

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS AMERICA, INC.,
SAMSUNG ELECTRONICS CO., LTD.,
Petitioners,

v.

COLLISION COMMUNICATIONS, INC.,
Patent Owner.

Case No. IPR2024-01250
U.S. Patent No. 8,089,946

**DECLARATION OF PAUL S. MIN, PH.D.
IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW OF
U.S. PATENT NO. 8,089,946**

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I. Introduction

1. I, Paul S. Min, Ph.D., submit this declaration to state my opinions on the matter described below.

2. I have been retained by Petitioners Samsung Electronics Co., Ltd. and Samsung Electronics America, Inc. (“Petitioners”), as an independent expert in this proceeding before the United States Patent and Trademark Office. Although I am being compensated at my usual and customary rate of \$500 per hour, no part of my compensation depends on the outcome of this proceeding, and I have no other interest in this proceeding.

3. I understand that this proceeding involves U.S. Patent No. 8,089,946 (the “’946 patent”), and I have been asked to consider the validity of certain claims of the ’946 patent based on certain prior art references. I have also been asked to consider the state of the art and prior art available as of March 24, 2005. Based on the prior art discussed in this declaration, it is my opinion that claims 1-5, 7, 9-16, and 20 of the ’946 patent are unpatentable for the reasons provided below.

II. Qualifications and Background

4. I believe that I am well qualified to serve as a technical expert in this matter based upon my educational and work experience, and specifically, in the field of vehicle electronics and computing devices. My curriculum vitae (“CV”) is submitted as Exhibit 1010.

5. Of note, as shown in my CV, I have extensive experience design and implementation of receiver devices to be used in the cellular equipment and the WLAN equipment.

6. I received a B.S. degree in Electrical Engineering in 1982, an M.S. degree in Electrical Engineering in 1984, and a Ph.D. degree in Electrical Engineering in 1987 from the University of Michigan in Ann Arbor. I received several academic honors, including my B.S. degree with honors, a best graduate student award and a best teaching assistant award during my M.S. study, and a best paper award from a major international conference for reporting results from my Ph.D. thesis.

7. After receiving my Ph.D., I worked at Bellcore in New Jersey from August 1987 until August 1990. At Bellcore, I was responsible for evolving the public switched telephone network (POTS) into a multi-services voice and data network that incorporated packet switches, optical technologies, and wireless technologies.

8. In September 1990, I joined the faculty at Washington University in St. Louis. In July 1996, I was promoted to an Associate Professor of Electrical Engineering with tenure. I am currently a Senior Professor at Washington University of the Electrical and Systems Engineering. I have also served as the Chair of the

Graduate Curriculum (2000-2002) and the Chair of the Undergraduate Curriculum (2011-2014) for the Electrical and Systems Engineering department.

9. At Washington University, I have conducted research in communication, computing, and related electronic hardware and software. My research group has pioneered a new paradigm for designing electronic circuits that can alleviate the speed and performance mismatch against optical technology. I have received several grants from the U.S. Federal Agencies, including the National Science Foundation and the Defense Advanced Research Project Agency, and numerous contracts from companies and organizations around the world. Specifically related to the technology matters in this Investigation, I have researched a variety of wireless communication technologies, including CDMA, WCDMA, OFDM, FDD, SC-FDMA, and TDD. I have an extensive background and experience in each of these technologies.

10. As a faculty member at Washington University, I have taught a number of courses in electronics, communication, and computing at both the undergraduate and graduate levels. For example, I have taught communication theory (Washington University ESE 471), transmission and multiplexing (Washington University ESE 571), and signaling and control of communication networks (Washington University ESE 572).

11. I have supervised numerous graduate students, many of whom received a doctoral degree under my guidance. A number of doctoral theses that I have supervised relate specifically to LTE and other cellular technologies. In particular, my students and I have published a number of peer-reviewed articles on resource allocation, scheduling, modulation, mobility management, and multiplexing. Several of these articles received accolades in the field. For example, in 2011, we received a best paper award in 3G WCDMA-related mobility and resource management at the prestigious Mobility 2011 international conference.

12. In addition to my responsibilities as a university faculty member, I have founded two companies. In May 1997, I founded MinMax Technologies, Inc., a fabless semiconductor company that developed switch fabric integrated circuit chips for the Internet. In March 1999, I founded Erlang Technology, Inc., a fabless semiconductor company that focused on the design and development of integrated circuit chips and software for the Internet. One of Erlang's products received a best product of the year award in 2004 from a major trade journal for the electronics industry.

13. Outside my own start-up companies, I have also served in various technology and business advisor roles for other companies and organizations around the world. I was the main technical author for one of two winning proposals to the

Korean government for CDMA wireless service licenses (1996). I was responsible for designing a commercial scale IS-95 CDMA cellular network, which I understand to be one of the earliest such networks deployed in the world. I worked with numerous engineers and scientists around the world to implement this commercial-scale cellular network before IS-95 CDMA was widely accepted. This provided me with extensive insight into various components of CDMA technology, which by and large are used in WCDMA network. I have also been involved in a semiconductor company that specializes in semiconductor memories such as flash EEPROMs as a board member and as a technical advisor (2007-2011).

14. I am a named inventor on eleven U.S. patents, many of which are directly related to resource allocation, packet processing, and network designing. I have extensively published technical papers in international conferences and journals, technical memoranda and reports, and given a number of seminars and invited talks. Many of these papers are specifically within the context of the 3GPP standard. I have organized several international conferences and served as an international journal editor.

15. I am a member of and have been actively involved in a number of professional organizations. For example, I have served as the Chair of the Saint Louis Section of the IEEE with more than 3,000 members (2014), and a member of

the Eta Kappa Nu Honor Society for electrical engineers. I have also been an Ambassador of the McDonnell International Scholars Academy (2007-2013).

16. In my nearly 30 years of experience with telecommunications technology, I have acquired significant knowledge about telecommunications systems industry standards, standard setting organizations such as 3GPP, and the rules and document policies that those organizations have in place to develop industry standards.

III. Legal Standards

17. In forming my opinions and considering the subject matter of the '268 patent and its claims in light of the prior art, I am relying on certain legal principles that counsel in this case explained to me. My understanding of these concepts is summarized below.

18. I understand that the claims define the invention. I also understand that an unpatentability analysis is a two-step process. First, the claims of the patent are construed to determine their meaning and scope. Second, after the claims are construed, the content of the prior art is compared to the construed claims.

19. I understand that a claimed invention is only patentable when it is new, useful, and non-obvious in light of the "prior art." That is, the invention, as defined by the claims of the patent, must not be anticipated or rendered obvious by the prior

art.

A. Claim Construction

20. I understand that the United States Patent and Trademark Office interprets claim terms in an *inter-partes* review proceeding under the same claim construction standard that is used in a United States federal court. I understand that under this standard, the meaning of claim terms is considered from the viewpoint of one of ordinary skill in the art at the time of the alleged invention.

21. I understand that claim terms are generally given their ordinary and customary meaning as understood by one of ordinary skill in the art in light of the specification and the prosecution history pertaining to the patent. I understand, however, that claim terms are generally not limited by the embodiments described in the specification.

22. I understand that in addition to the claims, specification, and prosecution history, other evidence may be considered to ascertain the meaning of claim terms, including textbooks, encyclopedias, articles, and dictionaries. I have been informed that this other evidence is often less significant and less reliable than the claims, specification, and prosecution history.

B. Anticipation Under 35 U.S.C. § 102

23. I understand that under 35 U.S.C. § 102, a patent claim is invalid if its subject matter was patented or described in a printed publication before the effective

filing date of the claimed invention. I have been told that this is referred to as invalidity by anticipation. I have been told that a patent claim is anticipated under § 102 if a single prior art reference discloses all limitations of the claimed invention.

C. Obviousness Under 35 U.S.C. § 103

24. I understand that a patent claim is invalid as obvious if the claimed invention would have been obvious to a person of ordinary skill in the art (“POSITA”) at the time the claimed invention was made. This means that even if all of the elements of the claim cannot be found in a single prior art reference that would anticipate the claim, a person of ordinary skill in the field who knew about all the prior art would have come up with the claimed invention. I understand that in an obviousness determination, the person of ordinary skill in the art is presumed to have knowledge of all material prior art. I understand that whether a claim is obvious is based upon the determination of several factual issues.

25. I understand that obviousness is a determination of law based on underlying determinations of fact. I understand that these factual determinations include the scope and content of the prior art, the level of ordinary skill in the art, the differences between the claimed invention and the prior art, and secondary considerations of non-obviousness.

26. In considering obviousness, I understand that one must determine the scope and content of the prior art. I understand that, in order to be considered as prior

art to a patent being considered, a prior art reference must be reasonably related to the claimed invention of that patent. A reference is reasonably related if it is in the same field as the claimed invention or is from another field to which a person of ordinary skill in the art would look to solve a known problem.

27. I understand that one must determine what differences, if any, existed between the claimed invention and the prior art.

28. I understand that a patent claim composed of several elements is not proved obvious merely by demonstrating that each of its elements was independently known in the prior art. In evaluating whether such a claim would have been obvious, one may consider whether a reason has been identified that would have prompted a person of ordinary skill in the art to combine the elements or concepts from the prior art in the same way as in the claimed invention. There is no single way to define the line between true inventiveness on the one hand (which is patentable) and the application of common sense and ordinary skill to solve a problem on the other hand (which is not patentable). For example, market forces or other design incentives may be what precipitated a change, rather than true inventiveness.

29. I understand that whether a prior art reference renders a patent claim unpatentable as obvious is determined from the perspective of a person of ordinary skill in the art at the time of the alleged invention. I have been told that there is no

requirement that the prior art contain an express suggestion to combine known elements to achieve the claimed invention, but a suggestion to combine known elements to achieve the claimed invention may come from the prior art, as filtered through the knowledge of one skilled in the art. In addition, I have been told that the inferences and creative steps a person of ordinary skill in the art would employ are also relevant to the determination of obviousness.

30. I understand that there is no rigid rule that a reference or combination of references must contain a “teaching, suggestion, or motivation” to combine references. But I also understand that the “teaching, suggestion, or motivation” test can be a useful guide in establishing a rationale for combining elements of the prior art. I have been told that this test poses the question as to whether there is an express or implied teaching, suggestion, or motivation to combine prior art elements in a way that realizes the claimed invention, and that it seeks to counter impermissible hindsight analysis.

31. I understand that one may consider, e.g., whether (1) the change was merely the predictable result of using prior art elements according to their known functions, or whether it was the result of true inventiveness; (2) there is some teaching or suggestion in the prior art to make the modification or combination of elements claimed in the patent; (3) the claimed innovation applies a known technique

that had been used to improve a similar device or method in a similar way; (4) the claimed invention would have been obvious to try, meaning that the claimed innovation was one of a relatively small number of possible approaches to the problem with a reasonable expectation of success by those skilled in the art; (5) the invention merely substituted one known element for another known element in order to obtain predictable results; (6) the invention merely applies a known technique to a known device, method, or product to yield predictable results; or (7) known work in the field may have prompted variations of use of the same inventions in the same or different fields due to market forces or design incentives that would have been predictable to a person of ordinary skill in the art.

32. I understand that any assertion of secondary considerations of non-obviousness must be accompanied by a nexus between the merits of the invention and the evidence offered.

IV. The '946 patent

A. Background of Technology

33. I first begin with a summary of the technology involved with the '946 patent. In describing some of the basic concepts, I refer to a well-known text regarding wireless communications by Sergio Verdú: “Computational Complexity of Optimum Multiuser Detection,” *Algorithmica* (1989) (Ex. 1011).

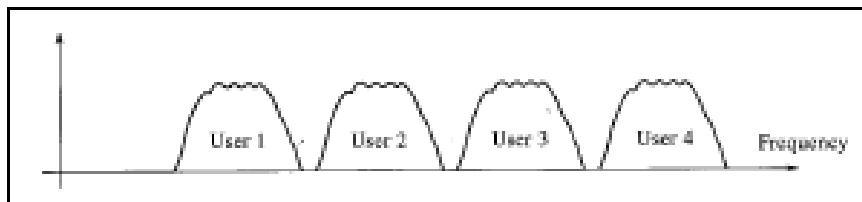
34. The '946 patent relates to the technology referred to as multiuser detection ("MUD"). MUD techniques have been well known for decades, and documented since at least the 1980s. Generally speaking, a MUD system allows users to transmit information over a shared communication path or channel. The users' information is transmitted as interfering signals over the shared communication path or channel. 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. 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. Of importance in the multiuser detection problem is that unlike the conventional multiple access mechanism, where the signals from different users are separated by the use of orthogonal channels, in the multiuser detection problem, the signals from different users cannot be separated individually, and must be decoded jointly.

35. MUD is described by Sergio Verdu in “Computational Complexity of Optimum Multiuser Detection,” *Algorithmica* (1989) (Ex. 1011). In 1989, MUD was well known as detecting signals for each user in a multi-user system. For example, one implementation of MUD was described as “[t]he optimum multiuser receiver can be viewed as a bank of single-user detectors followed by a common algorithm that selects the most likely transmitted symbols.” *Id.*, 304.

36. MUD has been used in many familiar wireless technologies that require sending multiple user data streams over a single signal. Indeed, since the 1980s, multiuser detection has been implemented in cellular networks, satellite communication, high-speed data transmission lines, digital radio/television broadcasting, fixed wireless local loops, and multitrack magnetic recording. All of these communication systems are subject to multiaccess interference and need a detector to determine the user for the data transmitted on the shared network. Ex. 1012, xix.

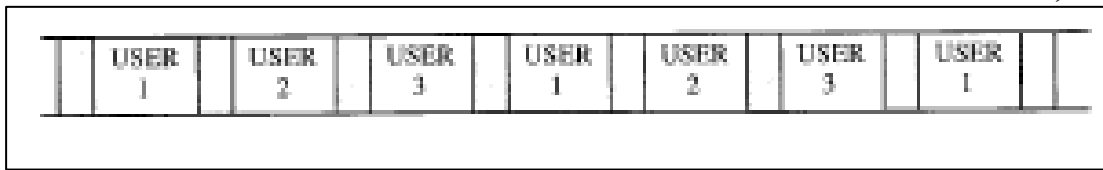
37. For example, Qualcomm pioneered the use of Code-Division Multiple-Access (“CDMA”) technology in the 1990s. In the CDMA cellular networks, multi-user detection was implemented by modulating each user’s transmitted signal using a signature waveform to identify the data that belonged to each user in the network. *Id.*

38. Another system pioneered by Qualcomm in the 1990s was Frequency Division Multiplexing or Frequency Division Multiple Access (“FDMA”). In FDMA systems, a different carrier frequency is assigned to each user in a network with a shared communication channel so that the resulting signals and spectra do not overlap. *Id.* This is shown below:



39. As shown in the above figure, each user has a signal parameter based on carrier frequency. The receiver can use this carrier frequency to demodulate the signal and correlate it to the user.

40. Yet another system in used in the 1990s was Time Division Multiplexing (“TDMA”) systems. In such systems, *time* is partitioned into slots assigned to each incoming digital stream in round-robin fashion and demultiplexing is carried out by simply switching on to the received signal at the appropriate times. Time division can be used not only to multiplex collocated message sources but also by geographically separated users who have the ability to maintain time-synchronism. This is shown below:



41. As shown in the above figure, each user has a signal parameter based on time division. The receiver can use this time division to demodulate the signal and correlate it to the user.

42. In the above CDMA, FDMA and TDMA systems, it was critical to correlate data streams to users. All of these systems employed MUD, and specifically, utilized parameters to identify the user that corresponds to the data sent over the shared channel. All of these systems used signal processors that would identify the signal parameters to estimate the signal and separate the signal from the interfering signals. Given bandwidth constraints, security concerns, and possible interference, it was well known in the 1990s to use an unshared channel to send the parameter information for the data. For example, FDMA and TDMA were well-known multiplexing schemes that would provide parameters over a separate and distinct time or frequency so as not to overlap with the data. Ex. 1011, 304. Solutions to the problem of sending parameter signals over the shared communication channel were well known at the time of the '946 patent's alleged invention.

B. Overview of the '946 patent (Ex. 1001)

43. The '946 patent is directed to a modem for use in a multiuser wireless network designed to provide compatibility with existing network hardware and protocols so that new multiuser modems can be added to the network without removing older infrastructure. Ex. 1001, Abstract.

44. Indeed, the '946 patent does not purport to invent MUD. In fact, the '946 patent expressly recognizes that MUD is conventional. Ex. 1001 at 14:7-9 ("Each of the analog front end 105, parameter estimation module 110, MUD module 115, and bank of decoders 117 can be implemented in conventional technology."). I agree that this technology was conventional at the time of the priority date of the '946 patent.

45. Instead, the purported invention is the backwards compatibility of a multiuser modem to enable a legacy protocol mode. Specifically, some modems in a network may have a bandwidth efficient aggressive access protocol mode, and others may not. The purported invention of the '946 patent is, when a modem does not support the bandwidth efficient aggressive access protocol mode, modems in communication with it may "enable a legacy protocol mode there by providing backwards compatibility." Ex. 1001 at 48-51.

46. Legacy protocol modes for backwards compatibility in wireless networks have been used for decades. For example, stereo FM radio broadcasting

was introduced in the 1960s. Stereo FM radios, however, were still made to be backwards compatible with a legacy mode—mono FM radio.

C. Prosecution History of the '946 patent

47. I have reviewed the prosecution history of the application that led to the '946 patent. Ex. 1002. I have provided a summary below of the prosecution history.

1. Prosecution History

48. 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.

49. I understand that 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.

2. April 3, 2010 Non-Final Rejection

50. 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. Ex. 1002, 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.

3. October 13, 2010 Applicant Remarks

51. 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." Ex. 1002, 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.*

4. December 27, 2010 Final Rejection

52. Examiner found Applicant's arguments unpersuasive and noted the Applicant's argument regarding low data rate were not recited in the claims.

**5. February 10, 2011 Applicant Amendments and Remarks
with Request for Continued Examination**

53. Applicant amended the claims to include recitation of “low data rate BPSK, QPSK, GMSK, and QAM.” Ex. 1002, 114. Applicant reiterated its argument that Reznik and Urs were limited to the CDMA context, and thus fail to render the claims obvious. Ex. 1002, 106.

6. April 14, 2011 Non-Final Rejection

54. 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. Ex. 1002, 85-88.

7. August 12, 2011 Applicant Amendment and Remarks

55. Applicant made minor edits to the claims that were not central to its argument, and added new claims. 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.” Ex. 1002, 8/12/2011 Remarks at 18-19. 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.” Ex. 1002, 67 (emphasis added).

56. A Notice of Allowability issued on November 14, 2011. Ex. 1002, 21.

D. Person of Ordinary Skill in the Art

57. I am informed that patentability must be analyzed from the perspective of “one of ordinary skill in the art” in the same field as the ’946 patent at the time of the invention. As previously discussed, the relevant time of invention is the patent’s priority date, which is no earlier than March 24, 2005. Moreover, I understand that whether or not a patent application provides “written description” support for patent claims must also be assessed from the perspective of a person of ordinary skill in the art.

