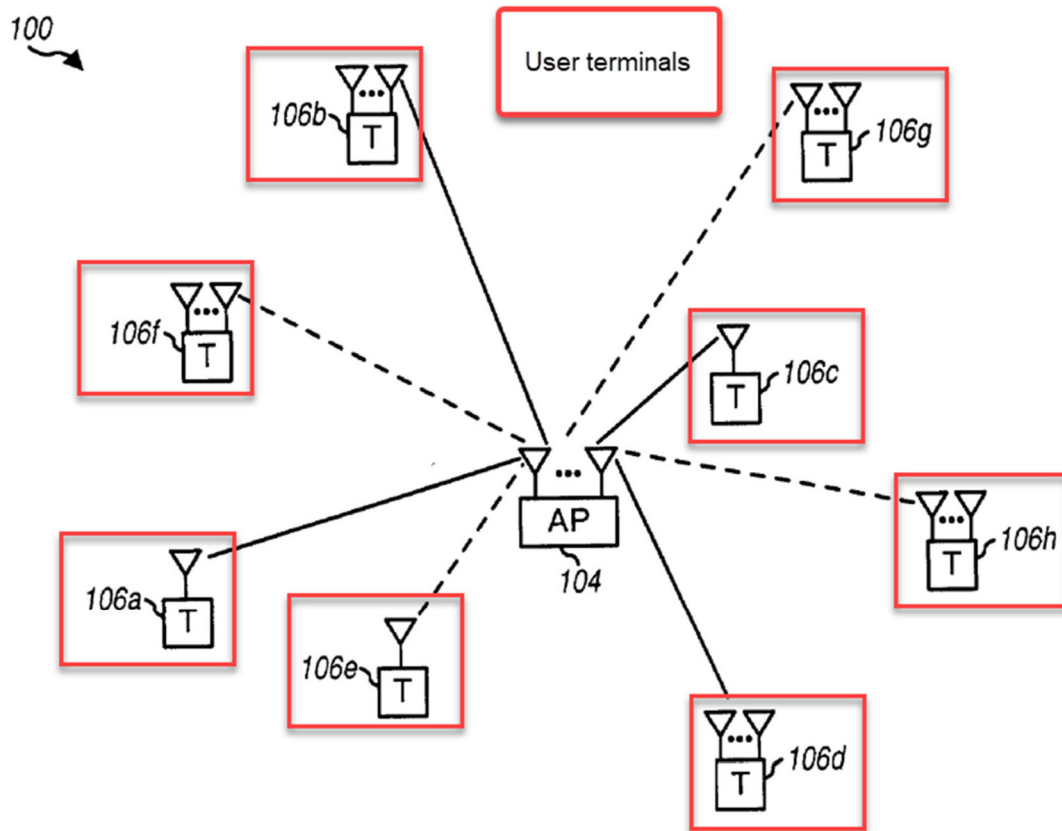


FIG. 1

Which enables efficient use of bandwidth: Walton teaches modems that enable *efficient use of bandwidth* by using techniques for transmitting data involving diversity transmission modes to improve reliability and spectral efficiency. EX1004, ¶¶56-58, 72-75, 92-94, 140; EX1003, ¶73.

In the presence of interference and noise: Walton also teaches that its system “combats frequency selective fading,” which causes “inter-symbol interference” for multiple-access systems (*i.e.*, *interference and noise*). EX1004, ¶¶8-10; EX1003, ¶73.

(b) 1a

A multiuser detection (MUD) module: Walton teaches a MUD module under the interpretation Patent Owner has advanced in the co-pending district court litigation. EX1003, ¶¶75-77. In the Samsung district court litigation, Patent Owner has mapped the “MUD module” to a receive processor in a MIMO system.⁵ EX1009, 2-14. Walton discloses the same technology. EX1004, ¶¶4-6. Specifically, Walton teaches a receive processor 260 in a MIMO system (*i.e.*, **MUD module**) that receives and processes signals streams to provide recovered symbols. EX1004, ¶¶7, 31, 42.

Configured to simultaneously demodulate and recover K wirelessly transmitted signals: Walton describes that “[f]or a MIMO system, a MIMO channel formed by the N_T transmit and N_R receive antennas may be decomposed into N_s independent channels.” EX1004, ¶7. “At each terminal 106, the downlink modulated signals from multiple transmit antennas of the access point are received by one or more multiple antennas 252 available at the terminal.” EX1004, ¶41. The receive processor (*i.e.*, **MUD module**) then “receives and processes the streams of

⁵ To the extent Patent Owner now argues that Walton’s receive processor is *not* a “MUD module,” Petitioner’s Ground 2 combines Walton with Learned for the express disclosure of a MUD module.

samples *from all receivers* 254 to provide *recovered symbols* (i.e., demodulated data)” (i.e., **demodulates and recovers K wirelessly transmitted signals**)

EX1004, ¶42; EX1003, ¶78. Walton also expressly teaches that multiple-access systems (such as its MIMO system) are “capable of supporting communication with multiple users ... *simultaneously*.” EX1004, ¶4.

Using co-channel demodulation: Walton’s receive processor uses orthogonal frequency division multiplexing (OFDM) (i.e., **co-channel demodulation**) to demodulate and recover the wirelessly transmitted signals. EX1003, ¶¶79-80. Walton teaches that OFDM “may be used to effectively partition the overall system bandwidth into a number of (N_F) subbands, which may also be referred to as OFDM subbands, frequency bins, or frequency sub-channels. Each subband is associated with a respective subcarrier upon which data may be modulated.” EX1004, ¶9. A POSITA would have understood that OFDM entails co-channel demodulation because OFDM signals are mapped onto overlapping subcarriers in a frequency channel. EX1003, ¶¶79-80. Patent Owner has also mapped OFDM demodulation to the claimed co-channel demodulation in the Samsung district court litigation. EX1009, 5 (citing to a Qualcomm patent that discloses a “receiver unit” performing “*OFDM demodulation*”), 22 (relying on an “*OFDM symbol stream for each subcarrier of the OFDM signal*” that is “*demodulated*”).

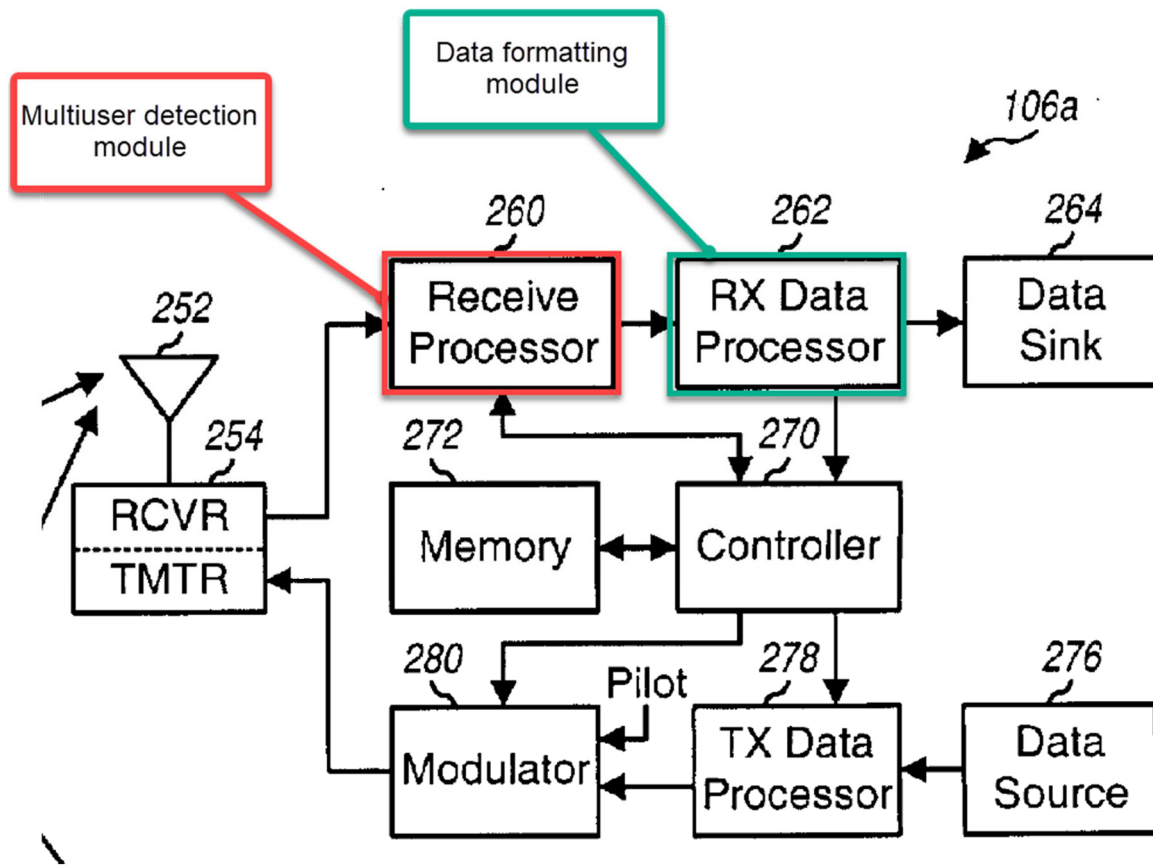
(c) 1b

A data formatting module ... configured to produce network data packets for at least one of the K recovered signals: Walton discloses a “receive (RX) data processor 262” (*i.e.*, a **data formatting module**) that “symbol demaps, deinterleaves, and decodes the recovered symbols to obtain the user-specific data and signaling transmitted on the downlink for the terminal.” EX1004, ¶43.

A POSITA would have understood that the symbol demapping, deinterleaving, and decoding process performed by the receive (RX) data processor produces network data packets for the recovered signals. EX1003, ¶¶82-83. Walton teaches that “wireless communication systems are widely deployed to provide various types of communication, such as voice, *packet data*, and so on.” EX1004, ¶4. In one embodiment, “the data for each data stream is initially partitioned into frames (or *packets*).” EX1004, ¶52. At the receive (RX) data processor, the decoder “provide[s] the status of each received *packet*” for each of the recovered signals. EX1004, ¶146. In order to provide the status of received packets, the receive (RX) data processor necessarily must first *produce* packets for the recovered signals. EX1003, ¶¶82-83.

Operatively coupled to the multiuser detection module: As shown in Figure 2, the receive (RX) data processor (*i.e.*, *data formatting module*) is operatively coupled to the receive processor (*i.e.*, *MUD module*) to receive the

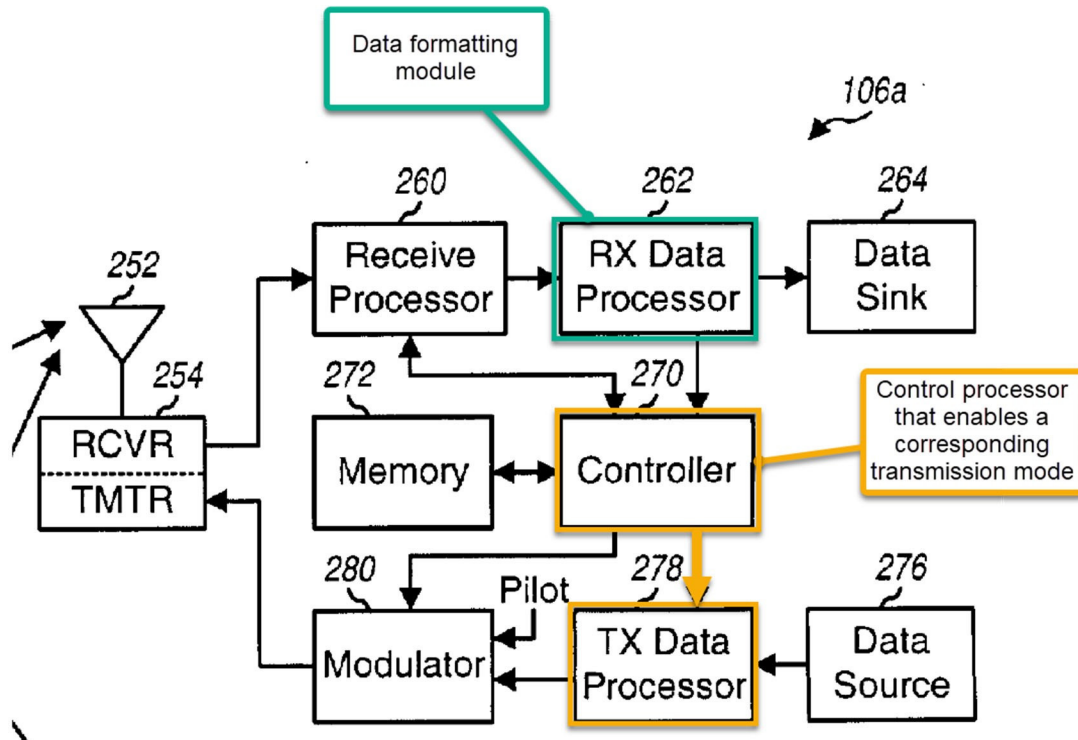
recovered symbols. EX1004, ¶¶41-42; EX1003, ¶84.



(d) 1c

A control processor operatively coupled to the formatting module:

Walton discloses a controller 270 (*i.e.*, **control processor**) that is **operatively coupled** to the receive (RX) data processor (*i.e.*, **data formatting module**), as shown in Figure 2, annotated below. EX1003, ¶85.



Configured to detect with which protocol mode the at least one of the K recovered signals was transmitted: Walton's controller "direct[s] the operation at the access point and the terminal." EX1004, ¶46. The "[c]ontroller 270 may be designed to perform various functions related to diversity processing at the receiver," including "*determin[ing] the diversity transmission mode used for each data stream to be recovered*" (i.e., *detecting with which protocol mode a recovered signal was transmitted*). EX1004, ¶147; see also *id.*, Claim 49 ("A receiver apparatus in a wireless communication system, comprising: means for *determining a particular diversity transmission mode used for each of one or more data streams to be recovered* from a received data transmission"); EX1003, ¶87.

To enable a corresponding transmission mode: A POSITA would have

understood that Walton's controller (*i.e.*, **control processor**) controls the transmission modes used by the TX data processor because the controller "direct[s] the operation at ... the terminal." EX1004, ¶46; EX1003, ¶¶88-97. Among other things, as shown in Figure 2 above, Walton's controller directs the operation of a "TX [transmission] data processor 278" that "codes the different types of traffic data in accordance with their respective coding schemes" and a "modulator 280" that "symbol maps the interleaved data to provide modulated data." EX1004, ¶44. In addition, a POSITA would have understood that the same protocol modes (*i.e.*, a **corresponding mode**) would be used to respond to a received packet because the access point and terminal need to use the same protocols in order to be able to communicate properly. EX1003, ¶¶88-97.

Including one of a legacy protocol mode and a bandwidth efficient aggressive access protocol mode that exploits co-channel demodulation capabilities of the modem: Each terminal in Walton supports a number of "diversity transmission modes" (*i.e.*, **protocol modes**) depending on the number of antennae and the type of channel. EX1004, ¶¶126-140 (describing "fixed or dynamically selected" diversity transmission modes); EX1003, ¶¶88-97. "The specific [diversity] transmission mode to use for a given data stream may be dependent on various factors such as (1) the type of data being transmitted (*e.g.*, whether common for all terminals or user-specific for a particular terminal), (2) the

number of antennas available at the transmitter and receiver, (3) the channel conditions, (4) the requirements of the data transmission (e.g., the required packet error rate), and so on.” EX1004, ¶134.

“The diversity transmission modes may be used to achieve higher reliability for certain data transmissions,” for example, “when the channel conditions are sufficiently poor (e.g., under certain mobility conditions) and cannot support more spectrally efficient transmission modes.” *Id.* ¶¶72-75, 140; EX1003, ¶¶88-97.

