

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ZYXEL COMMUNICATIONS CORPORATION AND
ZYXEL NETWORKS CORPORATION
Petitioners

v.

ATLAS GLOBAL TECHNOLOGIES LLC
Patent Owner

Case IPR2023-00863
U.S. Patent No. 9,531,520

**EXHIBIT 1003 – DECLARATION OF DR. PAUL MIN
IN SUPPORT OF *INTER PARTES* REVIEW OF
U.S. PATENT NO. 9,531,520**

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PETITIONER'S EXHIBIT LIST

<u>Exhibit No.</u>	<u>Description</u>
EX-1001	U.S. Patent No. 9,531,520
EX-1002	Prosecution History for U.S. Patent No. 9,531,520
EX-1003	Declaration of Paul Min, Ph.D.
EX-1004	U.S. Patent No. 10,257,806 (“Chu806”)
EX-1005	U.S. Patent No. 10,230,497 (“Merlin”)
EX-1006	U.S. Patent Appln. Pub. 2017/0367077 (“Shu”)
EX-1007	U.S. Patent Appln. Pub. 2010/0310003 (“Lauer”)
EX-1008	Complaint
EX-1009	Patent Owner’s Preliminary Infringement Contentions
EX-1010	<i>Curriculum Vitae</i> of Paul Min, Ph.D.
EX-1011	IEEE Std. 802.11-2012 (March 2012)
EX-1012	“Status of Project IEEE 802.11ax,” Background https://www.ieee802.org/11/Reports/tgax_update.htm , retrieved on April 13, 2023.
EX-1013	EP3,275,113 B1
EX-1014	U.S. Provisional Patent Application No. 62/088,257
EX-1015	Nee, R.V. & Prasad R., <u>OFDM For Wireless Multimedia Communications</u> (2000), ISBN: 0-89006-530-6 (“Nee”)
EX-1016	WiMAX Forum, “Mobile WiMax – Part 1: A Technical Overview and Performance Evaluation” (2006).
EX-1017	Etemad, K. & Lai, M.-Y. <u>WiMAX Technology and Network Evolution</u> (2010) (pages xxiii-xxxiv, 83-120). ISBN: 978-0-470-34387-6 (“Etemad”)
EX-1018	“Techniques for Short Downlink Frames,” 11-14-0855-00-00ax-techniques-for-short-downlink-frames (July 2014), https://mentor.ieee.org/802.11/dcn/14/11-14-0855-00-00ax-techniques-for-short-downlink-frames.pptx , retrieved on April 15, 2023.

<u>Exhibit No.</u>	<u>Description</u>
EX-1019	“Uplink multi-user transmission,” 11-13-1388-00-0hew-ul-mu-transmission (November 11, 2013), https://mentor.ieee.org/802.11/dcn/13/11-13-1388-00-0hew-ul-mu-transmission.pptx , retrieved on April 15, 2023.
EX-1020	“Consideration on UL MU Transmission,” 11-14-0802-00-00ax-consideration-on-ul-mu-transmission (July 14, 2014), https://mentor.ieee.org/802.11/dcn/14/11-14-0802-00-00ax-consideration-on-ul-mu-transmission.pptx , retrieved on April 15, 2023.
EX-1021	“Frame Exchange Control for Uplink Multi-user Transmission,” 11-14-1190-03-00ax-frame-exchange-control-for-uplink-multi-user-transmission (September 15, 2014), https://mentor.ieee.org/802.11/dcn/14/11-14-1190-03-00ax-frame-exchange-control-for-uplink-multi-user-transmission.pptx , retrieved on April 15, 2023.
EX-1022	Index of Claims 1-20 of U.S. Patent No. 9,531,520

TABLE OF ACRONYMS IN THE '520 PATENT

		<u>520 Patent (EX-1001) Citation</u>
ACK	acknowledgement/acknowledgment	Col. 6:2-3
AP	access point	Col. 5:9
DL	downlink	Col. 1:32
FDMA	Frequency Division Multiple Access	Col. 1:32-33
IEEE	Institute for Electrical and Electronics Engineers	Col. 4:65-66
MAC	medium access control	Col. 6:22
MPDU	MAC Protocol Data Unit	Col. 1:61-62
MU	multi-user	Col. 1:30
MU-MIMO	multi-user multiple-input multiple output	Col. 1:39
OFDM	Orthogonal Frequency Division Multiplexing	Col. 11:29-30
OFDMA	Orthogonal Frequency Division Multiple Access	Col. 1:32-33
PDU	Protocol Data Unit	Col. 5:11
PHY	physical	Col. 6:22-23
STA	station	Col. 5:12
UL	uplink	Col. 4:9-10
WLAN	Wireless local area network	Col. 1:26

I. INTRODUCTION

1. I, Paul Min, have been retained as an independent expert witness on behalf of ZyXEL Communications Corporation and ZyXEL Networks Corporation (collectively, “Petitioners”) to investigate and opine on certain issues relating to United States Patent No. 9,531,520 (“the ’520 Patent” or the “Challenged Patent”) in Petitioners’ Petition for *Inter Partes* Review (“IPR”) of this patent. I understand that the Petition requests that the Patent Trial and Appeal Board (“PTAB” or “Board”) review and cancel claims 1-20 (the “Challenged Claims”) of the ’520 Patent.

2. I have been asked to provide my opinions regarding whether or not the Challenged Claims of the ’520 Patent are patentable based on prior art from the viewpoint of a person having ordinary skill in the relevant art as of March 2015. The opinions set forth herein are based on my personal knowledge, professional experience, education and judgment in consideration of the ’520 Patent and its prosecution history and cited references, the documents identified in this IPR’s Petition, and the documents, materials and information referenced herein.

3. I have reviewed and am familiar with the specification of the ’520 Patent. I understand that the ’520 Patent has been provided as EX1001. I will cite to the specification using the following formats: EX1001, ’520 Patent, 1:1-10 (long

form) and EX1001, 1:1-10 (short form). These example citations both point to the '520 Patent specification at column 1, lines 1-10.

4. I am being compensated for my services. My compensation is in no way contingent upon the outcome of this IPR, and I have no financial or personal interest in either its outcome or of any related litigation. I expect to be available to provide oral testimony should the need arise.

II. QUALIFICATIONS AND EXPERIENCE

5. Based on my background and experience, I am familiar with the state of the art in the field of wireless communication technology as of March 2015, which is the earliest possible priority date for the '520 Patent. I am a technical expert in the fields relating to the '520 Patent, and I remain professionally active in these fields. I believe that my background and expertise qualify me as an expert in the technical issues in this case.

6. In formulating my opinions, I have relied upon my training, knowledge, and experience in the relevant art. I have over 25 years of experience working with wireless communication systems. As detailed below, I have worked on many projects that are highly relevant to the subject matter of the '520 Patent.

7. 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.

8. 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 (PSTN) into a multi-services voice and data network that incorporated packet switches, optical technologies, and wireless technologies.

9. 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 in the Department of Electrical and Systems Engineering. I have 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.

10. At Washington University, I have conducted research in communication, computing, and related electronic hardware and software. 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 litigation, I have researched a variety of communication, computing, and electronic technologies, including wireless communication (both cellular and local area networking), broadband communication, transmission and switching, integrated circuit design, software application and protocol design, and system prototype. I have an extensive background and experience in each of these technologies.

11. 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 electronic circuits (Washington University ESE 232), communication theory (Washington University ESE 471), transmission and multiplexing (Washington University ESE 571), and signaling and control of communication networks (Washington University ESE 572).

12. I have supervised numerous students, a number of whom received a doctoral degree under my guidance. Doctoral theses that I have supervised relate to wireless communication, broadband communication, transmission and switching, integrated circuit design, software application and protocol design, and system prototype. In particular, my students and I have published a number of peer-reviewed articles on wireless communication, transmission and switching,

electronic circuit and integrated circuit design, resource allocation, scheduling, modulation, mobility management, switching and transmission, and multiplexing. Several of these articles received accolades in the field. For example, in 2011, I received a best paper award at the Mobility 2011 international conference.

13. 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 and wireless networks. 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 and wireless networks. One of Erlang's products received a best product of the year award in 2004 from a major trade journal for the electronics industry.

14. 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 wireless communication technology. 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).

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 30+ years of experience with telecommunications technology, I have acquired significant knowledge about telecommunications systems industry standards, standard setting organizations such as Bellcore, IEEE, ATM Forum, IETF, ITU, 3GPP, and the rules and document policies that those organizations have in place to develop industry standards.

17. I am a named inventor on eleven U.S. patents, many of which focus on algorithm and device designs for the Internet and wireless networks. I have extensively published technical papers in international conferences and journals, technical memoranda and reports, and given a number of seminars and invited talks. I have organized several international conferences and served as an international journal editor.

18. More details on my publications, activities in certain professional societies and organizations can be found in my *Curriculum Vitae* in EX-1010.

19. I have previously offered testimony at depositions and trials as a technical Expert Witness, as detailed in my *Curriculum Vitae* in EX-1010.

III. LEGAL STANDARDS

20. As I am not a legal expert, I therefore offer no opinions on the law. However, I have been informed and am aware of legal standards that are relevant to my analysis, as summarized below.

A. Legal Standards: Patentability and Claim Construction

21. I have been informed and understand that an issued patent claim is presumed valid, and that establishing a patent claim to be unpatentable requires proof by a “preponderance of the evidence” – which I understand means proof that it is more likely than not that the claim is unpatentable.

22. I have been informed and understand that an unpatentability analysis involves (1) a first step to construe claims, as necessary, to determine their scope, and (2) a second step in which the construed claim language is compared to the disclosures of the prior art.

23. I have been informed and understand that a patent claim may be declared unpatentable if it is anticipated by, or rendered obvious in view of, prior art.

24. I understand that during an *inter partes* review proceeding, claims are to be construed in light of the specification as would be read by a person of ordinary skill in the relevant art at the time the application was filed. I understand that claim terms are given their ordinary and customary meaning as would be understood by a person of ordinary skill in the relevant art in the context of the entire disclosure. A claim term, however, will not receive its ordinary meaning if the patentee acted as his own lexicographer and clearly set forth a definition of the claim term in the specification. In this case, the claim term will receive the definition set forth in the patent.

25. I have been informed and understand that claim construction is a matter of law, and that the PTAB determines this proceeding's final claim constructions.

B. Legal Standards: Person of Ordinary Skill in the Art (“POSITA”)

26. I have been informed and understand that claims are generally given their ordinary and customary meaning as understood by a person of ordinary skill in the art (“POSITA”) at the time of the alleged invention, in light of the patent specification and prosecution history. Such an individual is considered to possess normal skills and knowledge in a particular technical field (as opposed to being a genius or an expert). I have been informed and understand that in considering what the claims of a patent require, what was known prior to that patent, what a

prior art reference discloses, and whether an invention is obvious or not, one must use the perspective of a POSITA.

C. Legal Standards: Claim Anticipation and Claim Obviousness

27. I have been informed and understand that a patent claim is anticipated under 35 U.S.C. § 102, and therefore unpatentable, if every element of the claimed subject matter is disclosed by a single publication before the priority date of the claimed invention. I have additionally been informed and understand that a patent claim is obvious under 35 U.S.C. § 103, and therefore unpatentable, if the claimed subject matter, as a whole, would have been obvious to a POSITA as of the priority date of the patent based on one or more prior art references and/or the knowledge of a POSITA.

28. I have been informed and understand that an obviousness analysis must consider (1) the scope and content of the prior art, (2) the differences between the claims and the prior art, (3) the level of ordinary skill in the pertinent art, and (4) secondary considerations, if any, of non-obviousness (such as unexpected results, commercial success, long felt but unmet need, failure of others, copying by others, and skepticism of experts).

29. I have been informed and understand that a single prior art reference can render a patent claim obvious under 35 U.S.C. § 103 if any differences between that reference and the claims would have been obvious to a person of

ordinary skill in the art. Alternatively, I have been informed and understand that a prior art reference may be combined with other references to disclose each element of the invention under 35 U.S.C. § 103. Thus, the teachings of two or more references may be combined in the same way as disclosed in the claims, if such a combination would have been obvious to one having ordinary skill in the art. I have been informed and understand that a reference may also be combined with the knowledge of a person of ordinary skill in the art, and that this knowledge may be used to combine multiple references. I have further been informed and understand that a person of ordinary skill in the art is presumed to know the relevant prior art. I have been informed and understand that the obviousness analysis may take into account the inferences and creative steps that a person of ordinary skill in the art would employ.

30. I have been informed and understand that the preamble of a claim limits the invention if it recites essential structure or steps, or if it is necessary to give life, meaning, and vitality to the claim. Otherwise, where a patentee defines a structurally complete invention in the claim body and uses the preamble only to state a purpose or intended use of the invention, the preamble does not separately or independently limit the claim.

31. I have been informed and understand that to prove that prior art or a combination of prior art renders a patent obvious, it is necessary to: (1) identify the

particular references that, singly or in combination, render the patent obvious; (2) specifically identify which elements of the patent claim appear in each of the asserted references; and (3) explain how the prior art references could have been combined in order to create the inventions claimed in the asserted claim.

32. I have been informed and understand that in determining whether a combination of prior art references renders a claim obvious, it is helpful to consider whether there is some teaching, suggestion, or motivation to combine the references, and a reasonable expectation of success in doing so. I also understand, however, that a teaching, suggestion, or motivation to combine is not required.

33. I have been informed and understand that the following principles may be considered in determining whether a prior art reference would have been combined with other prior art or other information known to a POSITA:

- a. whether the references to be combined involve non-analogous art;
- b. whether the references to be combined are in different fields of endeavor than the alleged invention in the Patent;
- c. whether the references to be combined are reasonably pertinent to the problems to which the inventions of the Patent are directed;
- d. whether the combination is of familiar elements according to known methods that yields predictable results;
- e. whether a combination involves the substitution of one known element for another that yields predictable results;
- f. whether the combination involves the use of a known technique to improve similar items or methods in the same way that yields predictable results;

- g. whether the combination involves the application of a known technique to a prior art reference that is ready for improvement, to yield predictable results;
- h. whether the combination is “obvious to try”;
- i. whether the combination involves the known work in one field of endeavor prompting variations of it for use in either the same field or a different one based on design incentives or other market forces, where the variations are predictable to a person of ordinary skill in the art;
- j. whether there is some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill in the art to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention;
- k. whether the combination requires modifications that render the prior art unsatisfactory for its intended use;
- l. whether the combination requires modifications that change the principle of operation of the reference;
- m. whether the combination is reasonably expected to be a success;
and
- n. whether the combination possesses the requisite degree of predictability at the time the invention was made.

IV. SUMMARY OF OPINIONS

34. My opinions as detailed in this Declaration are summarized as follows:

- Ground 1: Claims 1-20 of the '520 Patent are rendered obvious by Chu806.
- Ground 2: Claims 1-20 of the '520 Patent are rendered obvious by Merlin.

- Ground 3: Claims 1-20 of the '520 Patent are rendered obvious by Shu.

V. THE '520 PATENT: DESCRIPTION & PROSECUTION HISTORY

A. Description of the '520 Patent

35. The application issuing into the '520 Patent claimed priority to Provisional Application No. 62/137,138 filed on March 23, 2015 and Provisional Application No. 62/140,349 filed on March 30, 2015. *See* EX-1001, cover. I understand that the earlier of the filing dates, March 23, 2015, would be the earliest possible priority date (also called the effective filing date) for the '520 Patent. I understand that any publication prior to March 23, 2015, or any US patent/patent application having effective filing date prior to March 23, 2015, is considered prior art to the '520 Patent. To the extent that any such publication or US patent/patent application discloses the claimed subject matter of the '520 Patent, it may be used to show that the claims of the '520 Patent are not patentable.

36. According to its specification, the '520 Patent is directed to addressing inefficiencies in existing uplink serial acknowledgements from Stations (STAs) to an Access Point (AP). EX-1001, 5:64-67. To address these purported inefficiencies, the '520 Patent discusses an AP transmitting a downlink multi-user (DL MU) protocol data unit (PPDU) to multiple STAs. EX-1001, 5:9-12. "Each [DL] MPDU may include data and/or control frames intended for each respective

STA and may be placed in resource units within the DL MU frame assigned/allocated to each respective STA.” EX-1001, 14:9-12. Specifically, the ’520 Patent explains that “the resource units may be particular spatial streams or sub-channels of a wireless channel upon which the DL MU frame will be transmitted.” EX-1001, 14:12-14; 18:5-8; 20:48-50.

37. Figure 5A shows a method for coordinating a UL MU acknowledgement transmission to a DL MU transmission, and Figure 5B shows the corresponding transmission diagram. As reflected in Figures 5A and 5B, the AP generates and transmits the DL MU frame addressed to STA1, STA2, and STA3. Each MPDU may include data and/or control frames intended for each respective STA and may be placed in resource units within the DL MU frame assigned/allocated to each respective STA.

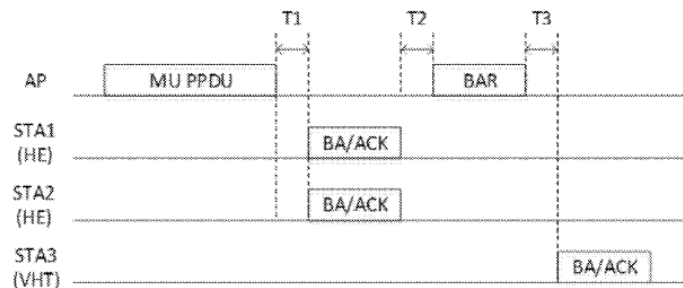


FIG. 5B

B. Prosecution History of the ’520 Patent

38. The USPTO issued an Office Action rejecting the original claims under 35 U.S.C. 103(a) as being unpatentable over U.S. 2013/0301569 (Wang).

EX-1002, June 9, 2016 Office Action. In response to the claim rejections, the inventors amended all the original claims to further require simultaneously uplink multi-user acknowledgements. Changes made to independent claims 1, 8 and 18 in the Amendment are reproduced below. Along with the amendments, the inventors argued, *inter alia*, that “Wang does not disclose UL MU transmissions....” EX-1002, July 22, 2016 Amendment.

1. (Currently amended) A method, implemented by a network device in a wireless network, for coordinating an uplink multi-user response transmission to a downlink multi-user transmission, the method comprising:

generating, by the network device, a downlink multi-user frame addressed to a plurality of stations operating in the wireless network, the downlink multi-user frame including a plurality of resource units ~~that are each assigned to a station in the plurality of stations~~ (RUs), wherein generating the downlink multi-user frame comprises:

assigning each RU of the plurality of RUs to a respective station in the plurality of stations, and

including a respective set of MAC Protocol Data Units (MPDUs) in each ~~resource unit~~ RU of the plurality of ~~resource units~~ RUs,

wherein ~~one or more MPDUs in each one or more of the resource units~~ one or more MPDUs in each RU of the plurality of RUs ~~downlink multi-user frame~~ includes acknowledgement information ~~transmitted by each~~ indicating properties of a multi-user acknowledgement transmission ~~transmitted by each~~ respectively that the station in the plurality of stations to which the RU is assigned is requested to transmit to acknowledge the downlink multi-user frame; [[and]]

transmitting the downlink multi-user frame to the plurality of stations over a wireless channel; and

receiving the uplink multi-user response transmission, the uplink multi-user response transmission including multi-user acknowledgement transmissions respectively and simultaneously transmitted by two or more stations in the plurality of stations,

wherein the plurality of RUs respectively correspond to a plurality of simultaneous uplink transmissions, and each of the plurality of simultaneous uplink transmissions uses a sub-channel, spatial stream, or sub-channel and spatial stream combination that is not used by any other of the plurality of simultaneous uplink transmissions.

EX-1002, July 22, 2016 Amendment.

8. (Currently amended) A method, implemented by a first station in a wireless network, for transmitting an uplink acknowledgment, the method comprising:

- receiving a downlink multi-user frame addressed to a plurality of stations, including the first station, and received from an access point in the wireless network;
- processing a first MAC Protocol Data Units (MPDU) in the downlink multi-user frame to determine acknowledgement information ~~[[for]]~~ indicating properties of a first multi-user acknowledgement frame ~~to acknowledge the downlink multi-user frame by two or more stations;~~
- generating the first multi-user acknowledgment frame based on the acknowledgement information; and
- transmitting the first multi-user acknowledgment frame to the access point ~~based on the acknowledgement information to acknowledge the downlink multi-user frame,~~

wherein the first multi-user acknowledgment frame is transmitted simultaneously to a second multi-user acknowledgment frame transmitted by a second station.

EX-1002, July 22, 2016 Amendment.

18. (Currently amended) A method, implemented by a first station in a wireless network, for transmitting an uplink acknowledgment, the method comprising:

- receiving a downlink multi-user frame addressed to a plurality of stations, including the first station, wherein the downlink multi-user frame is received from an access point in the wireless network;
- receiving a multi-user block acknowledgement request frame that solicits acknowledgements from ~~two or more stations~~ the first station and a second station, wherein the multi-user block acknowledgement request frame includes acknowledgement information ~~[[for]]~~ indicating properties of a first multi-user acknowledgement frame ~~that acknowledges receipt of the downlink multi-user frame by the first station;~~
- generating the first multi-user acknowledgment frame based on the acknowledgement information; and
- acknowledging the receipt of the downlink multi-user frame by transmitting the first multi-user acknowledgment frame to the access point based on the acknowledgement information,

wherein the first multi-user acknowledgment frame is transmitted simultaneously with a second multi-user acknowledgment frame generated and transmitted by the second station.

EX-1002, July 22, 2016 Amendment.

39. The USPTO issued a Notice of Allowance citing all the limitations of independent claims 1, 8 and 18 (as-amended) and stating: “the prior art of record...fails to fairly show or suggest the claimed method (claim 1)...the claimed

method (claim 8)...the claimed method (claim 18).” EX-1002, August 15, 2016

Notice of Allowance.

The Applicants' amendments/arguments in the outstanding response filed 07/22/16 have been fully appreciated and considered. The prior art of record, considered individually or in combination, fails to fairly show or suggest the claimed method (claim 1), implemented by a network device in a wireless network, for coordinating an uplink multi-user response transmission to a downlink multi-user transmission, comprising the novel and unobvious limitation of “*generating, by the network device, a*

downlink multi-user frame addressed to a plurality of stations operating in the wireless network, the downlink multi-user frame including a plurality of resource units 'RUs', wherein generating the downlink multi-user frame comprises assigning each RU of the plurality of RUs to a respective station in the plurality of stations, and including a respective set of MAC Protocol Data Units 'MPDUs' in each RU of the plurality of RUs, wherein an MPDU in one or more of the RUs in the plurality of RUs includes acknowledgement information indicating properties of a multi-user acknowledgement transmission that the station in the plurality of stations to which the RU is assigned is requested to transmit to acknowledge the downlink multi-user frame; transmitting the downlink multi-user frame to the plurality of stations over a wireless channel; and receiving the uplink multi-user response transmission, the uplink multi-user response transmission including multi-user acknowledgement transmissions respectively and simultaneously transmitted by two or more stations in the plurality of stations, wherein the plurality of RUs respectively correspond to a plurality of simultaneous uplink transmissions, and each of the plurality of simultaneous uplink transmissions uses a sub-channel, spatial stream, or sub-channel and spatial stream combination that is not used by any other of the plurality of simultaneous uplink transmissions.”

structurally and functionally interconnected with other limitations in a manner as recited in dependent claims 2-7.

The prior art of record also fails to fairly show or suggest the claimed method (claim 8) for transmitting an uplink acknowledgment, comprising the novel and unobvious limitations as “*receiving a downlink multi-user frame addressed to a plurality of stations, including the first station, and received from an access point in the wireless network; processing a first MAC Protocol Data Units 'MPDU' in the downlink multi-user frame to determine acknowledgement information indicating properties of a first multi-user acknowledgement frame; generating the first multi-user acknowledgment frame based on the acknowledgement information; and transmitting the first multi-user acknowledgement frame to the access point to acknowledge the downlink multi-user frame, wherein the first multi-user acknowledgement frame is transmitted simultaneously to a second multi-user acknowledgement frame transmitted by a second station.”* structurally and functionally interconnected with other limitations in a manner as recited in dependent claims 9-17.

The prior art of record also fails to fairly show or suggest the claimed method (claim 18) for transmitting an uplink acknowledgment, comprising the novel and unobvious limitations as "receiving a downlink multi-user frame addressed to a plurality of stations, including the first station, wherein the downlink multi-user frame is received from an access point in the wireless network; receiving a multi-user block acknowledgement request frame that solicits acknowledgements from the first station and a second station, wherein the multi-user block acknowledgement request frame includes acknowledgement information indicating properties of a first multi-user acknowledgement frame; generating the first multi-user acknowledgement frame based on the acknowledgement information; and acknowledging the receipt of the downlink multi-user frame by transmitting the first multi-user acknowledgement frame to the access point, wherein the first multi-user acknowledgement frame is transmitted simultaneously with a second multi-user acknowledgement frame generated and transmitted by the second station." structurally and functionally interconnected with other limitations in a manner as recited in dependent claims 19-20.

EX-1002, August 15, 2016 Notice of Allowance.

VI. THE STATE OF THE ART IN 2015

40. The '520 Patent broadly describes MU transmission techniques in WLAN systems involving a single Orthogonal Frequency Division Multiple Access (OFDMA) frame including a set of MAC Protocol Data Units (MPDUs) and allocating/assigning spatial streams or sub-channels of a wireless channel to STAs. EX-1001, 1:26-35. The claims of the '520 Patent recite these techniques in terms of four general concepts: (i) a DL OFDMA MU frame including (ii) a set of MPDUs, and (iii) a plurality of resource units (RUs) to solicit (iv) simultaneous UL acknowledgement frames from multiple STAs. But these concepts and techniques using DL OFDMA MU frames including MPDUs and allocating sub-channels, and the benefits thereof, were well-known before the '520 Patent's earliest possible priority date, March 23, 2015.

A. OFDMA Supporting MU Transmissions

41. The concept of using parallel data transmission in time together with frequency division multiplexing was known as the Orthogonal Frequency Division Multiplexing (OFDM) since at least the mid-1960s, with some early development traced back to the 1950s. EX-1015, 1, 20-21. Specifically, the OFDM technique has been adopted by the IEEE 802.11 since at least 1999. EX-1015, 4-5; 27 [24].

5
available since mid 1999. An industry alliance called the Wireless Ethernet Compatibility Alliance (WECA) has been established to promote the high rate IEEE 802.11 technology and to certify interoperability of products from different vendors [23]. The second IEEE 802.11 standard extension targets a range of data rates from 6 up to 54 Mbps using OFDM in the 5-GHz band [24]. The OFDM standard was developed jointly with ETSI BRAN and MMAC, making OFDM effectively a worldwide standard for the 5-GHz band.

EX-1015, 5.

27
[24] IEEE, "Supplement to Standard for Telecommunications and Information Exchange Between Systems—LAN/MAN Specific Requirements—Part 11: Wireless MAC and PHY Specifications: High Speed Physical Layer in the 5-GHz Band," P802.11a/D7.0, July 1999.

EX-1015, 27.

42. The OFDM technique also has been expanded to several variants, such as OFDMA, which accommodates the multiple users simultaneously. For example, OFDMA was proposed for the European Universal Mobile Telecommunication System (UMTS) in 1997. EX-1015, 217, 228 [3]. Also, OFDMA was implemented in wireless communication systems, such as WiMAX, as a multiple-user version of OFDM since at least 2006. EX-1016, 12.

43. The OFDMA technique has been known to provide "a multiple-access/multiplexing scheme that provides multiplexing operation of data streams

from multiple users onto the downlink sub-channels and uplink multiple access by means of uplink sub-channels.” EX-1016, 12.