58. I am also informed that several factors are considered in assessing the level of ordinary skill in the art, including (1) the types of problems encountered in the art; (2) the prior art solutions to those problems; (3) the rapidity with which innovations are made; (4) the sophistication of the technology; and (5) the education level of active workers in the field.

59. 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. Additional education could substitute for professional experience and vice versa. A person of ordinary skill in the art would also be able to understand and apply the prior art discussed herein.

60. Although I surpass this definition of one of ordinary skill in the art now and at the priority date of the '946 patent, my analysis regarding the '946 patent has been based on the perspective of one ordinary skill in the art as of the priority date of the '946 patent.

61. I am also familiar with the knowledge of the person of ordinary skill in the art as of the priority date of the '946 patent. I am able to opine on how the person of ordinary skill in the art would have understood the disclosure and claims of the '946 patent, the disclosures of the prior art, the motivation to combine the prior art, and what combinations would have been obvious to one of ordinary skill in the art.

V. Claim Construction of Terms of the '946 patent

62. As I discussed above, I have been informed that for purposes of *inter-partes* reviews, the standard for claim construction of terms within the claims of the patent is the same as that applied in federal district court litigation. I have been asked to assume that the claim terms otherwise have their plain and ordinary meaning to a person skilled in the art in light of the specification and the prosecution history.

63. As of this time, I am not aware of any term that requires specific construction for my opinions. To the extent Patent Owner suggests a narrow construction for a term, I reserve the right to respond to those opinions.

VI. Overview of Prior Art

64. Below, I discuss the references I rely on in my declaration.

A. Walton (Ex. 1004)

65. 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.” Ex. 1004 ¶¶ 42-43. Walton expressly teaches providing multiple modulation schemes, including legacy protocol modes (low code rate BPSK, QPSK, and 16-QAM) and bandwidth efficient aggressive access protocol modes (high code rate QPSK, 16-QAM, and 64-QAM). Ex. 1004 ¶¶ 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

B. Learned (Ex. 1005)

66. 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.” Ex. 1005 at 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.*

C. Quigley (Ex. 1006)

67. Quigley is directed to techniques for data transmission to enhance performance of the transmission system and permit multiple access from cable modems. Ex. 1006 at Abstract. It teaches a modem capable of burst transmissions.

VII. Summary of Opinions on Unpatentability

68. In the analysis that follows, I identify the following combinations of prior art that, in my opinion, anticipate and/or render obvious the '946 patent claims:

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

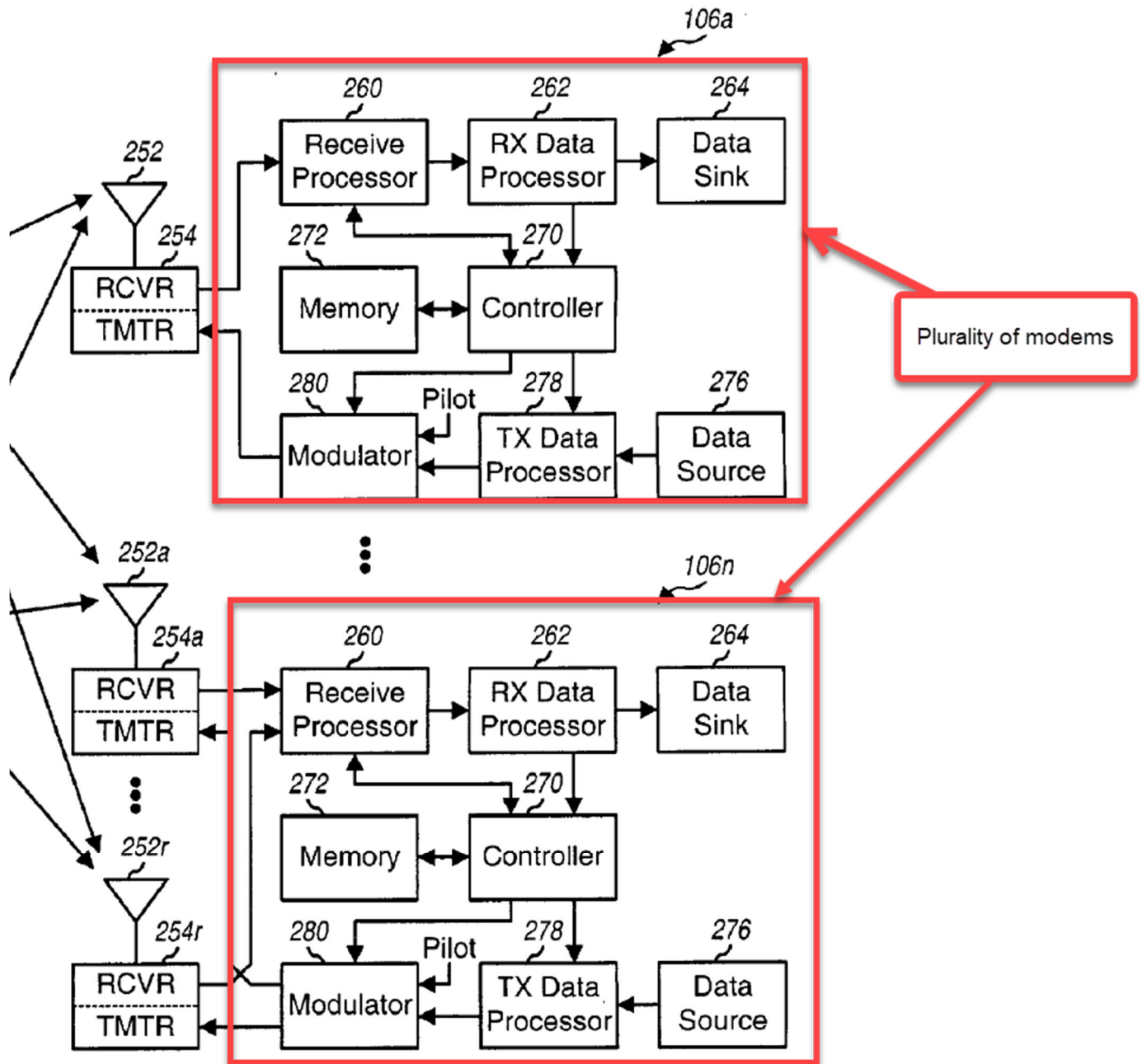
A. Ground 1: Claims 1-5, 7, 9-16, and 20 are Rendered Obvious by Walton under Section 103

69. I provide a summary of this ground as follows. Walton discloses all the limitations of the asserted '946 patent claims. Ground 1 addresses claims 1-5, 7, 9-16, and 20. Nevertheless, Ground 1 is presented as an obviousness ground to address potential arguments Patent Owner may present.

8. 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:

70. In my opinion, Walton discloses this limitation, to the extent the preamble is limiting.

71. Walton discloses a multiple-input and multiple-output (MIMO) system, comprising *multiple terminals containing modems*, using techniques for transmitting data involving diversity transmission modes to improve reliability. Ex. 1004 at 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).” Ex. 1004 ¶ 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*.



72. Further, as shown in Figure 2 Walton's network includes **multiple user terminals**. Indeed, Walton's wireless communication "systems may be multiple-access systems capable of supporting communication with **multiple users** either

sequentially or simultaneously.” Ex. 1004 ¶ 4. Thus, Walton teaches a system comprising a plurality of modems in a **multi-user** network. Figure 1 below additionally shows that Walton’s system comprises multiple user terminals 106a-n, each containing a modem.

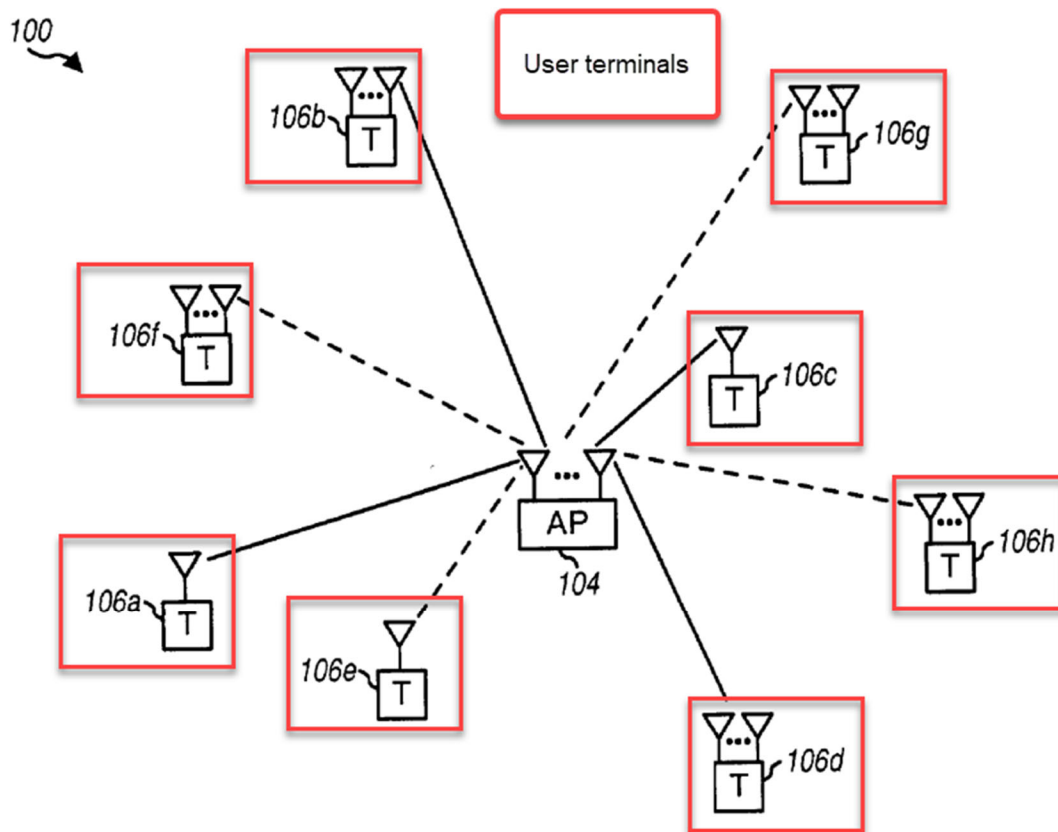


FIG. 1

73. 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. Ex. 1004 ¶¶ 56-58, 72-75, 92-94, 140. Walton also teaches that its system “combats frequency selective fading,” which

causes “inter-symbol interference” for multiple-access systems (*i.e.*, ***in the presence of interference and noise***). Ex. 1004 ¶¶ 8-10. Thus, Walton discloses modems which enables efficient use of bandwidth in a multiuser wireless network including a plurality of modems in the presence of interference and noise.

(b) 1a: a multiuser detection (MUD) module configured to simultaneously demodulate and recover K wirelessly transmitted signals using co-channel demodulation;

74. In my opinion, Walton discloses this limitation.

(i) A multiuser detection (MUD) module:

75. The '946 patent recognizes that MUD modules are conventional technology. Ex. 1001 at 14:7-9 (“Each of the analog front end 105, parameter estimation module 110, ***MUD module*** 115, and bank of decoders 117 can be implemented in conventional technology.”). I agree that this technology was conventional at the time of the priority date of the '946 patent.

76. Walton teaches a MUD module under the interpretation of the claims Patent Owner has advanced in the co-pending district court litigation. I have reviewed Patent Owner’s infringement contentions in the district court litigation, and I understand that Patent Owner’s mapping for this limitation suggests that that it is applying a construction for “MUD module” to mean a receive processor of a modem in a MIMO system (Ex. 1009, 2-14), the same technology described by Walton. Ex. 1004 ¶¶ 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. Ex. 1004 ¶¶ 7, 31, 42. Walton thus discloses **a multiuser detection (MUD) module**.

77. In my opinion, even if Patent Owner argues that the MIMO receive processor in the system of Walton does not disclose the claimed “multiuser detection (MUD) module,” Learned discussed in Ground 2 expressly discloses a multiuser detection (MUD) module.

(ii) Configured to simultaneously demodulate and recover K wirelessly transmitted signals:

78. As mentioned, the receive processor of Walton is a MUD module under Patent Owner’s construction. Further, Walton’s receive processor is 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.” Ex. 1004 ¶ 7. Further, “[a]t 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.” Ex. 1004 ¶ 41. The receive processor then “receives and processes the streams of samples from all receivers 254 to provide recovered symbols (i.e., demodulated data).” Ex. 1004 ¶ 42. Walton expressly teaches that multiple-access systems (such as its MIMO system) are “capable of

supporting communication with multiple users ... *simultaneously*.” Ex. 1004 ¶ 4. In other words, the receive processor *simultaneously demodulates and recovers the wirelessly transmitted signals*.

(iii) Using co-channel demodulation:

79. Walton teaches using co-channel demodulation for simultaneously demodulating and recovering multiple wirelessly transmitted signals because it discusses using orthogonal frequency division multiplexing (OFDM). 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.” Ex. 1004 ¶ 9. In other words, because OFDM signals are mapped onto subcarriers that overlap in frequency channel, Walton’s demodulation using OFDM is *co-channel demodulation*. A POSITA would have understood that OFDM entails co-channel demodulation because OFDM signals are mapped onto overlapping subcarriers in a frequency channel.

80. In its infringement contentions, Patent Owner has also mapped OFDM demodulation to be the claimed co-channel demodulation. Ex. 1009, 5 (citing to a Qualcomm patent that states “Each receiver unit 554 performs processing complementary to that performed by transmitter unit 532 (*including OFDM*

demodulation, if applicable)"); Ex. 1009, 13 (“The frequency domain signal comprises a separate *OFDM symbol stream for each subcarrier of the OFDM signal*. The symbols on each subcarrier, and the reference signal, is recovered and *demodulated*”).

- (c) **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;**

81. In my opinion, Walton discloses this limitation.

- (i) **A data formatting module . . . configured to produce network data packets for at least one of the K recovered signals:**

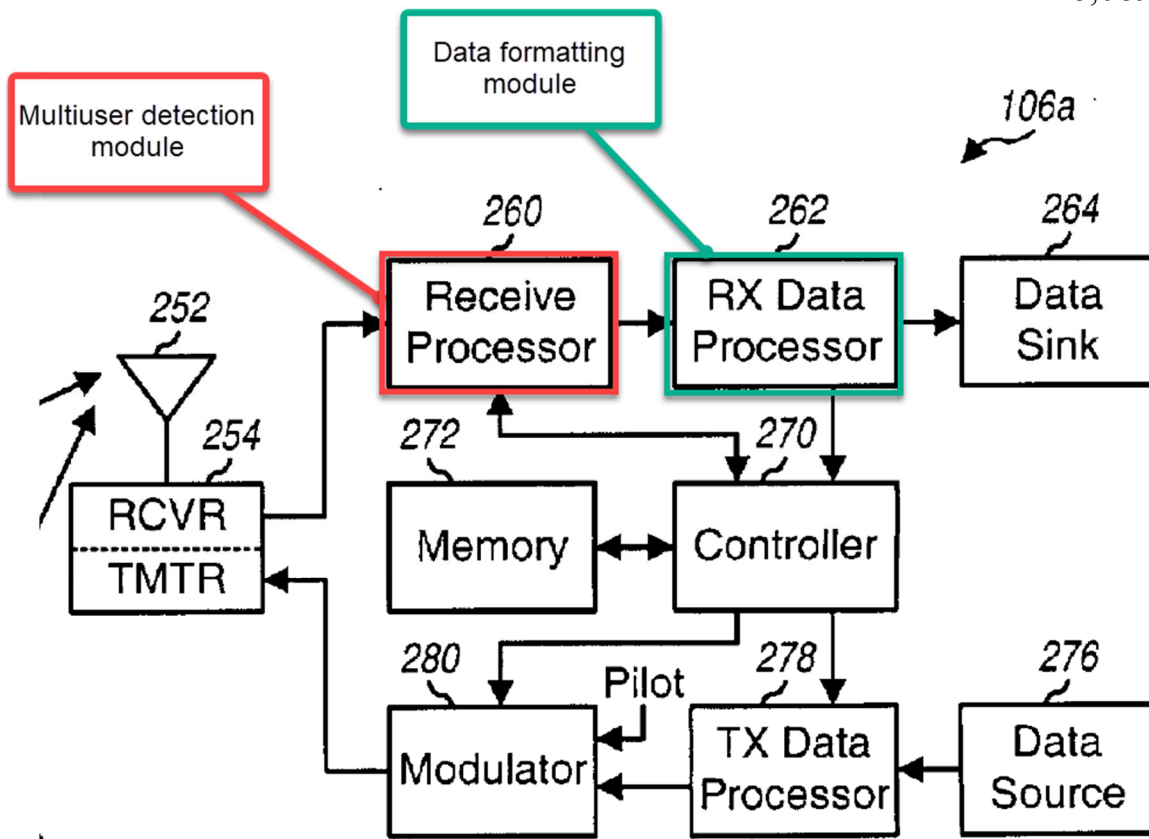
82. Walton’s “receive (RX) data processor 262” is the claimed data formatting module. Walton teaches that the receive data processor (a data formatting module) “symbol demaps, deinterleaves, and decodes the recovered symbols to obtain the user-specific data and signaling transmitted on the downlink for the terminal.”

83. 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. Walton teaches the data formatting module is configured to produce network data packets for the recovered signals. Walton recognizes that “wireless communication systems are widely

deployed to provide various types of communication, such as voice, ***packet data***, and so on.” Ex. 1004 ¶ 4. In one embodiment of the invention of Walton, “the data for each data stream is initially partitioned into frames (or ***packets***).” Ex. 1004 ¶ 52. Walton further indicates that the decoder of the data processor “provide[s] the status of each received ***packet***” for each of the recovered signals. Ex. 1004 ¶ 146. A POSITA would have understood that Walton’s data processor produces network data packets for recovered signals because in order to provide a ***status*** for each packet, the data processor necessarily must have first ***produced*** the packets for the recovered signals.

(ii) Operatively coupled to the multiuser detection module:

84. As shown in Figure 2, the receive data processor (***data formatting module***) is operatively coupled to the receive processor (*i.e.*, the ***MUD module***) to receive the recovered symbols. Ex. 1004 ¶¶ 41-42.

