UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD.,

SAMSUNG ELECTRONICS AMERICA, INC.

Petitioners,

v.

XIFI NETWORKS R&D, INC.

Patent Owner.

U.S. Patent No. 11,849,337

"Method and Apparatus for Processing Bandwidth Intensive Data Streams Using Virtual Media Access Control and Physical Layers"

DECLARATION OF KEVIN ALMEROTH, PH.D., IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW

TABLE OF CONTENTS

LIST OF EXHIBITS

Exhibit	Description
EX1001	U.S. Patent No. 11,849,337 ("the '337 patent")
EX1002	Declaration of Kevin Almeroth, Ph.D.
EX1003	12/19/2023 Certificate of Correction
EX1004	File History of U.S. Patent No. 11,849,337
EX1005	WO 2013/126859 ("Chincholi")
EX1006	Published U.S. Patent Application 2011/0320625 ("Riggert")
EX1007	U.S. Patent Application 2009/0141691 ("Jain")
EX1008	U.S. Patent 9,379,868 ("Wang")
EX1009	U.S. Patent 9,055,592 ("Clegg")
EX1010	U.S. Patent 10,567,147 ("DiFazio")
EX1011	Curriculum Vitae of Kevin Almeroth Ph.D.
EX1012	PO's District Court Infringement Contentions Cover Pleading
EX1013	PO's District Court Infringement Chart for U.S. Patent No. 11,849,337
EX1014	U.S. Patent 5,345,599 ("Paulraj")
EX1015	Gerard J. Foschini, "Layered Space-Time Architecture" (Foschini, Bell Labs Technical Journal, 1(2), 41-59) (1996)
EX1016	Exhibit Intentionally Omitted
EX1017	File History of U.S. Patent No. 11,818,591

I, Dr. Kevin Almeroth, declare as follows:

I. Introduction

1. I have been retained by Quinn Emanuel Urquhart & Sullivan, LLP on behalf of the Petitioners Samsung Electronics Co., Ltd. and Samsung Electronics America, LLC ("Petitioner") as an independent expert in this *inter partes* review (this "Proceeding") before the Patent Trial and Appeal Board of the United States Patent and Trademark Office (the "Board") to review claims 1-30 ("the challenged claims") of U.S. Patent No. 11,849,337 ("the '337 patent"). I have been asked by the Petitioner to assist in evaluating the claims and the disclosure of the '337 patent.

A. Qualifications

2. EX1011 is a true and correct copy of my current CV, which describes my education, patents and publications, employment and research history, and professional activities and awards.

1. Educational Background

3. I hold three degrees from the Georgia Institute of Technology: (1) a Bachelor of Science degree in Information and Computer Science (with minors in Economics, Technical Communication, and American Literature) earned in June 1992; (2) a Master of Science degree in Computer Science (with specialization in Networking and Systems) earned in June 1994; and (3) a Doctor of Philosophy (Ph.D.) degree in Computer Science (Dissertation Title: Networking and System

Support for the Efficient, Scalable Delivery of Services in Interactive Multimedia System, minor in Telecommunications Public Policy) earned in June 1997. I have taken a wide variety of courses as demonstrated by my minor. My undergraduate degree also included a number of courses more typical of a degree in electrical engineering, including digital logic, signal processing, and telecommunications theory.

2. Career

4. I am a Professor Emeritus in the Department of Computer Science at the University of California, Santa Barbara (UCSB). While active at UCSB, I held faculty appointments and was a founding member of the Computer Engineering (CE) Program, Media Arts and Technology (MAT) Program, and the Technology Management Program (TMP). I was the Associate Director of the Center for Information Technology and Society (CITS) from 1999 to 2012. I have been a faculty member at UCSB since July 1997.

5. One of the major concentrations of my research has been the delivery of multimedia content and data between computing devices, including various network architectures. In my research, I have studied large-scale content delivery systems, and the use of servers located in a variety of geographic locations to provide scalable delivery to hundreds or thousands of users simultaneously. I have also studied smaller-scale content delivery systems in which content is exchanged

between individual computers and portable devices. My work has emphasized the exchange of content more efficiently across computer networks, including the scalable delivery of content to many users, mobile computing, satellite networking, delivering content to mobile devices, and network support for data delivery in wireless networks.

6. In 1992, the initial focus of my research was on the provision of interactive functions (*e.g.*, VCR-style functions like pause, rewind, and fast-forward) for near video-on-demand systems in cable systems; in particular, how to aggregate requests for movies at a cable head-end and then how to satisfy a multitude of requests using one audio/video stream broadcast to multiple receivers simultaneously. This research has continually evolved and resulted in the development of techniques to scalably deliver on-demand content, including audio, video, web documents, and other types of data, through the Internet and over other types of networks, including over cable systems, broadband telephone lines, and satellite links.

7. An important component of my research has been investigating the challenges of communicating multimedia content, including video, between computers and across networks including the Internet. I have worked on a variety of research problems and used a number of systems that were developed to deliver multimedia content to users. One content-delivery method I have researched is the

one-to-many communication facility called "multicast," first deployed as the Multicast Backbone, a virtual overlay network supporting one-to-many communication. Multicast is one technique that can be used on the Internet to provide streaming media support for complex applications like video-on-demand, distance learning, distributed collaboration, distributed games, and large-scale wireless communication. The delivery of media through multicast often involves using Internet infrastructure, devices and protocols, including protocols for routing and TCP/IP.

8. Starting in 1997, I worked on a project to integrate the streaming media capabilities of the Internet together with the interactivity of the web. I developed a project called the Interactive Multimedia Jukebox (IMJ). Users would visit a web page and select content to view. The content would then be scheduled on one of a number of channels, including delivery to students in Georgia Tech dorms delivered via the campus cable plant. The content of each channel was delivered using multicast communication.

9. In the IMJ, the number of channels varied depending on the capabilities of the server including the available bandwidth of its connection to the Internet. If one of the channels was idle, the requesting user would be able to watch their selection immediately. If all channels were streaming previously selected content, the user's selection would be queued on the channel with the shortest wait time. In

the meantime, the user would see what content was currently playing on other channels, and because of the use of multicast, would be able to join one of the existing channels and watch the content at the point it was currently being transmitted.

10. The IMJ service combined the interactivity of the web with the streaming capabilities of the Internet to create a jukebox-like service. It supported true Video-on-Demand when capacity allowed, but scaled to any number of users based on queuing requested programs. As part of the project, we obtained permission from Turner Broadcasting to transmit cartoons and other short-subject content. We also connected the IMJ into the Georgia Tech campus cable television network so that students in their dorms could use the web to request content and then view that content on one of the campus's public access channels.

11. More recently, I have also studied issues concerning how users choose content, especially when considering the price of that content. My research has examined how dynamic content pricing can be used to control system load. By raising prices when systems start to become overloaded (*i.e.*, when all available resources are fully utilized) and reducing prices when system capacity is readily available, users' capacity to pay as well as their willingness can be used as factors in stabilizing the response time of a system. This capability is particularly useful in systems where content is downloaded or streamed on-demand to users.

12. As a parallel research theme, starting in 1997, I began researching issues related to wireless devices and sensors. In particular, I was interested in showing how to provide greater communication capability to "lightweight devices," *i.e.*, small form-factor, resource-constrained (*e.g.*, CPU, memory, networking, and power) devices. Starting in 1998, I published several papers on my work to develop a flexible, lightweight, battery-aware network protocol stack. The lightweight protocols we envisioned were similar in nature to protocols like Bluetooth, Universal Plug and Play (UPnP) and Digital Living Network Alliance (DLNA).

13. From this initial work, I have made wireless networking—including ad hoc, mesh networks and wireless devices—one of the major themes of my research. My work in wireless networks spans the protocol stack from applications through to the encoding and exchange of data at the data link and physical layers.

14. At the application layer, even before the large-scale "app stores" were available, my research looked at building, installing, and using apps for a variety of purposes, from network monitoring to support for traditional computer-based applications (*e.g.,* content retrieval) to new applications enabled by ubiquitous, mobile devices. For example, my research has looked at developing applications for virtually exchanging and tracking "coupons" through "opportunistic contact" among mobile wireless devices (*i.e.,* communication among devices moving into communication range with each other). In many of the courses I have taught there

is a project component. Through these projects I have supervised numerous efforts to develop new "apps" for download and use across a variety of mobile platforms.

15. Toward the middle of the protocol stack, my research has also looked to build wireless infrastructure support to enable communication among a set of mobile devices unaided by any other kind of network infrastructure. These kinds of networks are useful either in challenged network environments (e.g., when a natural disaster has destroyed existing infrastructure) or when suitable support for network communication never existed. The deployment of such networks (or even the use of traditional network support) are critical to support services like disaster relief, catastrophic event coordination, and emergency services deployment.

16. Yet another theme is monitoring wireless networks, in particular different variants of IEEE 802.11 compliant networks, to (1) understand the operation of the various protocols used in real-world deployments, (2) use these measurements to characterize use of the networks and identify protocol limitations and weaknesses, and (3) propose and evaluate solutions to these problems. I have successfully used monitoring techniques to study wireless data link layer protocol operation and to improve performance by enhancing the operation of such protocols. For wireless protocols, this research includes functions like network acquisition and channel bonding.

17. One theme in my wireless network research has been cross-layer solutions and innovations. As mentioned above, with greater wireless device use and network support, we envisioned new application paradigms and services, for example, when mobile devices come into contact with each other. Instead of relying on existing infrastructure to relay communication, the devices are able to discover each other and communicate directly. Other examples include discovering and using location information to enhance users' experiences. Network support and novel applications use a variety of network architectures supporting users on foot, in vehicles, and across varying terrains and environments. Finally, we studied how communication efficiency can be supported through intelligent handoffs as well as location and movement prediction.

18. Protecting networks, including their operation and content, has been an underlying theme of my research almost since the beginning of my research career. Starting in 2000, I have been involved in several projects that specifically address security, network protection, and firewalls. After significant background work, a team on which I was a member successfully submitted a $4.3M grant proposal to the Army Research Office (ARO) at the Department of Defense to propose and develop a high-speed intrusion detection system. Key aspects of the system included associating streams of packets and analyzing them for viruses and other malware. Once the grant was awarded, we spent several years developing and meeting the

milestones of the project. A number of my students worked on related projects and published papers on topics ranging from intrusion detection to developing advanced techniques to be incorporated into firewalls. I have also used firewalls, including their associated malware detection features, in developing techniques for the classroom to ensure that students are not distracted by online content.

19. Recent work ties some of the various threads of my past research together. I have investigated content delivery in online social networks and proposed reputation management systems in large-scale social networks and marketplaces. On the content delivery side, I have looked at issues of caching and cache placement, especially when content being shared and the cache has geographical relevance. We were able to show that effective caching strategies can greatly improve performance and reduce deployment costs. Our work on reputation systems showed that reputations have economic value, and as such, creates a motivation to manipulate reputations. In response, we developed a variety of solutions to protect the integrity of reputations in online social networks. The techniques we developed for content delivery and reputation management were particularly relevant in peer-to-peer communication.

20. My involvement in the research community extends to leadership positions for several academic journals and conferences. I am the co-chair of the Steering Committee for the ACM Network and System Support for Digital Audio

and Video (NOSSDAV) workshop and on the Steering Committees for the International Conference on Network Protocols (ICNP), ACM Sigcomm Workshop on Challenged Networks (CHANTS), and IEEE Global Internet (GI) Symposium. I have served or am serving on the Editorial Boards of IEEE/ACM Transactions on Networking, IEEE Transactions on Mobile Computing, IEEE Network, ACM Computers in Entertainment, AACE Journal of Interactive Learning Research (JILR), and ACM Computer Communications Review. I have co-chaired a number of conferences and workshops including the IEEE International Conference on Network Protocols (ICNP), IEEE Conference on Sensor, Mesh and Ad Hoc Communications and Networks (SECON), International Conference on Communication Systems and Networks (COMSNETS), IFIP/IEEE International Conference on Management of Multimedia Networks and Services (MMNS), the International Workshop On Wireless Network Measurement (WiNMee), ACM Sigcomm Workshop on Challenged Networks (CHANTS), the Network Group Communication (NGC) workshop, and the Global Internet Symposium, and I have served on the program committees for numerous conferences.

21. Furthermore, in the courses I taught at UCSB, a significant portion of my curriculum covered aspects of the Internet and network communication including the physical and data link layers of the Open System Interconnect (OSI) protocol stack, and standardized protocols for communicating across a variety of

physical media such as cable systems, telephone lines, wireless, and high-speed Local Area Networks (LANs). The courses I have taught also cover most major topics in Internet communication, including data communication, multimedia encoding, and mobile application design. My research and courses have covered a range of physical infrastructures for delivering content over networks, including cable, Integrated Services Digital Network (ISDN), Ethernet, Asynchronous Transfer Mode (ATM), fiber, and Digital Subscriber Line (DSL). For a complete list of courses I have taught, see my curriculum vitae (EX1011).

22. I co-founded a technology company called Santa Barbara Labs that was working under a sub-contract from the U.S. Air Force to develop very accurate emulation systems for the military's next generation internetwork. Santa Barbara Labs' focus was in developing an emulation platform to test the performance characteristics of the network architecture in the variety of environments in which it was expected to operate, and, in particular, for network services including IPv6, multicast, Quality of Service (QoS), satellite-based communication, and security. Applications for this emulation program included communication of a variety of multimedia-based services, including video conferencing and video-on-demand.

23. In addition to having co-founded a technology company myself, I have worked for, consulted with, and collaborated with companies for nearly 30 years. These companies range from well-established companies to start-ups and include

IBM, Hitachi Telecom, Turner Broadcasting System (TBS), Bell South, Digital Fountain, RealNetworks, Intel Research, Cisco Systems, and Lockheed Martin.

24. Through my graduate education, leadership with CITS, involvement in TMP, role in the development of the Internet2 infrastructure, and consulting with ISPs, I have gained a strong understanding in the role of the Internet in our society and the challenges of deploying large-scale production networking infrastructure. CITS, since its inception, has looked at the role of the Internet in society, including how the evolution of technology has created communication opportunities and challenges, including, for example, through disruptive technologies like P2P. TMP looks to focus on non-purely technical issues, including, for example, state-of-the-art business methods, strategies for successful technology commercialization, new venture creation, and best practices for fostering innovation. Through my industry collaborations and Internet2 work, I have developed significant experience in the challenges of deploying, monitoring, managing, and scaling communication infrastructure to support evolving Internet services like streaming media, conferencing, content exchange, social networking, and e-commerce.

25. Additional details about my employment history, fields of expertise, and publications are further included in my CV (EX1011).

3. Other Relevant Qualifications

26. I am a Member of the Association of Computing Machinery (ACM) and a Fellow of the Institute of Electrical and Electronics Engineers (IEEE).

27. As an important component of my research program, I have been involved in the development of academic research into available technology in the market place. One aspect of this work is my involvement in the Internet Engineering Task Force (IETF). The IETF is a large and open international community of network designers, operators, vendors, and researchers concerned with the evolution of the Internet architecture and the smooth operation of the Internet. I have been involved in various IETF groups including many content delivery-related working groups like the Audio Video Transport (AVT) group, the MBone Deployment (MBONED) group, Source Specific Multicast (SSM) group, the Inter-Domain Multicast Routing (IDMR) group, the Reliable Multicast Transport (RMT) group, the Protocol Independent Multicast (PIM) group, etc. I have also served as a member of the Multicast Directorate (MADDOGS), which oversaw the standardization of all things related to multicast in the IETF. Finally, I was the Chair of the Internet2 Multicast Working Group for seven years.