Walton teaches multiple diversity modes, including different modes for single-antenna terminals (“frequency diversity transmission mode with dual or quad diversity”), dual-antenna terminals (“STTD transmission mode for dual diversity and frequency-STTD transmission mode for quad diversity”), and quad-antenna terminals (“STTD transmission mode for dual diversity and Walsh-STTD transmission mode for quad diversity”). EX1004, ¶¶135-139; *see also id.* ¶14 (describing four different diversity transmission modes). These multiple modes constitute at least a “***legacy protocol mode***” (for single-antenna) and a “***bandwidth efficient aggressive access protocol mode***” (for dual- and quad-antenna)⁶

⁶ In Collision’s infringement contentions in the Samsung district court litigation, Collision cited to “non-MIMO, single antenna” as the “legacy” mode and single-user MIMO (SU-MIMO) as the “bandwidth efficient mode” (EX1009 at 29)—

because some modes are associated with “*higher spectral efficiency*” over other modes. *Id.* ¶¶103, 113 (STTD modes provide higher bandwidth efficiency than frequency diversity and Walsh modes and Walsh-STTD modes having twice the spectral efficiency of Walsh modes); EX1003, ¶93.

As discussed in Limitation 1a, Walton uses OFDM for co-channel demodulation. *See* EX1004, ¶9; EX1009, 5, 13 (Patent Owner’s infringement contentions citing to OFDM demodulation as evidence of co-channel demodulation). Walton’s dual-antenna and quad-antenna diversity transmission modes (*i.e.*, **bandwidth efficient aggressive access protocol modes**) use OFDM (*i.e.*, **exploit co-channel demodulation capabilities**). EX1003, ¶96. Walton teaches that the “Walsh diversity transmission mode ... transmits each modulation symbol over N_T **OFDM** symbol periods, where N_T is the number of transmit antennas used for data transmission”; “a space time transmit diversity (STTD) transmission mode ... transmits modulation symbols over multiple **OFDM** symbol periods and multiple transmit antennas”; and “a Walsh-STTD transmission mode ... transmits modulation symbols using a combination of Walsh diversity and STTD.” EX1004, ¶14; *see also id.*, ¶94 (“Space-time transmit diversity (STTD) supports

precisely the same “diversity transmission modes” described by Walton. EX1004, ¶¶126-140; EX1003 ¶92.

simultaneous transmission of effectively two independent symbol Streams *on two transmit antennas* while maintaining orthogonality at the receiver. An STTD scheme may thus provide higher spectral efficiency”).

Wherein the signals of the one of a legacy protocol mode can be selected from the group consisting of low data rate BPSK, QPSK, GMSK and QAM:

Walton teaches that various coding and modulation schemes may be used with the different diversity transmission modes (including the **legacy protocol mode**), including “**BPSK** [binary phase-shift keying], **QPSK** [quadrature phase shift keying], **16-QAM** [quadrature amplitude modulation], [and] **64-QAM**.” EX1004, ¶57. While Walton does not expressly teach GMSK⁷, it would have been obvious to one skilled in the art to use GMSK [Gaussian minimum-shift keying] as a modulation scheme because it is similar to QPSK, except that instead of square pulses it uses continuous pulses. EX1003, ¶¶98-102. A POSITA would have understood that at least the modulation and coding schemes employing BPSK, QPSK, or 16-QAM with a code rate of ½ would constitute “**low data rate BPSK, QPSK, ... and QAM**” (particularly when compared to Walton’s 64-QAM

⁷ Because this limitation sets forth a Markush grouping of *alternative* modulation schemes, only one is required to be disclosed in the prior art to establish invalidity. *In re Harnisch*, 631 F.2d 716 (CCPA 1980).

modulation with efficiency 5.0 bps/Hz and a code rate of 5/6). EX1004, Table 1

(annotated below); EX1003, ¶¶98-102. Walton expressly teaches that the different modulation and coding schemes enable “a range of spectral efficiencies (or bit rates).” EX1004, ¶¶56-58 Walton also teaches that “the data rate for each user-specific data stream may be adjusted based on the transmission capability of the receiver device.” *Id.*, ¶15.

TABLE 1

Convolutional Code			Turbo Code		
Efficiency (bps/Hz)	Code rate	Modulation	Efficiency (bps/Hz)	Code rate	Modulation
0.5	1/2	BPSK	0.5	1/2	BPSK
1.0	1/2	QPSK	1.0	1/2	QPSK
1.5	3/4	QPSK	1.5	3/4	QPSK
2.0	1/2	16-QAM	2.0	1/2	16-QAM
2.67	2/3	16-QAM	2.5	5/8	16-QAM
3.0	3/4	16-QAM	3.0	3/4	16-QAM
3.5	7/8	16-QAM	3.5	7/12	64-QAM
4.0	2/3	64-QAM	4.0	2/3	64-QAM
4.5	3/4	64-QAM	4.5	3/4	64-QAM
5.0	5/6	64-QAM	5.0	5/6	64-QAM

(e) 1d

A demultiplexer . . . configured to select one of the recovered K wirelessly transmitted signals as a target signal intended for a user associated with the modem: Although this limitation recites a “demultiplexer,” the function the element

is described as performing (“select[ing] one of the recovered K wirelessly transmitted signals”) is that of a “multiplexer.” EX1003, ¶¶104-105. A POSITA would have been familiar with demultiplexers and multiplexers, and would have known that a demultiplexer takes a single input signal and outputs multiple signals, while a multiplexer (also often referred to as a “data selector”) takes multiple signals as input and selects one of the input signals to forward. *Id.* Accordingly, a POSITA would have understood that the claimed “demultiplexer” implements functionality that in the prior art would be attributed to a multiplexer. *Id.*

Walton teaches a multiplexer configured to select one of the recovered K wirelessly transmitted signals as a target signal intended for a user associated with the modem because “multiplexer 1140 *receives the recovered symbols* [*i.e.*, the **recovered K wirelessly transmitted signals**] from RX subband processors 1120a through 1120f *and multiplexes these symbols into a recovered symbol stream, $\hat{s}_i(n)$, for receive antenna i* [*i.e.*, **a target signal intended for a user**].” EX1004, ¶156; EX1003, ¶¶104-107.

Walton further confirms that the “receive (RX) data processor 262 [] symbol demaps, deinterleaves, and decodes the recovered symbols to obtain the user-specific data,” *i.e.*, **a target signal intended for a user**. EX1004, ¶43; *see also* Claim 17 (“The method of claim 1, wherein at least one data stream is **user-specific** and transmitted for a **specific receiver device**.”).

Operatively coupled to the data formatting module and the control

processor: Figure 11 (below) in Walton “is a block diagram of an RX antenna processor within the RX diversity processor,” (EX1004, ¶29) which includes Walton’s multiplexer. The RX diversity processor is in turn included in Walton’s receive processors 260. EX1004, Figs. 2, 9, 11.

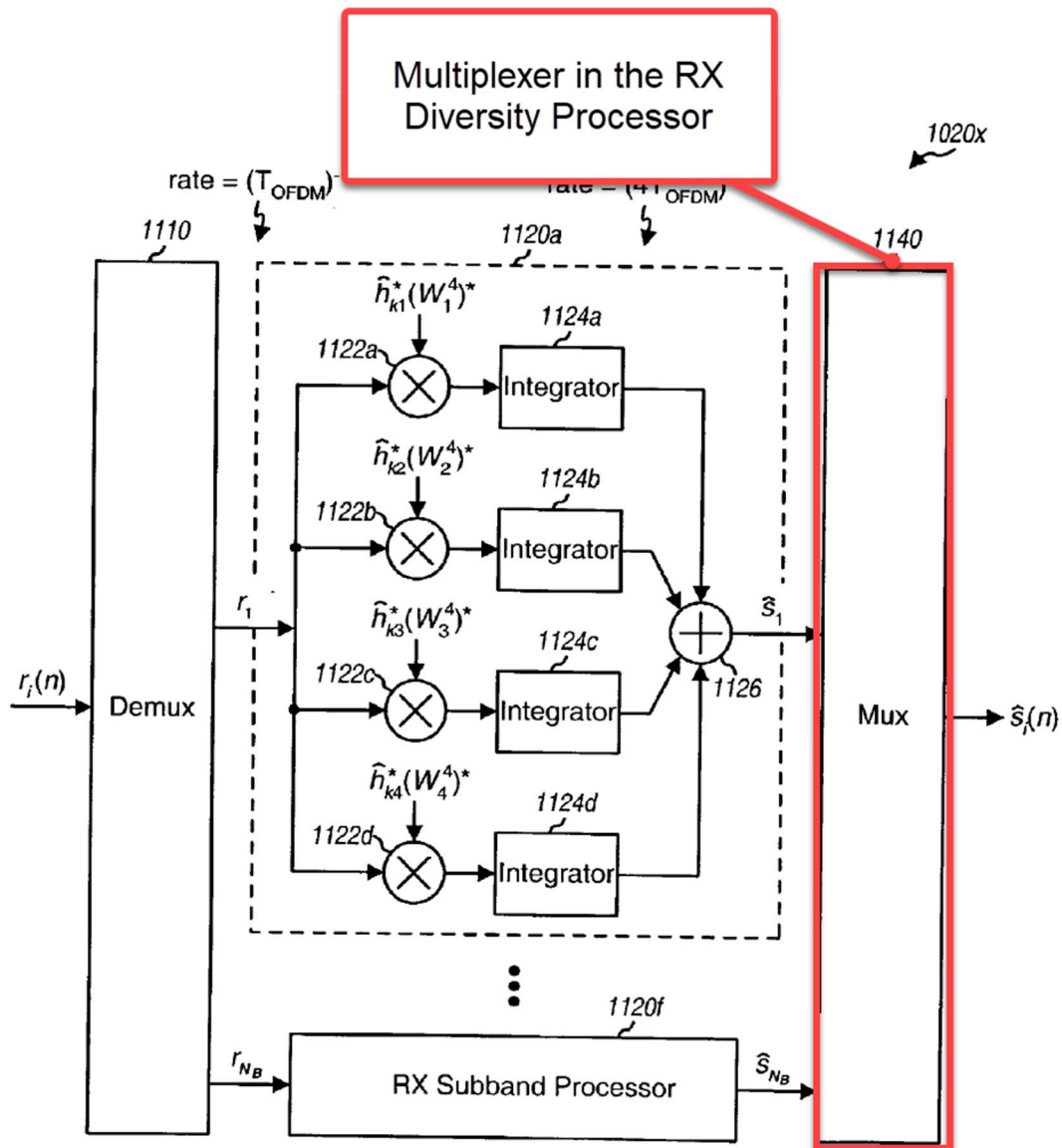
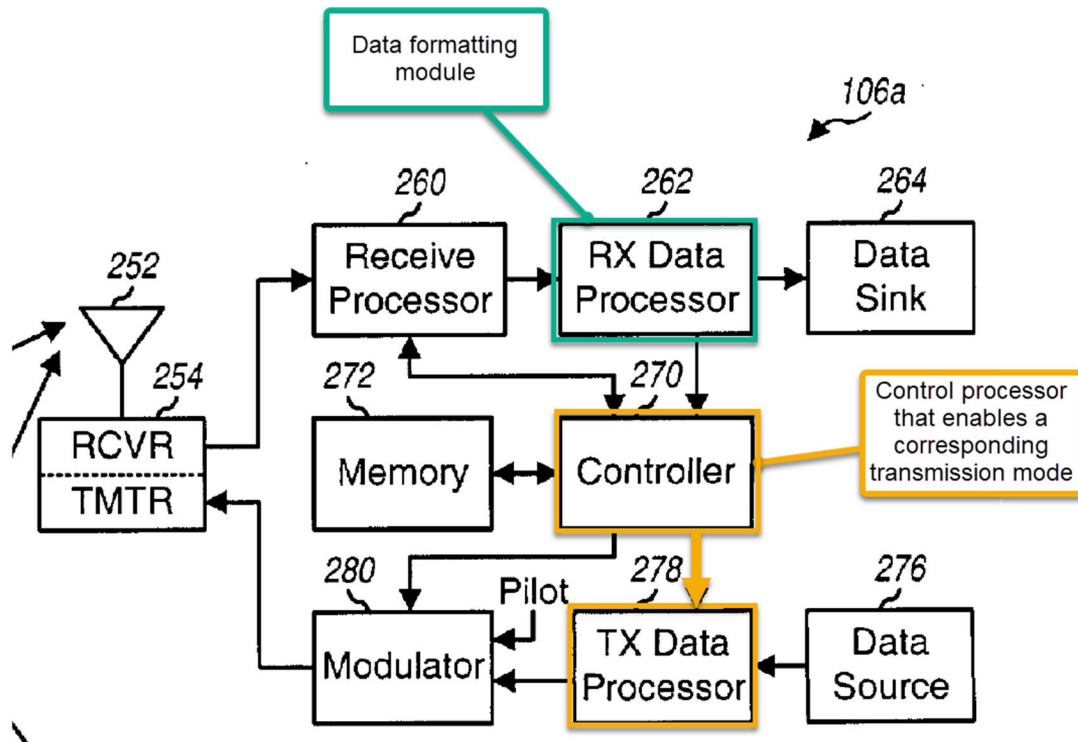


FIG. 11

As discussed in Limitation 1b and shown in Figure 2 (below), the receive

processor (and thus the multiplexer) *is operatively coupled* to both the RX data processor (the *data formatting module*) and the controller (the *control processor*).

EX1004, ¶¶41-42, Fig. 2; EX1003, ¶¶108-109.



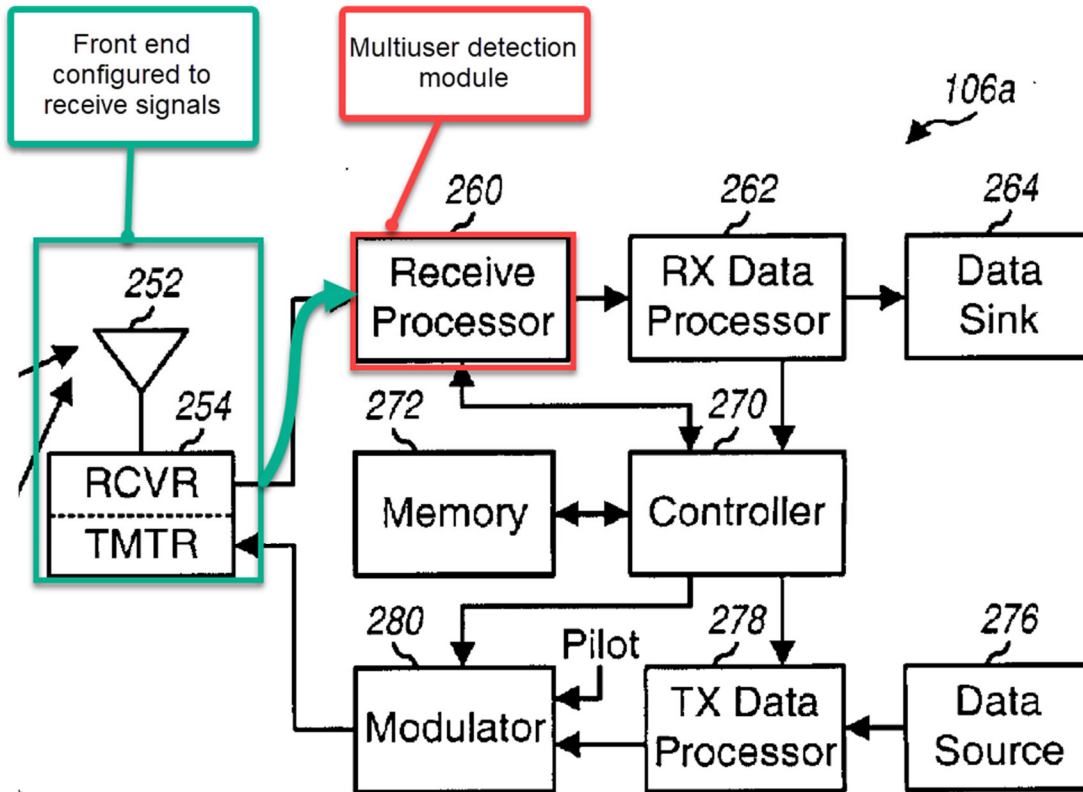
Where the selection is based on a control input from the control processor, wherein the data formatting module supports multiple types of format modes, and the control processor is configured to select a network data packet formatting mode in which the data formatting operates: Walton discloses that controller 270 (*i.e., the control processor*) “direct[s] the operation at the access point and the terminal,” and “may be designed to perform various functions related to diversity processing at the receiver,” including “determin[ing] the diversity transmission mode used for each data stream ... [and] further

direct[ing] the operation of RX diversity processor.” EX1004, ¶¶46, 147. A

POSITA would have understood that the controller processor, by directing the operation at the terminal and determining the diversity transmission mode, provides a **control input** that is used to **select the network data packet formatting mode** corresponding to the terminal operation and diversity transmission mode. EX1003, ¶¶109-111. EX1004, ¶44. In addition, as discussed above, Walton discloses multiple diversity transmission modes (*i.e.*, **multiple types of format modes**) that are supposed by the RX data processor (the **data formatting module**). *Id.* ¶¶14, 72-75, 135-140; EX1003, ¶¶109-111.