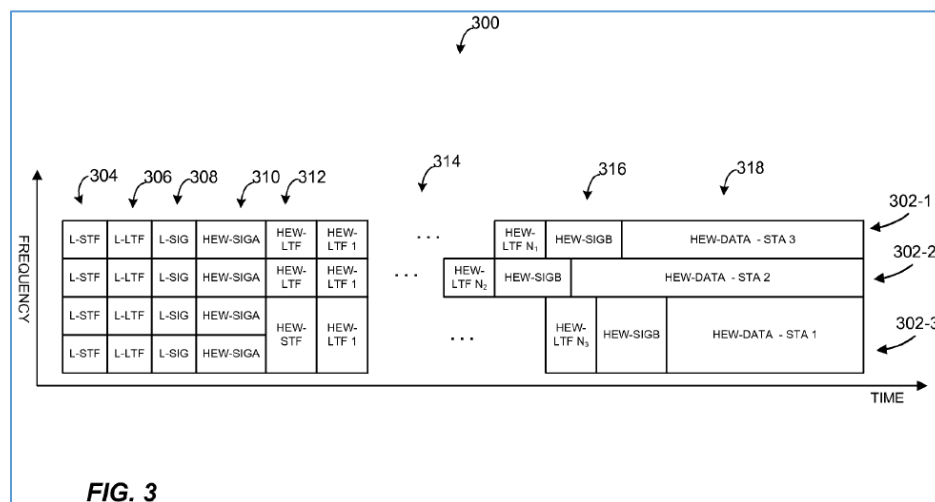
44. As a further example, Chu806 teaches an example OFDMA data unit that can be transmitted as a DL OFDMA data unit by an AP to multiple STAs. *See* EX-1004, 7:58-8:23; FIG. 3.

FIG. 3 is a diagram of an example OFDMA data unit 300, according to an embodiment. The OFDMA data unit 300 includes a plurality of OFDM data unit 302-1, 302-2 and 302-3. In an embodiment, the AP 14 transmits the OFDM data units 302-1, 302-2, 302-3 to different client stations 25 via respective OFDM sub-channels within the OFDMA data unit 300. In another embodiment, different client stations 25 transmit respective OFDM data units 302-1, 302-2, 302-3 to the AP 14 in respective OFDM sub-channels within the OFDMA data unit 300. In this embodiment, The AP 14

receives the OFDM data units 302-1, 302-2, 302-3 from the client stations 25 via respective OFDM sub-channels of within the OFDMA data unit 300, in this embodiment.

Each of the OFDM data units 302-1, 302-2, 302-3 conforms to a communication protocol that defines OFDMA communication, such as the HEW communication protocol, in an embodiment. In an embodiment in which the OFDMA data unit 300 corresponds to a downlink OFDMA data unit, the OFDMA data unit 300 is generated by the AP 14 such that each OFDM data unit 302 is transmitted to a respective client station 25 via a respective sub-channel of the WLAN 10 allocated for downlink transmission of the OFDMA data unit 300 to the client station. Similarly, an embodiment in which the OFDMA data unit 300 corresponds to an uplink OFDMA data unit, the AP 14 receives the OFDM data units 302 via respective sub-channels of the WLAN 10 allocated for uplink transmission of the OFDM data units 302 from the client stations, in an embodiment. For example, the OFDM data unit 302-1 is transmitted via a first 20 MHz sub-channel of the WLN 10, the OFDM data unit 302-2 is transmitted via a second 20 MHz sub-channel of the WLAN 10, and the OFDM data unit 302-3 is transmitted via a 40 MHz sub-channel of the WLAN 10, in the illustrated embodiment.

EX-1004, 7:58-8:23.



EX-1004, FIG. 3.

B. Dynamic Resource Allocation in MAC Frames

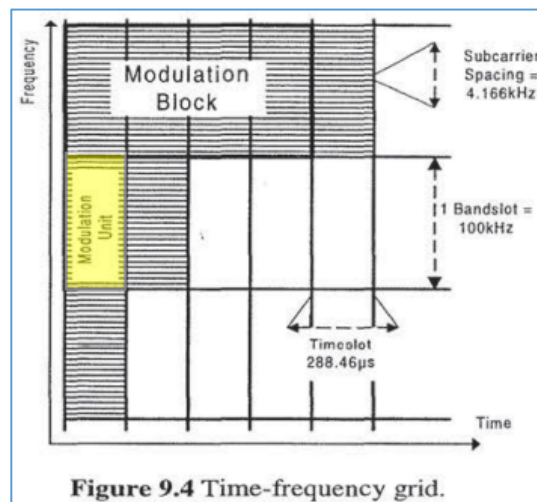
45. In wireless transmissions, physical transmission factors, such as time and frequency, often has been referred to as “resources.” EX-1015, 217.

Figure 9.4 illustrates the time-frequency grid of the OFDMA system. The resources (time and frequency) are allocated based on the type of services and operational environment. The number of timeslots and bandslots per user is variable to realize variable data rates. The smallest data rate is obtained for one bandslot of 24 subcarriers per timeslot of 288.46 μ s.

EX-1015, 217.

46. For example, it has been known that in an OFDM or OFDMA system, resources are available in the time domain by means of OFDM symbols and in the frequency domain by means of sub-carriers. EX-1015, 217, Figure 9.4; EX-1016, 12.

47. The resources also have been conceptualized as resource blocks/units in the context of a time-frequency grid. EX-1015, 217, Figure 9.4.



EX-1015, 218.

48. Further, WiMAX systems have been known to implement resource management by referring to “resource unit” in 2006. EX-1016, 13.

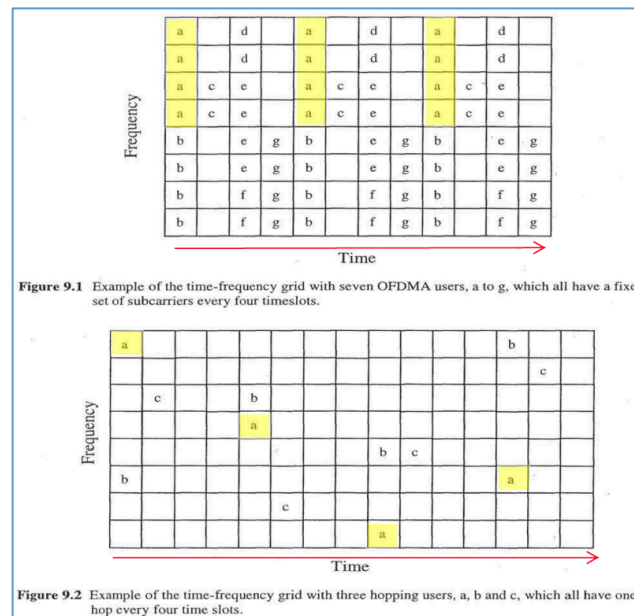
Active (data and pilot) sub-carriers are grouped into subsets of sub-carriers called sub-channels. The WiMAX OFDMA PHY [3] supports sub-channelization in both DL and UL. The minimum frequency-time resource unit of sub-channelization is one slot, which is equal to 48 data tones (sub-carriers).

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EX-1016, 13.

49. In addition, it has been known that the time and frequency resources can be organized into sub-channels for allocation to individual users. EX-1016, 12.

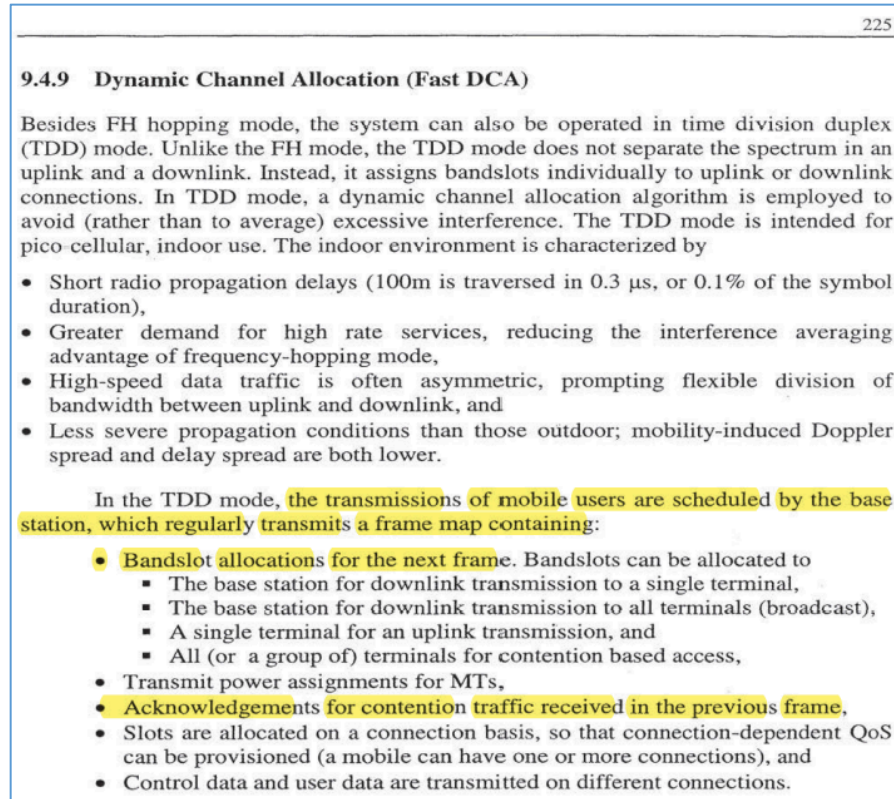
50. For example, a base station has been known to allocate the resources to multiple receiving stations dynamically or in a fixed manner. EX-1015, 213-214, 217-218, 225-227, Figure 9.1, Figure 9.2.



EX-1015, Figure 9.1, Figure 9.2 (annotated).

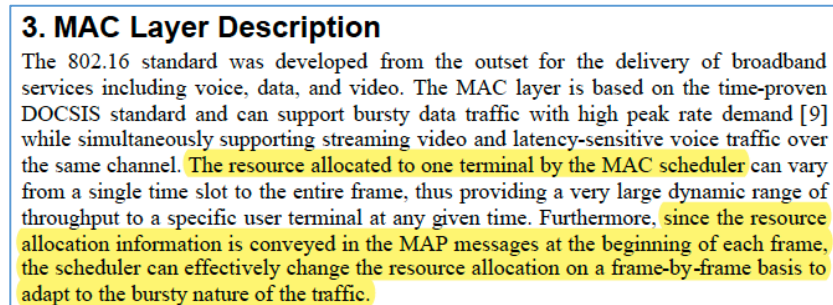
51. Specifically, a base station has been known to transmit to multiple users: resources allocations (e.g., bandslot allocations), acknowledgements for

contentions traffic received in the previous frame, and other control data. EX-1015, 225.



EX-1015, 225.

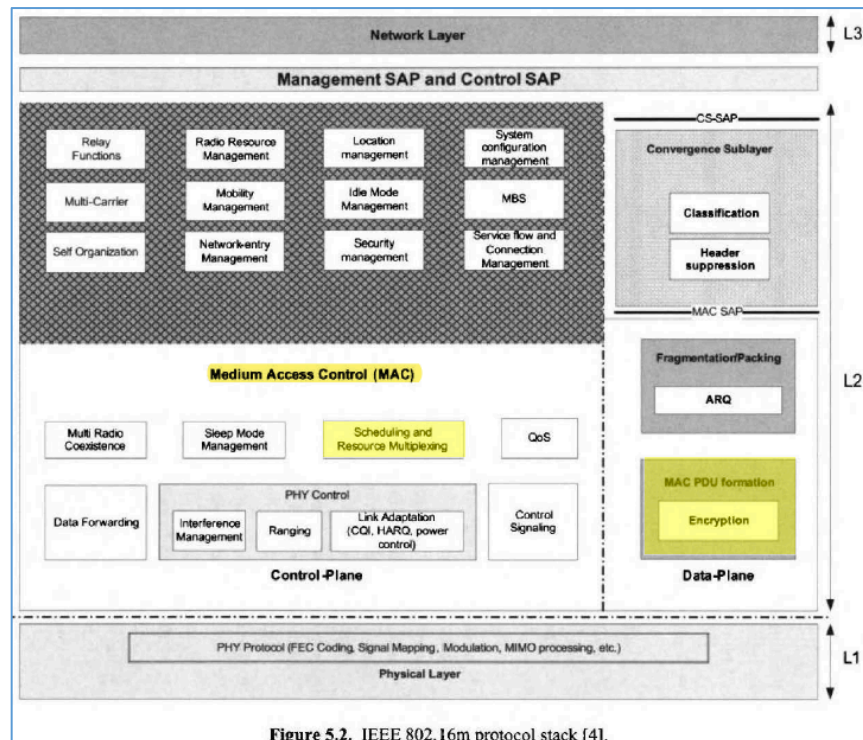
52. As a further example, it has been known in WiMAX systems to employ MAC-layer frames to provide frequency-time resource allocation in both DL and UL on a per-frame basis. EX-1016, 19-22.



EX-1016, 19.

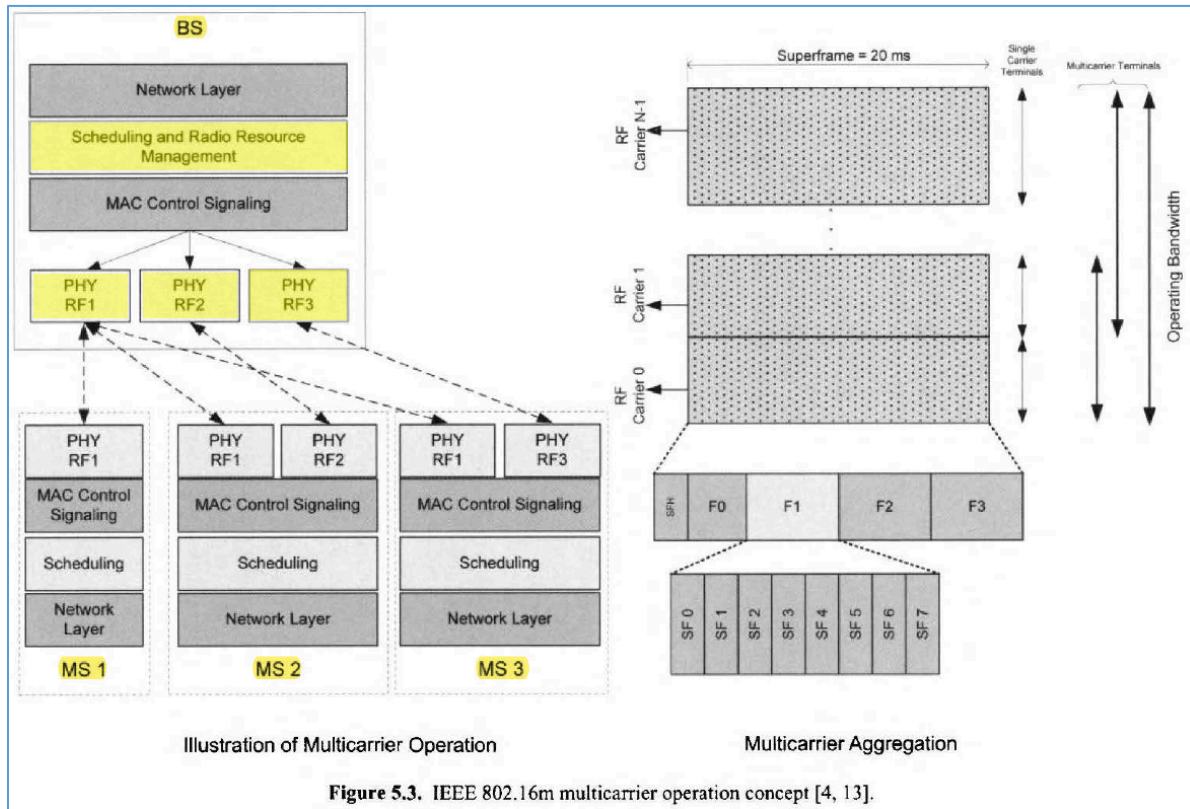
53. As the name suggests, medium access control (MAC) has been known to provide and transmit access control related function and information.

54. It also has been known that the MAC layer has multiple planes. A WiMAX system existing in 2010 provides scheduling and resources in the MAC physical plane, and MAC protocol data unit (MPDU) formation in the MAC data plane. EX-1017, 92-100, Figure 5.2.



EX-1017, 96.

55. Specifically, a base station has been known to allocate specific resources and acknowledgement policy to each of multiple users. EX-1017, 92-100, Figure 5.3.



EX-1017, 98.

The medium access control functional group includes functional blocks that are related to **physical layer and link controls** such as:

- **PHY control.** This block performs PHY signaling such as ranging, channel quality measurement/feedback (CQI), and HARQ **ACK or NACK signaling**.

- **Control signaling.** This block generates **resource allocation messages** such as an advanced medium access protocol (A-MAP) as well as specific control signaling messages.
- **Sleep mode management.** This block handles sleep mode operation and generates management messages related to sleep operation. It may communicate with the scheduler block in order to operate properly according to sleep period.
- **Quality-of-service (QoS).** This block performs rate control based on QoS input parameters from the connection management function for each connection.
- **Scheduling and resource and multiplexing.** This block schedules and multiplexes packets based on properties of connections.

The data plane includes functional blocks such as:

- **Fragmentation/packing.** This block performs fragmentation or packing of MAC service data units (MSDU) based on input from the scheduling and resource multiplexing block.
- **Automatic repeat request (ARQ).** This block performs the MAC ARQ function. For ARQ-enabled connections, a logical ARQ block is generated from fragmented or packed MSDUs of the same flow and sequentially numbered.
- **MAC protocol data unit (PDU) formation.** This block constructs the MAC PDU (MPDU) such that the BS/MS can transmit user traffic or management messages into PHY channels.

EX-1017, 95, 97.

56. As a further example, Chu806 discloses an AP to allocate different OFDM data units to different STAs and generate an OFDMA data unit that includes the different OFDM data units as allocated to STAs, such that the

allocated OFDM data units are modulated in respective sub-channel blocks of the OFDMA data unit. *See* EX-1004, 7:6-25; FIG. 3.

In an embodiment, the AP 14 is configured to transmit different OFDM units to different client stations 25 simultaneously by forming an OFDMA data unit that includes the different OFDM data units modulated in respective sub-channel blocks of the OFDMA data unit. In an embodiment, the AP 14 allocates different sub-channels to different client stations and forms the OFDMA data unit that includes OFDM data units directed to by modulating the different client stations in sub-channel blocks corresponding to the sub-channels assigned to the client stations. In an embodiment, when the one or more client stations include a legacy client station, the AP assigns a channel that includes a primary channel of the WLAN 10 to the legacy client station, and assigns one or more non-primary communication channels of the WLAN 10 to one or more non-legacy client stations. When the one or more client stations do not include any legacy client stations, the AP assigns the primary and the non-primary communication channels in any suitable manner to the one or more client stations, in various embodiments.

EX-1004: 7:6-25.

57. Chu806 also discloses that “[i]n an embodiment, each of one or more of the OFDM data units 302 is an aggregate MAC service data units (A-MPDU) (e.g., a very high throughput (VHT) A-MPDU, an HEW MPDU, or another suitable aggregated data unit).” EX-1004, 8:62-67.

C. DL MU-MIMO & UL MU-MIMO Transmissions

58. As noted above, a base station has been known to provide simultaneous DL transmissions to multiple users. ¶¶37-49. For example, Figure 9.1 and Figure 9.2 of Nee illustrates that users a and b can utilize different sub-carriers during the same time slot to transmit concurrently to a base station. EX-1015, 213-212, Figure 9.1, Figure 9.2.

59. For example, WiMAX systems were known to provide DL MIMO and UL MIMO transmission.

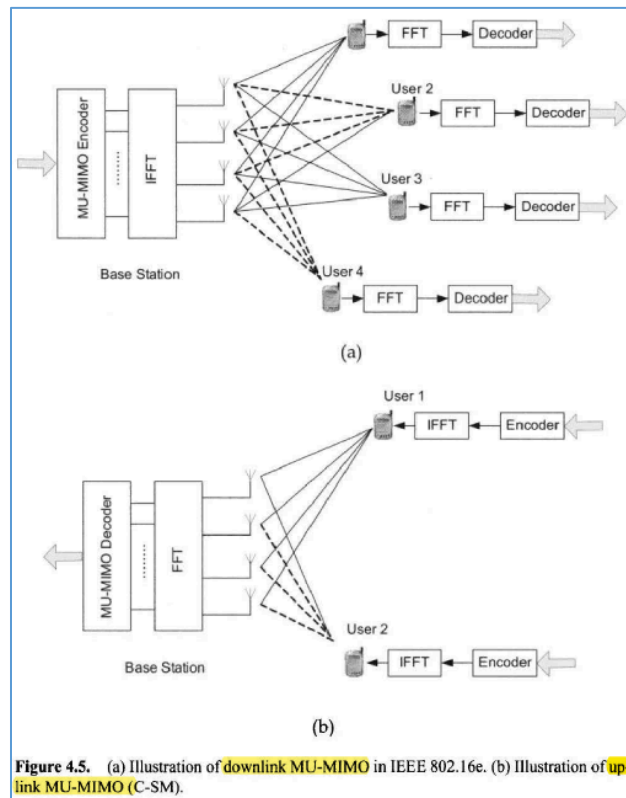
DL/UL Ratio			1:0	3:1	2:1	3:2	1:1	0:1
User Peak Rate (Mbps)	SIMO (1x2)	DL	31.68	23.04	20.16	18.72	15.84	0
		UL	0	4.03	5.04	6.05	7.06	14.11
	MIMO (2x2)	DL	63.36	46.08	40.32	37.44	31.68	0
		UL	0	4.03	5.04	6.05	7.06	14.11
Sector Peak Rate (Mbps)	SIMO (1x2)	DL	31.68	23.04	20.16	18.72	15.84	0
		UL	0	4.03	5.04	6.05	7.06	14.11
	MIMO (2x2)	DL	63.36	46.08	40.32	37.44	31.68	0
		UL	0	8.06	10.08	12.10	14.12	28.22

Table 6: Data Rates for SIMO/MIMO Configurations⁶
(For 10 MHz channel, 5 ms frame, PUSC sub-channel, 44 data OFDM symbols)

⁶ Peak rate is often used to describe channel capacity and is a good metric for comparative purposes. It should be noted however, that in practice the achievable peak data rates may be lower due to the specific traffic, propagation, and interference conditions encountered.

EX-1016, 26.

60. See also EX-1017, 83-86 (“IEEE 802.16e supports basic MU-MIMO operations in both downlink and uplink”), Figure 4.5.



EX-1017, 84.

61. As a further example, Chu806 provides an exemplary OFDMA data unit that can be transmitted as a DL MU frame or an UL MU frame. Besides being transmitted as DL OFDMA data unit, Chu806 explains the OFDMA data unit may be transmitted by the multiple STAs as a UL OFDMA data unit to the AP. *See* EX-1004, 7:58-8:23; FIG. 3. (EX-1004, 8:13-23: “an embodiment in which the OFDMA data unit 300 corresponds to an uplink OFDMA data unit, the AP 14 receives the OFDM data units 302 via respective sub-channels of the WLAN 10 allocated for uplink transmission of the OFDM data units 302 from the client stations, in an embodiment. For example, the OFDM data unit 302-1 is transmitted via a first 20 [MHz] sub-channel of the [WLAN] 10, the OFDM data unit 302-2 is transmitted via a second 20 MHz sub-channel of the WLAN 10, and the OFDM data unit 302-3 is transmitted via a 40 MHz sub-channel of the WLAN 10, in the illustrated embodiment.”).

D. '520 Inventors' Admitted Prior 'Resource Units' Allocation

62. Similarly, as acknowledged by the inventors in the Background Section in the related European Patent Application EP3,275,113B1 (“EP '113 Appln”), MIMO techniques were already well known in the art at the time of the '520 Patent. *See* EX-1013, [0003]. Particularly, it was known that “an [AP] may transmit a single [DL OFDMA] frame that assigns particular resource units (RUs) to separate [STAs] in the wireless system. Each RU may include data and/or

control information that is intended for a [STA] or a set of [STAs].” EX-1013, [0002]. For example, EP ’113 Appln cited as the example by “U.S. application 2010/0310003 A1 (LAUER, Joseph Paul et al.), published December 09, 2010, discloses methods and devices for coordinating the transmission of acknowledgment messages by a plurality of [STAs] in a wireless network using MU-MIMO, OFDMA, or both. Respective instructions for each [STA] for coordinating the acknowledgment messages are included in a DL MU packet.” EX-1013, [0004]. *See also* EX-1007.

EP 3 275 113 B1	
Description	
TECHNICAL FIELD	
[0001] The present description relates in general to wireless communication systems and methods, and more particularly to, for example, without limitation, systems and methods for multi-user transmission of response frames.	
BACKGROUND	
[0002] Wireless local area network (WLAN) devices are deployed in diverse environments. These environments are generally characterized by the existence of access points and non-access point stations. In some systems, stations may utilize multi-user (MU) transmissions to more efficiently communicate data. In particular, an access point may transmit a single downlink (DL) Orthogonal Frequency Division Multiple Access (OFDMA) frame that assigns particular resource units (RUs) to separate stations in the wireless system. Each RU may include data and/or control information that is intended for a single station or a set of stations.	
[0003] Although described in relation to OFDMA, MU transmissions may be implemented through the use of Multiple-Input and Multiple-Output (MIMO) techniques. MU-MIMO techniques utilize multiple transmit and receive antennas to exploit multipath propagation. MIMO may be used separately or jointly with OFDMA to transmit data and control information in both the downlink and uplink directions.	
[0004] It should be noted that different multi-user (MU) transmission techniques are already known. For example, the U.S. application 2010/0220654 A1 (WENTINK, Maarten Menzo), published on September 02, 2010, discloses methods and devices that allow a single access point to perform, through a single time and frequency resource, a plurality of simultaneous communications with a plurality of respective stations using Spatial Division Multiple Access (SDMA). This document discloses using a plurality of antennas to transmit a plurality of spatially-distinct symbol streams to respective stations using SDMA, and that the stations then simultaneously transmit a plurality of block acknowledgement (BA) frames using SDMA, each BA frame on its own spatial stream. Another US application 2013/0229996 A1 (WANG, Xiofei et al.), published on September 5, 2013, discloses methods and devices that allow an access point to perform, through a single time resource, a plurality of simultaneous communications with a plurality of respective stations by using separate frequency-domain channels for each station, that is, via Multi-User Parallel Channel Access (MU-PCA). In yet another example, the U.S. application 2010/0310003 A1 (LAUER, Joseph Paul et al.), published December 09, 2010, discloses methods and devices for coordinating the transmission of acknowledgment messages by a plurality of stations in a wireless network using MU-MIMO, OFDMA, or both. Respective instructions for each station for coordinating the acknowledgment messages are included in a DL MU packet.	

EX-1013, [0001]-[0004].

E. Dynamic and Efficient Resource Allocation

63. Moreover, the advantages of employing OFDMA technology and using a DL MU frame to indicate resource allocations to multiple STAs were widely known and widely employed. For example, the OFDMA system was known to provide dynamic channel allocation with MAC. EX-1015, 218, 225-226.

The following summary shows some advantages of the proposed OFDMA system:

- Use of frequency-hopping OFDMA for interference averaging and frequency diversity;
- Time-division duplex MAC with dynamic channel allocation used for unpaired spectrum allocations, asymmetrical services, and unlicensed usage;
- Straightforward and efficient high bit rate support by allocating more subcarriers and/or timeslots;
- Small guard band requirements at approximately 100 kHz;
- No frequency planning option available; effective re-use factor of 1;
- GSM backwards compatibility; and
- Minimum bandwidth requirements for system deployment only 1.6 MHz (or less) and deployment possible in steps of 100kHz.

EX-1015, 218.

64. *See also, e.g.,* EX-1016, 22 (“the MAC scheduler to make an efficient resource allocation and provide the desired QoS in the UL”; “Dynamic Resource Allocation... The resource allocation is delivered in MAP messages at the beginning of each frame. Therefore, the resource allocation can be changed frame-by-frame in response to traffic and channel conditions.”); *Id.*, 34 (“The MAP messages allow flexible control of resource allocation...to improve spectral efficiency and QoS.”).