28. I am an author or co-author of approximately 200 technical papers, published software systems, IETF Internet Drafts and IETF Request for Comments (RFCs). A complete list of my publications is in my CV (EX1011).

29. I have been awarded numerous teaching awards, including Computer Science Outstanding Faculty Member (1997-98, 1998-99, 1999-2000, 2004-06, UCSB Spotlight on Excellence Award (2000-01), and UCSB Academic Senate Distinguished Teaching Award (2006-07).

B. Previous Expert Witness Testimony

30. The list of recent matters in which I have testified can be found at the end of EX1011.

C. Preparation for this Declaration

31. In forming my opinions, I have considered the '337 patent specification, including the Abstract, the figures, and the claim language itself, as would have been understood by a person of ordinary skill in the art as of the priority date of the '337 patent (a "POSITA"). My understanding of "POSITA" and "priority date" are set forth below. I have also reviewed the file history of the '337 patent, the Exhibits that are listed in the list of Exhibits, and any other material cited in this declaration.

32. In forming my opinions, I have relied on my personal knowledge and professional experience, and on the documents and information referenced in this declaration.

33. This declaration explains, based on facts and information available to me to date, the subject matter and opinions related to this Proceeding. As such, I am

prepared to provide expert testimony regarding opinions formed resulting from my analysis of the issues considered in this declaration if asked about those issues by the Board or by the private parties' attorneys.

34. Additionally, I may discuss my own work, teachings, and knowledge of the state of the art in the relevant time period. I may rely on handbooks, textbooks, technical literature, and the like to demonstrate the state of the art in the relevant period and the evolution of relevant technologies.

35. Throughout this declaration, I refer to specific pages of the '337 patent and other documents. The citations are intended to be exemplary and are not intended to convey that the citations are the only source of evidence to support the propositions for which they are cited.

36. I am being compensated for my time spent on this matter at a rate of $850 per hour, and my compensation is in no way contingent upon the outcome of this matter or on the opinions I offer. All of the opinions expressed in this declaration are my own.

II. Legal Understanding

37. In this section, I describe my understanding of certain legal standards that I have relied upon in forming my opinions set forth in this declaration. I have been informed of these legal standards by Petitioner's attorneys. I am not an attorney,

and I have not thoroughly researched the law on patent invalidity. I am relying only on instructions from Petitioner's attorneys for these legal standards.

A. Claim Construction

38. I have been instructed by counsel that claim construction is a matter of law. I understand that in an *inter partes* review, claims are construed using the same claim construction standard that would be used to construe the claim in a civil action, namely according to their plain and ordinary meaning to a POSITA.

39. I understand that a patent may include two types of claims, independent claims and dependent claims. An independent claim stands alone and includes only the limitations it recites. A dependent claim can depend on an independent claim or another dependent claim. I understand that a dependent claim includes all the limitations that it recites in addition to the limitations recited in the claim from which it depends.

B. Anticipation

40. I understand that a patent claim is anticipated when a single piece of prior art describes every element of the claimed invention, either expressly or inherently, arranged in the same way as in the claim. For inherent anticipation to be found, it is required that the missing descriptive material is necessarily present in the prior art. I understand that, for the purpose of an *inter partes* review, prior art that

anticipates a claim can include both patents and printed publications from anywhere in the world.

C. Obviousness

41. I understand that a patent claim is unpatentable and invalid if the subject matter of the claim as a whole would have been obvious to a POSITA as of the time of the invention at issue. My understanding of a POSITA is set forth below. I understand that the following factors must be evaluated to determine whether the claimed subject matter is obvious: (1) the scope and content of the prior art; (2) the difference or differences, if any, between each claim of the patent and the prior art; and (3) the level of ordinary skill in the art at the time the patent was filed. Unlike anticipation, which allows consideration of only one item of prior art, I understand that obviousness may be shown by considering more than one item of prior art. Moreover, I have been informed and I understand that the so-called objective indicia of non-obviousness, also known as "secondary considerations," are also to be considered when assessing obviousness. These include: (1) commercial success; (2) long-felt but unresolved needs; (3) copying of the invention by others in the field; (4) initial expressions of disbelief by experts in the field; (5) failure of others to solve the problem that the inventor solved; and (6) unexpected results. I also understand that evidence of objective indicia of non-obviousness must be commensurate in scope with the claimed subject matter.

42. At this time, I am not aware of any evidence of secondary considerations of non-obviousness, have not seen anything identified by the Patent Owner, and do not think anything would overcome the strong showing of obviousness, but I reserve the right to respond if Patent Owner presents evidence or argument of secondary considerations of non-obviousness.

III. The ’337 patent

43. The ’337 patent is titled “Method and Apparatus for Processing Bandwidth Intensive Data Streams Using Virtual Media Access Control and Physical Layers.”

44. The ’337 patent lists inventor Sal C. Manapragada.

45. The ’337 patent was filed as U.S. Patent Application No. 18,448,281 on August 11, 2023, and issued on December 19, 2023.

A. Priority Date

46. The ’337 patent claims priority to U.S. Prov. Patent Application Nos. 61/897,216 and 61/897,219, both of which were filed on October 30, 2013.[1]

---

[1] I am assuming this priority date and have not been asked to assess whether this date is correct or not; a later (or earlier) date would not affect the opinions in this declaration.

B. Specification

47. The ’337 patent relates to evaluating the wireless bandwidth requirements of applications and the wireless bandwidth availabilities of wireless transceiver resources, and allocating bandwidth of the wireless transceivers to satisfy the bandwidth requirements of the applications. Ex. 1001, ’337 patent at Abstract.

48. The wireless networking architecture described in the ’337 patent “includes an application layer, actual MAC and PHY layers, and a processing layer between the actual MAC and PHY layers.” *Id.* at 2:47-50. The patent describes how the processing layer may comprise “virtual MAC and PHY layers” which “enable simultaneous allocation of multiple PHY resources for different signal types associated with different applications.” *Id.* at 3:41-44.

49. In one embodiment, a wireless networking system is show in an abstract “layer” context, described in Figure 1 below. *Id.* at 3:5-9.

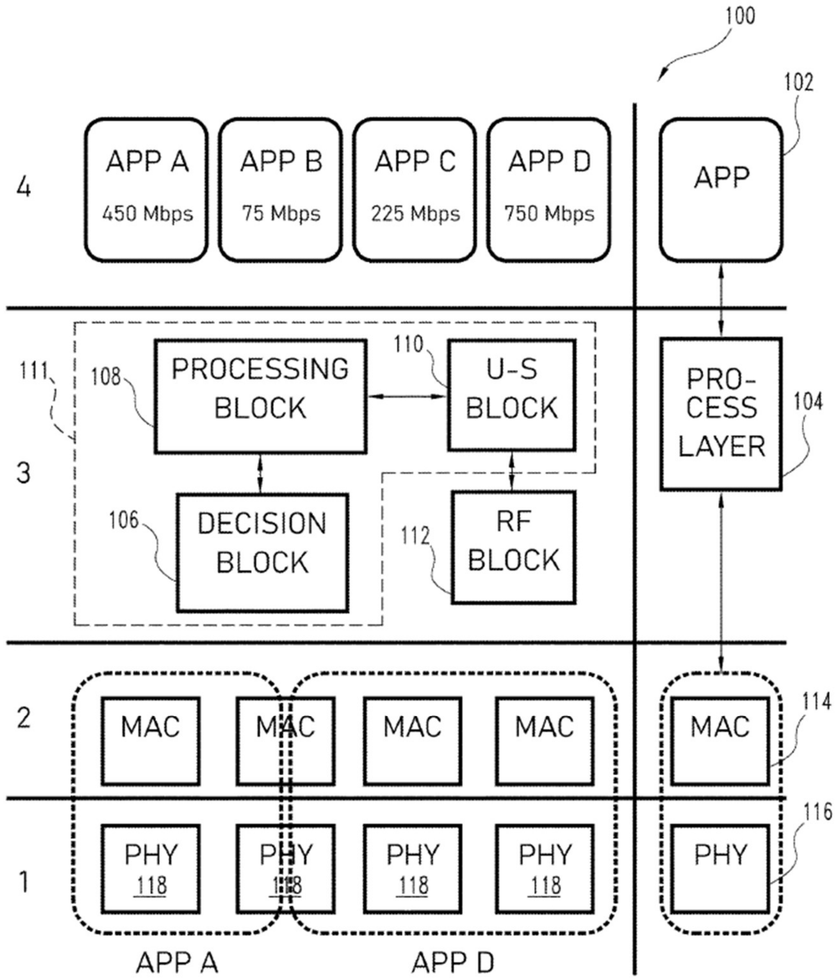


Fig. 1

The application layer 102 cooperates with a process layer at 104, which "determines available resources in the actual MAC and PHY layers 114 and 116" and "allocates the available resources to satisfy the bandwidth demands" of the various applications. *Id.* at 4:16-20.

50. Also illustrative is the embodiment of Figure 6, which demonstrates how the virtual MAC and PHY layers enable the wireless networking device to

configure the resources of two separate transceivers to each handle the bandwidth requirement of a respective application. *Id.* at 5:36-49.

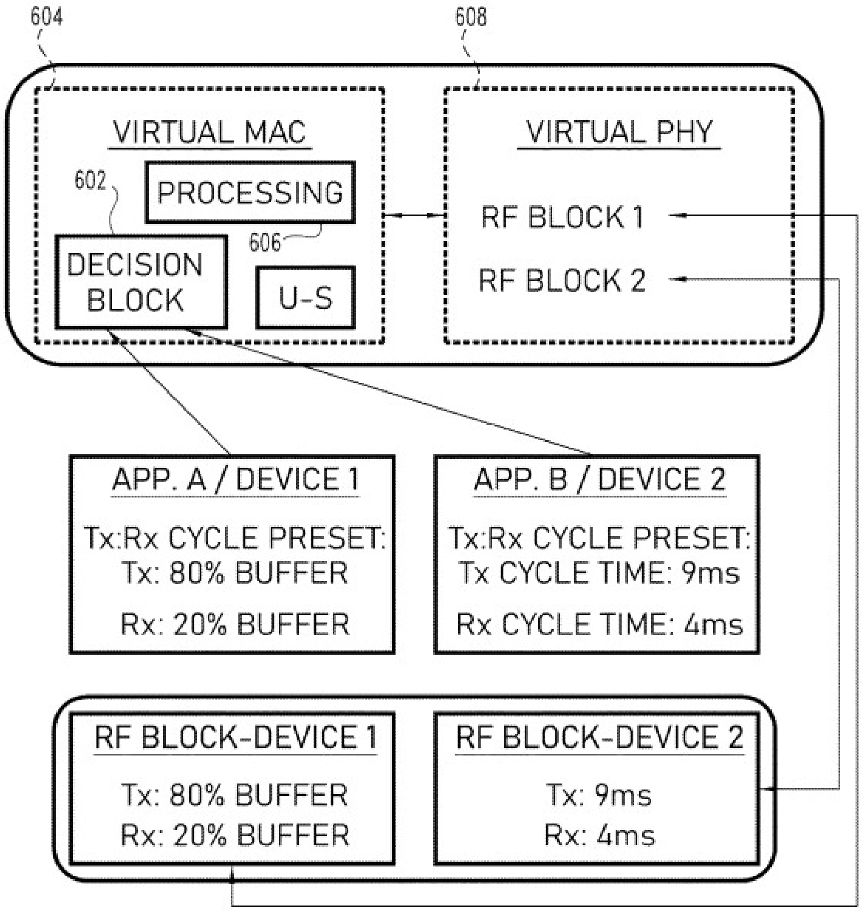


Fig. 6

C. Prosecution History (EX1004)

51. The ’337 patent was filed on August 11, 2023 as application 18/448,281, which was a continuation of application 17/468,509 now US Patent 11,818,591 (“’591 patent”). The applicant requested Track One status, which was granted on September 18, 2023. During prosecution, the Examiner issued a single

non-final rejection on October 3, 2023, asserting double patenting as to certain claims in light of the ’509 application. In response, applicant filed a terminal disclaimer. The Examiner issued a notice of allowance on October 30, 2023. A post-issuance certificate of correction has been filed. (EX1003.)

D. Level of Ordinary Skill in the Art

52. I understand that a person of ordinary skill in the art (“POSITA”) is a hypothetical person who is presumed to be aware of all pertinent art, thinks along conventional wisdom in the art, and is a person of ordinary creativity—not an automaton. In deciding the level of ordinary skill, I understand that the following factors may be considered:

- The levels of education and experience of persons working in the field;
- The types of problems encountered in the field; and
- The sophistication of the technology.

53. I understand that asserted claims must be evaluated from the perspective of a POSITA. I understand that the relevant point in time for determining the qualifications of a person of ordinary skill in the state-of-the-art is the time of the alleged invention, which I assume to be the earliest effective filing date for the patent. Here, I understand that the earliest alleged priority date is October 30, 2013.

54. In my opinion, a person of ordinary skill in the art at the time of the ’337 patent (“POSITA”) had at least a Bachelor of Science in electrical engineering,

computer engineering, or similar fields and at least two years of practical experience in the field of computer networks and wireless communication applications. More education can supplement for less practical experience, and vice versa.

55. I meet these criteria now and met them at the time of the alleged invention. I have applied this level of skill in my analysis. My opinions would not change if a slightly higher or lower level of ordinary skill applied.

E. Claim Construction

56. I have been instructed by Petitioner to perform my technical analysis of the disclosures of the prior art by applying the plain and ordinary meaning of all claim terms as understood by a POSITA in view of the specification and prosecution history.

57. I reserve the right to provide additional opinions concerning claim construction or the application of certain claim constructions to the prior art, as appropriate, and to respond to any particular claim construction-related argument advanced by PO and/or its expert.

58. As described in more detail in the remainder of this declaration, the prior art discloses or renders obvious the challenged claims under any reasonable potential claim interpretation.

F. Challenged Claims

59. I understand that claims 1-30 are at issue in Petitioner's petition for *inter partes* review. They are reproduced below for reference.