2. Claim 2

A front end configured to simultaneously receive the K wirelessly transmitted signals, and to provide those signals to the MUD: Walton teaches that at each terminal “the downlink modulated signals from multiple transmit antennas of the access point are *received* by one or multiple antennas 252 available at the terminal. The received signal from each antenna 252 is provided to a respective receiver (RCVR) 254.” EX1004, ¶41. This receiver is *a front end*, and is *coupled to the MUD module to provide the wirelessly transmitted signals*, as shown in Figure 2 below. EX1003, ¶¶113-114.



The receiver (*i.e.*, **front end**) receives these signals **simultaneously**.
EX1003,

¶114. Walton expressly discloses that multiple-access systems (including its MIMO system) are capable of supporting communication with multiple users simultaneously. EX1004, ¶4. Figure 9 confirms that Walton's system can simultaneously receive wirelessly transmitted signals through multiple antennas.

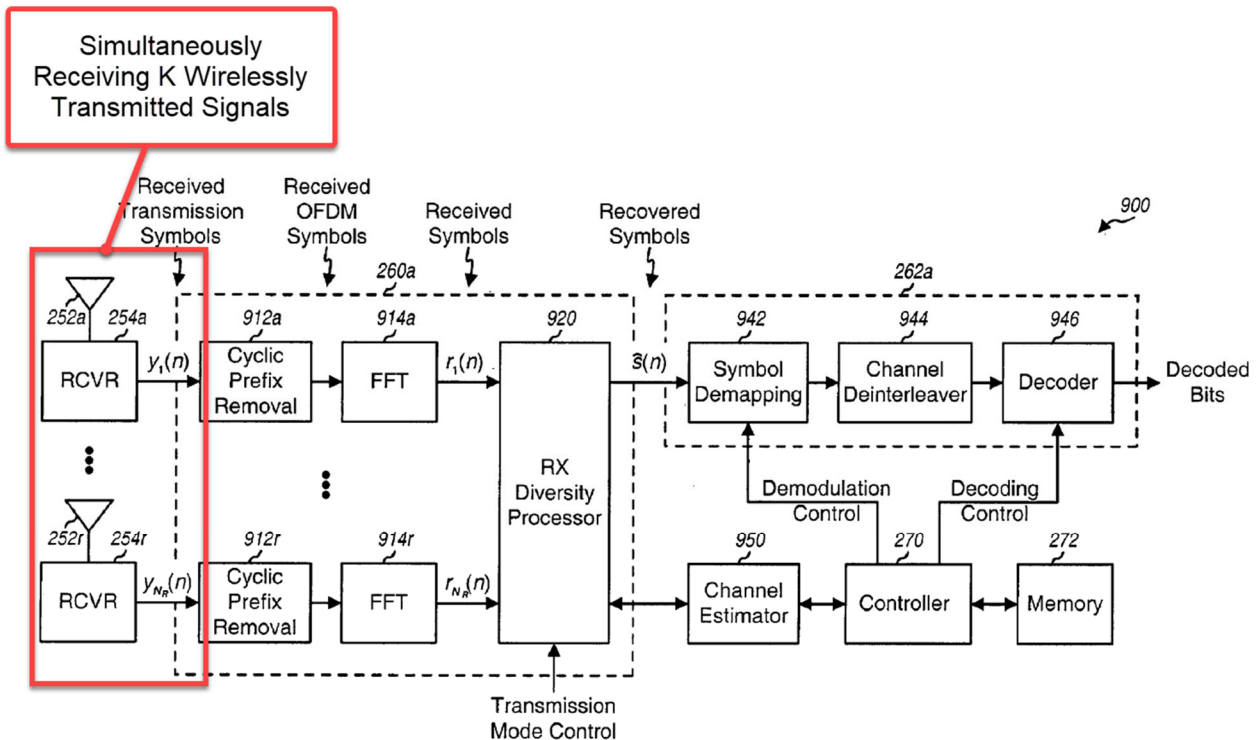


FIG. 9

[And to provide those signals to ...] a **parameter estimator** : Walton's receiver (*i.e.*, **front end**) transmits the received signals to a **parameter estimator**, *i.e.*, "**channel estimator** 950 [that] estimates various channel characteristics such as the channel response and the noise variance (e.g., based on recovered pilot symbols) and provides these estimates to controller 270." EX1004, ¶147; EX1003, ¶¶115-116. In its infringement contentions, Patent Owner has also mapped a channel estimator to be the claimed parameter estimator. EX1009, 43 ("The Accused '946 Instrumentalities include a **parameter estimator** (*e.g.*, **channel estimator**) that receives separate inputs from each A/D converter.").

In a form that facilitates their subsequent processing by the multiuser detection module: The transmitted signals are provided to the MUD module and

the parameter estimator **in a form that facilitates their subsequent processing** because they go through conditioning by the receiver (*i.e.*, the **front end**). EX1004, ¶41 (“Each receiver 254 conditions (e.g., filters, amplifies, and frequency down-converts) its received signal and further digitizes [*i.e.*, converts from analog to digital] the conditioned signal.”); EX1003, ¶¶117-118.

3. Claim 3

As discussed above for Limitation 1c, Walton discloses multiple diversity transmission modes, including single-antenna frequency diversity transmission modes (*i.e.*, **legacy protocol modes**), and dual- and quad-antenna STTD and Walsh modes (*i.e.*, **bandwidth efficient aggressive access protocol modes**). EX1004, ¶¶14, 135-139. “The specific transmission mode to use for a given data stream may be dependent on *various factors such as* (1) the type of data being transmitted (e.g., whether common for all terminals or user-specific for a particular terminal), (2) *the number of antennas available at the transmitter and receiver*, (3) the channel conditions, (4) the requirements of the data transmission (e.g., the required packet error rate), and so on.” EX1004, ¶134. A POSITA would have understood from this disclosure that if a modem only has one antenna—and thus *does not support* the multi-antenna STTD and Walsh modes (**bandwidth efficient aggressive access protocol modes**), then the *single-antenna* frequency diversity transmission mode (**legacy protocol mode**) will be enabled. EX1003, ¶¶120-121. Walton teaches that

the controller (*i.e.*, **control processor**) makes this determination, because the controller “determines the diversity transmission mode [*i.e.*, **protocol mode**] used for each data stream.” EX1004, ¶147.

4. Claim 4

A parameter estimator module receiving D diversity inputs from D analog to digital (A/D) converters: As discussed in claim 2 above, Walton discloses a channel estimator (*i.e.*, **parameter estimator module**). EX1004, ¶147; EX1003, ¶¶123-125; EX1009, 43 (Patent Owner’s infringement contentions mapping the claimed **parameter estimator module** to a “channel estimator” in accused products).

As shown in Figure 9 below, Walton teaches that its receivers provide R diversity signals (*i.e.*, **D diversity inputs**), corresponding to R receivers, to the channel estimator. EX1003, ¶¶123-125. Specifically, Walton’s front end contains multiple receivers, the received signals from which pass through the RX diversity processor and are received by the channel estimator. EX1004, ¶147; *see also* Figure 9 (annotated below). Each of the R receivers includes an analog to digital converter (*i.e.*, **D analog to digital (A/D) converters**) because it “conditions ... its received signal and further digitizes [*i.e.*, **converts from analog to digital**] the conditioned signal.” EX1004, ¶41.

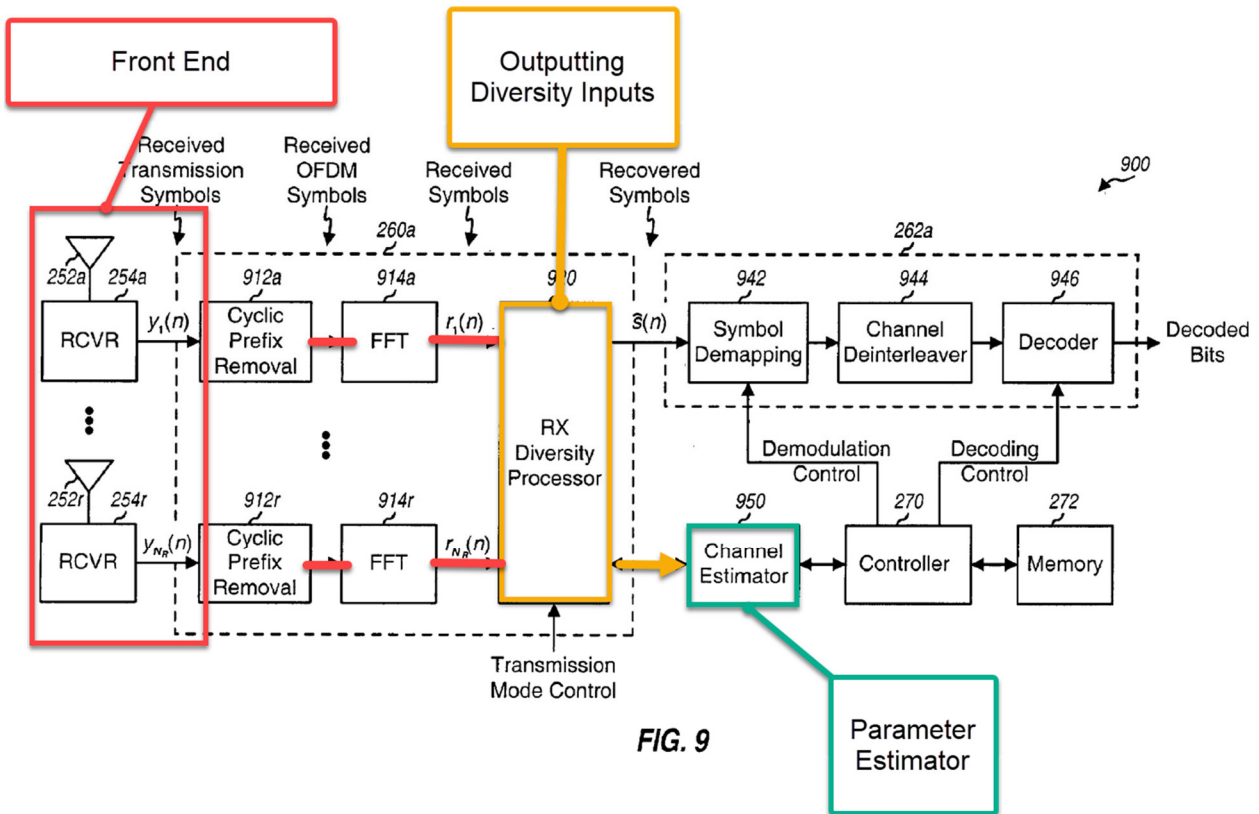


FIG. 9

The parameter estimator module outputting an S matrix to the MUD module, wherein the S matrix comprises estimated composite signature waveforms: Walton's "channel estimator [*i.e.*, parameter estimator module] ... estimates various channel characteristics such as the channel response and the noise variance (e.g., based on recovered pilot symbols) and provides these estimates to controller 270." EX1004, ¶147. The pilot symbols that are used for this estimation are separately transmitted from each transmitting antenna, and comprise signature waveforms for each channel. EX1004, ¶¶82-85, 147; EX1003, ¶¶126-130. As shown in Figure 9, the channel estimator output is provided to Walton's receive processor 260 (*i.e.*, MUD module) via the RX diversity processor. The estimates

are also provided to controller 270, which “direct[s] the operation of RX diversity processor 920.” EX1004, ¶147.

A POSITA would have known and it would have been obvious that the output of a parameter estimator (e.g., the channel estimates output from a channel estimator) are typically organized in matrix form (e.g., a data structure having row and column indices, such as an index for one of the N_T transmitters and another index for one of the N_R receivers). EX1003, ¶¶126-130. In addition, the '946 patent acknowledges that its parameter estimation module “can be implemented in conventional technology,” and that conventional parameter estimators output “a matrix (S) of estimated composite signature waveforms.” EX1001, 13:40-47, 14:7-9. Other references naming the same inventor as the '946 patent similarly recognize that “it is well known in the art how to compute parameter estimates for the S matrix.” EX1007, 26:51-62.

5. Claim 5

A bank of K decoders communicating with the K MUD module outputs:

Walton teaches that *a bank of decoders* is used in multi-antenna environments—one decoder for each antenna. EX1003, ¶¶132-134. For example, in the embodiment illustrated in Figures 9 and 10, RX diversity processor 920 receives input from multiple antennas and corresponding receivers—one for processing each received symbol stream: “the N_R received symbol streams for the N_R receive antennas are

provided to N_R RX antenna processors 1020 a through 1020 r . Each RX antenna processor 1020 processes a respective received symbol stream, $r_i(n)$, and provides a corresponding recovered symbol stream, $\hat{s}_i(n)$, for the associated receive antenna.”

EX1004, ¶148. A POSITA would have understood and it would have been obvious that each antenna and corresponding RX antenna processor is associated with a corresponding RX data processor (including a decoder) to process each respective received symbol stream and output a recovered symbol stream for that antenna.

EX1003, ¶¶132-134. Multiple decoders in parallel can make use of the diversity gain provided by multiple antennas and better handle interference by separately processing signals. *Id.*

Further, as disclosed in Figure 9 below, Walton’s decoders communicate with the multiple RX diversity processor (**MUD module**) outputs. EX1003, ¶134.

