

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

IPR2023-00877
U.S. Patent No. 9,917,679

**EXHIBIT 1003 – DECLARATION OF DR. PAUL MIN
IN SUPPORT OF *INTER PARTES* REVIEW OF
U.S. PATENT NO. 9,917,679**

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PETITIONER'S EXHIBIT LIST

<u>Exhibit No.</u>	<u>Description</u>
EX-1001	U.S. Patent No. 9,917,679
EX-1002	Prosecution History for U.S. Patent No. 9,917,679
EX-1003	Declaration of Paul Min, Ph.D.
EX-1004	U.S. Patent No. 10,230,497 (“Merlin”)
EX-1005	U.S. Patent Appln. Pub. 2016/0065466 (“Abraham466”)
EX-1006	U.S. Patent No. 10,257,806 (“Chu806”)
EX-1007	U.S. Patent No. 9,462,607 (“Ma”)
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	Gast, M, <u>802.11® Wireless Networks: The Definitive Guide</u> , 2 nd Ed. (2005). ISBN: 978-0-596-10052-0 (“Gast”)
EX-1014	U.S. Patent No. 9,924,512 (“Zhang”)
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	“DL-OFDMA for Mixed Clients,” 11-10-0317-01-00ac-dl- ofdma-for-mixed-clients (March 6, 2010), https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=w eb&cd=&ved=2ahUKEwjuiuHOG6z-AhWLM1kFHd-

<u>Exhibit No.</u>	<u>Description</u>
	kBXMQFnoECA8QAQ&url=https%3A%2F%2Fmentor.ieee.org%2F802.11%2Fdcn%2F10%2F11-10-0317-01-00ac-dl-ofdma-for-mixed-clients.ppt&usg=AOvVaw3oGSoj8tUEhXCZ8Z6Kvq8V , retrieved on April 15, 2023.
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 1-10 of U.S. Patent No. 9,917,679
EX-1023	Provisional Application No. 62/074,514 of '679 Patent
EX-1024	Provisional Application No. 62/080,026 of '679 Patent
EX-1025	Provisional Application No. 62/043,061 of Abraham466 (“Abraham466_Provisional”)
EX-1026	Provisional Application No. 61/902,413 of Chu806 (“Chu806_Provisional_1”)
EX-1027	Provisional Application No. 61/947,922 of Chu806 (“Chu806_Provisional_2”)
EX-1028	U.S. Patent No. 8,395,997 (“Banerjea”)

TABLE OF ACRONYMS IN THE '679 PATENT

		<u>679 Patent (EX-1001) Citation</u>
ACK	acknowledgement/acknowledgment	Col. 4:21
AP	access point	Col. 1:45-46
DL	downlink	Col. 4:15
IEEE	Institute for Electrical and Electronics Engineers	Col. 1:37-38
IFS	interframe space	Col. 7:27-28
MAC	medium access control	Col. 4:47-48
MCS	modulation and coding scheme	Col. 23:18
MPDU	MAC Protocol Data Unit	Col. 3:62; Col. 8:64-65
MIMO	multiple-input multiple output	Col. 1:39
MU	multi-user	Col. 2:17
MU-MIMO	multi-user multiple-input multiple output	Col. 5:26-27
OFDMA	Orthogonal Frequency Division Multiple Access	Col. 4:15-16
PDU	Protocol Data Unit	Col. 3:62
PHY	physical	Col. 4:48
QoS	Quality of Service	Col. 7:55
STA	station	Col. 2:12
SU	single-user	Col. 2:16
UL	uplink	Col. 4:22
WLAN	Wireless local area network	Col. 1:19-20

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. 9,917,679 (“the ’679 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 1-10 (the “Challenged Claims”) of the ’679 Patent.

2. I have been asked to provide my opinions regarding whether the Challenged Claims of the ’679 Patent are patentable based on prior art from the viewpoint of a person having ordinary skill in the relevant art as of November 2014. The opinions set forth herein are based on my personal knowledge, professional experience, education and judgment in consideration of the ’679 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 ’679 Patent. I understand that the ’679 Patent has been provided as EX-1001. I will cite to the specification using the following formats: EX-1001, ’679 Patent, 1:1-10

(long form) and EX1001, 1:1-10 (short form). These example citations both point to the '679 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 November 2014, which is the earliest possible priority date for the '679 Patent. I am a technical expert in the fields relating to the '679 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 '679 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 1-10 of the '679 Patent are rendered obvious by Merlin.
- Ground 2: Claims 1-10 of the '679 Patent are rendered obvious by Abraham466.

- Ground 3: Claims 1-10 of the '679 Patent are rendered obvious by Merlin in view of Abraham466, Chu806, and Ma.

V. THE '679 PATENT: DESCRIPTION & PROSECUTION HISTORY

A. Description of the '679 Patent

35. The application issuing into the '679 Patent claimed priority to Provisional Application No. 62/074,514 filed on November 3, 2014, and No. 62/080,026 filed on November 14, 2014, with November 3, 2014, being the purported earliest effective filing date. *See* EX-1001, cover. I understand that the earlier of the filing dates, November 3, 2014, would be the earliest possible priority date (also called the effective filing date) for the '679 Patent. I understand that any publication prior to November 3, 2014, or any US patent/patent application having effective filing date prior to November 3, 2014, clearly is considered prior art to the '679 Patent. To the extent that any such publication or US patent/patent application discloses the claimed subject matter of the '679 Patent, it may be used to show that the claims of the '679 Patent are not patentable.

36. In Section XII below, I also provide a more detailed review of the '679 Patent's "effective filing date" claim for certain claim limitations.

37. According to its specification, the '679 Patent is directed to addressing "protecting a transmitted frame and...for determining the type of a response frame in a HEW," in view of "a task group called IEEE 802.11 ax, [that

was discussing] High Efficiency WLAN (HEW) standardization.” EX-1001, 1:58-59; 1:65-67.

38. Specifically, the '679 Patent purposes a method for transmitting a response frame by a STA to an AP in a format as requested by the AP, where there are multiple formats available in the network. *See* EX-1001, 1:19-23. For example, FIG. 23 of the '679 Patent illustrates an AP may transmit a DL frame to multiple STAs, where “[t]he DL frame may include information about the type of a UL frame transmitted as [a] response,” and “[t]he type of the UL frame may be an SU type or an MU type.” EX-1001, 40:47-54; 55-56.

B. Prosecution History of the '679 Patent

39. The USPTO issued an Office Action rejecting all original twenty claims as being unpatenable over U.S. Publication No. 2013/0188627 (Cheong) in view of U.S. Publication No. 2015/0085836 (Kang) on March 21, 2017. The Examiner indicated that “Cheong discloses...receiving, from the AP, a downlink frame including information related to a type of the uplink frame, the type of the uplink frame including a single-user (SU) type and a multiple-user (MU) type [Cheong] [0069],” and “Kang et al. teaches for UL MU-MIMO transmission.” EX-1002, March 21, 2017 Office Action.

40. In response to the Office Action, ten claims were canceled, and the reminding claims were amended. The inventor further argued, *inter alia*, that

“[n]owhere in the cited portions of *Cheong* is seen to disclose or suggest that...

“acknowledgement information representing whether the STA is requested to transmit the acknowledgement frame in a single-user (SU) format or in a multiple-user (MU) format,” as recited in independent claim 1. The inventor also argued that “the cited portions of *Cheong* are not seen to disclose or suggest...

“transmitting the acknowledgement frame in the MU format on the allocated resource simultaneously with transmission of at least one acknowledgement frame from at least one other STA” when “the acknowledgement information represents that the STA is requested to transmit the acknowledgement frame in the MU format and the STA is allocated a resource,” as recited in independent claim 1.

EX-1002, June 21, 2017 Amendment.

41. The USPTO later issued a Notice of Allowance without an Examiner’s Statement for Allowance. EX-1002, October 31, 2017 Notice of Allowance.

VI. THE STATE OF THE ART IN NOVEMBER 2014

42. The ’679 Patent broadly describes how an AP indicates to STAs on how to transmit UL acknowledgement frames (whether in a SU format or a MU format or when (whether after an interface spacing (IFS))). *See* EX-1001, Abstract, lines 10-15. The claims of the ’679 Patent recite these techniques in terms of five general concepts: (i) a DL MU frame being transmitted by an AP, with the DL

frame including (ii) a quality of service (QoS) control field (iii) including acknowledgement information (iv) representing whether a STA is requested to transmit an acknowledgement frame in a SU format or a MU format (v) at a short inter-frame space (SIFS) after the DL MU frame. But these concepts and techniques using an AP to manage a STA's transmissions by transmitting a frame with a control field to indicate the format and the timing for the STA to transmit an acknowledgement frame, and the benefits thereof, were well-known before the '679 Patent's earliest possible priority date, November 3, 2014.

A. Transmission Management by an AP

43. As an initial matter, the term "AP" and the term "base station" might have been used interchangeably in the context of an 802.11 network. *See*, EX-1013, 2.

Wireless networks typically have a great deal of *flexibility*, which can translate into rapid deployment. Wireless networks use a number of base stations to connect users to an existing network. (In an 802.11 network, the base stations are called *access points*.) The infrastructure side of a wireless network, however, is qualitatively the same whether you are connecting one user or a million users. To offer service in a given area, you need base stations and antennas in place. Once that infrastructure is built, however, adding a user to a wireless network is mostly a matter of authorization. With the infrastructure built, it must be configured to recognize and offer services to the new users, but authorization does not require more infrastructure. Adding a user to a wireless network is a matter of configuring the infrastructure, but it does not involve running cables, punching down terminals, and patching in a new jack.²

EX-1013, 2.

44. The concept of transmission/traffic management by an AP or a base station has been known since at least the adoption of the local area network (LAN) technologies by the IEEE.

45. For example, it has been known since at least 2005 that in the infrastructure wireless LAN networks, “[a]ccess points (APs) are used for all communications.... **With all communications relayed through an access point....**” EX-1013, 18 (emphasis added).

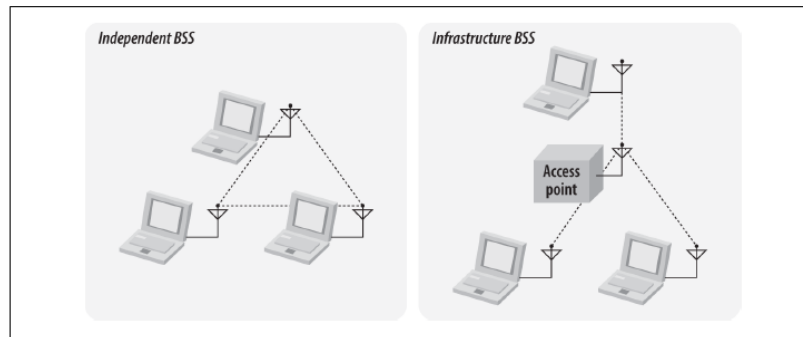


Figure 2-4. Independent and infrastructure BSSs

EX-1013, Figure 2-4 at 17.

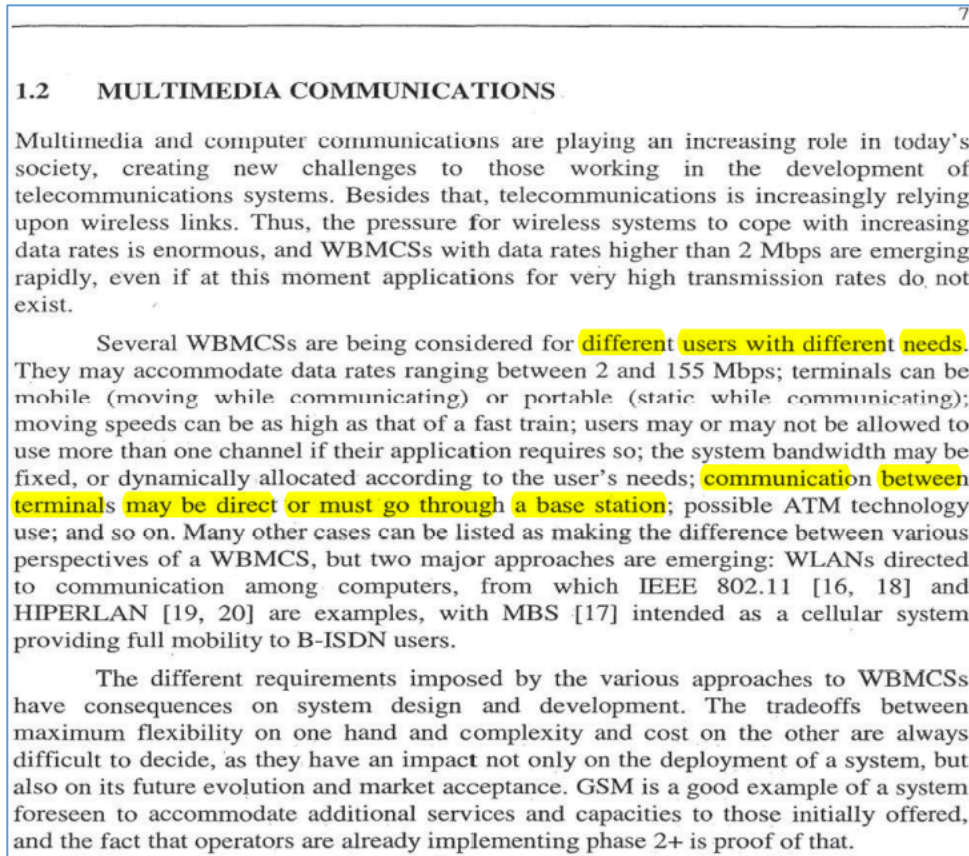
Infrastructure networks

On the right side of Figure 2-4 is an *infrastructure BSS*. (To avoid overloading the acronym, an infrastructure BSS is never called an IBSS). Infrastructure networks are distinguished by the use of an access point. Access points are used for all communications in infrastructure networks, including communication between mobile nodes in the same service area. If one mobile station in an infrastructure BSS needs to communicate with a second mobile station, the communication must take two hops. First, the originating mobile station transfers the frame to the access point. Second, the access point transfers the frame to the destination station. With all communications relayed through an access point, the basic service area corresponding to an infrastructure BSS is defined by the points in which transmissions from the access point can be received. Although the multihop transmission takes more transmission capacity than a directed frame from the sender to the receiver, it has two major advantages:

EX-1013, 18.

46. In addition, it has been known that a base station or an AP may manage transmission traffic in a wireless communication system particularly to support different users with different needs.

47. For example, it has been known by at least 2000 that wireless broadband multimedia communication systems (WBMCS) can utilize a base station or an AP to direct communications among “different users with different needs.” EX-1015, 7.



EX-1015, 7.

48. As another example, according to the IEEE Std 802.11-2012 released in 2012, “an access point (AP)...enables access to [a distribution system (DS)] for associated STAs” in an IEEE 802.11 network. EX-1011, 46-47.

4.3.4 Distribution system (DS) concepts

4.3.4.1 Overview

PHY limitations determine the direct station-to-station distance that may be supported. For some networks this distance is sufficient; for other networks, increased coverage is required.

Instead of existing independently, an infrastructure BSS may also form a component of an extended form of network that is built with multiple BSSs. The architectural component used to interconnect infrastructure BSSs is the DS.

IEEE Std 802.11 logically separates the WM from the distribution system medium (DSM). Each logical medium is used for different purposes, by a different component of the architecture. The IEEE 802.11 definitions neither preclude, nor demand, that the multiple media be either the same or different.

Recognizing that the multiple media are *logically* different is key to understanding the flexibility of the architecture. The IEEE 802.11 LAN architecture is specified independently of the physical characteristics of any specific implementation.

The DS enables mobile device support by providing the logical services necessary to handle address to destination mapping and seamless integration of multiple BSSs.

An access point (AP) is any entity that has STA functionality and enables access to the DS, via the WM for associated STAs.

Figure 4-2 adds the DS, DSM and AP components to the IEEE 802.11 architecture picture.

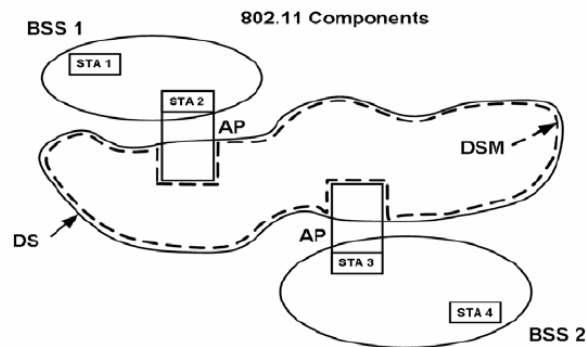


Figure 4-2—DSs and APs

Data move between a BSS and the DS via an AP. Note that all APs are also STAs; thus they are addressable entities. The addresses used by an AP for communication on the WM and on the DSM are not necessarily the same.

Data sent to the AP's STA address by one of the STAs associated with it are always received at the uncontrolled port for processing by the IEEE 802.1X port access entity. In addition, if the controlled port is authorized, these frames conceptually transit the DS.

EX-1011, 46-47.

49. Similarly, WiMAX systems, another IEEE network, have been known to utilize a base station to manage traffics to/from multiple terminals/STAs. See, for example, EX-1016, 9.

The WiMAX technology, based on the IEEE 802.16-2004 Air Interface Standard is rapidly proving itself as a technology that will play a key role in fixed broadband wireless metropolitan area networks. The first certification lab, established at Cetecom Labs in Malaga, Spain is fully operational and more than 150 WiMAX trials are underway in Europe, Asia, Africa and North and South America. Unquestionably, Fixed WiMAX, based on the IEEE 802.16-2004 [1] Air Interface Standard, has proven to be a cost-effective fixed wireless alternative to cable and DSL services. In December, 2005 the IEEE ratified the 802.16e amendment [2] to the 802.16 standard. This amendment adds the features and attributes to the standard necessary to support mobility. The WiMAX Forum is now defining system performance and certification profiles based on the IEEE 802.16e Mobile Amendment and, going beyond the air interface, the WiMAX Forum is defining the network architecture necessary for implementing an end-to-end Mobile WiMAX² network. Release-1 system profiles will be completed in early 2006.

Mobile WiMAX is a broadband wireless solution that enables convergence of mobile and fixed broadband networks through a common wide area broadband radio access technology and flexible network architecture. The Mobile WiMAX Air Interface adopts Orthogonal Frequency Division Multiple Access (OFDMA) for improved multi-path performance in non-line-of-sight environments. Scalable OFDMA (SOFDMA) [3] is introduced in the IEEE 802.16e Amendment to support scalable channel bandwidths from 1.25 to 20 MHz. The Mobile Technical Group (MTG) in the WiMAX Forum is developing the Mobile WiMAX system profiles that will define the mandatory and optional features of the IEEE standard that are necessary to build a Mobile WiMAX-compliant air interface that can be certified by the WiMAX Forum. The Mobile WiMAX System Profile enables mobile systems to be configured based on a common base feature set thus ensuring baseline functionality for terminals and base stations that are fully interoperable. Some elements of the base station profiles are specified as optional to provide additional flexibility for deployment based on specific deployment scenarios that may require different configurations that are either capacity-optimized or coverage-optimized. Release-1 Mobile WiMAX profiles will cover 5, 7, 8.75, and 10 MHz channel bandwidths for licensed worldwide spectrum allocations in the 2.3 GHz, 2.5 GHz, 3.3 GHz and 3.5 GHz frequency bands.

² The term WiMAX has been used generically to describe wireless systems based on the WiMAX certification profiles based on the IEEE 802.16-2004 Air Interface Standard. With additional profiles pending based on the IEEE 802.16e-2005 Mobile Amendment, it is necessary to differentiate between the two WiMAX systems. "Fixed" WiMAX is used to describe 802.16-2004 based systems and "Mobile" WiMAX is used to describe 802.16e-2005 based systems.

EX-1016, 9.

B. Transmission Management Utilizing MAC Frames

50. More specifically, it has been known that "[a]ll 802 networks have both a MAC and a Physical (PSY) component." EX-1013, 14.

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

52. For example, it has been known that a MAC frame can indicate “rules to determine how to access the medium and send data.” EX-1013, 14.

IEEE 802 Network Technology Family Tree

802.11 is a member of the IEEE 802 family, which is a series of specifications for local area network (LAN) technologies. Figure 2-1 shows the relationship between the various components of the 802 family and their place in the OSI model.

IEEE 802 specifications are focused on the two lowest layers of the OSI model because they incorporate both physical and data link components. All 802 networks have both a MAC and a Physical (PHY) component. The MAC is a set of rules to determine how to access the medium and send data, but the details of transmission and reception are left to the PHY.

EX-1013, 14.

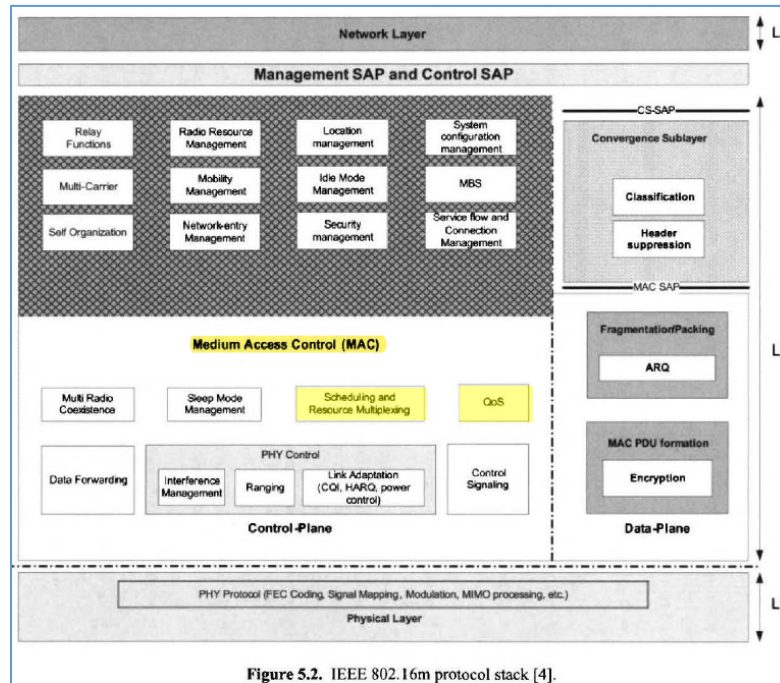
53. It has been known that the MAC frame “controls the transmission of user data.” EX-1013, 34.

That is why you should read this chapter. Now on to the details. The key to the 802.11 specification is the MAC. It rides on every physical layer and controls the transmission of user data into the air. It provides the core framing operations and the interaction with a wired network backbone. Different physical layers may provide different transmission speeds, all of which are supposed to interoperate.

EX-1013, 34.

C. MAC Frame to Include QoS Control Field Indicating Scheduling & Acknowledgement Information

54. In addition, it has been known that the MAC layer has multiple planes. For example, it has been known since at least 2010 that the MAC layer to include scheduling and QoS in the MAC physical plane. See EX-1017, 92-100, Figure 5.2.



EX-1017, 96.

55. It also has been known that in an 802.11 network, QoS and acknowledgement information are associated. For example, an 802.11 network can indicate and transmit “Block Acknowledgement Request (QoS)” or “Block Acknowledge (QoS)” in an 802.11 MAC frame. EX-1013, 47-50.

Frame Control

Each frame starts with a two-byte Frame Control subfield, shown in Figure 3-10. The components of the Frame Control subfield are:

Protocol version

Two bits indicate which version of the 802.11 MAC is contained in the rest of the frame. At present, only one version of the 802.11 MAC has been developed; it is assigned the protocol number 0. Other values will appear when the IEEE standardizes changes to the MAC that render it incompatible with the initial specification. So far, none of the revisions to 802.11 have required incrementing the protocol number.

Type and subtype fields

Type and subtype fields identify the type of frame used. To cope with noise and unreliability, a number of management functions are incorporated into the 802.11 MAC. Some, such as the RTS/CTS operations and the acknowledgments, have already been discussed. Table 3-1 shows how the type and subtype identifiers are used to create the different classes of frames.

In Table 3-1, bit strings are written most-significant bit first, which is the reverse of the order used in Figure 3-10. Therefore, the frame type is the third bit in the frame control field followed by the second bit (b3 b2), and the subtype is the seventh bit, followed by the sixth, fifth, and fourth bits (b7 b6 b5 b4).

EX-1013, 48.

Table 3-1. Type and subtype identifiers

Subtype value	Subtype name
Management frames (type=00) ^a	
0000	Association request
0001	Association response
0010	Reassociation request
0011	Reassociation response
0100	Probe request
0101	Probe response
1000	Beacon
1001	Announcement traffic indication message (ATIM)
1010	Disassociation
1011	Authentication
1100	Deauthentication
1101	Action (for spectrum management with 802.11h, also for QoS)
Control frames (type=01) ^b	
1000	Block Acknowledgment Request (QoS)
1001	Block Acknowledgment (QoS)
1010	Power Save (PS)-Poll
1011	RTS
1100	CTS
1101	Acknowledgment (ACK)
1110	Contention-Free (CF)-End
1111	CF-End+CF-Ack
Data frames (type=10)	
0000	Data
0001	Data+CF-Ack
0010	Data+CF-Poll
0011	Data+CF-Ack+CF-Poll
0100	Null data (no data transmitted)
0101	CF-Ack (no data transmitted)
0110	CF-Poll (no data transmitted)
0111	CF-Ack+CF-Poll (no data transmitted)
1000	QoS Data ^c
1001	QoS Data + CF-Ack ^c
1010	QoS Data + CF-Poll ^c

Frame Format | 49

EX-1013, Table 3-1 at 49.

Subtype value	Subtype name
1011	QoS Data + CF-Ack + CF-Poll ^c
1100	QoS Null (no data transmitted) ^c
1101	QoS CF-Ack (no data transmitted) ^c
1110	QoS CF-Poll (no data transmitted) ^c
1111	QoS CF-Ack+CF-Poll (no data transmitted) ^c
(Frame type 11 is reserved)	
^a Management subtypes 0110-0111 and 1110-1111 are reserved and not currently used.	
^b Control subtypes 0000-0111 are reserved and not currently used.	
^c Proposed by the 802.11e task group, but not yet standardized. Note that these frames all have a leading one, which has caused some to refer to the first bit as the QoS bit.	

EX-1013, Table 3-1 at 50.