LIST OF CHALLENGED CLAIMS

Claim	Limitation
1[pre]	A method of improving the performance of a wireless networking device, comprising the steps of:
1[a]	connecting an application interface to a processing interface, the application interface being associated with a first application, the first application providing, when the wireless networking device is being used, a first data stream and having a first wireless bandwidth requirement;
1[b]	connecting first and second actual MAC interfaces to the processing interface;
1[c]	connecting first and second actual PHY interfaces respectively to the first and second actual MAC interfaces;
1[d]	respectively associating first and second wireless transceivers with the first and second actual PHY interfaces, wherein each of the first and second wireless transceivers (i) is suitable for use in a wireless local area network, (ii) has a first and second bandwidth availability up to first and second actual bandwidths, and (iii) is adapted to emit radio waves in first and second different bands of frequencies;
1[e]	forming in the processing interface (i) at least one virtual MAC interface and (ii) first and second virtual PHY interfaces that, during operation of the wireless networking device, feed information regarding the bandwidth availabilities of the first and second wireless transceivers back to the at least one virtual MAC interface;
1[f]	wherein the processing interface is configured to, when the wireless networking device is being used in a manner transparent to any layer of the wireless networking device above the processing interface,

Claim	Limitation
1[g]	(i) identify at least one portion of each one of the first and second actual bandwidths of the first and second wireless transceivers that are available for communication,
1[h]	(ii) select one transceiver of the first and second transceivers which has the most bandwidth available, (iii) prepare the first data stream for transmission to a recipient from the selected wireless transceiver using a specific subset of frequencies corresponding to the identified at least one portion of its available bandwidth, and (iv) cause the prepared first data stream to be transmitted from the selected wireless transceiver to thereby at least partially satisfy the first wireless bandwidth requirement of the first application;
1[i]	wherein, if the unselected wireless transceiver has more bandwidth availability than the selected transceiver during use of the wireless networking device, the processing interface is adapted to, as a result of the increased bandwidth availability and in a manner transparent to any layer of the wireless networking device above the processing interface, (i) identify at least one portion of the bandwidth of the unselected transceiver that is available for communication and select the unselected transceiver, (ii) prepare the first data stream, without requiring the disassociation of the recipient from the actual MAC and PHY interfaces of any wireless transceiver, for transmission to the recipient from the unselected transceiver using a specific subset of frequencies corresponding to its identified at least one portion of available bandwidth, and (iii) cause the prepared first data stream to be transmitted to the recipient from the unselected transceiver, without requiring the disassociation of the recipient from the actual MAC and PHY interfaces of any wireless transceiver, to thereby continue to at least partially satisfy the first wireless bandwidth requirement of the first application; and
1[j]	wherein the wireless networking device's utilization of the available bandwidth of the selected and unselected transceivers does not prevent other wireless networking device from utilizing a range of frequencies corresponding to the remaining portion of the bandwidth availabilities of the selected and unselected wireless transceivers for data transmission purposes at the same time that processed data is being sent from the selected and unselected wireless transceivers.

Claim	Limitation
2	The method of claim 1,
2[a]	wherein the application interface is associated with a second application, the second application providing, when the wireless networking device is being used, a second data stream and having a second wireless bandwidth requirement;
2[b]	wherein the processing interface is configured to, when the wireless networking device is being used in a manner transparent to any layer of the wireless networking device above the processing interface, (i) prepare the first and second data streams for simultaneous transmission to the recipient from the selected wireless transceivers using a specific subset of frequencies corresponding to the identified at least one portion of its available bandwidth, and
2[c]	(ii) cause the prepared first and second data streams to be simultaneously transmitted from the selected wireless transceivers to thereby at least partially satisfy the first and second wireless bandwidth requirements of the first and second applications.
3	The method of claim 2,
3[a]	wherein, if the identified at least one portion of the bandwidth of the first wireless transceiver becomes unavailable during use of the wireless networking device or if it has an unidentified portion of bandwidth availability that is greater than its identified at least one portion of bandwidth availability during use of the wireless networking device, the processing interface is configured to, as a result of the unavailability or the increased bandwidth availability and in a manner transparent to any layer of the wireless networking device above the processing interface, (i) identify at least one new portion of the bandwidth of the first wireless transceiver that is available for communication and then select that wireless transceiver,
3[b]	(ii) prepare the first and second data streams, without requiring the disassociation of the recipient from the actual MAC and PHY interfaces associated with any wireless transceiver, for transmission to the recipient from the first wireless transceiver using a specific subset of frequencies corresponding to its newly identified at least one portion of available bandwidth, and

Claim	Limitation
3[c]	(iii) cause the prepared first and second data streams to be transmitted to the recipient from the first transceiver, without requiring the disassociation of the recipient from the actual MAC and PHY interfaces of any wireless transceiver, to thereby continue to at least partially satisfy the first and second wireless bandwidth requirements of the first and second applications.
4	The method of claim 3,
4[a]	wherein, if the identified at least one portion of the bandwidth of the second wireless transceiver becomes unavailable during use of the wireless networking device or if it has an unidentified portion of bandwidth availability that is greater than its identified at least one portion of bandwidth availability during use of the wireless networking device, the processing interface is configured to, as a result of the unavailability or the increased bandwidth availability and in a manner transparent to any layer of the wireless networking device above the processing interface, (i) identify at least one new portion of the bandwidth of the second wireless transceiver that is available for communication and then select that wireless transceiver,
4[b]	(ii) prepare the first and second data streams, without requiring the disassociation of the recipient from the actual MAC and PHY interfaces associated with any wireless transceiver, for transmission to the recipient from the second wireless transceiver using a specific subset of frequencies corresponding to its newly identified at least one portion of available bandwidth, and
4[c]	(iii) cause the prepared first and second data streams to be transmitted to the recipient from the second transceiver, without requiring the disassociation of the recipient from the actual MAC and PHY interfaces of any wireless transceiver, to thereby continue to at least partially satisfy the first and second wireless bandwidth requirements of the first and second applications.
5	The method of claim 4,
5[a]	wherein the processing interface is configured to, when the wireless networking device is being used, in a manner transparent to any layer of the wireless networking device above the processing interface, evaluate the identified bandwidth availabilities of the first and second wireless transceivers with

Claim	Limitation
	respect to the first and second bandwidth requirements of the first and second applications; and
5[b]	wherein, if, during operation of the wireless networking device, the first and second bandwidth requirements of the first and second applications are at least partially satisfied by the bandwidth availability of the selected transceiver, preparing the first and second data streams for simultaneous transmission to the recipient from both of the first and second wireless transceivers using a specific subset of frequencies corresponding to the identified at least one portion of their available bandwidth and causing the prepared first data stream to be transmitted from the first and second wireless transceivers to thereby at least partially satisfy the first and second wireless bandwidth requirements of the first and second applications.
6	The method of claim 4, further comprising the steps of:
6[a]	connecting a third actual MAC interface to the processing interface; connecting a third actual PHY interface to the third actual MAC interface; associating a third wireless transceiver with the third actual PHY interface, wherein the third wireless transceiver (i) is suitable for use in a wireless local area network, (ii) has a third bandwidth availability up to a third actual bandwidth, and (iii) is adapted to emit radio waves in a third band of frequencies;
6[b]	forming in the processing interface a third virtual PHY interface that is configured to, during operation of the wireless networking device, feed information regarding the bandwidth availability of the third wireless transceiver back to the at least one virtual MAC interface;
6[c]	wherein the processing interface is configured to, when the wireless networking device is being used in a manner transparent to any layer of the wireless networking device above the processing interface, request or create a third association between the recipient and the third actual MAC and PHY interfaces;
6[d]	wherein the selected transceiver comprises one of the first, second and third wireless transceivers and the unselected transceivers comprise the remaining two transceivers of the first, second and third transceivers;

Claim	Limitation
6[e]	wherein, if one of the unselected wireless transceivers has more bandwidth availability than the selected transceiver during use of the wireless networking device, the processing interface is adapted to, as a result of the increased bandwidth availability and in a manner transparent to any layer of the wireless networking device above the processing interface, (i) identify at least one portion of the bandwidth of at least of the one of the unselected wireless transceivers that has more bandwidth availability than the selected transceiver and select that new transceiver,
6[f]	(ii) prepare the first and second data streams, without requiring the disassociation of the recipient from the actual MAC and PHY interfaces of any wireless transceiver, for transmission to the recipient from the new transceiver using a specific subset of frequencies corresponding to its identified at least one portion of available bandwidth, and
6[g]	(iv) cause the prepared first and second data streams to be transmitted to the recipient from the new transceiver, without requiring the disassociation of the recipient from the actual MAC and PHY interfaces of any wireless transceiver, to thereby continue to at least partially satisfy the first and second bandwidth requirements of the first and second applications; and
6[h]	wherein the wireless networking device's utilization of the available bandwidth of the first, second and third wireless transceivers does not prevent other wireless networking devices from utilizing a range of frequencies corresponding to the remaining portion of the bandwidth availability of the first, second and third wireless transceivers for data transmission purposes at the same time that processed data is being sent from one or more of the first, second and third wireless transceivers.
7	The method of claim 6, wherein the at least one portion of the third bandwidth of the first transceiver comprises a single portion.
8	The method of claim 6, wherein the at least one portion of the third bandwidth of the third transceiver is contiguous.
9	The method of claim 6, wherein the third virtual PHY interface is not contiguous with the virtual MAC interface.
10	The method of claim 6 further comprising the step of coupling first and second buffer memories respectively to the first and second actual PHY layers, the first and second buffer memories being

Claim	Limitation
	configured to, during use of the wireless networking device, store data prior to its actual transmission to the recipient via the first and second actual PHY layers, the capacity of the first and second buffer memories being programmable.
11	The method of claim 10, wherein each of the first and second buffer memories comprises a programmable register.
12	The method of claim 10, further comprising the steps of:
12[a]	connecting a fourth actual MAC interface to the processing interface; connecting a fourth actual PHY interface to the fourth actual MAC interface; associating a fourth wireless transceiver with the actual PHY interface, wherein the fourth wireless transceiver (i) is suitable for use in a wireless local area network, (ii) has a fourth bandwidth availability up to a fourth actual bandwidth, and (iii) is adapted to emit radio waves in a fourth band of frequencies; and
12[b]	forming in the processing interface a fourth virtual PHY interface that is configured to, during operation of the wireless networking device, feed information regarding the bandwidth availability of the fourth wireless transceiver back to the at least one virtual MAC interface.
13	The method of claim 12, wherein the processing interface is configured to, when the wireless networking device is being used in a manner transparent to any layer of the wireless networking device above the processing interface, request or create a fourth association between the recipient and the fourth actual MAC and PHY interfaces; and wherein the selected transceiver comprises one of the first, second, third and fourth wireless transceivers and the unselected transceivers comprise the remaining three transceivers of the first, second, third and fourth transceivers.
14	The method of claim 12, wherein the fourth virtual PHY interface is not contiguous with the virtual MAC interface.
15	The method of claim 1, wherein the wireless networking device comprises a wireless access point.
16	The method of claim 1, wherein the wireless networking device comprises a handheld computing device.
17	The method of claim 1, wherein each one of the first and second frequency bands are specified in at least one member of the family of IEEE 802.11 standards.

Claim	Limitation
18	The method of claim 17, wherein the at least one member of the family of IEEE 802.11 standards was in existence as of Oct. 30, 2013.
19	The method of claim 1, wherein the virtual MAC interface includes a decision block.
20	The method of claim 1, wherein the virtual MAC interface includes a processing block.
21	The method of claim 1, wherein the virtual MAC interface includes an ultra-streaming block.
22	The method of claim 1, wherein each of the virtual PHY interfaces includes an RF block.
23	The method of claim 1, wherein the at least one portion of the first bandwidth of the first transceiver comprises a single portion.
24	The method of claim 1, wherein the at least one portion of the first bandwidth of the first transceiver is contiguous.
25	The method of claim 1, wherein the at least one portion of the second bandwidth of the second transceiver comprises a single portion.
26	The method of claim 1, wherein the at least one portion of the second bandwidth of the second transceiver is contiguous.
27	The method of claim 1, wherein the first virtual PHY of: layer is not contiguous with the virtual MAC interface.
28	The method of claim 1, wherein the second virtual PHY layer is not contiguous with the virtual MAC interface.
29	The method of claim 1, wherein the processing interface comprises multiple virtual MAC interfaces.
30	The method of claim 1, wherein the processing interface includes a bandwidth allocator.

IV. State of the Art

60. As the '337 patent recognizes, various signal protocols for transmitting and receiving data existed well before its priority date. EX1001 at 3:58-64. In fact, prior to the '337 patent priority date, developments in networking protocols had given rise to each of the concepts covered by the asserted claims.

61. For example, the foundational principles of Multiple-Input Multiple-Output (MIMO) technology were well-established in the 1990s, centering on the use of multiple antennas to exploit multipath propagation. Instead of treating multiple signal paths as interference, MIMO leverages them to improve data throughput and link reliability. The two primary techniques that defined this capability were spatial multiplexing and spatial diversity. Spatial multiplexing, in particular, was a significant development as it allowed for the transmission of multiple, independent data streams over a single radio frequency channel. This concept was extensively detailed in foundational works of the period, including U.S. Patent No. 5,345,599 ("Paulraj") (EX1014) and a 1996 paper from Bell Labs by Gerard J. Foschini, which described a "Layered Space-Time Architecture" for achieving linear increases in data rates by adding antennas (Foschini, *Bell Labs Technical Journal*, 1(2), 41-59) (EX1015).

62. The subsequent formalization of these long-standing MIMO principles into industry standards serves as clear evidence of their maturity and status as

established art. The development of the IEEE 802.11n standard, initiated in the early 2000s, was not based on the invention of new MIMO concepts, but rather on the codification of the well-understood techniques from the previous decade. The standard's primary purpose was to leverage the known benefits of spatial multiplexing and related space-time coding schemes to achieve the significant leap in Wi-Fi data rates that the market was demanding. The integration of these established MIMO techniques into a major interoperability standard like IEEE 802.11n confirms that the technology's fundamental aspects were considered thoroughly vetted and were already part of the existing body of technical knowledge.

63. Concepts of link and bandwidth aggregation similarly predated the '337 patent. As taught by WO 2013/126859A2 ("Chincholi"), a unique control layer, referred to as an "Opportunistic Multiple-Medium Access Control (OMMA) Aggregation" sits below the device's IP layer but above the individual network technology stacks, which Chincholi refers to as radio access technologies (RATs). EX1005 at [0003]. This OMMA layer makes intelligent decisions about how to route and potentially split IP packet traffic across the available networks. *Id.* at [0004]-[0007]. It operates by monitoring the estimated data arrival rate for each network interface and sending packets over a specific network when a corresponding variable, which increments with data arrival, exceeds a set threshold. *Id.* This allows

the system to aggregate bandwidth and make efficient use of multiple network connections based on real-time conditions and feedback.

64. Further, U.S. Pub. Pat. App. 2011/0320625 ("Riggert") describes using virtual PHY (physical) interfaces to create a unified, abstract layer that conceals the complexity of managing multiple underlying data communication channels, such as different network connections. Riggert teaches that "by identifying multiple physical interfaces" in a multi-transceiver network "and combining them together into one physical interface (*i.e.*, bondable ***virtual interface***), data throughput may be improved." (EX1006 at [0049].) Importantly, this "bondable virtual interface" may be used generically in the framework, allowing applications and higher-level network software to interact with it as if it were a single, resilient connection without needing to be rewritten to handle the specifics of each individual network. *Id.* at [0065]. Essentially, the virtual PHY provides a flexible and standardized method to combine or "bond" the capacities of multiple physical networks, thereby improving resilience to network load and impairments. U.S. Patent Application 2009/0141691 ("Jain") expands on this concept, describing a "virtual PHY" or adaptation layer that functions as an abstraction layer between the MAC and the multiple, distinct PHYs. EX1007 at [0032]. Jain's various embodiments allow a single access point to support multiple channel configurations, such as a mix of "MIMO, SIMO and wired channels configured according to the 802.11 standards." *Id.* at [0037].