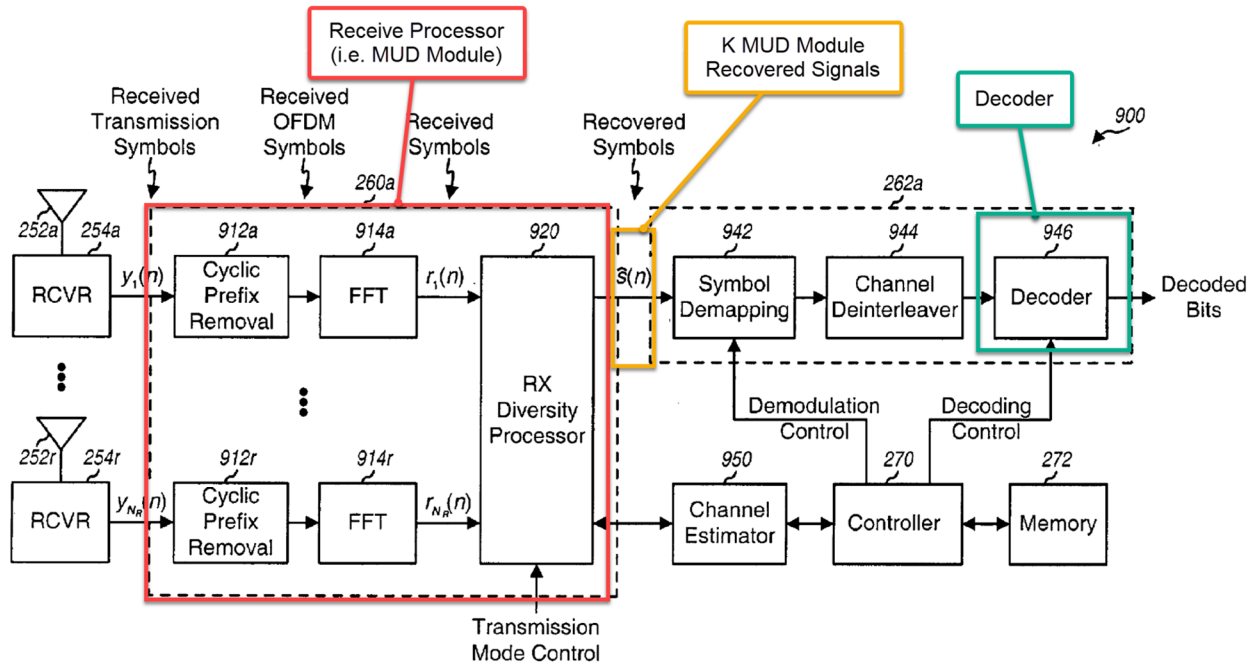


FIG. 9

The bank of K decoders producing a matrix $\hat{b}_n$ output to the MUD module from the input of K MUD module recovered signals, wherein the matrix $\hat{b}_n$ is a matrix of symbol estimates: Walton teaches that the received signal may be expressed in matrix form. EX1004, ¶96; EX1003, ¶¶135-141. Walton further teaches that the decoders receive the recovered signals from the receive processor (i.e., K MUD module recovered signals) as input, and that the outputs of the decoders are estimates of the transmitted data being recovered (i.e., symbol estimates). EX1004, ¶146 (“The decoded data from decoder 946 *represents an estimate* of the transmitted data being recovered.”); see also EX1004, ¶16 (The received signals are “processed based on the diversity transmission mode used for the data stream to provide recovered symbols, *which are estimates of modulation*

symbols transmitted from a transmitter for the data stream.”), ¶145 (“[T]he N_R received symbol streams to provide recovered symbols, [matrix] $\hat{s}(n)$, [] *are estimates of the modulation symbols, $s(n)$* , sent by the transmitter.”); Fig. 9. It would have been obvious to a POSITA to represent the decoder outputs corresponding to the plurality of symbol estimates in matrix form. EX1003, ¶¶135, 137. Patent Owner maps this limitation to identical functionality in its infringement contentions. Compare EX1009, 54 (“A decoder 776 decodes the deinterleaved data in a manner complementary to the encoding performed by transmitting entity 110 on that stream. For example, a Turbo decoder or a Viterbi decoder may be used for decoder 776 if Turbo or convolutional coding, respectively, is performed by transmitting entity 110.”) with EX1004, ¶146 (“[T]he deinterleaved data is further decoded by a decoder 946 in a manner complementary to the coding performed at the transmitter. For example, a Turbo decoder or a Viterbi decoder may be used for decoder 946 if Turbo or convolutional coding, respectively, is performed at the transmitter”).

It also would have been obvious to a POSITA to provide the decoder outputs to Walton’s receive processor (*i.e.*, **MUD module**) for iterative detection. EX1003, ¶140. The ’946 patent acknowledges it was known in conventional MUD systems to use a “*bank of decoders ... provid[ing] error correction for each user,*” where “*[t]he result of such conventional error correction is a matrix ($b(n)$) of symbol*

estimates which are used by the MUD module 115 in the iterative process to provide better estimates of the particular symbols.” EX1001, 13:54-67; *see also id.* at 14:7-9 (admitting that the claimed “*MUD module*” and “*bank of decoders*” “can be implemented in conventional technology”).

6. Claim 7

Walton discloses this limitation because it teaches that its controller (*i.e.*, **control processor**) “direct[s] the operation of RX diversity processor 920” (EX1004, ¶147), and each data stream of the received data signals “may be for an overhead channel or targeted for a specific receiver device” (*i.e.*, is an *intended data signal*). EX1004, ¶15; *see also id.*, ¶38 (“FIG. 2 is a block diagram of an embodiment of access point 104 and two terminals 106. On the downlink, at access point 104, various types of traffic data such as *user-specific data* from a data source 208, signaling, and so on *are provided to a transmit (TX) data processor* 210.”); EX1003, ¶¶142-146.

As explained in Limitation 1b, Walton’s receive (RX) data processor (*i.e.*, the **data formatting module**), determines and outputs packet information to the control processor. EX1004, ¶¶4, 43, 52, 146; EX1003, ¶¶82-84, 142-146. A POSITA would have understood that each of the data packets provided by the receive (RX) data processor have headers that describe the packet, including the packet’s destination, because it was well known that data packets in wireless communication protocols

are organized into headers and payloads, and packet headers include information about the packet's intended destination. *See, e.g.*, EX1013, §3.1 (packet headers include destination addresses); EX1003, ¶¶145.

7. Claim 9

As discussed for Claim 7, Walton discloses its controller (*i.e.*, **control processor**) detects which of the received data signals 1-K is the intended data signal m, based on packet header information provided by the receive (RX) data processor (*i.e.*, **data formatting module**). *See* EX1004, ¶¶4, 15, 38, 43, 52, 146-147; EX1003, ¶¶148-149. A POSITA would have understood that the receive (RX) data processor provides packet header information for each received signals, and each corresponding produced data packet. EX1003, ¶¶148-149.

Walton further discloses that only the intended data signal for the particular modem needs to be identified, while other received data signals can be ignored. EX1003, ¶¶148-149. Walton teaches that “[o]n the downlink, at access point 104, various types of traffic data such *as user-specific data* from a data source 208, signaling, and so on are provided to a transmit (TX) data processor 210.” EX1004, ¶38; *see also* EX1004, ¶43 (“A receive (RX) data processor 262 then symbol demaps, deinterleaves, and decodes the recovered symbols to obtain the *user-specific data* and signaling transmitted on the downlink for the terminal.”); EX1004, cl. 17 (“The method of claim 1, wherein at least one data stream *is user-specific* and

transmitted for a specific receiver device.”). A POSITA would have understood that only user-specific data streams intended for the receiving terminal needs to be identified, and it would have been obvious to configure the control processor to ignore other received data signals intended for other modems. EX1003, ¶149.

8. 10pre

See Limitation 1pre.

(a) 10a

A multiuser detection (MUD) module ... configured to simultaneously demodulate and recover K wirelessly transmitted signals using co-channel demodulation, simultaneously outputting K recovered signals: *See* Limitation 1a; *see also* EX1004, Figs. 9, 11 (showing the receive processor outputting the recovered signal streams in parallel); EX1003, ¶151.

Receiving D inputs from D analog to digital (A/D) converters: *See* Claim 4.

(b) 10b

See Claim 4.

(c) 10c

See Claim 5.

(d) 10d

A data formatting module operatively coupled to the parallel K MUD
module outputs of the MUD module, and configured to produce network data
packets of the parallel K recovered signals: *See* Limitation 1b. Walton
additionally teaches that the receive (RX) data processor (annotated in green, *i.e.*,
the **data formatting module**) receives **parallel recovered signal** outputs (annotated
in yellow) from the receive processor (annotated in red, *i.e.*, **MUD module**), as
shown in the annotated version of Figure 9 below. EX1003, ¶¶155-156.

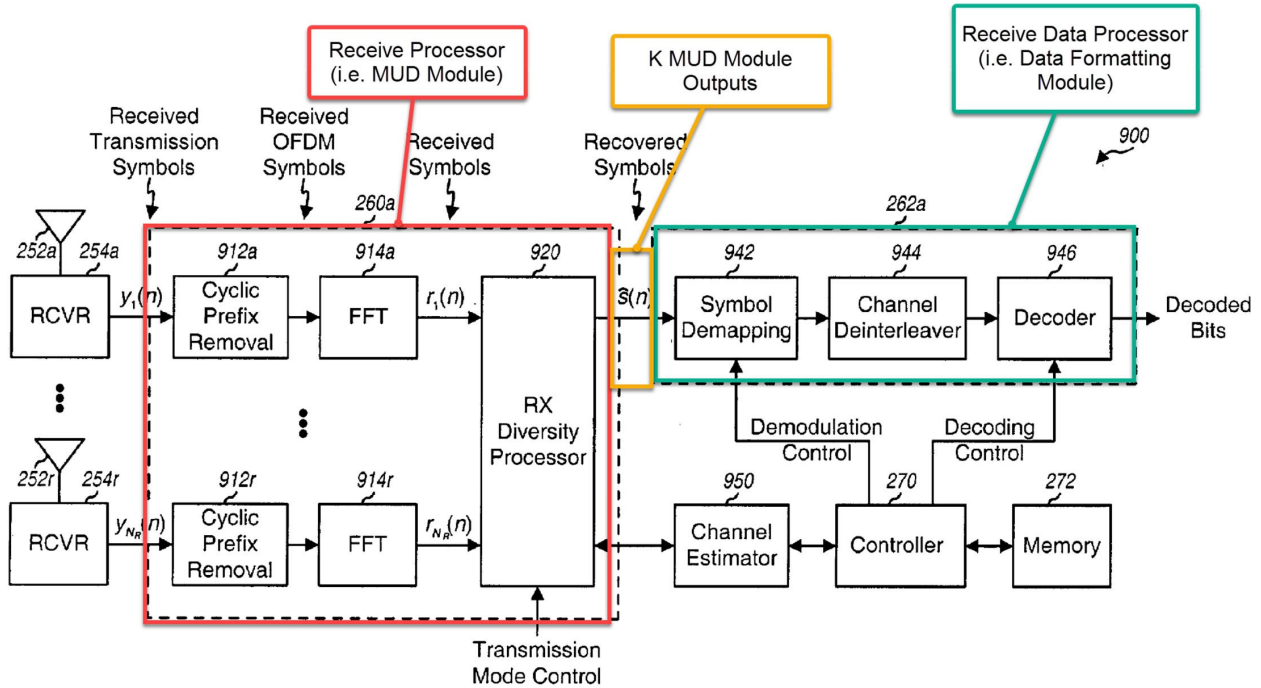
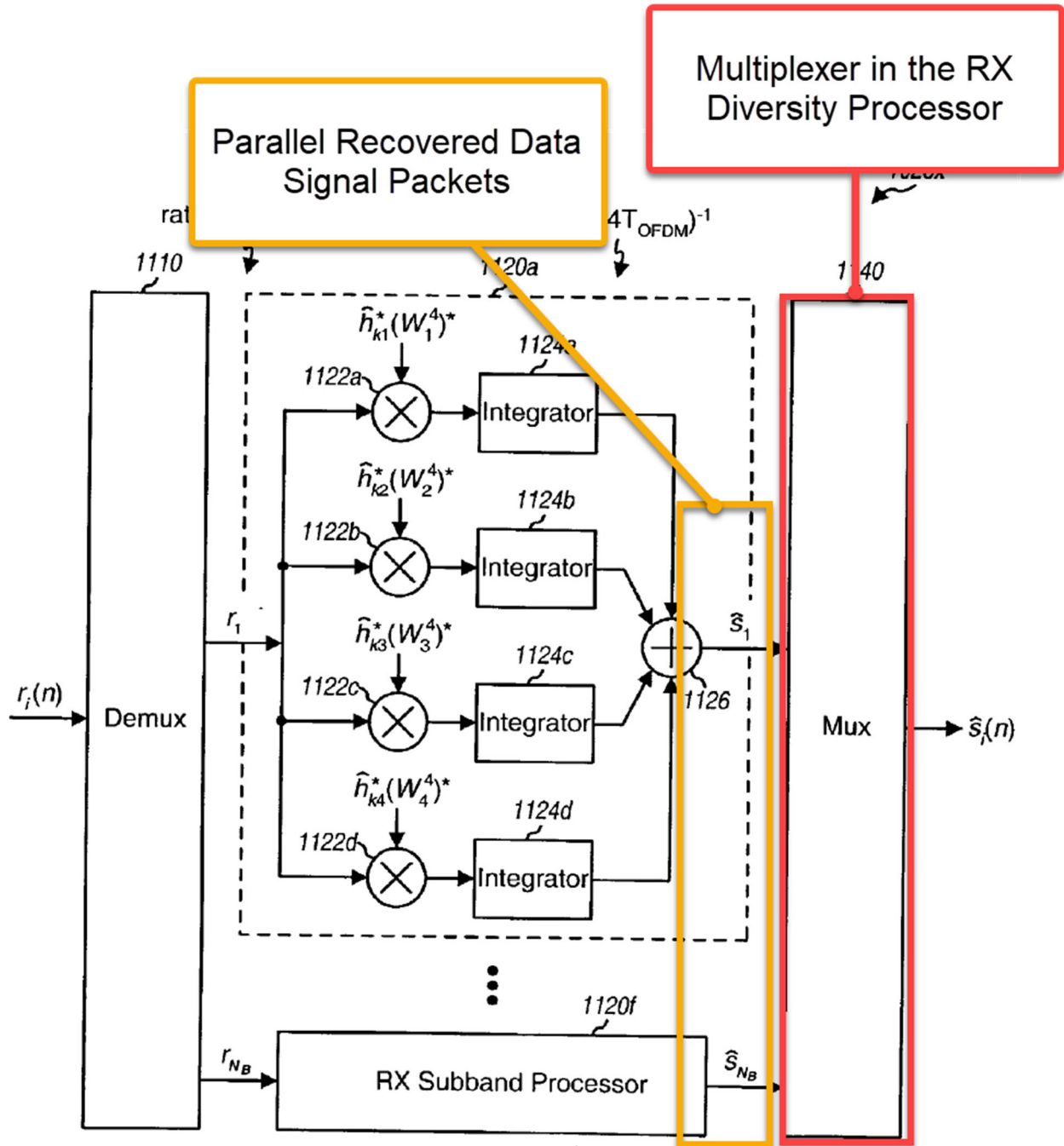


FIG. 9

The parallel K recovered signal data packets communicated to a
demultiplexer: *See* Limitation 1d; *see also* EX1004, Fig. 11 (annotated below);
EX1003, ¶¶157-158.



Wherein the data formatting module supports multiple types of network packet format modes: See Limitation 1d; see also EX1004, ¶38 (describing “format[ing] and encod[ing] the traffic data based on one or more coding schemes

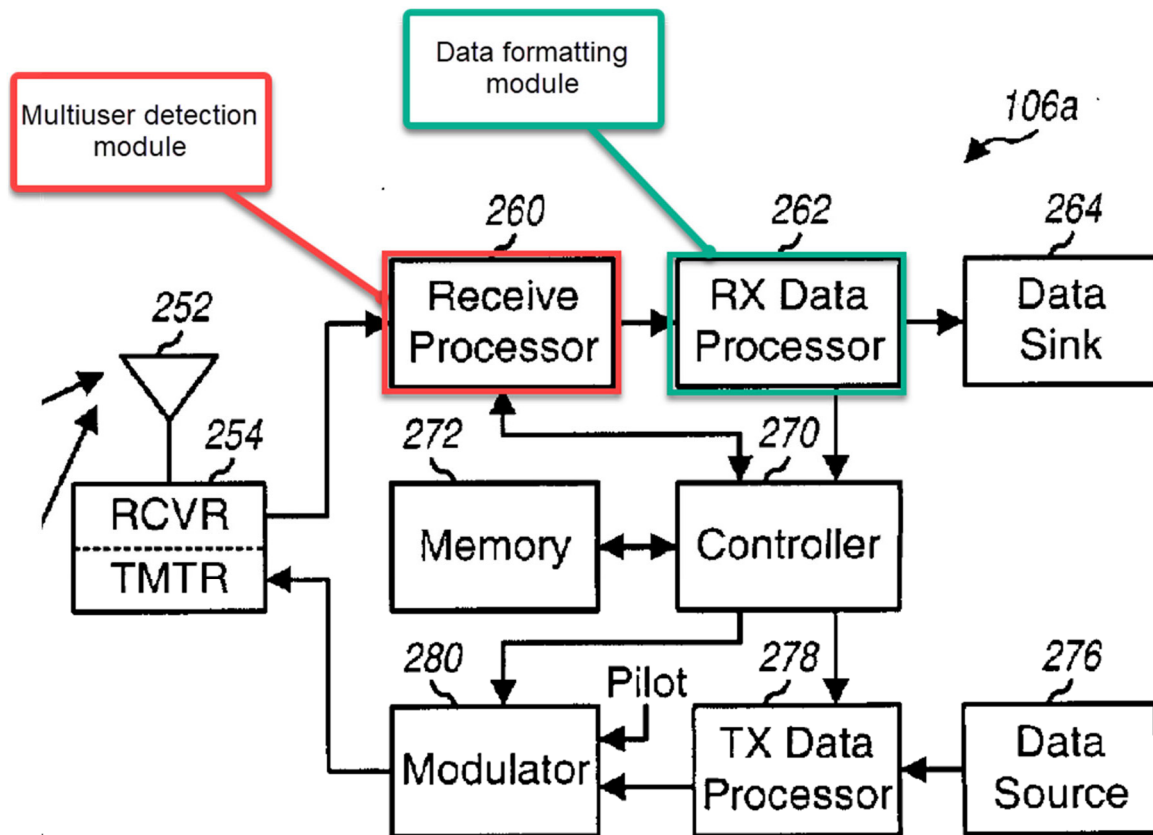
to provide coded data”); EX1003, ¶¶159-160.