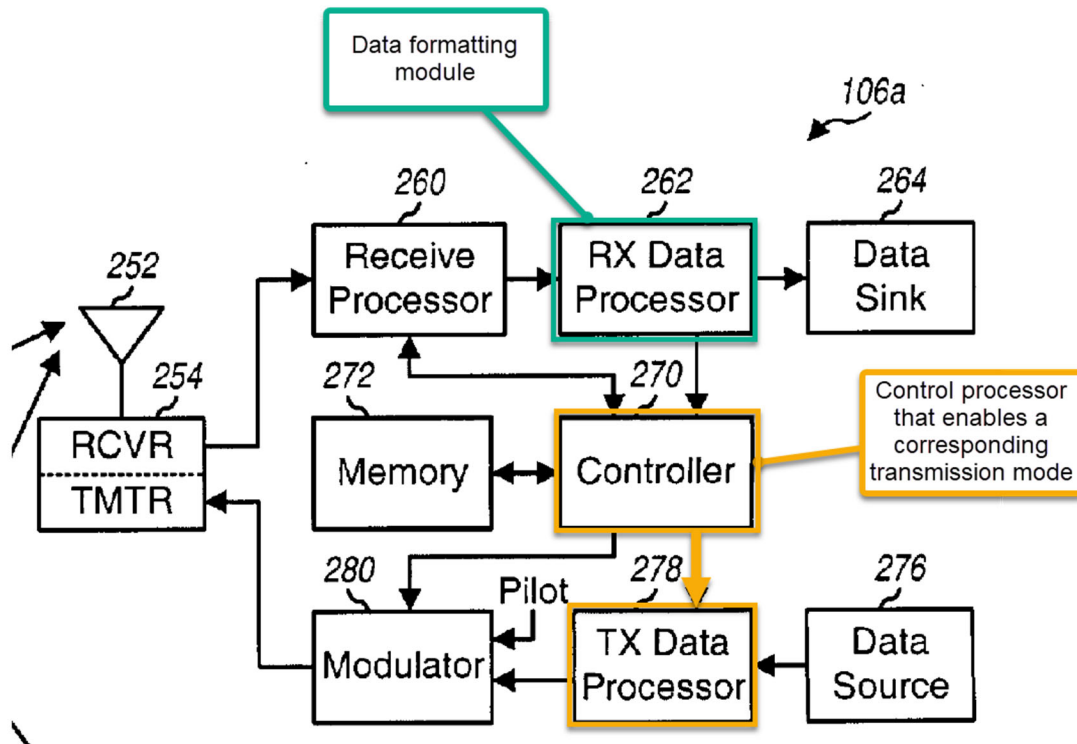


- (d) 1c: a control processor operatively coupled to the formatting module, and configured to detect with which protocol mode the at least one of the K recovered signals was transmitted, and to enable a corresponding transmission mode including one of a legacy protocol mode and a bandwidth efficient 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 QAM; and

85. In my opinion, Walton discloses this limitation.

- (i) A control processor operatively coupled to the formatting module:

86. Walton discloses that controller 270 (*i.e.*, **a control processor**) “direct[s] the operation at the access point and the terminal.” Ex. 1004 ¶ 46. As shown in Figure 2, it is **operatively coupled to the data formatting module**.



(ii) **Configured to detect with which protocol mode the at least one of the K recovered signals was transmitted:**

87. Walton teaches the control processor is configured to detect with which protocol mode the at least one of the K recovered signals was transmitted. The “[c]ontroller 270 may be designed to perform various functions related to diversity processing at the receiver. For example, controller 270 may determine the diversity transmission mode used for each data stream to be recovered” (*i.e.*, **detects with**

which protocol mode the recovered signals was transmitted) Ex. 1004 ¶ 147; *see*

also 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”).

- (iii) **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:**

88. 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. 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.

89. In Walton, the transmission data processor 278 that receives the data packets from the controller 270 (*i.e.*, the control processor) “codes the different types of traffic data *in accordance with their respective coding schemes* to provide coded data and further interleaves the coded data.” Ex. 1004 ¶ 44.

90. A POSITA would have understood that the same protocol mode (i.e., a corresponding mode) must be used for transmission as the received packet since the access point and terminal need to use the same protocol in order to be able to communicate. In other words, the transmission mode corresponds with the protocol mode of the received signal.

91. Further, each terminal in Walton supports a number of “diversity transmission modes,” depending on the number of antennae and the type of channel. Ex. 1004 ¶¶ 126-140 (describing “fixed or dynamically selected” diversity transmission modes). “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.” Ex. 1004 ¶ 134. And because a POSITA would have understood that the same protocol mode (i.e., a corresponding mode) must be used for transmission as the received packet since the access point and terminal need to use the same protocol in order to be able to communicate, the control processor *enables a corresponding transmission mode*.

92. I have reviewed Patent Owner’s infringement contentions in the district court litigation, and I understand that Patent Owner maps “non-MIMO, single antenna” to the “legacy” mode and single-user MIMO (SU-MIMO) to the “bandwidth efficient mode” (Ex. 1009 at 29). This is precisely the same “diversity transmission modes” described by Walton. Ex. 1004 ¶¶ 126-140.

93. “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. 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”). *Id.* ¶¶ 135-139; *see also id.* ¶ 14 (describing four different diversity transmission modes). These multiple modes thus constitute a “**legacy protocol mode and a bandwidth efficient aggressive access protocol mode**” because some modes are associated with “**higher spectral efficiency**” over other modes.” *Id.* ¶¶ 94, 113 (STTD modes provide higher bandwidth efficiency than Walsh modes and Walsh-

STTD modes having twice the spectral efficiency of Walsh modes). In addition to teaching multiple diversity transmission modes, Walton also teaches that each terminal may use the multiple modulation schemes shown in Table 1, with each scheme having an associated coding rate “used to achieve *a range of spectral efficiencies* (or bit rates) using convolutional and Turbo codes.” Ex. 1004 ¶¶ 56-58, Table 1. These multiple modulation schemes thus also constitute a “*legacy protocol mode and a bandwidth efficient aggressive access protocol mode.*”

94. Walton teaches “that orthogonal frequency division multiplexing (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.” Ex. 1004 ¶ 9. Accordingly, the signals transmitted by the sub-channels *require co-channel demodulation.*

95. I have reviewed Patent Owner’s infringement contentions in the district court litigation, and I understand that Patent Owner maps OFDM demodulation to be the claimed co-channel demodulation. Ex. 1009, 5 (citing to a Qualcomm patent that states “Each receiver unit 554 performs processing complementary to that performed by transmitter unit 532 (*including OFDM demodulation*, if

applicable)"); Ex. 1009, 13 ("The frequency domain signal comprises a separate *OFDM symbol stream for each subcarrier of the OFDM signal*. The symbols on each subcarrier, and the reference signal, is recovered and *demodulated*").

96. Walton also teaches that the transmission modes include "(1) a frequency diversity transmission mode that redundantly transmits modulation symbols over multiple *OFDM* subbands, (2) a Walsh diversity transmission mode that transmits each modulation symbol over NT *OFDM* symbol periods, where NT is the number of transmit antennas used for data transmission, (3) a space time transmit diversity (STTD) transmission mode that transmits modulation symbols over multiple *OFDM* symbol periods and multiple transmit antennas, and (4) a Walsh-STTD transmission mode that transmits modulation symbols using a combination of Walsh diversity and STTD." Ex. 1004 ¶ 14. And specifically, the bandwidth efficient aggressive access protocol modes (including the STTD transmission modes for dual-antenna terminals and quad-antenna terminals) use multiple antennas for efficiency. See Ex. 1004 ¶ 94 ("Space-time transmit diversity (STTD) supports 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").

97. Accordingly, Walton's bandwidth efficient aggressive access protocol mode that demodulates signals transmitted on separate antennas and separate channels *exploits co-channel demodulation*.

(iv) **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:**

98. Walton teaches that various coding and modulation schemes may be used, including “**BPSK** [binary phase-shift keying], **QPSK** [quadrature phase shift keying], **16-QAM** [quadrature amplitude modulation], **64-QAM**[,] ... [and] **DPSK** [differential phase-shift keying].” Ex. 1004 ¶ 57. While Walton does not expressly teach GMSK, 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.

99. I understand that, 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).

100. A POSITA would understand that at least the BPSK modulation with efficiency 0.5 bps/Hz and a code rate of $\frac{1}{2}$ would constitute a “low data rate” BPSK protocol mode (particularly when compared to 64-QAM modulation with efficiency 5.0 bps/Hz and a code rate of $\frac{5}{6}$, which is also expressly described by Walton in

Table 1). Ex. 1004, Table 1. Further, Walton teaches that “the data rate for each user-specific data stream may be adjusted based on the transmission capability of the receiver device.” Ex. 1004 ¶ 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

101. As shown in Table 1 of Walton, BPSK, QPSK, and 16-QAM (with a low code rates of 1/2) constitute low data rate modulation schemes (*i.e.*, the claimed “**legacy protocol mode**”). Higher 2/3, 3/4, 5/6, and 7/8 code rate QPSK, 16-QAM, and 64-QAM constitute higher data rate modulation schemes (*i.e.*, the claimed “**bandwidth efficient aggressive access protocol mode**”). Both modes are supported in each of the multiple modems to achieve “a range of spectral efficiencies (or bit rates).” Ex. 1004 ¶¶ 56-58, Table 1. Walton additionally teaches that its MIMO

OFDM system may “also be designed to implement one or more multiple access schemes such as code division multiple access (CDMA), time division multiple access (TDMA), frequency division multiple access (FDMA) and so on. CDMA may provide certain advantages over other types of system, such as increased system capacity” (*i.e., a bandwidth efficient aggressive access protocol mode*). Ex. 1004 ¶ 166.

102. Accordingly, Walton discloses 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 QAM.

- (e) **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.**

103. In my opinion, Walton discloses this limitation.

- (i) **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:**

104. Although this limitation recites a “demultiplexer,” the function the element is configured to perform (“select[ing] one of the recovered K wirelessly transmitted signals”) is that of a “multiplexer.”

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. Accordingly, a POSITA would have understood that the claimed “demultiplexer” implements functionality that in the prior art would be attributed to a multiplexer.

106. 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 from RX subband processors 1120a through 1120f and multiplexes these symbols into a recovered symbol stream, $\hat{s}_i(n)$, for receive antenna i.” Ex. 1004 ¶ 156. In other words, Walton’s multiplexer receives the recovered symbols and selects a target signal to be transmitted through an antenna.

107. Additionally, the “receive (RX) data processor [i.e., the *data formatting module*] 262 [] symbol demaps, deinterleaves, and decodes the recovered symbols to obtain the user-specific data,” i.e., *a target signal intended for a user*. Ex. 1004 ¶ 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*.”). Walton additionally teaches that “processor 210 then *formats and encodes the traffic data* based on *one or more coding* schemes to provide coded data.” Ex. 1004 ¶ 38. Accordingly, the multiplexer is configured to select one of the recovered K wirelessly transmitted signals as a target signal intended for a user associated with the modem

(ii) Operatively coupled to the data formatting module and the control processor:

108. Walton's multiplexer is operatively coupled to the data formatting module. Figure 11 (below) in Walton "is a block diagram of an RX antenna processor within the RX diversity processor" (Ex. 1004 ¶ 29) which is in the receive processors 260. Ex. 1004 Figures 2, 9, 11. As I discussed in with respect to claim limitation 1b, the receive processor *is operatively coupled to the data formatting module*.

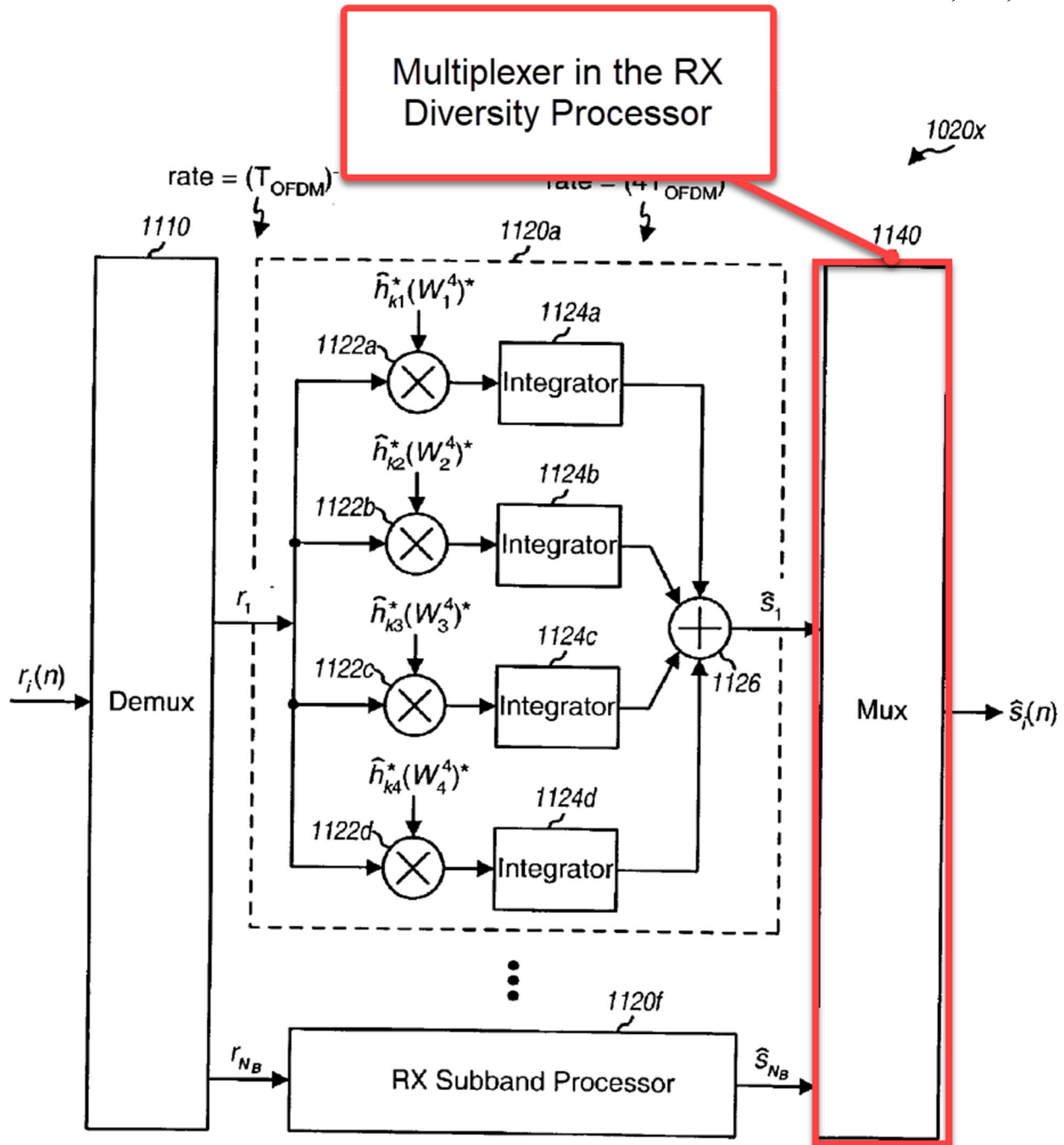
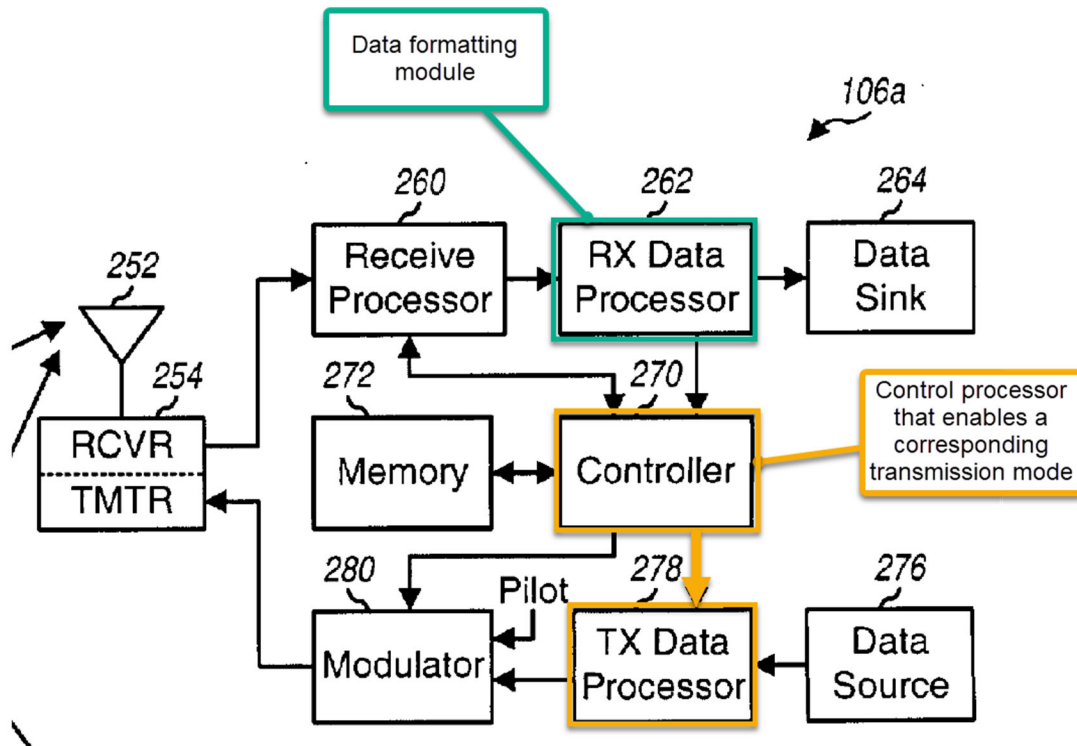


FIG. 11

109. As I discuss below for 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*)



- (iii) 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:

110. 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.” Ex. 1004 ¶¶ 46, 147. A person of ordinary skill 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. Ex. 1004, ¶ 44. In addition, as I 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.

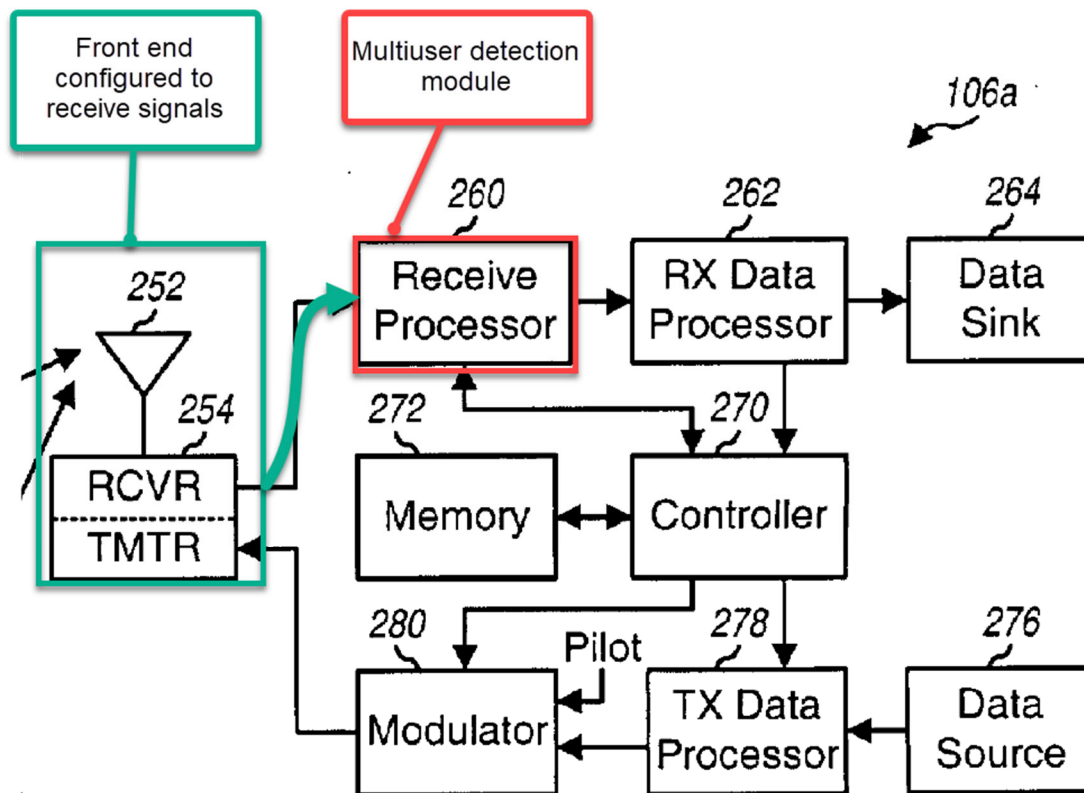
111. Accordingly, Walton discloses a multiplexer operatively coupled to the data formatting module and the control processor, and configured to select one of the recovered K wirelessly transmitted signals as a target signal intended for a user associated with the modem, where the selection is based on 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.