65. Concepts of addressing carrier-specific interference in bandwidth channels also existed during this timeframe. U.S. Patent 9,055,592 ("Clegg") discloses an IEEE 802.11 system designed for carrier specific interference mitigation. Clegg's technique "utilize[s] carriers across multiple sub-channels, even across disjointed bands (e.g., 2.4 GHz, 5 GHz, and or 60 GHz bands), without regard to whether those carriers are within an otherwise unavailable sub-channel." (EX1009 at 1:32-37.) This allows an 802.11 device to "fully utilize the available spectrum." (EX1008 at 1:32.)

66. Additionally, work was being done to enable full-duplex single channel (FDSC) communication and managing the interference caused by a device transmitting and receiving on the same frequency simultaneously. For example, U.S. Patent 10,567,147 ("DiFazio") describes a system designed to support a mix of devices, including a "first wireless transmit/receive unit (WTRU) configured for FDSC communication" and a "second WTRU configured for half-duplex (HD) communication," managing them on a single channel by allocating appropriate timeslots (EX1010 at 2:33-54). DiFazio offers a robust, multi-layered approach, noting that the system may have "at least three levels of interference . . . suppression," which it specifies as "antenna, analog, and/or digital." *Id.* at 30:39-43. To achieve this, the system's suppression algorithms are initially set using "preconfigured data" that can be "read from memory when the device may be

powered-on." *Id.* at 31:1-7. This provides a starting point that aides or speeds convergence to a more optimal state, which is then refined as the "algorithms operate" to adapt to changing conditions and achieve a much higher degree of interference suppression. *Id.* at 31:8-13.

67. Further, in the field of 802.11 systems, each associated terminal is assigned a unique association identifier ("AID"), and it was well-known that avoiding disassociation after initial association was desirable, as repeatedly re-forming associations was inefficient and disruptive. For example, U.S. Patent 9,379,868 ("Wang"), describing how an AP operating device must dissociate a non-AP device with undesirable AID and re-associate it with more desirable AID, states that such an approach is "undesirable, can be blunt and can disrupt the on-going services (e.g., requires disassociation)." EX1008 at 24:42-43; *see also id.* at 24:57-62 ("The lack of update/change of the AID values . . . after an initial AID assignment is inherently inflexible and can prevent the realization power saving, among other considerations, that an update/change of the AID values can provide.") Indeed, recognizing this issue, Wang describes techniques in a multiple transceiver/MIMO system for effectuating an update to a recipient's unique association identifier ("AID") through various interactions with the system without requiring a disassociation of a wireless device from an access point. (EX1008 at 24:63-25:57.)

V. Grounds

Ground	Basis	Reference	Claims
1	§103	WO 2013/126859 ("Chincholi") in combination with U.S. Pub. Pat. App. 2011/0320625 ("Riggert")	1-30

VI. GROUND: Chincholi In Combination With Riggert Renders Claims 1-30 Obvious[2]

A. Overview and Motivation to Combine

68. In my opinion, Chincholi in combination with Riggert renders claims 1-30 obvious. As I explain below, Chincholi teaches the same architecture as the '337 patent, including a wireless networking device with multiple transceivers, each having actual MAC and PHY interfaces. Chincholi uses a single "***Opportunistic Multiple-Medium Access Control (MAC) Aggregation layer***," positioned above the actual MAC-PHY layers of each transceiver, to aggregate available bandwidth portions to efficiently meet the requirements of data streams from one or more applications. (EX1005 at [0122-0123].)

[2] Unless noted otherwise, all emphases in quotes and annotations to figures from prior art references are added.

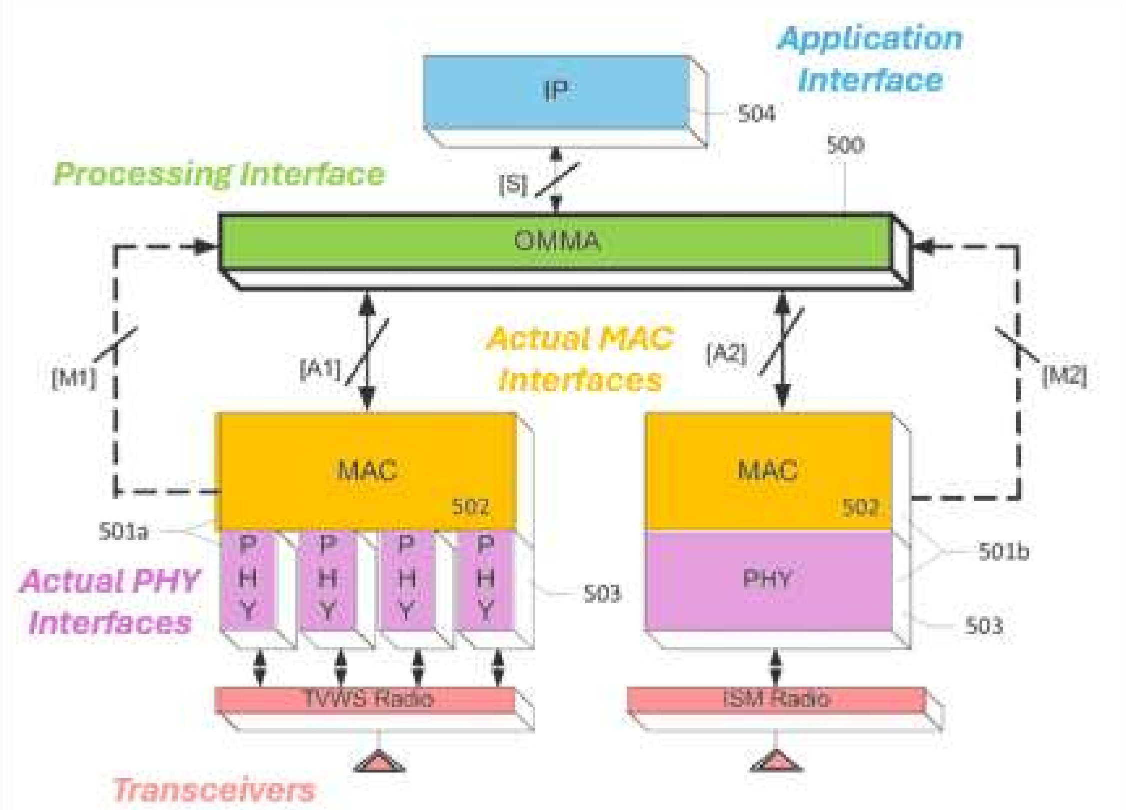


FIG. 5

69. Chincholi expressly discloses receiving, at the OMMA layer, feedback information regarding bandwidth availability on a per-transceiver basis and feeding that information back to the OMMA layer's virtual MAC function. (EX1005 at [0137].) In my opinion, because Chincholi already discloses a partial virtualization of the MAC function at the OMMA layer, a POSITA would have been motivated to leverage this virtualization at the OMMA/transceiver interfaces to further increase flexibility in the system. Specifically, in my opinion, rather than implement static (and limited) interfaces between Chincholi's OMMA layer and each RAT—i.e., each network protocol stack and associated transceiver—a POSITA would have

recognized the opportunity to implement "virtual PHY" interfaces. By 2013, virtualization was a well-understood and widely used tool in computing. A POSITA would have recognized that applying virtualization at the OMMA/transceiver interface—by adding one or more virtual PHY interfaces—would have been a straightforward extension of Chincholi's basic architecture and system design.

70. Providing a "virtualized" PHY interface between the OMMA layer and the RATs in Chincholi would have been particularly beneficial in implementing an 802.11-based system. This is because implementing virtualized PHY interfaces would allow the system to accommodate communication channels with wireless devices that may operate using various different generations of the 802.11 standards. (EX1005 at [0134] (teaching that "[a] Wi-Fi RAT may be a IEEE802.11n RAT, a IEEE802.11ac RAT, a IEEE802.11af RAT, etc.").) Virtualization of the physical interface for this purpose is taught, for example, in U.S. Patent Application 2009/0141691 ("Jain"). (EX1007 at [0034-0037]). In my opinion, a POSITA would have recognized that virtualizing the interfaces between Chincholi's OMMA layer and individual RATs would result in a flexible and "reconfigurable" PHY interface that could be used to match the different needs of potential recipient devices and networks. (EX1007 (Jain) at [0033].).

71. In my opinion, a POSITA would have understood that one way of implementing virtualized PHY interfaces to further enhance Chincholi is taught in

Riggert. Riggert teaches a "bondable virtual interface" which provides a virtualized, flexible interface to the actual PHY interfaces that can be used generically and thus easily substituted across differently configured PHY interfaces in the system. (EX1007 at [0065].)

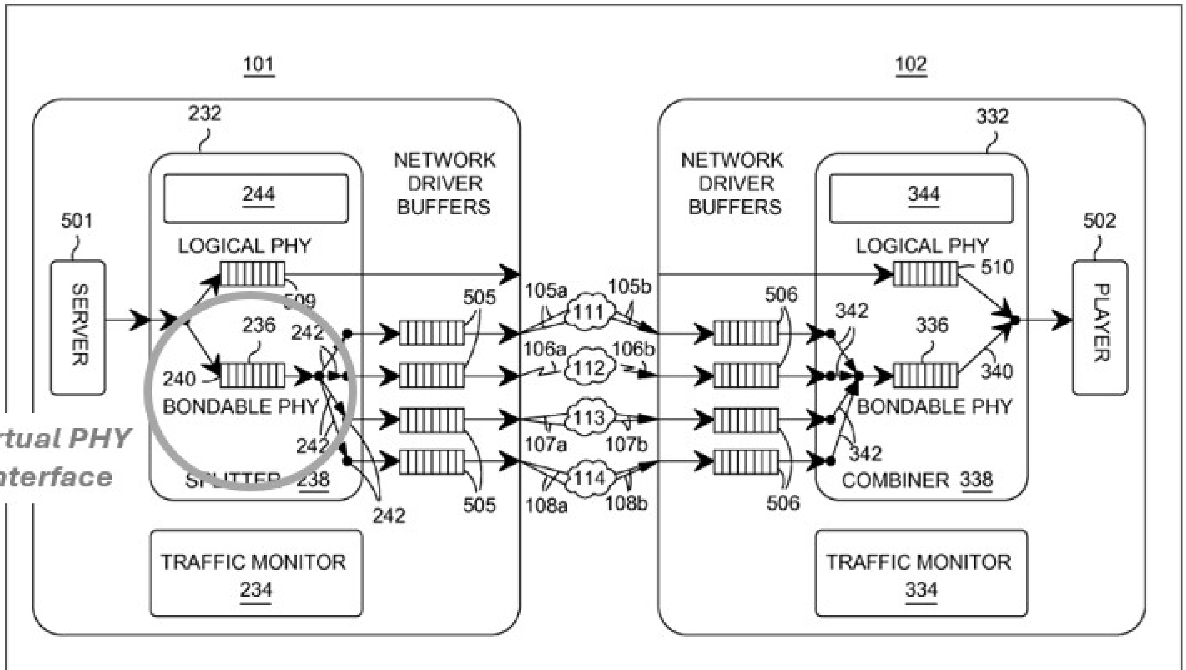


FIG. 5

72. In my opinion, a POSITA would have been motivated to modify Chincholi according to the teachings of Riggert's "virtual PHY" to improve the system of Chincholi. The references both arise in the same field of endeavor and are similarly addressed to increasing bandwidth efficiency and throughput in multi-transceiver, wireless communication networks. (EX1005 at [0002] ("Wireless technologies have been demanding higher data throughput rates and lower latencies"); EX1006 at [0004] ("In the field of data streaming in a network, there is

a problem in that data streaming from a sending endpoint to a recipient endpoint may be detrimentally affected by limited network bandwidth . . . .”).) Both references address 802.11 type systems specifically. (*See, e.g.*, EX1005 at [0137]; EX1006 at [0057].)

73. In my opinion, Riggert’s “bondable virtual interface” would improve the system of Chincholi by providing a flexible, universal interface between the OMMA layer and the actual transceiver resources. (EX1006 at [0065] (“The bondable virtual interfaces 236 and 336 conform to an interface, which allows them to be used generically in the framework.”).) The combined system would improve Chincholi by providing a universal interface between the OMMA controller and sets of potentially differently configured RATs, a benefit that cannot be achieved alone by Chincholi’s system. This combination would allow Chincholi’s system to operate seamlessly with a wider variety of recipient devices operating on different versions of the 802.11 standards.

74. In my opinion, implementing Riggert’s virtualized PHY interfaces into Chincholi would have been straightforward, requiring no more than the exercise of ordinary skill in the art, given that Chincholi already contemplates a virtualization of the MAC function at the OMMA layer. A POSITA would have been well aware of virtualization as a general technique in computing by 2013 and, given the guidance provided by Riggert in combination with the architecture of Chincholi,

would have understood how to implement virtualized PHY interfaces to extend Chincholi's basic architecture and system. In my opinion, based on the above, a POSITA would have recognized that the combination could be accomplished with a reasonable expectation of success.

75. In the analysis below, the combined prior art system as I have described it will be referred to as Chincholi/Riggert.

B. Limitation-By-Limitation Analysis

1. Claim 1

a) *1[pre]: A method of improving the performance of a wireless networking device, comprising the steps of:*

76. In my opinion, and to the extent limiting, Chincholi/Riggert discloses the preamble of claim 1. Chincholi discloses "[s]ystems, ***methods***, and instrumentalities . . . for managing multiple radio access technology (RAT) interfaces to enable opportunistic RAT selection and aggregation for sending data traffic over the multiple RAT interfaces." (EX1005 at Abstract; *see also* [0003].)

77. Chincholi discloses that its system may be implemented in connection with the RAT interfaces of a ("NT"), such as an access point, or a wireless transmit/receive unit ("WTRU"). These terminals "may be configured to work in an infrastructure mode or an adhoc mode, for example, in an IEEE802.11 based Wi-Fi system. (*Id.* at [0115].) Both are "***wireless networking devices***."

78. Chincholi's methods ***improve the performance*** of the disclosed wireless networking device, for example, by enabling dynamic selection and aggregation of wireless interfaces (*id.* at [0003]), which enhances throughput and reduces latency (*id.* at [0002]).

b) *1[a]: connecting an application interface to a processing interface, the application interface being associated with a first application, the first application providing, when the wireless networking device is being used, a first data stream and having a first wireless bandwidth requirement;*

79. In my opinion, Chincholi/Riggert discloses this limitation.

80. ***"a first application . . . "***: Chincholi discloses that "[u]sing multiple RATs simultaneously may provide the benefit of increased bandwidth for an ***application*** (*e.g.*, an IP flow) as well as increased reliability." (EX1005 at [0191].)

81. ***"providing, when the wireless networking device is being used, a first data stream . . . "***: The first data stream of a first application is referred to as an "IP flow." (EX1005 at [0132] ("A single IP flow may refer to a stream of IP packets belong[ing] to a particular application.").)