65. As a further example, Chu806 discloses an AP to allocate different OFDM data units to different STAs and generate an OFDMA data unit that

includes the different OFDM data units as allocated to STAs, where the allocated OFDM data units are modulated in respective sub-channel blocks of the OFDMA data unit. *See* EX-1004, 7:6-25; FIG. 3.

In an embodiment, the AP 14 is configured to transmit different OFDM units to different client stations 25 simultaneously by forming an OFDMA data unit that includes the different OFDM data units modulated in respective sub-channel blocks of the OFDMA data unit. In an embodiment, the AP 14 allocates different sub-channels to different client stations and forms the OFDMA data unit that includes OFDM data units directed to by modulating the different client stations in sub-channel blocks corresponding to the sub-channels assigned to the client stations. In an embodiment, when the one or more client stations include a legacy client station, the AP assigns a channel that includes a primary channel of the WLAN 10 to the legacy client station, and assigns one or more non-primary communication channels of the WLAN 10 to one or more non-legacy client stations. When the one or more client stations do not include any legacy client stations, the AP assigns the primary and the non-primary communication channels in any suitable manner to the one or more client stations, in various embodiments.

EX-1004: 7:6-25.

F. IEEE Standardization of WLAN Communication Systems

66. WLAN communications systems were well known in the art at the time of the '520 Patent and were in use and standardized. For example, the OFDM technique has been adopted by the Institute for Electrical and Electronics Engineers (IEEE) 802.11 since at least 1999. EX-1015, 4-5; 27 [24]. The IEEE had adopted 802.11ac since 2012 and fully by 2014.¹ *See also* EX-1011.

¹ "IEEE 802.11ac-2013, IEEE Standard for Information technology--Telecommunications and information exchange between systems--Local and metropolitan area networks--Specific requirements--Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications--Amendment 4: Enhancements for Very High Throughput for Operation in Bands

67. The IEEE set up a study group for High-Efficiency Wireless in May 2013, and subsequently approved the 802.11 Task Group ax in May 2014. EX-1012.

68. The 802.11 Task Group ax was chaired by a Huawei Technologies representative, co-vice-chaired by a Broadcom Ltd. representative and a Qualcomm representative, and comprised of representatives from other entities such as NTT, Intel, Cisco, Realtek and Ericsson. EX-1012; EX-1018.

69. Notably, it was known that the 802.11 Task Group ax had discussed testing of DL-OFDMA Data + UL-MU-MIMO ACK since at least July 2014. EX-1018.

July 2014		doc.: IEEE 802.11-14/0855r0
Transmission duration comparison		
• What is the best way to send 4 downlink frame to 4 clients, in an 80 MHz BSS, where each frame carries 90 octets?		
Technique ID	Technique	Medium time (see notes)
0	Aggregation with other traffic to the same RA	Disallowed due to traffic pattern
1	Explicit sounding + DL-MU-MIMO Data + polled BAs	≥ 846 us
2	4 * Data+Ack	456 us
3a	PSMP (SIFS)	462 us
3b	PSMP (RIFS)	350 us
4	DL-OFDMA Data + UL-MU-MIMO Ack	142 us
5	DL-OFDMA Data + UL-OFDMA Ack	114 us

Submission Slide 3 Brian Hart (Cisco Systems)

Large available gains!

EX-1018 (July 2014), 3.

below 6 GHz,” was published by the IEEE on December 18, 2013.
<https://standards.ieee.org/ieee/802.11ac/4473/>, retrieved on March 30, 2023.

70. It also was known that the 802.11 Task Group ax had discussed AP to notify multiple STAs about available resources and to solicit UL MU transmissions simultaneously from the STAs since at least July 2014. *See*, e.g., EX-1019, EX-1020.

November 2013 doc.: IEEE 11-13/1388r0

MAC Feasibility Check

- **DL-dependant UL frame**
 - Users already know the transmission timing and resource because UL data followed by DL transmission. The DL transmission contains UL scheduling information implicitly or explicitly.
 - Therefore there is little scheduling overhead. But the usage is limited.
 - e.g. UL MU ACK in response of DL-MU-MIMO frame
 - e.g. UL MU Sounding in response of DL NDP frame

< An example of DL-dependant UL frame >

Submission Slide 14 Jinyoung Chun et. al, LG Electronics

EX-1019 (November 2013), 14.

July 2014 doc.: IEEE 11-14/0802r0

Procedure of UL MU transmission

- **AP's scheduling**
 - For STAs to transmit UL data frame simultaneously, AP has to set TXOP and let each STA know its own resource such as frequency band in FDM and stream index in SDM.
- Therefore, we suggest the procedure of UL MU transmission as below.

Submission Slide 3 Jinyoung Chun et. al, LG Electronics

EX-1020 (July 2014), 3.

71. See also EX-1021 (“UL multi-user transmission was discussed in previous meetings, including UL MU-MIMO and UL OFDMA” in Sep 2014.)

September 2014	doc.: IEEE 802.11-14/1190r2
Background	
• In the 11ax PAR, it is said that “the project may include the capability to handle multiple simultaneous communications in both the spatial and frequency domains, in both the uplink (UL) and downlink (DL) direction”, [1]. – DL MU-MIMO has already been supported in 11ac. – UL multi-user transmission was discussed in previous meetings, including UL MU-MIMO and UL OFDMA. – UL MU transmission is identified as a candidate technology to improve the network efficiency in dense deployment case. • The feasibility of supporting OFDMA and UL MU-MIMO has been analyzed in [2] and [3].	
ubmission	Slide 2 Kaiying Lv (ZTE)

EX-1021 (September 2014), 2.

72. By September 2014, it also was known that the 802.11 Task Group ax had discussed AP’s responsibility in UL MU transmission, including “schedule for or trigger a UL MU transmission,” and “resource allocation.” EX-1021.

September 2014	doc.: IEEE 802.11-14/1190r2
Analysis	
• AP’s responsibility in UL MU transmission – Schedule for or trigger a UL MU transmission – Poll multiple STAs’ UL data and feedback ACK to multiple STAs. – Initiate the error recovery procedure when needed – Provision assistant information for UL MU transmission control • Power control • Time and frequency synchronization • STA’s responsibility in UL MU transmission – Send UL PPDU as indicated by AP – Perform power/time/frequency adjustment – Obey the transmission duration as indicated by AP • Easy for AP to control the transmission within the TXOP limit • Easy for AP to acknowledge multiple STAs at the same time	
ubmission	Slide 5 Kaiying Lv (ZTE)

EX-1021, 5.

September 2014	doc.: IEEE 802.11-14/1190r2	
Conclusion • UL MU TXOP needs a new scheme to allow flexible UL MU transmission. • In this proposal, we discussed a new control scheme with a multi-user BA+Poll frame – to achieve the acknowledgement, polling and resource allocation , error indication and assistant UL transmission control indication. – to provide the scheme with minimum overhead – to keep compatibility with legacy devices		
Submission	Slide 11	Kaiying Lv (ZTE)

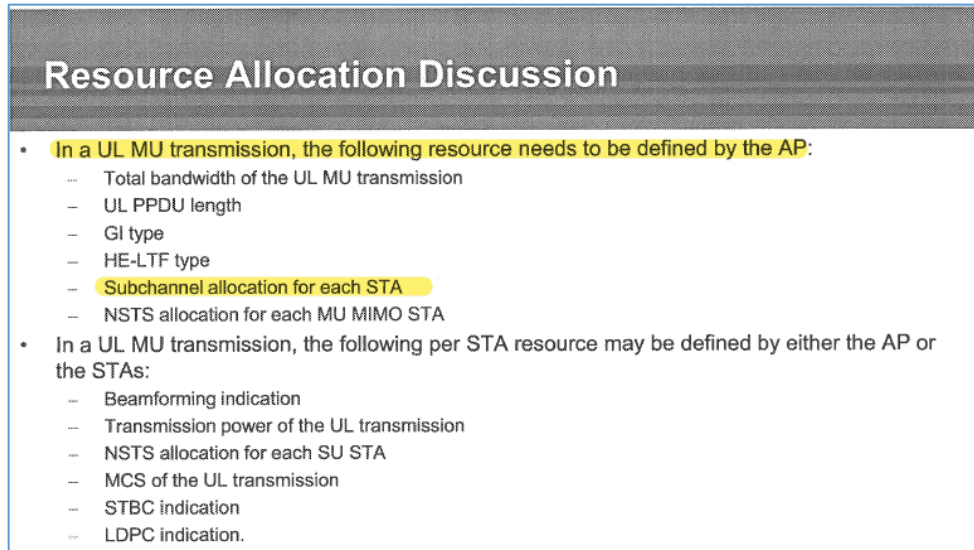
EX-1021, 11.

73. Further, as reflected in Provisional Application No. 62/088,257 filed in the U.S. on December 5, 2014, it was known that a group may have agreed on “a basic resource unit of 26 tones...for OFDMA transmission.” EX-1014, 15.

Subchannel Allocation • A basic resource unit of 26 tones are agreed for OFDMA transmission. • The subchannel allocation bitmap consists of one or multiple subchannel allocation codes, each code corresponds to an OFDMA subchannel that is allocated to a single STA if not using MU MIMO or to multiple STAs if using MU MIMO. – the continuous “1” or “0” sub bitmap indicates the subchannel allocation for a STA. • There is a deterministic mapping between the subchannel allocation codes and the allowed subchannel allocation sizes.
--

EX-1014, 15.

74. It also was known that an AP might allocate resources units, such as subchannel allocations, to multiple STAs. *See*, for example, EX-1014.



EX-1014, 13.

75. Moreover, the advantages of having an AP to coordinate available resources for multiple receiving STAs were widely known and widely employed. For example, each of Chu806, Merlin, and Shu describes that it was known that an AP may be configured to accommodate a first protocol and a second, legacy communication protocol. Chu806 teaches that the AP is configured to operate with a first set of STAs according to a first communication protocol and with a second set of STAs according to another communication protocol while increasing the efficiency in frame exchanges. EX-1004, 5:31-45. Similarly, Merlin teaches that an AP is configured to communicate with current STAs and legacy STAs, thereby extending the lifetime of an older version of STAs while introducing newer STAs.

EX-1005, 8:18-24. Merlin's disclosure also addresses protocol rules and enables efficient frame exchange sequences. EX-1005, 5:34-38. *See also* EX-1006, [0067].

76. At least in view of the foregoing, simultaneous transmissions for multiple users using different frequency sub-carriers and resource allocations in a DL MU frame to solicit UL MU response frames from multiple users had been well-known long before the effective filing date of the '520 Patent. The '520 Patent simply applies the well-known method to a well-known system (OFDMA, resource allocation in a DL MU frame (MAC layer), and UL MU response transmissions).

VII. TECHNOLOGY BACKGROUND

77. This section discusses a number of key technologies as encompassed by the art discussed in this Declaration.

A. Frame/MPDU

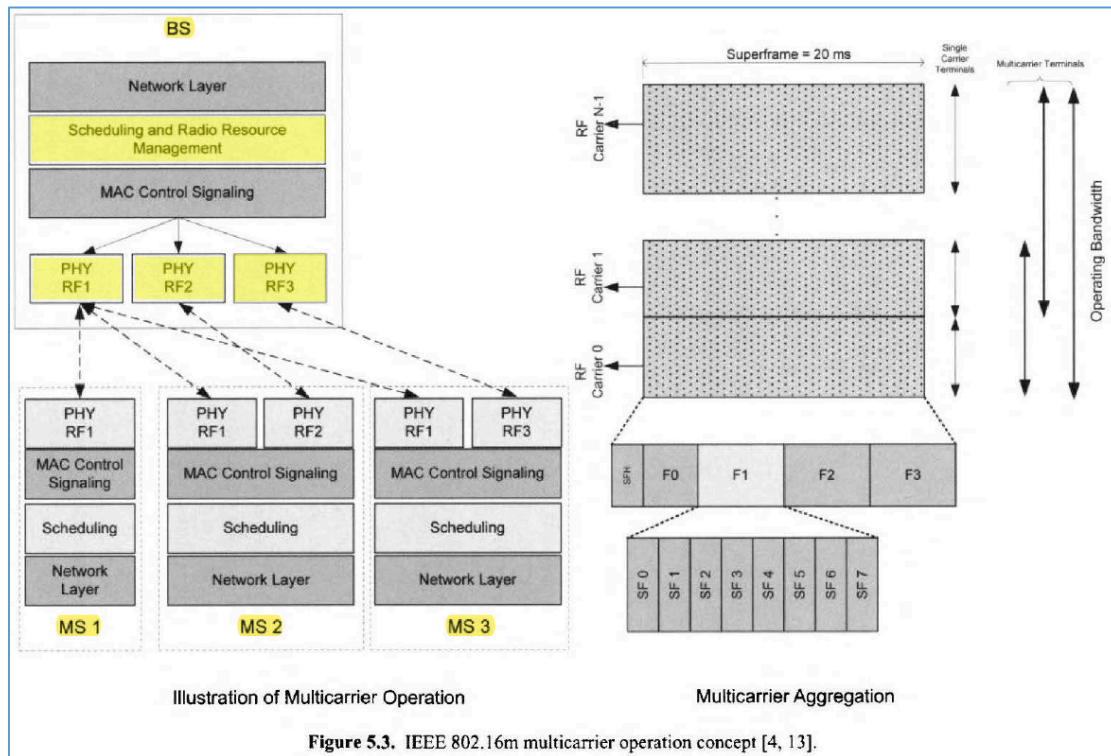
78. This section discusses certain frame formats used in wireless communications and known before the effective filing date of the '520 Patent.

79. One aspect of technology standardization is to provide interoperability among devices (whether or not manufactured by the same entity). *See, e.g.,* EX-1015, 4-5. In other words, standardization may provide a specified manner typically from among already existing/available techniques for devices to communicate with one another, such as frame formats.

5
available since mid 1999. An industry alliance called the Wireless Ethernet Compatibility Alliance (WECA) has been established to promote the high rate IEEE 802.11 technology and to certify interoperability of products from different vendors [23]. The second IEEE 802.11 standard extension targets a range of data rates from 6 up to 54 Mbps using OFDM in the 5-GHz band [24]. The OFDM standard was developed jointly with ETSI BRAN and MMAC, making OFDM effectively a worldwide standard for the 5-GHz band.

EX-1015, 5.

80. For example, it has been known that the wireless transmission may be conceptualized in layers, such as a network layer, a MAC layer, and a physical (PHY) layer. EX-1017, 92-100, Figure 5.3.



EX-1017, 98.

81. In connection with transmissions on MAC layer, it has been known to generate resource allocation messages to be transmitted in the MAC layer and form a MAC protocol data unit (MPDU) to include such control messages. EX-1017, 92-100, Figure 5.3.

- **Control signaling.** This block generates **resource allocation messages** such as an advanced medium access protocol (A-MAP) as well as specific control signaling messages.
- **Sleep mode management.** This block handles sleep mode operation and generates management messages related to sleep operation. It may communicate with the scheduler block in order to operate properly according to sleep period.
- **Quality-of-service (QoS).** This block performs rate control based on QoS input parameters from the connection management function for each connection.
- **Scheduling and resource and multiplexing.** This block schedules and multiplexes packets based on properties of connections.

The data plane includes functional blocks such as:

- **Fragmentation/packing.** This block performs fragmentation or packing of MAC service data units (MSDU) based on input from the scheduling and resource multiplexing block.
- **Automatic repeat request (ARQ).** This block performs the MAC ARQ function. For ARQ-enabled connections, a logical ARQ block is generated from fragmented or packed MSDUs of the same flow and sequentially numbered.
- **MAC protocol data unit (PDU) formation.** This block constructs the MAC PDU (MPDU) such that the BS/MS can transmit user traffic or management messages into PHY channels.

EX-1017, 95, 97.

82. Also, IEEE Std 802.11 specifies how devices exchange information over the MAC layer using frames. *See* EX-1011, 45.

4.2.5 Interaction with other IEEE 802[®] layers

IEEE Std 802.11 is required to appear to higher layers [logical link control (LLC)] as a wired IEEE 802 LAN. This requires that **the IEEE 802.11 network handle STA mobility within the MAC sublayer**. To meet reliability assumptions (that LLC makes about lower layers), it is necessary for IEEE Std 802.11 to incorporate functionality that is untraditional for MAC sublayers.

In a robust security network association (RSNA), IEEE Std 802.11 provides functions to protect **data frames**. IEEE Std 802.1X-2004 provides authentication and a Controlled Port, and IEEE Std 802.11 and IEEE Std 802.1X-2004 collaborate to provide key management. All STAs in an RSNA have a corresponding IEEE 802.1X entity that handles these services. This standard defines how an RSNA utilizes IEEE Std 802.1X-2004 to access these services.

When used to support applications with QoS requirements, each IEEE 802.11 LAN provides a link within an end-to-end QoS environment that may be established between, and managed by, higher layer entities. To handle QoS traffic in a manner comparable to other IEEE 802 LANs, the IEEE 802.11 QoS facility requires **the IEEE 802.11 MAC sublayers to incorporate functionality** that is not traditional for MAC sublayers. In addition, it may be necessary for certain higher layer management entities to be “WLAN aware” at least to the extent of understanding that the available bandwidth and other QoS characteristics of a WLAN are subject to frequent, and sometimes substantial, dynamic changes due to causes other than traffic load and are outside the direct control of network management entities.

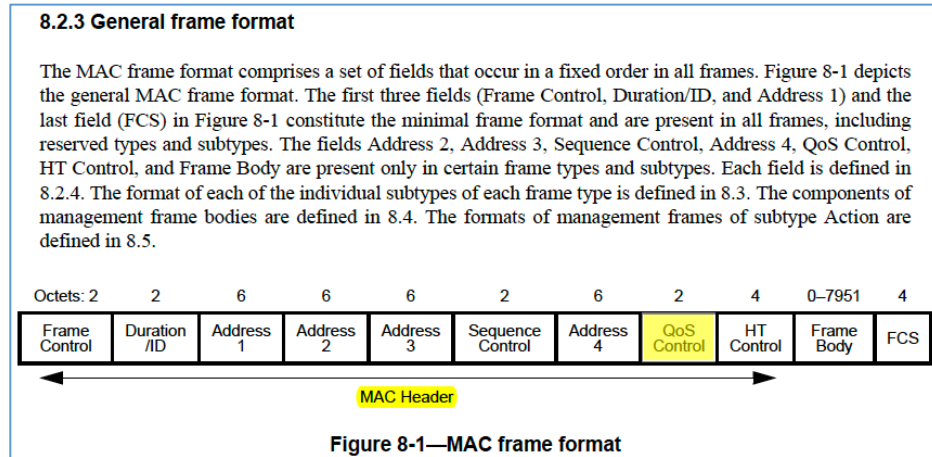
EX-1011, 45.

83. IEEE Std 802.11ac uses the term “MPDU” referring to MAC protocol data unit and as a synonym for “frame.” *See* EX-1011, 14.

medium access control (MAC) protocol data unit (MPDU): The unit of data exchanged between two peer MAC entities using the services of the physical layer (PHY). *Syn:* **frame.**

EX-1011, 14.

84. IEEE Std 802.11ac provides a general MAC frame format that has a MAC header. *See* EX-1011, 381.



EX-1011, 381.

85. IEEE Std 802.11ac also provides that a MAC header can include several fields, such as a QoS control field. *See* EX-1011, 380.

IEEE
Std 802.11-2012

LOCAL AND METROPOLITAN AREA NETWORKS—SPECIFIC REQUIREMENTS

8. Frame formats

8.1 General requirements

The format of the MAC frames is specified in this clause. A STA shall be able properly to construct a subset of the frames specified in this clause for transmission and to decode a (potentially different) subset of the frames specified in this clause upon validation following reception. The particular subset of these frames that a STA constructs and decodes is determined by the functions supported by that particular STA. All STAs shall be able to validate every received frame using the frame check sequence (FCS) and to interpret certain fields from the MAC headers of all frames.

A compliant STA shall transmit frames using only the frame formats described in Clause 8.

8.2 MAC frame formats

8.2.1 Basic components

Each frame consists of the following basic components:

- A **MAC header**, which comprises frame control, duration, address, optional sequence control information, optional QoS Control information (QoS data frames only), and optional HT Control fields (+HTC frames only);
- A variable-length *frame body*, which contains information specific to the frame *type* and *subtype*;
- A *FCS*, which contains an IEEE 32-bit CRC.

EX-1011, 380.

86. In addition, it has been known that the IEEE 802.11ac discusses using QoS control field to transmit acknowledgement policy or information. *See* EX-1011, 389-390.

8.2.4.5 QoS Control field								
8.2.4.5.1 QoS Control field structure								
The QoS Control field is a 16-bit field that identifies the TC or TS to which the frame belongs as well as various other QoS-related, A-MSDU related, and mesh-related information about the frame that varies by frame type, subtype, and type of transmitting STA. The QoS Control field is present in all data frames in which the QoS subfield of the Subtype field is equal to 1 (see 8.2.4.1.3). Each QoS Control field comprises five or eight subfields, as defined for the particular sender (HC or non-AP STA) and frame type and subtype. The usage of these subfields and the various possible layouts of the QoS Control field are described 8.2.4.5.2 to 8.2.4.5.12 and illustrated in Table 8-4. See 9.12.1 for constraints on the contents of the QoS Control field when present in an A-MPDU.								
Table 8-4—QoS Control field								
Applicable frame (sub) types	Bits 0–3	Bit 4	Bits 5–6	Bit 7	Bits 8	Bit 9	Bit 10	Bits 11–15
QoS CF-Poll and QoS CF-Ack+CF-Poll frames sent by HC	TID	EOSP	Ack Policy	Reserved	TXOP Limit			
QoS Data+CF-Poll and QoS Data+CF-Ack+CF-Poll frames sent by HC	TID	EOSP	Ack Policy	A-MSDU Present	TXOP Limit			
QoS Data and QoS Data+CF-Ack frames sent by HC	TID	EOSP	Ack Policy	A-MSDU Present	AP PS Buffer State			
QoS Null frames sent by HC	TID	EOSP	Ack Policy	Reserved	AP PS Buffer State			
QoS Data and QoS Data+CF-Ack frames sent by non-AP STAs that are not a TPU buffer STA or a TPU sleep STA in a nonmesh BSS	TID	0	Ack Policy	A-MSDU Present	TXOP Duration Requested			
	TID	1	Ack Policy	A-MSDU Present	Queue Size			

Table 8-4—QoS Control field (continued)								
Applicable frame (sub) types	Bits 0–3	Bit 4	Bits 5–6	Bit 7	Bits 8	Bit 9	Bit 10	Bits 11–15
QoS Null frames sent by non-AP STAs that are not a TPU buffer STA or a TPU sleep STA in a nonmesh BSS	TID	0	Ack Policy	Reserved	TXOP Duration Requested			
	TID	1	Ack Policy	Reserved	Queue Size			
QoS Data and QoS Data+CF-Ack frames sent by TPU buffer STAs in a nonmesh BSS	TID	EOSP	Ack Policy	A-MSDU Present	Reserved			
QoS Null frames sent by TPU buffer STAs in a nonmesh BSS	TID	EOSP	Ack Policy	Reserved	Reserved			
QoS Data and QoS Data+CF-Ack frames sent by TPU sleep STAs in a nonmesh BSS	TID	Reserved	Ack Policy	A-MSDU Present	Reserved			
QoS Null frames sent by TPU sleep STAs in a nonmesh BSS	TID	Reserved	Ack Policy	Reserved	Reserved			
All frames sent by mesh STAs in a mesh BSS	TID	EOSP	Ack Policy	A-MSDU Present	Mesh Control Present	Mesh Power Save Level	RSPI	Reserved

EX-1011, 389-390.

87. For example, it has been known that the IEEE 802.11ac discusses that QoS control field may be used to indicate and convey frame exchange rules, including acknowledgment policy or information. *See* EX-1011, 51-52.

4.3.7 QoS BSS: The QoS network

The IEEE 802.11 QoS facility provides **MAC enhancements** to support LAN applications with QoS requirements. The QoS enhancements are available to QoS STAs associated with a QoS access point in a QoS BSS. A subset of the QoS enhancements is available for use between STAs that are members of the same QoS IBSS. Similarly, a subset of the QoS enhancements is available for use between neighbor peer mesh STAs. A mesh BSS is one type of QoS BSS and it is described in 4.3.15. Because a nonmesh QoS STA implements a superset of STA functionality, as defined in this standard, the STA might associate with a non-QoS access point in a non-QoS BSS, to provide non-QoS MAC data service when there is no QoS BSS with which to associate. As a mesh STA does not implement the necessary service, the mesh STA does not associate with any access point.

The enhancements that distinguish QoS STAs from non-QoS STAs and QoS APs from non-QoS APs are collectively termed the *QoS facility*. Which of the QoS-specific mechanisms a QoS STA supports might vary among QoS implementations, as well as between QoS STAs and QoS APs, over ranges specified in subsequent clauses. All service primitives, **frame formats**, coordination function and **frame exchange rules**, and management interface functions except for the Block Acknowledgment (Block Ack) function, direct-link setup (DLS), and automatic power save delivery (APSD) **are part of the core QoS facilities**. A QoS STA or QoS AP implements those core QoS facilities necessary for its QoS functions to interoperate with other QoS STAs. Functions such as the Block Ack, DLS, and APSD are separate from the core QoS facilities; and the presence of these functions is indicated by STAs separately from the core QoS facilities.

EX-1011, 51.

VIII. LEVEL OF ORDINARY SKILL IN THE ART

88. As I explained above, the '520 Patent discloses a method by an AP to allocate resources to a plurality of STAs and coordinate the simultaneous UL transmission of acknowledgment messages by the STAs in a wireless network.

89. In my opinion, a POSITA in the relevant art, as of March 23, 2015, would have: (1) a bachelor's degree in electrical engineering or a closely related field, and (2) a minimum of 2-3 years of industry or academic experience with wireless communication physical layer protocols. However, an individual with an advanced degree in a relevant field, such as electrical engineering, would require less industry or academic experience (*e.g.*, 1-2 years).

IX. CLAIM CONSTRUCTION

90. I understand that the words of a claim are generally given their ordinary and customary meaning, which are the meanings that the terms would have to a POSITA in the relevant art at the time of the earliest priority claim. I further understand that the POSITA is deemed to have read the claim terms in the context of the entire patent and the prosecution history.

91. I understand that in IPR proceedings, the PTAB need only construe terms that are disputed, and then only to the extent necessary to resolve the controversy. I further understand that issues of indefiniteness are beyond the scope of the PTAB's authority to review.

92. Issues regarding definiteness aside, with the foregoing understanding, in my opinion, the following claim terms should be construed by the PTAB with the remaining claim terms to be given their ordinary and customary meaning.

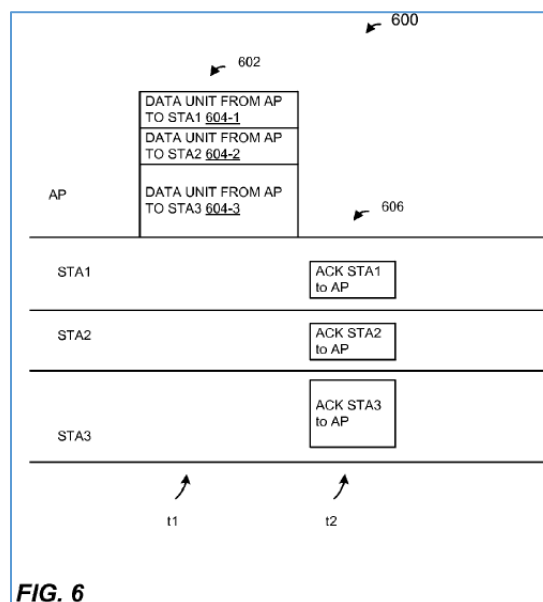
A. Claim preambles are limiting (claims 1, 8 and 18)

93. Each of claims 1, 8, and 18 refers to elements in their respective preamble and states such preamble element(s) in subsequent claim limitations. As such, it is my opinion that the preambles of claims 1, 8, and 18 are limiting. In addition, the Patent Owner had agreed in the WDTX proceeding that the claim preambles are limiting.