- 9. Claim 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 a parameter estimator in a form that facilitates their subsequent processing by the multiuser detection module.**

112. In my opinion, Walton discloses this limitation.

- (i) **A front end configured to simultaneously receive the K wirelessly transmitted signals, and to provide those signals to the MUD:**

113. 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.” Ex. 1004 ¶ 41. This receiver is *a front end* that is *coupled to the MUD module* to provide the wirelessly transmitted signals, as shown in Figure 2 below.



114. Further, the front end receives these signals simultaneously. Walton recognizes that multiple-access systems are capable of supporting communication

with multiple users simultaneously. Ex. 1004 ¶ 4. Further, Figure 9 shows simultaneous receipt of wirelessly transmitted signals through multiple antennas.

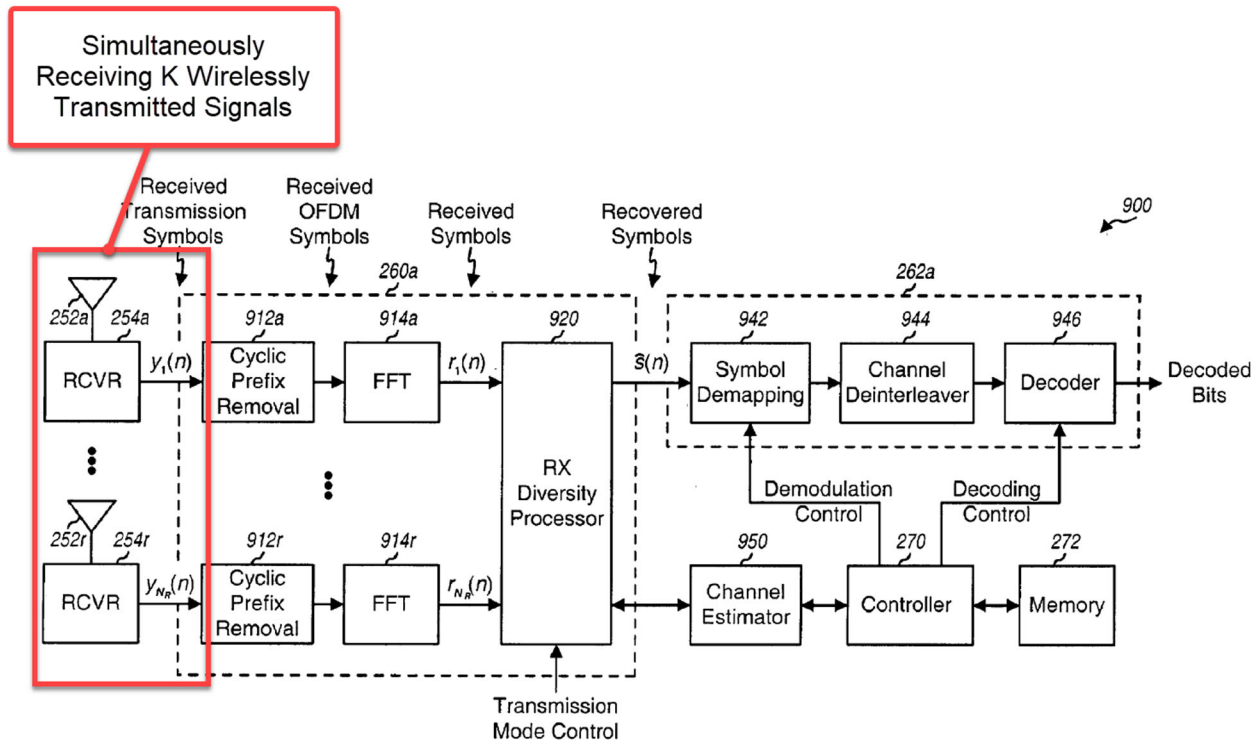


FIG. 9

(ii) [And to provide those signals to ...] a parameter estimator :

115. Walton further teaches that the front end provides the signals to a parameter estimator. Walton's 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." Ex. 1004 ¶ 147.

116. I have reviewed Patent Owner's infringement contentions in the district court litigation, and I understand that Patent Owner has mapped a channel estimator to be the claimed parameter estimator. Ex. 1009, 43 ("The Accused '946 Instrumentalities include a *parameter estimator (e.g., channel estimator)* that receives separate inputs from each A/D converter.").

(iii) In a form that facilitates their subsequent processing by the multiuser detection module:

117. The transmitted signals are provided to the MUD 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**). Ex. 1004 ¶ 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.").

118. Accordingly, the wireless transmitted signals are provided to a parameter estimator in a form that facilitates their subsequent processing by the multiuser detection module.

10. Claim 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.

119. In my opinion, Walton discloses this limitation.

120. As I discussed above regarding 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). Ex. 1004, ¶¶ 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.” Ex. 1004, ¶ 134.

121. 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. 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.” Ex. 1004, ¶147.

- 11. Claim 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.

122. In my opinion, Walton discloses this limitation.

(i) A parameter estimator module receiving D diversity inputs from D analog to digital (A/D) converters:

123. The '946 patent recognizes that parameter estimator modules and analog to digital converters are conventional technology. Ex. 1001 at 14:7-9 ("Each of the analog front end 105, *parameter estimation module* 110, MUD module 115, and bank of decoders 117 *can be implemented in conventional technology.*"); Ex. 1001 at 13:30-33 ("At baseband, *A/D converters* 105 b digitize each received signal into sampled data streams. Filtering, amplification, and other *conventional processing*, may also be implemented in the analog front end 105."). I agree that this technology was conventional at the time of the priority date of the '946 patent.

124. I have reviewed Patent Owner's infringement contentions in the district court case and I understand that Patent Owner has mapped a channel estimator to be the claimed parameter estimator. Ex. 1009, 43 ("The Accused '946 Instrumentalities include a *parameter estimator (e.g., channel estimator)* that receives separate inputs from each A/D converter.").

125. Walton discloses this limitation. As discussed in claim 2 above, Walton discloses a parameter estimator module (the channel estimator). As shown in Figure

9 below, Walton teaches that the front end provides diversity signals to the parameter estimator module. Specifically, the front end contains multiple receivers, the received signals from which pass through the RX diversity processor and are received by the parameter estimator module. Ex. 1004 ¶ 147; *see also* Figure 9. Further, Walton explains that the front end will have converted the signals from analog to digital, and thus will contain analog to digital converters. Ex. 1004 ¶ 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.” Accordingly, the parameter estimator module receives the diversity inputs from analog to digital (A/D) converters.

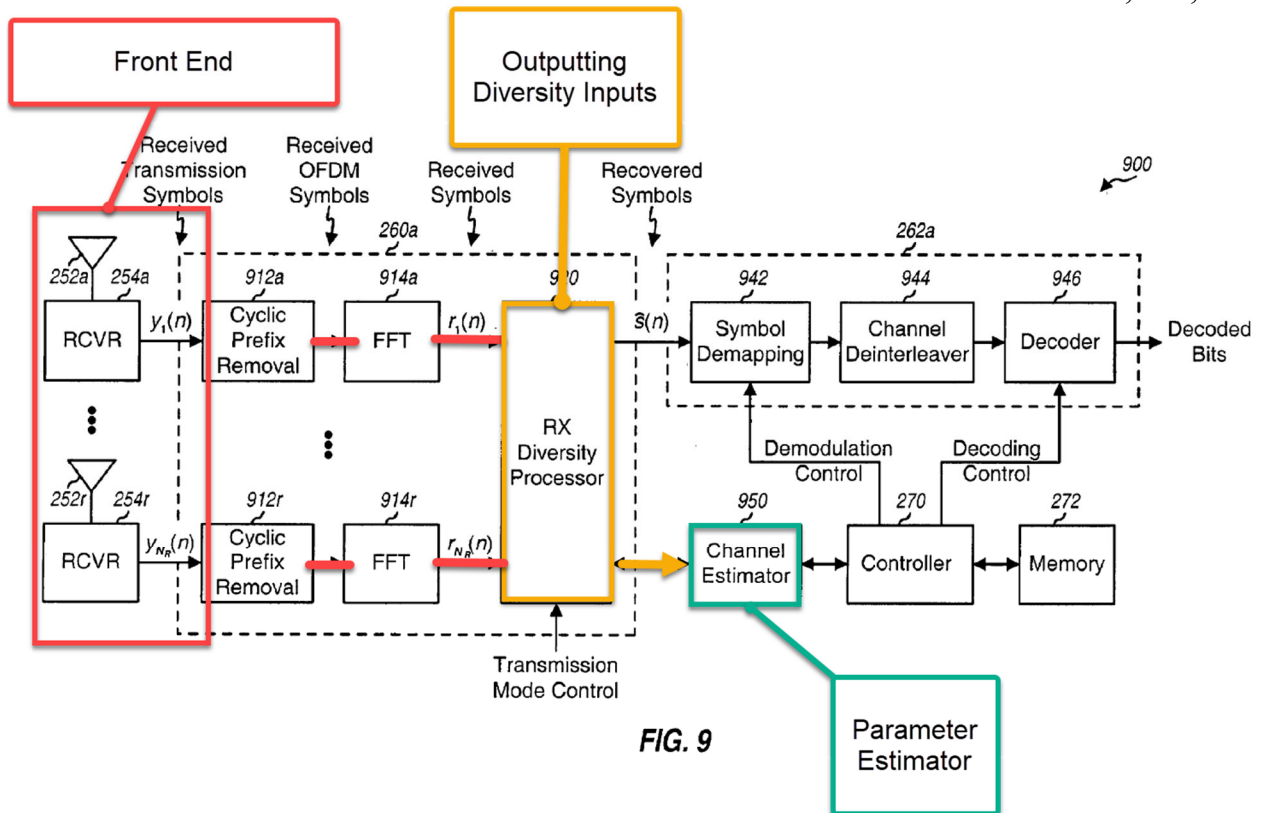


FIG. 9

- (ii) The parameter estimator module outputting an S matrix to the MUD module, wherein the S matrix comprises estimated composite signature waveforms:

126. The '946 patent recognizes that conventional parameter estimators output an S matrix, where the S matrix comprises estimated composite signature waveforms is conventional technology. Ex. 1001 at 13:40-47 ("The result of such *parameter estimation is a matrix (S) of estimated composite signature waveforms* for each of the K users, which is used by the MUD module 115 to help separate the channel signals. The MUD module 115 uses the S matrix of estimated composite signature waveforms in addition to inputs from all A/D converters 105 b to recover

the data bits from the interfering *signals as is conventionally done.*”). I agree that this technology was conventional at the time of the priority date of the ’946 patent.

127. In addition, a POSITA would have understood, and it was well known in the art, that a parameter estimator outputs an S matrix to a MUD module, wherein the S matrix comprises estimated composite signature waveforms. Ex. 1007 at 26:51-62 (“[I]t is well known in the art how to compute parameter estimates for the S matrix, and these estimates will be assumed to be known or made available to the joint detector 720.”).

128. Walton teaches a parameter estimator module outputting an S matrix to the MUD module, wherein the S matrix comprises estimated composite signature waveforms. Walton’s “channel estimator [] 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.” Ex. 1004 ¶ 147. The pilot symbols that are used for this estimation are separately transmitted from each transmitting antenna, and comprise signature waveforms for each channel. Ex. 1004, ¶¶ 82-85, 147.

129. Walton discloses that each of the N_T transmitting antennas transmits pilot signals as shown in Table 2 of Walton. Ex. 1004 ¶ 82-85 (“A demultiplexer 412 then receives the repeated symbols and pilot symbols and demultiplexes these

symbols into N_T transmit symbol streams. . . . Table 2 shows a specific implementation for dual and quad frequency diversity for the system.”). The channel conditions from the N_T transmitting antennas to the N_R receiving antennas are estimated by channel estimator 950, and channel estimator, by way of controller 270, outputs the estimated composite signature waveforms to the receive processor 260a. A POSITA would have known that data such as the estimated composite signature waveforms can be organized in a matrix form, i.e., data structure having row and column indices (for example, an index for one of the N_T transmitters and another index for one of the N_R receivers), because that is typically the form that such data is organized and processed in a modem.

130. Walton thus discloses a modem 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.

- 12. Claim 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 bn output to the MUD module from the input of K MUD module recovered signals, wherein the matrix bn is a matrix of symbol estimates.**

131. In my opinion, Walton discloses this limitation.

- (i) A bank of K decoders communicating with the K MUD module outputs:**

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132. The '946 patent recognizes that a bank of decoders is conventional technology. Ex. 1001 at 14:7-9 (“Each of the analog front end 105, parameter estimation module 110, MUD module 115, and bank of decoders 117 can be implemented in conventional technology.”). I agree that this technology was conventional at the time of the priority date of the '946 patent.

133. While Walton discloses a single decoder in the example of Figure 9, Walton teaches that *a bank of decoders* is used in multi-antenna environments—one decoder for each antenna. In these embodiments, RX diversity processor 920 can include a bank of RX antenna processors—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.” Ex. 1004 ¶ 148. A POSITA would have recognized that each RX antenna processor in the bank of processors would have been associated with its own decoder to process each respective received symbol stream and output a recovered symbol stream for that antenna because multiple parallel decoders can make use of the diversity gain provided by multiple antennas and better handle interference by separately processing signals. Ex. 1004, Fig. 10.

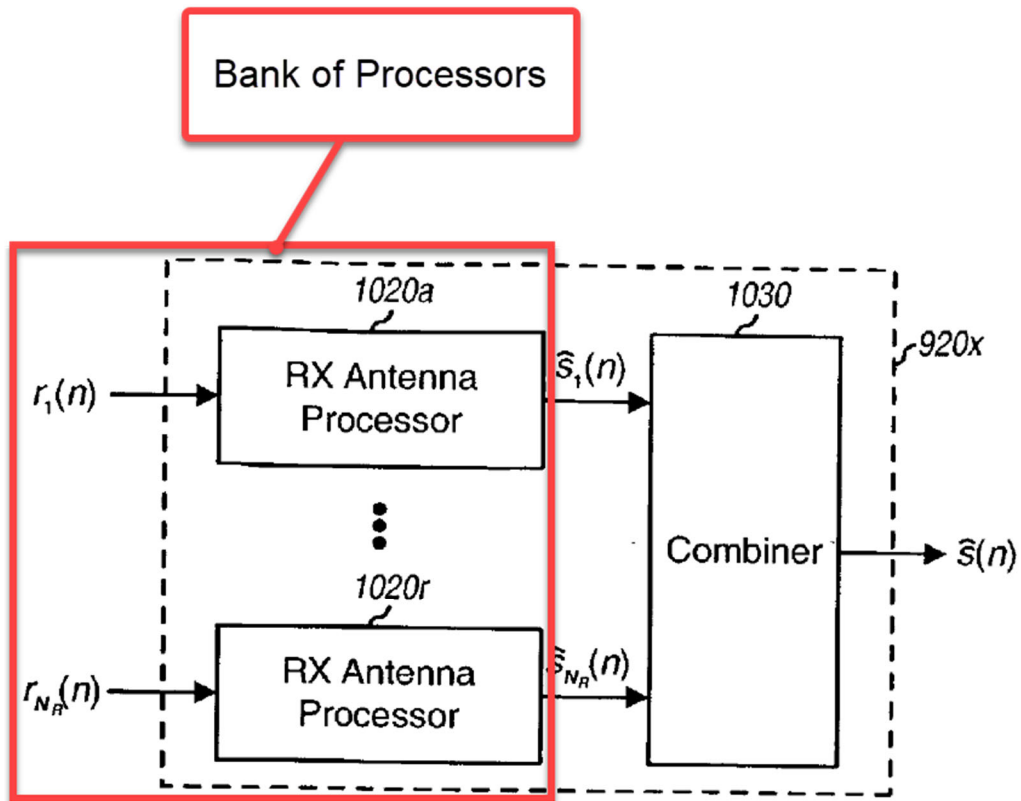


FIG. 10

134. Further, as disclosed in Figure 9 below, Walton's decoders communicate with multiple MUD module outputs.

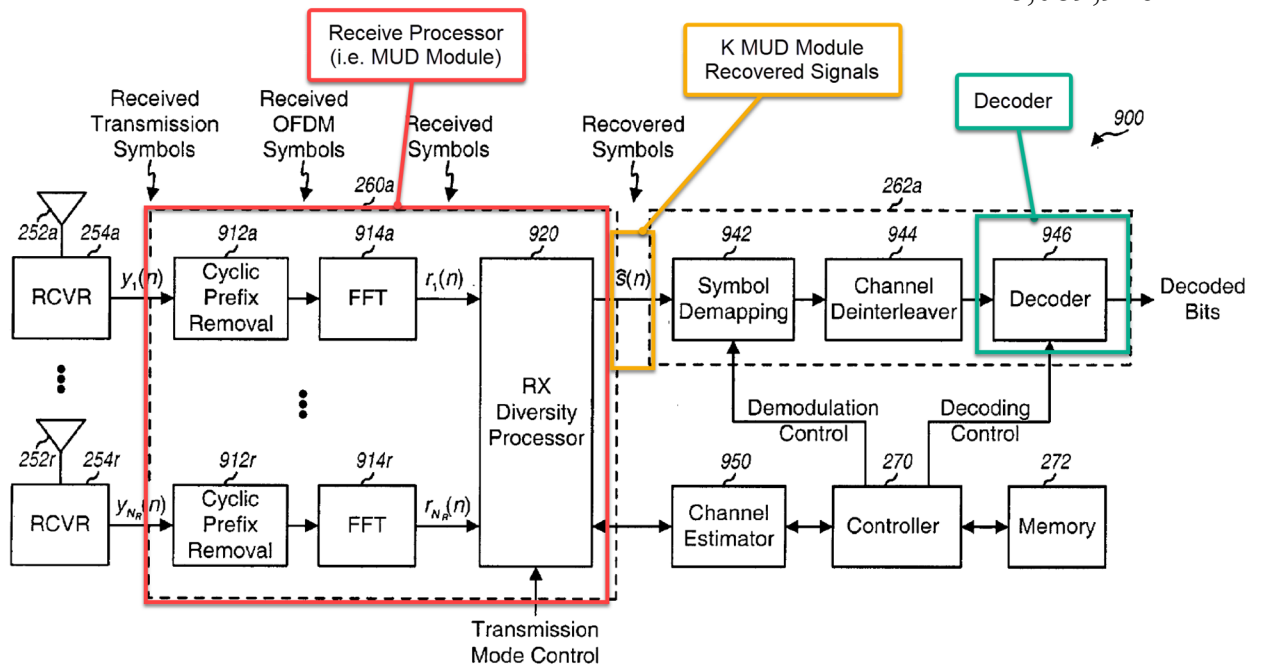


FIG. 9

- (ii) 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:

135. The '946 patent acknowledges, and a POSITA would have known, that using a bank of decoders to produce symbol estimates (*i.e.*, **matrix $\mathbf{b}_n$**) that are output to the MUD module, is part of a conventional MUD system. Ex. 1001 at 13:54-67 ("Note that the MUD module 115 is operatively coupled to a bank of decoders (1-K) 117, with each decoder communicatively coupled to a corresponding output of the MUD module 115. The bank of decoders . . . provides error correction for each user *The result of such conventional error correction is a matrix ($\mathbf{b}(n)$) of symbol estimates which are used by the MUD module 115 in the iterative*

process to provide better estimates of the particular symbols.”). I agree that this was conventional at the time of the priority date of the patent.