82. ***"application interface being associated with [the] first application"***: In an 802.11 embodiment (Figure 5), IP packets associated with the application data stream come from or are destined to an IP layer 504. Thus the IP flow (*i.e.,* the ***first data stream***) is provided by the application when the wireless networking device is being used. (EX1005 at [0138], Table 1 ("S" interface is for "Incoming/Outgoing

IP Packets").) The "[S]" interface from the IP layer for the IP stream is therefore an "*application interface associated with a first application.*"

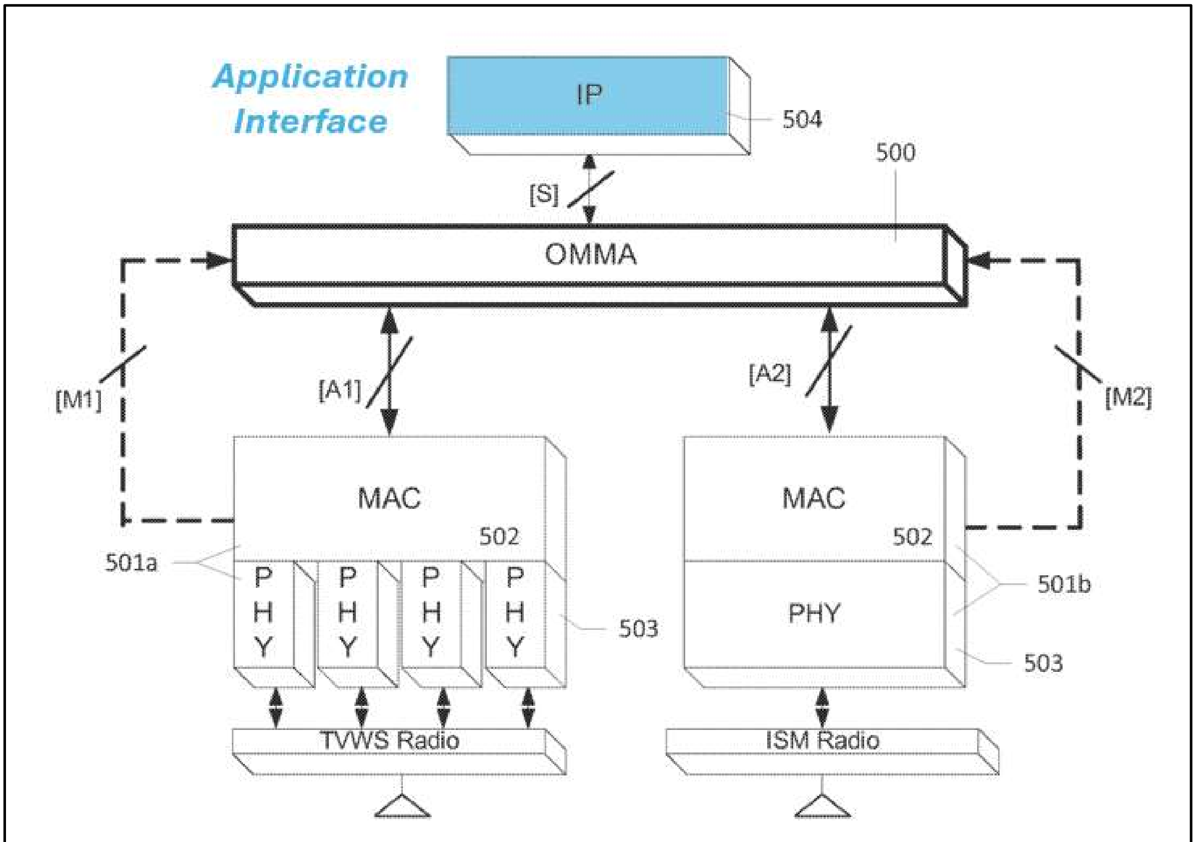


FIG. 5

83. "***connecting an application interface to a processing interface":*** Chincholi teaches an "*Opportunistic Multiple-Medium Access Control (MAC) Aggregation (OMMA) layer*." (EX1005 at [0003].) A POSITA would have understood that the plain meanings of "interface" and "layer" in the context of the '337 patent are congruent, which is underscored by the specification describing layers having the same functionality as the claimed interfaces, and the prosecution history of the prior related '591 patent, where Applicant interchangeably used the

terms "layer" and "interface" to describe Figure 1. (EX1017, Aug. 8, 2023 Applicant Remarks; Sep. 28, 2023 Applicant Remarks). The OMMA layer is a common layer/module between the IP layer/module and the multiple RAT layers/modules. (EX1005 at [0137]; *see also id.* at [0120] ("[T]he single thin software layer may enable one RAT to operate over industrial scientific medical (ISM) and another RAT to operate over a TVWS band for the same IP flow.").) An exemplary OMMA layer enabling a dual-RAT aggregation device in a 802.11n network is shown in Figure 5:

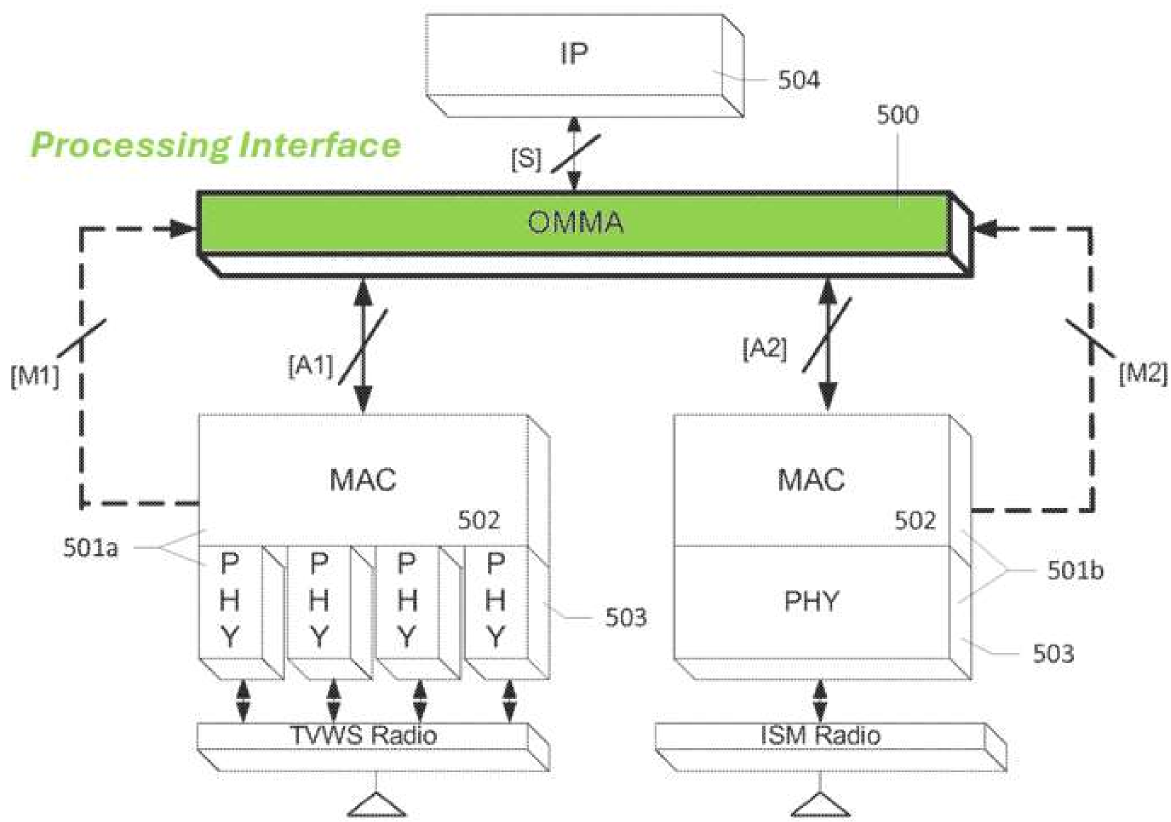


FIG. 5

84. The IP layer interface (*i.e.*, the ***application interface***) is connected to the OMMA layer and provides IP packets that the OMMA layer processes. (EX1005 at [0137].) The OMMA "may allow for enhanced throughput and reduced latency for a single IP flow." (EX1005 at [0120].) The OMMA layer therefore processes IP packets and provides an ***interface*** between the IP layer interface (the ***application interface***) and the actual MAC interfaces, *i.e.*, a ***processing interface***.

85. ***"first application . . . having a first wireless bandwidth requirement":*** Chincholi teaches "a bandwidth requirement for an IP flow." (EX1005 at [0260].) It thus teaches that the first application has a first bandwidth requirement.

c) *1[b]: connecting first and second actual MAC interfaces to the processing interface;*

86. In my opinion, Chincholi/Riggert discloses this limitation. Chincholi discloses connecting first and second ***actual MAC interfaces*** to the processing interface (*i.e.*, the common OMMA layer). Figure 5, for example, depicts a "dual-RAT aggregation" with the common OMMA layer existing above and connected to two RATs 501a and 501b, which comprise first and second actual MAC interfaces 502, respectively. (EX1005 at [0138] ("***The RATs 501a, 501b may comprise a*** ***MAC layer/module 502*** and one or more physical layers/modules 503.").)

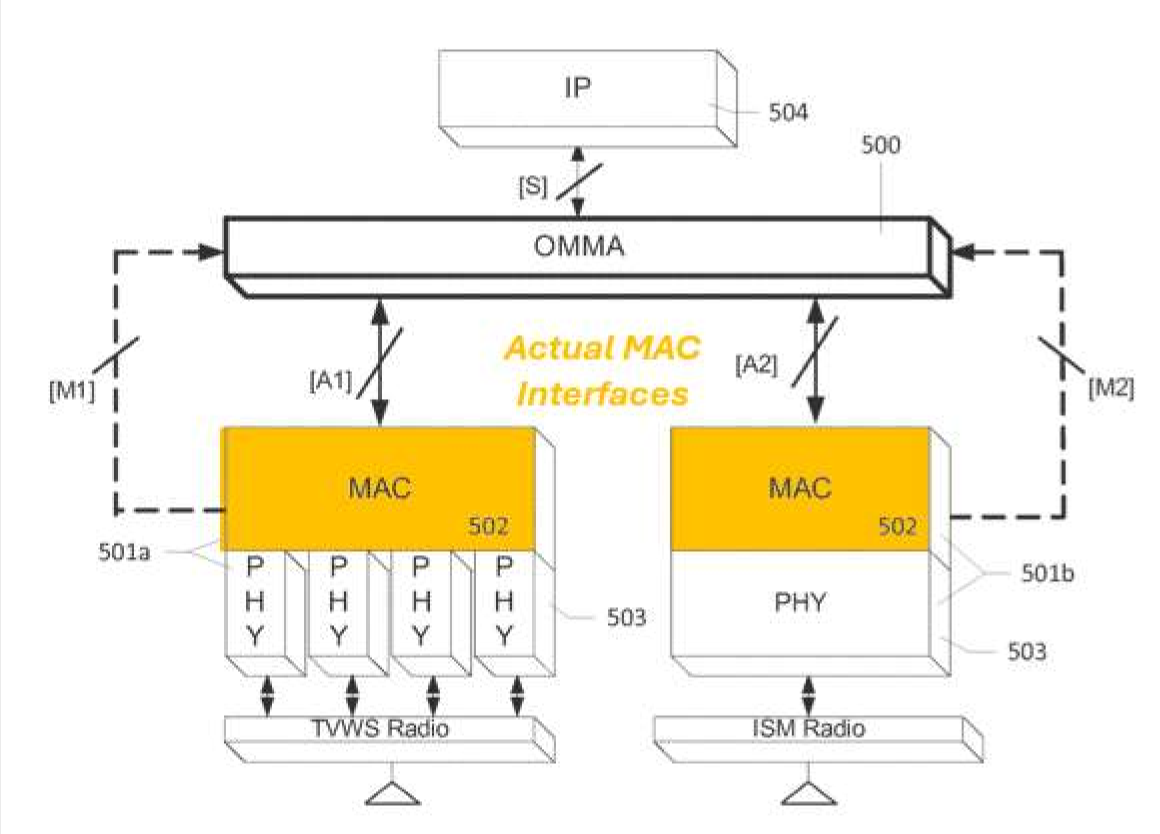


FIG. 5

87. Consistent with Figure 5, Chincholi explains that a given RAT can comprise a "PHY/MAC," *i.e.,* includes an actual MAC interface. (EX1005 at [0135].) A POSITA would have understood that in a typical 802.11 implementation, each RAT would have actual MAC and PHY interfaces.

d) *1[c]: connecting first and second actual PHY interfaces respectively to the first and second actual MAC interfaces;*

88. In my opinion, Chincholi/Riggert discloses this limitation. Chincholi explains that each RAT comprises ***one or more physical layers***. (EX1005 at [0138] ("The RATs 501a, 501b may comprise a MAC layer/module 502 and ***one or more***

physical layers/modules 503.").) As shown in Figure 5 below, Chincholi discloses connecting the first and second actual PHY interfaces (503) to the actual MAC interfaces (502):