(e) 10e

The demultiplexer operatively coupled to the data formatting module ... and configured to select one of the recovered K wirelessly transmitted signals as a target signal intended for a user, m, associated with the modem ... where the selection is based on a control input from the control processor: See Limitation 1d.

Receiving the parallel K recovered signal data packets: See Limitation 10d.

Communicate m data packets of the K recovered signal data packets to a recipient: Walton teaches that recovered data packets for the target signal are communicated to a recipient. EX1003, ¶¶161-165. For example, Walton discloses that the output of the receive (RX) data processor (*i.e.*, the **recovered signal data packets**) is communicated to a “data sink,” as shown in Figure 2.



A POSITA would have understood that when Walton's terminal is a user device (such as a mobile phone), the data sink refers to the elements of the system that receive data and make them available to a recipient. EX1003, ¶¶163-164.

Walton also teaches that “[o]n the uplink, at terminal 106, various types of traffic data such as user-specific data from a data source 276, signaling, and so on are provided to a TX data processor 278. Processor 278 codes the different types of traffic data in accordance with their respective coding schemes to provide coded data and further interleaves the coded data. A modulator 280 then symbol maps the interleaved data to provide modulated data, which is provided to one or more transmitters 254.” EX1004, ¶44. A POSITA would have understood that when the

terminal is a router or similar device, the TX data processor as described above would be used to communicate received packets to intended recipient devices connected to the router. EX1003, ¶¶163-164.

(f) 10f

The control processor operatively coupled to the demultiplexer and the data formatting module: *See* Limitations 1c (data formatting module), 1d (demultiplexer); *see also* EX1003 ¶¶167-169.

Configured to detect with which protocol mode the at least one of the K recovered signals was transmitted based on input from the data formatting module: *See* Limitation 1c; *see also* EX1003 ¶170. Walton's receive (RX) data processor (the **data formatting module**), provides input for the controller (the **control processor**) to detect with which protocol mode the recovered signals was transmitted. EX1003, ¶171. Specifically, the receive data processor generates "recovered symbols to *obtain the user-specific* data." EX1004, ¶43; *see also* Claim 17 ("The method of claim 1, wherein at least one data stream is user-specific and transmitted for a specific receiver device."). The controller takes into account the user-specific information for each data stream in determining the diversity transmission mode. *See* EX1004, ¶134 ("The diversity transmission modes may be used for data transmission between the access points and terminals. The specific transmission mode to use for a given data stream may be dependent on *various*

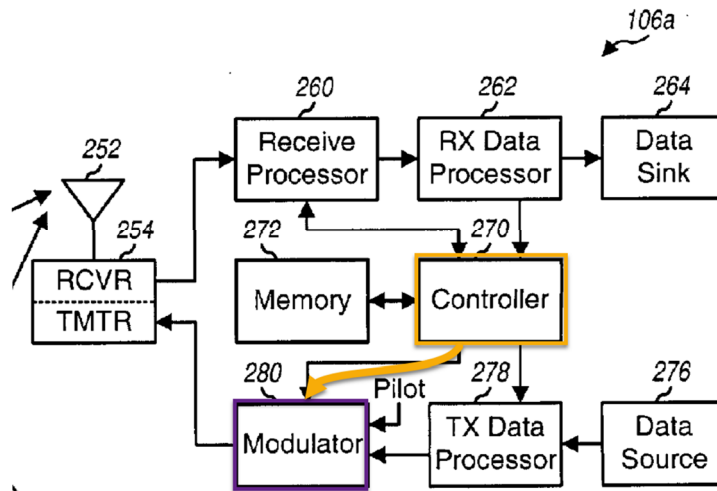
factors such as (1) the type of data being transmitted (e.g., whether common for all terminals or user-specific for a particular terminal), *(2) the number of antennas available at the transmitter and receiver*, (3) the channel conditions, *(4) the requirements of the data transmission (e.g., the required packet error rate)*, and so on.”)).

To enable a corresponding transmission mode including one of a legacy protocol mode and a bandwidth efficient aggressive access protocol mode that exploits co-channel demodulation capabilities of the modem: See Limitation 1c.

The control processor also configured to select a network data packet formatting mode in which the data formatting operates”: See Limitation 1d.

(g) 10g

A modulator operatively coupled to the control processor: Walton expressly discloses a modulator coupled to the controller (*i.e.*, **control processor**). See EX1004, Fig. 2 (below); EX1003, ¶174-175.



The control processor enabling the transmission mode of the modulator, the transmission mode corresponding to the protocol mode in which the at least one of the K recovered signals was transmitted: A POSITA would have understood that Walton's controller (*i.e.*, **control processor**) controls the transmission modes used by the TX data processor and the modulator because the controller "direct[s] the operation at ... the terminal." EX1004, ¶46; EX1003, ¶175. Among other things, as shown in Figure 2 above, Walton's controller directs the operation of a "TX [transmission] data processor 278" that "codes the different types of traffic data in accordance with their respective coding schemes" and a "modulator 280" that "symbol maps the interleaved data to provide modulated data." EX1004, ¶44. In addition, a POSITA would have understood that the same protocol modes (*i.e.*, a **transmission mode corresponding to the protocol mode in which the at least one of the K recovered signals was transmitted**) would be used to respond

to a received packet because the access point and terminal need to use the same protocols in order to be able to communicate properly. EX1003, ¶175.

(h) 10h

Walton expressly teaches that both its access points and terminals include receivers and transmitters comprising amplifiers. *See* EX1004, ¶¶40 (“Transmit processor 220 provides N_T streams of transmission symbols to N_T transmitters (TMTR) 222 a through 222_i, one transmitter for each antenna used for data transmission. Each transmitter 222 converts its transmission symbol stream into one or more analog signals and further conditions (*e.g.*, ***amplifies***, filters, and frequency upconverts) the analog signals to generate a respective downlink ***modulated*** signal suitable for transmission over a wireless communication channel. Each downlink modulated signal is then transmitted via a ***respective antenna 224*** to the terminals.”), 41 (“[T]he downlink modulated signals from multiple transmit antennas of the access point are received by [] antennas . . . Each receiver 254 conditions (*e.g.*, filters, ***amplifies***, and frequency downconverts) its received signal.”), Fig. 2 (showing at least one antenna and associated receiver and transmitter for each access point and terminal); EX1003, ¶¶176-177. As shown in Figure 2, at each terminal, the modulator 280 is coupled to the transmitters (TMTR) 254 (comprising the ***amplifiers***), which are in communication with a corresponding antenna 252. EX1003, ¶¶177.

9. Claim 11

(a) 11a

Walton discloses a front end receiver block. *See* Claim 2; EX1003 ¶¶178-179. As shown in Figure 9, annotated below, Walton’s front end includes a plurality of receivers, each coupled to at least one antenna. EX1004, ¶¶41, 143. A POSITA would have understood that the connection between an antenna and its corresponding receiver comprises an **antenna diversity port**, such that each antenna and each receiver in Walton’s terminal has a corresponding antenna diversity port (*i.e.*, **D antenna diversity ports**). EX1003, ¶179. Further, each of the plurality of receivers contain at least a tuner and analog-to-digital converter. EX1004, ¶41 (“Each receiver 254 conditions (e.g., filters, amplifies, and *frequency downconverts*) its received signal and further *digitizes* [*i.e.*, *converts from analog to digital*] the conditioned signal.”). A POSITA would have understood that frequency down-conversion is performed by a **tuner**, as the ’946 patent itself acknowledges. EX1003, ¶179; EX1001, 13:26-33 (“The antenna inputs feed corresponding *front end tuners* 105 a, each of which *downconverts higher frequency signals* into baseband signals”).

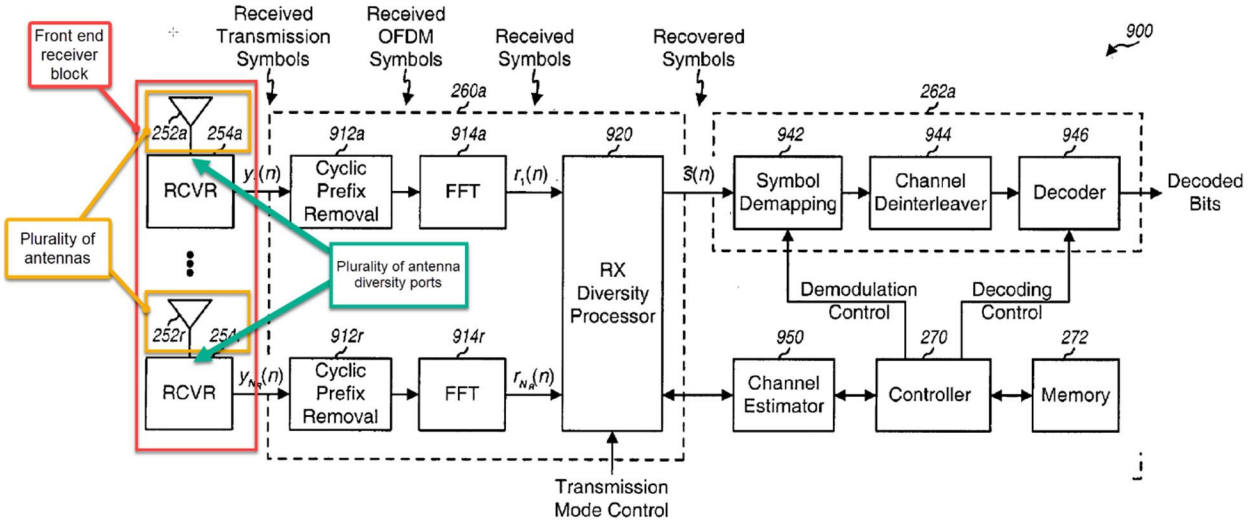


FIG. 9

(b) 11b

Walton discloses a plurality of antennas (**D antennas**) in communication with a plurality of receivers via a corresponding port of each receiver (**D antenna diversity ports**). See Limitation 11a.

(c) 11c

Each of Walton's antennas communicates with a corresponding tuner in the corresponding receiver via the antenna diversity port. EX1003, ¶¶181-182. Walton expressly discloses a frequency downconverter that receives and down-converts the signal from a corresponding antenna via the connection between the antenna and receiver (*i.e.*, the **antenna diversity port**). EX1004, ¶41 ("Each receiver 254 conditions (e.g., filters, amplifies, and *frequency downconverts*) its received signal."). As discussed above, a tuner is a component that varies the frequency, and a downconverter is a type of tuner that converts a received signal to a baseband

frequency. *See* EX1003, ¶¶179, 182; EX1001, 13:26-33.

(d) 11d

As discussed above, each of Walton's receivers includes a corresponding frequency downconverter (*i.e.*, **tuner**) communicating with a corresponding antenna via an antenna diversity port. EX1003, ¶¶183-184. A POSITA would have understood that the output of a frequency downconverter is a baseband waveform. *Id.* Walton teaches that the "conditioned" (*i.e.*, frequency downconverted) analog signals are "further digitize[d] [*i.e.*, **converted from analog to digital**] ... to provide a respective stream of samples."). EX1004, ¶41; *see also id.*, ¶143 ("Each receiver 254 processes (e.g., conditions, digitizes, and data demodulates) the received signal to provide a stream of received transmission symbols, which is then provided to a respective OFDM demodulator within a receive processor 260 a."). A POSITA would have understood that an analog-to-digital converter is used to digitize analog signals. EX1003, ¶184.

10. Claim 12

The m data packets of the K recovered signal data packets are formatted for and provided to a network: Walton's system is specifically designed to operate in a network involving multiple access points and terminals. EX1004, ¶134 ("The diversity transmission modes may be used for data transmission *between the access points and terminals*"). Walton also specifically discloses using its system in

cellular and wireless networks. *See id.*, ¶31 (“An access point may also be referred to as *a base station, a UTRAN* [UMTS Terrestrial Radio Access Network], or some other terminology.”), 54 (“[F]or *a wireless local area network (WLAN)*, the time diversity realized by interleaving over multiple OFDM symbols may not be significant if the minimum expected coherence time of the communication channel is many times longer than the interleaving interval.”); EX1003, ¶186. Accordingly, the recovered signal data packets are formatted for and provided to a network—here, either a UTRAN or a WLAN. As discussed in limitation 10e, a POSITA would have understood that when Walton’s system is implemented in a router or similar device, the TX data processor would be used to communicate received packets to intended recipient devices connected to the router via a network. EX1003, ¶186.

The selection is based on a control input from the control processor: *See* Limitation 10e.

11. Claim 13

The m data packets of the K recovered signal data packets are formatted for and provided to a backbone: Walton teaches that “[a]n access point may also be referred to as *a base station, a UTRAN* [UMTS Terrestrial Radio Access Network], or some other terminology.” EX1004, ¶31. A component of a UMTS network architecture is the UTRAN backbone. EX1003, ¶188. A POSITA would have understood that when Walton’s system is implemented in a UMTS system, data

packets from recovered signals are provided to a backbone. EX1003, ¶188.

The selection is based on a control input from the control processor: *See* Limitation 10e.

12. Claim 14

The m data packets of the K recovered signal data packets are formatted for and provided to a local host: Walton teaches the recovered signal datapackets may be formatted for and provided to *a wireless local area network (WLAN)*. *See* EX1004, ¶54. A WLAN will comprise a *local host*. EX1003, ¶190. A POSITA would have understood that when Walton's system is implemented in a WLAN network, data packets from recovered signals are provided to a local host. EX1003, ¶190.

The selection is based on a control input from the control processor: *See* Limitation 10e.

13. Claim 15

See Claim 9.

14. Claim 16

The packet header information of a data signal comprises intended destination of that data signal: *See* Claim 7.

The data signal intended for a particular modem can be identified,

while other received data signals are ignored: *See* Claim 9.

15. 20pre

See Limitation 1pre.

(a) 20a

See Limitation 11a.

(b) 20b

See Limitation 11b.

(c) 20c

See Limitation 11c.

(d) 20d

See Limitation 11d.

(e) 20e

See Limitation 10a.

(f) 20f

A parameter estimator module receiving the D inputs from the D A/D converters ... [and] outputting parameter estimation matrix S to the MUD module: *See* Claim 4.