X. OVERVIEW OF THE PRIOR ART

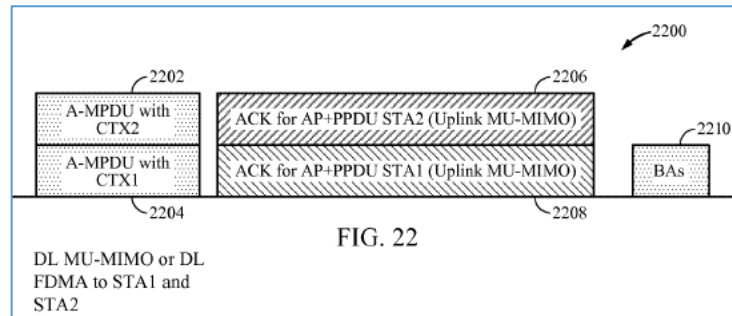
A. Chu806 discloses a method where an AP allocates resources to STAs in a DL MU frame and the STAs transmit UL acknowledgment simultaneously.

94. Chu806 discloses, *inter alia*, “a method for simultaneously communication with multiple communication devices in a [WLAN] includes allocating, by a first communication device, respective sub-channels of an [OFDM] channel to two or more second communication devices for [UL OFDMA] transmission from the two or more second communication devices,” and “receiving, at the first communication device, an [UL] OFDMA data unit that includes at least a first OFDM data unit from the first one of the two or more second communication devices and a second OFDM data unit from the second one of the two or more second communication devices.” EX-1004, 1:47-2:9; FIG. 6; FIG. 11C.



B. Merlin discloses a method where an AP allocates resources to STAs in a DL MU frame and the STAs transmit UL acknowledgment simultaneously.

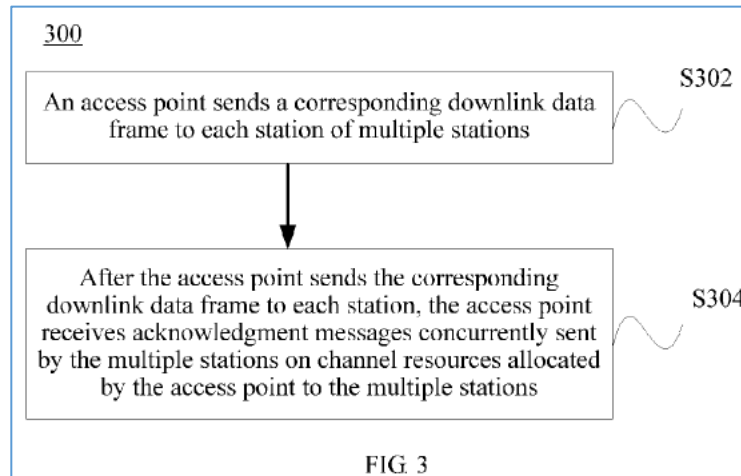
95. Merlin discloses frame structures and protocols for uplink (UL) multiple user (MU) frame exchanges. *See* EX-1005, 2:1-13, 28-42; 3:45-53; Fig. 22.



C. Shu discloses a method where an AP allocates resources to STAs in a DL MU frame and the STAs transmit UL acknowledgment simultaneously.

96. Shu is directed to wireless transmission method including “sending, by an access point, a corresponding downlink data frame to each station of the multiple stations; and receiving, by the access point after the access point sends the corresponding downlink data frame to each station, acknowledgment messages concurrently sent by the multiple stations on channel resources allocated by the access point to the multiple stations.” EX-1006, Abstract. As illustrated in Fig. 3, Shu discloses the step 304 where “the access point sends the corresponding downlink data frame to each station, the access point receives acknowledgment

messages concurrently sent by the multiple stations on channel resources allocated by the access point to the multiple stations.” EX-1006, [0054].



XI. DETAILED UNPATENTABILITY ANALYSIS

97. This section details my analysis of how claims of the '520 Patent are obvious and unpatentable. The claims discussed for each of four grounds in my analysis are shown in the following table:

Ground 1: Chu806	Ground 2: Merlin	Ground 3: Shu
1-20	1-20	1-20

A. Ground 1: Chu806 renders obvious Claims 1-20.

98. As set forth below, Chu806 renders Claims 1-20 obvious and unpatentable.

1. Claim 1.

- a. [1pre] A method, implemented by a network device in a wireless network, for coordinating an uplink multi-

user response transmission to a downlink multi-user transmission, the method comprising:

99. Chu806 discloses [1pre]. For example, Chu806 discloses a method implemented by an AP to “allocate[] respective sub-channels of an [OFDM] channel to...second communication devices for [UL OFDMA] transmission from the...second communication devices.” EX-1004, Abstract. Specifically, Chu806 discloses a communication method where an “AP is configured to operate with client [STAs] according to... 802.11 ax communication protocol.” EX-1004, 5:31-36; FIG. 1; FIG. 3; FIG. 6; FIG. 11C; FIG. 20A.

FIG. 1

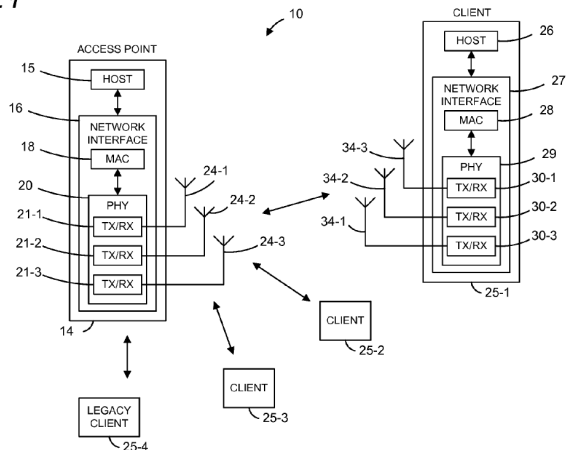
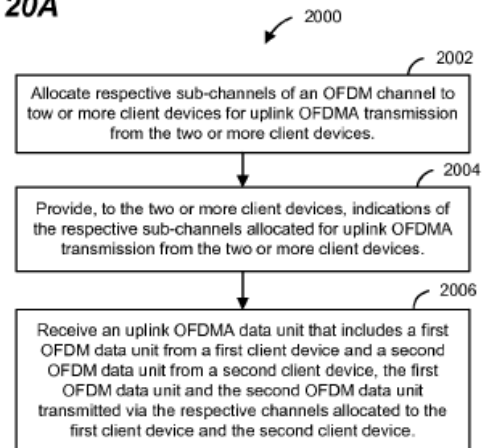


FIG. 20A



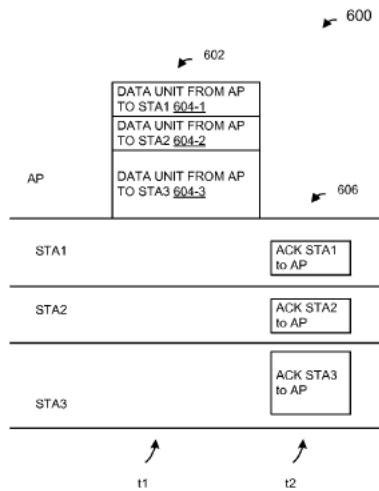


FIG. 6

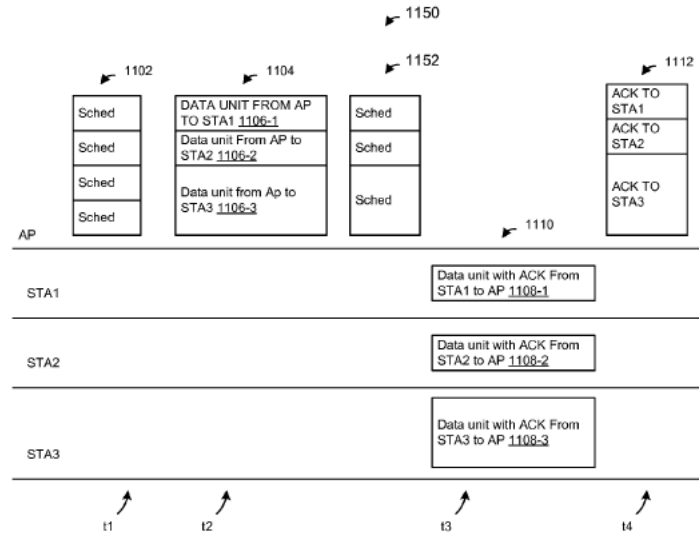


FIG. 11C

- b. [1a] generating, by the network device, a downlink multi-user frame addressed to a plurality of stations operating in the wireless network, the downlink multi-user frame including a plurality of resource units (RUs), wherein generating the downlink multi-user frame comprises:

assigning each RU of the plurality of RUs to a respective station in the plurality of stations, and

including a respective set of MAC Protocol Data Units (MPDUs) in each RU of the plurality of RUs,

wherein an MPDU in one or more of the RUs in the plurality of RUs includes acknowledgement information indicating properties of a multi-user acknowledgement transmission that the station in the plurality of stations to which the RU is assigned is requested to transmit to acknowledge the downlink multi-user frame;

100. Chu806 discloses or renders [1a] obvious. For example, Chu806 discloses that “the AP 14 allocates different sub-channels to different client [STAs]

and forms the OFDMA data unit that includes OFDM data units directed to by modulating the different client [STAs] in sub-channel blocks corresponding to the sub-channels assigned to the client [STAs].” EX-1004, 7:11-15.

101. Chu806 also illustrates an example OFDMA data unit in FIG. 3.

Chu806 discloses that “[t]he OFDMA data unit 300 includes a plurality of OFDM data unit 302-1, 302-2 and 302-3. In an embodiment, the AP 14 transmits the OFDM data units 302-1, 302-2, 302-3 to different client stations 25.... Each of the OFDM data units 302-1, 302-2, 302-3 conforms to a communication protocol that defines OFDMA communication, such as the HEW communication protocol... In an embodiment in which **the OFDMA data unit 300 corresponds to a [DL] OFDMA data unit**, the OFDMA data unit 300 is generated by the AP 14 such that each OFDM data unit 302 is transmitted to a respective client **station 25....**” EX-1004, 7:58-8:13 (emphasis added).

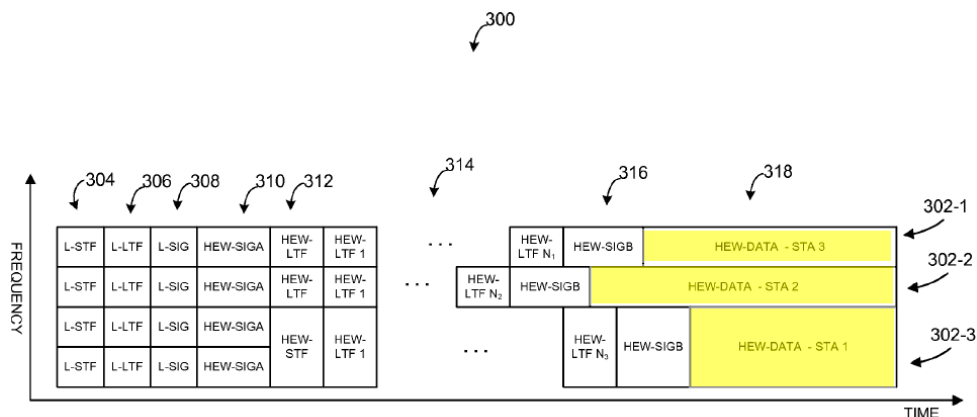


FIG. 3

102. As another example, Chu806 illustrates in FIG. 6, a DL frame including an OFDMA data unit 602 directed to multiple STAs, where the OFDMA data unit 602 includes respective OFDMA data units 604-1, 604-2, 604-3. EX-1004, 11:59-60; 12:28-34; FIG. 6.

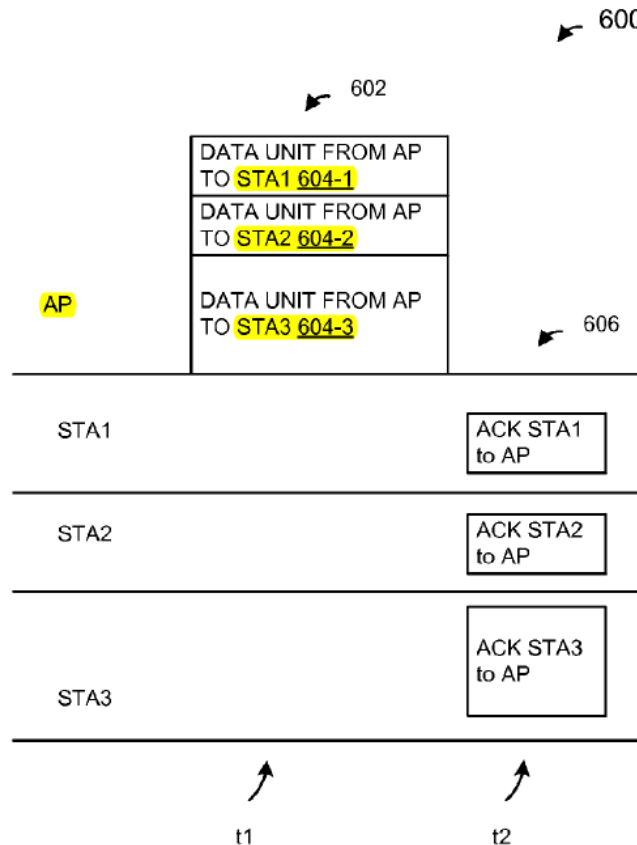


FIG. 6

103. Chu806 illustrates a further example in FIG. 11C, where AP generates and transmits a DL MU frame including an OFDMA data unit 1104 directed to multiple STAs. EX-1004, 23:28-64; 24:23-41; FIG. 11C.

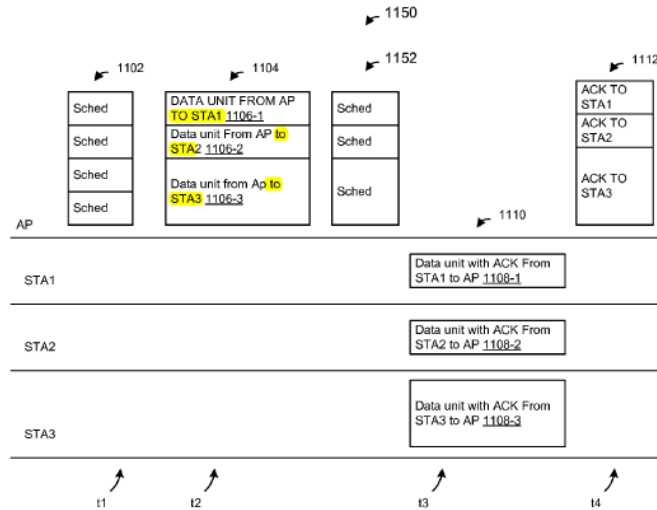


FIG. 11C

104. From at least Chu806’s disclosures of the OFDMA data unit generated by the AP to multiple STAs, a POSITA would readily understand that Chu806 discloses or renders obvious the [1a] limitation “generating, by the network device, a downlink multi-user frame addressed to a plurality of stations operating in the wireless network, the downlink multi-user frame including a plurality of resource units (RUs).”

105. Alternatively or in addition, particularly in view of the State of the Art, e.g., how OFDMA has been known to provide MU transmissions (*see* Section VI.A above), a POSITA would readily understand that the AP disclosed in Chu806 generates a DL MU frame addressed to multiple STAs, and that Chu806 discloses or renders obvious the [1a] limitation “generating, by the network device, a downlink multi-user frame addressed to a plurality of stations operating in the wireless network.”

106. In addition, Chu806 discloses that “[i]n an embodiment, the preamble of the OFDMA data unit [] includes **a channel allocation field.**” EX-1004, 12:28-34. For example, “[t]he channel allocation field indicates that the highest 20 MHz channel of the 80 MHz channel is allocated to the client station STA1, the second highest 20 MHz channel of the 80 MHz channel is allocated to the client station STA2... in the illustrated embodiment.” EX-1004, 12:55-61 (emphases added).

107. Chu806 also discloses that “the AP 14 allocates different sub-channels to different client [STAs] and forms the OFDMA data unit that includes OFDM data units directed to by modulating the different client [STAs] in sub-channel blocks corresponding to the sub-channels assigned to the client [STAs].” EX-1004, 7:11-15.

108. From at least Chu806’s disclosures of sub-channel allocation and a channel allocation field in a OFDMA data unit by the AP, a POSITA would readily understand that the AP disclosed in Chu806 generates a DL MU frame including a channel allocation field to reflect the sub-channel allocations to multiple STAs, and that Chu806 discloses or renders obvious the [1a] limitation “generating, by the network device, a downlink multi-user frame addressed to a plurality of stations operating in the wireless network, the downlink multi-user frame including a plurality of resource units (RUs), wherein generating the downlink multi-user

frame comprises: assigning each RU of the plurality of RUs to a respective station in the plurality of stations.”

109. In addition, Chu806 illustrates the channel resource allocation as OFDM ‘sub-channel blocks’ for STAs. *See* EX-1004, 7:26-42, FIGs. 2A-2C.

110. For example, Chu806 illustrates “[i]n FIG. 2A, the communication channel is partitioned into four contiguous OFDM sub-channel blocks, each having a bandwidth of 20 MHz. The OFDM **sub-channel blocks include independent data streams for four client stations.**” EX-1004, 7:28-31 (emphasis added).

111. From at least Chu806’s disclosures of the allocations of different sub-channels or sub-channel blocks to STAs, a POSITA would readily understand that the AP disclosed in Chu806 allocates and assigns each of the resources, such as sub-channels, to a respective one of the multiple STAs, and that Chu806 renders obvious the [1a] limitation “assigning each RU of the plurality of RUs to a respective station in the plurality of stations.”

112. Alternatively or in addition, particularly since the ’520 Patent inventors describe the phrase “resource units (RU)” used in the ’520 Patent may be “particular spatial streams or sub-channels” (Ex-1001, 14:12-14; 18:5-8; 20:48-50), a POSITA would readily understand that Chu806’s disclosed AP assigns ‘RUs’ to STAs, includes MPDUs in each ‘RU’, and includes ‘RUs’ in a DL MU OFDMA frame to the STAs.

113. Alternatively or in addition, particularly in view of the State of the Art, e.g., how it has been known to dynamically allocate resource units and the IEEE Standardization was known to discuss dynamic allocation of resource units (*see* Section VI.D-VI.F above), a POSITA would readily understand Chu806 discloses or renders obvious the [1a] limitation “assigning each RU of the plurality of RUs to a respective station in the plurality of stations.”

114. In addition, Chu806 discloses that the “AP 14 includes... a medium access control (MAC) processing unit 18 and a physical layer (PHY) processing unit 20.” EX-1004, 5:57-60; FIG. 1. Chu806 also discloses that the “AP is configured to operate with client [STAs] according to... **802.11 ax communication protocol**” (EX-1004, 5:31-36) (emphasis added).

115. Also, Chu806 teaches that “[i]n an embodiment, each of one or more of the **OFDM data units 302 is an aggregate MAC service data units (A-MPDU)** (e.g., a very high throughput (VHT) A-MPDU, an HEW MPDU, or another suitable aggregated data unit).” EX-1004, 8:62-67 (emphasis added). *See also* EX-1004, 8:67-9:4; FIG. 3.

116. Further as an example, Chu806 describes “in an embodiment... **the OFDM data units 604-1, 604-2, 604-3 are MPDUs.**” EX-1004, 13:22-24 (emphasis added). Particularly in view of Chu806’s disclosed components and available protocols for the AP 14, a POSITA would have recognized any Chu806’s

disclosed OFDMA data unit can correspond to MAC Protocol Data Unit (MPDU) under the 802.11ax protocol.

117. In view of Chu806's disclosed OFDMA data units being in MPDU or A-MPDU frame format, a POSITA would readily understand Chu806 discloses or render obvious the [1a] limitation "generating the downlink multi-user frame comprises... including a respective set of MAC Protocol Data Units (MPDUs) in each RU of the plurality of RUs."

118. As noted above, Chu806 specifically discloses that the AP 14 generates an OFDMA data unit that includes the different OFDM data units as allocated to STAs 25, where **the allocated OFDM data units are modulated in respective sub-channel blocks** of the OFDMA data unit. *See* EX-1004, 7:6-25 (emphasis added).

In an embodiment, the AP 14 is configured to transmit different OFDM units to different client stations 25 simultaneously by forming an OFDMA data unit that includes the different OFDM data units modulated in respective sub-channel blocks of the OFDMA data unit. In an embodiment, the AP 14 allocates different sub-channels to different client stations and forms the OFDMA data unit that includes OFDM data units directed to by modulating the different client stations in sub-channel blocks corresponding to the sub-channels assigned to the client stations. In an embodiment, when the one or more client stations include a legacy client station, the AP assigns a channel that includes a primary channel of the WLAN 10 to the legacy client station, and assigns one or more non-primary communication channels of the WLAN 10 to one or more non-legacy client stations. When the one or more client stations do not include any legacy client stations, the AP assigns the primary and the non-primary communication channels in any suitable manner to the one or more client stations, in various embodiments.

EX-1004: 7:6-25.

119. In addition, Chu806 discloses that “FIG. 3 is a diagram of an example OFDMA data unit 300, according to an embodiment.... In an embodiment, the **AP 14 transmits the OFDM data units 302-1, 302-2, 302-3 to different client stations 25 via respective OFDM sub-channels within the OFDMA data unit 300.**” EX-1004, 7:58-64 (emphasis added).

120. Chu806 discusses that “[i]n an embodiment, the OFDMA data unit 602 includes a plurality of OFDM data units 604 directed to respective client stations 25, **each OFDM data unit 604 transmitted in a respective sub-channel of the WLAN 10 to a particular client station 25.**” EX-1004, 12:9-13 (emphasis added).

121. From at least Chu806’s disclosures of modulating the allocated OFDM data units in respective sub-channel blocks of the OFDMA data unit and transmitting OFDM data units in the respective sub-channel allocated to each STA, a POSITA also would readily understand that the AP disclosed in Chu806 discloses or renders obvious the [1a] limitation “generating the downlink multi-user frame comprises: assigning each RU of the plurality of RUs to a respective station in the plurality of stations, and including a respective set of MAC Protocol Data Units (MPDUs) in each RU of the plurality of RUs.”

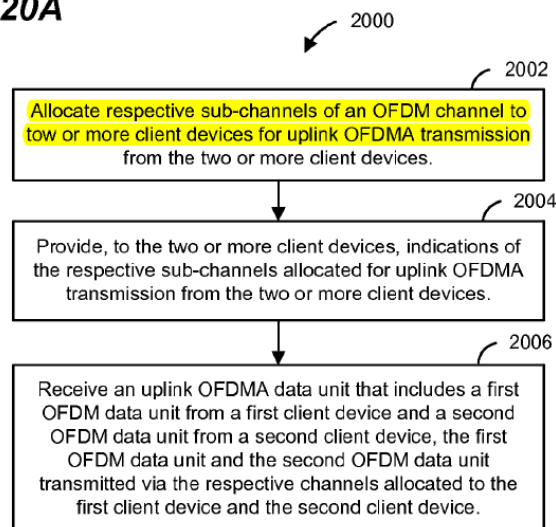
122. Alternatively or in addition, particularly in view of the State of the Art, e.g., how DL MU OFDMA frame has been known to dynamically allocate

resources (*see* Section VI.E above), a POSITA would readily understand Chu806 discloses or render obvious the [1a] limitation “generating the downlink multi-user frame comprises: assigning each RU of the plurality of RUs to a respective station in the plurality of stations, and including a respective set of MAC Protocol Data Units (MPDUs) in each RU of the plurality of RUs.”

123. In addition, Chu806 illustrates in FIG. 20A that “[a]t block 2002, respective sub-channels of an OFDM channel are allocated to two or more client devices for uplink OFDMA transmission from the two or more client devices.” *See* EX-1004, 37:8-11; FIG. 20A.

124. Chu806 further illustrates in FIG. 20A that “[a]t block 2004, indications of the respective two or more sub-channels allocated to the two or more client devices are provided to the two or more client devices.” *See* EX-1004, 37:11-13; FIG. 20A.

FIG. 20A



125. From at least Chu806's disclosures of the AP's allocations of different OFDM channels or sub-channels to STAs for uplink transmission, a POSITA would readily understand that the AP disclosed in Chu806 assigns each of the resources to a respective one of the STAs for the UL transmission by the STAs, and that Chu806 renders obvious the [1a] limitation "the plurality of RUs includes [] information indicating properties of a multi-user acknowledgement transmission that the station in the plurality of stations to which the RU is assigned is requested to transmit."

126. In addition, Chu806 discloses "[i]n an embodiment, client stations 25 that successfully receive data in the respective sub-channels allocated to the client stations 25 transmit respective acknowledgement (ACK or BlkAck) frames 606 to the AP 14," and "[i]n an embodiment, each client station 25 transmits its acknowledgement (ACK or BlkAck) frame 606 in the respective sub-channel allocated to the client station 25. EX-1004, 13:4-10.

127. Chu806 also discloses an example where "a PHY preamble or a **MAC header of the OFDM data unit** directed to the first client station **includes an ACK policy field** set to indicate that an immediate acknowledgement of the data unit is not required, in an embodiment. On the other hand, the OFDM data unit directed to the second client station indicates that an immediate acknowledgement is required, in an embodiment." EX-1004, 29:37-43 (emphases added).

128. From at least Chu806's disclosures of an ACK policy in a MAC header of the OFDM data unit² to STAs and acknowledgement frame transmission in the allocated sub-channels, a POSITA would readily understand that Chu806 discloses or renders obvious the [1a] limitation "generating, by the network device, a downlink multi-user frame addressed to a plurality of stations operating in the wireless network, the downlink multi-user frame including a plurality of resource units (RUs), wherein generating the downlink multi-user frame comprises: assigning each RU of the plurality of RUs to a respective station in the plurality of stations, and including a respective set of MAC Protocol Data Units (MPDUs) in each RU of the plurality of RUs, wherein an MPDU in one or more of the RUs in the plurality of RUs includes acknowledgement information indicating properties of a multi-user acknowledgement transmission that the station in the plurality of stations to which the RU is assigned is requested to transmit to acknowledge the downlink multi-user frame."

- c. **[1b] transmitting the downlink multi-user frame to the plurality of stations over a wireless channel; and**
- d. **[1c] receiving the uplink multi-user response transmission, the uplink multi-user response**

² A POSITA would readily understand Chu806's OFDM data units to be MPDUs. *See, for example, EX-1004, 8:62-67, 13:22-24, and Section VII (Background on Frame/MPDU).*

transmission including multi-user acknowledgement transmissions respectively and simultaneously transmitted by two or more stations in the plurality of stations,

129. Chu806 discloses [1b] and [1c]. Chu806 discloses that “the client [STAs] 25 are configured to receive corresponding **data streams that are transmitted simultaneously by the AP 14**. Additionally, two or more of the [STAs] 25 are configured to transmit corresponding data streams to the AP 14 such that **the AP 14 receives the data streams simultaneously.**” EX-1004, 6:3-8 (emphases added). For example, Chu806 illustrates in FIG. 6 that “[d]uring a time t1, the AP 14 transmits an OFDMA data unit 602 directed to a plurality of [STAs].” EX-1004, 11:59-60. Also, Chu806 discloses “[d]uring a time t2, in an embodiment, [STAs] 25 that successfully receive data in the respective sub-channels allocated to the [STAs] 25 transmit respective acknowledgement (ACK or BlkAck) frames 606 to the AP 14.” EX-1004, 13:4-8; FIG. 6.