56. As a further example, it has been known since at least 2006 that QoS can provide “a flexible mechanism for optimal scheduling of space, frequency and time resources...on a frame-by-frame basis.” *See* EX-1016, 10.

Mobile WiMAX systems offer scalability in both radio access technology and network architecture, thus providing a great deal of flexibility in network deployment options and service offerings. Some of the salient features supported by Mobile WiMAX are:

- **High Data Rates:** The inclusion of MIMO antenna techniques along with flexible sub-channelization schemes, Advanced Coding and Modulation all enable the Mobile WiMAX technology to support peak DL data rates up to 63 Mbps per sector and peak UL data rates up to 28 Mbps per sector in a 10 MHz channel.
- **Quality of Service (QoS):** The fundamental premise of the IEEE 802.16 MAC architecture is QoS. It defines Service Flows which can map to DiffServ code points or MPLS flow labels that enable end-to-end IP based QoS. Additionally, sub-channelization and MAP-based signaling schemes provide a flexible mechanism for optimal scheduling of space, frequency and time resources over the air interface on a frame-by-frame basis.
- **Scalability:** Despite an increasingly globalized economy, spectrum resources for wireless broadband worldwide are still quite disparate in its allocations. Mobile WiMAX technology therefore, is designed to be able to scale to work in different channelizations from 1.25 to 20 MHz to comply with varied worldwide requirements as efforts proceed to achieve spectrum harmonization in the longer term. This also allows diverse economies to realize the multi-faceted benefits of the Mobile WiMAX technology for their specific geographic needs such as providing affordable internet

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EX-1016, 10.

D. Simultaneous Multiple-User Transmissions Managed by an AP

57. 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.

58. In particular, the OFDM technique is known to transmit a single datastream. EX-1015, 20-21.

1.5 HISTORY OF OFDM
OFDM is a special case of multicarrier transmission, where a single datastream is transmitted over a number of lower rate subcarriers. It is worth mentioning here that OFDM can be seen as either a modulation technique or a multiplexing technique. One

of the main reasons to use OFDM is to increase the robustness against frequency selective fading or narrowband interference. In a single carrier system, a single fade or interferer can cause the entire link to fail, but in a multicarrier system, only a small percentage of the subcarriers will be affected. Error correction coding can then be used to correct for the few erroneous subcarriers. The concept of using parallel data transmission and frequency division multiplexing was published in the mid-1960s [64, 65]. Some early development is traced back to the 1950s [66]. A U.S. patent was filed and issued in January, 1970 [67].

In a classical parallel data system, the total signal frequency band is divided into N nonoverlapping frequency subchannels. Each subchannel is modulated with a separate symbol and then the N subchannels are frequency-multiplexed. It seems good to avoid spectral overlap of channels to eliminate interchannel interference. However, this leads to inefficient use of the available spectrum. To cope with the inefficiency, the ideas proposed from the mid-1960s were to use parallel data and FDM with overlapping subchannels, in which each carrying a signaling rate b is spaced b apart in frequency to avoid the use of high-speed equalization and to combat impulsive noise and multipath distortion, as well as to fully use the available bandwidth.

EX-1015, 20-21.

59. 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.

60. 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.

OFDM exploits the frequency diversity of the multipath channel by coding and interleaving the information across the sub-carriers prior to transmissions. OFDM modulation can be realized with efficient Inverse Fast Fourier Transform (IFFT), which enables a large number of sub-carriers (up to 2048) with low complexity. In an OFDM system, resources are available in the time domain by means of OFDM symbols and in the frequency domain by means of sub-carriers. The time and frequency resources can be organized into sub-channels for allocation to individual users. Orthogonal Frequency Division Multiple Access (OFDMA) is 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.

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E. Multiple Users' Acknowledgement Transmissions Managed by an AP

61. Specifically, a base station has been known to schedule multiple users' transmission, and to indicate acknowledgements for contentions traffic received in the previous frame, resources allocations (e.g., bandslot allocations), and other control data. EX-1015, 225.

225

9.4.9 Dynamic Channel Allocation (Fast DCA)

Besides FH hopping mode, the system can also be operated in time division duplex (TDD) mode. Unlike the FH mode, the TDD mode does not separate the spectrum in an uplink and a downlink. Instead, it assigns bandslots individually to uplink or downlink connections. In TDD mode, a dynamic channel allocation algorithm is employed to avoid (rather than to average) excessive interference. The TDD mode is intended for pico-cellular, indoor use. The indoor environment is characterized by

- Short radio propagation delays (100m is traversed in 0.3 μ s, or 0.1% of the symbol duration),
- Greater demand for high rate services, reducing the interference averaging advantage of frequency-hopping mode,
- High-speed data traffic is often asymmetric, prompting flexible division of bandwidth between uplink and downlink, and
- Less severe propagation conditions than those outdoor; mobility-induced Doppler spread and delay spread are both lower.

In the TDD mode, the transmissions of mobile users are scheduled by the base station, which regularly transmits a frame map containing:

- Bandslot allocations for the next frame. Bandslots can be allocated to
 - The base station for downlink transmission to a single terminal,
 - The base station for downlink transmission to all terminals (broadcast),
 - A single terminal for an uplink transmission, and
 - All (or a group of) terminals for contention based access,
- Transmit power assignments for MTs,
- Acknowledgements for contention traffic received in the previous frame,
- Slots are allocated on a connection basis, so that connection-dependent QoS can be provisioned (a mobile can have one or more connections), and
- Control data and user data are transmitted on different connections.

EX-1015, 225.

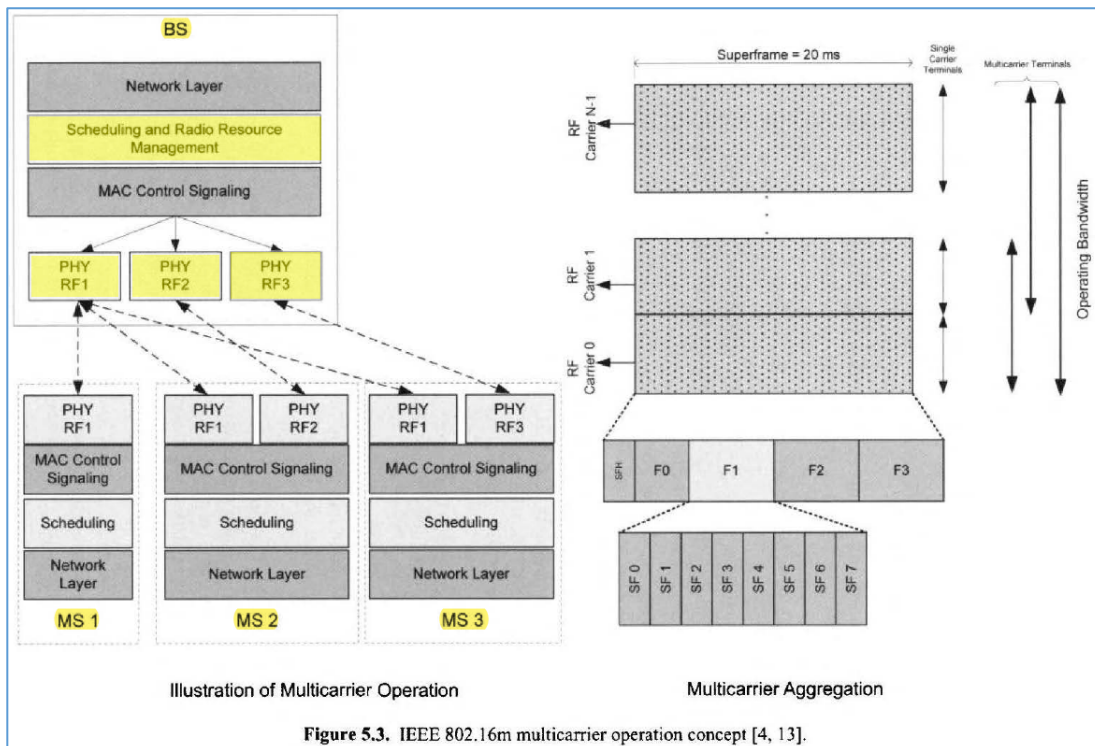
62. As a further example, it has been known in WiMAX systems to employ MAC-layer scheduler frames to provide frequency-time resource allocation in both DL and UL on a per-frame basis. EX-1016, 19-22.

3. MAC Layer Description

The 802.16 standard was developed from the outset for the delivery of broadband services including voice, data, and video. The MAC layer is based on the time-proven DOCSIS standard and can support bursty data traffic with high peak rate demand [9] while simultaneously supporting streaming video and latency-sensitive voice traffic over the same channel. The resource allocated to one terminal by the MAC scheduler can vary from a single time slot to the entire frame, thus providing a very large dynamic range of throughput to a specific user terminal at any given time. Furthermore, since the resource allocation information is conveyed in the MAP messages at the beginning of each frame, the scheduler can effectively change the resource allocation on a frame-by-frame basis to adapt to the bursty nature of the traffic.

EX-1016, 19.

63. As a further example, a base station has been known to allocate acknowledgement policy and specific resources to each of multiple users via the MAC layer. 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.

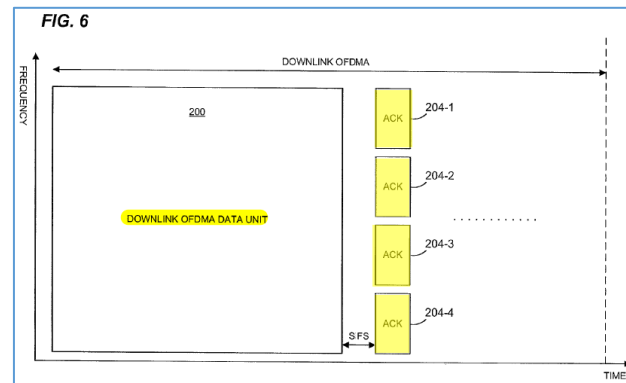
EX-1017, 95, 97.

F. DL MU Data Unit to Solicit Acknowledgement Responses by STAs

64. As an example, U.S. Patent No. 9,924,512 to Zhang et al. (“Zhang”), filed on March 24, 2010, discloses an exemplary DL OFDMA data unit by an AP that solicits the transmission of simultaneous acknowledgment signals (ACKs) by STAs in response to the DL OFDMA data unit. *See*, EX-1014, 7:24-34; FIG. 6.

An OFDM signal comprising a plurality of OFDM sub-channel blocks to transmit independent data streams as described above is also referred to herein as an orthogonal frequency division multiple access (OFDMA) signals. According to an embodiment, a WLAN utilizes downlink OFDMA signals and uplink OFDMA signals. Downlink OFDMA signals are transmitted synchronously from a single AP to multiple client stations (i.e., point-to-multipoint). An uplink OFDMA signal is transmitted by multiple clients stations jointly to a single AP (i.e., multipoint-to-point). Frame formats and/or signaling schemes for downlink OFDMA and uplink OFDMA are different, according to some embodiments.

EX-1014, 7:24-26



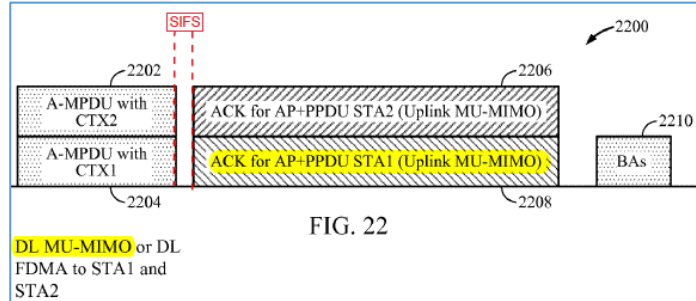
EX-1014, FIG. 6

65. As a further example, Merlin teaches an example DL MU-MIMO frame including a [block acknowledgement request (BAR)] frame per each STA

that can be transmitted as a DL data unit by an AP to multiple STAs. *See*, e.g., EX-1004, 5:31-40; FIG. 22.

Certain aspects of the present disclosure generally relate to wireless communications and, more particularly, to 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) and frequency division multiple access (FDMA) systems. According to certain aspects, a multi-STA BA request (BAR) frame may simultaneously solicit multiple immediate BAs. According to certain aspects, frame exchange sequences involve special subframes and/or reverse direction grants (RDGs).

EX-1004, 5:31-43.



EX-1004, 5:31-40.

66. As another 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

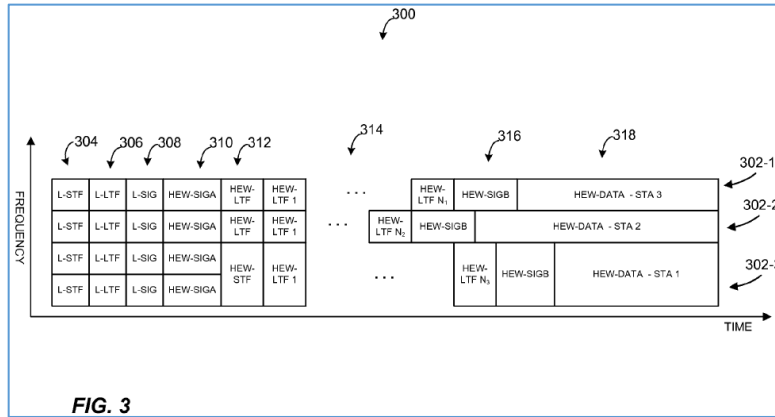
receives the OFDM data units 302-1, 302-2, 302-3 from the client stations 25 via respective OFDM sub-channels of within the OFDMA data unit 300, in this embodiment.

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 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, 7:58-8:23.

67. In addition, Chu806 teaches an example OFDMA data unit that can be transmitted as a DL OFDMA data unit by an AP to multiple STAs that have

“HEW” capabilities to receive and transmit, for example, “HEW-DATA”. *See* EX-1004, 7:58-8:54; FIG. 3.

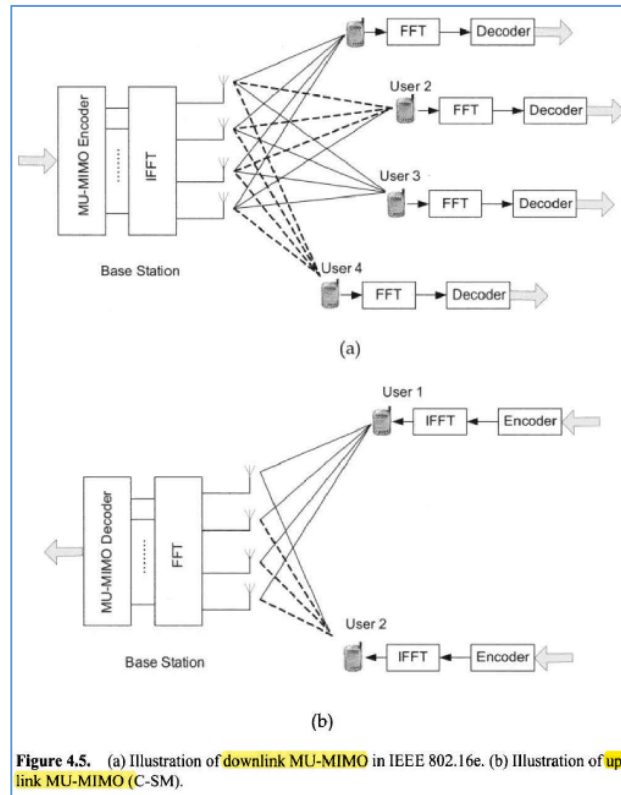


EX-1004, FIG. 3.

G. DL MU & UL MU Transmissions

68. As noted above, a base station has been known to provide simultaneous DL transmissions to multiple users and support simultaneous UL transmission from multiple users. ¶¶59-60; 64-67. 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.

69. Similarly, WiMAX systems were known to provide DL MIMO and UL MIMO transmission. *See* EX-1017, 83-86 (“IEEE 802.16e supports basic MU-MIMO operations in both downlink and uplink”), Figure 4.5.

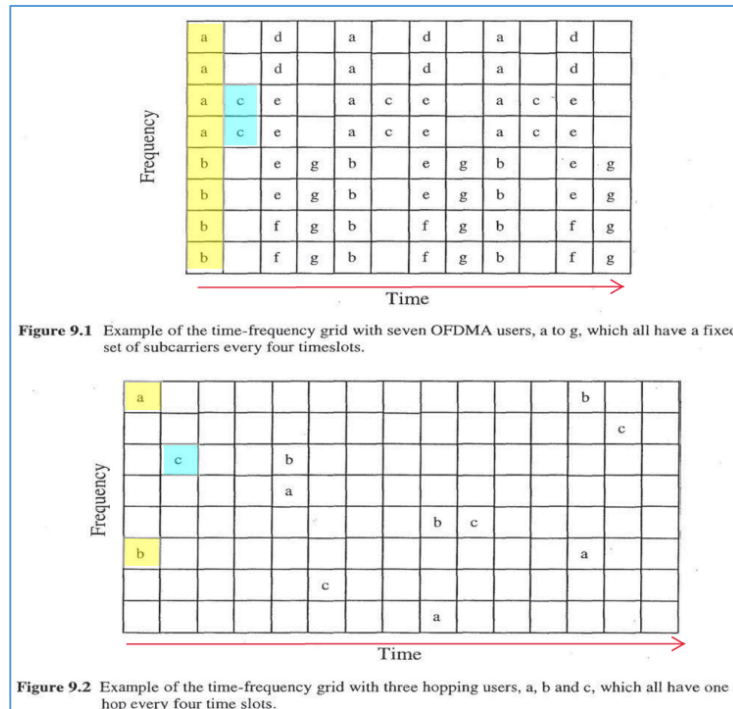


EX-1017, 84.

H. DL MU, UL MU & UL SU Transmissions

70. The concept of a wireless network that can support multiple protocols or different transmission formats have been known since at least 2000.

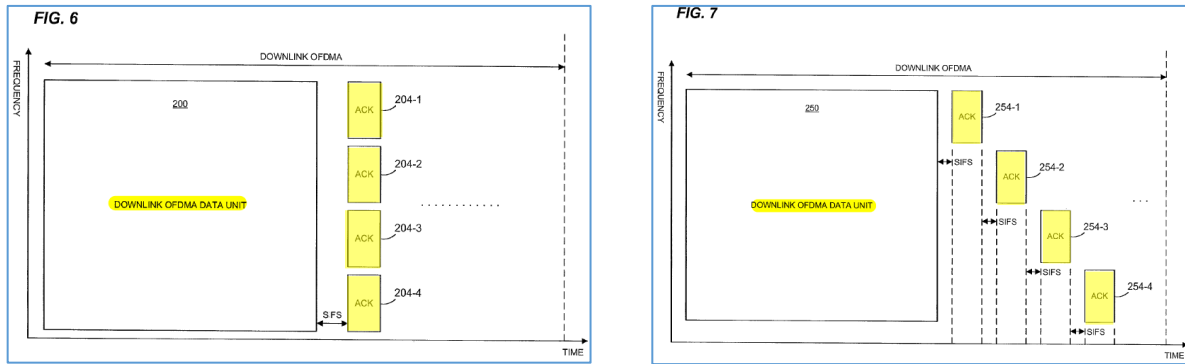
71. For example, a base station has been known to schedule simultaneous responses from multiple users at a first time period and a single response from only one user at a second time period. *See*, e.g., EX-1015, 213-214, 217-218, 225-227, Figure 9.1, Figure 9.2.



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

72. As a further example, it has been known that an AP may utilize “MAC layer signaling to specify a single time at which all client stations corresponding to the downlink OFDMA signal [] should simultaneously transmit respective acknowledgments” after an SIFS of the DL OFDMA signal. *See*, EX-1027, 8:34-38, FIG. 6.

73. It also has been known that an AP may alternatively utilize “MAC layer signaling ... [that] specifies different respective times at which respective client stations should send respective acknowledgments of the downlink OFDMA signal.” *See*, EX-1027, 8:29-34, FIG. 7.



EX-1027, FIGs. 6 and 7.

I. UL MU & UL SU Transmissions By Non-Legacy and Legacy STAs in the Same Basic Service Set (BSS) Managed by AP

74. The concept of having legacy STAs and non-legacy STAs in a same wireless network and having the AP to manage transmission using different protocols have been known since at least 2005. *See*, for example, EX-1013.

Mixed mode is required to coexist with older devices. (If the experience of 802.11g deployment is any guide, most 802.11n devices are likely to operate in the mixed mode for quite some time.) Mixed mode is a broad classification with several subdivisions. Mixed capable networks will allow association from legacy devices, but do not divide time between legacy and high-throughput transmissions. Access points in managed mixed networks do actively divide the time between high-throughput transmissions and legacy transmissions. Much like the division between the contention-free period and the contention period (see Chapter 9), an AP operating in managed mixed mode will allow legacy stations their timeslice, while using mechanisms similar to the protection mechanism to reserve some timeslice for MIMO stations only.

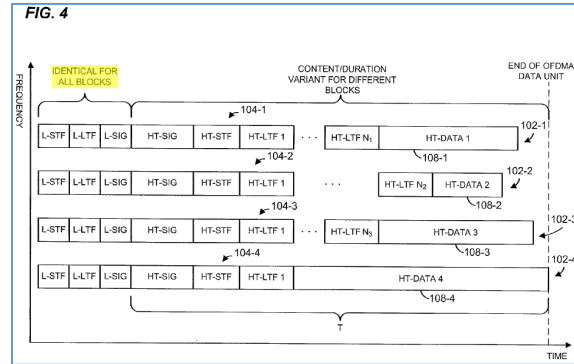
EX-1013, 336-337.

75. As another example, it has been known a DL MU transmission to be received by STAs with different capabilities.

76. For example, Zhang discloses despite the different protocol versions, an AP can configure a DL MU OFDMA that can be decoded by a legacy STA and a non-legacy STA. *See*, for example, EX-1014, 10:50-63.

In an embodiment, the downlink OFDMA signal is configured to be received and decoded by a legacy client station (e.g., a client station configured to communicate according to the IEEE 802.11a Standard and/or the IEEE 802.11n Standard). In an embodiment, the AP does not signal to at least the legacy client stations that an OFDMA data unit is an OFDMA signal (as opposed to an OFDM data unit according to the legacy protocol (e.g., the IEEE 802.11a Standard and/or the IEEE 802.11n Standard). In an embodiment, at least OFDM sub-channel blocks corresponding to legacy client stations have the same duration as the downlink OFDMA signal so that ACKs/NAKs transmitted by the legacy client station occur at appropriate times with respect to the OFDMA data unit.

EX-1014, 10:50-63.



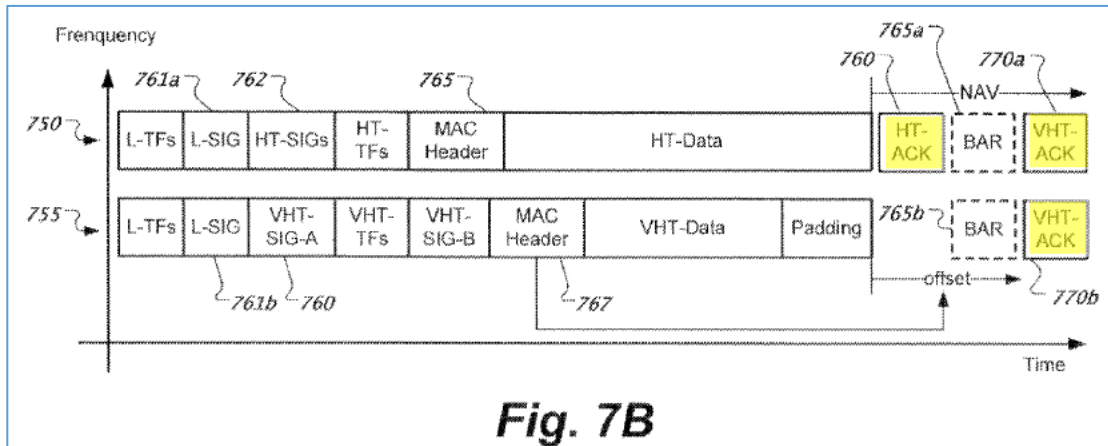
EX-1014, FIG. 4.

77. Zhang also discloses that the DL MU frame can have additional acknowledgement information for non-legacy STAs. See, e.g., EX-1014, 8:1-9.

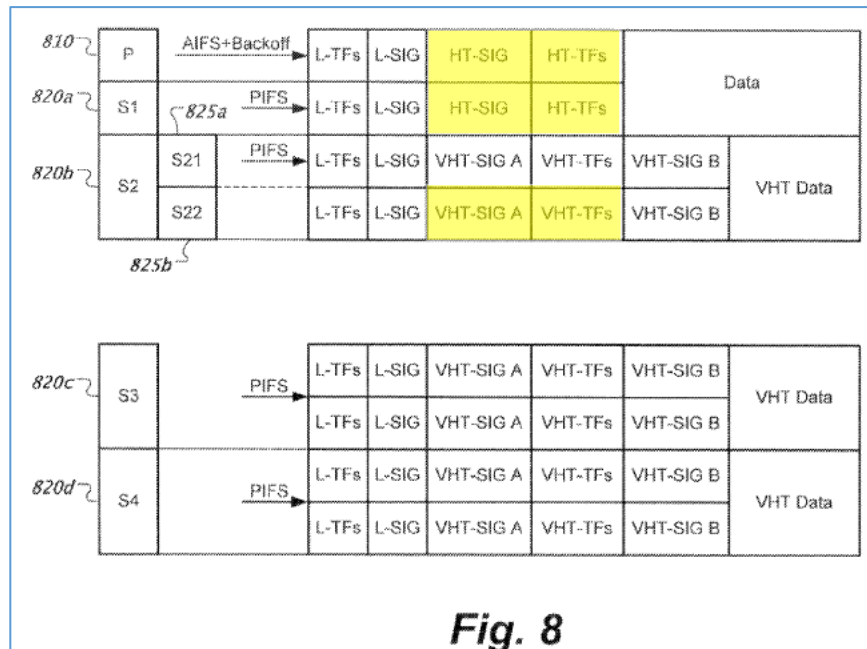
The legacy portion of the preamble 104 (i.e., L-STF, L-LTF, and L-SIG) is identical in all of the OFDM sub-channel blocks 102, according to an embodiment. For the high throughput portion of the preamble 104 (i.e., starting with HT-SIG), the content of the OFDM sub-channel blocks 102 can be variant for different client stations depending on factors such as rate, data quantity, configuration (e.g., number of antennas, number of supported multiple input, multiple output (MIMO) data streams, etc.) of different clients.