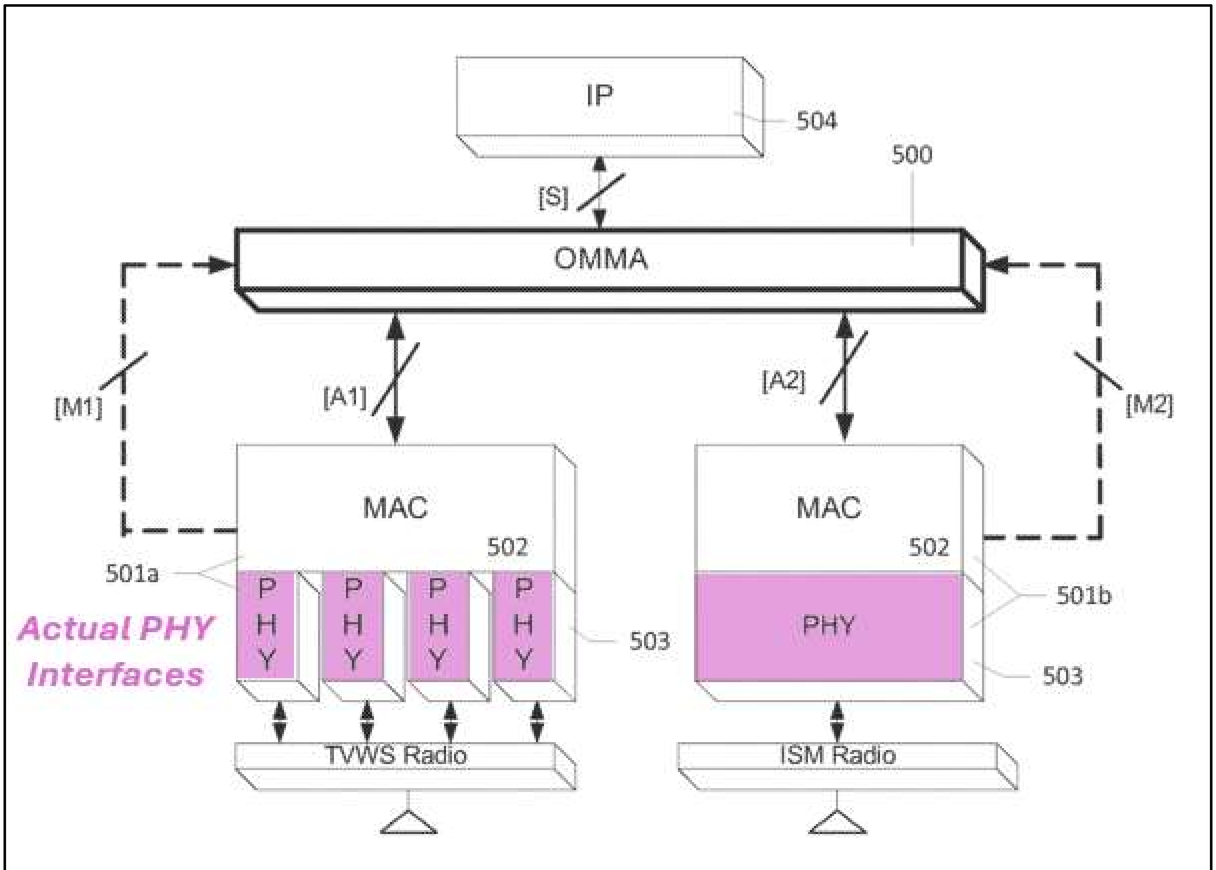
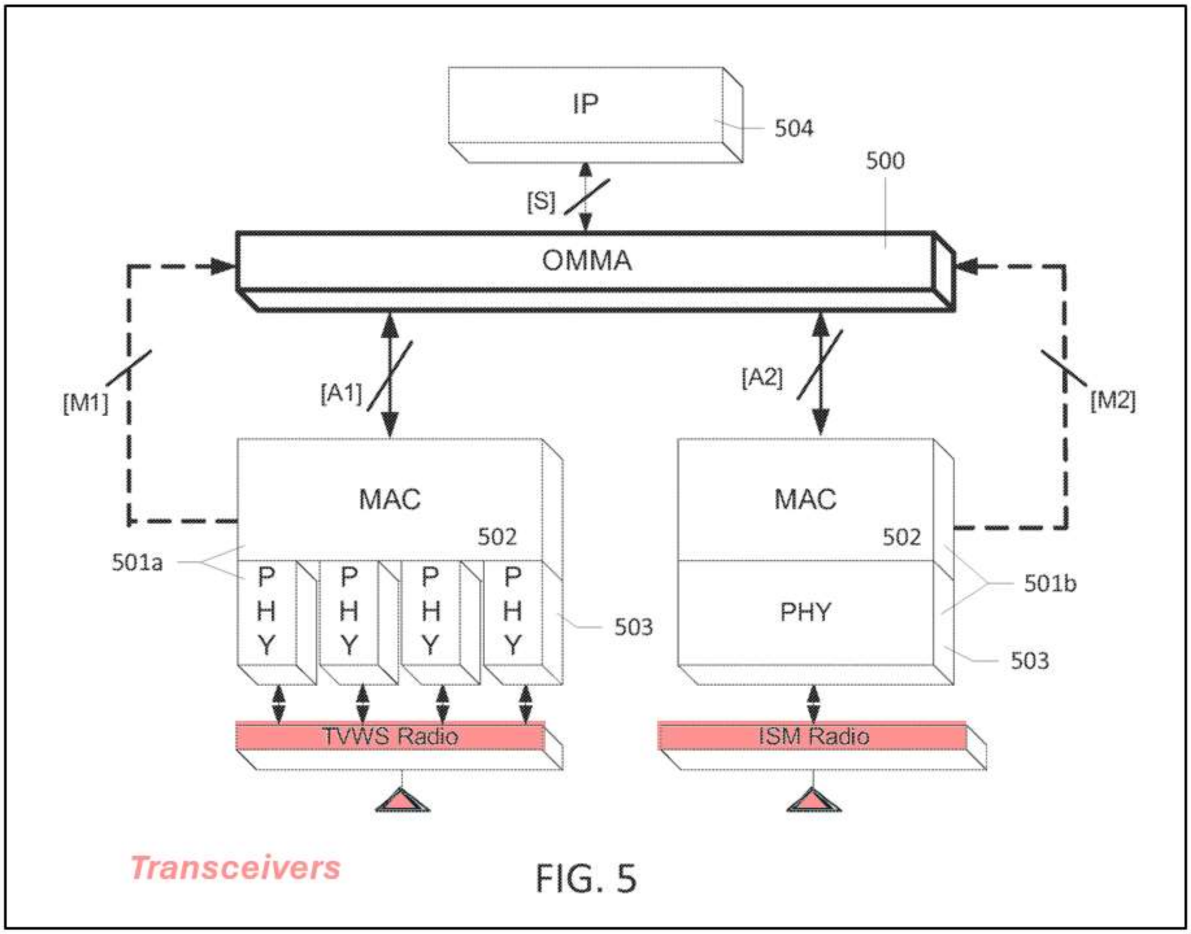


FIG. 5

e) *1[d]: respectively associating first and second wireless transceivers with the first and second actual PHY interfaces, wherein each of the first and second wireless transceivers (i) is suitable for use in a wireless local area network, (ii) has a first and second bandwidth availability up to first and second actual bandwidths, and (iii) is adapted to emit radio waves in first and second different bands of frequencies;*

89. In my opinion, Chincholi/Riggert discloses this limitation.

90. ***"respectively associating first and second wireless transceivers with the first and second actual PHY interfaces … suitable for use in a wireless local area network"*:** The system shown in annotated Figure 5 associates each actual PHY interface of each RAT with an ***antenna/radio frequency (RF) front-end pair***. (EX1005, [0133].)



91. The ***antenna/radio frequency (RF) front-end pairs*** in Figure 5 include first and second transceivers. A POSITA would have understood that a "transceiver" is a physical device that can both transmit and receive information. (Id.) Thus, each

of Chincholi's disclosed "antenna/RF front-end pairs" is a wireless transceiver because each operates according to wireless protocols for transmitting and receiving data, such as IEEE802.11, IEEE802.11ac, IEEE802.11af, LTE, WCDMA, etc. (EX1005, [0134].) A POSITA would have further understood that the transceivers in Figure 5 are associated with the actual PHY layer of each respective RAT, because the PHY layer is understood to be the physical connection between a transceiver and the rest of the RAT.

92. Chincholi also teaches that each RAT may be implemented as a Wi-Fi RAT, and thus their associated transceivers are suitable for use in a wireless local area network. (Ex. 1005 [0134].)

93. ***"each of the first and second wireless transceivers … has a first and second bandwidth availability up to first and second actual bandwidths":*** The plain meaning of this limitation is that each of the wireless transceivers has at least two bandwidth availabilities and two respective actual bandwidths. However, Patent Owner has alleged in the parallel litigation that this limitation may be met by each of the two wireless transceivers having one respective bandwidth availability up to an actual bandwidth. (EX1012; EX1013.) Regardless, Chincholi discloses or renders obvious this limitation under either interpretation.

94. Consistent with PO's infringement contentions, a POSITA would have recognized that each transceiver has an "actual" bandwidth (*i.e.*, total bandwidth of

the transceiver) with a "bandwidth availability" that may be a subset of the actual bandwidth (*i.e.*, sub-portions of the total bandwidth that are available for use). Indeed, as Chincholi teaches, the RATs associated with each transceiver provide "meta-data feedback" allowing the OMMA layer to split IP packets amongst the RATs based on their available bandwidth. (EX1005 at [0138]; [0161] (listing "Channel bandwidth(s)" sent by the PHY layer as an example of "feedback metric[] used by an OMMA layer"); *see also id.* at [0167] ("At startup, the OMMA layer may receive the ***available bandwidth of each of the one or more RATs***.").) Thus, Chincholi discloses that each of the two transceivers has a bandwidth availability up to an actual bandwidth.

95. Chincholi also discloses that there are multiple available bandwidths for each transceiver, specifically that a transceiver's feedback metrics include available "[c]hannel bandwidth(s)" in the form of a "Vector/list of elements which are multiple of 0.5 MHz." EX1005 [0161], Table 2. A POSITA would have understood a "vector" or "list" data structure is a data structure for transferring multiple data elements of indeterminate count, and would therefore understand that the number of available "channel bandwidths" stored in the vector could and would exceed two.

96. "***each of the first and second wireless transceivers … is adapted to emit radio waves in first and second different bands of frequencies***": The plain

meaning of this limitation is that each of the transceivers emit radio waves in the same two frequency bands. Patent Owner, however, has read this limitation to only require that each transceiver emit on a single, mutually exclusive frequency band. For example, in its infringement contentions, Patent Owner alleges that this limitation is met by implementation of the Wi-Fi 7 Draft Standard where "[t]he first transceiver is the 2.4 GHz transceiver," the second is "one of the 5 GHz and 6 GHz transceivers." (EX1012; EX1013 at 19-20.) Regardless, Chincholi discloses or renders obvious this limitation under either interpretation.

97. The transceivers of each RAT are adapted to emit radio waves in respective different bands of frequencies, consistent with PO's infringement contentions. In the context of Figure 4, Chincholi discloses that "[f]or multiple RATs 401, ***each RAT 401 may be operating on a specific band***. For example, a 802.11n PHY/MAC operating over 2.4GHz ISM band, a 802.11af PHY/MAC operating over 512 MHz-698 MHz TVWS band, an LTE RAT operating of a licensed band (*e.g.*, 700 MHz band), a Bluetooth RAT operating on 2.4 GHz ISM band, *etc.*" (EX1005 at [0135].) Thus, a POSITA would have understood that Chincholi discloses this limitation under PO's interpretation.

98. Chincholi also discloses that each transceiver can emit radio waves within all of the at least two frequency bands. For example, Chincholi describes that an NT and WTRU "may communicate with each other over a single radio frequency

(RF) spectral band" such as "2.4 GHz ISM band, ***or*** 5 GHz ISM band," even when the devices are "multi-RAT capable devices," *i.e.* comprising multiple transceivers. (EX1005 at [0118].) Chincholi further describes that the frequency band is comprised of "multiple contiguous or noncontiguous channels" within the band over which the devices communicate. *Id.* Accordingly, a POSITA would have understood that each transceiver operating on the 2.4 GHz ISM band is adapted to emit radio waves in any one of two contiguous channels, *i.e.,* the first and second different bands of frequencies, and thus satisfies the claim limitation under the alternative interpretation.

f) *1[e]: forming in the processing interface (i) at least one virtual MAC interface and (ii) first and second virtual PHY interfaces that, during operation of the wireless networking device, feed information regarding the bandwidth availabilities of the first and second wireless transceivers back to the at least one virtual MAC interface;*

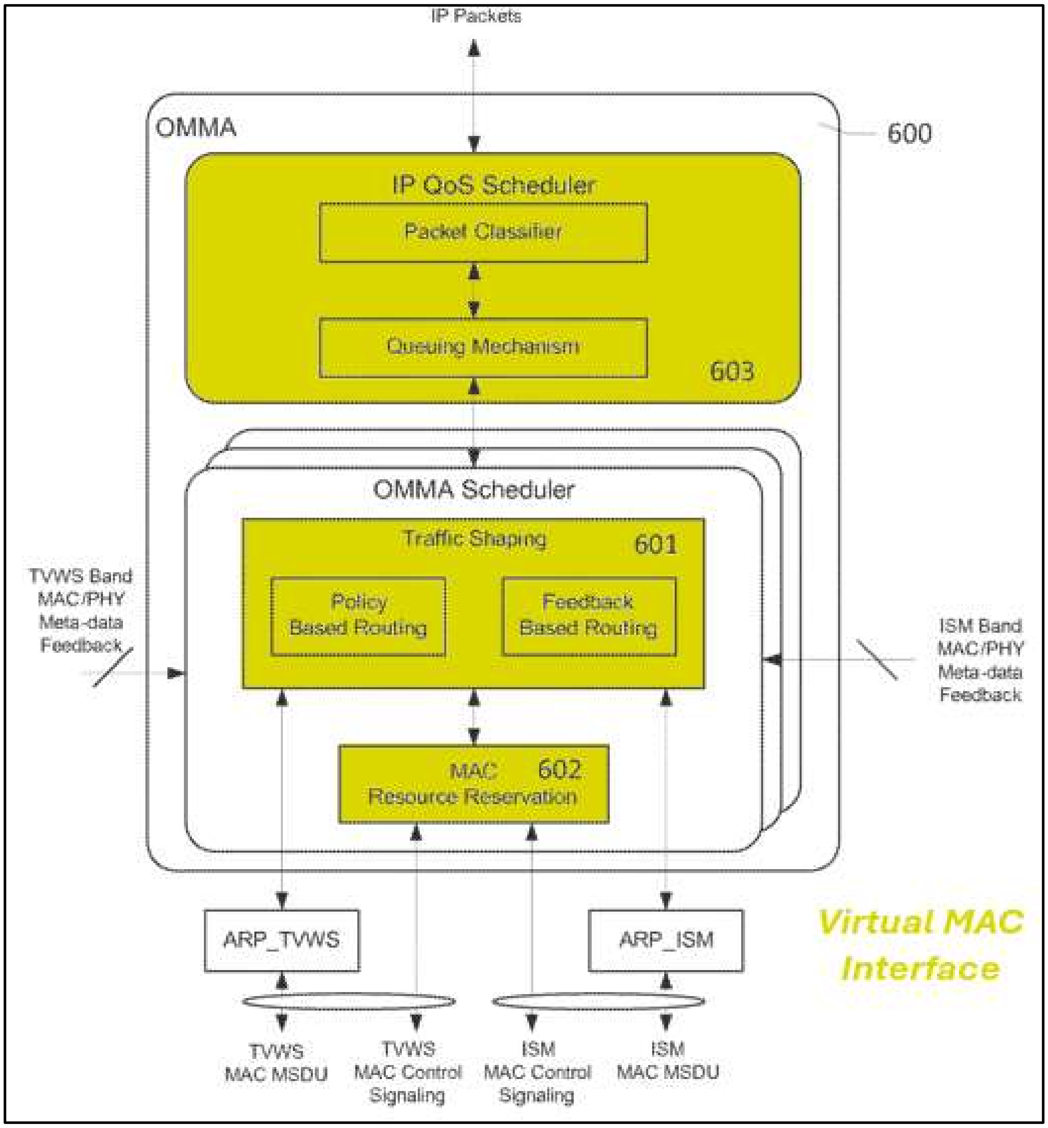
99. In my opinion, Chincholi/Riggert discloses or renders obvious this limitation. According to the '337 patent, the claimed virtual MAC and PHY layers "enable simultaneous allocation of multiple PHY resources for different signal types associated with different applications." (EX1001 at 3:41-47.) The patent states that the virtual MAC layer comprises the functionality of "decision," "processing," and "ultra-streaming" blocks, while the virtual PHY layer may comprise one or more "RF blocks." (EX1001 at 4:39-44.) The virtual PHY layer may include multiple RF

blocks, each representing the virtual use of some set of allocated transceiver resources. (*Id.* at 4:41-44; *see also* Fig. 3 (depicting two RF blocks associated with "two sets" of transceiver resources).) "By employing a virtual MAC and virtual PHY between an application layer and an actual MAC and PHY layer, wireless transceiver resources may be allocated more efficiently to handle various data bandwidth requirements from different applications." (EX1001 at 5:60-64.)