136. Further, Walton discloses this limitation. Walton teaches that the received signal may be expressed in matrix form. Ex. 1004 ¶ 96.

137. 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). Ex. 1004 ¶ 146 (“The decoded data from decoder 946 **represents an estimate** of the transmitted data being recovered.”); *see also* Ex. 1004 ¶ 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.”); Ex. 1004 ¶ 42 (“The recovered symbols are estimates of the modulation symbols transmitted by the access point.”); ¶ 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.”). It would have been obvious to a POSITA to represent the decoder outputs corresponding to the plurality of symbol estimates in matrix form

138. Accordingly, when the recovered signals received from the MUD module are decoded by the decoder, the decoded data is in matrix form

“represent[ing] an estimate of the transmitted data being recovered.” Ex. 1004 ¶ 146.

139. I have reviewed Patent Owner’s infringement contentions in the district court litigation, and Patent Owner maps this limitation to identical functionality in its infringement contentions. *Compare* Ex. 1009, 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* Ex. 1004 ¶ 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”).

140. 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.

141. Walton thus discloses a modem comprising a bank of K decoders communicating with the K MUD module outputs, 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.

13. Claim 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.

142. In my opinion, Walton discloses this limitation.

143. Walton discloses this limitation because it teaches that its control processor “direct[s] the operation of RX diversity processor 920” (Ex. 1004 ¶ 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*). ” Ex. 1004 ¶ 15; *see also* ¶ 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.”).

144. Walton’s receive data processor (*i.e.*, the data formatting module), determines and outputs packet information to the control processor. Ex. 1004 ¶ 43 (the receive data processor “symbol demaps, deinterleaves, and decodes the recovered symbols to obtain the user-specific data,” *i.e.*, *a target signal intended for a user*), ¶ 146.

145. A POSITA would have understood that each of the data packets provided by the data processor have headers that describe the packet, including the packet’s destination because data packets were typically organized into headers and

payloads, and packet headers conventionally included information about the packet's intended destination. Ex. 1013

(<https://datatracker.ietf.org/doc/html/rfc791#page-11>) at § 3.1 (packet headers include destination addresses).

146. Walton thus discloses a modem 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.

14. Claim 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 for a particular modem can be identified, while other received data signals can be ignored.

147. In my opinion, Walton discloses this limitation.

148. As discussed for Claim 7, Walton discloses its 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. A POSITA would have understood that the data formatting module would have provided packet header information for each of the received signals.

149. Walton further discloses a data signal intended for a particular modem can be identified, while other received data signals can be ignored because it 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..” Ex. 1004 ¶ 38; *see also* Ex. 1004 ¶ 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.”); Ex. 1004 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 terminals are capable of detecting streams with data intended for a plurality of users, and it would have been obvious to a POSITA to configure the control processor to ignore data streams (packets) intended for other users.

15. 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:

150. This claim limitation mirrors claim limitation 1pre discussed above. In my opinion, Walton renders this claim obvious for the same reasons.

(a) 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;

151. This claim limitation mirrors limitations 1a and claim 4 discussed above. *See* Limitation 1a (discussing a multiuser detection (MUD) module . . . configured to simultaneously demodulate and recover K wirelessly transmitted

signals using co-channel demodulation, simultaneously outputting K recovered signals) and Claim 4 (discussing D inputs from D analog to digital (A/D) converters), *supra*. Figures 9 and 11 of Walton also clearly show the receiver processor outputting the recovered signal streams in parallel through data streams from multiple receivers. In my opinion, Walton renders this claim obvious for the same reasons.

(b) 10b: a parameter estimator module receiving the D inputs from the D A/D converters;

152. This claim limitation mirrors Claim 4 discussed above. In my opinion, Walton renders this claim obvious for the same reasons.

(c) 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;

153. This claim limitation mirrors Claim 5 discussed above. In my opinion, Walton renders this claim obvious for the same reasons.

(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, the parallel K recovered signal data packets communicated to a demultiplexer, wherein the data formatting module supports multiple types of network packet format modes;

154. In my opinion, Walton discloses this limitation.

- (i) **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:**

155. Parts of this claim limitation mirror limitation 1b. In my opinion regarding limitation 1b, I opine Walton discloses a data formatting module (the receive data processor), operatively coupled to the multiuser detection module (the receive processor), and configured to produce network data packets for at least one of the K recovered signals. Ex. 1004 ¶¶ 4, 41, 42, 52, 146, and Figure 2.

156. Further, Walton teaches that the data formatting module (*i.e.*, the receive data processor annotated in green) is coupled to parallel MUD module outputs (*i.e.*, the outputs annotated in yellow from the receive processor annotated in red), as shown in the annotated version of Figure 9 below.

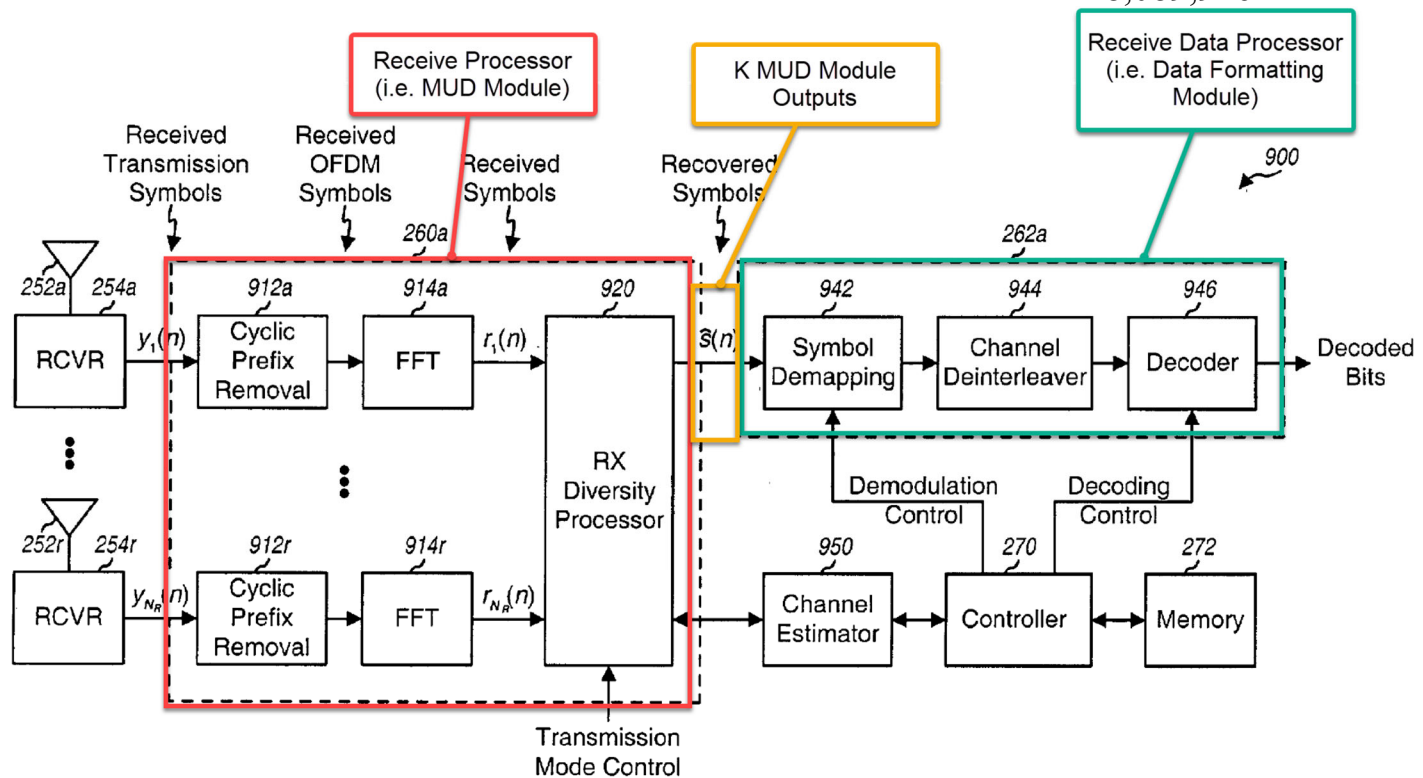


FIG. 9

(ii) The parallel K recovered signal data packets communicated to a demultiplexer:

157. As discussed in my opinion for limitation 1b, the “demultiplexer” in this claim limitation is functionally referring to a multiplexer.

158. The multiplexer of Walton receives parallel recovered signal data packets. Ex. 1004 ¶ 156. (“The multiplexer 1140 *receives the recovered symbols* from RX subband processors 1120a through 1120f and multiplexes these symbols into a recovered symbol stream, $\hat{s}_i(n)$, for receive antenna i.”); *see* Figure 11 below.

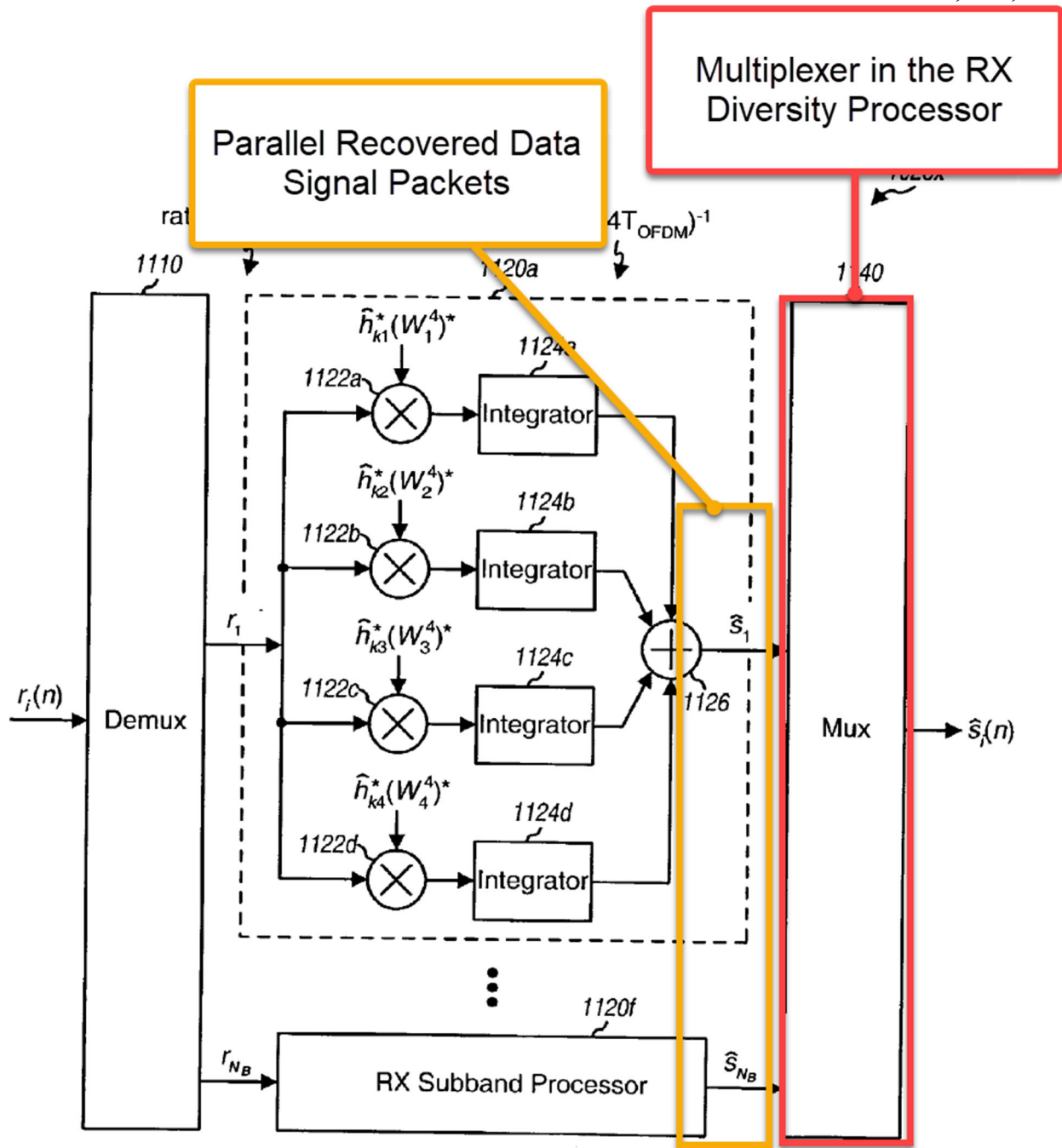


FIG. 11

(iii) Wherein the data formatting module supports multiple types of network packet format modes:

159. Walton's data formatting module (*i.e.*, its receive data processor) supports multiple types of network packet format modes because it is capable of formatting and encoding data based on multiple coding schemes. The data formatting module "symbol demaps, deinterleaves, and decodes the recovered symbols to obtain the user-specific data," *i.e.*, a target signal intended for a user. Ex. 1004 ¶ 43. The system then "then formats and encodes the traffic data based on one or more coding schemes to provide coded data," *i.e.*, ***supports multiple types of network packet format modes***. Ex. 1004 ¶ 38.

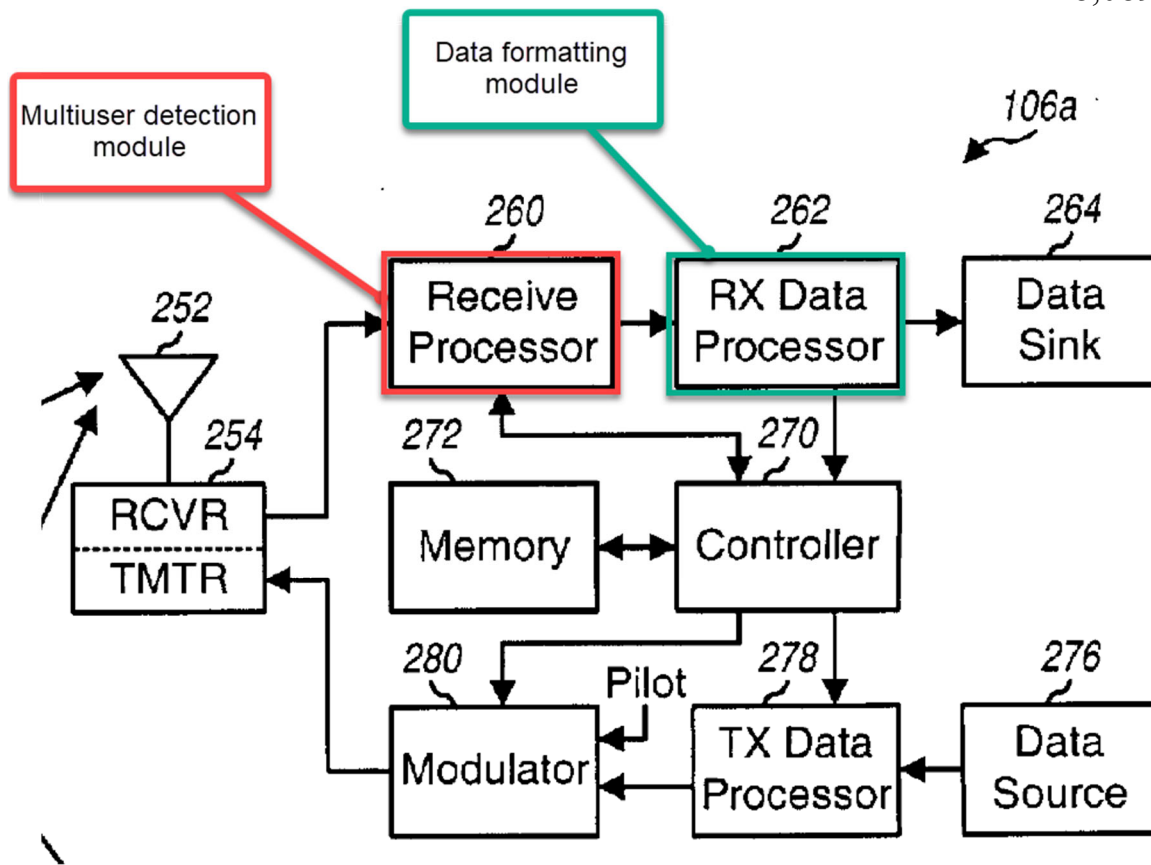
160. Accordingly, Walton discloses a data formatting module operatively coupled to the parallel K MUD module outputs of the MUD module, and configured to produce network data packets of the parallel K recovered signals, the parallel K recovered signal data packets communicated to a demultiplexer, wherein the data formatting module supports multiple types of network packet format modes.

- (e) **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;**

161. This claim limitation mirrors claim limitation 1d and 10d. In my opinion regarding limitation 1d, I opine Walton teaches a multiplexer operatively coupled to the data formatting module, and configured to select one of the recovered 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 a control processor. Ex. 1004 ¶¶ 29, 38, 43, 44, 46, 156, Figures 2, 9, 11 and Claim 17. In my opinion regarding limitation 10d, I opine Walton discloses the multiplexer receiving parallel recovered signal data packets. Ex. 1004 ¶¶ 4, 41, 42, 52, 146, 156 and Figure 2, 11.

- (i) **Communicate m data packets of the K recovered signal data packets to a recipient:**

162. Walton teaches that recovered data packets for the target signal are communicated to a recipient. 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.



163. 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.