EX-1014, 8:1-9.

78. U.S. Patent No. 8,395,997 to Banerjee et al. (“Banerjee”), which was issued on March 12, 2013, discloses an AP that “concurrently transmits HT data and VHT data” and solicit acknowledgement responses based on OFDMA. EX-1028, 10:29-34. For example, FIG. 7B illustrates an example where “HT-ACK” is transmitted in a SU format and two “VHT-ACKs” are subsequently transmitted simultaneously. See, e.g., EX-1028, FIG. 7B, FIG. 8.



EX-1028, FIG. 7B.



EX-1028, FIG. 8.

79. Similarly, Chu806 teaches an example DL OFDMA data unit transmitted by an AP to multiple STAs that have “HEW” capabilities to receive and transmit, for example, “HEW-DATA” and another STA having “very high throughput (VHT)” capabilities. See EX-1004, EX-1004, 8:62-67; FIG. 4.

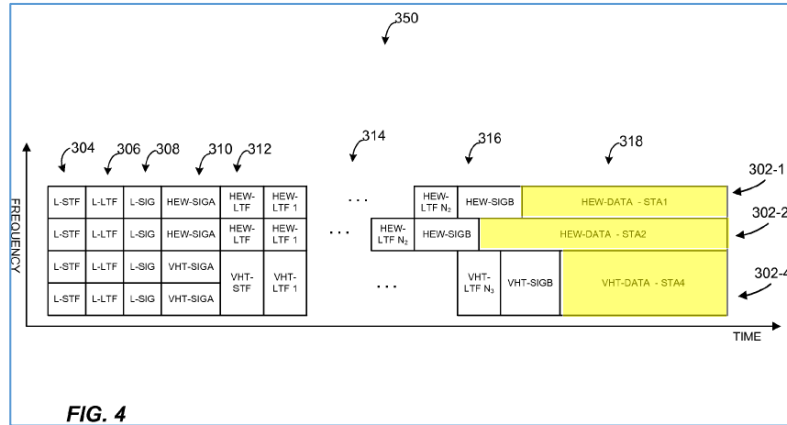
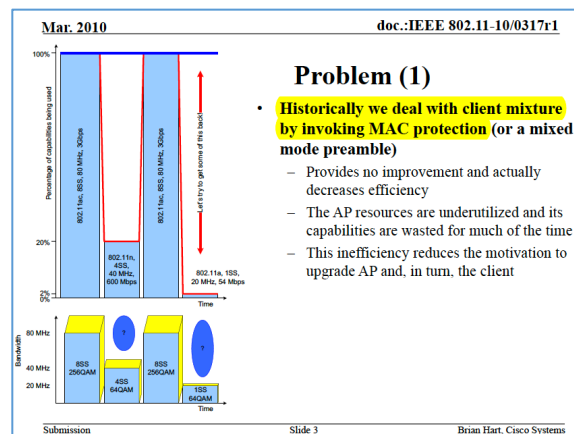


FIG. 4

J. IEEE Standardization of WLAN Communication Systems

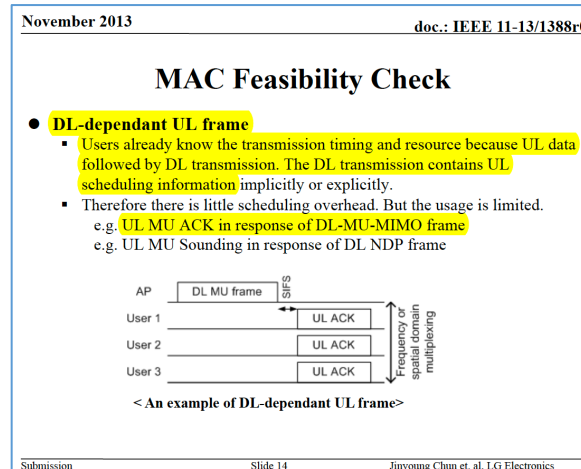
80. WLAN communications systems were well known in the art at the time of the '679 Patent and were in use and standardized. For example, the IEEE set up a study group for High-Efficiency Wireless in May 2013, and subsequently approved the 802.11 Task Group ax in May 2014. EX-1012.

81. Notably, even prior to the 802.11 Task Group ax and as early as March 2010, it has been known to utilize the MAC in a DL MU frame to accommodate STAs with different capabilities and to protect UL transmissions by “mixed” STAs. See, for example, EX-1018.



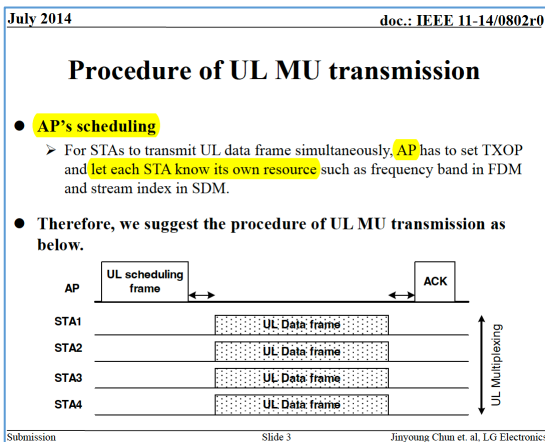
EX-1018, 3.

82. It also has been known by at least November 2013 that simultaneous UL acknowledgement frames can be transmitted by multiple STAs in the time as directed and in the manner as indicated by a DL MU frame from an AP. For example, STAs would know the “transmission timing and resource because UL data followed by DL transmission[, where the] DL transmission contains UL scheduling information.” EX-1019, 14.

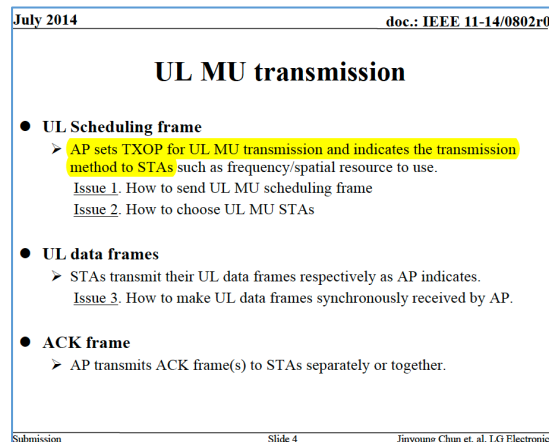


EX-1019, 14.

83. Further, an AP has been known to specify the transmission method to STAs on how STAs to transmit the UL MU transmissions. See, e.g., EX-1020.



EX-1020, 3.



EX-1020, 4.

84. Further, it also has been known by November 2013 that there is advantage with the DL MU frame to scheduled UL MU acknowledgements by STAs to be transmitted after SIFS of the DL frame. *See*, e.g., EX-1019, 15.

November 2013		doc.: IEEE 11-13/1388r0
Summary of MAC Feasibility Check		
	Stand-alone UL data frame	DL-dependant UL frame
Delay	Can't guarantee transmission time (contention-based channel)	Right after SIFS + DL frame (no contention channel)
MAC overhead	Need new DL & UL control frames - UL BW request frame - DL scheduling frame	little overhead - Just follow the rule of DL frame - Add some signaling field in DL frame
Usage	All UL data frames	Limited. (DL-dependant UL frame only)
Submission		Slide 15 Jinyoung Chun et. al, LG Electronics

EX-1019, 15.

85. Notably, it was known that at least by September 2014, the 802.11 Task Group ax specifically discussed AP's responsibility in UL MU transmission, including "schedule for or trigger a UL MU transmission," and "resource allocation, while providing compatibility with legacy devices. EX-1020.

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	
Submission	Slide 5 Kaiying Lv (ZTE)

EX-1021, 5.

September 2014	doc.: IEEE 802.11-14/1190r2
Multi-user acknowledgement and Polling	
• A multi-user acknowledgement and Polling scheme should provide following functions: - Acknowledgement to received UL MU PPDU, allowing Error indication - Polling and UL MU transmission resource allocation - Providing transmission control information, e.g. time/frequency/power adjustment • Principle and justice - To achieve the above purposes with less overhead - To keep compatibility with legacy devices • A scheme using multi-user BA+Poll frame is introduced - The multi-user BA + Poll frame combines the functions of BA, scheduling control, error indication - The multi-user BA + Poll frame can reuse the current BA frame structure, eg. Similar to Multi-TID BA variant - The multi-user BA + Poll frame can be sent in non-HT format - No additional scheduling/poll frame needed	
Submission	Slide 6 Kaiying Lv (ZTE)

EX-1021, 6.

K. Exemplary Advantages of Transmission Management By AP

86. Moreover, the advantages of having an AP to coordinate available resources for multiple receiving STAs were widely known and widely employed.

87. For example, transmission management by AP can improve system efficiency, provide flexible control, and increase adaptability to changing traffic/channel conditions. See, *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.”).

88. As further examples, each of Merlin, Abraham466, and Chu806 describes that it was known that an AP may be configured to accommodate a first protocol and a second, legacy communication protocol. 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. See, *e.g.*, EX-1004, 8:18-24. Merlin’s disclosure also addresses protocol rules and enables efficient frame exchange sequences. See, *e.g.*, EX-1004, 5:34-38. 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. *See*, e.g., EX-1006, 5:31-45. *See also* EX-1005, [0037] (“STAs... may comprise high efficiency (HEW) wireless stations..., while the [other] STAs...may comprise “legacy” wireless stations.”).

89. 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 '679 Patent. The '679 Patent simply applies the well-known method to a well-known system (OFDMA, resource allocation in a DL MU frame (MAC layer), and supporting both UL MU and UL SU response transmissions).

VII. TECHNOLOGY BACKGROUND

90. This section discusses a number of key technologies as encompassed by the art discussed in this Declaration and known before the earliest possible effective filing date of the '679 Patent.

A. Modulation and Coding Scheme (MCS)

91. One aspect of technology standardization is to provide interoperability among devices (whether or not manufactured by the same entity). 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.

92. For example, the IEEE Std 802.11-2012 discusses including a modulation and coding scheme (MCS) field in a frame to indicate modulation and coding information.

modulation and coding scheme (MCS): A specification of the high-throughput (HT) physical layer (PHY) parameters that consists of modulation order (e.g., BPSK, QPSK, 16-QAM, 64-QAM) and forward error correction (FEC) coding rate (e.g., 1/2, 2/3, 3/4, 5/6).

modulation and coding scheme 32 (MCS 32) format: A physical layer convergence procedure (PLCP) protocol data unit (PPDU) format of the high-throughput (HT) physical layer (PHY) in which signals in two

28 Copyright © 2012 IEEE. All rights reserved.

EX-1011, 28.

93. It also has been known for an AP “that transmit a frame containing an HT Operation element... shall include at least one MCS.” EX-1011, 854. *See also* EX-1011, 1688.

9.7.2 Basic MCS Set field

An AP that transmits a frame containing an HT Operation element with either the Dual Beacon field or the Dual CTS Protection field equal to 1 shall include at least one MCS that has only one spatial stream in the Basic MCS Set field of the HT Operation element of that frame.

EX-1011, 854.

94. Particularly in connection with MIMO transmission, it has been known for an AP to specify MCS for the STAs. See, e.g., EX-1013.

Modulation and Coding Set (MCS) (6 bits)

One of the disadvantages to using MIMO is that there are myriad options when you account for different modulation schemes, differing numbers of spatial streams, and different code rates. The MCS field selects the modulation and coding scheme, along with the number of spatial streams. Values of 0-31 are used for basic MIMO modes, and values of 33-63 are used for advanced MIMO modes.

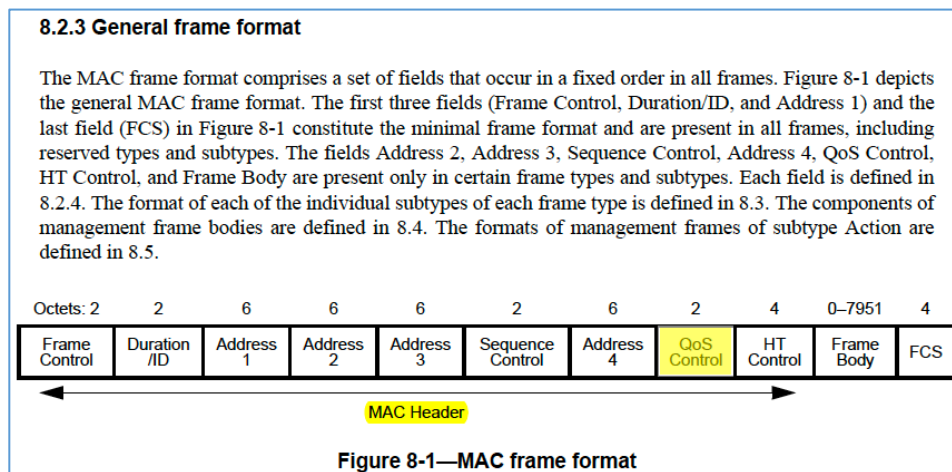
EX-1013, 348

95. In view of the foregoing, indicating MCS in a DL frame, particularly in MU/MIMO transmission, has been known before the earliest possible effective filing date of the '679 Patent.

B. QoS Control Field Indicating Acknowledgement Information

96. As discussed above in Section IV.B above, it has been known to utilize the medium access control (MAC) to indicate and transmit access control related function and information to STAs.

97. For example, IEEE Std 802.11ac (released in 2012) discusses how a MAC header can include several fields, such as a QoS control field. *See* EX-1011, 380-381.



EX-1011, 381.

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) 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);
- b) A variable-length *frame body*, which contains information specific to the frame *type* and *subtype*;
- c) A *FCS*, which contains an IEEE 32-bit CRC.

EX-1011, 380.

98. 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.

99. 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-1020, 51.

100. In view of the foregoing, utilizing QoS control field to indicate acknowledge information or acknowledgement policy for subsequent acknowledgement frames has been known before the earliest possible effective filing date of the '679 Patent.

VIII. LEVEL OF ORDINARY SKILL IN THE ART

101. As I explained above, the '679 Patent discloses a method by an AP to coordinate the UL transmission of acknowledgment messages by STAs either in a SU format or a MU format in a wireless network.

102. In my opinion, a POSITA in the relevant art, as of November 2014, 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

103. 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.

104. 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.

105. 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 and 6)

106. Each of claims 1 and 6 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 and 6 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

107. As explained below, each of Merlin, Abraham466, Chu806, and Ma relates to communication systems and methods, such as WLANs that support the transmission of a DL MU frame from an AP to multiple STAs and the transmission of UL frames in SU-format or MU-format from STAs to an AP in response to the DL MU frame.

A. Merlin discloses a method where an AP transmits to STAs acknowledgment policies in a DL MU frame and the STAs transmit UL acknowledgment in a MU or SU format.

108. U.S. Patent No. 10,230,497, entitled “Protocols for Multiple User Frame Exchanges”, and claimed priority to a Provisional Application No. 61/899,121 filed on November 1, 2013, was filed on October 30, 2014, and issued on March 12, 2019, to Merlin et al. (“Merlin”) (EX-1004). Merlin is prior art to the ’679 Patent under AIA 35 U.S.C. § 102 (a)(2).

109. Merlin relates to communication systems, frame structures and protocols for supporting both uplink (UL) multiple-user (MU) and UL single-user SU frame exchanges from multiple STAs. *See* EX-1004, 2:1-13, 28-42; 3:45-53; FIG. 4; FIG. 22.

110. For example, Merlin discloses “setting of ACK policies and signaling for allocating MU-MIMO or FDMA resources to the recipient STAs for the replies. Such signaling may include which STAs [] are solicited for immediate response (e.g., for immediate BAs), which STAs may use existing ACK policy indications, which mode is to be used for the replies (e.g., UL SU-MIMO, UL MU-MIMO, or UL MU FDMA), and which parameters to use for MU-MIMO or FDMA transmissions.” EX-1004, 12:57-65.

111. Specifically, Merlin discloses methods to “allow older versions of user terminals (“legacy” stations) to remain deployed in an enterprise, extending their useful lifetime, while allowing newer [] user terminals to be introduced as deemed appropriate.” EX-1004, 8:14-24.

112. For example, Merlin discloses frame structures, where “the DL MU-MIMO/FDMA PPDU may be addressed to a mix of legacy (e.g., non-HEW) STAs and HEW STAs (i.e., some of the addressed STAs support UL MU-MIMO, UL FDMA, or both, and some of the addressed STAs do not).” EX-1004, 13:24-28.

B. Abraham466 discloses a method where an AP transmits to STAs acknowledgment policies in a DL MU frame and the STAs transmit UL acknowledgment in a MU or SU format.

113. U.S. Patent Application Publication No. 2016/0065466, entitled “Systems and Methods for Signaling Multi-Destination Aggregated Multi-User Media Access Control Protocol Data Units in A Wireless Network”, and claimed

priority to a Provisional Application No. 62/043,061 filed on August 28, 2014, was filed on August 26, 2015, by Abraham et al. (“Abraham466”) (EX-1005).

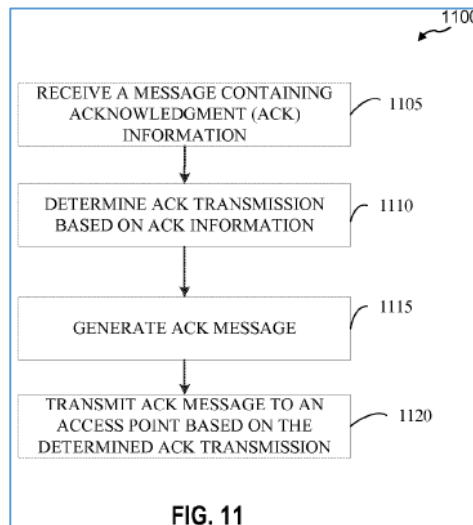
Abraham466 is prior art to the ’679 Patent under AIA 35 U.S.C. § 102 (a)(2).¹

114. Abraham466 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-1005, Abstract. EX-1025-Abstract.

115. For example, Abraham466 discloses that “**the AP 104 may set an acknowledgment policy for stations** receiving MD-AMPDUs (e.g., A-MPDU 400). To coordinate acknowledgements from each of the STAs, **one or more of the A-MPDU sub-frames 305 a-305 c or 405 a-405 n** (See FIGS. 3 and 4) **may include one or more fields defining an acknowledgement policy** (e.g., **transmission parameters of acknowledgment frames transmitted from each of**

¹ I may include citations to Abraham466 Provisional Application 62/043,061 (EX-1025) following to citations to Abraham466. I also provide a table in Section XIII summarizing the support in Abraham466 Provisional Application for Abraham466 and independent claim 1.

the STAs in response to the A-MPDU 400) for the A-MPDU sub-frame.” EX-1005, [0062] (emphases added). *See also* EX-1005, FIG. 11; EX-1025, [0059], FIG. 11



C. Chu806 discloses a method where an AP transmits to STAs acknowledgment policies in a DL MU frame and the STAs transmit UL acknowledgment in a MU or SU format.

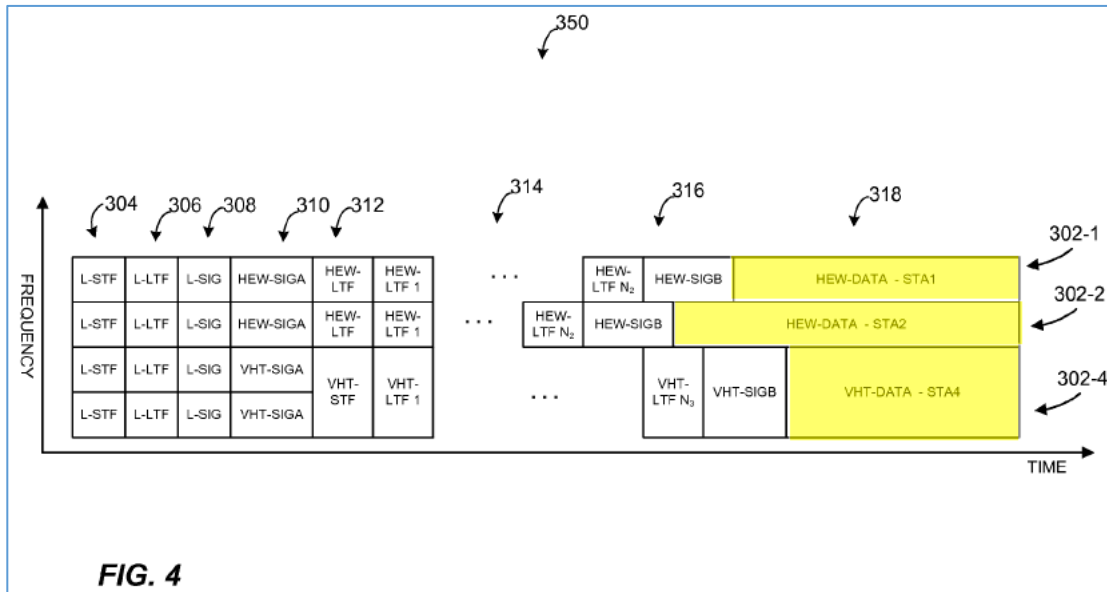
116. U.S. Patent No. 10,257,806, entitled “Medium Access Control for Multi-Channel OFDM in a Wireless Local Area Network”, and claimed priority to Provisional Application No. 61/902,413 filed on November 11, 2013, and No. 61/947,922 filed on March 4, 2014, was filed on November 11, 2014, and issued on April 9, 2019, to Chu et al. (EX-1006). Chu806 is prior art to the ’679 Patent under AIA 35 U.S.C. § 102 (a)(2).²

² I may include citations to Chu806 Provisional Applications (EX-1026 and EX-1027) following to citations to Abraham466. I also provide a table in Section XIII

117. 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-1006, 1:47-2:9.

118. For example, Chu806 discloses that “[d]uring a time t2, in 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. In 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-1006, 13:4-10. *See also* EX-1006, FIG. 4; FIG. 8A; FIG. 14A; EX-1026, 10, 16, 24; EX-1027, 8, 14, 22.

summarizing the support in Chu806 Provisional Applications for Chu806 and independent claim 1.



D. Ma discloses a method where an AP transmits to STAs acknowledgment policies in a DL MU frame and the STAs transmit UL acknowledgment in a MU or SU format.

119. U.S. Patent No. 9,462,607, entitled “Apparatus, Method, and System of Multi-User”, was filed on August 28, 2014, by Ma et al. (“Ma”) (EX-1006). Ma is prior art to the ’679 Patent under AIA 35 U.S.C. § 102 (a)(2).

120. Ma is directed to “an apparatus may include a transmitter to transmit a multi-user (MU) downlink transmission to a plurality of wireless stations; a receiver to receive from the plurality of wireless stations a plurality of acknowledgement (ACK) frames.” EX-1007, Abstract. For example, Ma discloses that “AP 500 may transmit a MU ACK request 510, e.g., a Block ACK Request (BAR), to wireless stations 502, 504 and 506,” and the “wireless stations 502, 504 and 506 may simultaneously transmit a plurality of ACK frames 512, e.g., each including an EACK 200 (FIG. 2), in response to the ACK

request 510.” EX-1007, 15:50-56. Ma also discloses that “the plurality of ACK frames may be communicated in a sequential manner or in a simultaneous manner.” EX-1007, 11:24-26.

XI. DETAILED UNPATENTABILITY ANALYSIS

121. This section details my analysis of how claims of the ’679 Patent are obvious and unpatentable. The claims discussed for each of four grounds in my analysis are shown in the following table:

Ground 1: Merlin	Ground 2: Abraham466	Ground 3: Merlin in view of Abraham466, Chu806 or Ma
1-10	1-10	1-10

A. Ground 1: Merlin renders obvious Claims 1-10.

122. As set forth below, Merlin renders Claims 1-10 obvious and unpatentable.

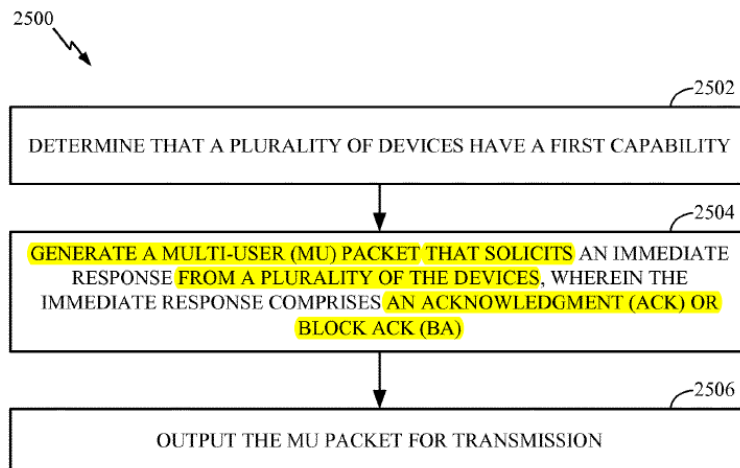
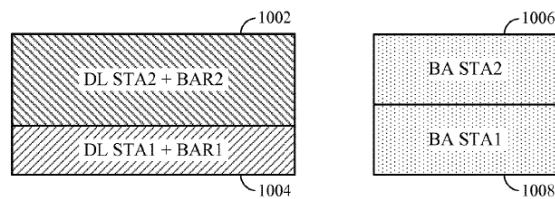
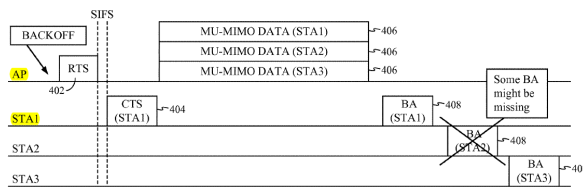
1. Claim 1.

- a. [1pre] A method for transmitting an acknowledgement frame for notifying successful data reception by a station (STA) to an access point (AP) in a wireless local area network, the method comprising:**

123. Merlin discloses [1pre].

124. Merlin discloses how STAs to transmit acknowledgement frames to an AP in WLAN systems, including how to transmit UL MU/SU acknowledgement frames to acknowledge receipt of DL MU data. For example,

Merlin discloses a method where “[i]n DL-MU-MIMO transmissions, multiple packets are sent at the same time toward different STAs. **If all the acknowledgments (ACKs) [or block ACKs (BAs)] are received, the transmission may be considered successful.**” EX-1004, 11:35-38 (emphasis added); FIG. 4; FIG. 10; FIG. 22; FIG. 25.