100. *First*, Chincholi discloses that the OMMA (*i.e.*, the processing interface) includes the claimed "***virtual MAC interface***." Indeed, "OMMA" is an abbreviation for "opportunistic multi-medium access control ***(MAC) aggregation***," which refers to the fact that the OMMA layer aggregates multiple MAC interfaces, as depicted in Figure 5. (EX1005 at [0120].) The OMMA layer includes an interface acting as a "virtual MAC interface" because it transparently "distributes and/or combines" packets between the IP layer and the RATs. (EX1005 at [0192].) A POSITA would have recognized that this "virtualizes" a MAC interface because the OMMA would effectively appear to the IP layer as a single interface for exchanging packets that are ultimately sent or received by the actual MAC-PHY pairs.

101. Chincholi's OMMA layer also includes all of the functionality that the '337 patent associates with the "virtual MAC interface." Specifically, Figure 6 of Chincholi is a block diagram of an OMMA layer, comprising an IP QoS Scheduler

603, a MAC Resource Reservation module 602, and a Traffic Shaping Module 601. (EX1005 at [0139].)



102. The IP QoS Scheduler classifies incoming packets of a packet stream and may segregate them into distinct IP QoS streams (EX1005 at [0143]), which a POSITA would have recognized to fulfill the functionality of the "decision block" of the '337 patent's "virtual MAC interface" (EX1001 at 3:21-24). The MAC Resource Reservation module determines the time duration or spectral

fragment/bandwidth required by a packet or set of packets (EX1005 at [0142]), which a POSITA would have recognized to fulfill the functionality of the "processing block" of the '337 patent's "virtual MAC interface" (EX1001 at 3:24-26). Finally, the Traffic Shaping module determines the way packets are routed across RATs using either policy based routing or feedback based routing (EX1005 at [0139]), which a POSITA would have recognized to fulfill the functionality of the "ultra-streaming block" of the '337 patent's "virtual MAC interface" (EX1001 at 3:26-30). Thus, a POSITA would have recognized that Chincholi's OMMA layer includes a "***virtual MAC interface***."

103. <u>*Second*</u>, Chincholi discloses that its processing interface comprises "***first and second virtual PHY interfaces that, during operation of the wireless networking device, feed information regarding the bandwidth availabilities of the first and second wireless transceivers back to the at least one virtual MAC interface.***" Chincholi discloses that the traffic shaping module of the OMMA (*i.e.*, part of the "virtual MAC interface") may determine packet routing using "feedback based routing." (EX1005 at [0139].) In feedback based routing, "the OMMA transmitter may use measurement metrics fed back from each RAT," which include "channel quality metrics and the ***number of available resources on the medium***." (EX1005 at [0161].)

104. Figures 28, 29, and their associated descriptions describe how Chincholi collects feedback from each RAT for the traffic shaping module. Figure 28 illustrates how the OMMA layer includes an OMMA Controller, which interfaces with each RAT to collect metrics regarding the channel quality and number of resources available on the medium. Specifically, using interface "A2" in Figure 28, "[a] RAT (*e.g.*, ***each RAT***) may provide feedback metrics (*e.g.*, a vector comprising a value of serving rate, jitter, packet delay, and packet loss rate on its MAC) to the OMMA Controller 2900 ***per device (e.g., WTRU or NT) per access category supported at that RAT***." (EX1005 at [0205].) It would have been obvious to a POSITA to incorporate first and second virtual PHY interfaces into the OMMA Controller of Chincholi to collect the disclosed feedback metrics from each RAT over the "A2" interface and feed them back to the virtual MAC interface.

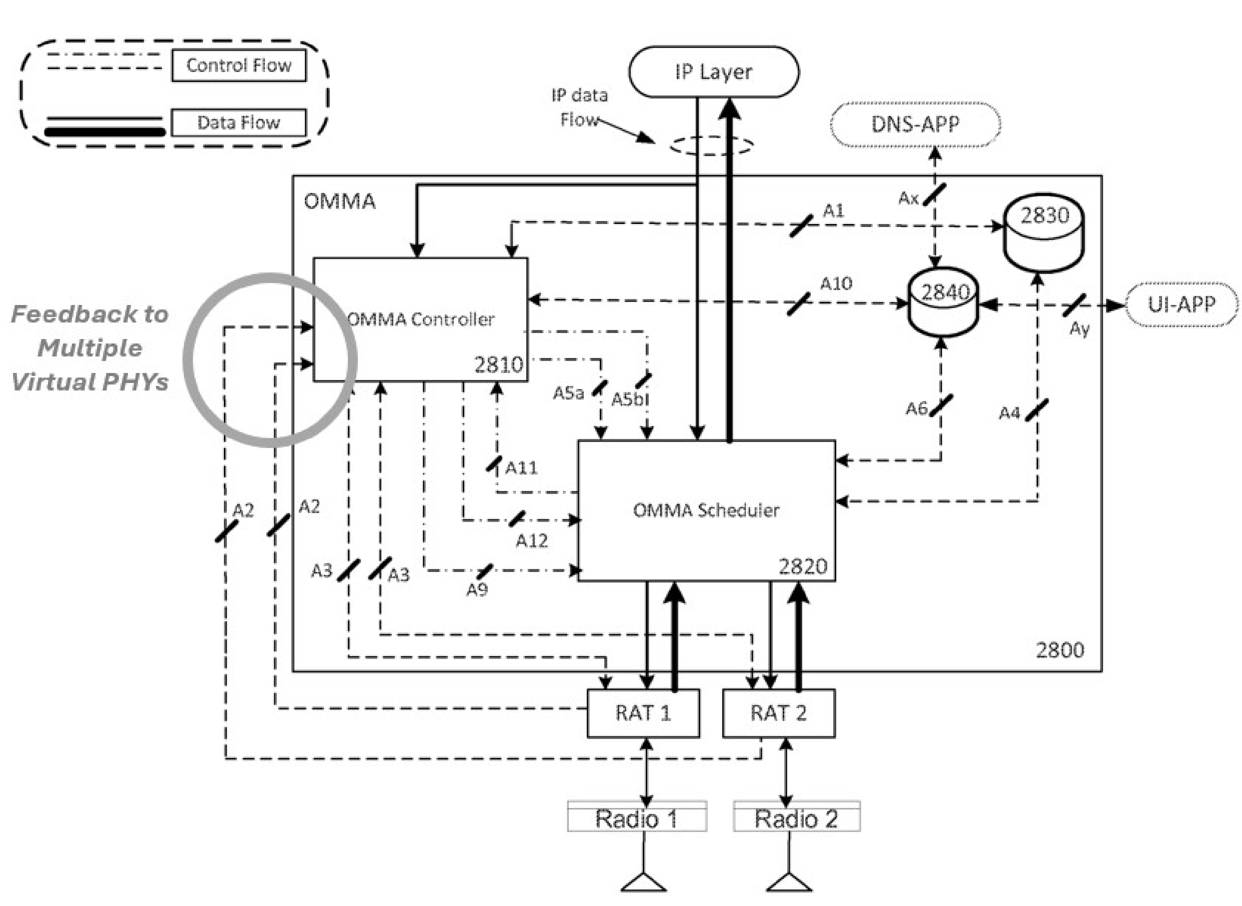


FIG. 28

105. Further details regarding the implementation of virtual PHY interfaces are disclosed by Riggert. As discussed above, *supra* Section IV, Riggert teaches a "bondable virtual interface" that provides one or more virtualized physical interfaces to the actual PHY layers of the communication channels, allowing for easy substitution of the interface throughout the system. (EX1006 at [0065].) Providing this sort of virtualized physical interface for transceivers in an 802.11 system is particularly beneficial as it allows an access point to accommodate communication channels with wireless devices that may operate using various different generations

of the 802.11 standards. Virtualization of the physical interface for this purpose is taught, for example, in background reference U.S. Patent Application 2009/0141691 ("Jain"). (*See* EX1007 at [0034-0037]).

106. Figure 5 of Riggert teaches the basic architecture for implementing "bondable physical interfaces" in the wireless network devices of a multi-channel network:

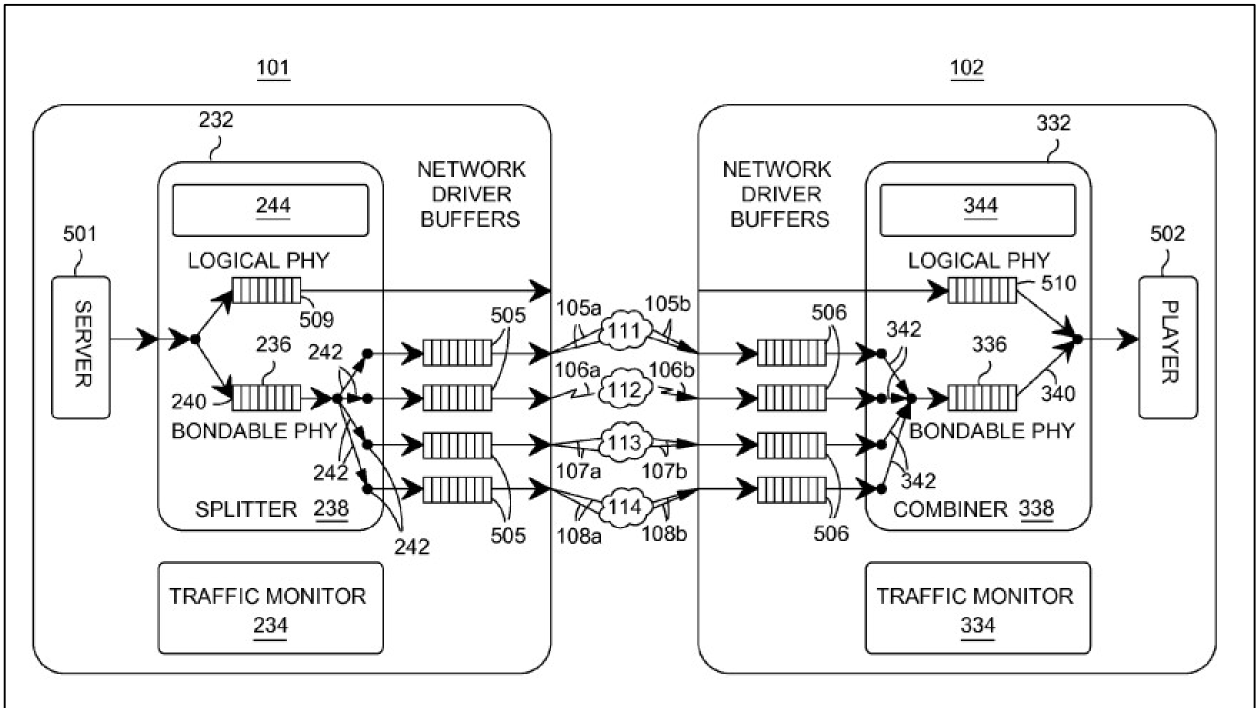


FIG. 5

107. The "bondable virtual interface" in Figure 5 on the server side is denoted as a "bondable PHY" (240). While the exemplary architecture depicts only a single "bondable virtual interface" associated with four actual transceiver resources, Riggert teaches that ***multiple*** physical bondable interfaces are possible in a single device. For example, each network endpoint may comprise a "plurality of

bondable virtual interface connectors 244 and 344, respectively," each one of which may be associated with specific bondable virtual interface. (EX1006 at [0069].)

108. For the reasons discussed above, *see* Section VI.A, a POSITA would have been motivated to combine Riggert's implementation of virtual PHY interfaces into the OMMA Controller of Chincholi for the purposes of receiving the feedback statistics over the "A2" interfaces and passing that feedback data to Chincholi's traffic shaping module. The resulting combination would implement one or more bondable virtual PHY interfaces into Chincholi's OMMA controller, each associated with one or more actual MAC-PHY pairs, thus increasing flexibility in the system.

g) *1[f]: wherein the processing interface is configured to, when the wireless network device is being used in a manner transparent to any layer of the wireless networking device above the processing interface,*

109. In my opinion, Chincholi/Riggert discloses this limitation. Chincholi discloses that its OMMA layer (*i.e.*, processing interface) is configured to operate in a manner transparent to any higher layer. For example, Chincholi discloses that "[t]he OMMA layer ***may be transparent*** in that it distributes and/or combines packets from different RATs and forwards the packets to the IP layer." (EX1005 at [0192], [0126].) This is as opposed to a "non-transparent" configuration in which the OMMA layer would "add[] additional headers [] at the transmitter, and read and/or remove the headers at the receiver." (*Id.*)

h) *1[g]: (i) identify at least one portion of each one of the first and second actual bandwidths of the first and second wireless transceivers that are available for communication,*

110. In my opinion, Chincholi/Riggert discloses this limitation. Chincholi teaches that NTs and WTRUs communicate with one another over "channels," which are portions of a transceiver bandwidth availability. Specifically, "[t]he NT and WTRU may communicate with each other over a single radio frequency (RF) spectral band, for example, 2.4 GHz ISM band, or 5 GHz ISM band, or TVSWS band, or 60 GHz band, ***using a channel within the band or aggregating multiple contiguous or noncontiguous channels***." (EX1005 at [0118]; *see also id.* at [0121] ("An 802.11 based system may operate in a time division duplexing (TDD) mode, for example, ***on a band over a single 20/40MHz channel in the case of ISM band or a single 5/10/20 MHz channel in television white space (TVWS) band*** using contiguous/non-contiguous carrier aggregation.").)

111. Chincholi also discloses identifying available bandwidth channels for communication. The OMMA layer receives various feedback information from each RAT. (EX1005 at [0123].) For example, "the OMMA transmitter may use measurement metrics fed back from each RAT," which include "channel quality metrics and the ***number of available resources on the medium***." (EX1005 at [0161].) Amongst the available resources provided as part of the feedback

information are the "number of channels" and "channel bandwidth." (EX1005 at [0161].)

112. A POSITA would have understood that the ability of Chincholi's OMMA layer to receive from each RAT a number of channels and channel bandwidth is an identification of "at least one portion" (*i.e.*, at least one available channel, or an aggregation of multiple contiguous or non-contiguous channels) of the first and second actual bandwidths of the first and second wireless transceivers that are available for communication.

i) *1[h] (ii) select one transceiver of the first and second transceivers which has the most bandwidth available, (iii) prepare the first data stream for transmission to a recipient from the selected wireless transceiver using a specific subset of frequencies corresponding to the identified at least one portion of its available bandwidth, and (iv) cause the prepared first data stream to be transmitted from the selected wireless transceiver to thereby at least partially satisfy the first wireless bandwidth requirement of the first application;*

113. In my opinion, Chincholi/Riggert discloses this limitation. Based on its evaluation of transceiver bandwidth availability with respect to the application bandwidth requirement, Chincholi discloses selecting one transceiver having the most bandwidth available, preparing the first data stream for transmission using a subset of the available bandwidth on that transceiver, and causing the transmission to thereby at least partially satisfy the first application's bandwidth requirement.