Wherein the parameter estimator estimates the relative received timing offsets, phases, received amplitudes, and multipath structure for each of the interfering signals present in the received signal: Walton's channel estimator "estimates various channel characteristics such as the channel response and the noise

variance (e.g., based on recovered pilot symbols).” EX1004, ¶147. Walton also expressly discloses that timing delay or offset, amplitude, phase, and multipath structure are parameters relating to the transmission and detection of each signal. *See id.*, ¶¶8 (referring to “channel conditions due to various factors such as ... multipath”), 63 (referring to “multipath delay spread”), 98 (describing the received signals in terms of “gain,” *i.e.*, amplitude), 105 (describing symbols “rotated in phase”). It would have been obvious to a POSITA to estimate these parameters, *i.e.*, **timing offset, phase, amplitude, and multipath structure**, using Walton’s channel estimator. EX1003, ¶¶200-203. Indeed, the ’946 patent acknowledges that the claimed “parameter estimation module ... can be implemented in conventional technology,” and that estimating parameters such as “relative received timing offsets, phases, received amplitudes, and multipath structure” for use in a MUD module is “conventionally done.” EX1001, 13:36-47, 14:7-9. Earlier references from the same named inventor similarly confirm that “it is well known in the art how to compute parameter estimates for the S matrix.” EX1007, 26:51-62. Accordingly, a POSITA would have been motivated to use these known techniques to estimate parameters in Walton’s channel estimator, with a reasonable expectation of success, in order to improve detection of multi-user signals. EX1003, ¶¶200-203.

(g) 20g

See Limitation 10c.

(h) 20h

See Limitation 10d.

(i) 20i

See Limitation 10e.

(j) 20j

See Limitation 10f.

The signals of the one of a legacy protocol mode comprise low data rate BPSK or QPSK, or BPSK and QPSK: *See* Limitation 1c.

(k) 20k

See Limitation 10g.

The control processor providing a burst control input: Walton teaches “[t]he data rate, coding, interleaving, and symbol mapping may be determined by controls provided by a controller 230 and a *scheduler* 234.” EX1004, ¶38. This scheduler “schedules the data transmission on the downlink (and *possibly the uplink*) for the terminals,” (i.e., a *burst transmission*). EX1004, ¶46; EX1003, ¶210-211.

An input of data from the user m from the demultiplexer:

As discussed above regarding Limitation 10g, a POSITA would have understood that the transmission mode of Walton’s modulator corresponds to the protocol mode of the recovered signal for user m received from Walton’s multiplexer. EX1004, ¶¶44, 46; EX1003, ¶¶212-214. A POSITA would have

understood that the same protocol modes would be used to respond to a received packet because the access point and terminal need to use the same protocols in order to be able to communicate properly. EX1003, ¶¶212-214.

Walton also discloses that the transmission mode is based on user-specific data (i.e., *input of data from a user*). EX1003, ¶213. Specifically, Walton teaches that “[t]he specific mode to use for a given data stream may be dependent on various factors,” including “the type of data being transmitted (e.g., whether common for all terminals or user-specific for a particular terminal),” “the number of antennas available at the transmitter and receiver,” and “the requirements of the data transmission,” also of which are information associated with a particular user. EX1004, ¶134. Walton teaches that this user-specific data is produced by and received from the multiplexer. *See* EX1004, ¶43 (teaching that the data formatting module, including the multiplexer, “symbol demaps, deinterleaves, and decodes the recovered symbols to obtain the *user-specific data*”), Figs. 9, 11 (below).

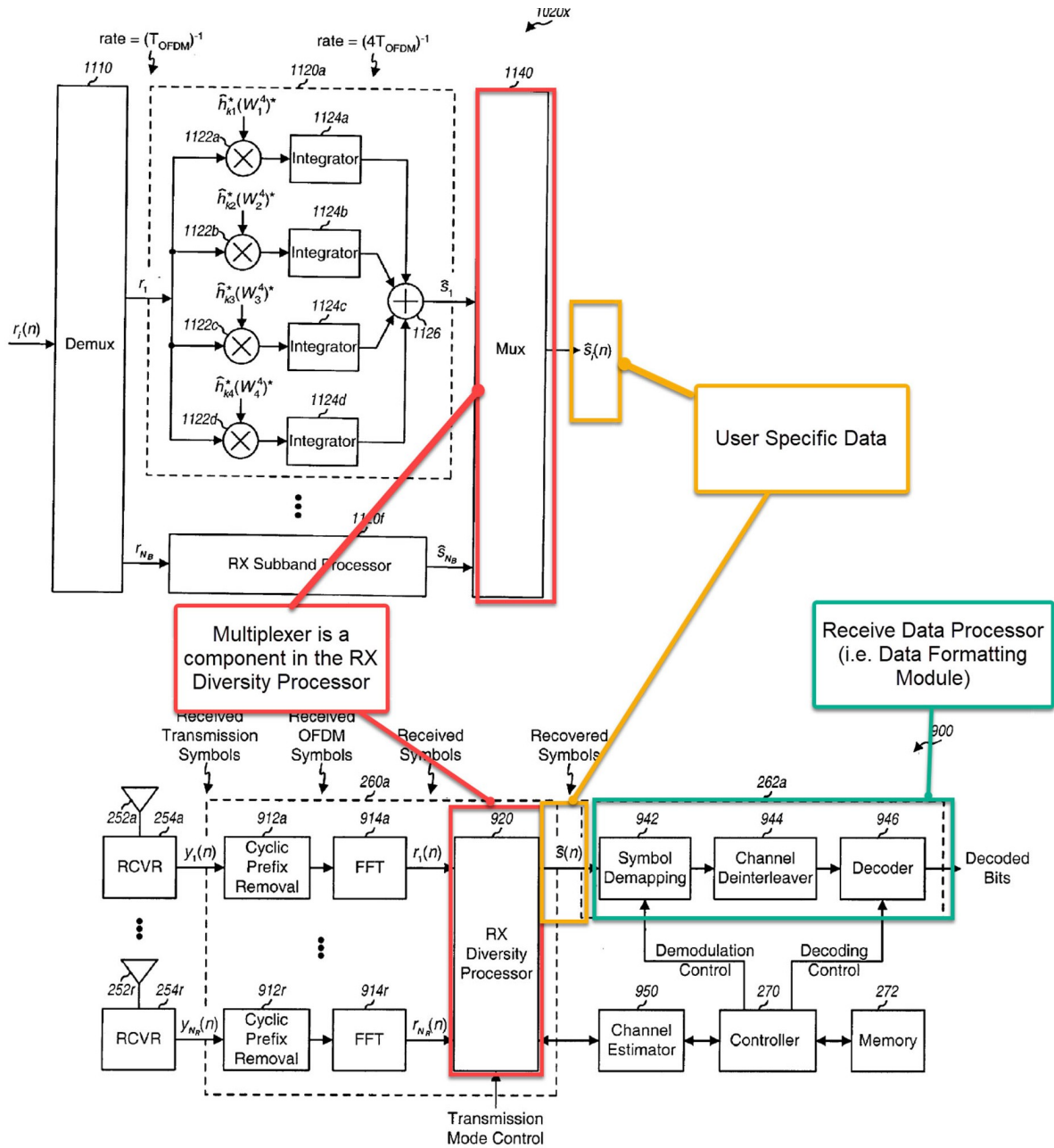


FIG. 9

(1) 201

See Limitation 10h.

B. Ground 2: Claims 1-5, 7, 9-16, and 20 are obvious over Walton in view of Learned

Learned is a BAE patent directed to a multiuser detector that uses a tree decoder and a parameter estimation unit to reduce signal processing time to a minimum. It would have been obvious to combine the multiuser detection techniques in Learned with the MIMO system of Walton. EX1003, ¶¶216-224.

1. Motivation to Combine

A POSITA would have been motivated to combine Learned's teaching of a multiuser detection techniques, into Walton's MIMO system and modem. EX1003, ¶¶219-224.

The system in Walton is already in the multiuser network context and includes elements and procedures for demodulating and recovering wirelessly transmitted signals using co-channel demodulation. EX1004, ¶31 ("Each terminal 106 may concurrently communicate with multiple access points 104"); EX1004, ¶33 ("Each access point 104 can communicate with one or multiple terminals 106, either concurrently or sequentially."). A POSITA would have been motivated to further improve Walton by applying Learned's teachings regarding improved multiuser detection for enhancing the detection of interfering signals from a plurality of users in a multiuser network. EX1003, ¶¶219-220. Learned expressly teaches that a "multi-user detector" is able to remove "[t]he effects of ... multi-user interference" when "multiple interfering signals [are] transmitted on the same communication

channel,” and thus can “accommodate increased traffic, and ... make maximum utilization of a traffic channel.” EX1005, 1:59-67. Accordingly, a POSITA would have known that adding multi-user detection to Walton’s system would improve performance of the corresponding communication system. EX1003, ¶219-220. And a POSITA would have been particularly motivated to apply Learned’s multiuser detection technique because it solves problems associated with conventional multi-user detection in order to “speed the decoding processing and allow for acceptable detection performance at real-time operational speeds.” EX1005, 4:27-32; EX1003, ¶221.

A POSITA would have also been motivated to include in the combined system additional elements necessary for the proper and optimal operation of Learned’s multiuser detector, including a parameter estimation unit and a bank of iterative decoders. EX1003, ¶222. Learned expressly teaches that “a parameter estimation unit is *required* ... to identify and determine parameters associated with each signal that are required by the multi-user detector (MUD) to separate each signal from the other interfering signals.” EX1005, 2:1-23. And Learned further teaches that in the preferred embodiment, the received signals “are iteratively processed” by the MUD and a “bank of single user decoders,” which allows a “desired bit error rate performance [to be] attained,” and “reduces the overall complexity of the [MUD] and allows for real-time operation,” both of which a POSITA would know to be

advantageous. *Id.*, 10:28-42, 12:37-54; EX1003, ¶222.

A POSITA would have reasonably expected this combination to succeed. MUD was well known in the art at the time of the '946, and the '946 patent expressly acknowledges that the claimed “parameter estimation module [], MUD module, [] and bank of decoders [] can be implemented in conventional technology.” EX1001, 14:7-9; EX1003, ¶223. Learned also expressly teaches that “[u]sing a MUD does not require a change in the existing transmitted signaling method,” such that Learned’s MUD could be implemented in Walton’s MIMO system without requiring changes to the underlying communication protocols. EX1005, 1:65-57; EX1003, ¶223. A POSITA would have known how to implement a conventional MUD (including the parameter estimation unit and bank of decoders) in a MIMO system like Walton’s, and would have been able to do so by applying standard engineering capabilities to implement the well-known structures to perform their conventional functions. EX1003, ¶223.

Finally, Learned, Walton, and the '946 patent are analogous art because all three are directed to systems and techniques to improve performance in multiuser networks in the presence of interference, and particularly techniques with respect to demodulating, recovering, and modulating received signals. EX1001, 1:16-20; EX1004, Abstract; EX1005, 4:35-42; EX1003, ¶224.

2. Claim 1

Walton discloses limitations 1pre and 1b-1d as set forth in Ground 1.

Limitation 1a is addressed below.

(a) 1a

A multiuser detection (MUD) module: Learned discloses that “power ordered signals are iteratively processed by *multi-user decoder (MUD)* 13 and bank of single user decoders 16.” EX1005, 10:39-42; *see also id.*, 6:2 (“*The multi-user detector 13* is preferably based on the M-algorithm.”); EX1003 ¶226-227. Learned specifically discloses a using a tree-pruned multi-user decoder, as illustrated in Figure 4 (below), as the “multi-user detector 13.” EX1003, ¶227.

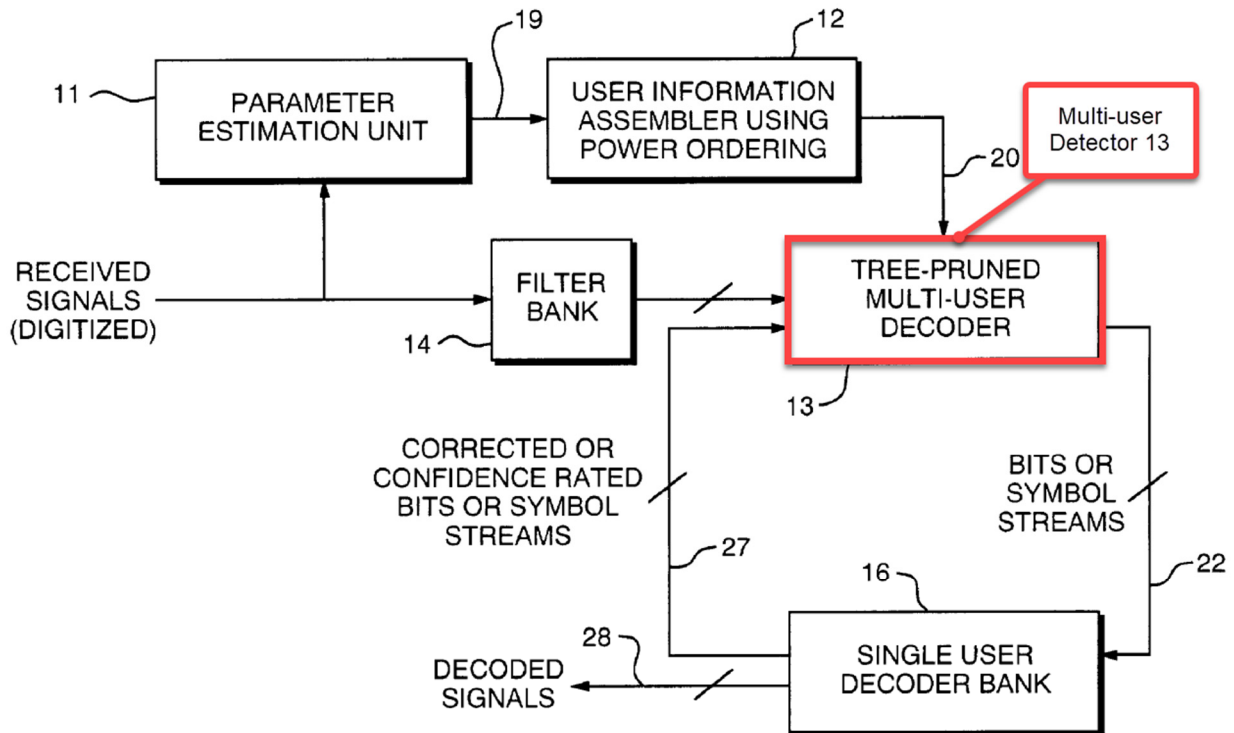


FIG. 4

Configured to simultaneously demodulate and recover K wirelessly

transmitted signals: Learned discloses that “multi-user detection (MUD) techniques” are used to “successfully *demodulate simultaneously occurring* interfering signals.” EX1005, 2:1-3. The MUD is used to “separate” (*i.e.*, **recover**) “multiple interfering signals transmitted on the same communication channel” (*i.e.*, **K wirelessly transmitted signals**). EX1005, 2:24-27; *see also* EX1003, ¶228.

Using co-channel demodulation: Learned teaches that demodulation using MUD is intended to handle *co-channel* interfering signals. EX1005, 4:53-55 (“When a decoding tree is constructed in the turbo multi-user detector (MUD), one level of the tree is defined for each of *the co-channel, interfering signals.*”); *id.*, 5:7-12 (“This power ordering process of ordering the decoding tree is repeated for each symbol interval of the signals in each block of received data and results in pruning the decoding tree very quickly to properly decode the individual signals making *up the co-channel, interfering signal.*”); *see also* EX1003, ¶229-230.

A POSITA would have been motivated to apply Learned’s teachings regarding multiuser detection into Walton’s modem, and would have reasonably expected to be successful doing so, for the reasons stated above.

3. Claim 2

Walton disclose a receiver (*i.e.*, **front end**) configured to simultaneously receive the K wirelessly transmitted signals, and to provide those signals to the MUD module and a channel estimator in a form that facilitates their subsequent processing

by the multiuser detection module. *See* Ground 1, claim 2.

To the extent Patent Owner argues that Walton's channel estimator is not a parameter estimator, it would have been obvious to include a parameter estimator as taught by Learned in Walton's system. EX1003, ¶233. Learned teaches that the "received, digitized signal passes through conventional receiver circuitry ... and is then input to parameter estimation unit [] which utilizes unique apriori knowledge of the system specification ... to help identify parameters for each received signal." EX1005, 10:48-55. As discussed above, Walton's receiver (*i.e.*, **front end**) "conditions" and "digitizes" the received signals, and would thus provide the digitized signals to the parameter estimation unit in the combined system. EX1004, ¶41; EX1003, ¶233.