164. Walton 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.” Ex. 1004 ¶ 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. Accordingly, *recovered user-specific signal data packets are communicated to recipients.*

165. Accordingly, Walton discloses 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.

- (f) **10f: 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, the control processor also configured to select a network data packet formatting mode in which the data formatting operates**

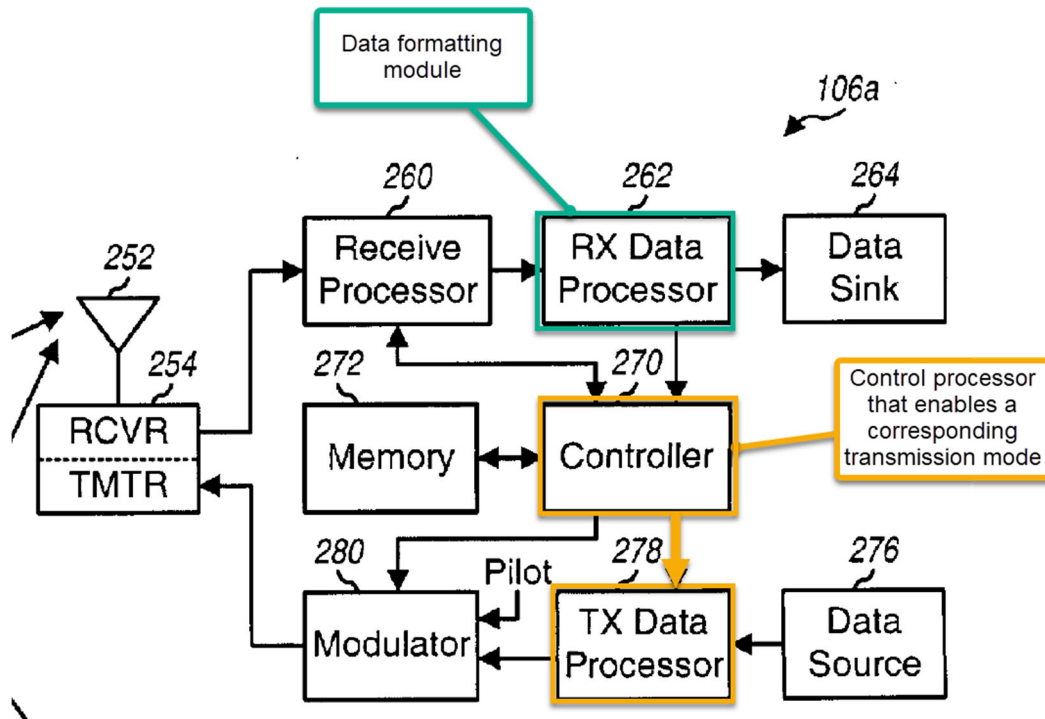
166. In my opinion, Walton discloses this limitation.

- (i) **The control processor operatively coupled to the demultiplexer and the data formatting module:**

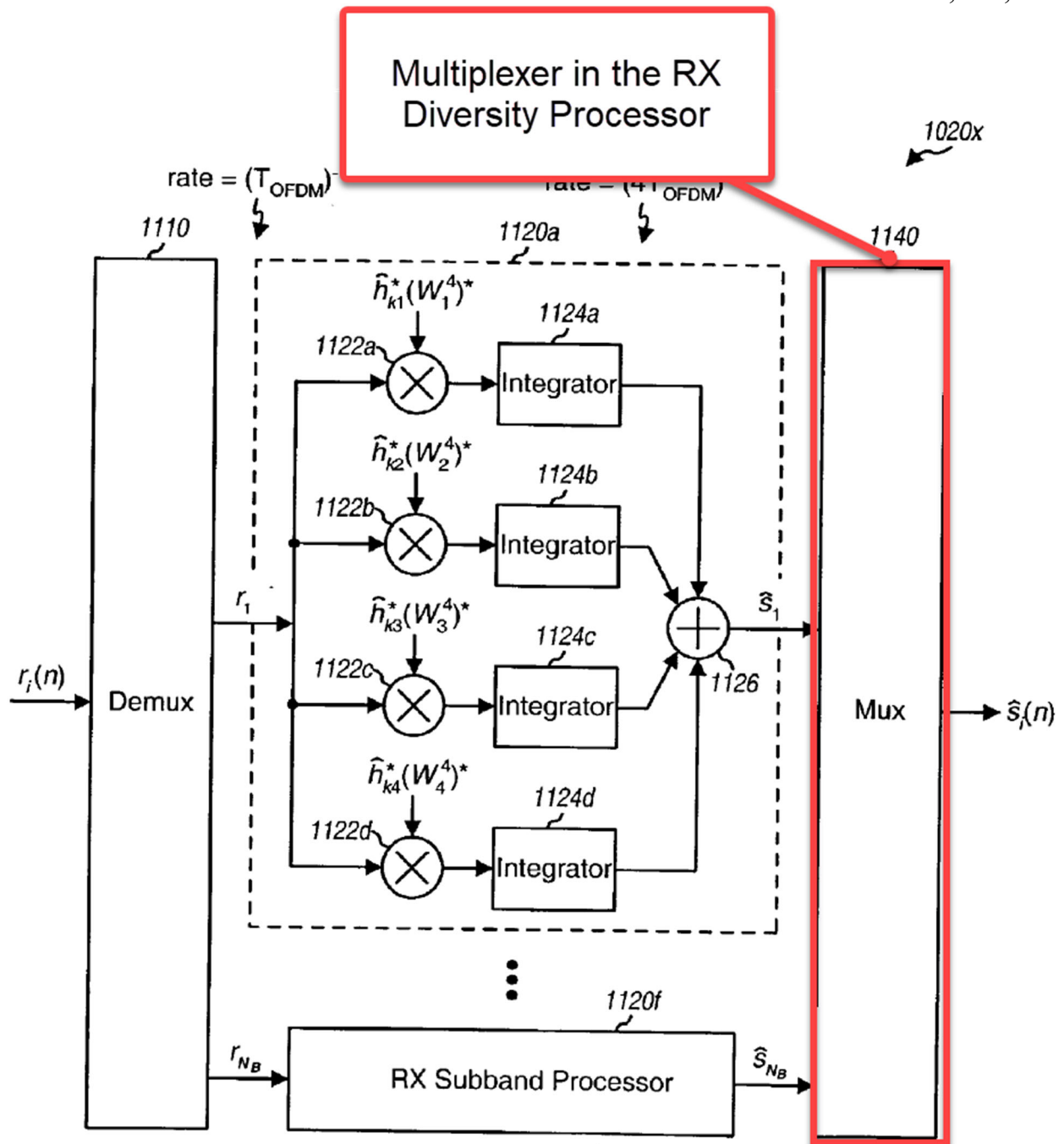
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167. Walton teaches its controller 270 (i.e., the **control processor**) “direct[s] the operation at the access the access point and the terminal.” Ex. 1004 ¶ 46. As shown in Figure 2, it is **operatively coupled to the data formatting module**.



168. As discussed, Walton discloses a **multiplexer** operatively coupled to the control processor. Figure 11 in Walton “is a block diagram of an RX antenna processor within the RX diversity processor” (Ex. 1004 ¶ 29) which is in the receive processors 260. Ex. 1004 Figures 2, 9, 11. As shown in Figure 11, the multiplexer is in the RX diversity processor.

**FIG. 11**

169. As discussed regarding limitations 1b and 1c, the receive processor is operatively coupled to the control processor. Accordingly, because the receive

processor is coupled to the control processor, the multiplexer is also coupled to the control processor.

(ii) Configured to detect with which protocol mode the at least one of the K recovered signals was transmitted:

170. This claim limitation mirrors limitation 1c discussed above. In my opinion, Walton renders this claim obvious for the same reasons.

(iii) Based on input from the data formatting module:

171. Walton's receive data processor (the data formatting module), provides input for the control processor to detect with which protocol mode the recovered signals was transmitted. Specifically, the receive data processor "symbol demaps, deinterleaves, and decodes the recovered symbols to *obtain the user-specific* data". Ex. 1004 ¶ 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 this user-specific information to determine the specific transmission mode. Ex. 1004 ¶ 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.”)). Accordingly, the detection is based on input from the data formatting module.

- (iv) 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:**

172. This claim limitation mirrors Limitation 1c discussed above. In my opinion, Walton renders this claim obvious for the same reasons.

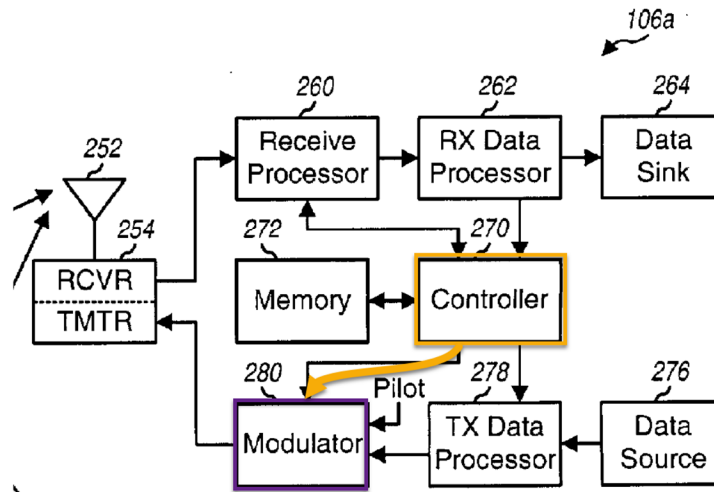
- (v) The control processor also configured to select a network data packet formatting mode in which the data formatting operates”:**

173. This claim limitation mirrors Limitation 1d discussed above. In my opinion, Walton renders this claim obvious for the same reasons.

- (g) 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**

- (i) A modulator operatively coupled to the control processor:**

174. Walton expressly discloses a modulator coupled to the control processor. See Figure 2 below.



- (ii) **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:**

175. 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." Ex. 1004 ¶ 46. Among other things, as shown in Figure 2, 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." Ex. 1004 ¶ 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.

(h) 10h: an amplifier operatively coupled to the modulator, the amplifier in communication with at least one antenna output port.

176. The '946 patent recognizes that amplifiers are conventional technology. Ex. 1001 at 13:30-34 (“ At baseband, A/D converters 105 b digitize each received signal into sampled data streams. Filtering, *amplification*, and other conventional processing, may also be implemented in the analog front end 105.”). I agree that this technology was conventional at the time of the priority date of the '946 patent.

177. Walton expressly teaches that the modulated signals from antennas are received by the receiver, and is then amplified. Ex. 1004 ¶ 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.”). Walton expressly teaches that both its access points and terminals include receivers and transmitters comprising amplifiers. Ex. 1004 ¶ 40 (“Transmit processor 220 provides N_T streams of transmission symbols to N_T transmitters (TMTR) 222 a through 222_t, 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). 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.

16. 11pre: The modem of claim 10, further comprising:

- (a) 11a: 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;**

178. The '946 patent recognizes that its described 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, is conventional technology. Ex. 1001 at 13:21-33 (“Note that D is the number of diversity ports, while K is the number of estimated co-channel interfering signals. The *antenna inputs* feed corresponding *front end tuners 105a*, each of which downconverts higher frequency signals into baseband signals or other relatively lower frequency signals prior to processing. At baseband, *A/D converters 105b digitize each received signal* into sampled data streams.

Filtering, amplification, and *other conventional processing*, may also be implemented in the analog frontend 105.”); Ex. 1001 at 14:14:7-9 (“Each of *the analog front end* 105, parameter estimation module 110, MUD module 115, and bank of decoders 117 *can be implemented in conventional technology*.”). I agree that this technology was conventional at the time of the priority date of the ’946 patent.

179. Walton discloses the claimed front end receiver block. As shown in Figure 9 annotated below, Walton discloses a front end with a plurality of receivers, each coupled to at least one antenna. 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). Accordingly, each of the receivers of the front end includes a diversity port to couple to each of the antennas. Further, each of the plurality of receivers contain at least a tuner and analog to digital converter. Ex. 1004 ¶ 41 (“Each receiver 254 conditions (e.g., filters, amplifies, and frequency down-converts [i.e. frequency *tunes*]) its received signal and further *digitizes* (i.e., *converts from analog to digital*) the conditioned signal.” A POSITA would have understood that an analog-to-digital converter is used to digitize analog signals. Walton’s receiver block thus comprise *a plurality*

of antenna ports, a plurality of tuners, and a plurality of digital to analog converters. *Id.* (each receiver frequency down-converts and digitizes the conditioned signal). A POSITA would have understood that frequency down-conversion is performed by a **tuner**, as the '946 patent itself acknowledges. EX1001, 13:26-33 (“The antenna inputs feed corresponding *front end tuners* 105 a, each of which *downconverts higher frequency signals* into baseband signals”).

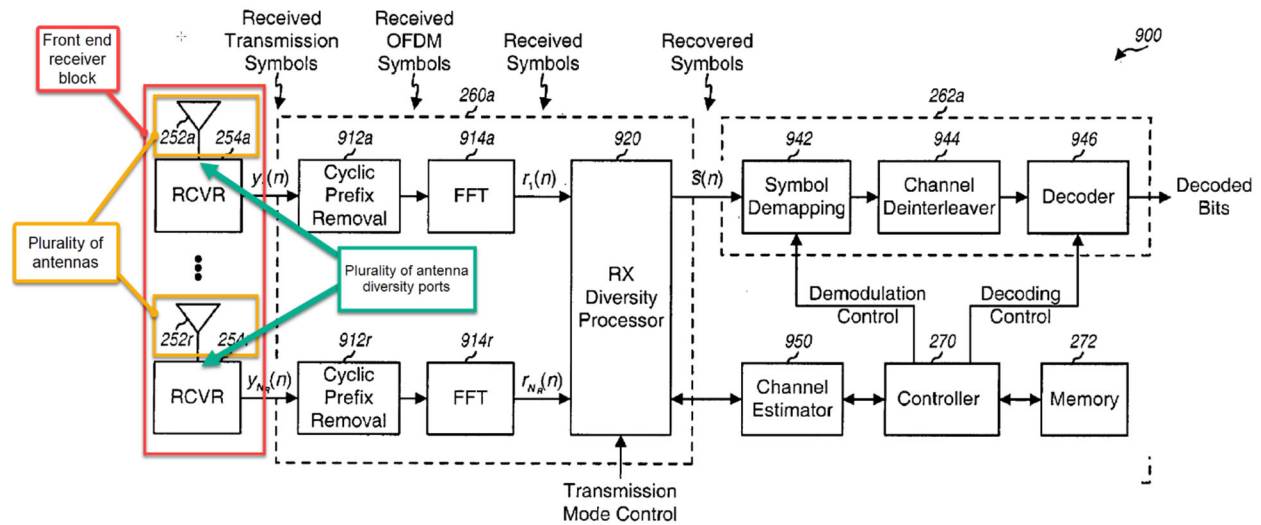


FIG. 9

(b) 11b: the plurality, D, of antenna diversity ports communicating, respectively, with D antennas;

180. Walton discloses the plurality, D, of antenna diversity ports communicating, respectively, with D antennas. Specifically, as shown in Figure 9 above, Walton discloses a front end with a plurality of receivers, each coupled to at least one antenna. Accordingly, each of the receivers of the front end includes a diversity port to couple to each of the antennas. Ex. 1004 ¶ 41 (“Each receiver 254

conditions (e.g., filters, amplifies, and frequency *down-converts*) its received signal and further *digitizes* the conditioned signal.” Walton’s receiver block further comprise a plurality of antenna ports, a plurality of tuners, and a plurality of digital to analog converters. *Id.* (each receiver *frequency down-converts* and *digitizes* the conditioned signal).

(c) 11c: the plurality of D tuners communicating, respectively, with the D antenna diversity ports;

181. The ’946 patent recognizes that tuners are conventional technology. Ex. 1001 at 13:26-33 (“The antenna inputs feed corresponding *front end tuners* 105 a, each of which *downconverts higher frequency signals* into baseband signals or other relatively lower frequency signals prior to processing. . . . Filtering, amplification, and other *conventional processing*, may also be implemented in the analog front end 105.”). I agree that this technology was conventional at the time of the priority date of the ’946 patent.

182. Walton’s receiver block comprise a plurality of antenna ports and a plurality of tuners. For the tuner, Walton specifically discloses a frequency downconverter. Ex. 1004 ¶ 45 (each receiver *frequency down-converts* and *digitizes* the conditioned signal). 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—the ’946’s front end tuner is a downconverter. Ex. 1001 at 13:26-33

(“The antenna inputs feed corresponding *front end tuners* 105 a, each of which *downconverts higher frequency signals* into baseband signals”). Because the receiver block 254 is operatively communicating with antenna 252, Walton discloses its frequency down converters, or tuners, are coupled to the antenna diversity ports.

(d) 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.

183. The '946 patent recognizes that A/D converters are conventional technology. Ex. 1001 at 13:30-33 (“At baseband, *A/D converters* 105 b digitize each received signal into sampled data streams. Filtering, amplification, and other *conventional processing*, may also be implemented in the analog front end 105.”). I agree that this technology was conventional at the time of the priority date of the '946 patent.

184. Walton teaches 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. Specifically, Walton teaches that each of the received signals from the front end are frequency downconverted as part of the conditioning from the receiver. Ex. 1004 ¶ 41 (“*Each receiver* 254 conditions (e.g., filters, amplifies, and *frequency downconverts* its received signal and further digitizes the conditioned signal to provide a respective stream of

samples.”). This downconversion is a *frequency tune to a baseband waveform*.

Then, each of the downconverted baseband signal is *digitized*, or converted from analog to digital. Ex. 1004 ¶ 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. Accordingly, the each of the plurality A/D converters communicate with the tuners, each outputting a baseband waveform, respectively corresponding to each of the antenna diversity ports.

17. Claim 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 network, where the selection is based on a control input from the control processor.

185. This claim limitation mirrors limitation 10e discussed above. I opine that Walton teaches a modem wherein the m data packets of the K recovered signal data packets are selected based on control input from the control processor.

(i) The m data packets of the K recovered signal data packets are formatted for and provided to a network:

186. Walton further teaches that the 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. Ex. 1004 ¶ 134 (“The diversity transmission modes may be used for data transmission *between the access points and terminals*”). Walton also specifically discloses common network types. Walton teaches “[a]n access point may also be referred to as *a base station, a UTRAN* [UMTS Terrestrial Radio Access Network], or some other terminology.” Ex. 1004 ¶ 31. Walton also teaches “for *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.” Ex. 1004 ¶ 54. Accordingly, the recovered signal data packets are formatted for and provided to a network—here, either a UTRAN or a WLAN. 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

18. Claim 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.

187. See Limitation 10e, *supra*, discussing that Walton teaches a modem wherein the m data packets of the K recovered signal data packets are selected based on control input from the control processor.

(i) Recovered signal data packets are formatted for and provided to a backbone:

188. 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.” Ex. 1004, ¶ 31. A component of a UMTS network architecture is the UTRAN backbone. 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

19. Claim 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.

189. This claim limitation mirrors limitation 10e discussed above. I opine that Walton teaches a modem wherein the m data packets of the K recovered signal data packets are selected based on control input from the control processor.

(i) Recovered signal data packets are formatted for and provided to a local host:

190. As mentioned above regarding Claim 12, Walton teaches the recovered signal data packets are formatted for and provided to *a wireless local area network (WLAN)*. A WLAN will comprise a *local host*. 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

- 20. Claim 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.**

191. This limitation mirrors parts of Claim 9 discussed above. In my opinion, Walton renders this claim obvious for the same reasons.

- 21. Claim 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.**

192. This limitation mirrors parts of Claim 9 discussed above. In my opinion, Walton renders this claim obvious for the same reasons.