130. From at least Chu806’s disclosures of simultaneous DL MU and UL MU transmissions, a POSITA would readily understand that Chu806 discloses or renders obvious the [1b] limitation and the [1c] limitation.

- e. **[1d] wherein the plurality of RUs respectively correspond to a plurality of simultaneous uplink transmissions, and each of the plurality of simultaneous uplink transmissions uses a sub-channel, spatial stream, or sub-channel and spatial stream combination that is not used by any other of the plurality of simultaneous uplink transmissions.**

131. Chu806 discloses [1d]. For example, Chu806 discloses that “the **AP 14 allocates different sub-channels to different client [STAs]** and forms the OFDMA data unit that includes OFDM data units directed to by modulating the different [STAs] in sub-channel blocks corresponding to the sub-channels assigned to the [STAs].” EX-1004, 7:11-15 (emphasis added). Further, Chu806 discloses that “**the AP 14 receives the OFDM data units 302 via respective sub-channels of the WLAN 10 allocated for uplink transmission** of the OFDM data units 302 **from the [STAs].**” EX-1004, 8:15-18 (emphases added). For example, Chu806 discloses that “each [STA] 25 transmits its acknowledgement (ACK or BlkAck) frame 606 in the respective sub-channel allocated to the [STA] 25” (EX-1004, 13:8-10), and that “[t]he channel allocation field indicates that the highest 20 MHz channel of the 80 MHz channel is allocated to the [] STA1, the second highest 20 MHz channel of the 80 MHz channel is allocated to the [] STA2... in the illustrated embodiment.” EX-1004, 12:55-61.

132. In addition, Chu806 illustrates the channel resource allocation as independent OFDM ‘sub-channel blocks’ for STAs. *See* EX-1004, 7:26-42, FIGs. 2A, 2B, and 2C.

133. For example, Chu806 illustrates “[i]n FIG. 2A, the communication channel is partitioned into four contiguous OFDM sub-channel blocks, each having a bandwidth of 20 MHz. The OFDM **sub-channel blocks include independent data streams for four client stations.**” EX-1004, 7:28-31 (emphasis added).

134. For the foregoing reasons, claim 1 of the ’520 Patent is unpatentable as anticipated by or obvious in view of Chu806.

2. Claim 2.

[2] The method of claim 1, wherein generating the downlink multi-user frame further comprises: including the acknowledgement information, for indicating properties of the multi-user acknowledgement transmission transmitted by each respective station in the plurality of stations to acknowledge the downlink multi-user frame, in a header of the one or more MPDUs.

3. Claim 3.

[3] The method of claim 2, wherein the header is a MAC header of the one or more MPDUs.

135. Chu806 discloses or renders [2] and [3] obvious. Specifically, Chu806 discloses “a PHY preamble or a MAC header of the OFDM data unit directed to the first [STA] includes an ACK policy field set to indicate that an immediate acknowledgement of the data unit is not required, in an embodiment.”

EX-1004, 29:37-41. For example, Chu806 discloses that “[d]uring a time t2, the AP 14 transmits OFDM data units 1406 as part of an OFDMA transmission 1404. In an embodiment, a preamble or a header of the OFDM data unit 1406-2... includes an indication that an immediate acknowledgement is not required for the OFDM data unit 1406-2. For example, **an ACK policy field in the PHY preamble or the MAC header of the OFDM data unit** 1406-2 indicates that an immediate acknowledgement is not required.” EX-1004, 30:21-30 (emphases added). A POSITA would readily understand Chu806’s disclosed OFDMA data unit to correspond to MPDU under the 802.11ax protocol. *See* Section XI.B.1.b (discussion of Limitation [1a]).

136. Accordingly, claim 2 and claim 3 are unpatentable as anticipated by or obvious in view of Chu806.

4. Claim 4.

[4] The method of claim 1, wherein one of the one or more MPDUs in each of the RUs of the plurality of RUs is a unicast trigger frame that contains the acknowledgement information for the respective station in the plurality of stations.

137. Chu806 discloses or renders [4] obvious. Chu806 discloses that “**WLANS operate in either a unicast mode or a multicast mode.**” EX-1004, 1:39-40 (emphases added).

138. Chu806 also discloses that “[t]he method further includes transmitting a scheduling frame to trigger transmission of the uplink OFDMA data unit, wherein the scheduling frame includes the respective indications of the respective sub-channels allocated to the two or more second communication devices,” and that “[t]he network interface is configured transmit a scheduling frame to trigger transmission of the uplink OFDMA data unit, wherein the scheduling frame provides the respective indications of the respective sub-channels allocated to the two or more second communication devices.” EX-1004, 38:31-35, 41:1-5.

139. For example, “the AP provides to the [STAs] 25 indications of different specific times at which to transmit their respective ACK frames 606, or a specific order in which to transmit their respective ACK frames 606, and the [STAs] 25 transmit the ACK frames 606 at the specific times or in the specific order indicated by the AP....” EX-1004, 13:38-42.

140. As a further embodiment, Chu806 discloses “in the frame exchange 1130 scheduling for the uplink OFDMA transmission 1110 is provided to the client stations 25 as part of the downlink OFDMA transmission 1134 to the client stations 25. For example, respective scheduling frames 1138 are appended to the OFDM data units 1106 of the OFDMA transmission 1134,” and “[a]s another example, respective scheduling frames 1138 are prepended to the OFDM data units 1106 of the OFDMA transmission 1134.” EX-1004, 23:60-66; 23:67-24:2.

141. Chu806 also discloses that “[i]n some embodiments, each scheduling frames 1134 includes scheduling information for each of STA1, STA2 and STA3.” EX-1004, 24:2-4. *See also* EX-1004; FIG. 11B.

142. In view of at least Chu806’s disclosures of UL scheduling information for all STAs in the DL OFDMA frame 1134, a POSITA also would readily understand that the AP disclosed in Chu806 to render obvious the [4] limitation.

143. Accordingly, claim 4 is unpatentable as anticipated by or obvious in view of Chu806.

5. Claim 5.

[5] The method of claim 4, wherein the trigger frame instigates each respective station in the plurality of stations to transmit the multi-user acknowledgement transmission after an interframe spacing period following receipt of the downlink multi-user frame.

144. Chu806 discloses or renders [5] obvious. Specifically, Chu806 discloses “[i]n various frame changes described above with respect to FIG. 6 and FIGS. 8-19, the time t1 generally at the beginning of a TXOP.... Subsequent times, such as time t2, time t3, time t4, etc. during which certain frames or data units are transmitted the AP 14 or the [STAs] 25, generally begin upon expiration of a predetermined time interval, such as a time interval corresponding to a short **inter-frame space** (SIFS), after completion of transmission or reception of the previous frame or data unit transmitted in the frame exchange.... Accordingly,

consecutive frames and data units in the described frame exchanges are generally separated, in time, by certain predetermined time intervals....” EX-1004, 34:31-46 (emphasis added).

145. Chu806 also illustrates time gap between the DL MU frame and the UL ACK frames, for example, in FIG. 6 (annotated below).

146. In addition, in view of at least Chu806’s disclosures of a time gap between DL and UL frames, a POSITA would readily understand that Chu806 discloses or renders obvious the [5] limitation “each respective station in the plurality of stations to transmit the multi-user acknowledgement transmission after an interframe spacing period following receipt of the downlink multi-user frame.”

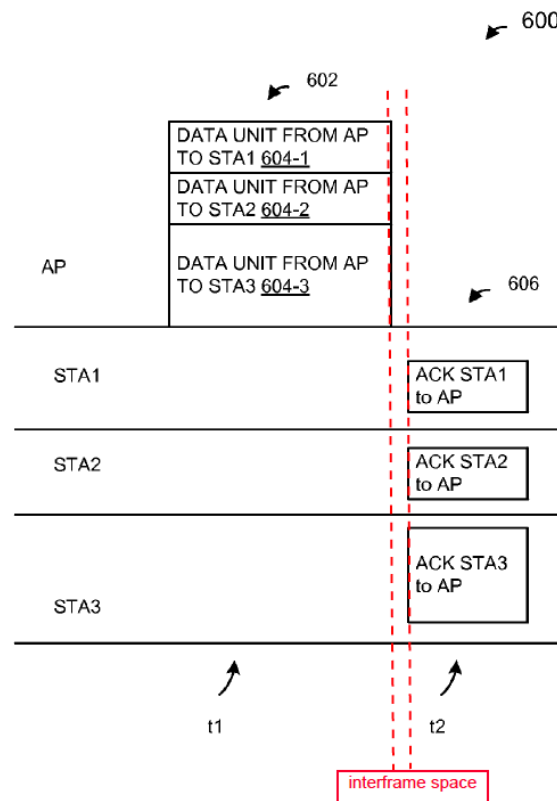


FIG. 6

147. Accordingly, claim 5 is unpatentable as anticipated by or obvious in view of Chu806.

6. Claim 6.

[6] The method of claim 1, further comprising:

generating, by the network device, a multi-user block acknowledgement request frame to solicit acknowledgements from two or more stations of the plurality of stations; and

transmitting the multi-user block acknowledgment request frame following transmission of the downlink multi-user frame.

148. Chu806 discloses or renders [6] obvious. For example, Chu806 discloses a further embodiment where “uplink scheduling information is provided to the client [STAs] 25 by respective separate scheduling frames 1152 transmitted as control frames separate from the OFDM data units 1104” (EX-1004, 24:27-30), and “the scheduling frames 1152 are transmitted to the [STAs] 25 as separate control frames that follow transmission of the respective OFDM data units 1106 to the [STAs] 25.” EX-1004, 24:32-38; FIG. 11C.

149. Also, as illustrated in FIG. 11C, Chu806 shows the scheduling frames being transmitted at the same time to STAs, and the acknowledgement frames transmitted at the same time from STAs to the AP.

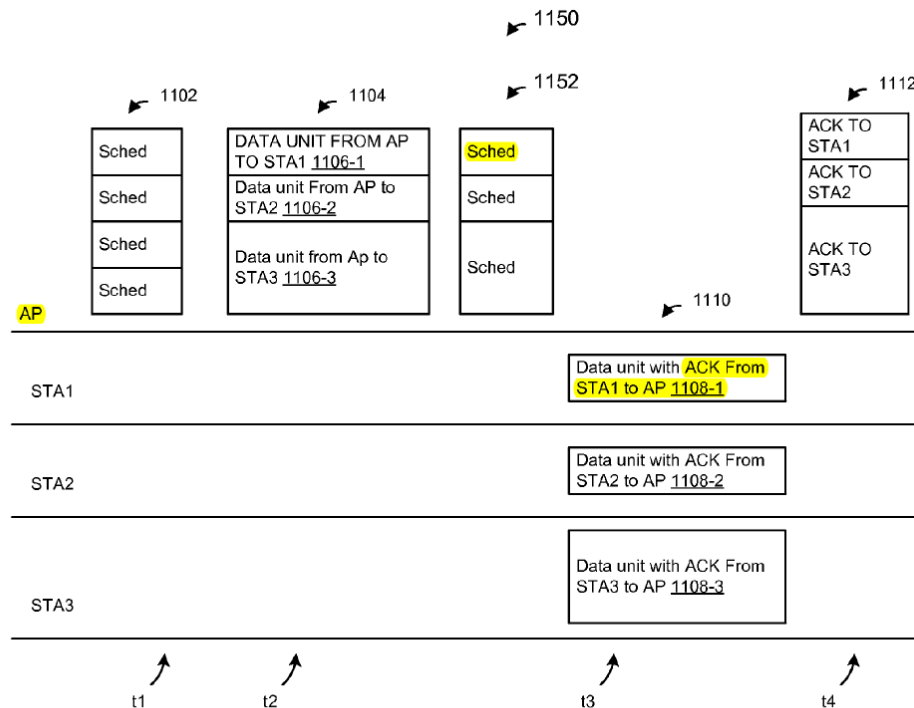


FIG. 11C

150. Chu806 also indicates that “[g]enerally speaking, as used herein, **the terms “acknowledgement frame” and “ACK frame”** are used interchangeably and **encompass both an acknowledgement frame** that acknowledges successful or unsuccessful receipt of a single data unit, and **a block acknowledgement frame** that acknowledges successful or unsuccessful receipt of multiple data units (e.g., multiple data units transmitted as parts of an aggregated data unit).” EX-1004, 13:42-49 (emphases added).

151. In view of at least Chu806’s disclosure of BlkAck, a POSITA also would readily understand that Chu806 discloses or suggests a MU block acknowledgement request frame to solicit such BlkAck.

152. Also, in view of at least Chu806's disclosure of separate scheduling frames as one frame and Chu806's indication that ACK may encompass BlkAck, a POSITA also would readily understand that Chu806 discloses or suggests the [6] limitation "generating, by the network device, a multi-user block acknowledgement request frame to solicit acknowledgements from two or more stations of the plurality of stations; and transmitting the multi-user block acknowledgment request frame following transmission of the downlink multi-user frame."

153. In addition, Chu806 discloses "[i]n an embodiment, client stations 25 that successfully receive data in the respective sub-channels allocated to the client stations 25 transmit respective acknowledgement (ACK or BlkAck) frames 606 to the AP 14," and "[i]n an embodiment, each client station 25 transmits its acknowledgement (ACK or BlkAck) frame 606 in the respective sub-channel allocated to the client station 25. EX-1004, 13:4-10.

154. Alternatively or in addition, in view of Chu806's disclosures of DL A-MPDUs soliciting BlkAck, e.g., acknowledgement frames 606, a POSITA also would readily understand that Chu806's scheduling frames 1152 can be A-MPDUs and responsive data frames 1106 can be A-MPUDs. A POSITA would readily understand Chu806 renders obvious the [6] limitation "generating, by the network device, a multi-user block acknowledgement request frame to solicit

acknowledgements from two or more stations of the plurality of stations; and transmitting the multi-user block acknowledgment request frame following transmission of the downlink multi-user frame.”

155. Chu806 also discloses that the “AP is configured to operate with client [STAs] according to... 802.11 ax communication protocol.” EX-1004, 5:31-36. (emphasis added). Further in view of Chu806’s disclosures of configuration according to “802.11 ax communication protocol,” a POSITA would readily understand Chu806 renders obvious the [6] limitation. Accordingly, claim 6 is unpatentable as anticipated by or obvious in view of Chu806.

7. Claim 7.

[7] The method of claim 1, wherein the acknowledgement information includes one or more of: (1) an indication of whether the acknowledgement transmission is multi-user or single user, and (2) an indication of whether the acknowledgment transmission is immediate or non-immediate, and further includes resource scheduling information when the multi-user acknowledgement transmission is indicated.

156. Chu806 discloses or renders [7] obvious. Chu806 discloses “a PHY preamble or a MAC header of the OFDM data unit directed to the first [STA] includes an ACK policy field set to indicate that an immediate acknowledgement of the data unit is not required, in an embodiment.” EX-1004, 29:37-41. In addition, Chu806 discloses that “[a]ccording to an embodiment, the legacy client station 25-4 is not enabled to transmit a data stream that to the AP 14 as part of

OFDMA transmission from multiple client stations 25.” EX-1004, 6:29-32.

Chu806 also discloses that “**the preamble of each OFDM data unit** included in the OFDMA transition is substantially the same as a preamble used for regular OFDM transmission to single [STA] 25, but includes **an indication that the OFDM data unit is part of an OFDMA transmission to multiple [STAs]** 25.”

EX-1004, 14:26-31 (emphases added). A POSITA also would readily understand that the AP disclosed in Chu806 indicates information soliciting ACK by a single user.

157. Chu806 also discloses in a further embodiment “the preamble of the OFDMA data unit 602 includes the channel allocation field 550 of FIG. 5B.” EX-1004, 12:50-52. A POSITA would readily understand Chu806’s disclosed OFDMA data unit to provide resource scheduling information.

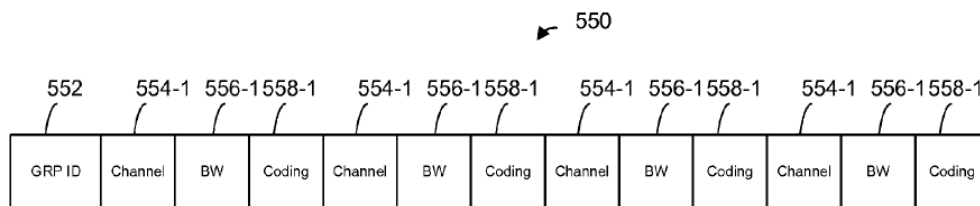


FIG. 5B

158. In addition, Chu806 illustrates a further embodiment in FIG. 11B. Chu806 discloses “each scheduling frames 1134 includes scheduling information for each of STA1, STA2 and STA3. For example, each scheduling frame 1134 includes an OFDMA uplink scheduling element, such as the OFDMA

uplink scheduling element 750 of FIG. 7B, which includes a plurality of user fields 754 corresponding to the plurality of client stations 25. In another embodiment, each scheduling frame 1134 includes scheduling information of only the client stations 25 to which the corresponding OFDM data unit 1106 is directed. For example, each scheduling frame 1134 includes an OFDMA uplink scheduling element, such as the OFDMA uplink scheduling element 750 of FIG. 7B, which includes a single user field 754 corresponding to the one client station 25 to which the corresponding OFDM data unit 1106 is directed.” EX-1004, 24:4-17.

159. Chu806 also discloses an example where “a PHY preamble or a MAC header of **the OFDM data unit directed to the first client station includes an ACK policy field set to indicate that an immediate acknowledgement** of the data unit **is not required**, in an embodiment. On the other hand, **the OFDM data unit directed to the second client station indicates that an immediate acknowledgement is required**, in an embodiment.” EX-1004, 29:37-43 (emphases added). A POSITA also would readily understand that the AP disclosed in Chu806 also indicates information for ACK by a single user.

160. From at least Chu806’s disclosures of the single-user field 754 in an UL scheduling element and different ACK timings for STA1 and STA2, a POSITA also would readily understand that the AP disclosed in Chu806 to render obvious the [7] limitation “wherein the acknowledgement information includes one or more

of: (1) an indication of whether the acknowledgement transmission is multi-user or single user.”

161. In addition, Chu806 discloses that “the [STAs] 25 are configured to determine their respective uplink channels based on uplink channel allocation information included in the control frame and to subsequently transmit data to the AP 14 simultaneously with the other [STAs] 25 as part of an uplink OFDMA transmission to the AP 14, in an embodiment.” EX-1004, 14:7-12 (emphasis added).

162. Accordingly, claim 7 is unpatentable as obvious in view of Chu806.

8. Claim 8.

[8pre] A method, implemented by a first station in a wireless network, for transmitting an uplink acknowledgment, the method comprising:

163. Chu806 discloses [8pre]. For example, Chu806 discloses that “two or more of the [STAs] 25 are configured to transmit corresponding data streams to the AP 14 such that the AP 14 receives the data streams simultaneously.” EX-1004, 6:3-8; FIG. 20A.

164. Chu806 also discloses that “[i]n an embodiment, the ACK frames 606 are block acknowledgement (Blk Ack) frames that indicate successful or unsuccessful reception of a plurality of data units, such as of a plurality of data

units aggregated in the corresponding A-MPDU 602.” EX-1004, 38-42. See
Section XI.A.1.

FIG. 1

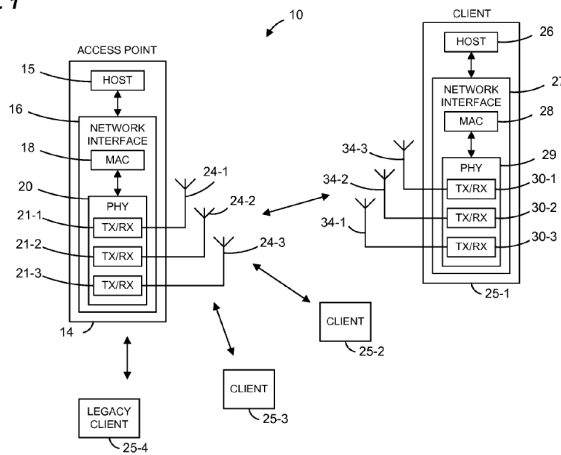
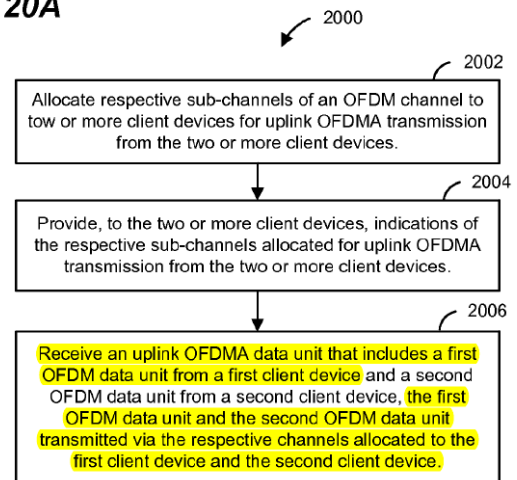


FIG. 20A



- b. [8a] receiving a downlink multi-user frame addressed to a plurality of stations, including the first station, and received from an access point in the wireless network;

165. Chu806 discloses [8a] obvious. Specifically, Chu806 discloses that “the client [STAs] 25 are configured to receive corresponding **data streams that are transmitted simultaneously by the AP 14.**” EX-1004, 6:3-5 (emphasis added).

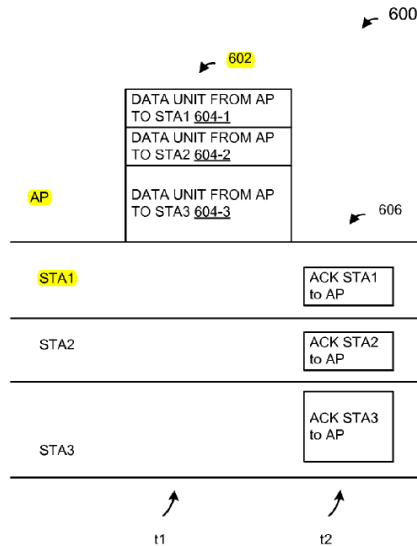
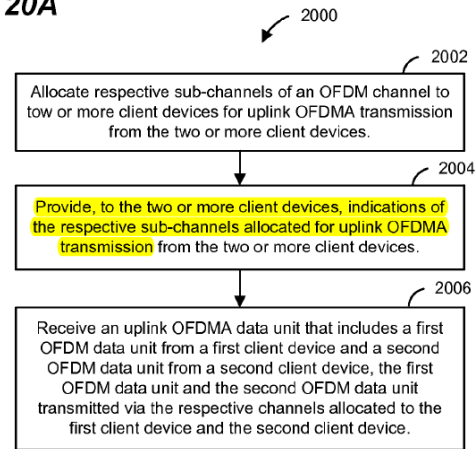


FIG. 20A



166. For example, Chu806 discloses that “[d]uring a time t1, the AP 14 transmits an OFDMA data unit 602 directed to a plurality of [STAs].” EX-1004, 11:59-60. Chu806 illustrates a DL frame including an OFDMA data unit 602 directed to multiple STAs, where the OFDMA data unit 602 includes respective OFDMA data units 604-1, 604-2, 604-3. EX-1004, 11:59-60; 12:28-34; FIG. 6.

- c. **[8b] processing a first MAC Protocol Data Units (MPDU) in the downlink multi-user frame to determine acknowledgement information indicating properties of a first multi-user acknowledgement frame;**

167. Chu806 discloses [8b]. Chu806 discloses that “[a STA] 25-1 includes a host processor 26 coupled to a network interface 27. The network interface 27 includes a MAC processing unit 28 and a PHY processing unit 29.”

EX-1004, 6:9-11. Particularly in view of Chu806's disclosed a host processor and a MAC processing unit, a POSITA would have recognized any Chu806's disclosed STA can process MPDU in the downlink multi-user frame or any other DL frames.

168. Chu806 also discloses an example where "a PHY preamble or a MAC header of the OFDM data unit directed to the first client station includes an ACK policy field set to indicate that an immediate acknowledgement of the data unit is not required, in an embodiment. On the other hand, the OFDM data unit directed to the second client station indicates that an immediate acknowledgement is required, in an embodiment." EX-1004, 29:37-43. Particularly in view of Chu806's disclosed ACK policy in a MAC header, a POSITA would have recognized any Chu806's disclosed STA can process MPDU in the downlink multi-user frame or another DL frames to determine acknowledgement information/policy.

169. Chu806 further discloses that "[i]n an embodiment, the ACK frames 606 are block acknowledgement (Blk Ack) frames that indicate successful or unsuccessful reception of a plurality of data units, such as of a plurality of data units aggregated in the corresponding A-MPDU 602." EX-1004, 13:38-42. Particularly in view of Chu806's disclosed block acknowledgement frames, a POSITA would have recognized any Chu806's disclosed STA can process MPDU in the downlink multi-user frame or another DL frames to determine

acknowledgement information/policy indicating properties of a first multi-user acknowledgement frame.

170. In addition, Chu806 discloses that “the [STAs] **25 are configured to determine their respective uplink channels based on uplink channel allocation information** included in the control frame and to subsequently transmit data to the AP 14 simultaneously with the other [STAs] 25 as part of an uplink OFDMA transmission to the AP 14, in an embodiment.” EX-1004, 14:7-12 (emphasis added).

171. Chu806 also discloses “a PHY preamble or a MAC header of the OFDM data unit directed to the first [STA] includes an ACK policy field set to indicate that an immediate acknowledgement of the data unit is not required, in an embodiment.” EX-1004, 29:37-41.

172. Chu806 also discloses that the “**AP is configured to operate with client [STAs] according to... 802.11 ax communication protocol**” (EX-1004, 5:31-36) (emphases added). For example, Chu806 describes “in an embodiment... **the OFDM data units 604-1, 604-2, 604-3 are MPDUs.**” EX-1004, 13:22-24 (emphasis added). Particularly in view of Chu806’s disclosed components and available protocols for the AP 14, a POSITA would have recognized any Chu806’s disclosed OFDMA data unit can correspond to MAC Protocol Data Unit (MPDU) under the 802.11ax protocol.

- d. **[8c] generating the first multi-user acknowledgment frame based on the acknowledgement information; and**
- e. **[8d] transmitting the first multi-user acknowledgement frame to the access point to acknowledge the downlink multi-user frame,**

173. Chu806 discloses [8c] and [8d]. For example, Chu806 discloses that “[d]uring a time t2, in an embodiment, [STAs] 25 that successfully receive data in the respective sub-channels allocated to the [STAs] 25 transmit respective acknowledgement (ACK or BlkAck) frames 606 to the AP 14.” EX-1004, 13:4-8; FIG. 6. In a further embodiment, “[d]uring a time t3, the [STAs] 25 transmit respective uplink OFDM data units 1108 as parts of an uplink OFDMA transmission 1110 to the AP 14. In an embodiment, the respective uplink data units 1108 from the [STAs] 25 are transmitted in respective uplink channels allocated for uplink transmission by the [STAs] 25 as indicated by the scheduling frame 1102. In an embodiment, each uplink data unit 1108 includes an acknowledgement indicating successful receipt of the corresponding OFDM downlink data unit 1106.” EX-1004, 23:41-50; FIG. 11C. Chu806 further discloses that “[i]n an embodiment, the ACK frames 606 are block acknowledgement (Blk Ack) frames that indicate successful or unsuccessful reception of a plurality of data units, such as of a plurality of data units aggregated in the corresponding A-MPDU 602.” EX-1004, 13:38-42.