125. Also, Merlin discloses “**setting of ACK policies and signaling for allocating MU-MIMO or FDMA resources to the recipient STAs for the replies.**” Such signaling may include which STAs should be solicited for immediate response (e.g., for immediate BAs), which STAs may use existing ACK

policy indications, **which mode is to be used for the replies (e.g., UL SU-MIMO, UL MU-MIMO, or UL MU FDMA)**, and which parameters to use for MU-MIMO or FDMA transmissions.” EX-1004, 12:57-65 (emphases added).

- b. **[1a] receiving, from the AP, a downlink frame including a quality of service (QoS) control field including acknowledgement information representing whether the STA is requested to transmit the acknowledgement frame in a single-user (SU) format or in a multiple-user (MU) format at a Short Inter-Frame Space (SIFS) time after the downlink frame; and**

126. Merlin discloses or renders [1a] obvious.

127. Merlin discloses that an AP to transmit a DL MU frame that includes acknowledgement information for a STA, for example, the format and the timing of an UL ACK by the STA. For example, Merlin discloses “**setting of ACK policies and signaling for allocating MU-MIMO or FDMA resources** to the recipient STAs **for the replies**. Such signaling may include which STAs should be solicited for immediate response (e.g., for immediate BAs), which STAs may use existing ACK policy indications, **which mode is to be used for the replies (e.g., UL SU-MIMO, UL MU-MIMO, or UL MU FDMA)**, and which parameters to use for MU-MIMO or FDMA transmissions.” EX-1004, 12:57-65 (emphases added).

128. Merlin further discloses that “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,” and “the DL MU-MIMO/FDMA PPDU may be addressed to a mix of legacy (e.g., non-HEW) STAs and HEW STAs (i.e., some of the addressed STAs support UL MU-MIMO, UL FDMA, or both, and some of the addressed STAs do not).” EX-1004, 12:66-13:3, 13:24-28.

129. Merlin also discloses “[a]ccording to certain aspects, 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. For example, **the requested STA may know or be indicated whether to reply with SU-MIMO, MU-MIMO, or FDMA.**” EX-1004, 14:12-17 (emphasis added).

130. From at least Merlin’s disclosures of DL MU frame that include ACK policy indications of the reply mode by the STAs and parameters for MU-MIMO transmissions, a POSITA would readily understand that Merlin discloses or renders obvious the [1a] limitation “receiving, from the AP, a downlink frame including... acknowledgement information representing whether the STA is requested to transmit the acknowledgement frame in a single-user (SU) format or in a multiple-user (MU) format.”

131. Merlin also discloses an AP to transmit a DL MU frame that includes a quality of service (QoS) control field including acknowledgement information. For example, Merlin also discloses that “**response parameters for UL MU-**

MIMO and UL FDMA replies may be dynamically allocated and indicated to each STA in the received DL PSDU. For example, the parameters may be included **in each MPDU (e.g., in the QoS control field** or in the FC field), in the A-MPDU delimiter preceding the MPDU, or in an extended MAC header.” EX-1004, 16:62-17:1.

132. Merlin also discloses that **“a response type indication for each STA may be added in each MPDU or PSDU.** 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).** For a response type indication in each MPDU, the indication may **be included in the Quality of Service (QoS) control field....**” EX-1004, 14:26-32 (emphases added). A POSITA would readily understand that Merlin discloses or renders obvious the [1a] limitation “receiving, from the AP, a downlink frame including a quality of service (QoS) control field including acknowledgement information representing whether the STA is requested to transmit the acknowledgement frame in a single-user (SU) format or in a multiple-user (MU) format.”

133. Further, Merlin discloses that **“[t]he STA BA transmissions may be separated by SIFS.** The order and **timing for the STA BA transmissions may be sent in the DL-MU-MIMO data 406.**” EX-1004, 11:32-34 (emphases added). A POSITA would readily understand that Merlin discloses or renders obvious the

[1a] limitation “receiving, from the AP, a downlink frame including a quality of service (QoS) control field including acknowledgement information representing whether the STA is requested to transmit the acknowledgement frame in a single-user (SU) format or in a multiple-user (MU) format at a Short Inter-Frame Space (SIFS) time after the downlink frame.”

134. Alternatively or in addition, Merlin further discloses an AP to transmit a DL MU frame that includes acknowledgement information and block acknowledgement request (BAR). For example, Merlin discloses “in FIG. 9, **the BAR frame 900** may include a frame control field 902, duration/ID field 904, receiver address field 906, transmitter address field 908, BAR control field 910, BAR information field 912, and frame check sequence field 914. According to certain aspects, some of the 8 reserved bits in the BAR control field 910 may be used for the variable length BAR information field 912 to indicate the resource allocation for the responses. According 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)**. For example, SU may be indicated by 00, MU-MIMO may be indicated by 01....” EX-1004, 18:11-33 (emphases added). *See also* EX-1004, FIG. 9.

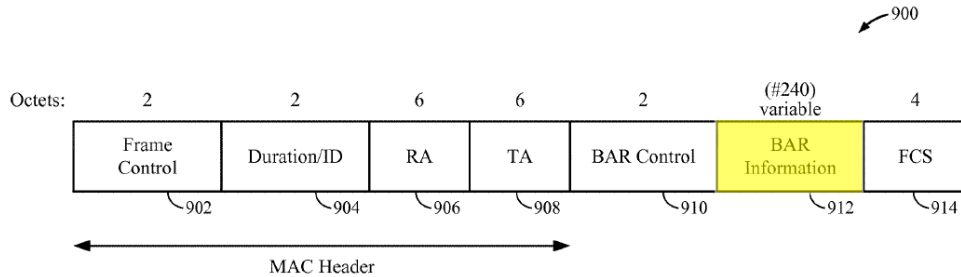


FIG. 9

135. Merlin also discloses that “FIG. 12 illustrates an example format for a multi-TID [block acknowledgment request] BAR, in accordance with certain aspects of the present disclosure,” and “[t]he multi-STA BAR may use some of the reserved bits in the BAR control field... 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-1004, 4:26-28; 18:67-19:5; FIG. 12. *See also* EX-1004, FIG. 4.

136. In view of at least Merlin’s disclosures of “[f]or a response type indication in each MPDU, the indication may be included in the Quality of Service (QoS) control field” (EX-1004, 14:26-32), a POSITA would readily understand that Merlin discloses or renders obvious the [1a] limitation “receiving, from the AP, a downlink frame including a quality of service (QoS) control field including acknowledgement information representing whether the STA is requested to transmit the acknowledgement frame in a single-user (SU) format or in a multiple-user (MU) format.”

137. Alternatively or in addition, particularly in view of the State of the Art, e.g., how QoS control field has been known to include acknowledgement information or acknowledgement policy for subsequent acknowledgement frames (see Section VII.B above), a POSITA would readily understand that the DL MU frame disclosed in Merlin includes QoS control field including acknowledgement information about acknowledgment format and timing, and that Merlin discloses or renders obvious the [1a] limitation “receiving, from the AP, a downlink frame including a quality of service (QoS) control field including acknowledgement information representing whether the STA is requested to transmit the acknowledgement frame in a single-user (SU) format or in a multiple-user (MU) format at a Short Inter-Frame Space (SIFS) time after the downlink frame.”

c. [1b] transmitting, to the AP, the acknowledgement frame based on the acknowledgement information at the SIFS time after the downlink frame,

138. Merlin discloses [1b].

139. Merlin discloses multiple STAs to transmit UL acknowledgement frames based on the DL MU frame received from the AP and after SIFS of the DL MU frame from the AP. For example, Merlin discloses that “[t]he **STA BA transmissions may be separated by SIFS**. The order and **timing for the STA BA transmissions may be sent in the DL-MU-MIMO data** 406.” EX-1004, 11:32-34 (emphases added). *See also* EX-1004, FIG. 4 (annotated below).

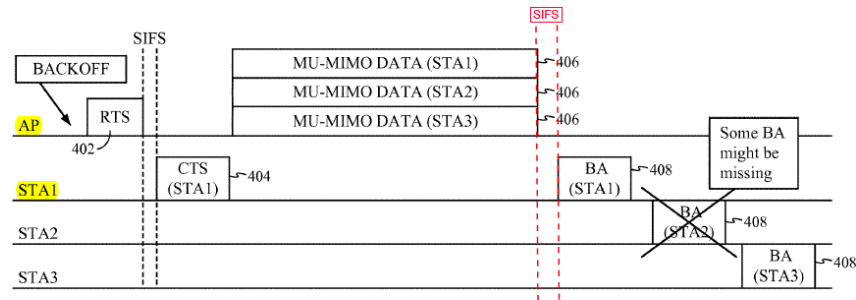


FIG. 4

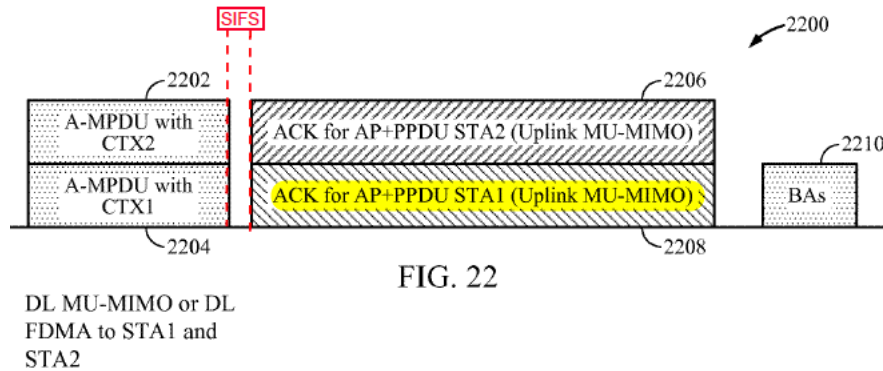
- d. [1c] wherein transmitting the acknowledgment frame comprises: when the acknowledgment information represents that the STA is requested to transmit the acknowledgement frame in the MU format and the STA is allocated a resource, transmitting the acknowledgement frame in the MU format on the allocated resource simultaneously with transmission of at least one acknowledgement frame from at least one other STA, and

140. Merlin discloses [1c].

141. Merlin discloses the acknowledgement information contained in the DL MU frame from AP to indicate resources allocated to the STAs and the STAs to transmit BAs in the MU format using the allocated resources based on the acknowledgement information in the DL MU frame from the AP. For example, Merlin discloses that “[a]ccording to certain aspects, **if a STA determines** (e.g., receives an indication, derives, statically agrees, or is configured) **that UL MU-MIMO or FDMA 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.... Option 1: According to certain aspects, a first option to indicate response parameters may be to extend existing **rules for the** immediate response bandwidth (BW) and **modulation and coding schemes (MCSs).**” EX-1004, 15:26-41 (emphases added).

142. Also, Merlin discloses an “option for indicating the response type may be to aggregate an additional “special” frame into the A-MPDU from which the STA can know the **response type and parameters.** For example, if the special subframe is received, **the STA may reply according to an allocation defined by the special subframe.**” EX-1004, 14:39-45 (emphases added). Merlin further discloses that “[i]f the 1 or 2 bits indicate that the response type is SU-MIMO, the STA may reply with a SU transmission. However, **if the 1 or 2 bits indicate that the response type is MU-MIMO/FDMA, and if a special frame is received (e.g., as in the second option), the STA may reply according to the allocation defined by the special subframe.** Alternatively, if the 1 or 2 bits indicate that the response type is MU and if a special frame is not received, then the STA may know not to reply.” EX-1004, 14:55-63 (emphasis added). *See also* EX-1004, FIG. 22 (annotated below).



143. Merlin also discloses that “FIG. 12 illustrates an example format for a multi-TID [block acknowledgment request] BAR, in accordance with certain aspects of the present disclosure,” and “[t]he multi-STA BAR may use some of the reserved bits in the BAR control field... **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-1004, 4:26-28; 18:67-19:5 (emphases added); FIG. 12.

- e. [1d] [wherein transmitting the acknowledgment frame comprises:...] when the acknowledgment information represents that the STA is requested to transmit the acknowledgement frame in the SU format, transmitting the acknowledgement frame in SU format.

144. Merlin discloses [1d].

145. Merlin discloses the STAs to transmit BAs sequentially in the SU format using the allocated resources based on the acknowledgement information in the DL MU frame from the AP. For example, Merlin discloses “[a]ccording to certain aspects, multiple simultaneous responses may be solicited, even if one of

the STAs does not support UL FDMA or UL MU-MIMO (e.g., a legacy STA or a HEW STA not supporting UL FDMA or UL MU-MIMO). **For example, a legacy STA may respond with a regular SU transmission on a primary channel**, while other capable STAs may respond at the same time on other channels.” EX-1004, 13:64-14:3 (emphases added). As an example, Merlin discloses that “[i]f the 1 or 2 bits indicate that the response type is SU-MIMO, the STA may reply with a SU transmission.” EX-1004, 14:55-57 (emphasis added).

146. For the foregoing reasons, claim 1 of the '679 Patent is unpatentable as obvious in view of Merlin.

2. Claim 2.

[2] The method according to claim 1, wherein the downlink frame further includes Modulation and Coding Scheme (MCS) information for the acknowledgement frame.

147. Merlin discloses [2].

148. Merlin discloses an AP to transmit a DL MU frame that includes acknowledgement information and MCS information for the acknowledgement frame by the STA. For example, Merlin discloses that “[a]ccording to certain aspects, if a STA determines (e.g., receives an indication, derives, statically agrees, or is configured) that UL MU-MIMO or FDMA 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....

Option 1: According to certain aspects, **a first option to indicate response parameters may be to extend existing rules for the immediate response bandwidth (BW) and modulation and coding schemes (MCSs).**” EX-1004, 15:26-41 (emphases added).

149. Merlin also discloses that “[o]n the uplink, at each user terminal 120 selected for uplink transmission, a transmit (TX) data processor 288 receives traffic data from a data source 286 and control data from a controller 280. **TX data processor 288 processes** (e.g., **encodes, interleaves, and modulates**) **the traffic data for the user terminal based on the coding and modulation schemes associated with the rate selected for the user terminal** and provides a data symbol stream.” EX-1004, 9:13-20 (emphases added).

150. In view of at least Merlin’s disclosures of response parameters of MCSs indicated or selected for STAs, a POSITA would readily understand that Merlin discloses or renders obvious the [2] limitation “wherein the downlink frame further includes Modulation and Coding Scheme (MCS) information for the acknowledgement frame.”

151. Accordingly, claim 2 is unpatentable as obvious in view of Merlin.

3. Claim 3.

[3] The method according to claim 2, wherein a same MCS based on the MCS information is applied to the

acknowledgement frame by the STA and the at least one other STA.

152. Merlin renders [3] obvious.

153. Merlin discloses that “Uplink (UL) MU-MIMO or UL FDMA can be used to transmit multiple block acknowledgements (BAs) at the same time, for example, in response to a downlink (DL) MU physical protocol data unit (PPDU).” EX-1004, 12:30-34. Particularly since the ’679 Patent describes that “[t]he same transmission time of the block ACK frames transmitted by the plurality of STAs may mean the same transmission MCS of the block ACK frames transmitted by the plurality of STAs,” (EX-1001, 39:51-54) and since Merlin discloses simultaneous UL MU-MIMO acknowledgements by STAs, a POSITA would readily understand that Merlin discloses or renders obvious the [3] limitation.

154. Alternatively, Patent Owners states in its preliminary infringement contention that “Two STAs receiving the same trigger frame can be assigned the same MCS.” EX-1009, 48. *See* also EX-1009, 48-50.

'679 Claim 3	Elements in Accused Instrumentality
3. The method according to claim 2, wherein a same MCS based on the MCS information is applied to the acknowledgement frame by the STA	A Wi-Fi 6 High Efficiency Station Device receives from the AP a downlink frame, wherein the downlink frame further includes Modulation and Coding Scheme (MCS) information for the acknowledgement frame, and wherein a same MCS based on the MCS information is applied to the acknowledgement frame by the STA and the at least one other STA, as shown by the following excerpts from the 802.11ax-2021 Standard: Two STAs receiving the same trigger frame can be assigned the same MCS;

EX-1009, 48.

155. As mentioned above, Merlin discloses that “Uplink (UL) MU-MIMO or UL FDMA can be used to transmit multiple block acknowledgements (BAs) at

the same time, for example, in response to a downlink (DL) MU physical protocol data unit (PPDU).” EX-1004, 12:30-34. Particularly since the Patent Owner’s own contention of same MCS being used by STAs receiving a same trigger frame (EX-1009, 48-50) and since Merlin discloses simultaneous UL MU-MIMO acknowledgements by STAs in response to the same DL MU frame, a POSITA would readily understand that Merlin discloses or renders obvious the [3] limitation.

156. Merlin also mentions that “[a]ccording to certain aspects, the MCS... may also account for the bandwidth.” EX-1004, 15:54-58. Merlin discloses that “as an example, **the bandwidth may be set to a value equal for all responders.**” EX-1004, 15:61-62 (emphasis added). Merlin further illustrates, for example, in FIG. 6, 7, 8 or 10, that the BA by STA1 and STA2 have the same width of bandwidth. From at least Merlin’s disclosure of the MCS indication to account for the bandwidth or setting equal bandwidth value to STAs, a POSITA would readily understand that Merlin renders obvious the [3] limitation.

157. In addition, Merlin discloses that “[o]n the **uplink, at each user terminal 120 selected for uplink transmission**, a transmit (TX) data processor 288 receives traffic data from a data source 286 and control data from a controller 280. TX data **processor 288 processes** (e.g., encodes, interleaves, and modulates) the traffic data for the user terminal **based on the coding and**

modulation schemes associated with the rate selected for the user terminal and provides a data symbol stream.” EX-1004, 9:13-20 (emphases added). In view of at least Merlin’s disclosure of STA to determine MCS scheme associated with the rate selected for the STA, a POSITA would readily understand that Merlin renders obvious the feature of assigning a same MCS information for the UL acknowledgement frames by two or more STAs, if the AP selects the same rate for the STAs.

158. See Section XI.A.2 (discussion of Limitation [2]).

4. Claim 4.

[4] The method according to claim 1, wherein the downlink frame includes downlink data for a plurality of STAs including the STA and the at least one other STA.

159. Merlin discloses or renders [4] obvious.

160. Merlin discloses an AP transmitting a DL MU frame to include downlink data for a plurality of STAs. For example, Merlin discloses that “[t]he order and timing for the STA BA transmissions may be sent in the **DL-MU-MIMO data 406**,” and “[i]n DL-MU-MIMO transmissions, multiple packets are **sent at the same time toward different STAs**.” EX-1004, 11:33-36 (emphases added). Merlin also discloses that “in FIG. 4, MU-MIMO data 406 was sent to STA1, STA2, and STA3 (access terminals 120).” EX-1004, 11:45-46. See also EX-1004, FIG. 4, FIG. 22. See Section XI.B.1.b (discussion of Limitation [1a]).

161. Accordingly, claim 4 is unpatentable as obvious in view of Merlin.

5. Claim 5.

[5] The method according to claim 1, wherein the downlink frame includes block acknowledgement (ACK) requests for a plurality of STAs including the STA and the at least one other STA.

162. Merlin discloses [5].

163. Merlin discloses an AP transmitting a DL MU frame that includes block acknowledgement requests (BARs) for a plurality of STAs. For example, Merlin discloses that “[a]ccording to certain aspects, a multi-STA BAR frame may be used to request BAs from multiple STA.” EX-1004, 18:57-58. Further, “FIG. 12 illustrates an example format for a multi-TID **[block acknowledgment request] BAR**, in accordance with certain aspects of the present disclosure,” and “[t]he multi-STA BAR may use some of the reserved bits in the BAR control field... **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-1004, 4:26-28; 18:67-19:5 (emphases added); FIG. 12.

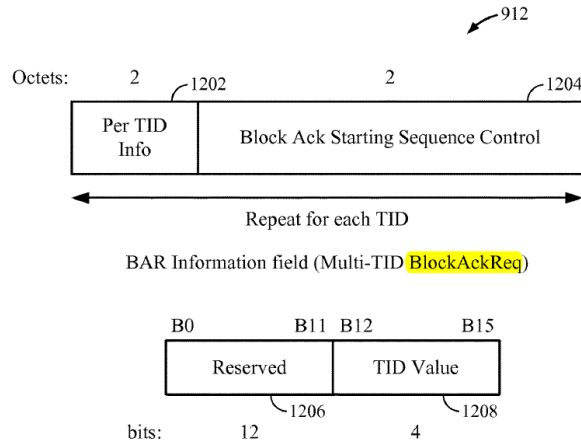


FIG. 12

164. As a further example, Merlin discloses that “FIG. 10 illustrates an example frame exchange 1000 of a DL A-MPDU including a BAR frame per each STA, in accordance with certain aspects of the present disclosure. As shown in FIG. 10, a different BAR frame for each STA may be aggregated in the DL A-MPDUs for each STA. For example, BAR frame 1002 (DL STA2+BAR2) and BAR frame 1004 (DL STA1+BAR1) may be aggregated into A-MPDU and may solicit BAs 1006 (BA STA2) and 1008 (BA STA1) from STAs 2 and 1, respectively.” EX-1004, 18:35-43; FIG. 10.

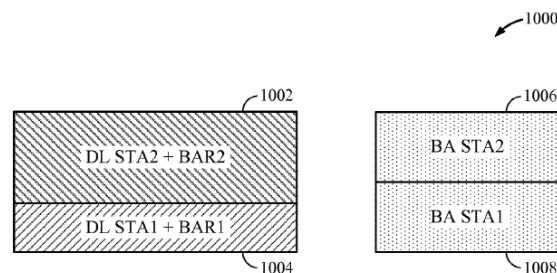


FIG. 10

165. Accordingly, claim 5 is unpatentable as obvious in view of Merlin.

6. Claim 6.

- a. [6pre] A method for receiving an acknowledgement frame for notifying successful data reception by an access point (AP) from a station (STA) in a wireless local area network, the method comprising:

166. Merlin discloses [6pre]. Merlin discloses where “FIG. 4 illustrates an example downlink multiuser multiple-input multiple-output (DL-MU-MIMO) between an access point and a plurality of stations,” “the AP may send DL-MU-MIMO data 406 to STAs selected by the scheduler (typically part of the processing system of the AP, such as scheduler 234 in FIG. 2),” “[t]he STAs receiving the MU-MIMO data 406 may transmit BAs 408 in the uplink (UL),” and “[i]n DL-MU-MIMO transmissions, multiple packets are sent at the same time toward different STAs. If all the acknowledgments (ACKs) [or block ACKs (BAs)] are received, the transmission may be considered successful.” EX-1004, 11:10-12; 11:26-28; 11:29-30; 11:35-38 (emphases added). *See also* EX-1004, FIG. 22 (annotated below).

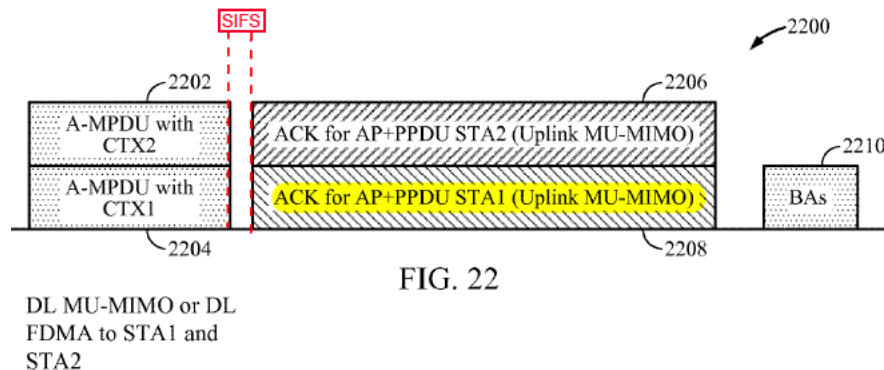


FIG. 22

167. *See also* Section XI.A.1.a (discussion of Limitation [1pre]).

- b. [6a] transmitting, to the STA, a downlink frame including a quality of service (QoS) control field including acknowledgement information representing whether the STA is requested to transmit the acknowledgement frame in a single-user (SU) format or in a multiple-user (MU) format at a Short Inter-Frame Space (SIFS) time after the downlink frame; and

168. Merlin discloses or renders [6a] obvious.

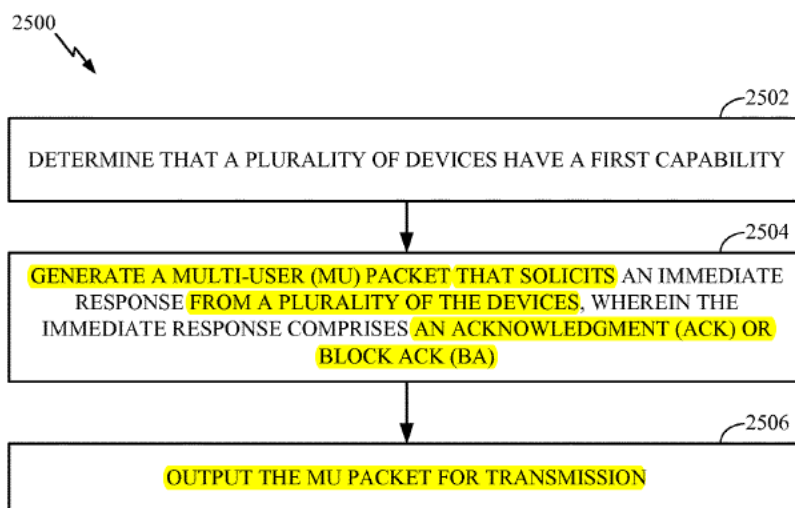


FIG. 25

169. Specifically, Merlin discloses “[a]ccording to certain aspects, 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. For example, **the requested STA may know or be indicated whether to reply with SU-MIMO, MU-MIMO, or FDMA.** The PHY preamble mode to be used may be different depending on technique is to reply.” EX-1004, 14:12-18 (emphasis added).

170. For example, Merlin teaches “a response type indication for each STA may be added in each MPDU or PSDU. 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).** For a response type indication in each MPDU, the indication may be included in the Quality of Service (QoS) control field....” EX-1004, 14:26-32 (emphases added).