- 22. 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:**

193. This limitation mirrors limitation 1pre discussed above. In my opinion, Walton renders this claim obvious for the same reasons.

- (a) 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;**

194. This limitation mirrors limitation 11a discussed above. In my opinion, Walton renders this claim obvious for the same reasons.

- (b) 20b: the plurality, D, of antenna diversity ports communicating, respectively, with D antennas;**

195. This limitation mirrors limitation 11b discussed above. In my opinion, Walton renders this claim obvious for the same reasons.

- (c) 20c: the plurality of D tuners communicating, respectively, with the D antenna diversity ports;**

196. This limitation mirrors limitation 11c discussed above. In my opinion, Walton renders this claim obvious for the same reasons.

- (d) 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;**

197. This limitation mirrors limitation 11d discussed above. In my opinion, Walton renders this claim obvious for the same reasons.

- (e) 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;**

198. This limitation mirrors limitation 10a discussed above. In my opinion, Walton renders this claim obvious for the same reasons.

- (f) **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;**
- (i) **A parameter estimator module receiving the D inputs from the D A/D converters ... [and] outputting parameter estimation matrix S to the MUD module:**

199. This limitation mirrors parts of claim 4 discussed above. In my opinion, Walton renders this claim obvious for the same reasons.

- (ii) **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:**

200. The '946 patent recognizes that a parameter estimator that 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 are conventional technology. Ex. 1001 at 13:36-47 (*"The parameter estimation module 110 estimates the relative received timing offsets, phases, received amplitudes, and multipath structure for each of the interfering signals present in the received signal. The result of such parameter estimation is a matrix (S) of estimated composite signature waveforms for each of*

the K users, which is used by the MUD module 115 to help separate the channel signals. The MUD module 115 uses the S matrix of estimated composite signature waveforms in addition to inputs from all A/D converters 105 b to recover the data bits from the interfering signals *as is conventionally done.* ”). I agree that this technology was conventional at the time of the priority date of the '946 patent.

201. It was well known in the art for parameter estimator modules to output an S matrix to a MUD module, wherein the S matrix comprises estimated composite signature waveforms. Ex. 1007 at 26:51-62 (“[I]t is well known in the art how to compute parameter estimates for the S matrix, and these estimates will be assumed to be known or made available to the joint detector 720.”).

202. Walton’s channel estimator “estimates various channel characteristics such as the channel response and the noise variance (e.g., based on recovered pilot symbols).” Ex. 1004, ¶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.

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." Ex. 1001, 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." Ex. 1007, 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.

(g) 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;

204. This limitation mirrors claim 5 discussed above. In my opinion, Walton renders this claim obvious for the same reasons.

- (h) 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;**

205. This limitation mirrors limitation 10d discussed above. In my opinion, Walton renders this claim obvious for the same reasons..

- (i) 20i: the demultiplexer operatively coupled to the data formatting module, receiving the parallel K recovered signal network 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;**

206. This limitation mirrors limitation 10e discussed above. In my opinion, Walton renders this claim obvious for the same reasons.

- (j) **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;**

207. Parts of this limitation mirror limitation 10f discussed above. In my opinion, Walton renders this claim obvious for the same reasons. I opine that Walton teaches the control processor operatively coupled to the multiplexer 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, the control processor also configured to select a network data packet formatting mode in which the data formatting operates.

208. Parts of this limitation mirror limitation 1c discussed above. In my opinion, Walton renders this claim obvious for the same reasons. I opine that Walton

teaches wherein the signals of the one of a legacy protocol mode comprise low data rate BPSK or QPSK, or BPSK and QPSK.

- (k) **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**

209. Parts of this limitation mirror limitation 10g discussed above. In my opinion, Walton renders this claim obvious for the same reasons. I opine that Walton teaches 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.

- (i) **The control processor providing a burst control input:**

210. Walton further teaches providing a *burst control input*. Specifically, 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. The processing by TX data processor 210 is described in further detail below.” Ex. 1004 ¶ 38. This scheduler “schedules the data transmission on the downlink (and *possibly the uplink*) for the terminals,” (i.e., a *burst transmission*). Ex. 1004 ¶ 46.

211. Additionally, it would have been obvious to a POSITA to use a burst control input for scheduled transmission because this was conventional technology much earlier than even the '946 patent priority date.

(ii) An input of data from the user m from the demultiplexer:

212. 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. Ex. 1004 ¶¶ 44, 46. 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.

213. As discussed above regarding Claim 3, user specific data (i.e., *input of data from a user*) is used to enable the specific transmission mode. Specifically, the controller takes into account user-specific information to enable the specific transmission mode. Ex. 1004 ¶ 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, and so on.”)).

214. Further, Walton teaches that this user-specific data is from the *multiplexer*. Specifically, the data formatting module receives the recovered symbols from the multiplexer and “symbol demaps, deinterleaves, and decodes the recovered symbols to obtain the *user-specific data*.” Ex. 1004 ¶ 43; *see* the combination of Figure 9 and Figure 11 below.

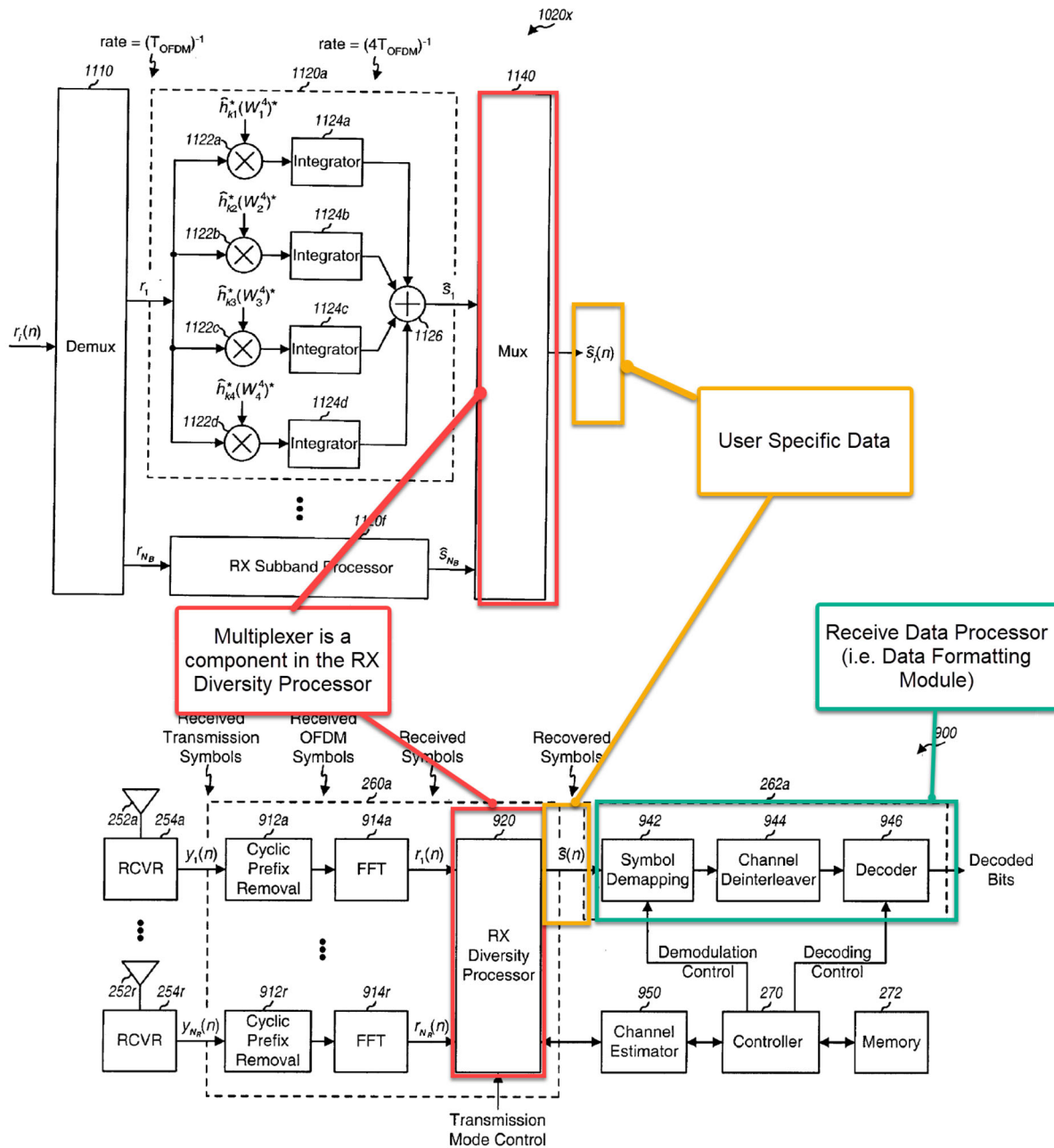


FIG. 9

- (l) **20l: an amplifier operatively coupled to the modulator, the amplifier in communication with at least one antenna output port.**

215. This claim limitation mirrors Limitation 10h discussed above. In my opinion, Walton renders this claim obvious for the same reasons.

B. Ground 2: Claims 1, 2, 3, 4, 5, 7, 9, 10, 11, 12, 13, 14, 15, 16, and 20 are obvious over Walton in view of Learned

216. 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.

217. As discussed above, Walton teaches a multiuser detection module under Patent Owner's apparent construction in the district court,

218. Learned expressly discloses a multiuser detection module.

1. Motivation to Combine

219. 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. Ex. 1004, ¶31 ("Each terminal 106 may concurrently communicate with multiple access points 104"); Ex. 1004, ¶33 ("Each access point 104 can communicate with one or multiple terminals 106, either concurrently or sequentially.").

220. 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. 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." Ex. 1005, 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.

221. 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." Ex. 1005, 4:27-32.

222. 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. 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.” Ex. 1005, 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.

223. 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. Ex. 1001 at 14:7-9 (“Each of the analog front end 105, parameter estimation module 110, **MUD module** 115, and bank of decoders 117 can be implemented in conventional technology.”). 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. Ex. 1005, 1:65-57. 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.

224. Finally, Learned, Walton, and the '946 patent are analogous 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. Ex. 1001 at 16-20 ("The invention relates to wireless networks, and more particularly, to a wireless digital signal demodulator and modulator for wireless networks where efficient use of allocated frequency bandwidth is desirable."); Ex. 1004 at Abstract ("Techniques for transmitting data using a number of diversity transmission modes to improve reliability. . . . For OFDM, the transmit symbols for all data streams are further OFDM modulated to provide a stream of transmission symbols for each transmit antenna used for data transmission."); Ex. 1005 at 4:35-42 ("The present invention provides an improved method and apparatus for processing simultaneously occurring, interfering signals using a multi-user detector (MUD) . . . , which speeds the pruning of a tree by improving tree construction and tree pruning to reduce signal processing time to a minimum.").

2. 1a: a multiuser detection (MUD) module configured to simultaneously demodulate and recover K wirelessly transmitted signals using co-channel demodulation;

225. As described above, Walton teaches this limitation under Patent Owner's apparent interpretation. But to the extent Walton does not disclose a MUD module, Learned discloses this limitation.

(i) A multiuser detection (MUD) module:

226. The '946 patent recognizes that MUD modules are conventional technology. Ex. 1001 at 14:7-9 ("Each of the analog front end 105, parameter estimation module 110, ***MUD module*** 115, and bank of decoders 117 can be implemented in conventional technology."). I agree that this technology was conventional at the time of the priority date of the '946 patent.

227. Learned teaches a MUD module. Ex. 1005 at 10:39-42 ("During each symbol interval the power ordered signals are iteratively processed by ***multi-user decoder (MUD)*** 13 and bank of single user decoders 16."); Ex. 1005 at 6:2 ("***The multi-user detector 13*** is preferably based on the M-algorithm."). Learned expressly refers to the tree-pruned multi-user decoder in Figure 4 (below) as "multi-user detector 13."

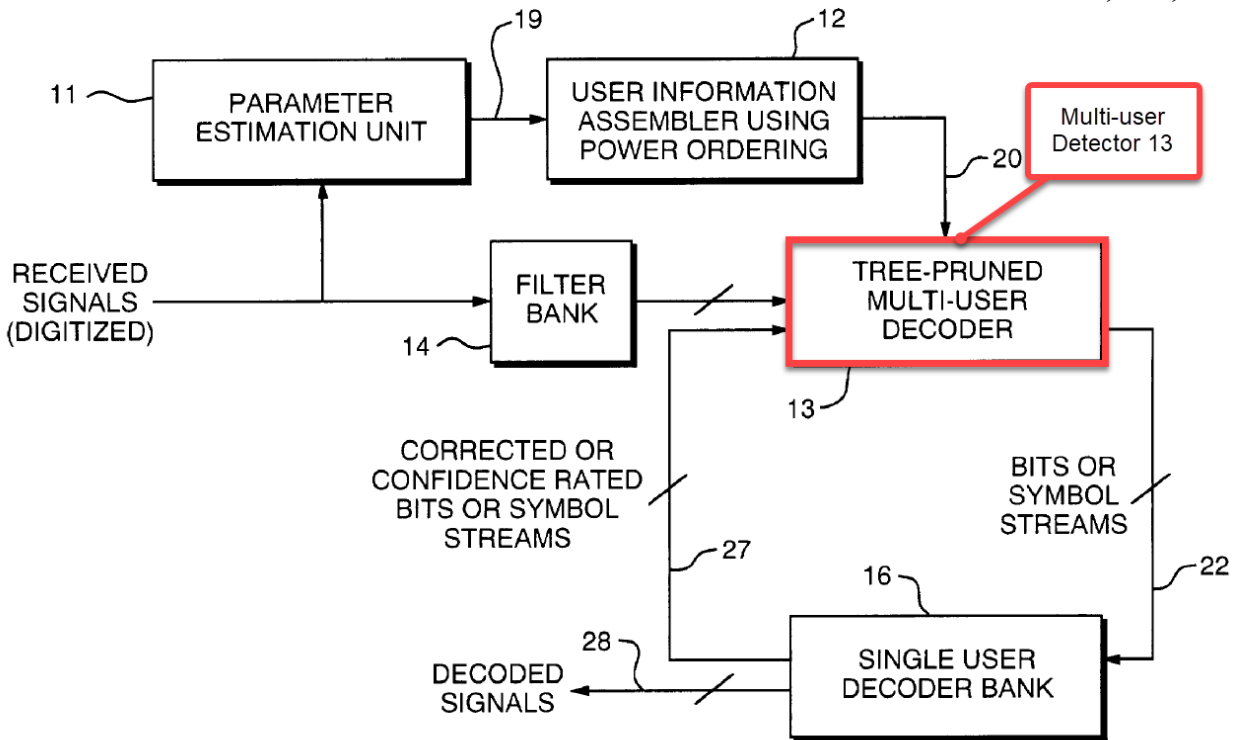


FIG. 4

(ii) **Configured to simultaneously demodulate and recover K wirelessly transmitted signals:**

228. Learned expressly teaches that its MUD module is configured to simultaneously demodulate and recover K wirelessly transmitted signals. Specifically, Learned discloses that MUD modules are used to “*demodulate simultaneously* occurring interfering signals, signal processing of the received signal is accomplished utilizing multi-user detection (MUD) techniques” to “separate multiple interfering signals transmitted on the same communication

channel.” Ex. 1005 at 2:1-27. In other words, Learned’s MUD modules simultaneously demodulate and recover the wirelessly transmitted signals.

(iii) Using co-channel demodulation:

229. As mentioned, Learned’s MUD module separates and recovers multiple interfering signals transmitted *on the same communication channel*. Further, Learned teaches that its demodulation technique is intended to handle co-channel interfering signals. Ex. 1005 at 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*.”); *see also* Ex. 1005 at 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*.”). Thus, Learned’s MUD module is configured to demodulate using co-channel demodulation.

230. It would have been obvious to combine Learned’s multiuser detection into Walton’s modem for the reasons stated above.

3. **Claim 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 a parameter estimator in a form that facilitates their subsequent processing by the multiuser detection module.**

231. Walton disclose a front end configured to simultaneously receive the K wirelessly transmitted signals, and to provide those signals to the MUD and a parameter estimator in a form that facilitates their subsequent processing by the multiuser detection module. *See supra*, Section VI.A.2.

232. 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. 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." Ex. 1005, 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. Ex. 1004, ¶41.

233. Learned also discloses a parameter estimator. *See infra* Section VI.B.5.

4. **Claim 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.**

234. As described above, Walton teaches this limitation.

(i) A parameter estimator module receiving D diversity inputs from D analog to digital (A/D) converters:

235. Learned also teaches using a parameter estimation unit (the *claimed parameter estimator module*) receiving multiple digitized received signals with its multi-user detector. See Figure 4 annotated below. Because these received signals are digitized, they would be processed by an analog to digital converter. Accordingly, Learned teaches a parameter estimator module receiving inputs from analog to digital (A/D) converters. It would have been obvious to a POSITA to include multiple diversity inputs from the A/D converter to the parameter estimator module, especially when combining with the MIMO (multiple input multiple output) system of Walton. 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.

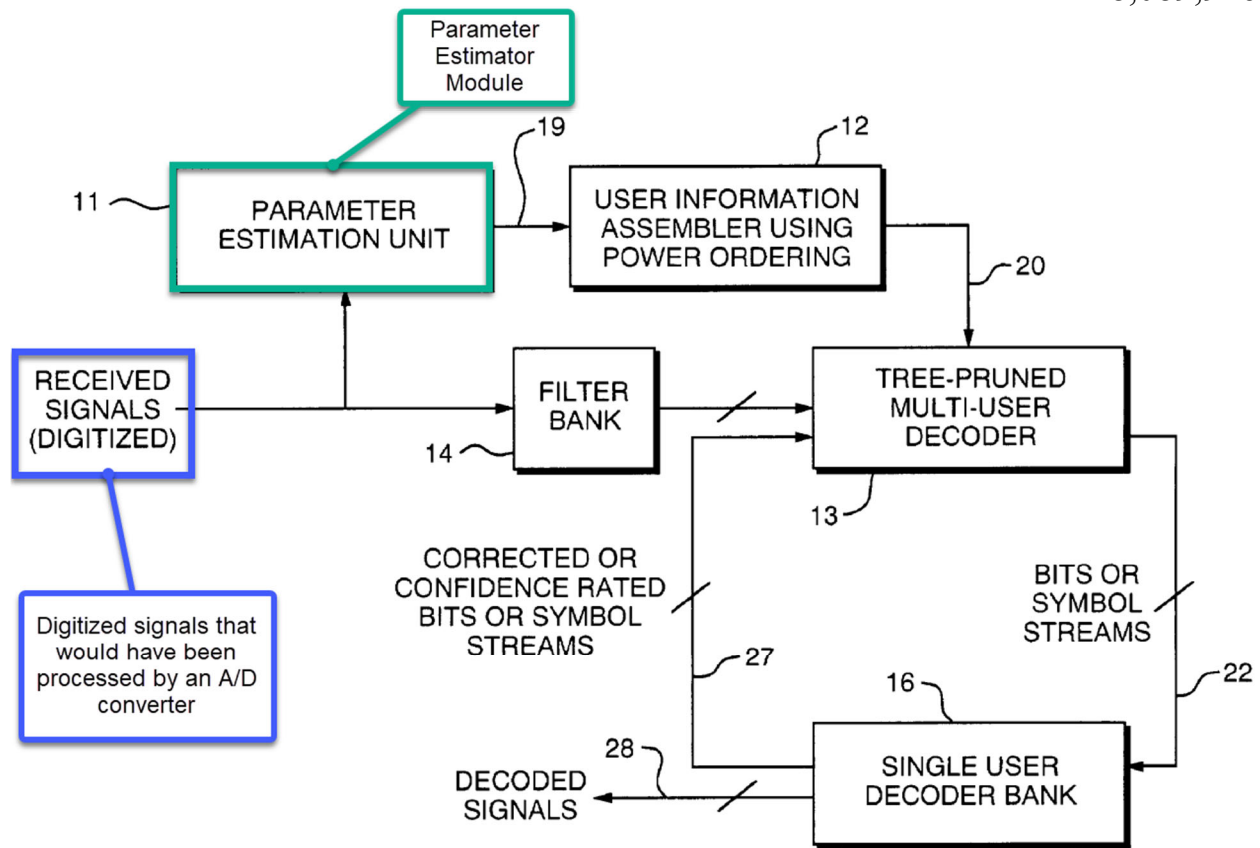


FIG. 4

- (ii) **The parameter estimator module outputting an S matrix to the MUD module, wherein the S matrix comprises estimated composite signature waveforms:**

236. It was well known in the art for parameter estimator modules to output an S matrix to a MUD module, wherein the S matrix comprises estimated composite signature waveforms. Ex. 1007 at 26:51-62 (“[I]t is well known in the art how to compute parameter estimates for the S matrix, and these estimates will be assumed to be known or made available to the joint detector 720.”).