A POSITA would have been motivated to apply Learned's teachings regarding parameter estimation into Walton's modem, and would have reasonably expected to be successful doing so, for the reasons stated above.

4. Claim 4

A parameter estimator module receiving D diversity inputs from D analog to digital (A/D) converters: To the extent Patent Owner argues that Walton's channel estimator is not a parameter estimator, it would have been obvious to include a parameter estimator as taught by Learned in Walton's system.

As discussed above, Walton discloses a plurality of antennas, each of which

provides a received signal “to a respective receiver (RCVR),” which in turn

“conditions ... its received signal and further digitizes the conditioned signal.”

EX1004, ¶41, Fig. 9; *see also* Ground 1, Claim 4. Each receiver includes an analog to digital (A/D) converter (*i.e.*, **D analog to digital (A/D) converters**) to digitize the corresponding analog conditioned signal. EX1003, ¶235. In the combined system, the collective outputs of each receiver’s A/D converter would be input to the parameter estimation module (*i.e.*, **D diversity inputs**) because Learned teaches that the “received, digitized signal” is “input to parameter estimation unit.” EX1005, 10:48-55, Fig. 4 (annotated below); EX1003, ¶235 *see also* Claim 2.

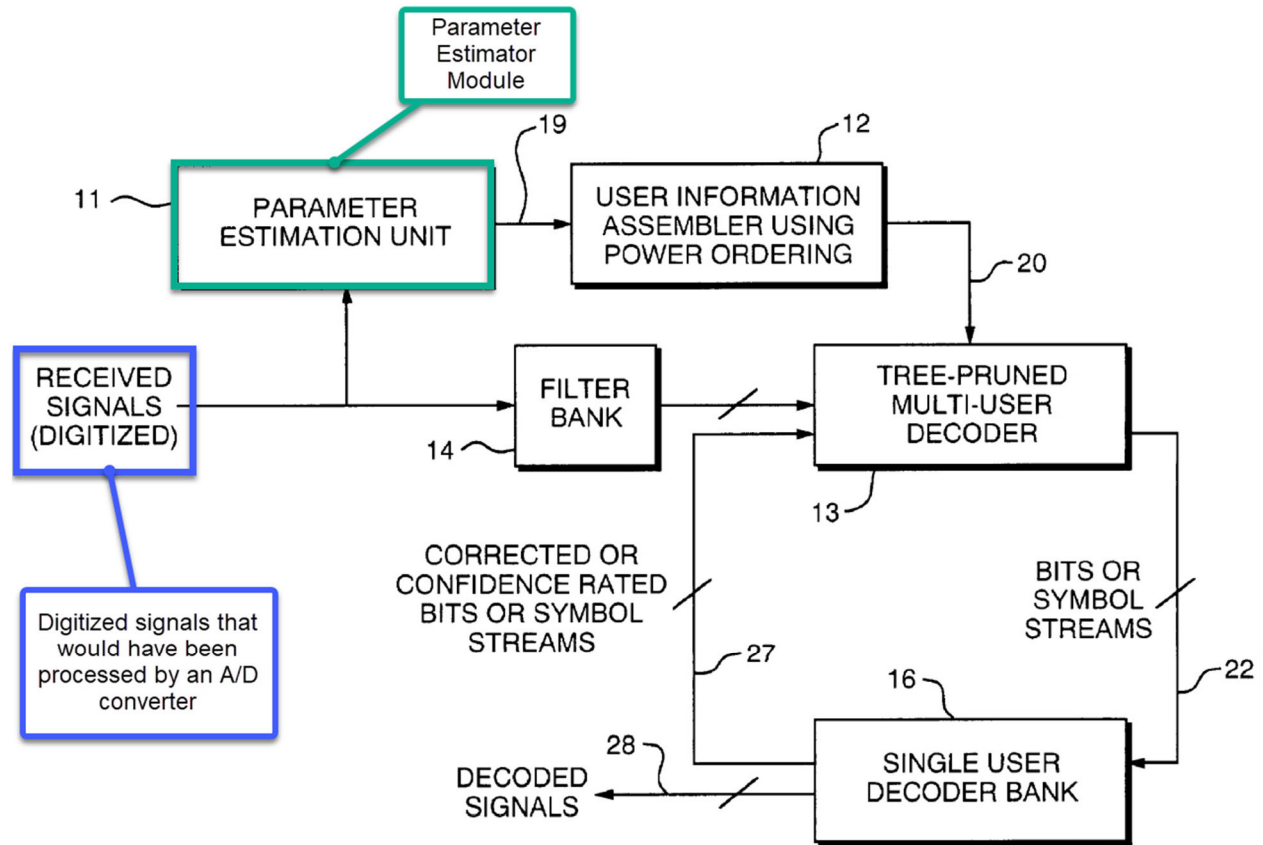


FIG. 4

The parameter estimator module outputting an S matrix to the MUD module, wherein the S matrix comprises estimated composite signature waveforms: Learned discloses that its parameter estimation unit 11 determines “parameter estimates ... for each of the signals that actually make up the received signal,” and uses those estimates to calculate “the signature vectors of all the interfering users [*i.e.*, **estimated composite signature waveforms**] over the time frame associated with the data sequences of interest.” EX1005, 7:43-52. Further, these signature vectors are “entries in [a] *correlation matrix*” (*i.e.*, an **S matrix**).

Id.; EX1003, ¶¶236-240.

As shown in Figure 4 of Learned, the output of the parameter estimation module (including the S matrix) is provided to the tree-pruned multi-user decoder (*i.e.*, the **MUD module**) via the user information assembler. EX1005, 11:14-17 (“[P]ower order information, as well as all other parameter values for each detected user, is passed from user information assembler unit 12 to MUD 13.”); EX1003, ¶238.

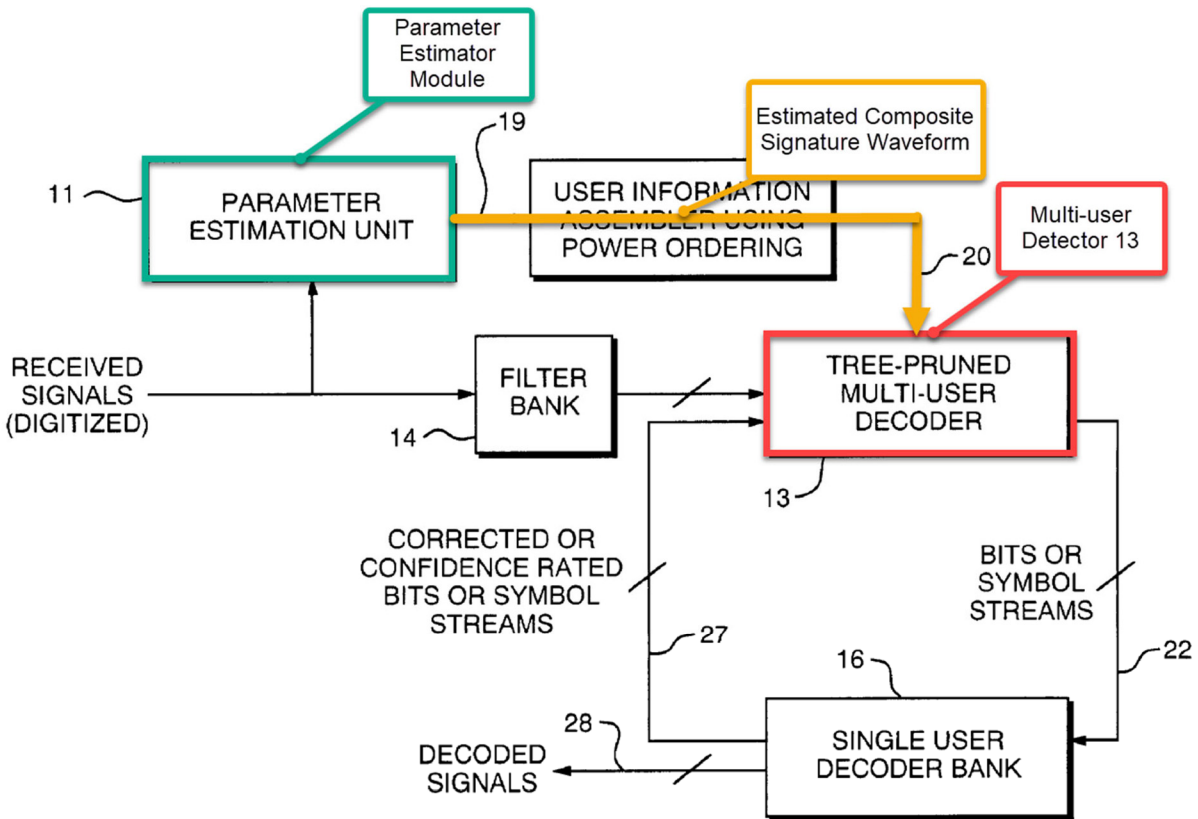


FIG. 4

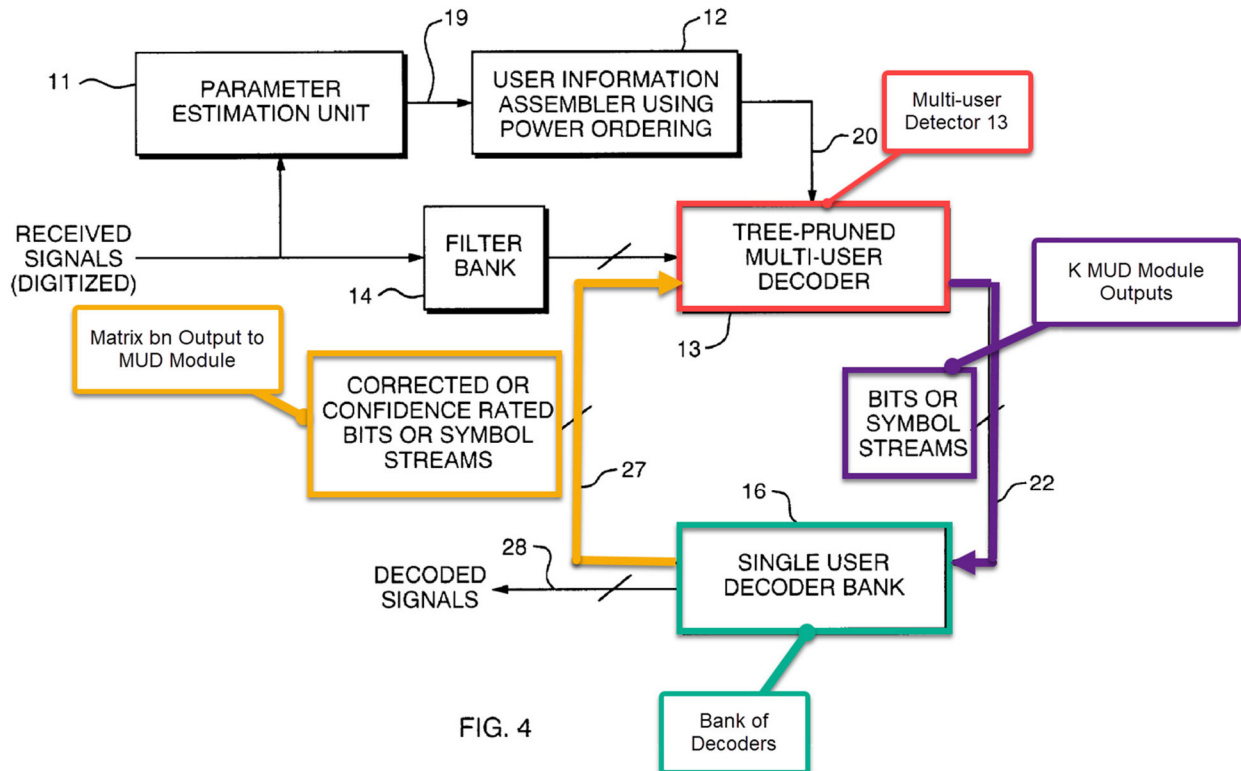
A POSITA would have been motivated to apply Learned’s teachings regarding parameter estimation into Walton’s modem, and would have reasonably

expected to be successful doing so, for the reasons stated above.

5. Claim 5

To the extent Patent Owner argues that Walton does not disclose a bank of decoders producing a matrix $\mathbf{b}_n$ output to the MUD module, wherein the matrix $\mathbf{b}_n$ is a matrix of symbol estimates, it would have been obvious to include such a bank of decoders coupled to the MUD module, as taught by Learned, in Walton's system. EX1003, ¶241.

A bank of K decoders communicating with the K MUD module outputs: Learned discloses that symbols are “iteratively processed by *multi-user decoder (MUD) 13 and bank of single user decoders 16.*” EX1005, 10:39-42; *see also* Fig. 4 (annotated below, showing the symbol streams (*i.e.*, **K MUD module outputs**) communicated to a **single user decoder bank**); EX1003, ¶242. Learned also expressly teaches that the number of decoders is the same as the number of MUD module outputs because there is one decoder for each user signal received. EX1005, 12:24-25 (“[T]here is only a single user associated with each of decoders 16.”).



The bank of K decoders producing a matrix $\mathbf{b}_n$ output to the MUD module from the input of K MUD module recovered signals, wherein the matrix $\mathbf{b}_n$ is a matrix of symbol estimates: As discussed above, Learned discloses that the bank of decoders produces an output based on symbols streams received as input from the MUD module (**the input of K MUD module recovered signals**). EX1005, 11:58-62 (“The stream of channel symbol estimates for each user presently contributing to the received signal is calculated by MUD 13 and is input to one of a plurality of single-user decoders 16, with there being one single-user decoder 16 used for each user’s signal to be decoded.”); Fig. 4; EX1003, ¶¶243-244. Learned’s MUD performs “iterative processing comprised of MUD 13, line 22, a bank of single

user decoders 16, and line 27 back to MUD 13.” EX1005, 11:11-14.

The bank of decoders then outputs “estimates,” “one for each decoded symbol of each user” (*i.e.*, **symbol estimates**), which “are forwarded via lead 27 to MUD 13 to be used in constructing the decoding tree for the next iteration of decoding.” EX1005, 11:62-12:21. It would have been obvious to a POSITA to output the symbol estimates as a matrix, *i.e.*, a data structure having row and column indices, because that is a well known and conventional way of representing two-dimensional data. EX1003, ¶¶243-244.

A POSITA would have been motivated to apply Learned’s teachings regarding iterative MUD and decoding into Walton’s modem, and would have reasonably expected to be successful doing so, for the reasons stated above.

6. Claim 10

Walton discloses limitations 10pre and 10d-10h as set forth in Ground 1. Limitations 10a-10c are addressed below.

(a) 10a

A multiuser detection (MUD) module ... configured to simultaneously demodulate and recover K wirelessly transmitted signals using co-channel demodulation, simultaneously outputting K recovered signals: *See* Limitation 1a; *see also* EX1005, 11:58-62 (“The stream of channel symbol estimates for each user presently contributing to the received signal is calculated by MUD 13 and is

input to one of a plurality of single-user decoders 16, with there being one single-user decoder 16 used for each user's signal to be decoded."); EX1003, ¶246.

Receiving D inputs from D analog to digital (A/D) converters: *See* Claim 4.

(b) 10b

See Claim 4.

(c) 10c

See Claim 5.

7. Claim 20

Walton discloses limitations 20pre-20d and 20h-20l as set forth in Ground 1. Limitations 20e-20g are addressed below.

(a) 20e

See Limitation 10a.

(b) 20f

A parameter estimator module receiving the D inputs from the D A/D converters ... [and] outputting parameter estimation matrix S to the MUD module: *See* Claim 4.