171. Further, Merlin discloses that “[t]he **STA BA transmissions may be separated by SIFS. The order and timing for the STA BA transmissions may be sent in the DL-MU-MIMO data 406.**” EX-1004, 11:32-34 (emphases added). *See also* EX-1004, FIG. 4; Section XI.A.1.b (discussion of Limitation [1a]).

- c. **[6b] receiving, from the STA, the acknowledgement frame based on the acknowledgement information at the SIFS time after the downlink frame,**

172. Merlin discloses [6b]. Merlin discloses that “[t]he **STA BA transmissions may be separated by SIFS. The order and timing for the STA BA transmissions may be sent in the DL-MU-MIMO data 406.**” EX-1004, 11:32-34 (emphases added). *See also* EX-1004, FIG. 4 (annotated below); Section XI.A.1.c (discussion of Limitation [1b]).

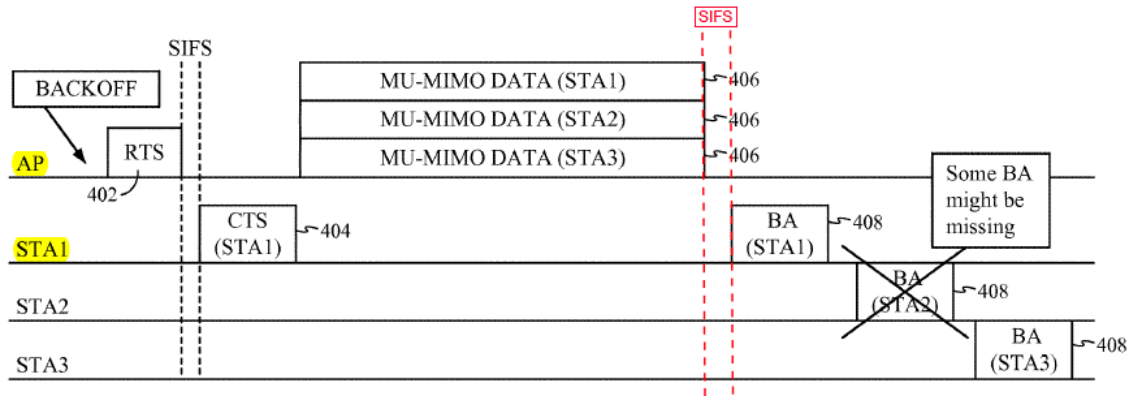


FIG. 4

- d. **[6c] wherein receiving the acknowledgment frame comprises: when the acknowledgment information represents that the STA is requested to transmit the acknowledgement frame in the MU format, receiving the acknowledgement frame in the MU format on an allocated resource simultaneously with transmission of at least one acknowledgement frame from at least one other STA, and**

173. Merlin discloses [6c]. *See also* EX-1004, FIG. 22; Section XI.A.1.d (discussion of Limitation [1c]).

- e. **[6d] [wherein receiving the acknowledgment frame comprises:...] when the acknowledgment information represents that the STA is requested to transmit the acknowledgement frame in the SU format, receiving the acknowledgement frame in SU format.**

174. Merlin discloses [6d]. *See also* EX-1004, FIG. 4; Section XI.A.1.e (discussion of Limitation [1d]).

175. For the foregoing reasons, claim 6 of the '679 Patent is unpatentable as obvious in view of Merlin. *See* Section XI.A.1 (discussion of [1]).

7. Claim 7.

[7] The method according to claim 6, wherein the downlink frame further includes Modulation and Coding Scheme (MCS) information for the acknowledgement frame.

176. Merlin discloses [7]. *See* Section XI.A.2 (discussion of Limitation [2]).

8. Claim 8.

[8] The method according to claim 7, wherein a same MCS based on the MCS information is applied to the acknowledgement frame by the STA and the at least one other STA.

177. Merlin discloses or renders [8] obvious. *See* Section XI.A.3 (discussion of Limitation [3]).

9. Claim 9.

[9] The method according to claim 6, wherein the downlink frame includes downlink data for a plurality of STAs including the STA and the at least one other STA.

178. Merlin discloses or renders [9] obvious. *See* Section XI.A.4 (discussion of Limitation [4]).

10. Claim 10.

[10] The method according to claim 6, wherein the downlink frame includes block acknowledgement (ACK) requests for a plurality of STAs including the STA and the at least one other STA.

179. Merlin discloses [10]. *See* Section XI.A.5 (discussion of Limitation [5]).

B. Ground 2: Abraham466 renders obvious Claims 1-10.

180. As set forth below, Abraham466 renders Claims 1-10 obvious and unpatentable.

1. Claim 1.

- a. [1pre] A method for transmitting an acknowledgement frame for notifying successful data reception by a station (STA) to an access point (AP) in a wireless local area network, the method comprising:**

181. Abraham466 discloses [1pre].

182. Abraham466 discloses how STAs to transmit acknowledgement frames to an AP in WLAN systems, including how to transmit UL MU/SU acknowledgement frames to acknowledge receipt of DL MU data. For example, Abraham466 discloses that “[d]ata frames may be used for transmitting data from an AP and/or a STA to other APs and/or STAs. **Control frames may be used together with data frames for performing various operations and for reliably delivering data (e.g., acknowledging receipt of data,** polling of APs, area-clearing operations, channel acquisition, carrier-sensing maintenance functions, etc.).” EX-1005, [0049] (emphases added). EX-1025, [0046].

183. Abraham466 also discloses that “[i]n some aspects, **method 1100 may be performed by the STA 106 a** or any suitable device. At block 1105, **the STA 106 a may receive a message containing ACK information.** In some embodiments, the message may comprise **a MD-AMPDU**

frame from the AP 104 which comprises the ACK control field 765.... At block 1115, the STA 106 *a* may then generate the ACK message. In some embodiments, the ACK message is generated based on the determination in block 1110. At block 1120, the STA 106 *a* transmits to the ACK message to the AP 104 based on the determined transmission.” EX-1005, [0074] (emphases added). *See also* EX-1005, FIG. 11.

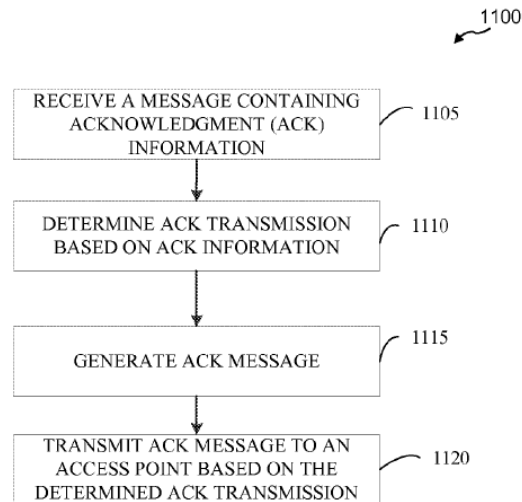


FIG. 11

184. *See also* Abraham466_Provisional, EX-1025, [0046].

[0046] As discussed above, the wireless device 202 may comprise an AP 104 or an STA 106a-106f, and may be used to transmit and/or receive communications. The communications exchanged between devices in a wireless network may include data units which may comprise packets or frames. In some aspects, the data units may include data frames, control frames, and/or management frames. Data frames may be used for transmitting data from an AP and/or a STA to other APs and/or STAs. Control frames may be used together with data frames for performing various operations and for reliably delivering data (e.g., acknowledging receipt of data, polling of APs, area-clearing operations, channel acquisition, carrier-sensing maintenance functions, etc.). Management frames may be used for various supervisory functions (e.g., for joining and departing from wireless networks, etc.).

185. *See also* Abraham466_Provisional, EX-1025, [0071].

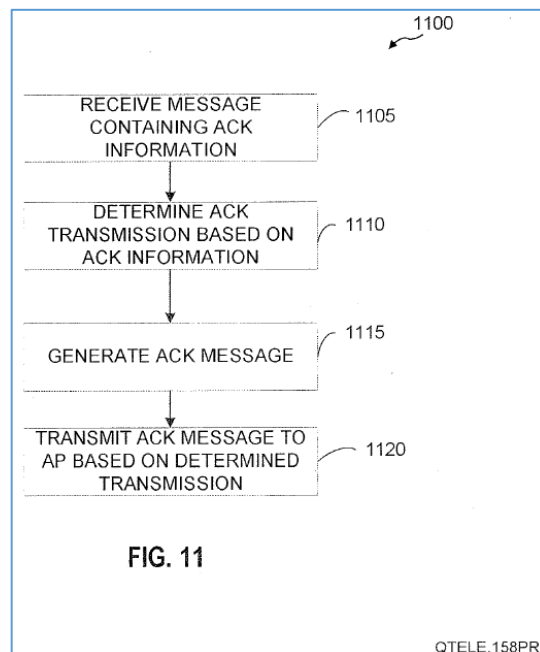
[0071] FIG. 11 is a flowchart of a method 1100 for wireless communication, in accordance with an implementation. In some aspects, the method 1100 may be performed by the wireless device 202, shown above with respect to FIG. 2. In some

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aspects, method 1100 may be performed by the STA 106a or any suitable device. At block 1105, the STA 106a may receive a message containing ACK information. In some embodiments, the message may comprise a MD-AMPDU frame from the AP 104 which comprises the ACK control field 765. At block 1110, the STA 106a may then determine when and how to send its ACK message transmission based on the ACK information. For example, the ACK control field 765 may include a MCS, a bandwidth allocated to the STA 106a, and an order of when the STA should send its ACK message. The STA 106a may then determine based on such information the specific time to transmit the ACK and type of transmission (e.g., BA, MU-MIMO, FDMA, OFDMA, etc.). At block 1115, the STA 106a may then generate the ACK message. In some embodiments, the ACK message is generated based on the determination in block 1110. At block 1120, the STA 106a transmits to the ACK message to the AP 104 based on the determined transmission.

186. *See also* EX-1025, FIG. 11.



- b. **[1a] receiving, from the AP, a downlink frame including a quality of service (QoS) control field including acknowledgement information representing whether the STA is requested to transmit the acknowledgement frame in a single-user (SU) format or in a multiple-user (MU) format at a Short Inter-Frame Space (SIFS) time after the downlink frame; and**

187. Abraham466 discloses or renders [1a] obvious.

[1a] “receiving, from the AP, a downlink frame including... acknowledgement information representing whether the STA is requested to transmit the acknowledgement... at a Short Inter-Frame Space (SIFS) time after the downlink frame”

188. Abraham466 discloses multiple STAs to receive, from an AP, a downlink frame including acknowledgement information. For example, Abraham466 discusses that “[a]t block 1105, **the STA 106 a may receive a message containing ACK information.** In some embodiments, **the message may comprise a MD-AMPDU frame from the AP 104....**” EX-1005, [0074] (emphases added).

189. Abraham466 also discloses the downlink frame from AP to include acknowledgement information/policy to STAs. As a further example, Abraham466 discusses that “[i]n order to set the acknowledgment, **the AP 104 may include an indication of the acknowledgment policy in the MAC header portion of a frame.**” EX-1005, [0063] (emphases added).

190. Abraham466 discloses the acknowledgement information contained in the DL MU frame from AP to indicate when and how the STA is to transmit an acknowledgement and indicates the timing for an UL ACK to be after a SIFS. For example, Abraham466 discusses that “[t]he **ACK control field 765 may indicate** to a station receiving the MPDU frame 700 **when and how a BA is sent and a time gap (or frequency offset or spatial stream gap) between successive BAs (e.g., transmission parameters of block acknowledgment frames transmitted from each of the STAs in response to the MPDU frame 700).** For example, **ACK control field 765 may indicate that one or more stations should send a BA a Short Interframe Space (SIFS) time period after the PPDU carrying the MPDU frame 700.**” EX-1005, [0064] (emphases added). *See also* EX-1025, [0060], [0061], [0071].

[1a] “...a downlink frame including a quality of service (QoS) control field including acknowledgement information...”

191. Abraham466 illustrates an embodiment whether the bits of QoS control field indicate the existence of acknowledgment policy in the DL MU frame. For example, Abraham466 discusses that “[i]n some embodiments, **the presence of the ACK control field 765 may be indicated using a reserved bit/bit combination in the frame control field 710, QoS control field 755 or the HT/VHT control field 760.**” EX-1005, [0064] (emphases added).

192. *See also* EX-1025, Abraham466_Provisional [0061].

[0061] The ACK control field 765 may indicate to a station receiving the MPDU frame 700 when and how a BA is sent and a time gap (or frequency offset or spatial stream gap) between successive BAs. For example, ACK control field 765 may indicate that one or more stations should send a BA a Short Interframe Space (SIFS) time period after the PPDU carrying the MPDU frame 700. In some embodiments, the presence of the ACK control field 765 may be indicated using a reserved bit/bit combination in the frame control field 710, QoS control field 755 or the HT/VHT control field 760. Information that may be included in the ACK control field 765 may include: BA modulation and coding scheme (MCS); bandwidth and/or spatial stream information such as total uplink bandwidth, per STA bandwidth for BA, or the total number of uplink spatial streams; and BA index in which each STA determines the time, exact bandwidth and spatial stream index from its BA index and the bandwidth and spatial stream information.

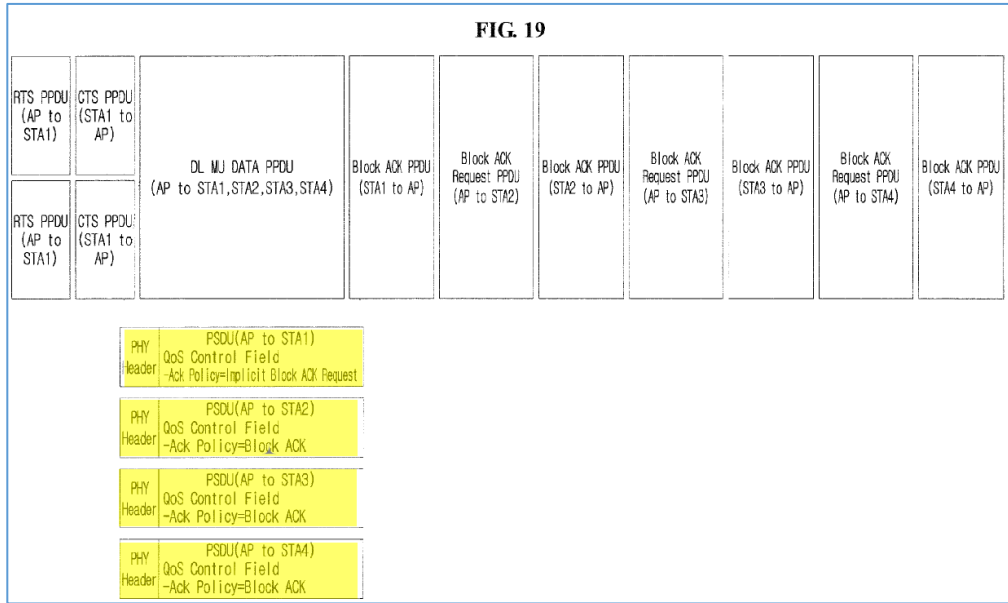
EX-1025, [0061].

193. As discussed above regarding the State of the Art, it has been known to use QoS control field bits to indicate ACK policy directly. *See* Section VI.B above. Particularly in view of the known techniques to utilize bits of a DL MU frame to convey transmission management by an AP, a POSITA would have understood that Abraham466's disclosed "indication of the presence of ACK policy" in the QoS control field can represent the ACK policy directly. For example, a POSITA would understand that as long as both the AP and the receiving STAs agree on what the bits in QoS control field can represent whether the information of the existence of ACK policy or a specific ACK request, the bits in QoS control field can either represent the existence of ACK policy or an explicit ACK instruction.

194. It also has been known that additional bits/frames may be considered as “overhead” to the systems. For example, Ma mentions that “dedicated frames may introduce extra overhead” (EX-1006, 9:35-36), while other POSITA system designers may not consider additional bits/frames inefficient. *See*, for example, EX-1026, 11 (“It is allowed to add padding [bits] for OFMDA PPDU’s....”). Thus, a POSITA would understand that QoS control field can be utilized to represent either the existence of ACK policy or the specific ACK instruction as a design choice, for example, whether to reserve additional frames for another purpose/function depending on the system parameters and preferences.

195. In view of at least Abraham466’s disclosures of the QoS control field containing bits to indicate acknowledgement information, a POSITA would readily understand that Abraham466 discloses or renders obvious the [1a] limitation “receiving, from the AP, a downlink frame including a quality of service (QoS) control field including acknowledgement information.”

196. In addition, the ’679 Patent provides an example of “a quality of service (QoS) control field including acknowledgement information” in FIG. 19. The ’679 Patent references “QoS Control Field-ACK policy=Block ACK” in “PSDU (AP to STA1),” “PSDU (AP to STA3),” and “PSDU (AP to STA4). EX-1001, FIG. 19.



EX-1001, FIG. 19.

197. Turning to the State of the Art, it has known the QoS control field may be utilized to indicate ACK policy. Specifically, the IEEE Std. 802.11-2012 provides specifically how the control bits can represent “Block Acknowledgement Request,” “QoS Data,” “QoS Data + CF-Ack”, “QoS CF-Ack,” etc. *See, e.g., EX-1013. See also 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 subtype 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 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			
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			
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.

Table 3-1. Type and subtype identifiers

Subtype value	Subtype name
Management frames (type=00) ^a	
0000	Association request
0001	Association response
0010	Reassociation request
0011	Reassociation response
0100	Probe request
0101	Probe response
1000	Beacon
1001	Announcement traffic indication message (ATIM)
1010	Disassociation
1011	Authentication
1100	Deauthentication
1101	Action (for spectrum management with 802.11h, also for QoS)
Control frames (type=01) ^b	
1000	Block Acknowledgment Request (QoS)
1001	Block Acknowledgment (QoS)
1010	Power Save (PS)-Poll
1011	RTS
1100	CTS
1101	Acknowledgment (ACK)
1110	Contention-Free (CF)-End
1111	CF-End+CF-Ack
Data frames (type=10)	
0000	Data
0001	Data+CF-Ack
0010	Data+CF-Poll
0011	Data+CF-Ack+CF-Poll
0100	Null data (no data transmitted)
0101	CF-Ack (no data transmitted)
0110	CF-Poll (no data transmitted)
0111	CF-Ack+CF-Poll (no data transmitted)
1000	QoS Data ^c
1001	QoS Data + CF-Ack ^c
1010	QoS Data + CF-Poll ^c

Frame Format | 49

Subtype value	Subtype name
1011	QoS Data + CF-Ack + CF-Poll ^c
1100	QoS Null (no data transmitted) ^c
1101	QoS CF-Ack (no data transmitted) ^c
1110	QoS CF-Poll (no data transmitted) ^c
1111	QoS CF-Ack+CF-Poll (no data transmitted) ^c
(Frame type 11 is reserved)	
^a Management subtypes 0110-0111 and 1110-1111 are reserved and not currently used.	
^b Control subtypes 0000-0111 are reserved and not currently used.	
^c Proposed by the 802.11e task group, but not yet standardized. Note that these frames all have a leading one, which has caused some to refer to the first bit as the QoS bit.	

EX-1013, Table 3-1 at 49-50.

198. Particularly in view of the State of the Art, e.g., how QoS control field has been known in IEEE 802.11 systems to include acknowledgement information or acknowledgement policy for subsequent acknowledgement frames (see Section

VI.B above), a POSITA would readily understand that the MPDU frame disclosed in Abraham466 can include QoS control field including acknowledgement information, and that Abraham466 renders obvious the [1a] limitation “receiving, from the AP, a downlink frame including a quality of service (QoS) control field including acknowledgement information.”

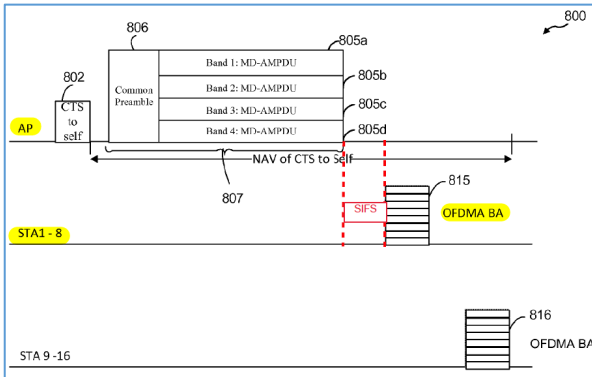
[1a] “... acknowledgement information representing whether the STA is requested to transmit the acknowledgement frame in a single-user (SU) format or in a multiple-user (MU) format at a Short Inter-Frame Space (SIFS) time after the downlink frame”

199. Abraham466 discloses that **“the acknowledgement policy may indicate whether an acknowledgement for the A-MPDU sub-frame should be transmitted by an addressed receiver, the type of acknowledgement that should be transmitted (e.g., whether an acknowledgement or block acknowledgement should be transmitted) and/or a delay time period between when the A-MPDU frame 304 is received and when an acknowledgement to any MPDU sub-frame included in the A-MPDU frame 304 is transmitted.”** EX-1005, [0062]. *See also* Abraham466_Provisional, EX-1025, [0059].

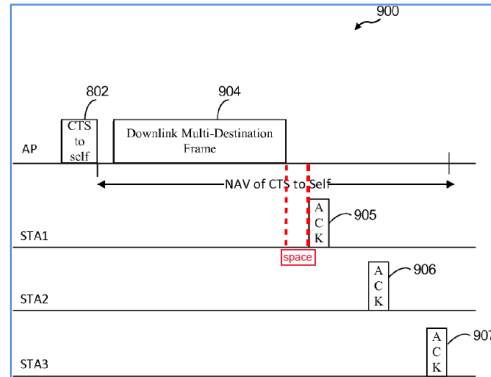
[1a] “... acknowledgement information representing whether the STA is requested to transmit the acknowledgement frame...in a multiple-user (MU) format”

200. For example, Abraham466 discloses that “the STA 106 *a* may then determine **based on such information the specific time to transmit the ACK and type of transmission (e.g., BA, MU-MIMO, FDMA, OFDMA, etc.).**” EX-

1005, [0074] (emphases added). *See also* EX-1005, FIG. 8 and FIG. 9. *See also* Abraham466_Provisional, EX-1025, [0065], [0071], FIG. 8, FIG. 9.



EX-1005, FIG. 8 (annotated).



EX-1005, FIG. 9 (annotated).

[1a] “... acknowledgement information representing whether the STA is requested to transmit the acknowledgement frame in a single-user (SU) format...”

201. For example, Abraham466 discloses that “**ACK control field 765 may indicate that one or more stations should send a BA a Short Interframe Space (SIFS) time period after the PPDU carrying the MPDU frame 700.**” EX-1005, [0064] (emphases added). *See also* Abraham466_Provisional, EX-1025, [0061].

[0061] The ACK control field 765 may indicate to a station receiving the MPDU frame 700 when and how a BA is sent and a time gap (or frequency offset or spatial stream gap) between successive BAs. For example, ACK control field 765 may indicate that one or more stations should send a BA a Short Interframe Space (SIFS) time period after the PPDU carrying the MPDU frame 700. In some embodiments, the presence of

EX-1025, [0061].

202. At least in view of the foregoing, a POSITA would readily understand that the MPDU frame disclosed in Abraham466 to indicated to only one STA to

transmit ACK, and a POSTA would readily understand that under such a situation, the STA would transmit ACK in a SU format.

[1a] receiving, from the AP, a downlink frame including a quality of service (QoS) control field including acknowledgement information representing whether the STA is requested to transmit the acknowledgement frame in a single-user (SU) format or in a multiple-user (MU) format at a Short Inter-Frame Space (SIFS) time after the downlink frame”

203. Abraham466 also discloses that “[u]sing the information in the ACK control field 765 (e.g., BA MCS, total uplink bandwidth, per STA bandwidth, total uplink spatial streams, BA index, etc.) the STAs 1-3 can determine when to send ACK messages 905, 906, and 907....” EX-1005, [0071]. As illustrated in FIG. 9, STAs send ACK messages at different times. EX-1005, FIG. 9. *See also* EX-1025, [0068], FIG. 9.

204. In view of Abraham466’s disclosure of ACKs by multiple STAs sequentially at different times in FIG. 9, a POSITA would readily understand Merlin’s disclosed ACK information in a DL MU frame to indicate to STAs whether to transmit UL acknowledgement frames in SU format or MU format.

205. In addition, from at least Abraham466’s disclosures of ACK control information including ACK timing, modulation, and per STA bandwidth, and UL MU ACKs and UL SU ACKs (e.g., FIG. 8 and FIG. 9), a POSITA would readily understand that Abraham466 discloses or renders obvious the [1a] limitation “receiving, from the AP, a downlink frame including a quality of service (QoS)

control field including acknowledgement information representing whether the STA is requested to transmit the acknowledgement frame in a single-user (SU) format or in a multiple-user (MU) format at a Short Inter-Frame Space (SIFS) time after the downlink frame.”

206. Alternatively or in addition, particularly in view of the State of the Art, e.g., how AP has been known to manage acknowledgements by legacy STAs and non-legacy STAs in a same network by using DL MU frame (*see* Section VI.C-VI.J above), a POSITA would readily understand that the MPDU frame disclosed in Abraham466 includes QoS control field including acknowledgement information, and that Abraham466 discloses or renders obvious the [1a] limitation “receiving, from the AP, a downlink frame including a quality of service (QoS) control field including acknowledgement information representing whether the STA is requested to transmit the acknowledgement frame in a single-user (SU) format or in a multiple-user (MU) format at a Short Inter-Frame Space (SIFS) time after the downlink frame.”

207. *See also* Abraham466_Provisional, EX-1025, [0071].

[0071] FIG. 11 is a flowchart of a method 1100 for wireless communication, in accordance with an implementation. In some aspects, the method 1100 may be performed by the wireless device 202, shown above with respect to FIG. 2. In some

aspects, method 1100 may be performed by the STA 106a or any suitable device. At block 1105, the STA 106a may receive a message containing ACK information. In some embodiments, the message may comprise a MD-AMPDU frame from the AP 104 which comprises the ACK control field 765. At block 1110, the STA 106a may then determine when and how to send its ACK message transmission based on the ACK information. For example, the ACK control field 765 may include a MCS, a bandwidth allocated to the STA 106a, and an order of when the STA should send its ACK message. The STA 106a may then determine based on such information the specific time to transmit the ACK and type of transmission (e.g., BA, MU-MIMO, FDMA, OFDMA, etc.). At block 1115, the STA 106a may then generate the ACK message. In some embodiments, the ACK message is generated based on the determination in block 1110. At block 1120, the STA 106a transmits the ACK message to the AP 104 based on the determined transmission.