237. 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.” Ex. 1005, 7:43-52. Further, these signature vectors are “entries in [a] correlation matrix” (i.e., an S matrix). *Id.*

238. 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. Ex. 1005, 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.”).

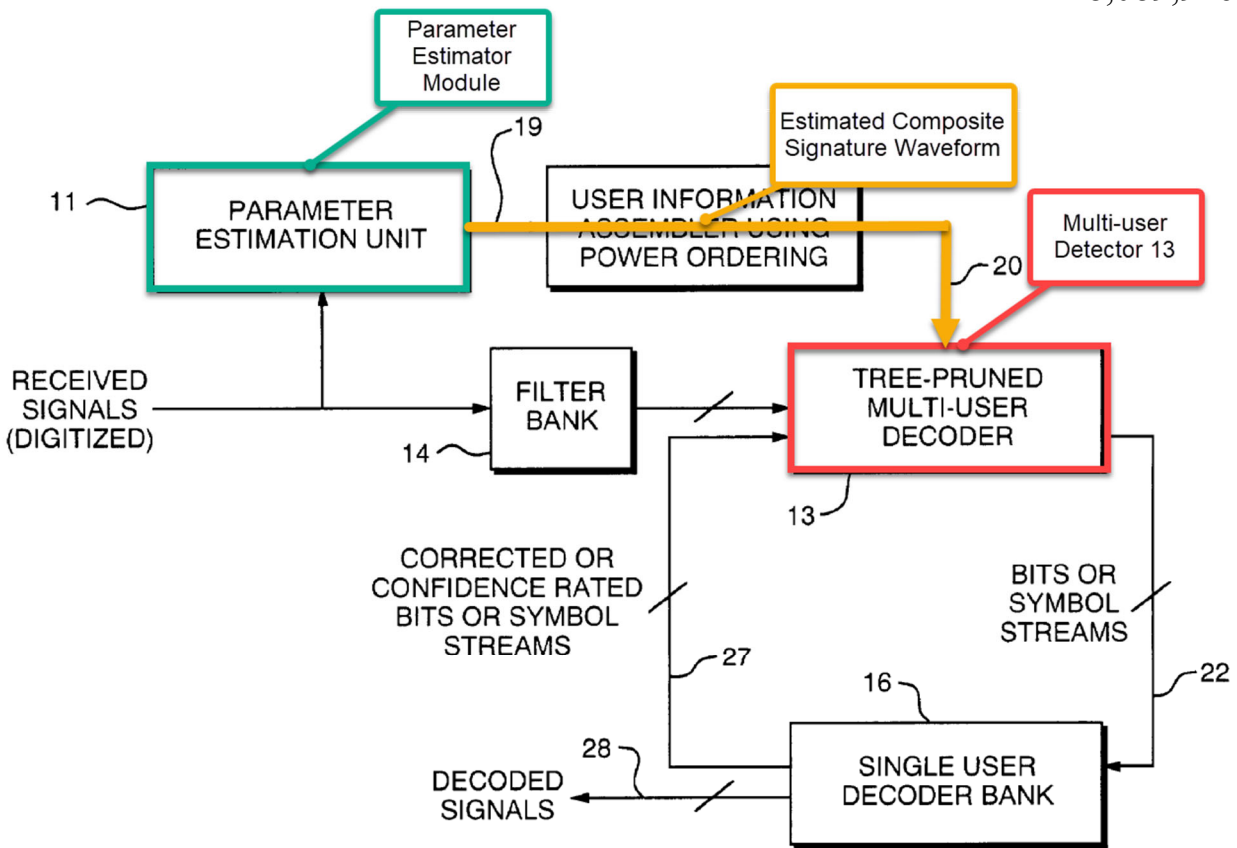


FIG. 4

239. As mentioned, the output of Learned's parameter estimator module is a vector space representation of the received interfering signals. A POSITA would have known that such representations can be organized in a matrix form, i.e., data structure having row and column indices (for example, an index for one of the N_T transmitters and another index for one of the N_R receivers).

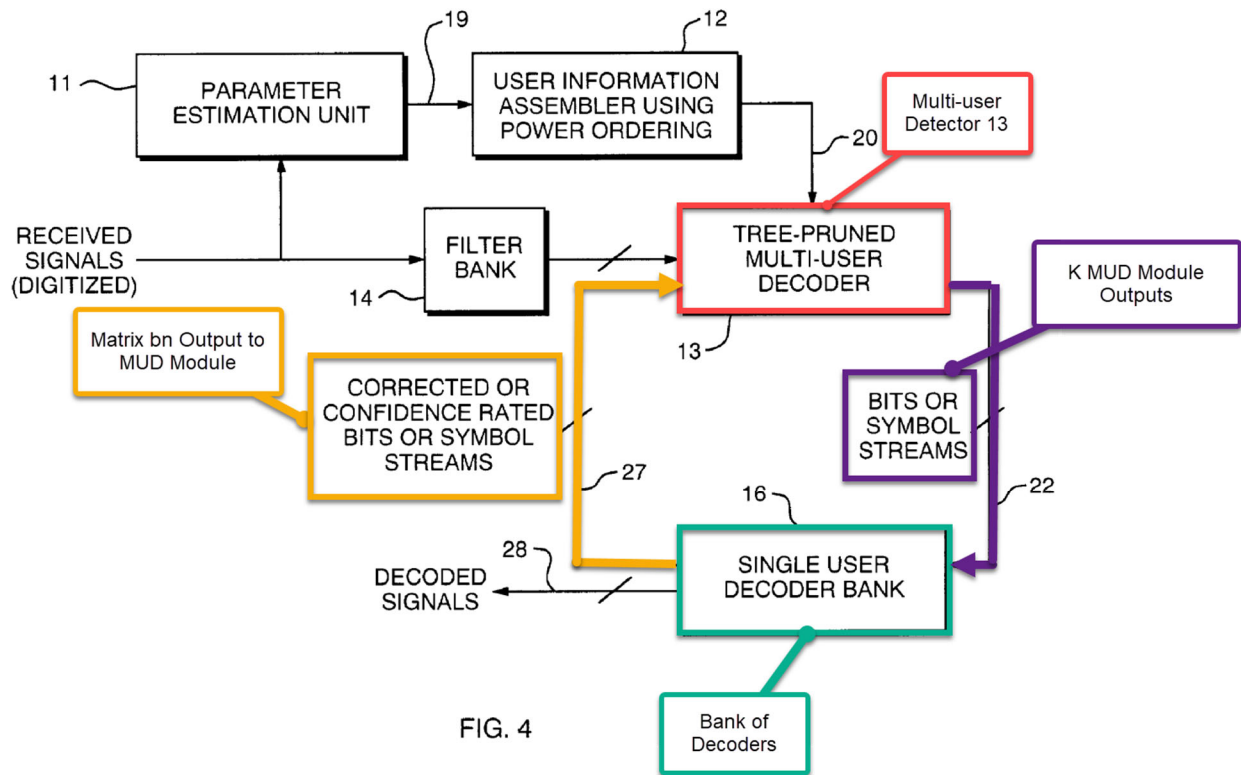
240. A POSITA would have been motivated to apply Learned's teachings regarding parameter estimation into Walton's modem, and would have reasonably expected to be successful doing so, for the reasons stated above.

5. **Claim 5: 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 $\mathbf{b}_n$ 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.**

241. As described above, Walton teaches this limitation. Learned additionally teaches that its multi-user detector communicates with a bank of decoders. 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.

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

242. Learned teaches a bank of K decoders communicating with the K MUD module outputs. Ex. 1005 at 10:39-42 (“During each symbol interval the power ordered signals are iteratively processed by *multi-user decoder (MUD) 13 and bank of single user decoders 16*.”); see Figure 4 annotated below. Further, Learned expressly teaches that the number of decoders is the same as the number of MUD module outputs. This is because it teaches that there is one decoder for each user signal received. Ex. 1005 at 12:24-25 (“[T]here is only a single user associated with each of decoders 16.”)



- (ii) The bank of K decoders producing a matrix bn output to the MUD module from the input of K MUD module recovered signals, wherein the matrix bn is a matrix of symbol estimates:

243. Learned teaches the bank of K decoders producing a matrix bn output to the MUD module from the input of K MUD module recovered signals, wherein the matrix bn is a matrix of symbol estimates. As shown in the annotated Figure 4 above, Learned's bank of decoders receives the output from the MUD module through line 22. The output of the MUD module is the received, digitized signal (i.e., recovered signal). Ex. 1005 at 11:1-15. The bank of decoders then outputs to the MUD module through line 27. The output of the bank of decoders is symbol

estimates. Ex. 1005 at 11:35-46 (“The output from multi-user decoder (MUD) 13 may be either hard or soft estimates of the signal symbols and are called “*channel symbol estimates*” in this description. . . . [E]ither type of estimate (soft or hard) is possible for either the output of MUD 13 on line 22 or for *the output of the bank of single user error correction decoders on line 27.*”). A POSITA would have known that data such as the symbol estimates output from the bank of decoders can be organized in a matrix form, i.e., data structure having row and column indices, because that is typically the form that such data is organized and processed in a modem.

244. 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.” Ex. 1005, 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.

6. Claim 10

245. As discussed, Walton discloses limitations 10pre and 10d-10h as set forth in Ground 1. I address limitations 10a-10c below.

(a) 10a:

- (i) A multiuser detection (MUD) module ... configured to simultaneously demodulate and recover K wirelessly transmitted signals using co-channel demodulation, simultaneously outputting K recovered signals**

246. This limitation mirrors Limitation 1a that I discuss above. *See also* Ex. 1005, 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.”).

- (ii) Receiving D inputs from D analog to digital (A/D) converters**

247. This limitation mirrors portions of Claim 4 that I discuss above. In my opinion, Walton renders this claim obvious for the same reasons.

- 7. 10b: a parameter estimator module receiving the D inputs from the D A/D converters;**

248. This claim limitation mirrors parts of Claim 4 discussed above. In my opinion, Walton renders this claim obvious for the same reasons.

- 8. 10c: a parameter estimator module receiving the D inputs from the D A/D converters;**

249. This claim limitation mirrors parts of Claim 5 discussed above. In my opinion, Walton renders this claim obvious for the same reasons.

9. Claim 20

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

(a) 20e

This claim limitation mirrors parts of limitation 10a discussed above. In my opinion, Walton renders this claim obvious for the same reasons.

(b) 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;

251. As described above, Walton teaches this limitation.

(i) A parameter estimator module receiving the D inputs from the D A/D converters:

252. This claim limitation mirrors parts of Claim 4 discussed above. In my opinion, Walton renders this claim obvious for the same reasons.

(ii) 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:

253. Learned expressly teaches this limitation. Specifically, Learned states “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. These parameters include the received power level [related to the *received amplitude*], the *phase* of the oscillator which generated each received signal, the timing offset relative to the base station clock [i.e., *received timing offsets*], 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*]."). Ex. 1005 at 6:23-36. Learned thus teaches sending these estimates (the relative received timing offsets, phases, received amplitudes, and multipath structure) for each of the received signals to the MUD module to allow the MUD to process and recover the signals.

254. It was well known in the art for parameter estimator modules to output an S matrix to a MUD module, wherein the S matrix comprises estimated composite signature waveforms. Ex. 1007 at 26:51-62 ("[I]t is well known in the art how to compute parameter estimates for the S matrix, and these estimates will be assumed to be known or made available to the joint detector 720."). 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.

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

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

C. Ground 3: Claims are obvious over Walton in view of Learned and Quigley

256. 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. Quigley at Abstract.

257. As discussed above, Walton teaches providing a burst control input, but to the extent Patent Owner argues Walton lacks a burst control input, Quigley discloses this aspect of the claims.

258. It would have been obvious to a person of ordinary skill in the art to combine the burst control input disclosed in Quigley into the modem and MIMO system of Walton, in combination with Learned.

1. Motivation to Combine

259. A POSITA would have been motivated to incorporate 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. While Quigley is related to cable modems and Walton to wireless modems, the use of burst

transmissions to increase efficiency, latency, and resource utilization would be applicable in either context. Quigley 7:66-8:2 (Figures 78 and 79 are modifications of figures 1 and 2 adapting the invention to *wireless* transmission).

260. A POSITA would have reasonably expected this combination to succeed because Walton discloses that various transmission schemes can be used. Walton ¶ 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.”).

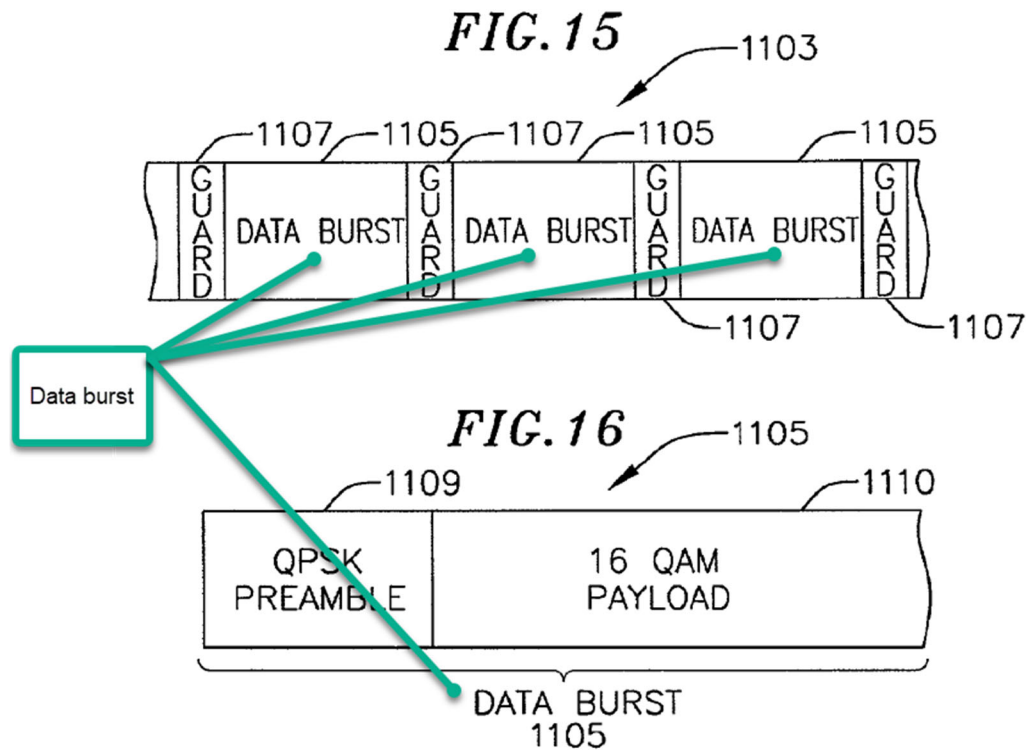
261. Finally, Walton, Quigley, Learned, and the '946 patent are analogous art because all three are directed to systems and techniques to improve efficiency and robustness in multiuser networks, and particularly techniques with respect to demodulating, recovering, and modulating received signals.

2. Limitation 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

262. As discussed above, Walton teaches this limitation, including providing a burst control input.

263. But to the extent Patent Owner argues Walton does not disclose a burst control input, Quigley expressly teaches a burst control input. Quigley at 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* Quigley at 4:64-5:2 (“FIG. 15 shows a plurality of **data bursts** separate by guard bands”).



VIII. Secondary Considerations of Non-obviousness

264. I am not aware of any secondary considerations, or so-called “objective indicia of non-obviousness” for the challenged claims.

265. Secondary considerations could include things like commercial success of a product due to the merits of the claimed invention; a long felt need for the solution provided by the claimed invention; unsuccessful attempts by others to find the solution provided by the claimed invention; copying of the claimed invention by others; unexpected and superior results from the claimed invention; acceptance by others of the claimed invention as shown by praise from others in the field or from the licensing of the claimed invention; teaching away from the conventional wisdom

in the art at the time of the invention; independent invention of the claimed invention by others before or at about the same time as the named inventor thought of it; and other evidence tending to show obviousness.

266. Patent Owner has not identified any such secondary considerations, and I am not independently aware of any. For example, Patent Owner has no commercial products embodying the '946 patent that I am aware of. Additionally, as discussed throughout, the claimed features reflect predictable results of combining known elements according to their known functions, and thus, there are no unexpected and superior results from the claimed invention. Also, there are no licenses of the '946 patent of which I am aware.

267. Further, even if Patent Owner were to assert that secondary considerations exist, given the strong reasons that the challenged claims are obvious in light, including the motivations to combine the references set forth above, I do not believe any such secondary considerations would rise to the level of overcoming the invalidity opinions I have expressed.

268. I understand that Patent Owner may address the issue of secondary considerations more fully in the future. I reserve the right to respond to any specific bases for such secondary considerations that Patent Owner may identify.

IX. Conclusion

269. For the reasons set forth above, I believe claims 1-5, 7, 9-16, and 20 of the '946 patent are unpatentable in view of the prior art. In signing this declaration, I understand that the declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I acknowledge that I may be subject to cross-examination in this case and that cross-examination will take place within the United States. If cross-examination is required of me, I will appear for cross-examination within the United States during the time allotted for cross-examination.

270. I declare that all statements made herein of my knowledge are true, that all statements made on information and belief are believed to be true, and that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Dated: August 2, 2024

By: 

Paul S. Min, Ph.D.