Wherein the parameter estimator estimates the relative received timing offsets, phases, received amplitudes, and multipath structure for each of the interfering signals present in the received signal: Learned discloses that

“parameter estimation units are used to identify and determine parameters associated with each signal that are required by a multi-user detector (MUD) to allow the MUD to correctly process *the received signal* and separate out each user’s bit stream regardless of the fact that the transmitted signals exist in the same communications bandwidth and at the same instant in time.” EX1005, 6:23-30. Learned teaches that the estimated parameters “include the received power level [*i.e.*, *received amplitude*], the *phase* of the oscillator which generated each received signal, the *timing offset* relative to the base station clock, carrier frequency, any frequency offset of the carrier, the assigned spreading code if any is used, and the structure of multi-path replicas [*i.e.*, *the multipath structure*].” *Id.*, 6:30-35; EX1003, ¶¶251-254.

A POSITA would have been motivated to apply Learned’s teachings regarding parameter estimation into Walton’s modem, and would have reasonably expected to be successful doing so, for the reasons stated above.

(c) 20g

See Claim 5.

8. Claims 3, 7, 9, and 11-16

Walton independently discloses the additional limitations of each of these claims, as set forth in Ground 1.

C. **Ground 3: Claim 20 is obvious over Walton in view of Learned and Quigley**

Quigley is a Broadcom patent titled “Robust Techniques for Optimal Upstream Communication Between Cable Modem Subscribers and a Headend.” It is directed to techniques for data transmission to permit multiple access from cable modems. EX1006, Abstract.

It would have been obvious to a POSITA to combine the burst control input disclosed in Quigley into the combined Walton-Learned system. EX1003, ¶¶256-261.

1. Motivation to Combine

A POSITA would have been motivated to apply Quigley’s teaching of burst commands and control inputs, into Walton’s MIMO system and modem. Both Quigley and Walton are directed to multiple access networks. EX1003, ¶259. While Quigley is primarily related to cable modems and Walton to wireless modems, the use of burst transmissions to increase efficiency, latency, and resource utilization would be applicable and advantageous in either context, and Quigley expressly discloses adapting its invention to wireless transmissions. EX1003, ¶259; *see also* EX1006, 7:66-8:2 (Explaining that Figures 78 and 79 “adapt[] the invention to wireless transmission”).

A POSITA would have reasonably expected this combination to succeed because Walton discloses that various transmission schemes can be used, and

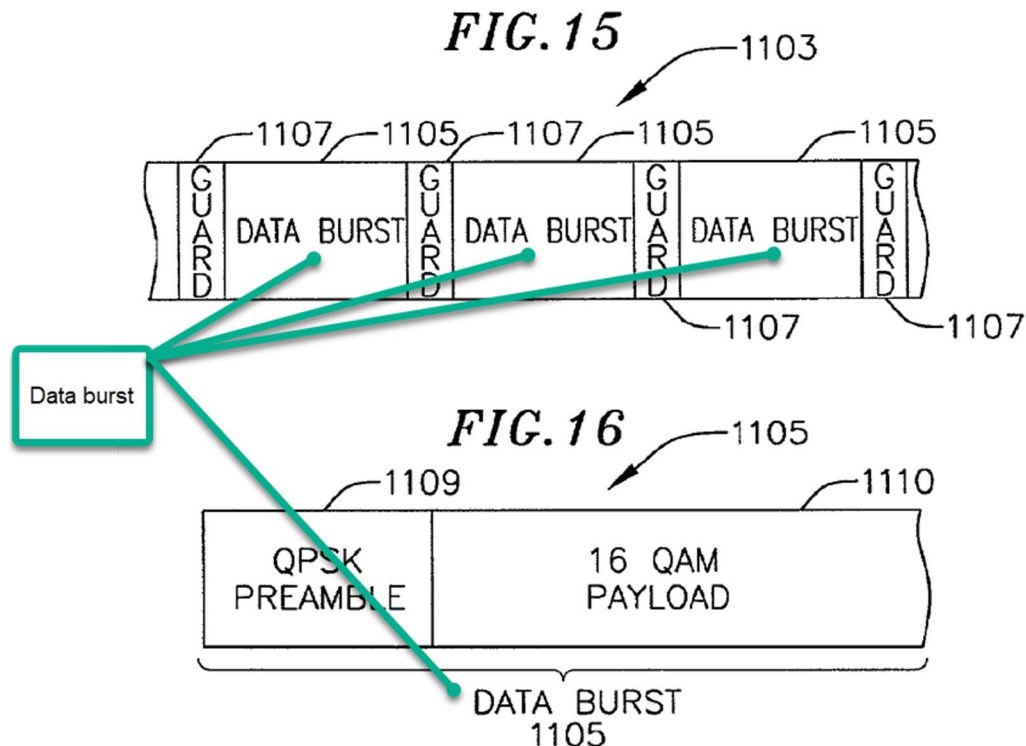
Quigley expressly discloses that its burst techniques may be used in wireless systems. EX1004, ¶47 (“Various transmit diversity schemes are specifically described below for downlink transmission. These schemes may also be used for uplink transmission, and this is within the scope of the invention.”); EX1006, 7:66-8:2; EX1003, ¶260.

Finally, Walton, Quigley, Learned, and the '946 patent are analogous art because all three are directed to systems and techniques to improve efficiency and robustness in multiuser networks, and particularly techniques with respect to demodulating, recovering, and modulating received signals. EX1003, ¶261.

2. Limitation 20k

To the extent Patent Owner argues Walton does not disclose a burst control input, Quigley expressly teaches a burst control input. EX1006, 61:13-19 (“[T]he subscriber cable *modem 12 is capable of transmitting upstream data via burst modulator* 458 and analog front end 457 in a desired upstream channel 456”); 23:18-27 (“Each cable modem 12 (FIG. 2) comprises a *burst transmitter* 294 for transmitting data to the cable modem termination system including line card 1042 via downstream data flow, a continuous receiver 296 for receiving transmissions from the cable modem termination system including line card 1042 via the upstream data flow and medium access control (Subscriber MAC) 90 for providing an *interface between the burst transmitter 294, the continuous receiver 296 and*

subscriber communications equipment such as a PC 1048 (FIG. 2), a telephone, a television, etc.”); 14: 32-38 (“FIG. 6A shows a **“Burst Controller”** feeding into a **“Downstream Modulator”** block.”); 14:18-24 (“When the time reference 88 is equal 67 to the designated transmit time, then an **initiate burst command 65 is issued** and the upstream data queue 71 is modulated to form upstream transmission 75.”). See also EX1006, 4:64-5:2 (“FIG. 15 shows a plurality of **data bursts** separate by guard bands”); EX1003, ¶¶262-263.



VII. DISCRETIONARY DENIAL IS NOT WARRANTED

A. *Fintiv*

The Board balances six factors in considering discretionary denial under 35 U.S.C. § 314(a) when parallel litigation exists. *Apple Inc. v. Fintiv, Inc.*, IPR2020-

00019, Paper 11 (PTAB Mar. 20, 2020) (precedential). To the extent the Board institutes the Samsung IPR that Petitioners seek to join, *Fintiv* is not relevant. If the Board were to consider Petitioners' petition in the first instance, the *Fintiv* factors would favor institution.

Factor 1—potential stay of the district court litigation—is neutral because Lenovo Group Limited (“Lenovo”) has not requested a stay. *VMWare, Inc. v. Intellectual Ventures I LLC*, IPR2020-00470, Paper 13 (PTAB Aug. 18, 2020), at 17 (finding in the absence of a stay motion that this factor “does not weigh for or against discretionary denial”).

Factor 2—district court trial date and the Board's statutory deadline—weigh against denial. The Guidance Memo states that this factor weighs against denial “if the median time-to-trial is around the same time or after the projected statutory deadline for the PTAB's final written decision.” EX1016. This petition is filed in December 2024, so a final written decision would likely issue by June 2026. The median time-to-trial in the Eastern District of Texas is 22 months. EX1015. Although the Complaint against Lenovo was filed on December 12, 2023, the Complaint was not served until April 29, 2024. This unusually long delay in serving the Complaint has already once pushed back all case deadlines because the response date to a Complaint is based on the date of service, *see* Fed. R. Civ. P. 12(a), and Judge Gilstrap does not hold a scheduling conference until after there has been a

response to the Complaint, *see* Standing Order Regarding Readiness for Scheduling Conference, EX1017. The four-month delay in service combined with the 22-month time-to-trial statistic results in a likely February-March 2026 trial date. The date currently set for jury selection—January 5, 2026, EX1018—does not support denial where, as here, it is close in time to the final written decision, and the time-to-trial statistics and other evidence suggest that additional delays are likely. *See Dish Network v. Broadband iTV*, IPR 2020-01280, Paper 17 at 16 (PTAB Feb. 4, 2021) (“We cannot ignore the fact that the currently scheduled trial date is more than nine months away and much can change during this time”).

Factor 3—investment in the district court proceedings—weighs heavily against discretionary denial. The associated district court case is still in the very early stages of litigation. Because Lenovo, a Chinese company, has challenged the district court’s personal jurisdiction, the parties have been engaged in jurisdictional discovery, with the court’s jurisdictional authority still to be decided. Even if the court has personal jurisdiction over Lenovo, a claim construction hearing is not scheduled until July 15, 2025, so a claim construction order will not issue prior to the PTAB’s projected institution decision date in June 2025. EX1018. Fact discovery will still be open, and dispositive motions and expert reports will be months away. *Id.* Accordingly, the district court will not invest significant resources or issue

substantive orders related to the challenged patent prior to the issuance of an institution decision. *See Fintiv*, IPR2020-00019, Paper 11 at 9-12.

Factor 4—overlap in the parallel proceedings—is neutral. Petitioners acknowledge that the grounds of invalidity asserted here are also asserted in the district court. But if “the Board will address the overlapping validity issues prior to the district court reaching them at trial, the Board’s final written decision will simplify or fully resolve the issues for trial in the litigation,” which weighs in favor of institution. *GAF Materials LLC v. Kirsch Research and Dev., LLC*, IPR2021-00192, Paper 14 at 14–15 (PTAB May 25, 2021).

Factor 5—overlapping parties—is neutral because while the petitioners are different from the named defendant, Lenovo (United States) and Motorola Mobility LLC manufacture the accused products at issue in the litigation, and named defendant Lenovo Group Limited is their ultimate parent and holding company.

Factor 6—other considerations—weighs against discretionary denial. None of the grounds asserted here were previously considered by either the Office or the district courts. *Cf. Comcast Cable Commn’s, LLC v. Rovi Guides, Inc.*, IPR2019-00231, Paper 14 at 11 (PTAB May 20, 2019) (obviousness challenges not “previously considered by the Office or any court” weigh in favor of not denying institution). Moreover, the ’946 patent is currently asserted in a district court case.

Institution of this IPR provides the opportunity for narrowing and simplifying the litigation for the district court.

Finally, discretionary denial is not warranted because this petition presents compelling evidence of unpatentability. As discussed above, the '946 patent admits that multi-user detectors, including most of the elements recited in the claims, were known. The '946 patent only purports to invent enabling support for legacy communication protocols in a multi-user detection system. However, Walton and Learned clearly teach this.

Accordingly, the Board should decline to exercise its discretion under *Fintiv* and institute trial.

B. *General Plastic*

Factor 1: While a prior petitioner (Samsung Electronics Co., Ltd.) challenged the '946 patent in IPR2024-01250, Petitioners are neither the same petitioner nor a real party-in-interest. Rather, Petitioners and Samsung do not have a “significant relationship ... with respect to [the challenged patent].” *Valve Corp. v. Elec. Scripting Prods., Inc.*, IPR2019-00062, Paper 11 at 2, 9 (PTAB Apr. 2, 2019) (precedential).

Factors 2-5: The remaining *General Plastic* factors are “necessarily outweigh[ed]” when the different petitioners have no “significant relationship.” *Videndum Prod. Sols., Inc. v. Rotolight Ltd.*, IPR2023-01218, Paper

12, at 6 (PTAB Apr. 19, 2024) (Vidal) (“[W]here, as here, the first and second petitioners are neither the same party, nor possess a significant relationship under *Valve, General Plastic* factor one necessarily outweighs the other *General Plastic* factors.”) (emphasis added); *see also Toshiba Am. Info. Sys., Inc. v. Wallex Microelectronics Ltd.*, IPR201801538, Paper 11, at 21 (PTAB Mar. 5, 2019). *Videndum* is controlling here.

Factors 6-7: Factors 6-7 favor institution. Petitioners seek to join the Samsung IPR and are not raising new arguments and will participate in an inactive/understudy role so that there should be no material impact on the Board’s finite resources or its ability to issue a final determination within one year. *General Plastic Industrial Co., Ltd. v. Canon Kabushiki Kaisha*, IPR2016-01357, Paper 19 at 15-19 (PTAB Sept. 6, 2017).

Thus, discretionary denial under *General Plastic* is not warranted.

VIII. MANDATORY NOTICES AND FEES

A. Real Party-In-Interest

Lenovo (United States) Inc. and Motorola Mobility LLC are real parties-in-interest and, solely because it is named as a defendant in a co-pending district court case listed below, Lenovo Group Ltd. is also a real party-in-interest.

B. Related Matters

The ’946 patent is the subject of civil actions, *Collision Communications, Inc.*

v. Samsung Electronics Co. Ltd et al, 2-23-cv-00587 (E.D. Tex.) filed December 12, 2023 (pending) and *Collision Communications, Inc. v. Lenovo Group Ltd*, 2-23-cv-00594 (E.D. Tex.) filed December 12, 2023 (pending). The '946 patent is also the subject of IPR2024-01250, filed August 2, 2024 (pending).

Petitioners are not aware of any other disclaimers, reexamination certificates, or IPR petitions addressing the '946 Patent.

C. Lead and Backup Counsel

Petitioners provide the following counsel and service information.

Petitioners consent to electronic service the email addresses listed in the table below. Pursuant to 37 C.F.R. § 42.10(b), a Power of Attorney accompanies this Petition.

Lead Counsel	Backup counsel
Timothy Riffe, Reg. No. 43,881 Fish & Richardson P.C. 60 South Sixth Street, Suite 3200 Minneapolis, MN 55402 Tel: 202-783-5070 Fax: 877-769-7945 Email: IPR55851-0023IP1@fr.com	Jennifer Huang, Reg. No. 64,297 Whitney Reichel, Reg. No. 59,173 Lawrence Jarvis, Reg. No. 74,636 60 South Sixth Street, Suite 3200 Minneapolis, MN 55402 Tel: 202-783-5070 Fax: 877-769-7945 PTABInbound@fr.com

D. Service Information

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

Petitioners consent to electronic service by email at IPR55851-0023IP1@fr.com

(referencing No. 55851-0023IP1 and cc'ing PTABInbound@fr.com).

E. Payment of Fees

The undersigned authorizes the Office to charge the fee required for this Petition for Inter Partes Review to Deposit Account No. 06-1050. Any additional fees that might be due are also authorized.

IX. CONCLUSION

For the reasons above, *inter partes* review is requested.

Respectfully submitted,

Dated: December 12, 2024

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Attorneys for Petitioners

CERTIFICATION UNDER 37 CFR § 42.24

Under the provisions of 37 CFR § 42.24(d), the undersigned hereby certifies that the word count for the foregoing Petition for *Inter Partes* Review totals 13,099 words, which is less than the 14,000 allowed under 37 CFR § 42.24.

Dated: December 12, 2024

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CERTIFICATE OF SERVICE

Pursuant to 37 CFR §§ 42.6(e)(4)(i) *et seq.* and 42.105(b), the undersigned certifies that on December 12, 2024, a complete and entire copy of this Petition for *Inter Partes* Review, Motion for Joinder, and all supporting exhibits were provided by Federal Express, to the Patent Owner, by serving the correspondence address of record as follows:

Official Correspondence Address
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20 Depot Street
Suite 2A Peterborough, NH
UNITED STATES

Courtesy copies were also sent via electronic mail to Patent Owner's counsel of record in the related district court proceeding:

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