208. See also Abraham466_Provisional, EX-1025, [0061], FIG. 8, FIG. 9.

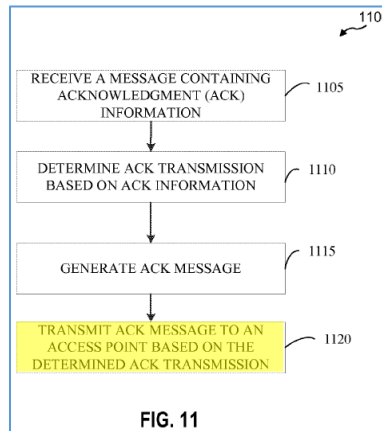
[0061] The ACK control field 765 may indicate to a station receiving the MPDU frame 700 when and how a BA is sent and a time gap (or frequency offset or spatial stream gap) between successive BAs. For example, ACK control field 765 may indicate that one or more stations should send a BA a Short Interframe Space (SIFS) time period after the PPDU carrying the MPDU frame 700. In some embodiments, the presence of the ACK control field 765 may be indicated using a reserved bit/bit combination in the frame control field 710, QoS control field 755 or the HT/VHT control field 760. Information that may be included in the ACK control field 765 may include: BA modulation and coding scheme (MCS); bandwidth and/or spatial stream information such as total uplink bandwidth, per STA bandwidth for BA, or the total number of

c. [1b] transmitting, to the AP, the acknowledgement frame based on the acknowledgement information at the SIFS time after the downlink frame,

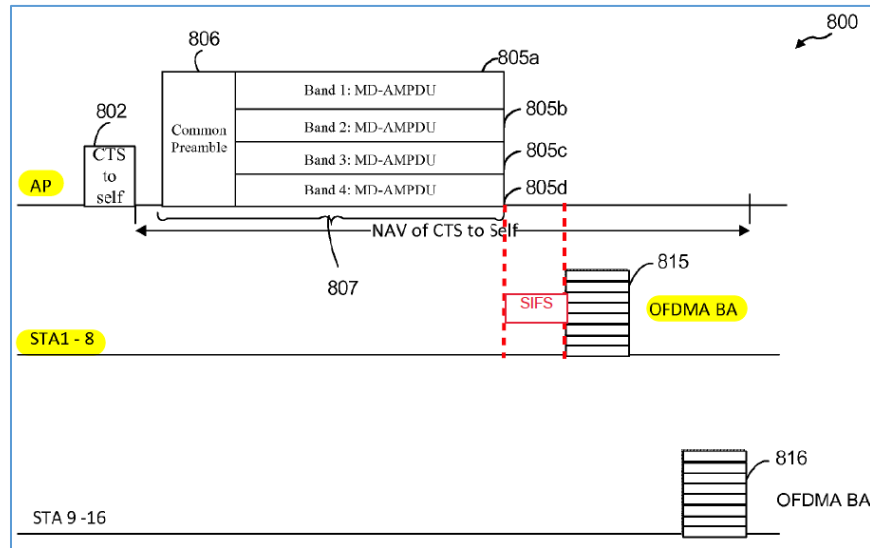
209. Abraham466 discloses [1b].

210. Abraham466 discloses multiple STAs to transmit acknowledgement frames based on the acknowledgement information in the DL MU frame from the AP at a SIFS time after the DL MU frame. For example, Abraham466 discloses

that “[a]t block 1120, the STA 106 *a* transmits to the ACK message to the AP 104 based on the determined transmission.” EX-1005, [0074]. *See also* EX-1005, FIG. 11.



211. Abraham466 discloses multiple STAs to transmit acknowledgement frames after SIFS of the DL MU frame from the AP. For example, Abraham466 discloses that “[a]s shown, 8 STAs (e.g., STAs 1-8) **send uplink BAs 815** over 8 different bandwidths **a short time (e.g., SIFS) after receiving MD-AMPDUs 805 a-d.**” EX-1005, [0068] (emphases added). *See also* EX-1005, FIG. 8 (annotated below).



212. See also Abraham466_Provisional, EX-1025, [0065], [0071], FIG. 8, FIG. 9, FIG. 11.

- d. [1c] wherein transmitting the acknowledgment frame comprises: when the acknowledgment information represents that the STA is requested to transmit the acknowledgement frame in the MU format and the STA is allocated a resource, transmitting the acknowledgement frame in the MU format on the allocated resource simultaneously with transmission of at least one acknowledgement frame from at least one other STA, and

213. Abraham466 discloses [1c].

214. Abraham466 discloses the acknowledgement information contained in the DL MU frame from AP to indicate resources allocated to the STAs and the STAs to transmit BAs in the MU format using the allocated resources based on the acknowledgement information in the DL MU frame from the AP. For example, Abraham466 discloses that “[a]t block 1110, the STA 106 *a* may then determine

when and how to send its ACK message transmission based on the ACK information. For example, the ACK control field 765 may include a MCS, a bandwidth allocated to the STA 106 *a*, and an order of when the STA should send its ACK message. **The STA 106 *a* may** then determine based on such information the specific time to **transmit the ACK and type of transmission (e.g., BA, MU-MIMO, FDMA, OFDMA, etc.).** EX-1005, [0074] (emphases added). *See also* EX-1005, FIG. 8.

215. Abraham466 also discloses that “[a]t block 1210, **the AP 104 then allocates STA to each bandwidth group.**” EX-1005, [0075] (emphasis added).

216. From at least Abraham466’s disclosure of AP’s allocation of STA to a bandwidth group, a POSITA would readily understand that Abraham466’s AP may allocate multiple STAs to a bandwidth group and that Abraham466 discloses or renders obvious the [1c] limitation.

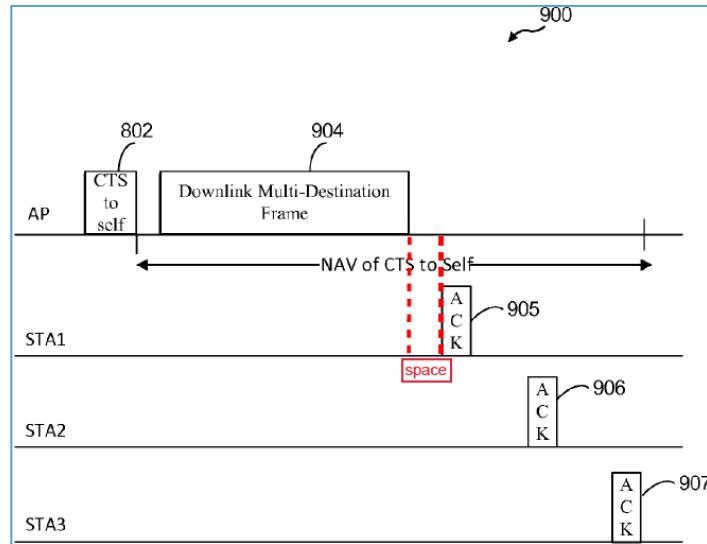
217. *See also* EX-1025, Abraham466_Provisional, [0071], [0072], FIG. 8, FIG. 11, FIG. 12.

- e. **[1d] [wherein transmitting the acknowledgment frame comprises:...] when the acknowledgment information represents that the STA is requested to transmit the acknowledgement frame in the SU format, transmitting the acknowledgement frame in SU format.**

218. Abraham466 discloses [1d].

219. Abraham466 discloses the STAs to transmit BAs sequentially in the SU format using the allocated resources based on the acknowledgement information in the DL MU frame from the AP. For example, Abraham466 discloses that “[a]t block 1110, the STA 106 *a* may then determine when and how to send its ACK message transmission based on the ACK information. For example, the ACK control field 765 may include a MCS, a bandwidth allocated to the STA 106 *a*, and an order of when the STA should send its ACK message. **The STA 106 *a* may then determine based on such information the specific time to transmit the ACK and type of transmission (e.g., BA, MU-MIMO, FDMA, OFDMA, etc.).**” EX-1005, [0074] (emphasis added). EX-1025, [0071].

220. Abraham466 further discloses that “[u]sing the information in the ACK control field 765 (e.g., BA MCS, total uplink bandwidth, per STA bandwidth, total uplink spatial streams, BA index, etc.) the STAs 1-3 can determine when to send ACK messages 905, 906, and 907 so that they don't interfere with each other and fit within the time reserved by the network allocation vector (NAV) of the CTS to self 802..” EX-1005, [0071]. *See also* EX-1005, FIG. 9 (annotated below); EX-1025, [0068], FIG. 9.



221. Abraham466 further discloses “[i]n some embodiments, any two octet field may be sufficient to create the ACK control field 765. In some embodiments, ten (10) bits of the ACK control field 765 may be partitioned as follows: 3 bits to indicate a number of spatial streams (e.g, one of 8 spatial stream indices), 4 bits to indicate a number of frequency bands (e.g., one of 16 frequency bands), and 3 bits to indicate a time position for the BA. From the 10 bits of the ACK control field 765, a device can determine exactly how and when to send the BA. In some embodiments, **the BA MCS is to be set to MCS of the downlink PPDU.**” EX-1005, [0065] (emphasis added). *See* EX-1025, [0062].

222. Alternatively or in addition, in view of at least Abraham466’s disclosure of AP’s allocation of STA to a bandwidth group, a POSITA would readily understand that Abraham466’s AP may allocate only one STA to a

bandwidth group and that Abraham466 discloses or renders obvious the [1d] limitation.

223. *See also* Abraham466_Provisional, EX-1025, [0062], FIG. 8, FIG. 9.

[0062] In some embodiments, any two octet field may be sufficient to create the ACK control field 765. In some embodiments, 10 bits of the ACK control field 765 may be partitioned as follows: 3 bits to indicate one of 8 spatial stream indices, 4 bits to indicate one of 16 frequency bands, and 3 bits to indicate a time position for the BA. From the 10 bits of the ACK control field 765, a device can determine exactly how and when to send the BA. In some embodiments, the BA MCS is to be set to MCS of the downlink PPDU.

224. For the foregoing reasons, claim 1 of the '679 Patent is unpatentable as obvious in view of Abraham466.

2. Claim 2.

[2] The method according to claim 1, wherein the downlink frame further includes Modulation and Coding Scheme (MCS) information for the acknowledgement frame.

225. Abraham466 discloses [2].

226. Abraham466 discloses the DL MU frame from AP includes MCS for the UL ACK frame. For example, Abraham466 discloses that **“the ACK control field 765 may include: BA modulation and coding scheme (MCS);** bandwidth and/or spatial stream information such as total uplink bandwidth, per STA bandwidth for BA, or the total number of uplink spatial streams; and BA index in which each STA determines the time, exact bandwidth and spatial stream index

from its BA index and the bandwidth and spatial stream information.” EX-1005, [0064] (emphasis added).

227. As a further example, Abraham466 further discloses “[i]n some embodiments, **the BA MCS is to be set to MCS of the downlink PPDU.**” EX-1005, [0065] (emphasis added).

228. *See also* EX-1025, Abraham466_Provisional, [0061], [0062].

229. Accordingly, claim 2 is unpatentable as obvious in view of Abraham466.

3. Claim 3.

[3] The method according to claim 2, wherein a same MCS based on the MCS information is applied to the acknowledgement frame by the STA and the at least one other STA.

230. Abraham466 discloses or renders [3] obvious.

231. For example, Abraham466 discloses that “[a]s shown, 8 STAs (e.g., STAs 1-8) **send uplink BAs** 815 over 8 different bandwidths a short time (e.g., SIFS) after receiving MD-AMPDUs 805 a-d.” EX-1005, [0068] (emphasis added). *See also* EX-1005, FIG. 8; Abraham466_Provisional, EX-1025, [0065], FIG. 8.

232. Particularly since the ’679 Patent describes that “[t]he same transmission time of the block ACK frames transmitted by the plurality of STAs may mean the same transmission MCS of the block ACK frames transmitted by the plurality of STAs,” (EX-1001, 39:51-54) and since Abraham466 discloses

simultaneous UL ACKs by STAs, a POSITA would readily understand that Abraham466 discloses or renders obvious the [3] limitation.

233. Alternatively, Patent Owners states in its preliminary infringement contention that “Two STAs receiving the same trigger frame can be assigned the same MCS.” EX-1009, 48. *See also* EX-1009, 48-50.

*679 Claim 3	Elements in Accused Instrumentality
3. The method according to claim 2, wherein a same MCS based on the MCS information is applied to the acknowledgement frame by the STA	A Wi-Fi 6 High Efficiency Station Device receives from the AP a downlink frame, wherein the downlink frame further includes Modulation and Coding Scheme (MCS) information for the acknowledgement frame, and wherein a same MCS based on the MCS information is applied to the acknowledgement frame by the STA and the at least one other STA, as shown by the following excerpts from the 802.11ax-2021 Standard: Two STAs receiving the same trigger frame can be assigned the same MCS;

EX-1009, 48.

234. As mentioned above, Abraham466 discloses that “[a]s shown, **8 STAs (e.g., STAs 1-8) send uplink BAs 815** over 8 different bandwidths a short time (e.g., SIFS) **after receiving MD-AMPDUs 805 a-d.**” EX-1005, [0068] (emphases added). *See also* EX-1005, FIG. 8; Abraham466_Provisional, EX-1025, [0065], FIG. 8. Particularly since the Patent Owner’s own contention of same MCS being used by STAs receiving a same trigger frame (EX-1009, 48-50) and since Abraham466 discloses simultaneous UL ACKs by STAs in response to the same DL MU AMPDU frame, a POSITA would readily understand that Abraham466 discloses or renders obvious the [3] limitation.

235. Abraham466 discloses that “[t]he MD-AMPDU messages 805c and 805d may be addressed to STAs 9-16 and may have an indication in a MAC header of a MDPU that indicates that the STAs 9-16 should send their ACK messages

over different frequencies a specific time after receiving the MD- AMPDU messages 805 *c* and 805 *d*. The specific time may be determined by the AP 104 by calculating the transmission time for the PPDU 810 based on **the MCS of the STAs** and based on the estimated transmission time of the ACK messages from STAs 1-8. As shown, 8 STAs (e.g., STAs 1-8) send uplink BAs 815 over 8 different bandwidths a short time (e.g., SIFS) after receiving MD-AMPDUs 805 *a-d*.” EX-1005, [0068] (emphasis added). *See also* EX-1025, [0065]. In view of at least Abraham466’s disclosure of a single “MCS of the [multiple] STAs,” a POSITA would readily understand that Abraham466 discloses one MCS for multiple STAs and Abraham466 renders obvious the [3] limitation.

236. In addition, Abraham466 discloses the DL MU frame from AP includes MCS for the UL ACK frame. For example, Abraham466 discloses that “FIG. 6 is a diagram of an exemplary VHT-SIG-A2 field 600 structure. The VHT-SIG-A2 field 600 comprises... a single/multi-user (SU/MU) coding field 603.... the VHT-SIG-A2 field 600 comprises **MU coding field 615a, 615b, 615c.**” EX-1005, [0060] (emphasis added). *See also* EX-1005, FIG. 6 (“SU VHT-MCS” and “SU VHT-MCS/MU[1-3] Coding” highlighted below).

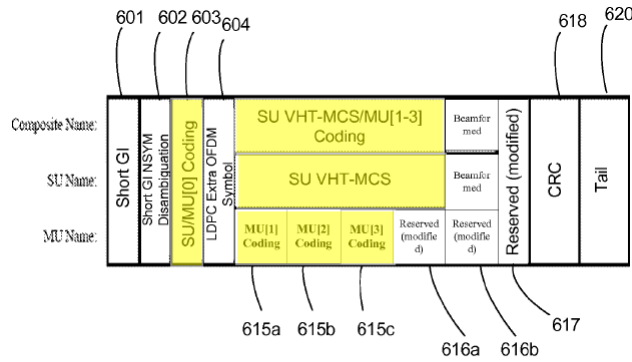


FIG. 6

237. From at least Abraham466’s disclosure of the “SU VHT-MCS/MU [1-3]” and “MU [1] Coding” for STAs 1-3, a POSITA would readily understand that Abraham466 discloses or renders obvious the [3] limitation.

238. *See also* EX-1025, Abraham466_Provisional, [0057], FIG. 6.

239. *See* Section XI.B.2 (discussion of Limitation [2]).

4. Claim 4.

[4] The method according to claim 1, wherein the downlink frame includes downlink data for a plurality of STAs including the STA and the at least one other STA.

240. Abraham466 discloses [4].

241. Abraham466 discloses the DL MU frame from AP includes downlink data for two or more STAs. For example, Abraham466 discloses that “[d]ata frames may be used for transmitting data from an AP and/or a STA to other APs and/or STAs. **Control frames may be used together with data frames** for performing various operations and for reliably delivering data (e.g., **acknowledging receipt of data**, polling of APs, area-clearing operations, channel

acquisition, carrier-sensing maintenance functions, etc.).” EX-1005, [0049]
(emphases added).

242. For example, Abraham466 discloses that “**ACK control field 765 may indicate that one or more stations should send a BA** a Short Interframe Space (SIFS) time period after the PPDU carrying the MPDU frame 700.” EX-1005, [0064] (emphasis added). *See also* EX-1005, FIG. 8, FIG. 9; Section XI.B.1.b (discussion of Limitation [1a]).

243. *See also* Abraham466_Provisional, EX-1025, [0046], [0061], FIG. 8 and FIG. 9.

[0046] As discussed above, the wireless device 202 may comprise an AP 104 or an STA 106a-106f, and may be used to transmit and/or receive communications. The communications exchanged between devices in a wireless network may include data units which may comprise packets or frames. In some aspects, the data units may include data frames, control frames, and/or management frames. Data frames may be used for transmitting data from an AP and/or a STA to other APs and/or STAs. **Control frames may be used together with data frames for performing various operations and for reliably delivering data (e.g., acknowledging receipt of data,** polling of APs, area-clearing operations, channel acquisition, carrier-sensing maintenance functions, etc.). Management frames may be used for various supervisory functions (e.g., for joining and departing from wireless networks. etc.).

244. Accordingly, claim 4 is unpatentable as obvious in view of Abraham466.

5. Claim 5.

[5] The method according to claim 1, wherein the downlink frame includes block acknowledgement (ACK) requests for

a plurality of STAs including the STA and the at least one other STA.

245. Abraham466 renders [5] obvious.

246. Abraham466 discloses the DL MU frame from AP initiating or triggering simultaneous acknowledgement request from STAs. For example, Abraham466 discloses that “ACK control field 765 may indicate that one or more stations should **send a BA a Short Interframe Space (SIFS) time period after the PPDU** carrying the MPDU frame 700.” EX-1005, [0064] (emphasis added). *See also* EX-1005, FIG. 8, FIG. 9; Section XI.B.1.b (discussion of Limitation [1a]).

247. *See also* EX-1025, Abraham466_Provisional, [0061], FIG. 8, FIG. 9.

248. Accordingly, claim 5 is unpatentable as obvious in view of Abraham466.

6. Claim 6.

- a. [6pre] A method for receiving an acknowledgement frame for notifying successful data reception by an access point (AP) from a station (STA) in a wireless local area network, the method comprising:**

249. Abraham466 renders [6pre] obvious. *See* Section XI.B.1.a (discussion of Limitation [1pre]).

- b. **[6a] transmitting, to the STA, a downlink frame including a quality of service (QoS) control field including acknowledgement information representing whether the STA is requested to transmit the acknowledgement frame in a single-user (SU) format or in a multiple-user (MU) format at a Short Inter-Frame Space (SIFS) time after the downlink frame; and**

250. Abraham466 discloses or renders [6a] obvious. Abraham466 discloses that “[a]t block 1005, the AP 104 indicates **the presence of an acknowledgment (ACK) policy for responding to MD-AMPDU frames**. In some embodiments, AP 104 may include this indication in the ACK control field 765. In some embodiments, **the indication may be included in** a portion of the FC field 710, **QoS control field 755**, or the HT control field 760. In some aspects, the indication may be included in the MD-AMPDU indicator 450. At block 1010, the AP 104 may generate a message with the ACK policy for responding to the MD-AMPDU. In some embodiments, the message may comprise the PPDU 300 which may comprise the A-MPDU frame 304 and MPDU 700.” EX-1005, [0072] (emphases added). *See also* Abraham466_Provisional, EX-1025, [0069]. *See also* Section XI.B.1.b (discussion of Limitation [1a]).

- c. **[6b] receiving, from the STA, the acknowledgement frame based on the acknowledgement information at the SIFS time after the downlink frame,**

251. Abraham466 discloses [6b]. *See* Section XI.C.1.c (discussion of Limitation [1b]).

- d. **[6c] wherein receiving the acknowledgment frame comprises: when the acknowledgment information represents that the STA is requested to transmit the acknowledgement frame in the MU format, receiving the acknowledgement frame in the MU format on an allocated resource simultaneously with transmission of at least one acknowledgement frame from at least one other STA, and**

252. Abraham466 discloses [6c]. *See also* Section XI.B.1.d (discussion of Limitation [1c]).

- e. **[6d] [wherein receiving the acknowledgment frame comprises:...] when the acknowledgment information represents that the STA is requested to transmit the acknowledgement frame in the SU format, receiving the acknowledgement frame in SU format.**

253. Abraham466 discloses [6d]. *See also* Section XI.B.1.e (discussion of Limitation [1d]).

254. For the foregoing reasons, claim 6 of the '679 Patent is unpatentable as obvious in view of Abraham466. *See* Section XI.B.1 (discussion of [1]).

7. Claim 7.

[7] The method according to claim 6, wherein the downlink frame further includes Modulation and Coding Scheme (MCS) information for the acknowledgement frame.

255. Abraham466 discloses [7]. *See* Section XI.B.2 (discussion of Limitation [2]).

8. Claim 8.

[8] The method according to claim 7, wherein a same MCS based on the MCS information is applied to the

acknowledgement frame by the STA and the at least one other STA.

256. Abraham466 discloses or renders [8] obvious. *See* Section XI.B.3 (discussion of Limitation [3]).

9. Claim 9.

[9] The method according to claim 6, wherein the downlink frame includes downlink data for a plurality of STAs including the STA and the at least one other STA.

257. Abraham466 discloses [9]. *See* Section XI.B.4 (discussion of Limitation [4]).

10. Claim 10.

[10] The method according to claim 6, wherein the downlink frame includes block acknowledgement (ACK) requests for a plurality of STAs including the STA and the at least one other STA.

258. Abraham466 renders [10] obvious. *See* Section XI.B.5 (discussion of Limitation [5]).

C. Ground 3: Merlin in view of Abraham466, Chu806, or Ma renders obvious Claims 1-10.

259. As set forth below, Merlin in view of Abraham466, Chu806, or Ma renders Claims 1-10 obvious and unpatentable.

1. Motivation to Combine Merlin with Abraham466, Chu806 or Ma

260. Each of Merlin, Abraham 466, Chu806 and Ma discusses how an AP provide acknowledgement information/policy to STAs in a 802.11 system. *See*, e.g., EX-1004, 1:19-45; EX-1005, [0005], [0028]-[0031]; EX-1006, 1:23-43, 5:31-45; EX-1007, 1:11-27, 3:10-40, 4:63-55.

261. Also, each of Merlin, Abraham 466, Chu806 and Ma discusses the AP employing OFDMA or MU-MIMO to provide acknowledgement information/policy to STAs.

262. In addition, each of Merlin, Abraham 466, Chu806 and Ma how an AP manages UL acknowledgement frames by non-legacy STAs and legacy STAs or different STAs with different capabilities.

263. For example, Merlin discloses frame structures, where “the DL MU-MIMO/FDMA PPDU may be addressed to a mix of legacy (e.g., non-HEW) STAs and HEW STAs (i.e., some of the addressed STAs support UL MU-MIMO, UL FDMA, or both, and some of the addressed STAs do not).” EX-1004, 13:24-28.

264. All Merlin, Abraham 466, Chu806 and Ma discuss dynamic transmission management by an AP to increase uplink efficiency while monitoring or reducing collision. For example, Merlin teaches “aspects [to] provide protocol rules and **efficient frame exchange** sequences to enable sending multiple block acknowledgments (BAs) in UL.” EX-1004, 5:34-36 (emphasis added).

Abraham466 discloses “to coordinate acknowledgements of each of the MPDU sub-frames 305a-305c, 405a-405n so as **to reduce the probability of collisions** occurring.” EX-1005, [0062] (emphasis added). See also EX-1025, [0059].

Chu806 also discusses collision avoidance, as well as “the AP... dynamically selects a bandwidth for transmission based on channels available for the transmission.” EX-1006, 6:55-57. *See also* EX-1026, 10 (“multi-channel contention mechanism that minimizes collisions”), 11 (“STAs can switch channel....”). Ma discusses “the efficiency of UL resource assignments.” EX-1006, 10:14-16. *See* EX-10016, FIG. 6.

265. Moreover, all Merlin, Abraham 466, Chu806 and Ma utilize OFDMA to provide DL MU and UL MU transmissions and relate to transmissions according to the IEEE 802.11 protocol. *See, e.g.,* EX-1004, 11:50-12:38; EX-1005, [0031], [0036], EX-1025, [0028], [0033]; EX-1006, 5:31-37, EX-1026, title “OFDMA MAC Consideration,” 11 (“A STA/AP indicates whether it supports

OFDMA operation through HEW Capabilities element. Legacy (11n/ac) data PPDU's can be transmitted..."); EX-1007, 3:10-38, 4:6-12.

266. In view of the foregoing, a POSITA would understand that any of the many DL MU frame structures described in Abraham466, Chu806, or Ma can be incorporated or implemented in Merlin's DL MU frame.

267. At the time of the '679 Patent, a POSITA would have been motivated to combine Merlin's DL MU frame with a portion or the DL MU frame of Abraham466 in light of the "need to more efficiently transmit messages and frames across various communication schemes" as *expressly stated in Abraham466*. EX-1005, [0006].