- f. **[8e] wherein the first multi-user acknowledgement frame is transmitted simultaneously to a second multi-user acknowledgement frame transmitted by a second station.**

174. Chu806 discloses [8e]. Specifically, Chu806 discloses that “two or more of the [STAs] 25 are configured to transmit corresponding data streams to the AP 14 such that the AP 14 receives the data streams simultaneously.” EX-1004, 6:5-8. For example, Chu806 discloses in FIG. 6 that “[d]uring a time t2, in an embodiment, [STAs] 25 that successfully receive data in the respective sub-channels allocated to the [STAs] 25 transmit respective acknowledgement (ACK or BlkAck) frames 606 to the AP 14.” EX-1004, 13:4-8. Chu806 further discloses that “[i]n an embodiment, the ACK frames 606 are block acknowledgement (Blk Ack) frames that indicate successful or unsuccessful reception of a plurality of data units, such as of a plurality of data units aggregated in the corresponding A-MPDU 602.” EX-1004, 13:38-42.

175. For the foregoing reasons, claim 8 of the '520 Patent is unpatentable as anticipated by or obvious in view of Chu806. *See* Section XI.A.1 (discussion of [1]).

9. Claim 9.

[9] The method of claim 8, wherein the first MPDU is located in a first resource unit of the downlink multi-user frame allocated to the first station, wherein the downlink multi-user frame includes a second resource unit that contains a second MPDU that includes acknowledgement

information for the second multi-user acknowledgement frame.

176. Chu806 renders [9] obvious. For example, Chu806 discloses that “the AP 14 allocates different sub-channels to different client [STAs] and forms the OFDMA data unit that includes OFDM data units directed to by modulating the different [STAs] in sub-channel blocks corresponding to the sub-channels assigned to the [STAs].” EX-1004, 7:11-15.

177. Chu806 also discloses that “[i]n an embodiment, the preamble of the OFDMA data unit [] includes a channel allocation field.” EX-1004, 12:28-30. For example, Chu806 discloses that in an embodiment, “[t]he channel allocation field indicates that the highest 20 MHz channel of the 80 MHz channel is allocated to the client station STA1, the second highest 20 MHz channel of the 80 MHz channel is allocated to the client station STA2... in the illustrated embodiment.” EX-1004, 12:55-61.

178. Chu806 discloses a further embodiment that “the first OFDM data unit 602-1 occupies the highest 20 MHz sub-channel of the 80 MHz channel, the second OFDM data unit 602-2 occupies the second highest 20 MHz sub-channel of the 80 MHz channel, and the third OFDM data unit 602-3 is transmitted in a 40 MHz sub-channel that includes the lowest two 20 MHz sub-channels of the 80 MHz channel.” EX-1004, 12:19-25.

179. Particularly since the '520 Patent inventors describe the phrase “resource units (RU)” used in the '520 Patent may be “particular spatial streams or sub-channels,” (Ex-1001, 14:12-14; 18:5-8; 20:48-50), a POSITA would readily understand that Chu806's disclosed the first MPDU is located in a first RU and a second RU that contains a second MPDU.

180. Chu806 also discloses an example where “a PHY preamble or a MAC header of **the OFDM data unit directed to the first client station includes an ACK policy field** set to indicate that an immediate acknowledgement of the data unit is not required, in an embodiment. On the other hand, **the OFDM data unit directed to the second client station indicates that an immediate acknowledgement** is required, in an embodiment.” EX-1004, 29:37-43 (emphases added).

181. Accordingly, claim 9 is unpatentable as obvious in view of Chu806.

10. Claim 10.

[10] The method of claim 9, wherein the first multi-user acknowledgement frame and the second multi-user acknowledgement frame together form a multi-user acknowledgement frame for acknowledging the downlink multi-user frame.

182. Chu806 renders [10] obvious. Chu806 discloses “an embodiment in which the OFDMA data unit 300 corresponds to an uplink OFDMA data unit, the AP 14 receives the OFDM data units 302 via respective sub-channels of the

WLAN 10 allocated for uplink transmission of the OFDM data units 302 from the client stations, in an embodiment. For example, the OFDM data unit 302-1 is transmitted via a first 20 MHz sub-channel of the WLAN 10, the OFDM data unit 302-2 is transmitted via a second 20 MHz sub-channel of the WLAN 10, and the OFDM data unit 302-3 is transmitted via a 40 MHz sub-channel of the WLAN 10, in the illustrated embodiment.” EX-1004, 8:13-23.

183. For example, Chu806 discloses in FIG. 6 that “[d]uring a time t2, in an embodiment, [STAs] 25 that successfully receive data in the respective sub-channels allocated to the [STAs] 25 transmit respective acknowledgement (ACK or BlkAck) frames 606 to the AP 14.” EX-1004, 13:4-8. Accordingly, claim 10 is unpatentable as anticipated by or obvious in view of Chu806.

11. Claim 11.

[11] The method of claim 8, wherein processing the first MPDU comprises: extracting the acknowledgement information indicating the properties of the first multi-user acknowledgement frame from a header of the first MPDU.

12. Claim 12.

[12] The method of claim 11, wherein the header is a MAC header of the first MPDU.

184. Chu806 renders [11] and [12] obvious. Chu806 discloses that “[i]n an embodiment, the preamble of the OFDMA data unit [] includes a channel allocation field.” EX-1004, 12:28-34. Chu806 also discloses “a PHY preamble or

a MAC header of the OFDM data unit directed to the first [STA] includes an ACK policy field set to indicate that an immediate acknowledgement of the data unit is not required, in an embodiment.” EX-1004, 29:37-41. For example, Chu806 discloses that “[d]uring a time t2, the AP 14 transmits OFDM data units 1406 as part of an OFDMA transmission 1404. In an embodiment, a preamble or a header of the OFDM data unit 1406-2... includes an indication that an immediate acknowledgement is not required for the OFDM data unit 1406-2. For example, **an ACK policy field in the PHY preamble or the MAC header of the OFDM data unit 1406-2** indicates that an immediate acknowledgement is not required.” EX-1004, 30:21-30 (emphases added). A POSITA would readily understand Chu806’s disclosed OFDMA data unit to correspond to MPDU under the 802.11ax protocol. *See* Section VII.B.1.b (discussion of Limitation [1a]).

185. Accordingly, claim 11 and 12 are unpatentable as obvious in view of Chu806. *See* Section XI.A.2 and XI.A.3 (discussion of [2] and [3]).

13. Claim 13.

[13] The method of claim 8, wherein processing the MPDU comprises: extracting the acknowledgement information indicating the properties of the first multi-user acknowledgement frame transmission from a payload of the first MPDU, wherein the first MPDU is a unicast trigger frame.

186. Chu806 discloses or renders [13] obvious. For example, Chu806 discloses that “**WLANs operate in either a unicast mode** or a multicast mode.”

EX-1004, 1:39-40 (emphases added). Chu806 also discloses in a further embodiment “the preamble of the OFDMA data unit 602 includes the channel allocation field 550 of FIG. 5B.” EX-1004, 12:50-52. A POSITA would readily understand Chu806’s disclosed OFDMA data unit to provide resource scheduling information to multiple STAs.

187. As a further embodiment, Chu806 discloses “in the frame exchange 1130 scheduling for the uplink OFDMA transmission 1110 is provided to the client stations 25 as part of the downlink OFDMA transmission 1134 to the client stations 25. For example, respective scheduling frames 1138 are appended to the OFDM data units 1106 of the OFDMA transmission 1134,” and “[a]s another example, respective scheduling frames 1138 are prepended to the OFDM data units 1106 of the OFDMA transmission 1134.” EX-1004, 23:60-66; 23:67-24:2.

188. Chu806 also discloses that “[i]n some embodiments, each scheduling frames 1134 includes scheduling information for each of STA1, STA2 and STA3.” EX-1004, 24:2-4. *See also* EX-1004; FIG. 11B.

189. In addition, from at least Chu806’s disclosures of UL scheduling information for all STAs in the DL OFDMA frame 1134, a POSITA also would readily understand that the STA disclosed in Chu806 to render obvious the [13] limitation. *See* Section XI.A.4 (discussion of [4]).

14. Claim 14.

[14] The method of claim 13, further comprising: processing a second MPDU in a same resource unit as the first MPDU, wherein the second MPDU includes data intended for the first station.

190. Chu806 discloses or renders [14] obvious. Specifically, Chu806 discloses that “the AP 14 **allocates different sub-channels to different client [STAs] and forms** the OFDMA data unit that includes **OFDM data units directed to by modulating the different [STAs] in sub-channel blocks corresponding to the sub-channels assigned to the [STAs].**” EX-1004, 7:11-15 (emphases added). For example, Chu806 discloses in a further embodiment, “[d]uring a time t3, the AP 14 transmits respective acknowledgment frames 1112, acknowledging successful receipt of the OFDM data units 1108. In an embodiment, the respective acknowledgment frames 1112 are transmitted as parts of an OFDMA transmission to the [STAs] 25, in the respective uplink channels allocated to the [STAs] 25.” EX-1004, 23:50-56; FIG. 11C.

191. As another example, Chu806 discloses “[d]uring a time t2, the AP 14 transmits an OFDMA data unit 1204 directed to [STAs] 25...in respective sub-channels allocated to the [STA] 25,” and “[d]uring a time t4, the AP 14 transmits a second scheduling frame 1212 that includes uplink channel allocation information for OFDMA uplink transmission by the client

stations 25... via the downlink sub-channels allocated to the client stations 25.”

EX-1004, 25:18-22, 26:4-9. *See also* EX-1004, FIG. 12

192. From at least Chu806’s disclosures of transmitting multiple frames in the respective sub-channel allocated to each STA, a POSITA also would readily understand that the STA disclosed in Chu806 discloses or renders obvious the [14] limitation “processing a second MPDU in a same resource unit as the first MPDU, wherein the second MPDU includes data intended for the first station.

193. Accordingly, claim 14 is unpatentable as obvious in view of Chu806.

15. Claim 15.

[15] The method of claim 13, wherein the trigger frame instigates the first station to transmit the first multi-user acknowledgement after an interframe spacing period following receipt of the downlink multi-user frame.

194. Chu806 discloses or renders [15] obvious. *See* Section XI.A.5 (discussion of [5]).

16. Claim 16.

[16] The method of claim 8, further comprising: receiving a multi-user block acknowledgement request frame that solicits acknowledgements from the first and second station, wherein the first multi-user acknowledgement frame is transmitted after receipt of and in response to the multi-user block acknowledgement request frame.

195. Chu806 discloses or renders [16] obvious. For example, Chu806 discloses a further embodiment where “uplink scheduling information is provided

to the client [STAs] 25 by respective separate scheduling frames 1152 transmitted as control frames separate from the OFDM data units 1104.” EX-1004, 24:27-30. Chu806 also discloses that “[d]uring a time t3, the [STAs] 25 transmit respective uplink OFDM data units 1108 as parts of an uplink OFDMA transmission 1110 to the AP 14. In an embodiment, the respective uplink data units 1108 from the client stations 25 are transmitted in respective uplink channels allocated for uplink transmission by the client stations 25 as indicated by the scheduling frame 1102. In an embodiment, each uplink data unit 1108 includes an acknowledgement indicating successful receipt of the corresponding OFDM downlink data unit 1106.” EX-1004, 23:41-50; FIG. 11C. *See* Section XI.A.6 (discussion of [6]).

17. Claim 17.

[17] The method of claim 8, wherein the acknowledgement information includes one or more of: (1) an indication of whether the first multi-user acknowledgement frame is part of a multi-user or a single user transmission, and (2) an indication of whether the first multi-user acknowledgement frame is transmitted immediately following receipt of the downlink multi-user frame or upon receipt of a multi-user block acknowledgement request frame, and further includes resource scheduling information when the first multi-user acknowledgement frame is indicated as being part of the multi-user transmission.

196. Chu806 discloses or renders [17] obvious. Chu806 discloses “a PHY preamble or a MAC header of the OFDM data unit directed to the first [STA] includes an ACK policy field set to indicate that an immediate acknowledgement

of the data unit is not required, in an embodiment.” EX-1004, 29:37-41. In addition, Chu806 discloses that “the [STAs] **25 are configured to determine their respective uplink channels based on uplink channel allocation information** included in the control frame and to subsequently transmit data to the AP 14 simultaneously with the other [STAs] 25 as part of an uplink OFDMA transmission to the AP 14, in an embodiment.” EX-1004, 14:7-12 (emphasis added). Accordingly, claim 17 is unpatentable as anticipated by or obvious in view of Chu806. *See* Section XI.A.7 (discussion of [7]).

18. Claim 18.

- a. **[18pre] A method, implemented by a first station in a wireless network, for transmitting an uplink acknowledgment, the method comprising:**

197. Chu806 discloses [18pre]. *See* Section XI.A.8.a (discussion of Limitation [8pre]).

- b. **[18a] receiving a downlink multi-user frame addressed to a plurality of stations, including the first station, wherein the downlink multi-user frame is received from an access point in the wireless network;**

198. Chu806 discloses [18a]. *See* Section XI.A.8.b (discussion of Limitation [8a]).

- c. **[18b] receiving a multi-user block acknowledgement request frame that solicits acknowledgements from the first station and a second station, wherein the multi-user block acknowledgement request frame includes acknowledgement information indicating**

**properties of a first multi-user acknowledgement
frame;**

199. Chu806 discloses or renders [18b] obvious. For example, Chu806 discloses an embodiment where “uplink scheduling information is provided to the client [STAs] 25 by respective separate scheduling frames 1152 transmitted as control frames separate from the OFDM data units 1104.” EX-1004, 24:27-30. Chu806 discloses in a further embodiment where “the scheduling frame 1202 indicates to the [STA] 25 that the [STAs] 25 should provide indications of the amount of buffered data at the [STAs] 25 and/or indications of requested medium time for an uplink transmission by the [STAs] 25.” EX-1004, 25:34-38. Particularly since Chu806 describes additional control for a subsequent UL ACK frame, a POSITA would readily understand Chu806’s disclosed the multi-user block acknowledgement request frame to include acknowledgement information indicating properties of a first multi-user acknowledgement frame.

200. Chu806 also discloses “a PHY preamble or a MAC header of the OFDM data unit directed to the first [STA] includes an ACK policy field set to indicate that an immediate acknowledgement of the data unit is not required, in an embodiment.” EX-1004, 29:37-41.

201. In addition, Chu806 discloses “[d]uring a time t_2 , in an embodiment, [STAs] 25 that successfully receive data in the respective sub-channels allocated to

the [STAs] 25 transmit respective acknowledgement (ACK or BlkAck) frames 606 to the AP 14.” EX-1004, 13:4-8; FIG. 6.

202. From at least Chu806’s disclosures of BlkAck frames by multiple STAs, a POSITA also would readily understand that the AP disclosed in Chu806 discloses or renders obvious the [18b] limitation “receiving a multi-user block acknowledgement request frame that solicits acknowledgements from the first station and a second station, wherein the multi-user block acknowledgement request frame includes acknowledgement information indicating properties of a first multi-user acknowledgement frame.” *See also* Section XI.A.16 (discussion of Claim [16]).

- d. **[18c] generating the first multi-user acknowledgment frame based on the acknowledgement information; and**
- e. **[18d] acknowledging the receipt of the downlink multi-user frame by transmitting the first multi-user acknowledgement frame to the access point,**

203. Chu806 discloses [18c] and [18d]. For example, Chu806 discloses “[d]uring a time t2, in an embodiment, [STAs] 25 that successfully receive data in the respective sub-channels allocated to the [STAs] 25 transmit respective acknowledgement (ACK or BlkAck) frames 606 to the AP 14.” EX-1004, 13:4-8; FIG. 6. *See* Section XI.A.8.b; Section XI.A.8.c.

- f. **[18e] wherein the first multi-user acknowledgement frame is transmitted simultaneously with a second**

multi-user acknowledgement frame generated and transmitted by the second station.

204. Chu806 discloses [18e]. Specifically, Chu806 discloses that “two or more of the [STAs] 25 are configured to transmit corresponding data streams to the AP 14 such that **the AP 14 receives the data streams simultaneously.**” EX-1004, 6:5-8 (emphasis added).

205. For the foregoing reasons, claim 18 of the '520 Patent is unpatentable as anticipated by or obvious in view of Chu806. *See* Section XI.A.8 (discussion of [8]).

19. Claim 19.

[19] The method of claim 18, wherein the acknowledgement information includes one or more of: (1) an indication of whether the first multi-user acknowledgement frame is part of a multi-user or single user transmission and (2) resource scheduling information for the first multi-user acknowledgement transmission.

206. Chu806 discloses or renders [19] obvious. For example, Chu806 discloses that “[i]n an embodiment, the ACK frames 606 are block acknowledgement (Blk Ack) frames that indicate successful or unsuccessful reception of a plurality of data units, such as of a plurality of data units aggregated in the corresponding A-MPDU 602.” EX-1004, 38-42.

207. Chu806 discloses in a further embodiment where “the scheduling frame 1202 indicates to the [STA] 25 that the [STAs] 25 should provide

indications of the amount of buffered data at the [STAs] 25 and/or indications of requested medium time for an uplink transmission by the [STAs] 25.” EX-1004, 25:34-38.

208. Chu806 also discloses “[i]n an embodiment, the AP 14 forms OFDMA groups of client stations 25, and informs the client stations 25 that the client stations 25 are members of particular OFDMA groups,” and “the AP 14 allocates respective OFDM sub-channels to client stations 25 that belong to an OFDMA group, and provides channel allocation information to the client stations 25 of the OFDMA group.” EX-1004, 9:17-19; 9:27-31. Chu806 further discloses that “the client stations 25 of the OFDMA group subsequently transmit respective data as part of an OFDMA transmission to the AP 14 by transmitting the data in the respective OFDM sub-channels allocated to the client stations 25 by the AP 14.” EX-1004, 9:36-41. A POSITA would readily understand Chu806’s disclosed OFDMA data unit to provide an indication of whether the first multi-user acknowledgement frame is part of a multi-user or single user transmission and to provide resource scheduling information for MU acknowledgement transmission.

209. *See* Section XI.A.6, XI.A.8b., and XI.A.17.

20. Claim 20.

[20] The method of claim 18, wherein the acknowledgment scheduling information includes properties of the second multi-user acknowledgement frame generated and transmitted by the second station, wherein the first multi-

user acknowledgement frame and the second multi-user acknowledgement together form a multi-user transmission.

210. Chu806 discloses or renders [20] obvious. Chu806 discloses that “[i]n an embodiment, the preamble of the OFDMA data unit [] includes a channel allocation field.” EX-1004, 12:28-34. For example, Chu806 discloses that in an embodiment, “[t]he channel allocation field indicates that the highest 20 MHz channel of the 80 MHz channel is allocated to the client station STA1, the second highest 20 MHz channel of the 80 MHz channel is allocated to the client station STA2....” EX-1004, 12:55-61. Chu806 also discloses in FIG. 6 that “[d]uring a time t2, in an embodiment, [STAs] 25 that successfully receive data in the respective sub-channels allocated to the [STAs] 25 transmit respective acknowledgement (ACK or BlkAck) frames 606 to the AP 14.” EX-1004, 13:4-8.

211. Accordingly, claim 20 is unpatentable as anticipated by or obvious in view of Chu806. *See* Section XI.A.8.e (discussion of Limitation [8e]).

B. Ground 2: Merlin renders obvious Claims 1-20.

212. As set forth below, Merlin renders Claims 1-20 obvious and unpatentable.

1. Claim 1.

- a. [1pre] A method, implemented by a network device in a wireless network, for coordinating an uplink multi-user response transmission to a downlink multi-user transmission, the method comprising:**

213. Merlin discloses [1pre]. Merlin discloses a method involving “frame structures and protocols for uplink (UL) multiple user (MU) frame exchanges. Certain aspects provide protocol rules and efficient frame exchange sequences to enable sending multiple block acknowledgments (BAs) in UL and/or downlink (DL) MU multiple-input multiple-output (MIMO).” EX-1005, 5:32-37; FIG. 10; FIG. 25.

214. For example, Merlin discloses “an AP may transmit an MU PPDU soliciting immediate response from multiple high efficiency wireless (HEW) STAs.... Therefore, multiple responses (e.g., ACKs/BAs) to the MU PDDU, from multiple STAs, are possible at the same time.” EX-1005, 12:66-13:5.

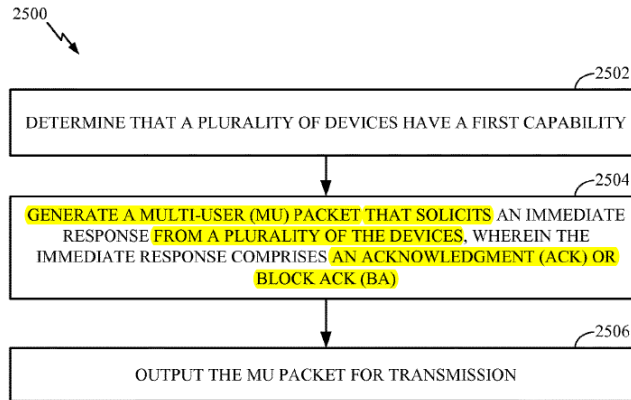


FIG. 25

- b. [1a] generating, by the network device, a downlink multi-user frame addressed to a plurality of stations operating in the wireless network, the downlink multi-user frame including a plurality of resource units (RUs), wherein generating the downlink multi-user frame comprises:
- assigning each RU of the plurality of RUs to a respective station in the plurality of stations, and
 - including a respective set of MAC Protocol Data Units (MPDUs) in each RU of the plurality of RUs,
 - wherein an MPDU in one or more of the RUs in the plurality of RUs includes acknowledgement information indicating properties of a multi-user acknowledgement transmission that the station in the plurality of stations to which the RU is assigned is requested to transmit to acknowledge the downlink multi-user frame;
- c. [1b] transmitting the downlink multi-user frame to the plurality of stations over a wireless channel; and
- d. [1c] receiving the uplink multi-user response transmission, the uplink multi-user response transmission including multi-user acknowledgement

transmissions respectively and simultaneously transmitted by two or more stations in the plurality of stations,

215. Merlin discloses or renders [1a], [1b], and [1c] obvious. Merlin discloses that “the AP may solicit multiple immediate responses by **transmitting an MU PPDU including** multiple aggregate medium access control (MAC) protocol data units (A-MPDUs) having **MPDUs that solicit an immediate response....**” EX-1005; 13:11-16 (emphases added). For example, Merlin discloses that “**a multi-STA BA request (BAR) frame may simultaneously solicit multiple immediate BAs,**” and “**multiple responses (e.g., ACKs/BAs) to the MU PDDU, from multiple STAs, are possible at the same time.**” EX-1005, 5:39-40; 13:3-5 (emphases added).

216. In addition, Merlin discloses that “**indicating the resource allocation for the STAs to send in UL MU-MIMO... may be accomplished by including the spatial stream/channel allocation and power control for each STA,**” and for example, “the parameters to be used (e.g., duration of the response PPDU, spatial stream/channel allocation, and power allocation) **may also be indicated by bits in the BAR frame.**” EX-1005, 18: 24-28; 19:27-30 (emphases added).

217. From at least Merlin’s disclosures of the AP’s allocations of spatial streams/channels to STAs and the indication of resource allocations in a DL MU A-MPDU that solicits UP MU responses, a POSITA would readily understand that

the AP disclosed in Merlin allocates and assigns each of the resources, such as spatial streams or channels, to a respective one of the multiple STAs, and that Merlin renders obvious the [1a] limitation “generating, by the network device, a downlink multi-user frame addressed to a plurality of stations operating in the wireless network, the downlink multi-user frame including a plurality of resource units (RUs), wherein generating the downlink multi-user frame comprises: assigning each RU of the plurality of RUs to a respective station in the plurality of stations, and including a respective set of MAC Protocol Data Units (MPDUs) in each RU of the plurality of RUs, wherein an MPDU in one or more of the RUs in the plurality of RUs includes acknowledgement information indicating properties of a multi-user acknowledgement transmission that the station in the plurality of stations to which the RU is assigned is requested to transmit to acknowledge the downlink multi-user frame.”

218. Particularly since the '520 Patent inventors describe the phrase “resource units (RU)” used in the '520 Patent may be “particular spatial streams or sub-channels” (Ex-1001, 14:12-14; 18:5-8; 20:48-50), a POSITA would readily understand that Merlin’s disclosed AP assigns ‘RUs’ to STAs, includes MPDUs in each ‘RU’, and includes ‘RUs’ in a DL MU OFDMA frame to the STAs.

219. Alternatively or in addition, particularly in view of the State of the Art, e.g., how it has been known to dynamically allocate resource units and the

IEEE Standardization was known to discuss dynamic allocation of resource units (see Section VI.D-VI.F above), a POSITA would readily understand Merlin discloses or render obvious the [1a] limitation “assigning each RU of the plurality of RUs to a respective station in the plurality of stations.”

220. In addition, Merlin discusses that “[a]n OFDMA system utilizes orthogonal frequency division multiplexing (OFDM), which is a modulation technique that partitions the overall system bandwidth into multiple orthogonal sub-carriers. These sub-carriers may also be called tones, bins, etc. With OFDM, each sub-carrier may be independently modulated with data.” EX-1005, 7:9-15.

221. Merlin discloses that “[a]ccording to certain aspects, **STAs may send the response frame using the same spatial streams of the soliciting frame** (e.g., number and position of spatial streams).” EX-1005, 15:65-67 (emphasis added).

222. For example, Merlin also discloses that “FIG. 6 illustrates an example frame exchange with spatial streams used for response frames equal to the spatial streams used for the frames soliciting the responses.” Merlin illustrates in FIG. 6 that “the soliciting frame for STA2 may use a first spatial stream 602 and the STA2 may reply using the same spatial stream 604. Similarly, the soliciting frame for STA1 may use a second spatial stream 606 and the STA1 may reply using the same spatial stream 608.” EX-1005, 3:66-4:2, 16:2-6.

223. Especially in view of at least Merlin's disclosures of OFDM modulating and transmitting UL response frames using the same spatial streams as the DL soliciting frame, a POSITA also would readily understand that the AP disclosed in Merlin discloses or renders obvious the [1a] limitation "generating the downlink multi-user frame comprises:... including a respective set of MAC Protocol Data Units (MPDUs) in each RU of the plurality of RUs."

224. Alternatively or in addition, particularly in view of the State of the Art, e.g., how DL MU OFDMA frame has been known to dynamically allocate resources (*see* Section VI.E above), a POSITA would readily understand Chu806 discloses or render obvious the [1a] limitation "generating the downlink multi-user frame comprises: assigning each RU of the plurality of RUs to a respective station in the plurality of stations, and including a respective set of MAC Protocol Data Units (MPDUs) in each RU of the plurality of RUs."

225. Merlin discloses that **"the AP may send DL MU-MIMO A-MPDUs to multiple STAs. In the DL MU-MIMO A-MPDUs, the AP may indicate that the transmission opportunity is transferred to the STAs. As discussed above, the recipient STAs may support UL MU-MIMO/FDMA and, thus, multiple recipient STAs may transmit UL MU PPDU at the same time. According to certain aspects, the UL MU PPDU may contain data or acknowledgements."** EX-1005, 19:53-60 (emphases added).

226. For example, Merlin discloses that “a FDMA transmission may consist of... **MU PPDU**s on each channel (e.g. 20 MHz). Each MU PPDU may be... a MU-MIMO....” EX-1005; 12:6-9 (emphasis added). For example, Merlin discloses in FIG. 10 “a **DL A-MPDU** including a BAR frame per each STA,” and “BAR frame 1002 (DL STA2+BAR2) and BAR frame 1004 (DL STA1+BAR1)... may solicit BAs 1006 (BA STA2) and 1008 (BA STA1) from STAs 2 and 1, respectively.” EX-1005, 18:35-43 (emphasis added); FIG. 10.

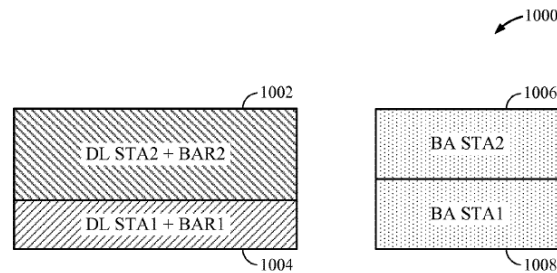


FIG. 10

227. Especially in view of at least Merlin’s disclosures of DL MU-MIMO A-MPDUs and responding UL MU PPDU, a POSITA also would readily understand that the AP disclosed in Merlin discloses or renders obvious the [1b] and [1c] limitations “transmitting the downlink multi-user frame to the plurality of stations over a wireless channel; and receiving the uplink multi-user response transmission, the uplink multi-user response transmission including multi-user acknowledgement transmissions respectively and simultaneously transmitted by two or more stations in the plurality of stations.”