268. Also, at the time of the '679 Patent, a POSITA would have been motivated to combine Merlin's DL MU frame with a portion or the DL MU frame of Chu806 in light of the additional "standards [] to provide even greater throughputs" as *expressly stated in Chu806*. EX-1006, 1:36-38.

269. In addition, at the time of the '679 Patent, a POSITA would have been motivated to combine Merlin's DL MU frame with a portion or the DL MU frame of Ma, in light of Ma's express teaching that "[f]unctions, operations, components and/or features described herein with reference to one or more embodiments, may be combined with, or may be utilized in combination with, one or more other

functions, operations, components and/or features described herein with reference to one or more other embodiments, or vice versa.” EX-1007: 27:32-37.

270. Indeed, as discussed in Section VI (State of the Art) by 2014, it has been known to arrange the control fields and bits of a DL MU frame by an AP to accommodate different STAs with different capabilities.

271. As such, a POSITA would have a strong expectation of success in combining Merlin’s DL MU frame including ACK information/policy for multiple STAs with the Abraham466’s DL MU frame, Chu806’s DL MU frame, or Ma’s DL MU frame, and would also have a strong expectation of having success in the marketplace by offering such a product.

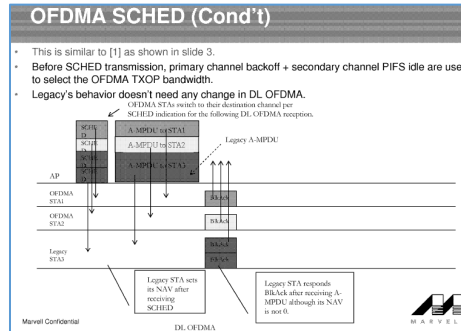
2. Claim 1.

- a. **[1pre] A method for transmitting an acknowledgement frame for notifying successful data reception by a station (STA) to an access point (AP) in a wireless local area network, the method comprising:**

272. As indicated in Section XI.A.1 above, Merlin discloses [1pre].
Alternatively, Merlin in view of Abraham466, Chu806, or Ma renders [1pre] obvious. Abraham466 discloses [1pre]. See Section XI.B.1.

273. Further, 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-1006, 13:4-8 (emphases added). *See also* Chu806_Provisional_1, EX-1026, 16; Chu806_Provisional_2, EX-1027, 14.



EX-1026, 16.

274. Similarly, Ma discloses that “[i]n some demonstrative embodiments, transmitter 134 may transmit to device 102 an ACK frame, e.g., an EACK frame, to acknowledge receipt of the downlink data.” EX-1007, 10:65-67 (emphasis added). For example, Ma discloses that “the plurality of STAs 304 may send to AP 302 a respective plurality of EACK frames 308 to confirm receipt of the DL MU data frames.” EX-1007, 14:6-9 (emphasis added). *See also* EX-1007, FIGs. 3, 4, 5 and 8.

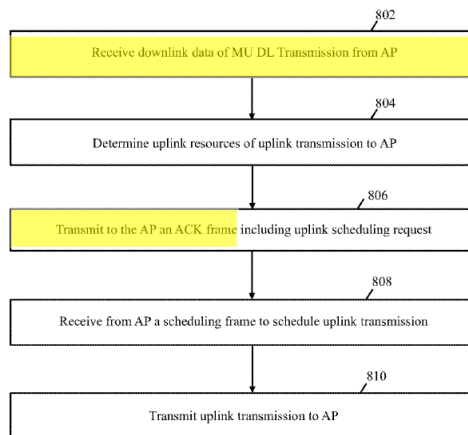


Fig. 8

- b. **[1a] receiving, from the AP, a downlink frame including a quality of service (QoS) control field including acknowledgement information representing whether the STA is requested to transmit the acknowledgement frame in a single-user (SU) format or in a multiple-user (MU) format at a Short Inter-Frame Space (SIFS) time after the downlink frame; and**

275. As indicated in Section XI.A.1 above, Merlin discloses [1a].

Alternatively, Merlin in view of Abraham466, Chu806, or Ma renders [1a] obvious.

276. Abraham466 discloses [1a]. *See* Section XI.B.1.

277. Further, Chu806 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-1006, 29:37-43 (emphases added).

278. Chu806 discloses that “[i]n an embodiment, **the scheduling frame 802 is a control frame.**” EX-1006, 16:13-14 (emphasis added). Chu806 further discloses that “FIG. 4 is a diagram of an example OFDMA data unit 350, according to another embodiment. The OFDMA data unit 350 is similar to the OFDMA data unit 300 of FIG. 3 accept that the OFDMA data unit 350 includes an

OFDMA data unit 302-4 formatted according to a legacy communication protocol that does not support OFDMA communication (e.g., the IEEE 802.11ac Standard).” EX-1006, 9:10-16; FIG. 20A.

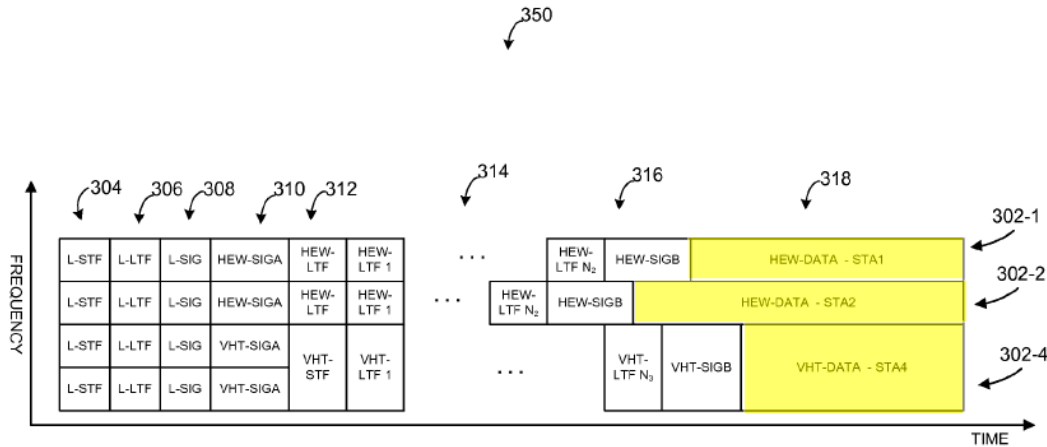


FIG. 4

279. See also EX-1026, 10-11, 15, 16, 24; EX-1027, 8, 9, 13, 14, 22.

OFDMA SCHED

- Before DL/UL OFDMA, a duplicate OFDMA SCHED frame is transmitted in OFDMA TXOP channel.
- OFDMA SCHED frame includes the following information: UL PPDU length, {AID, channel position and bandwidth (4bits, see slide 5 for coding)} (1 to 4 AID channel position pairs) for DL and/or UL.
 - When OFDMA group management frame includes member bandwidth allocation, member channel bandwidth indications are not required in OFDMA CCHED.
 - Duration in OFDMA SCHED is used to protect the OFDMA TXOP.
- With OFDMA SCHED frame before UL/DL OFDMA PPDU's,
 - HEW preamble may add one bit to indicate OFDMA transmission for power control or synchronization or HEW preamble may not need to be changed. Other OFDMA indication in preamble header is also possible.
 - Legacy STAs can receives legacy PPDU's in primary 20MHz/40MHz/80MHz channel.
- OFDMA group management may not be required.

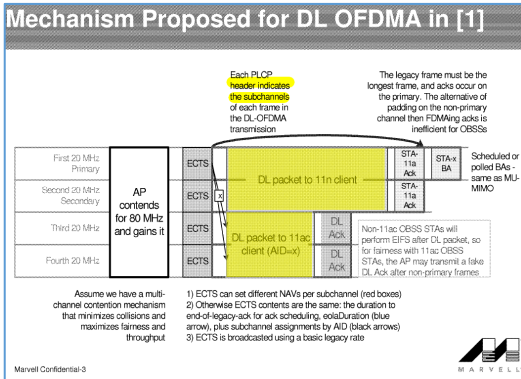
bits: 2 2

position Bandwidth

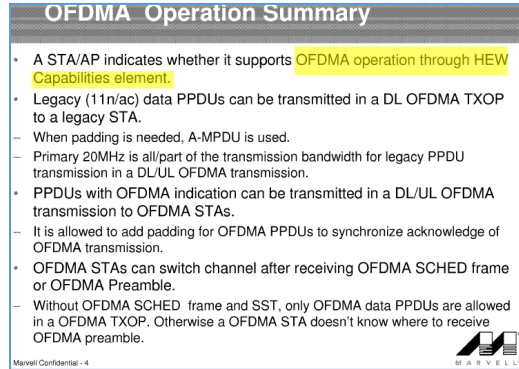
Position and Bandwidth


MARVELL

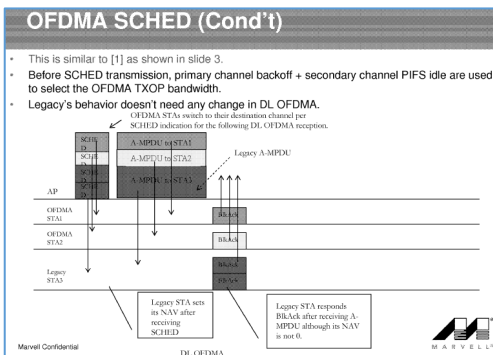
EX-1026, 15.



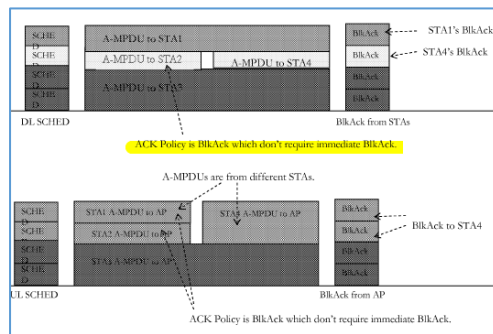
EX-1026, 10.



EX-1026, 11.



EX-1026, 16.



EX-1026, 24

280. Similarly, Ma discloses that “AP 302 may transmit a DL MU data transmission 306 to the plurality of STAs 304. For example, transmitter 104 (FIG. 1) may transmit DL MU data frames to devices 132, 160, and/or 170 (FIG. 1).” EX-1007, 13:65-14:1. Ma also discloses that “[a]s indicated at block 802, the method may include **receiving downlink data of a MU downlink transmission from an AP.**” EX-1007, 17:54-57 (emphasis added).

281. Ma discloses that “[i]n some demonstrative embodiments, the plurality of **EACK frames 308 may be transmitted separately, e.g., sequentially, or concurrently, e.g., using an OFDMA scheme.**” EX-1007, 14:11-14 (emphasis added). See also EX-1007, FIGs. 3, 4, 5 and 8.

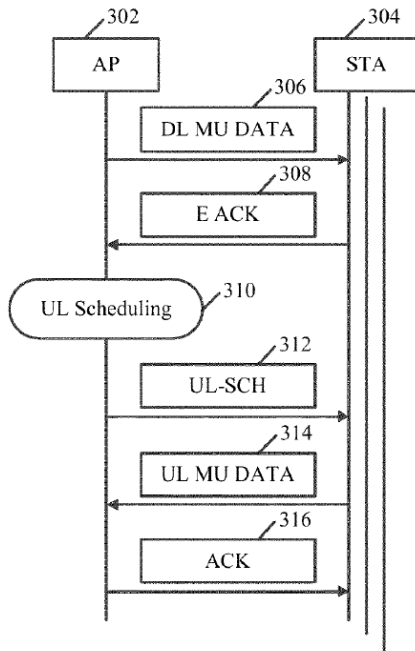


Fig. 3

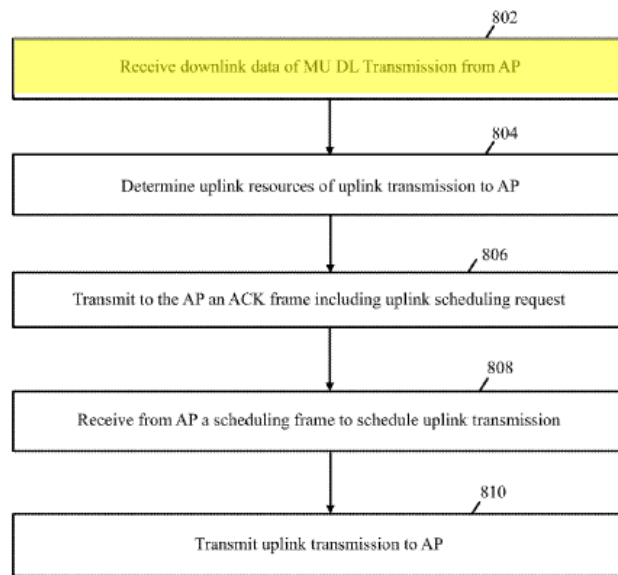


Fig. 8

- c. [1b] transmitting, to the AP, the acknowledgement frame based on the acknowledgement information at the SIFS time after the downlink frame,

282. As indicated in Section XI.A.1 above, Merlin discloses [1b].

Alternatively, Merlin in view of Abraham466, Chu806, or Ma renders [1b] obvious.

283. Abraham466 discloses [1b]. See Section XI.B.1.

284. Further, 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-1006, 34:31-46 (emphasis added). *See* EX-1006, FIG. 6 (annotated below).

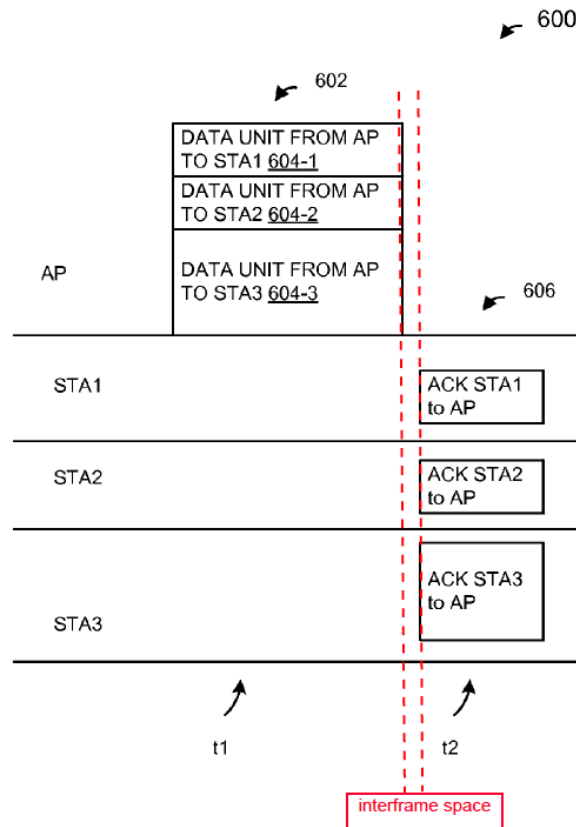
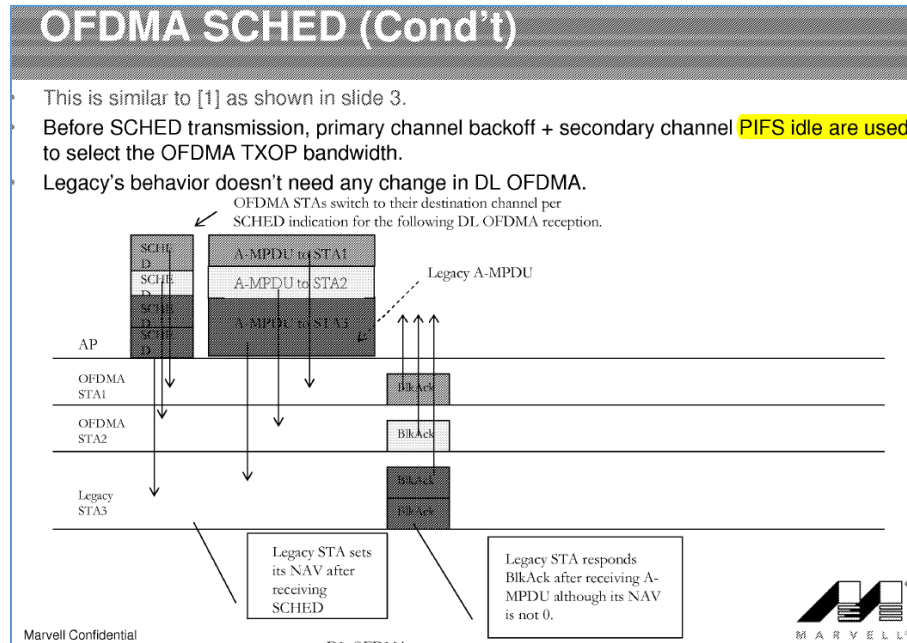


FIG. 6

285. *See also* EX-1026, 16; EX-1027, 14.



EX-1026, 16.

286. Similarly, Ma discloses that “[i]n some demonstrative embodiments, receiver 136 may be configured to transmit to device 102 an ACK message (“the extended ACK message” or EACK) to acknowledge a MU downlink transmission from device 102.” EX-1007, 10:1-4. Ma also discloses that “the plurality of STAs 304 may send to AP 302 a respective plurality of EACK frames 308 to confirm receipt of the DL MU data frames.” EX-1007, 14:6-9. See, EX-1006, FIGs. 3 and 5 (annotated below).

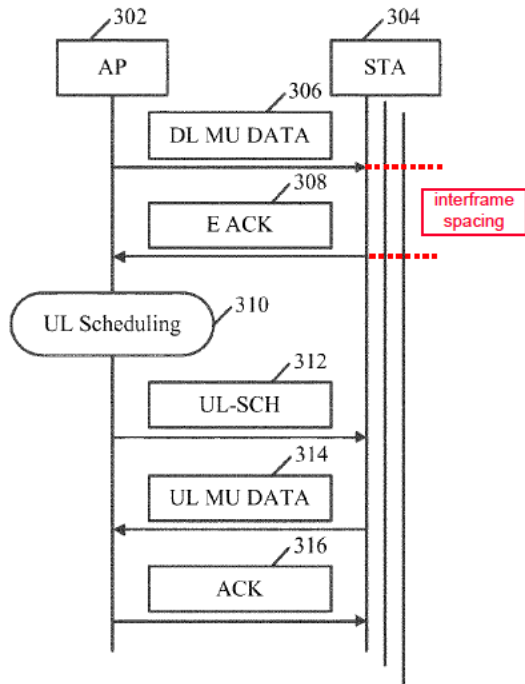


Fig. 3

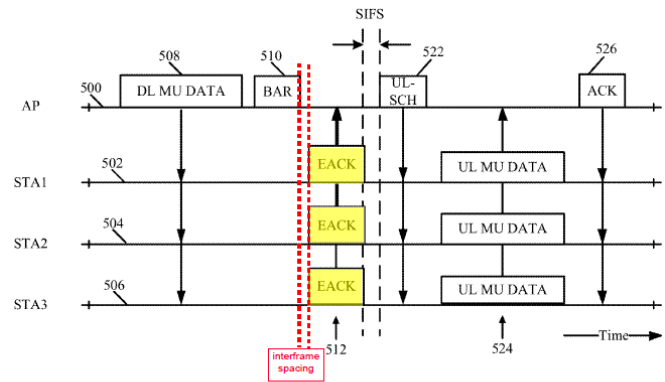


Fig. 5

- d. [1c] wherein transmitting the acknowledgment frame comprises: when the acknowledgment information represents that the STA is requested to transmit the acknowledgement frame in the MU format and the STA is allocated a resource, transmitting the acknowledgement frame in the MU format on the allocated resource simultaneously with transmission of at least one acknowledgement frame from at least one other STA, and
- e. [1d] [wherein transmitting the acknowledgment frame comprises:...] when the acknowledgment information represents that the STA is requested to transmit the acknowledgement frame in the SU format, transmitting the acknowledgement frame in SU format.

287. As indicated in Section XI.A.1 above, Merlin discloses [1c] and [1d].

Alternatively, Merlin in view of Abraham466, Chu806, or Ma renders [1c] and [1d] obvious.

288. For example, Abraham466 discloses [1c] and [1d]. *See* Section XI.B.1.

289. Also, 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-1006, 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-1006, 13:4-8 (emphases added); FIG. 6. Chu806 further discloses that “[f]or example, **transmission of the ACK frames 506 is staggered among the client stations 25, in an embodiment.** For example, the AP provides to the client stations 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 client stations 25 transmit the ACK frames 606 at the specific times or in the specific order indicated by the AP, in an embodiment.” EX-1006, 13:29-37 (emphasis added).

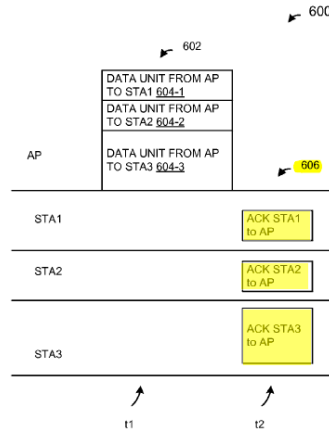
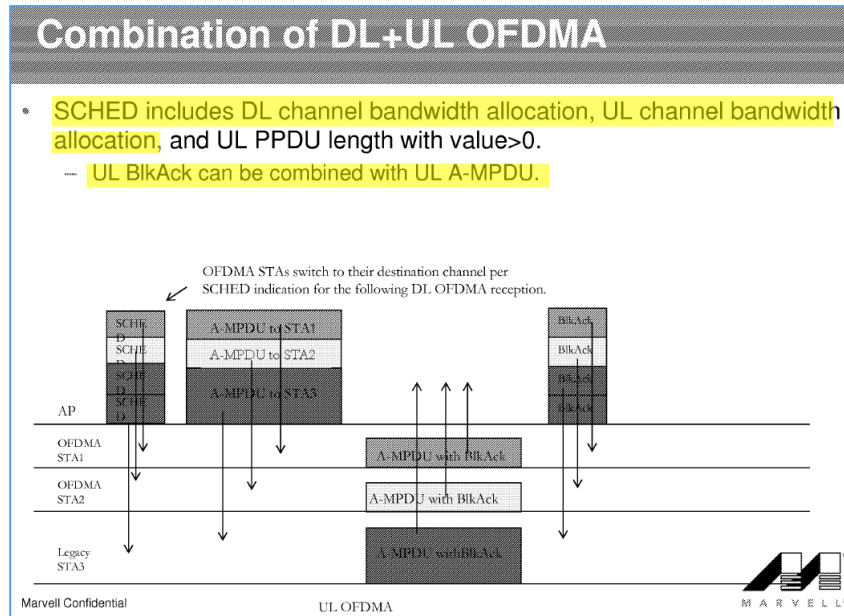


FIG. 6

290. See also EX-1026, 19, 24; EX-1027, 17, 22.



EX-1026, 19.

291. Similarly, Ma discloses that “[i]n some demonstrative embodiments, the plurality of **EACK frames 308** may be transmitted separately, e.g., sequentially, or concurrently, e.g., using an OFDMA scheme.” EX-1007, 14: 11-14. See also EX-1007, FIG. 3 (emphasis added). See also EX-1006, FIGs. 4 and 5.

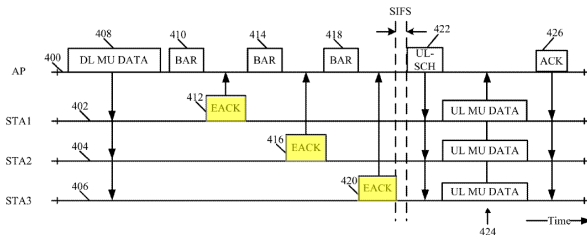


Fig. 4

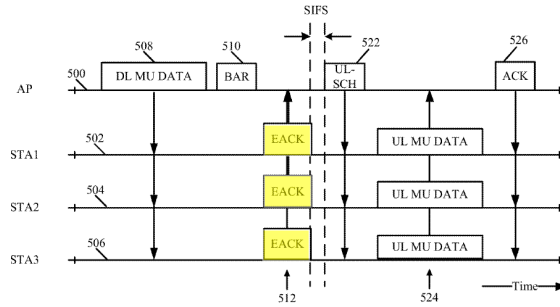


Fig. 5

292. For the foregoing reasons, claim 1 of the '679 Patent is unpatentable as obvious in view of Merlin in view of Abraham466, Chu806, or Ma.

3. Claim 2.

[2] The method according to claim 1, wherein the downlink frame further includes Modulation and Coding Scheme (MCS) information for the acknowledgement frame.

4. Claim 3.

[3] The method according to claim 2, wherein a same MCS based on the MCS information is applied to the acknowledgement frame by the STA and the at least one other STA.

293. As indicated in Sections XI.A.2 and XI.A.3 above, Merlin discloses [2] and [3]. Alternatively, Merlin in view of Abraham466, Chu806, or Ma renders [2] and [3] obvious.

294. For example, Abraham466 discloses [2] and [3]. *See* Section XI.B.2, XI.B.3.

295. For example, Chu806 discloses that “[i]n an embodiment, the scheduling frame 1308 includes other information related to uplink transmission by

the client stations 25, such as **an MCS, or respective MCSs**, to be used for the uplink transmissions, transmission power level, or respective transmission power levels, to be used for the uplink transmissions, etc.” EX-1006, 28:37-42 (emphasis added).

296. Chu806 also discloses that “**the scheduling frame 1308 includes other information related to uplink transmission by the client stations 25, such as an MCS, or respective MCSs**, to be used for the uplink transmissions....” EX-1006, 28:37-40. At least in view of the foregoing, a POSITA would readily understand that the scheduling frame disclosed by Chu806 to indicated to “an MCS” to STAs, and a POSTA would readily understand that Chu806 renders obvious [2] and [3].

297. *See also* EX-1026, 15; EX-1027, 13.

OFDMA SCHED

- Before DL/UL OFDMA, a duplicate OFDMA SCHED frame is transmitted in OFDMA TXOP channel.
- OFDMA SCHED frame includes the following information: UL PPDU length, {AID, channel position and bandwidth (4bits, see slide 5 for coding)} (1 to 4 AID channel position pairs) for DL and/or UL.
 - When **OFDMA group management frame includes member bandwidth allocation**, member channel bandwidth indications are not required in OFDMA CCHED.
 - Duration in OFDMA SCHED is used to protect the OFDMA TXOP.
- With OFDMA SCHED frame before UL/DL OFDMA PPDU,
 - HEW preamble may add one bit to indicate OFDMA transmission for power control or synchronization or HEW preamble may not need to be changed. Other **OFDMA indication in preamble header is also possible.**
 - Legacy STAs can receive legacy PPDU in primary 20MHz/40MHz/80MHz channel.
- OFDMA group management may not be required.

bits: 2 2

position	Bandwidth
----------	-----------

Position and Bandwidth

Marvell Confidential


M A R V E L L

EX-1026, 15.

298. Similarly, Ma discloses “**a chosen Modulation and Coding Scheme (MCS)**”, and $\text{Time}_{\text{DL}+\text{UL}}$ denotes a transmission time, e.g., including control frames, data frames, ACK frames, and interframe spaces, of a DL/UL period.: EX-1007, 16:51-54 (emphasis added). At least in view of the foregoing, a POSITA would readily understand that Ma discloses “a chosen MCS” for STAs, and a POSTA would readily understand that Ma renders obvious [2] and [3].

299. Accordingly, claim 2 and claim 3 are unpatentable as obvious in view of Merlin in view of Abraham466, Chu806, or Ma.

5. Claim 4.

[4] The method according to claim 1, wherein the downlink frame includes downlink data for a plurality of STAs including the STA and the at least one other STA.

300. As indicated in Section XI.A.4 above, Merlin discloses [4].
Alternatively, Merlin in view of Abraham466, Chu806, or Ma renders [4] obvious.

301. For example, Abraham466 discloses [4]. See Section XI.B.4.

302. Also, Chu806 discloses that “**each OFDM data unit 302 includes a high efficiency WLAN data portion (HEW-DATA) 318**” and that “FIG. 4 is a diagram of an example OFDMA data unit 350, according to another embodiment. The OFDMA data unit 350 is similar to the OFDMA data unit 300 of FIG. 3 except that the OFDMA data unit 350 includes an OFDMA data unit 302-4 formatted according to a legacy communication protocol that does not support OFDMA

communication (e.g., the IEEE 802.11ac Standard).” EX-1006, 8:31-33 (emphases added); 9:10-16; FIG. 20A. *See also* EX-1026, 10-11, 15, 16, 24; EX-1027, 8, 9, 13, 14, 22.

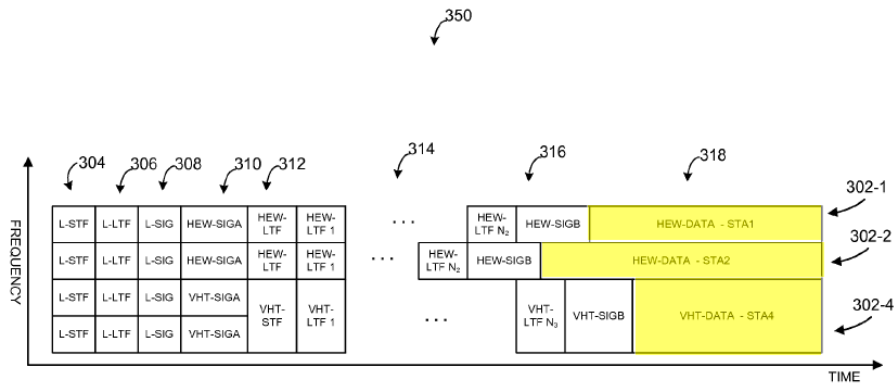


FIG. 4

303. Similarly, Ma discloses that “[i]n some demonstrative embodiments, **AP 302 may transmit a DL MU data transmission 306 to the plurality of STAs 304.**” EX-1007, 13:65-67 (emphasis added). Ma also discloses that “[i]n some demonstrative embodiments, AP 400 may transmit a DL MU data transmission 408 to wireless stations 402, 404 and 406.” EX-1007, 14:61-63. As a further example, Ma discloses “[i]n some demonstrative embodiments, AP 500 may transmit a DL MU data transmission 508 to wireless stations 502, 504 and 506.” EX-1007, 15:47-49.

304. Accordingly, claim 4 is unpatentable as obvious in view of Merlin in view of Abraham466, Chu806, or Ma.

6. **Claim 5.**

[5] The method according to claim 1, wherein the downlink frame includes block acknowledgement (ACK) requests for a plurality of STAs including the STA and the at least one other STA.

305. As indicated in Section XI.A.5 above, Merlin discloses [5].

Alternatively, Merlin in view of Abraham466, Chu806, or Ma renders [5] obvious.

306. For example Abraham466 discloses [5]. *See* Section XI.B.5.

307. Also, 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-1006, 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-1006, 13:4-8. *See also* EX-1006, FIG. 6. *See also* EX-1026, 16, 19; EX-1027, 14, 17.

308. Similarly, Ma discloses that “[i]n one example, transmitter 104 may transmit a unicast acknowledgement request, e.g., a unicast **Block ACK Request (BAR)**, to each wireless station of the plurality of stations....” EX-1007, 11:27-30 (emphasis added). As a further example, Ma discloses “[i]n some demonstrative embodiments, AP 500 may transmit a MU ACK request 510, e.g., a **Block ACK Request (BAR)**, to wireless stations 502, 504 and 506.” EX-1007, 15:50-52 (emphasis added).

309. Accordingly, claim 5 is unpatentable as obvious in view of Merlin in view of Abraham466, Chu806, or Ma.

7. Claim 6.

310. *See* Section XI.C.2 (discussion of claim 1).

8. Claim 7.

311. *See* Section XI.C.3 (discussion of claim 2).

9. Claim 8.

312. *See* Section XI.C.4 (discussion of claim 3).

10. Claim 9.

313. *See* Section XI.C.5 (discussion of claim 4).

11. Claim 10.

314. *See* Section XI.C.6 (discussion of claim 5).

XII. ANALYSIS OF THE '679 PATENT'S PRIORITY CLAIM FOR AN EARLIER EFFECTIVE FILING DATE FOR INDEPENDENT CLAIMS

315. As indicated in Section V above, I understand the earliest possible priority date (also called the effective filing date) for the '679 Patent is November 3, 2014.

316. I further understand that a claim can only be entitled to an earlier filing date if the claim is disclosed in the earlier priority document(s).

317. In other words, I understand that, for example, if a claim includes a limitation that was not disclosed in the earliest filed priority documents (i.e., Provisional Application No. 62/074,514 for the '679 Patent), such a claim in should not be entitled to the benefit of the earliest filing date. Instead, such a claim limitation or claim should only be entitled to the filing date of a later application that first discloses such claim limitation/claim.

318. I have reviewed the two provisional applications to which the '679 Patent makes a priority claim, i.e., EX-1023, Provisional Application No. 62/074,514 filed on November 3, 2014, and EX-1024, Provisional Application No. 62/080,026 filed on November 14, 2014.

319. It is my opinion that the [1a] and [6a] claim limitations relating to “a downlink frame including a quality of service (QoS) control field including acknowledgement information representing whether the STA is requested to

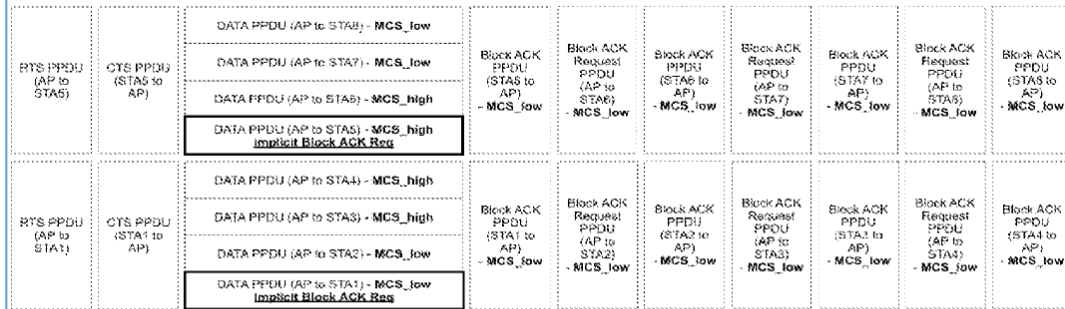
transmit the **acknowledgement frame in a single-user (SU) format or in a multiple-user (MU) format** at a Short Inter-Frame Space (SIFS) time after the downlink frame” are not disclosed in EX-1023, Provisional Application No. 62/074,514 filed on November 3, 2014.

320. It is also my opinion that the [1c] and [6c] claim limitations relating to “when the acknowledgment information represents that the STA is requested **to transmit the acknowledgement frame in the MU format**” are not disclosed in EX-1023, Provisional Application No. 62/074,514 filed on November 3, 2014.

321. Instead, the limitations of independent claim 1 or independent claim 6 relating on a downlink frame including acknowledgement information whether a STA is requested to transmit an acknowledgement frame in a MU format and when the STA is to transmit an acknowledgment frame in the MU format are first disclosed in EX-1024, Provisional Application No. 62/080,026 filed on November 14, 2014.

322. For example, EX-1023, Provisional Application No. 62/074,514 filed on November 3, 2014, at most shows an embodiment of a downlink frame including acknowledgement information whether a STA is requested to transmit an acknowledgement frame in a SU format.

Upon receipt of an OFDMA DATA PPDU, STAs perform the following Block ACK mechanism.



In the above drawing, the AP has transmitted a plurality of DATA PPDU's simultaneously to STA1, STA2, STA3, STA4, STA5, STA6, STA7, and STA8 by configuring a total of eight 5MHz sub-channels out of a 40MHz channel. Also, the AP has transmitted an RTS PPDU simultaneously to STA1 and STA5 on 20-MHz channels and has received CTS PPDU's from STA1 and STA5 on the respective 20MHz channels before trans-

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DM-US-67087847-1-096809-0032

mitting the plurality of DATA PPDU's.

It is noted that when simultaneously transmitting the plurality of DATA PPDU's to STA2, STA3, STA4, STA5, STA6, STA7, and STA8 by configuring the respective 5MHz sub-channels out of the 40MHz channel, the ACK Policy of a DATA PPDU may be set to implicit Block ACK Request only for one destination STA on a 20MHz channel basis. This is done to prevent collision caused by simultaneous transmissions of Block ACK PPDU's from the plurality of destination STAs.

When the destination STAs transmit Control Response frames such as Block ACK PPDU's as illustrated in the above drawing, they should use the same Transmit Spectrum Mask. This is done to reduce the implementation complexity of a receiving STA. If the destination STAs simultaneously transmit the Control Response frames using different Transmit Spectrum Masks, the receiving STA should have a function of simultaneously receiving a plurality of Spectrum Masks. To enable use of the same transmit Spectrum Mask when the Control Response frames are simultaneously transmitted, the destination STAs determine a Spectrum Mask to be used for transmission of the Control Response frames based on the total Channel Width (RXVECTOR parameter CH_BANDWIDTH) of the received OFDMA PPDU.

EX-1023, 9-10.

323. Although the Specification that is in the English language (which was submitted by the '679 inventor on October 22, 2015 in EX-1023, Provisional Application No. 62/074,514) mentions "implicit Block ACK Request", the Specification explicitly states that "the ACK Policy of a DATA PPDU may be set to implicit Block ACK Request only for one destination STA." EX-1023, 9-10.

324. Also, the figure at page 9 illustrates the "Block ACK" by STA sequentially. EX-1023, 9.

325. In view of at least the disclosures at pages 9-10 of EX-1023, Provisional Application No. 62/074,514 filed on November 3, 2014, at most shows an embodiment when the STA is to transmit an acknowledgment frame in the SU format, but not in a MU format.

A plurality of destination STAs may acquire their allocated sub-channel information from a HEW SIG-A field in the downlink OFDMA PPDU. However, the destination STAs to which sub-channels are allocated are not confined to a single STA because the number of available bits for the HEW SIG-A field is limited. In other words, although some of the plurality of STAs receiving the downlink OFDMA PPDU may consider itself to be a destination STA, a sub-channel may actually not be allocated to the STA. Such an STA is STA21 and sub-channel allocation information is shown as shared between STA11 and STA21 in the HEW SIG-A field in the above drawing. In other words, it means that STA11 and STA21 cannot be serviced simultaneously in the downlink OFDMA PPDU.

STA21 considers that a sub-channel allocated to it by the HEW SIG-A field corresponds to the third 5-MHz channel from the bottom in the secondary 20-MHz channel (above 20MHz channel). Accordingly, STA21 starts to receive a HEW-STF, a HEW-LTF, a HEW SIG-B, and a PSDU by switching to the sub-channel after the HEW SIG-A. However, after receiving the PSDU, STA21 may be aware that the destination STA of the PSDU is not STA21 but STA11 from the Receiver Address field of the MAC Header. In this case, STA21 corresponds to the afore-described NAC setting rule for an OFDMA PPDU, that is, a case in which a received frame has been transmitted on an arbitrary sub-channel of a 40-MHz OFDMA PPDU on a primary 40-MHz channel and an RA field does not match, and thus the NAV is set to the value of the Duration field of the MAC Header of the received frame.

It is concluded that third HEW STAs receiving an OFDMA PPDU set their NAVs to the value of the Duration field of the MAC Header of the received frame, even though the received frame has been transmitted only on a secondary channel, not on a primary 20-MHz channel.

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EX-1023, 11.

326. In addition, the Specification in the English language does **not** mention the acknowledgement to be included in the QoS control field of a downlink frame by an AP.

327. EX-1023, Provisional Application No. 62/074,514 filed on November 3, 2014, at most shows in the Specification in the English language (which was

submitted by the '679 inventor on October 22, 2015) discussing QoS control field to contain a "UL MU-MIMO Sequence ID field." EX-1024, 1-2, 17.

Title: Enhanced Downlink MU-MIMO Procedure	Date: 2014/11/13
MU-MIMO PPDU, only for one or none of Uplink MU-MIMO Non-supported STAs included in the destination STAs of the downlink MU-MIMO transmission.	
In the above figure, the Ack Policies of PSDUs directed to the Uplink MU-MIMO Supported STAs, STA1, ST2, and STA3 are set to Implicit Block ACK Request. On the contrary, the Ack Policy of a PSDU directed to the Uplink MU-MIMO Non-supported STA, STA4 may not be set to Implicit Block ACK Request and thus is set to Block ACK. The Uplink MU-MIMO Non-supported STA, STA4 replies to the AP with a Block ACK frame after receiving a Block ACK Request frame from the AP.	
If the Ack Policy of a PSDU in a downlink MU-MIMO DATA PPDU is Implicit Block ACK Request, the destination STA of the PSDU may transmit a Block ACK frame an SIFS after receiving the downlink MU-MIMO PPDU using a PPDU type of Legacy PPDU or Uplink MU-MIMO PPDU. If the STA transmits the Block ACK frame in an Uplink MU-MIMO PPDU, identification information that determines a different Channel Estimation Sequence (a HEW-STF, and a HEW-LTF) for use in uplink MU-MIMO PPDU transmission is additionally required. For this purpose, the present invention proposes that a UL MU-MIMO Sequence ID field is included in the QoS Control field of a PSDU in a downlink MU-MIMO DATA PPDU. If the UL MU-MIMO Sequence ID field is 0 (or any predetermined value), Legacy PPDU is used as the PPDU type for transmission of a Block ACK frame an SIFS after reception of the downlink MU-MIMO PPDU. On the other hand, if the UL MU-MIMO Sequence ID field is 1 (or any predetermined value), UL MU-MIMO PPDU is used as the PPDU type for transmission of a Block ACK frame an SIFS after reception of the downlink MU-MIMO PPDU. If a set of Channel Estimation Sequences (HEW-STFs and HEW-LTFs) is predefined for use in uplink MU-MIMO PPDU transmission, a Channel Estimation Sequence (a HEW-STF and a HEW-LTF) is determined from the Channel Estimation Sequence set based on the UL MU-MIMO Sequence ID, for use in UL MU-MIMO PPDU transmission.	

EX-1024, 17

328. Thus, it is my opinion that the [1a] and [6a] claim limitations relating to "a downlink frame including a quality of service (QoS) control field including acknowledgement information representing whether the STA is requested to transmit the acknowledgement frame in a single-user (SU) format or in a multiple-user (MU) format at a Short Inter-Frame Space (SIFS) time after the downlink frame" are not disclosed in EX-1023, Provisional Application No. 62/074,514 filed on November 3, 2014. As a result, my understanding is that claim 1 or claim 6 should be not entitled to the earliest possible priority date of November 3, 2014.

329. When the Board agrees that claim 1 or claim 6 should not be entitled to the earliest possible priority date of November 3, 2014, I understand that my

analysis of Chu806 should not be altered even if a feature was not fully disclosed in any one of the two Chu806 Provisional Applications (as the filing date of the non-provisional application resulting Chu806 is earlier than November 14, 2014 – the filing date of EX-1024, Provisional Application No. 62/080).

XIII. SUMMARY OF CITATIONS TO ABRAHAM466 AND CHU806 IN RELATION TO THEIR RESPECTIVE PROVISIONAL APPLICATIONS

330. The specification of Abraham466 contains an abstract, ninety (90) numbered paragraphs and fourteen figures (FIG. 1-3, 4A, 4B, and 5-13). EX-1005. The specification Abraham466 Provisional contains an abstract, eighty-six (86) numbered paragraphs and fourteen figures (FIG. 1-3, 4A, 4B, and 5-13). EX-1025.

331. The fourteen figures in each of Abraham466 and Abraham466 Provisional are substantially similar, if not identical.

332. The content of the abstract and the 90 numbered paragraphs of Abraham466 is substantially the same as the content of the abstract and the 86 numbered paragraphs of Abraham466 Provisional.

333. The difference in the total numbers of paragraph in Abraham466 and Abraham466 Provisional appears to be due to the following three factors:

- (1) Abraham466 further includes a section on cross-reference numbered as [0001],
- (2) numbering on the two headings in the Background Section (“Field” and “Background”) is adding to Abraham466 but is not in Abraham466 Provisional;

and (3) the first paragraph, which is un-numbered on page 19 of Abraham466 Provisional specification (EX-1025, 41), is numbered in Abraham466 as [0077].

334. As a result, it is my opinion that the abstract, paragraphs, and figure of Abraham466 are supported by Abraham466 Provisional. Each paragraph and figure of Abraham466 seemingly has a corresponding paragraph/figure in Abraham466 Provisional.

335. Abraham466 Provisional also include provisional claims that are substantially similar to the claims of Abraham466.

336. For the particular Abraham466 citations identified above, the table below shows where these citations or representative support can be found in Abraham466 Provisional Application.

EX-1005, Abraham466	EX-1025, Abraham466_Provisional
Abstract.	Abstract; [0001], [0005], FIG. 4B
[0031]	[0028]
[0036]	[0033]
[0049]	[0046]
[0050]	[0047]
[0060]	[0057]
[0062]	[0059]
[0063]	[0060]
[0064]	[0061]

EX-1005, Abraham466	EX-1025, Abraham466_Provisional
[0065]	[0062]
[0068]	[0065]
[0071]	[0068], [0071]
[0072]	[0069]
[0074]	[0071], FIG. 9
FIG. 6	FIG. 6
FIG. 7	FIG. 7
FIG. 8	FIG. 8
FIG. 9	FIG. 9
FIG. 11.	FIG. 11

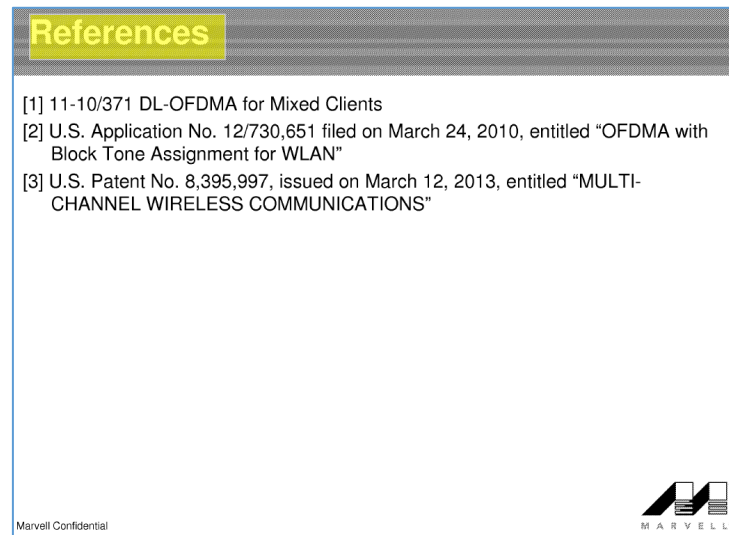
337. The table below shows where the representative support can be found in Abraham466 Provisional Application for Abraham466 claim 1.

EX-1005, Abraham466, claims 1-2	EX-1025, Abraham466_Provisional
What is claimed is: 1. A method of wireless communication, comprising: generating, by an apparatus, an aggregated media access control protocol data unit (A-MPDU) frame within a physical layer convergence procedure (PLCP) protocol data unit (PPDU), the A-MPDU frame comprising a plurality of A-MPDU sub-frames, wherein at least one A-MPDU sub-frame of the plurality of A-MPDU sub-frames is addressed to at least a first device and at least one other A-MPDU sub-frame of the plurality of A-MPDU sub-frames is addressed to at least a second device; and inserting an indication that the A-MPDU frame is addressed to at least the first and second devices into a field of the PPDU. 2. The method of claim 1, wherein the at least one A-MPDU sub-frame comprises a media access control protocol data unit (MPDU) delimiter field, wherein the indication comprises a value in the MPDU delimiter field.	146852P1 PATENT WHAT IS CLAIMED IS: 1. A method of wireless communication, comprising: generating, by an apparatus, an aggregated media access control protocol data unit (A-MPDU) frame comprising a plurality of A-MPDU sub-frames, wherein at least one sub-frame of the plurality of A-MPDU sub-frames is addressed to at least a first device and at least one other sub-frame of the plurality of A-MPDU sub-frames is addressed to at least a second device; and inserting an indication that the A-MPDU frame is addressed to at least the first and second devices into a physical layer data unit (PPDU) field. 2. The method of claim 1, wherein the A-MPDU sub-frame, comprises a media access control protocol data unit (MPDU) delimiter field, wherein the indication comprises a value in the MPDU delimiter field. EX-1025, 45. <i>See also</i> EX-1025, [0047]-[0054], [0073], FIG. 3, 4A, 4B, 13.

Correlations Between Chu806 and Chu806_Provisionals

338. For the particular Chu806 citations identified above, the table below shows where these citations or representative support can be found in Chu806 Provisional Applications.

339. Chu806_Provisional_1 and Chu806_Provisional_2 include a list of References. EX-1026, 31, EX-1027, 29. U.S. Patent No. 8,395,997 (“Banerjea”) (EX-1028) is identified as a reference by Chu806_Provisional_1 and Chu806_Provisional_2.



EX-1026, 31.

EX-1006, Chu806	EX-1026, Chu806_Provisional_1 EX-1027, Chu806_Provisional_2
Abstract	EX-1026, 11-12; EX-1027, 9-10
1:47-2:9	EX-1026, 19, EX-1027, 17
13:4-10, 13:29-37, 11:59-60	EX-1026, 16, EX-1027, 14 EX-1026, 19, EX-1027, 17 EX-1026, 27, EX-1027, 25
8:31-33; 9:10-16	EX-1026, 11-12; EX-1027, 9; Banerjea, EX-1028, FIG. 8

	Fig. 8
	EX-1028, FIG. 8.
16:13-14	EX-1026, 15-16, EX-1027, 13-14
29:37-43	EX-1026, 24, EX-1027, 22
34:31-46	EX-1026, 16, EX-1027, 14 Banerjea, EX-1028, 8:32-34. Based on obtaining a TXOP, the device can send one or more frames continuously with a SIFS duration gap between the frames. In this example, based on a duration corresponding to EX-1028, 8:32-34.
28:37-42	EX-1026, 15; EX-1027, 13
FIG. 4	EX-1026, 10; EX-1027, 8
FIG. 6	EX-1026, 14, EX-1027, 12
FIG. 8A	EX-1026, 16, EX-1027, 14
FIG. 14A	EX-1026, 24, EX-1027, 22
FIG. 20A	EX-1026, 19, EX-1027, 17

Correlations Between Chu806 Claim 41 and Chu806 Provisionals

340. The table below shows where the representative support can be found in Chu806 Provisional Applications for Chu806 claim 41.

EX-1006, Chu806	EX-1026, Chu806_Provisional_1 EX-1027, Chu806_Provisional_2
41. A first communication device, comprising: a network interface configured to: allocate respective sub-channels of an orthogonal frequency division multiplexing (OFDM) channel to two or more second communication devices for downlink orthogonal frequency division multiple access (OFDMA) transmission to the two or more second communication devices, including: (i) allocating non-contiguous sub-channels by skipping a particular sub-channel of the OFDM channel, when the particular sub-channel is determined to be unavailable for transmission, and (ii) allocating a first sub-channel to a first one of the two or more second communication devices and a second sub-channel to a second one of the two or more communication devices; generate a signal field of an OFDMA data unit to include indications of the respective sub-channels allocated for downlink OFDMA transmission from the two or more second communication devices, including indications of the non-contiguous sub-channel allocation; generate the OFDMA data unit to include (i) the signal field, (ii) a first OFDM data unit directed to the first one of the two or more second communication devices and (iii) a second OFDM data unit directed to the second one of the two or more second communication devices, wherein the first OFDM data unit is to be transmitted in the first sub-channel and the second OFDM data unit is to be transmitted in the second sub-channel; and transmit the OFDMA data unit to the two or more second communication devices.	EX-1026, 19, EX-1027, 17 (e.g., “Combination of DL+UL OFDMA”, “SCHED [frame] includes DL channel bandwidth allocation, UL channel bandwidth allocation...,” “A-MPDU to STA1,” “A-MPDU to STA2,” “A-MPDU to STA3”) EX-1026, 29, EX-1027, 27 (e.g., “Non continuous transmission”; “AP detects 3rd 20MHz channel busy”)

XIV. SECONDARY CONSIDERATIONS

341. I am informed that neither Patent Owner nor the '679 Patent applicants identified any secondary considerations of non-obviousness with respect to the '679 Patent.

342. I reserve the right to supplement this Declaration should any evidence of secondary considerations of non-obviousness with respect to the '679 Patent be produced during this proceeding.

XV. CONCLUSION

343. It is my opinion that claims 1-10 of the '679 Patent should be found unpatentable and should be canceled for the reasons I have set forth above.

344. 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. 9,917,679

Date: 4-21-2023

By: 
Paul Min