- e. **[1d] wherein the plurality of RUs respectively correspond to a plurality of simultaneous uplink transmissions, and each of the plurality of simultaneous uplink transmissions uses a sub-channel, spatial stream, or sub-channel and spatial stream combination that is not used by any other of the plurality of simultaneous uplink transmissions.**

228. Merlin discloses [1d]. For example, Merlin discloses that “each STA that is a recipient of the DL MU PPDU may receive a potentially different BAR, requesting a BA and granting the resources for that STA to reply. **Each STA may be granted a different resource,**” and “the multiple responses may be in different streams and/or different frequencies.” EX-1005; 13:8-10; 17:66-18:2 (emphasis added).

229. Merlin illustrates in FIG. 6 that “the soliciting frame for STA2 may use a first spatial stream 602 and the STA2 may reply using the same spatial stream 604. Similarly, the soliciting frame for STA1 may use a second spatial stream 606 and the STA1 may reply using the same spatial stream 608.” EX-1005; 16:2-6.

230. Merlin also discloses that “[a]ccording to certain aspects, an AP may transmit an MU PPDU soliciting immediate response from multiple high efficiency wireless (HEW) STAs (e.g., very high throughput (VHT) STAs) that support UL MU-MIMO, UL FDMA, or both. Therefore, **multiple responses (e.g., ACKs/BAs) to the MU PDDU, from multiple STAs, are possible at the same**

time. For example, if all of the addressed STAs in the DL MU-MIMO PPDU support UL MU-MIMO, UL FDMA, or both, then none, some, or all of the STAs may be solicited for immediate response. According to certain aspects, **the multiple responses may be in different streams and/or different frequencies.”** EX-1005, 12:66-13:10 (emphases added).

231. For the foregoing reasons, claim 1 of the '520 Patent is unpatentable as anticipated by or obvious in view of Merlin.

2. Claim 2.

[2] The method of claim 1, wherein generating the downlink multi-user frame further comprises: including the acknowledgement information, for indicating properties of the multi-user acknowledgement transmission transmitted by each respective station in the plurality of stations to acknowledge the downlink multi-user frame, in a header of the one or more MPDUs.

3. Claim 3.

[3] The method of claim 2, wherein the header is a MAC header of the one or more MPDUs.

232. Merlin discloses or renders [2] and [3] obvious. Specifically, Merlin discloses that “the AP may generate a MU packet that solicits an immediate response from a plurality of the devices.... the MU packet may include a plurality of MPDUs, each MPDU being addressed to a different one of the plurality of devices and the response type indication may be provided in... an extended **MAC header.... the response type indication may be provided in a PHY header of**

the MU packet.... According to certain aspects, **an indication of one or more parameters (e.g., spatial streams to use, channels, a duration, transmission power) to use** for sending the immediate using MU MIMO [] **may be provided according to any of the alternatives described above** for explicitly or implicitly providing the response type indication....” EX-1005; 23:58-24:26 (emphasis added). *See* Section XI.B.1.b (discussion of Limitation [1a]).

233. Accordingly, claim 2 and claim 3 are unpatentable as anticipated by or obvious in view of Merlin.

4. Claim 4.

[4] The method of claim 1, wherein one of the one or more MPDUs in each of the RUs of the plurality of RUs is a unicast trigger frame that contains the acknowledgement information for the respective station in the plurality of stations.

234. Merlin discloses or renders [4] obvious. For example, Merlin discloses in FIG. 10 “a DL A-MPDU including a BAR frame per each STA,” and “BAR frame 1002 (DL STA2+BAR2) and BAR frame 1004 (DL STA1+BAR1)... may solicit BAs 1006 (BA STA2) and 1008 (BA STA1) from STAs 2 and 1, respectively.” EX-1005, 18:35-43; FIG. 10.

235. Particularly in view of Merlin’s disclosure of a separate BAR for STA1 and STA2, a POSTIA would readily understand that such a separate BAR is a unicast trigger frame.

236. As a further embodiment, Merlin also discloses “[a]ccording to certain aspects, a fifth option to indicate the response parameters may be in a special frame aggregated in the A-MPDU,” and “[t]he special frame may be a **trigger frame** or a modified **BAR frame**.” EX-1005, 17:11-13, 17:25-26 (emphasis added).

237. Accordingly, claim 4 is unpatentable as anticipated by or obvious in view of Merlin.

5. Claim 5.

[5] The method of claim 4, wherein the trigger frame instigates each respective station in the plurality of stations to transmit the multi-user acknowledgement transmission after an interframe spacing period following receipt of the downlink multi-user frame.

238. Merlin discloses or renders [5] obvious. Specifically, Merlin discloses that “a short inter-frame space (SIFS) [refers to] a small interval between a data frame or other message and its acknowledgment (ACK),” and “[t]he order and timing for the STA BA transmissions may be sent in the DL-MU-MIMO data.” EX-1005; 11:23-25; 11:33-34. *See also* EX-1005, FIG. 15.

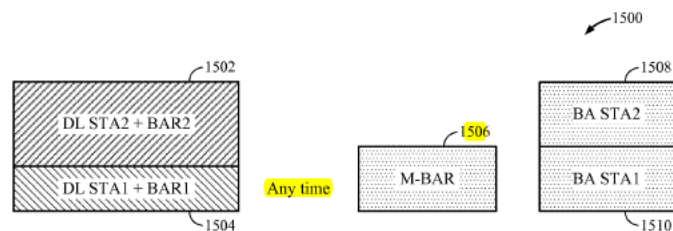


FIG. 15

239. Accordingly, claim 5 is unpatentable as anticipated by or obvious in view of Merlin.

6. Claim 6.

[6] The method of claim 1, further comprising:

generating, by the network device, a multi-user block acknowledgement request frame to solicit acknowledgements from two or more stations of the plurality of stations; and

transmitting the multi-user block acknowledgement request frame following transmission of the downlink multi-user frame.

240. Merlin discloses or renders [6] obvious. For example, Merlin discloses a further embodiment where “a single multi-STA **BAR frame 1506** may be sent in a separate DL PPDU subsequent to the DL A-MPDU having data PSDUs 1502 and 1504 addressed to STA2 and STA1, respectively, and **may request BAs 1508 and 1510 from STA2 and STA1, respectively.**” EX-1005, 19:44-49 (emphases added); FIG. 15.

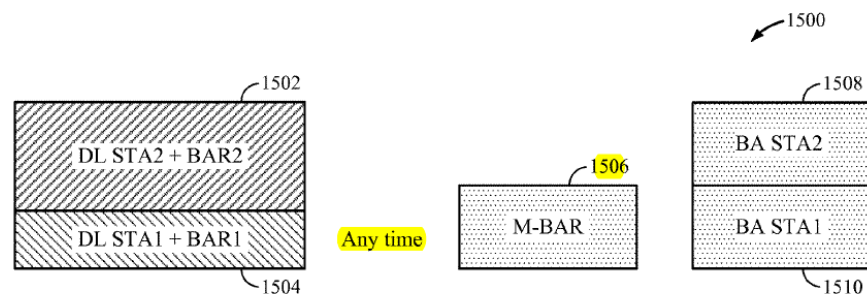


FIG. 15

241. As a further embodiment, Merlin also discloses “[a]ccording to certain aspects, a fifth option to indicate the response parameters may be in a special frame aggregated in the A-MPDU,” and “[t]he special frame may be a **trigger frame** or a modified **BAR frame.**” EX-1005, 17:11-13, 17:25-26 (emphases added).

242. Accordingly, claim 6 is unpatentable as anticipated by or obvious in view of Merlin.

7. Claim 7.

[7] The method of claim 1, wherein the acknowledgement information includes one or more of: (1) an indication of whether the acknowledgement transmission is multi-user or single user, and (2) an indication of whether the acknowledgment transmission is immediate or non-immediate, and further includes resource scheduling information when the multi-user acknowledgement transmission is indicated.

243. Merlin discloses or renders [7] obvious. For example, Merlin discloses that “[a]ccording to certain aspects, 1 or 2 bits of the BAR information field 912 may be used to indicate which mode of response is to be used (e.g., SU, UL MU-MIMO, or UL FDMA).” EX-1005, 18:19-22. Merlin also discloses that “[a]ccording to certain aspects, the BA policy for all data MPDUs may be set to BA (no immediate response). . . .” EX-1005, 18:31-32. In addition, Merlin discloses “[a]ccording to certain aspects, the multi-STA BAR... may use some of the reserved bits in the BAR control field, in the PER-TID information field, or in other existing fields to indicate: that the BAR is a multi-STA BAR, which STAs are the recipients, the duration of the allowed response, and resource allocation for the replies in UL MU-MIMO or UL FDMA.” EX-1005, 18:65-19:5.

244. Accordingly, claim 7 is unpatentable as anticipated by or obvious in view of Merlin.

8. Claim 8.

[8pre] A method, implemented by a first station in a wireless network, for transmitting an uplink acknowledgment, the method comprising:

245. Merlin discloses [8pre]. For example, Merlin discloses that “each recipient STA that is requested to send an immediate response may know—or be indicated—how the immediate reply (e.g., ACK/BA) should be sent.” EX-1005; 14:12-15. *See* Section XI.B.1.

b. [8a] receiving a downlink multi-user frame addressed to a plurality of stations, including the first station, and received from an access point in the wireless network;

246. Merlin discloses [8a] obvious. Merlin discloses that “each STA that is a recipient of the DL MU PPDU may receive a potentially different BAR, requesting a BA and granting the resources for that STA to reply.” EX-1005; 17:66-18:2. Merlin also discloses that “an AP may transmit an MU PPDU soliciting immediate response from multiple high efficiency wireless (HEW) STAs.... Therefore, multiple responses (e.g., ACKs/BAs) to the MU PDDU, from multiple STAs, are possible at the same time.” EX-1005, 12:66-13:5. For example, Merlin discloses in FIG. 10 “a DL A-MPDU including a BAR frame per each STA,” and “BAR frame 1002 (DL STA2+BAR2) and BAR frame 1004 (DL STA1+BAR1)... may solicit BAs 1006 (BA STA2) and 1008 (BA STA1) from STAs 2 and 1, respectively.” EX-1005, 18:35-43; FIG. 10. Merlin also discloses

that “a multi-STA BAR frame may be used to request BAs from multiple STA.”

EX-1005, 18:57-58.

- c. **[8b] processing a first MAC Protocol Data Units (MPDU) in the downlink multi-user frame to determine acknowledgement information indicating properties of a first multi-user acknowledgement frame;**

247. Merlin discloses [8b]. Merlin discloses that “if a STA determines (e.g., receives an indication, derives...) that UL MU-MIMO... is to be used for an immediate response, the STA may also know which parameters to use for the response. Response parameters may include, for example, which spatial streams/channels to use, what duration to use, and what power to use for the immediate response.” EX-1005; 15:26-33. For example, Merlin discloses that “a response type indication for each STA may be added in each MPDU.... For example, 1 or 2 bits may indicate which mode of response is to be used (e.g., UL SU-MIMO, UL MU-MIMO, or UL FDMA).... the indication may be included in the Quality of Service (QoS) control field, the HT or VHT Control field, the frame control (FC) field, the A-MPDU delimiter preceding the MPDU, an extended MAC header....” EX-1005; 14:26-35.

- d. **[8c] generating the first multi-user acknowledgment frame based on the acknowledgement information; and**

248. Merlin discloses [8c]. For example, Merlin discloses that “each STA that is a recipient of the DL MU PPDU may receive a potentially different BAR, requesting a BA and granting the resources for that STA to reply. **Each STA may be granted a different resource,**” and “the multiple responses may be in different streams and/or different frequencies.” EX-1005; 13:8-10; 17:66-18:2 (emphasis added). Merlin illustrates that “STAs may send the response frame using the same spatial streams of the soliciting frame (e.g., number and position of spatial streams), as shown in FIG. 6.,” and “the soliciting frame for STA2 may use a first spatial stream 602 and the STA2 may reply using the same spatial stream 604. Similarly, the soliciting frame for STA1 may use a second spatial stream 606 and the STA1 may reply using the same spatial stream 608.” EX-1005; 15:65-16:6.

- e. **[8d] transmitting the first multi-user acknowledgement frame to the access point to acknowledge the downlink multi-user frame,**
- f. **[8e] wherein the first multi-user acknowledgement frame is transmitted simultaneously to a second multi-user acknowledgement frame transmitted by a second station.**

249. Merlin discloses [8d] and [8e]. Merlin discloses that “each STA that is a recipient of the DL MU PPDU may receive a potentially different BAR, requesting a BA and granting the resources for that STA to reply. Each STA may

be granted a different resource.” EX-1005; 17:66-18:2. In addition, Merlin discloses that “multiple responses (e.g., ACKs/BAs) to the MU PDDU, from multiple STAs, are possible at the same time.” EX-1005, 13:3-5.

250. For the foregoing reasons, claim 8 of the '520 Patent is unpatentable as anticipated by or obvious in view of Merlin. *See* Section XI.B.1 (discussion of [1]).

9. Claim 9.

[9] The method of claim 8, wherein the first MPDU is located in a first resource unit of the downlink multi-user frame allocated to the first station, wherein the downlink multi-user frame includes a second resource unit that contains a second MPDU that includes acknowledgement information for the second multi-user acknowledgement frame.

251. Merlin discloses or renders [9] obvious. Merlin discloses that “the soliciting frame for STA2 may use a first spatial stream 602 and the STA2 may reply using the same spatial stream 604. Similarly, the soliciting frame for STA1 may use a second spatial stream 606 and the STA1 may reply using the same spatial stream 608.” EX-1005, 16:2-6.

252. Merlin also discloses that “the bandwidth 502 used for the soliciting immediate response from STA2 is equal to the bandwidth 504 used by STA2 for the reply (BA STA2). Similarly, the bandwidth 506 used for the soliciting

immediate response from STA1 is equal to the bandwidth 508 used by STA1 for the reply (BA STA1).” EX-1005, 15:45-50.

253. Accordingly, claim 9 is unpatentable as anticipated by or obvious in view of Merlin.

10. Claim 10.

[10] The method of claim 9, wherein the first multi-user acknowledgement frame and the second multi-user acknowledgement frame together form a multi-user acknowledgement frame for acknowledging the downlink multi-user frame.

254. Merlin discloses or renders [10] obvious. For example, Merlin discloses that “[a]ccording to certain aspects, BAs/ACKs may be aggregated with the UL PPDU.” EX-1005, 20:21-22. Accordingly, claim 10 is unpatentable as anticipated by or obvious in view of Merlin.

11. Claim 11.

[11] The method of claim 8, wherein processing the first MPDU comprises: extracting the acknowledgement information indicating the properties of the first multi-user acknowledgement frame from a header of the first MPDU.

12. Claim 12.

[12] The method of claim 11, wherein the header is a MAC header of the first MPDU.

13. Claim 13.

[13] The method of claim 8, wherein processing the MPDU comprises: extracting the acknowledgement information indicating the properties of the first multi-user

acknowledgement frame transmission from a payload of the first MPDU, wherein the first MPDU is a unicast trigger frame.

255. Merlin discloses or renders [11], [12], and [13] obvious. For example, Merlin discloses that “**a response type indication for each STA** may be added in **each MPDU**.... For example, 1 or 2 bits may indicate which mode of response is to be used (e.g., UL SU-MIMO, UL MU-MIMO, or UL FDMA).... the indication may be included in the Quality of Service (QoS) control field, the HT or VHT Control field, the frame control (FC) field, the A-MPDU delimiter preceding the MPDU, **an extended MAC header**....” EX-1005; 14:26-35 (emphasis added).

256. Merlin also discloses “[a]ccording to certain aspects, a fifth option to indicate the response parameters may be in a special frame aggregated in the A-MPDU,” and “[t]he special frame may be **a trigger frame** or a modified BAR frame.” EX-1005, 17:11-13, 17:25-26 (emphasis added).

257. Accordingly, claim 11, 12, and 13 are unpatentable as anticipated by or obvious in view of Merlin. *See* Section XI.B.2, XI.B.3, XI.B.4 (discussion of [2], [3], [4]).

14. Claim 14.

[14] The method of claim 13, further comprising: processing a second MPDU in a same resource unit as the first MPDU,

wherein the second MPDU includes data intended for the first station.

258. Merlin discloses or renders [14] obvious. For example, Merlin discloses a further embodiment where “each special frame may be received by one STA and may include the parameter information for that STA only. Alternatively, the special frame(s) (e.g., one special frame per STA or a single broadcast special frame) may be sent in a separate PPDU following the data DL PPDU, as shown in FIG. 8.” EX-1005, 17:13-19.

259. Accordingly, claim 14 is unpatentable as anticipated by or obvious in view of Merlin.

15. Claim 15.

[15] The method of claim 13, wherein the trigger frame instigates the first station to transmit the first multi-user acknowledgement after an interframe spacing period following receipt of the downlink multi-user frame.

260. Merlin discloses or renders [15] obvious. *See* Section XI.B.5 (discussion of [5]).

16. Claim 16.

[16] The method of claim 8, further comprising: receiving a multi-user block acknowledgement request frame that solicits acknowledgements from the first and second station, wherein the first multi-user acknowledgement frame is

transmitted after receipt of and in response to the multi-user block acknowledgement request frame.

261. Merlin discloses or renders [16] obvious. For example, Merlin discloses a further embodiment where “a single multi-STA BAR frame 1506 may be sent in a separate DL PPDU subsequent to the DL A-MPDU having data PSDUs 1502 and 1504 addressed to STA2 and STA1, respectively, and may request BAs 1508 and 1510 from STA2 and STA1, respectively.” EX-1005, 19:44-49; FIG. 15.

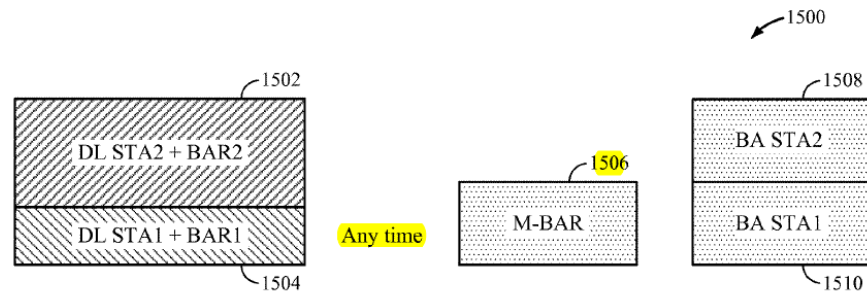


FIG. 15

262. Accordingly, claim 16 is unpatentable as anticipated by or obvious in view of Merlin.

17. Claim 17.

[17] The method of claim 8, wherein the acknowledgement information includes one or more of: (1) an indication of whether the first multi-user acknowledgement frame is part of a multi-user or a single user transmission, and (2) an indication of whether the first multi-user acknowledgement frame is transmitted immediately following receipt of the downlink multi-user frame or upon receipt of a multi-user block acknowledgement request frame, and further includes resource scheduling information when the first multi-user

acknowledgement frame is indicated as being part of the multi-user transmission.

263. Merlin discloses or renders [17] obvious. *See* Section XI.B.7 (discussion of [7]).

18. Claim 18.

- a. **[18pre] A method, implemented by a first station in a wireless network, for transmitting an uplink acknowledgment, the method comprising:**

264. Merlin discloses [18pre]. *See* Section XI.B.8.a (discussion of Limitation [8pre]).

- b. **[18a] receiving a downlink multi-user frame addressed to a plurality of stations, including the first station, wherein the downlink multi-user frame is received from an access point in the wireless network;**

265. Merlin discloses [18a]. *See* Section XI.B.8.b (discussion of Limitation [8a]).

- c. **[18b] receiving a multi-user block acknowledgement request frame that solicits acknowledgements from the first station and a second station, wherein the multi-user block acknowledgement request frame includes acknowledgement information indicating**

properties of a first multi-user acknowledgement frame;

- d. [18c] generating the first multi-user acknowledgement frame based on the acknowledgement information; and**
- e. [18d] acknowledging the receipt of the downlink multi-user frame by transmitting the first multi-user acknowledgement frame to the access point,**

266. Merlin discloses [18b], [18c] and [18d]. For example, Merlin discloses that “each special frame may be received by one STA and may include the parameter information for that STA only. Alternatively, the special frame(s) (e.g., one special frame per STA or a single broadcast special frame) may be sent in a separate PPDU following the data DL PPDU, as shown in FIG. 8.” EX-1005, 17:13-19. Merlin also discloses as “illustrated in FIG. 8, the special frame 804 indicating the parameters for the immediate responses 806 (BA STA2) and 810 (BA STA1) from STA2 and STA1, respectively, may be send in a separate DL PPDU following the DL PPDU 802 (DL STA2) and 808 (DL STA1) soliciting immediate responses from STA2 and STA1, respectively. The special frame may be a trigger frame or a modified BAR frame.” EX-1005, 17:19-26. *See* Section XI.B.8.b; Section XI.B.8.c.

- f. [18e] wherein the first multi-user acknowledgement frame is transmitted simultaneously with a second**

multi-user acknowledgement frame generated and transmitted by the second station.

267. Merlin discloses [18e]. Merlin discloses that “multiple responses (e.g., ACKs/BAs) to the MU PDDU, from multiple STAs, are possible at the same time.” EX-1005, 13:3-5.

268. For the foregoing reasons, claim 18 of the '520 Patent is unpatentable as anticipated by or obvious in view of Merlin. *See* Section XI.B.8 (discussion of [8]).

19. Claim 19.

[19] The method of claim 18, wherein the acknowledgement information includes one or more of: (1) an indication of whether the first multi-user acknowledgement frame is part of a multi-user or single user transmission and (2) resource scheduling information for the first multi-user acknowledgement transmission.

269. Merlin discloses or renders [19] obvious. In addition, Merlin discloses that “**indicating the resource allocation for the STAs to send in UL MU-MIMO... may be accomplished by including the spatial stream/channel allocation and power control for each STA,**” and for example, “the parameters to be used (e.g., duration of the response PPDU, spatial stream/channel allocation, and power allocation) **may also be indicated by bits in the BAR frame.**” EX-1005, 18: 24-28; 19:27-30 (emphases added). *See also* Section XI.B.6, XI.B.8.b, and XI.B.17.

20. Claim 20.

[20] The method of claim 18, wherein the acknowledgment scheduling information includes properties of the second multi-user acknowledgement frame generated and transmitted by the second station, wherein the first multi-user acknowledgement frame and the second multi-user acknowledgement together form a multi-user transmission.

270. Merlin discloses or renders [20] obvious. *See* Section XI.B.8.e

(discussion of Limitation [8e]).

C. Ground 3: Shu renders obvious Claims 1-20.

271. As set forth below, Shu renders Claims 1-20 obvious and unpatentable.

1. Claim 1.

a. [1pre] A method, implemented by a network device in a wireless network, for coordinating an uplink multi-user response transmission to a downlink multi-user transmission, the method comprising:

272. Shu discloses [1pre]. For example, Shu discloses “a method 300 for acknowledging transmission of downlink data frames by multiple stations in a wireless local area network.” EX-1006, [0049]; FIG. 3.

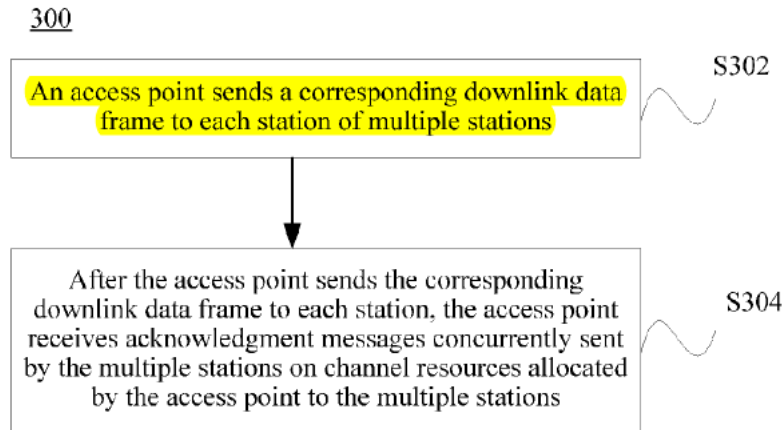


FIG. 3

- b. [1a] generating, by the network device, a downlink multi-user frame addressed to a plurality of stations operating in the wireless network, the downlink multi-user frame including a plurality of resource units (RUs), wherein generating the downlink multi-user frame comprises:

assigning each RU of the plurality of RUs to a respective station in the plurality of stations, and

including a respective set of MAC Protocol Data Units (MPDUs) in each RU of the plurality of RUs,

wherein an MPDU in one or more of the RUs in the plurality of RUs includes acknowledgement information indicating properties of a multi-user acknowledgement transmission that the station in the plurality of stations to which the RU is assigned is requested to transmit to acknowledge the downlink multi-user frame;

273. Shu renders [1a] obvious. Specifically, Shu discloses that “[t]he [AP] may add channel resource information to an acknowledgment request message sent to the multiple [STAs], where the channel resource information is used to indicate

the channel resource allocated by the [AP] to each [STA] of the multiple [STAs]..., [and] where the channel resource information is used to indicate a channel resource allocated by the access point to a station receiving the corresponding downlink data frame.” EX-1006, [0054].

274. Shu also discloses that “information used to identify a channel resource that is used to send an acknowledgment message and that is allocated by an [AP] to a [STA] corresponding to a downlink data frame may be carried in a header of a physical-layer frame format of the downlink data frame, or may be carried in a header of a Media Access Control (Media Access Control, MAC for short)-layer frame format of the downlink data frame...” EX-1006, [0069].

275. From at least Shu’s disclosures of the AP’s allocations of channel resource information to STAs, a POSITA would readily understand that the AP disclosed in Shu allocates and assigns each of the resources, such as spatial streams or channels, to a respective one of the multiple STAs, and that Shu renders obvious the [1a] limitation “assigning each RU of the plurality of RUs to a respective station in the plurality of stations.”

276. Particularly since the ’520 Patent inventors describe the phrase “resource units (RU)” used in the ’520 Patent may be “particular spatial streams or sub-channels,” (EX-1001, 14:12-14; 18:5-8; 20:48-50), a POSITA would readily

understand that Shu's disclosed AP assigns 'RUs' to STAs and includes 'RUs' in a MAC header of a DL MU frame to the STAs. *See* EX-1006; FIG. 7A; FIG. 7B.

277. Alternatively or in addition, particularly in view of the State of the Art, e.g., how it has been known to dynamically allocate resource units and the IEEE Standardization was known to discuss dynamic allocation of resource units (*see* Section VI.D-VI.F above), a POSITA would readily understand Shu discloses or render obvious the [1a] limitation "assigning each RU of the plurality of RUs to a respective station in the plurality of stations."

278. Shu discloses that "the receiving, by the access point, acknowledgment messages concurrently sent by the multiple stations on channel resources allocated by the access point to the multiple stations is specifically: receiving, by the access point, the acknowledgment messages concurrently sent by the multiple stations on the channel resources indicated by the channel resource information included in the acknowledgment request message." EX-1006, [0008].

279. Shu discloses that in an embodiment, "the downlink data frame includes information used to identify a channel resource allocated to a [STA] corresponding to the downlink data frame," and "the information is located in a physical frame convergence procedure header PLCP Header of the downlink data frame." EX-1006, [0011]-[0012]. *See also* EX-1006; FIG. 7A; FIG. 7B.

280. Shu also discloses that “information used to **identify a channel resource that is used to send an acknowledgment message** and that **is allocated by an [AP] to a [STA] corresponding to a downlink data frame** may be carried in a header of a physical-layer frame format of the downlink data frame, or **may be carried in a header of a Media Access Control** (Media Access Control, MAC for short)-layer frame format of the downlink data frame....” EX-1006, [0069] (emphases added).

281. In view of Shu’s disclosure of a channel resource information in a MAC header and corresponding to a DL frame, a POSITA would readily understand that the frames generated by the AP disclosed in Shu renders obvious the [1a] limitation “generating the downlink multi-user frame comprises: assigning each RU of the plurality of RUs to a respective station in the plurality of stations, and including a respective set of MAC Protocol Data Units (MPDUs) in each RU of the plurality of RUs.”

282. In addition, particularly in view of the State of the Art, e.g., how MAC protocol data unit (MPDU) formation in the MAC data plane has been known to provide MU transmissions (*see* Section VI.B and VI.D above), a POSITA would readily understand that the frames generated by the AP disclosed in Shu renders obvious the [1a] limitation “generating the downlink multi-user frame comprises: assigning each RU of the plurality of RUs to a respective station

in the plurality of stations, and including a respective set of MAC Protocol Data Units (MPDUs) in each RU of the plurality of RUs.”

283. In addition, Shu discloses “[a]n access point (Access Point, AP for short) can send a downlink data frame to multiple stations (Station, STA for short) at the same time by using the multi-user multiple-input multiple-output (Multi-User Multiple-Input Multiple-Output, MU MIMO for short) or orthogonal frequency division multiple access (Orthogonal Frequency Division Multiple Access, OFDMA for short) technology.” EX-1006, [0003].

284. For example, Shu discloses “the access point first sends a null data packet announcement (Null Data Packet Announce, NDPA for short)” EX-1006, [0003].

285. Shu also discloses “[i]n the next-generation WLAN (Wireless Local Area Network, wireless local area network) technology standard IEEE 802.11ax following the IEEE 802.11ac standard, the PLCP Header may further include an HEW SIG (High Efficiency WLAN Signal, high efficiency WLAN signal) field. The added sub-channel index field may be located in the PLCP Header field. For example, the sub-channel index field may be at a location following the L-SIG field and followed by the HEW SIG field. Alternatively, the sub-channel index field may be at a location followed by the L-SIG field.” EX-1006, [0067].

286. Particularly in view of the IEEE Standardization was known to discuss dynamic allocation of resource units (*see* Section VI.D-VI.F above), a POSITA would readily understand that Shu renders obvious the [1a] limitation “generating, by the network device, a downlink multi-user frame addressed to a plurality of stations operating in the wireless network, the downlink multi-user frame including a plurality of resource units (RUs), wherein generating the downlink multi-user frame comprises: assigning each RU of the plurality of RUs to a respective station in the plurality of stations, and including a respective set of MAC Protocol Data Units (MPDUs) in each RU of the plurality of RUs, wherein an MPDU in one or more of the RUs in the plurality of RUs includes acknowledgement information indicating properties of a multi-user acknowledgement transmission that the station in the plurality of stations to which the RU is assigned is requested to transmit to acknowledge the downlink multi-user frame.”

- c. **[1b] transmitting the downlink multi-user frame to the plurality of stations over a wireless channel; and**
- d. **[1c] receiving the uplink multi-user response transmission, the uplink multi-user response transmission including multi-user acknowledgement transmissions respectively and simultaneously**

transmitted by two or more stations in the plurality of stations,

287. Shu discloses [1b] and [1c]. Shu discloses that “[t]he [AP] may concurrently send the downlink data frame to each station of the multiple [STAs] by using....MU MIMO...,” and “[a]fter the [AP] sends the corresponding downlink data frame to each [STA], the [AP] receives acknowledgment messages concurrently sent by the multiple [STA] stations on channel resources allocated by the [AP] to the multiple [STAs].” EX-1006, [0051]; [0053].

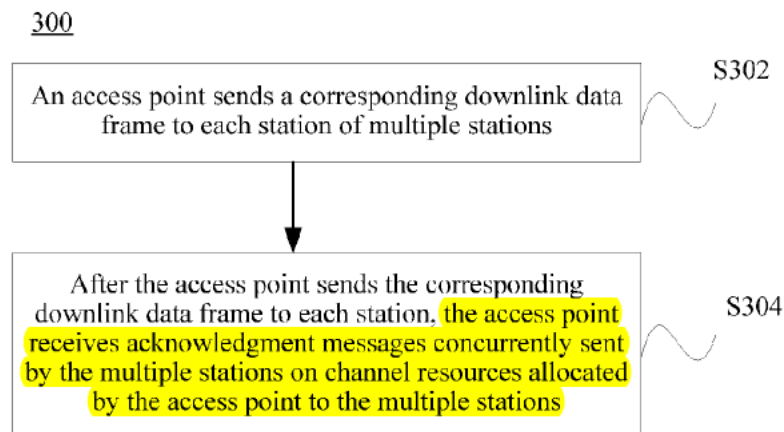


FIG 3

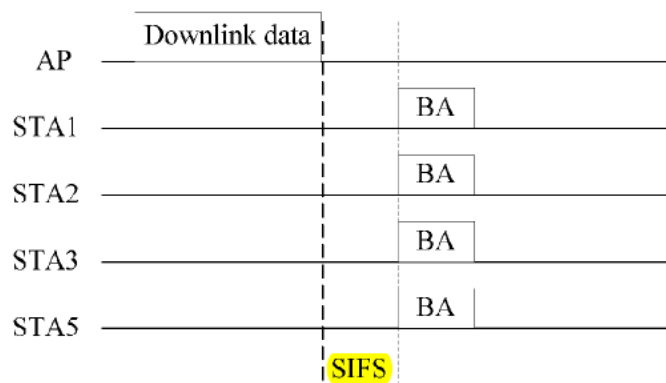


FIG 6

288. Shu also discloses “sending, by the access point, an acknowledgment request message to the multiple stations after preset time, where the acknowledgment request message includes channel resource information, and the channel resource information is used to indicate the channel resources allocated by the access point to the multiple stations” EX-1006, [0057].

- e. **[1d] wherein the plurality of RUs respectively correspond to a plurality of simultaneous uplink transmissions, and each of the plurality of simultaneous uplink transmissions uses a sub-channel, spatial stream, or sub-channel and spatial stream combination that is not used by any other of the plurality of simultaneous uplink transmissions.**

289. Shu discloses [1d]. For example, Shu discloses that “[t]he multiple [STAs] may use the OFDMA technology to concurrently send the acknowledgment messages to the [AP] by using the channel resources allocated by the [AP] and indicated by the channel resource information, so as to notify the [AP] of whether the downlink data frames are received successfully.” EX-1006, [0054]. Shu also discloses that “[i]f the [AP] allocates the tenth sub-channel to a corresponding [STA], the tenth bit of the 16 binary bits may be set to 1, and remaining binary bits are set to 0, which indicates that the tenth sub-channel is allocated to the corresponding [STA], and the [STA] feeds back an acknowledgment message by using the tenth sub-channel.” EX-1006, [0062].

290. For the foregoing reasons, claim 1 of the '520 Patent is unpatentable as obvious in view of Shu.

2. Claim 2.

[2] The method of claim 1, wherein generating the downlink multi-user frame further comprises: including the acknowledgement information, for indicating properties of the multi-user acknowledgement transmission transmitted by each respective station in the plurality of stations to acknowledge the downlink multi-user frame, in a header of the one or more MPDUs.

3. Claim 3.

[3] The method of claim 2, wherein the header is a MAC header of the one or more MPDUs.

291. Shu renders [2] and [3] obvious. For example, Shu discloses that “information used to identify a channel resource that is used to send an acknowledgment message and that is allocated by an [AP] to a [STA] corresponding to a downlink data frame may be carried in a header of a physical-layer frame format of the downlink data frame, or may be carried in a header of a Media Access Control (Media Access Control, MAC for short)-layer frame format of the downlink data frame....” EX-1006, [0069]. Shu also discloses that in an embodiment, “the downlink data frame includes information used to identify a channel resource allocated to a [STA] corresponding to the downlink data frame,” and “the information is located in a physical frame convergence procedure header

PLCP Header of the downlink data frame.” EX-1006, [0011]-[0012]. *See* Section XI.C.1.b (discussion of Limitation [1a]).

292. Accordingly, claim 2 and claim 3 are unpatentable as obvious in view of Shu.

4. Claim 4.

[4] The method of claim 1, wherein one of the one or more MPDUs in each of the RUs of the plurality of RUs is a unicast trigger frame that contains the acknowledgement information for the respective station in the plurality of stations.

293. Shu renders [4] obvious. For example, Shu discloses that “[t]he [AP] sends BlockAckReq to a corresponding [STA] by means of unicast....” EX-1006, [0064].

294. Accordingly, claim 4 is unpatentable as obvious in view of Shu.

5. Claim 5.

[5] The method of claim 4, wherein the trigger frame instigates each respective station in the plurality of stations to transmit the multi-user acknowledgement transmission after an interframe spacing period following receipt of the downlink multi-user frame.

295. Shu renders [5] obvious. For example, Shu discloses that “[t]he preset time may be a short interframe space (Short Interframe Space, SIFS for short). Values of the SIFS may be different in different IEEE 802.11 standards. For example, in the IEEE 802.11a standard, the value of the SIFS is 16 μ s, and in the

IEEE 802.11g standard, the value of the SIFS is 10 μ s.” EX-1006, [0058]. See FIG. 6.

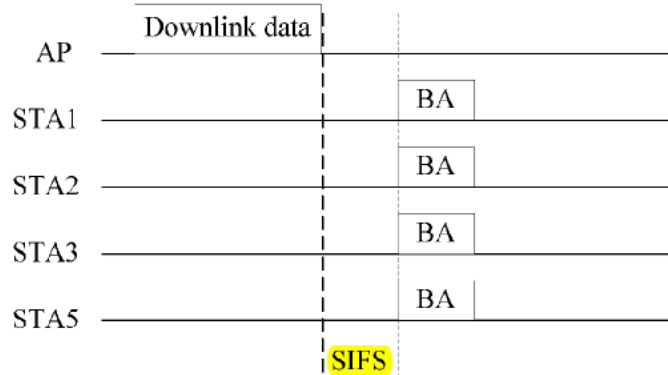


FIG. 6

296. Accordingly, claim 5 is unpatentable as obvious in view of Shu.

6. Claim 6.

[6] The method of claim 1, further comprising:

generating, by the network device, a multi-user block acknowledgement request frame to solicit acknowledgements from two or more stations of the plurality of stations; and

transmitting the multi-user block acknowledgment request frame following transmission of the downlink multi-user frame.

297. Shu renders [6] obvious. For example, Shu discloses a further embodiment where “receiving, by the station after preset time, an acknowledgment request message sent by the access point, where the acknowledgment request message includes channel resource information, and the channel resource information is used to indicate the channel resource allocated by the access point to

the station.” EX-1006, [0081]; FIG. 4. Shu also discloses “the acknowledgment request message may be a block acknowledgment request message BlockAckReq, and the block acknowledgment request message BlockAckReq includes the channel resource information that indicates the channel resources allocated by the access point to the multiple stations.” EX-1006, [0083].

298. Shu also discloses “sending, by the access point, an acknowledgment request message to the multiple stations after preset time, where the acknowledgment request message includes channel resource information, and the channel resource information is used to indicate the channel resources allocated by the access point to the multiple stations,” and “the acknowledgment request message may be a block acknowledgment request message BlockAckReq. When the access point sends the acknowledgment request message to the multiple stations by means of multicast, the block acknowledgment request message BlockAckReq includes channel resource information that indicates the channel resources allocated by the access point to the multiple stations.” EX-1006, [0057], [0060].

299. Accordingly, claim 6 is unpatentable as obvious in view of Shu.

7. Claim 7.

[7] The method of claim 1, wherein the acknowledgement information includes one or more of: (1) an indication of whether the acknowledgement transmission is multi-user or single user, and (2) an indication of whether the

acknowledgment transmission is immediate or non-immediate, and further includes resource scheduling information when the multi-user acknowledgement transmission is indicated.

300. Shu renders [7] obvious. Shu discloses that “[t] he acknowledgment request message may be a BlockAckReq (...BlockAckReq may also be BAR for short)” and “[a]fter receiving the acknowledgment request messages, the multiple stations sequentially return acknowledgment messages to the AP in a time division manner.” EX-1006, [0004]. In view of Shu’s disclosures of BAR (which is known to be transmitted as a MU DL frame) and sequential UL ACKs from the STAs, a POSITA would readily understand Shu discloses or renders obvious “wherein the acknowledgement information includes one or more of: (1) an indication of whether the acknowledgement transmission is multi-user or single user...”

301. Shu also discloses that “[s]pecifically, the acknowledgment request message may be a block acknowledgment request message BlockAckReq, and the block acknowledgment request message BlockAckReq includes the channel resource information that indicates the channel resources allocated by the [AP] to the multiple [STAs]. After the [AP] sends the downlink data frame to each station of the multiple [STAs], the [AP] receives the acknowledgment messages concurrently sent by the multiple [STAs], where the multiple [STAs] concurrently send the acknowledgment messages to the [AP] by using the channel resources indicated by the channel resource information included in the block

acknowledgment request message BlockAckReq.” EX-1006, [0110]. A POSITA would readily understand Shu’s disclosed acknowledgement request to provide resource scheduling information. Accordingly, claim 7 is unpatentable as obvious in view of Shu.

8. Claim 8.

[8pre] A method, implemented by a first station in a wireless network, for transmitting an uplink acknowledgment, the method comprising:

302. Shu discloses [8pre]. Shu discloses that “a method for acknowledging transmission of a downlink data frame by a station in a wireless local area network.” EX-1006, [0075]; FIG. 8. *See* Section XI.C.1.

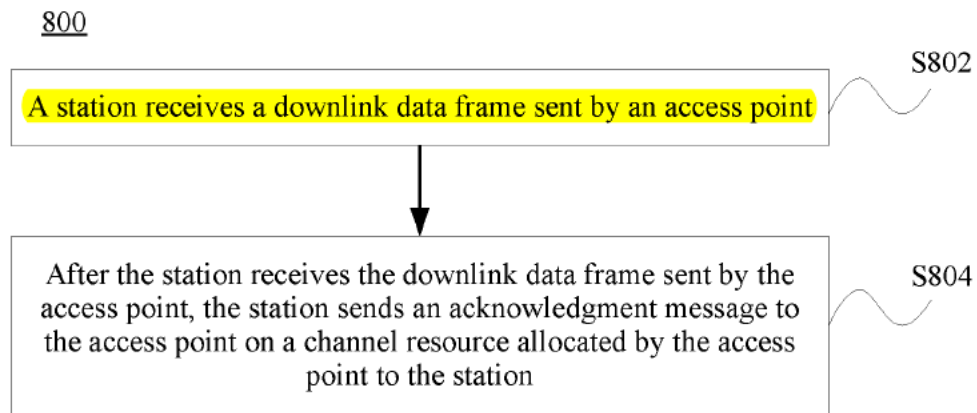


FIG. 8

- b. [8a] receiving a downlink multi-user frame addressed to a plurality of stations, including the first station, and received from an access point in the wireless network;**

303. Shu renders [8a] obvious. For example, Shu discloses that “[t]he station receives a downlink data frame sent by an access point.” EX-1006, [0076]; FIG. 6; FIG. 8.

- c. [8b] processing a first MAC Protocol Data Units (MPDU) in the downlink multi-user frame to determine acknowledgement information indicating properties of a first multi-user acknowledgement frame;**

304. Shu discloses [8b]. Shu discloses that “[t]he [AP] may add channel resource information to an acknowledgment request message sent to the multiple [STAs], where the channel resource information is used to indicate the channel resource allocated by the [AP] to each [STA] of the multiple [STAs]..., [and] where the channel resource information is used to indicate a channel resource allocated by the access point to a station receiving the corresponding downlink data frame.” EX-1006, [0054].

305. Shu also discloses that “information used to identify a channel resource that is used to send an acknowledgment message and that is allocated by an [AP] to a [STA] corresponding to a downlink data frame may be carried in a header of a physical-layer frame format of the downlink data frame, or may be carried in a header of a Media Access Control (Media Access Control, MAC for

short)-layer frame format of the downlink data frame....” EX-1006, [0069]. Shu also discloses that in an embodiment, “the downlink data frame includes information used to identify a channel resource allocated to a [STA] corresponding to the downlink data frame,” and “the information is located in a physical frame convergence procedure header PLCP Header of the downlink data frame.” EX-1006, [0011]-[0012]. *See* Section XI.D.1.b (discussion of Limitation [1a]). In view of Shu’s disclosed PLCP header and a MAC header, a POSITA would have understood that although Shu does not use the phrase “MPDUs,” Shu still discloses or render obvious the concept of “MPDU.”

- d. **[8c] generating the first multi-user acknowledgment frame based on the acknowledgement information; and**
- e. **[8d] transmitting the first multi-user acknowledgement frame to the access point to acknowledge the downlink multi-user frame,**

306. Shu discloses [8c] and [8d]. For example, Shu discloses that “[a STA] may find, from a server or from a local data table of the [STA] according to the index number, a channel resource allocated to the [STA].” EX-1006, [0064]; [0071]. Shu also discloses that “[a]fter the [STA] receives the downlink data frame sent by the [AP], the [STA] sends an acknowledgment message to the [AP] on a channel resource allocated by the [AP] to the [STA].” EX-1006, [0077].

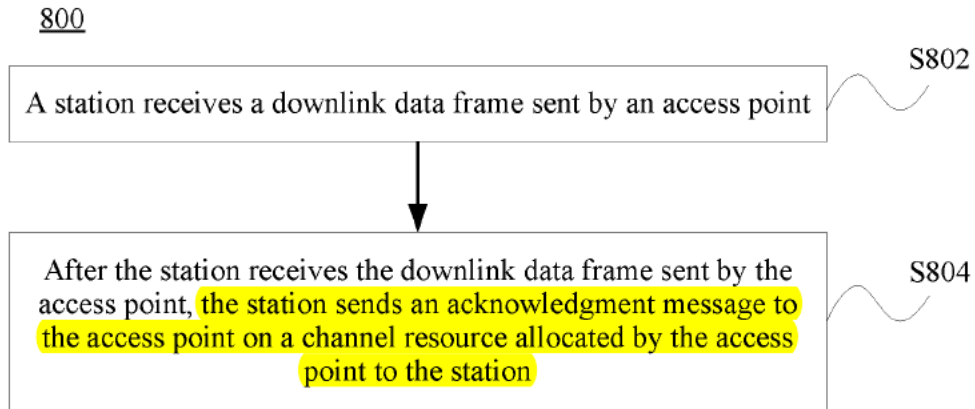


FIG. 8

- f. **[8e] wherein the first multi-user acknowledgement frame is transmitted simultaneously to a second multi-user acknowledgement frame transmitted by a second station.**

307. Shu discloses [8e]. Specifically, Shu discloses that “[t]he multiple [STAs] may use the OFDMA technology to concurrently send the acknowledgment messages to the [AP] by using the channel resources allocated by the [AP] and indicated by the channel resource information, so as to notify the [AP] of whether the downlink data frames are received successfully.” EX-1006, [0054]. *See also* EX-1006, FIG. 6.

308. For the foregoing reasons, claim 8 of the ’520 Patent is unpatentable as obvious in view of Shu. *See* Section XI.C.1 (discussion of [1]).

9. Claim 9.

[9] The method of claim 8, wherein the first MPDU is located in a first resource unit of the downlink multi-user frame allocated to the first station, wherein the downlink multi-user frame includes a second resource unit that contains a second MPDU that includes acknowledgement

information for the second multi-user acknowledgement frame.

309. Shu renders [9] obvious. *See* Section XI.C.1.b (discussion of Limitation [1a]).

10. Claim 10.

[10] The method of claim 9, wherein the first multi-user acknowledgement frame and the second multi-user acknowledgement frame together form a multi-user acknowledgement frame for acknowledging the downlink multi-user frame.

310. Shu renders [10] obvious. *See* Section XI.C.1.d (discussion of Limitation [1c]).

11. Claim 11.

[11] The method of claim 8, wherein processing the first MPDU comprises: extracting the acknowledgement information indicating the properties of the first multi-user acknowledgement frame from a header of the first MPDU.

12. Claim 12.

[12] The method of claim 11, wherein the header is a MAC header of the first MPDU.

311. Shu renders [11] and [12] obvious. *See* Section XI.C.2 and XI.C.3 (discussion of [2] and [3]).

13. Claim 13.

[13] The method of claim 8, wherein processing the MPDU comprises: extracting the acknowledgement information indicating the properties of the first multi-user acknowledgement frame transmission from a payload of the

first MPDU, wherein the first MPDU is a unicast trigger frame.

312. Shu renders [13] obvious. *See* Section XI.C.4 (discussion of [4]).

14. Claim 14.

[14] The method of claim 13, further comprising: processing a second MPDU in a same resource unit as the first MPDU, wherein the second MPDU includes data intended for the first station.

313. Shu renders [14] obvious. For example, Shu discloses the AP “sending the downlink data frame to the multiple stations,” and sending “the acknowledgment request message to the multiple stations after preset time.” EX-1006, [0096]. *See also*, EX-1006, FIG. 2 and 4.

314. Shu discloses that “[t]he access point may add channel resource information to an acknowledgment request message sent to the station, where the channel resource information is used to indicate the channel resource allocated by the access point to the station; or the access point may add channel resource information to the downlink data frame sent to the station, where the channel resource information is used to indicate the channel resource allocated by the access point to the station.” EX-1006, [0054].

315. Shu also discloses that “[t]he access point may add channel resource information to an acknowledgment request message sent to the station, where the channel resource information is used to indicate the channel resource allocated by

the access point to the station; or the access point may add channel resource information to the downlink data frame sent to the station, where the channel resource information is used to indicate the channel resource allocated by the access point to the station.” EX-1006, [0106]. Also, “the acknowledgment request message may be a block acknowledgment request message BlockAckReq, and the block acknowledgment request message BlockAckReq includes the channel resource information that indicates the channel resources allocated by the access point to the multiple stations.” EX-1006, [0097].

316. In view of at least Shu’s disclosure of channel resource allocation by the AP to each STA and transmission of multiple DL MU frames by the AP, a POSITA would readily understand that the STA disclosed in Shu received multiple DL MU frames in the allocated channel units from the AP, and that Shu discloses or renders obvious the [14] limitation “processing a second MPDU in a same resource unit as the first MPDU, wherein the second MPDU includes data intended for the first station.”

15. Claim 15.

[15] The method of claim 13, wherein the trigger frame instigates the first station to transmit the first multi-user acknowledgement after an interframe spacing period following receipt of the downlink multi-user frame.

317. Shu renders [15] obvious. *See* Section XI.C.5 (discussion of [5]).

16. Claim 16.

[16] The method of claim 8, further comprising: receiving a multi-user block acknowledgement request frame that solicits acknowledgements from the first and second station, wherein the first multi-user acknowledgement frame is transmitted after receipt of and in response to the multi-user block acknowledgement request frame.

318. Shu renders [16] obvious. *See* Section XI.C.6 (discussion of [6]).

17. Claim 17.

[17] The method of claim 8, wherein the acknowledgement information includes one or more of: (1) an indication of whether the first multi-user acknowledgement frame is part of a multi-user or a single user transmission, and (2) an indication of whether the first multi-user acknowledgement frame is transmitted immediately following receipt of the downlink multi-user frame or upon receipt of a multi-user block acknowledgement request frame, and further includes resource scheduling information when the first multi-user acknowledgement frame is indicated as being part of the multi-user transmission.

319. Shu renders [17] obvious. *See* Section XI.C.7 (discussion of [7]).

18. Claim 18.

a. [18pre] A method, implemented by a first station in a wireless network, for transmitting an uplink acknowledgment, the method comprising:

320. Shu discloses [18pre]. *See* Section XI.C.8.a (discussion of Limitation [8pre]).

- b. **[18a] receiving a downlink multi-user frame addressed to a plurality of stations, including the first station, wherein the downlink multi-user frame is received from an access point in the wireless network;**

321. Shu discloses [18a]. *See* Section XI.C.8.b (discussion of Limitation [8a]).

- c. **[18b] receiving a multi-user block acknowledgement request frame that solicits acknowledgements from the first station and a second station, wherein the multi-user block acknowledgement request frame includes acknowledgement information indicating properties of a first multi-user acknowledgement frame;**

322. Shu discloses [18b]. Shu discloses “sending, by the access point, an acknowledgment request message to the multiple stations after preset time, where the acknowledgment request message includes channel resource information, and the channel resource information is used to indicate the channel resources allocated by the access point to the multiple stations,” and “the acknowledgment request message may be a block acknowledgment request message BlockAckReq. When the access point sends the acknowledgment request message to the multiple stations by means of multicast, the block acknowledgment request message BlockAckReq includes channel resource information that indicates the channel resources allocated by the access point to the multiple stations.” EX-1006, [0057], [0060]. *See* Section XI.C.16 (discussion of Claim [16]).

- d. **[18c] generating the first multi-user acknowledgment frame based on the acknowledgement information; and**
- e. **[18d] acknowledging the receipt of the downlink multi-user frame by transmitting the first multi-user acknowledgement frame to the access point,**

323. Shu discloses [18c] and [18d]. *See* Section XI.C.8.b; Section XI.C.8.c.

- f. **[18e] wherein the first multi-user acknowledgement frame is transmitted simultaneously with a second multi-user acknowledgement frame generated and transmitted by the second station.**

324. Shu discloses [18e].

325. For the foregoing reasons, claim 18 of the '520 Patent is unpatentable as anticipated by or obvious in view of Shu. *See* Section XI.C.8 (discussion of [8]).

19. Claim 19.

[19] The method of claim 18, wherein the acknowledgement information includes one or more of: (1) an indication of whether the first multi-user acknowledgement frame is part of a multi-user or single user transmission and (2) resource scheduling information for the first multi-user acknowledgement transmission.

326. Shu discloses or renders [19] obvious. Shu discloses “sending, by the access point, an acknowledgment request message to the multiple stations after preset time, where the acknowledgment request message includes channel resource information, and the channel resource information is used to indicate the channel

resources allocated by the access point to the multiple stations,” and “the acknowledgment request message may be a block acknowledgment request message BlockAckReq. When the access point sends the acknowledgment request message to the multiple stations by means of multicast, the block acknowledgment request message BlockAckReq includes channel resource information that indicates the channel resources allocated by the access point to the multiple stations.” EX-1006, [0057], [0060]. *See also* Section XI.C.6, XI.C.8.b, and XI.C.17.

20. Claim 20.

[20] The method of claim 18, wherein the acknowledgment scheduling information includes properties of the second multi-user acknowledgement frame generated and transmitted by the second station, wherein the first multi-user acknowledgement frame and the second multi-user acknowledgement together form a multi-user transmission.

327. Shu discloses or renders [20] obvious. *See* Section XI.C.8.e (discussion of Limitation [8d]).

XII. SECONDARY CONSIDERATIONS

328. I am informed that neither Patent Owner nor the '520 Patent applicants identified any secondary considerations of non-obviousness with respect to the '520 Patent.

329. I reserve the right to supplement this Declaration should any evidence of secondary considerations of non-obviousness with respect to the '520 Patent be produced during this proceeding.

XIII. CONCLUSION

330. It is my opinion that claims 1-20 of the '520 Patent should be found unpatentable and should be canceled for the reasons I have set forth above.

331. I hereby declare under penalty of perjury under the laws of the United States of America that the foregoing is true and correct, that all statements made of my own knowledge are true, and that all statements made on information and belief are believed to be true. I understand that willful false statements are punishable by fine or imprisonment or both. *See* 18 U.S.C. § 1001.

Declaration of Paul Min, Ph.D.
U.S. Patent No. 9,531,520

Date: 4-18-2023

By: 
Paul Min