114. *First*, Chincholi discloses that the OMMA layer uses feedback metrics indicating the amount of available bandwidth on each RAT to select between the first and second transceivers. For example, in a "cold start" phase, Chincholi teaches how the OMMA layer "may request the individual RATs to transmit the total channel bandwidths supported by them." (EX1005 at [0163].) Thus, the distribution of IP packets across two separate RATs, operating on two different frequency bands, may be calculated as the simple ratio of available bandwidth on the two RATs:

$$BW_{ISM} : \sum_{k=1}^{N} BW_{TVWS}^{k}$$

(EX1005 at [0163].) Chincholi also discloses more sophisticated algorithms for allocating packets based on *both* available bandwidth and link quality for each of a "ramp-up phase" and a "steady state phase." (EX1005 at [0164]-[0165]).

115. A POSITA would have understood from these calculations that a higher ratio of IP packets will be allocated to the transceiver with more available bandwidth. Further, where the available bandwidth of the first transceiver is substantially better than that of the second transceiver, a POSITA would have understood the capability to transmit the *entire* first data stream using only the first transceiver. Thus, Chincholi teaches a selection of the transceiver with the most available bandwidth for preparation and transmission of the first data stream.

116. *Second*, after selecting the transceiver, Chincholi discloses that the OMMA layer ***prepares the data stream for transmission*** using available spectral fragments (i.e., portions of the transceiver's available bandwidth allocated for transmission). For example, Chincholi teaches that its MAC Resource Reservation module "may determine an amount of time duration and/or spectral fragment/bandwidth required by a packet or a set of packets." (EX1005 at [0142].) A POSITA would have understood that these spectral fragments correspond to the claimed "subset of frequencies" of the transceiver's available bandwidth. Once bandwidth and spectral fragments have been allocated, preparing the data stream for transmission further includes segmenting the data, mapping the data stream to the allocated bandwidth resources, applying appropriate modulation and coding schemes, and generating the physical-layer signals for transmission over the selected transceiver.

117. *Third*, Chincholi further discloses causing the prepared first data stream to be transmitted from the selected transceiver, thereby at least ***partially satisfying the application's bandwidth requirement***. As Chincholi explains, "[u]sing multiple RATs simultaneously may provide increased bandwidth and/or increased reliability for an application." (EX1005 at [0194].)

118. Finally, Chincholi discloses that this selection, preparation, and transmission is performed by the OMMA layer in a manner transparent to higher

layers: "[t]he OMMA layer ***may be transparent***, in that it distributes and/or combines packets from different RATs and forwards the packets to the IP layer." (EX1005 at [0192], [0126].)

j) *1[i]: wherein, if the unselected wireless transceiver has more bandwidth availability than the selected transceiver during use of the wireless networking device, the processing interface is adapted to, as a result of the increased bandwidth availability and in a manner transparent to any layer of the wireless networking device above the processing interface, (i) identify at least one portion of the bandwidth of the unselected transceiver that is available for communication and select the unselected transceiver,*

119. In my opinion, Chincholi/Riggert discloses this limitation. Chincholi teaches that the OMMA layer dynamically monitors bandwidth availability and may select a transceiver with greater bandwidth availability as conditions change. Chincholi explains that the OMMA layer may "continuously update . . . the available RAT capability of a device . . . based on feedback metrics from each RAT." (EX1005 at [0235].) These feedback metrics include both channel quality and the number of available resources on the medium. (EX1005 at [0161].)

120. Chincholi further discloses that the processing interface (i.e., the OMMA layer) is adapted to identify a bandwidth portion of an unselected transceiver and select an unselected transceiver if its bandwidth availability exceeds that of the selected transceiver during use of the wireless networking device. Chincholi teaches that "[a]s the channel quality/availability of RATs 1301a, 1301b changes, the best

RAT may be selected which may be different from the one previously used." (EX1005 at [0154].) A POSITA would have understood that this includes situations where bandwidth availability (i.e., the amount of available spectrum or channel resources on a RAT) increases relative to the previously selected transceiver, prompting the OMMA layer to switch and select the RAT with more bandwidth availability.

121. Finally, Chincholi discloses that this selection of an unselected transceiver performed by the OMMA layer in a manner transparent to higher layers: "[t]he OMMA layer may be transparent, in that it distributes and/or combines packets from different RATs and forwards the packets to the IP layer." (EX1005 at [0192], [0126].) Accordingly, a POSITA would have understood that the OMMA's transparent routing of packets across RATs allows the switching to occur without requiring disassociation and reassociation at the MAC/PHY level.

k) *(ii) prepare the first data stream, without requiring the disassociation of the recipient from the actual MAC and PHY interfaces of any wireless transceiver, for transmission to the recipient from the unselected transceiver using a specific subset of frequencies corresponding to its identified at least one portion of available bandwidth, and*

122. In my opinion, Chincholi/Riggert discloses this limitation. After selecting the unselected transceiver, Chincholi discloses that the OMMA layer prepares the first data stream for transmission to the recipient from the transceiver

using a specific subset of frequencies corresponding to its identified at least one portion of available bandwidth. For example, Chincholi teaches that the MAC Resource Reservation module "may determine an amount of time duration and/or spectral fragment/bandwidth required by a packet or a set of packets." (EX1005 at [0142].) A POSITA would have understood that, once bandwidth and spectral fragments have been allocated, preparing the data stream for transmission further includes segmenting the data, mapping the data stream to the allocated bandwidth resources, applying appropriate modulation and coding schemes, and generating the physical-layer signals for transmission over the selected transceiver.

123. Additionally, Chincholi does not "require" disassociation of recipient WTRUs from actual MAC and PHY interfaces of any wireless transceiver during operation, including during preparation of the first data stream for transmission and transmission by a newly selected transceiver.

124. Indeed, a POSITA would have also recognized the desirability of implementing Chincholi combined with the teachings of Riggert to transmit the first data stream to the recipient without requiring "disassociation" of the recipient from either or both of the first and second actual MAC and PHY interfaces. For example, in the field of 802.11 systems—where each associated terminal is assigned a unique association identifier ("AID")—it was well-known that avoiding disassociation after initial association was desirable, as repeatedly re-forming associations was

inefficient and disruptive. EX1008 (U.S. Patent 9,379,868) ("Wang") at 24:42-43 ("This approach is undesirable, can be blunt and can disrupt the on-going services (e.g., requires disassociation), at 24:57-62 ("The lack of update/change of the AID values . . . after an initial AID assignment is inherently inflexible and can prevent the realization power saving, among other considerations, that an update/change of the AID values can provide.") Indeed, recognizing this issue, background prior art reference Wang described techniques in a multiple transceiver/MIMO system for effectuating an update to a recipient's unique association identifier ("AID") through various interactions with the system without requiring a disassociation of a wireless device from an access point. (EX1008 at 24:63-25:57.)

125. In light of this background art, a POSITA would have recognized that in implementing the Chincholi/Riggert combination, it would be desirable implement known dynamic AID reassignment techniques to avoid disassociation of recipients from the actual MAC and PHY interfaces of any wireless transceiver during operation including throughout any process of reallocating transceiver, channel, and/or bandwidth resources to a recipient.

l) *(iii) cause the prepared first data stream to be transmitted to the recipient from the unselected transceiver, without requiring the disassociation of the recipient from the actual MAC and PHY interfaces of any wireless transceiver, to thereby continue to at least partially satisfy the first wireless bandwidth requirement of the first application; and*

126. In my opinion, Chincholi/Riggert discloses this limitation. Chincholi further discloses causing the prepared first data stream to be transmitted from the newly selected transceiver, thereby continuing to at least partially satisfy the application's bandwidth requirement. As Chincholi explains, "[u]sing multiple RATs simultaneously may provide increased bandwidth and/or increased reliability for an application." (EX1005 at [0194].)

127. As discussed above in the prior limitation, Chincholi does not require disassociation of the recipient from the actual MAC and PHY interfaces of any wireless transceiver during operation including throughout any process of reallocating transceiver, channel, and/or bandwidth resources to a recipient.

m) *1[j]: wherein the wireless networking device's utilization of the available bandwidth of the selected and unselected transceivers does not prevent other wireless networking device from utilizing a range of frequencies corresponding to the remaining portion of the bandwidth availabilities of the selected and unselected wireless transceivers for data transmission purposes at the same time that processed data is being sent from the selected and unselected wireless transceivers.*

128. In my opinion, Chincholi/Riggert discloses this limitation. Chincholi discloses examples of "***multi-WTRU*** multi-IP flow cases." (EX1005 at [0328].) For example, "[a] system may comprise ***multiple WTRUs***, a single NT, and multiple IP flows from the NT to one or more WTRUs." (EX1005 at [0328].) This is disclosed, for example in Figure 3.

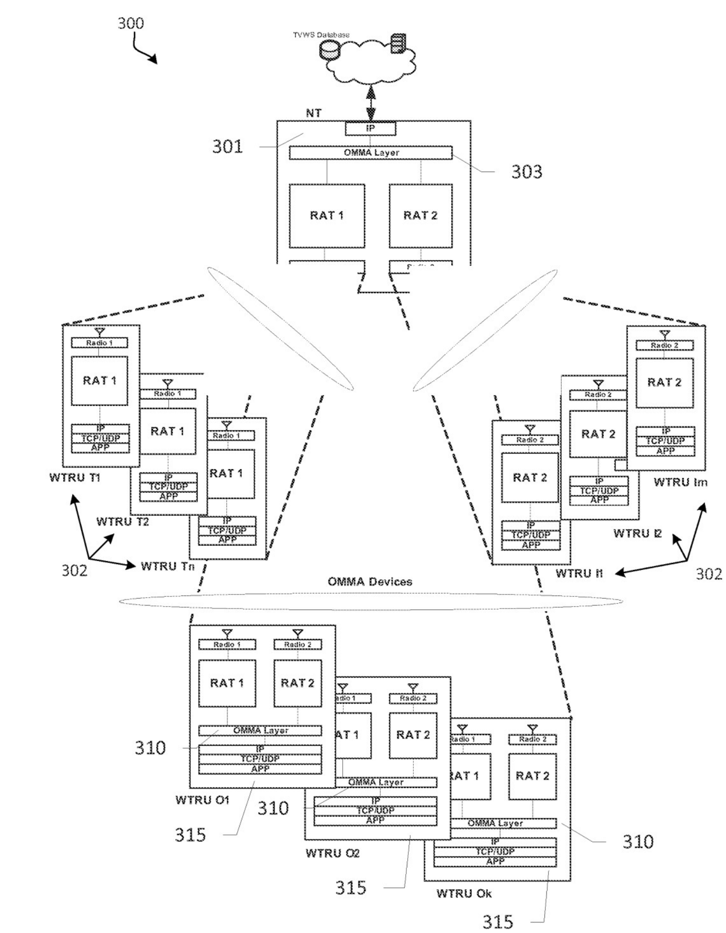


FIG. 3

129. To manage data flows for multiple WTRUs, Chincholi teaches techniques for queuing packets according to their access categories and/or WTRU addresses and optimizing the distribution of packets of multiple streams for multiple WTRUs across multiple RATs. (EX1005 at [0351]-[0356].) For example, Chincholi discloses a MAC layer of a given transceiver may implement multiple transmission buffers, denoted Q_{ik}, where "i" refers to the WTRU for which a group of packets is designated and "k" refers to the IP flow associated with the group of packets. (EX1005 at [352].)

130. Chincholi further discloses how utilization of the available transceiver bandwidth for one WTRU does not prevent other WTRUs from utilizing a range of frequencies corresponding to the remaining transceiver bandwidth at the same time. As discussed above, Chincholi's OMMA layer receives feedback metrics from each RAT. (EX1005 at [0161].) Amongst the feedback metrics are the "MAC Type," for example "OFDMA." (EX1005 at [0161] & Table 2.) OFDMA stands for "Orthogonal Frequency Division Multiple Access," which was a known wireless communication technique for dividing an available bandwidth into smaller subcarriers (*i.e.* frequency ranges) which are then allocated to different users. These subcarriers are described as orthogonal because they do not interfere with each other when simultaneously transmitted. A POSITA would have recognized that OFDMA techniques would allow multiple WTRUs to access different channels of the transceiver resources simultaneously and without interference.

131. Because Chincholi's RATs may provide feedback to the OMMA indicating that they are operating as an OFDMA MAC Type, a POSITA would have recognized that Chincholi discloses the capability to allow multiple WTRUs to simultaneously utilize different portions of the bandwidth availabilities of the selected and unselected transceivers.

2. Claim 2: The method of claim 1,

a) *2[a]: wherein the application interface is associated with a second application, the second application providing, when the wireless networking device is being used, a second data stream and having a second wireless bandwidth requirement;*

132. In my opinion, Chincholi/Riggert discloses the limitations of claim 2. Chincholi discloses that a "single IP flow may refer to a stream of IP packets belong[ing] to a particular application." (EX1005 at [0132].) Moreover, Chincholi discloses "multi-WTRU ***multi-IP flow*** cases." (EX1005 at [0328], [0349].) For example, "[a] system may comprise multiple WTRUs, a single NT, and ***multiple IP flows*** from the NT to one or more WTRUs." (EX1005 at [0328].)

133. Chincholi teaches techniques for queuing packets according to their access categories and/or WTRU addresses and optimizing the distribution of packets of multiple streams for multiple WTRUs across multiple RATs. (EX1005 at [0351]-[0356].) For example, Chincholi discloses that a MAC layer of a given transceiver may implement multiple transmission buffers, denoted Q_{ik}, where "i" refers to the WTRU for which a group of packets is designated and "k" refers to the IP flow associated with the group of packets. (EX1005 at [0352].)

b) *2[b]: wherein the processing interface is configured to, when the wireless networking device is being used in a manner transparent to any layer of the wireless networking device above the processing interface, (i) prepare the first and second data streams for simultaneous transmission to the recipient from the selected wireless transceivers using a specific subset of frequencies corresponding to the identified at least one portion of its available bandwidth, and*

134. In my opinion, Chincholi/Riggert discloses this limitation. A POSITA would have understood that Chincholi discloses that the OMMA layer evaluates the identified channel availabilities and selects amongst available transceivers with respect to *both* the first bandwidth requirement of the first application and the second bandwidth of the second application. As discussed above, *see* limitation 2[a], Chincholi teaches the use of transmission buffers Q_{ik} to store data destined for WTRU "i" from IP flow (*i.e.*, application "k"). (EX1005 at [0352].) Chincholi then discloses various feedback metrics for "multi WTRU multi IP flow (QoS) cases" along with algorithms for optimizing the distribution of packets in this scenario across multiple RATs. (EX1005 at [0353]-[0356].)

135. After selecting between first and second transceivers with respect to both first and second applications, Chincholi discloses that its MAC Resource Reservation module "may determine an amount of time duration and/or spectral fragment/bandwidth required by a packet or a set of packets." (EX1005 at [0142].) A POSITA would have understood that in the multi-IP flow scenario, this would

involve reserving a specific subset of frequencies from one of the first or second transceivers for *each* of the first and second applications.

136. A POSITA would have further understood that, once bandwidth resources across the transceivers are allocated for each of the first and second application, Chincholi would prepare the first and second data streams, including by segmenting the data, mapping the data streams to the allocated resources, and applying modulation, encoding, and physical layer processing for transmission.

137. Finally, Chincholi discloses that this selection, preparation, and transmission of the two data streams is performed by the OMMA layer in a manner transparent to higher layers: "[t]he OMMA layer ***may be transparent***, in that it distributes and/or combines packets from different RATs and forwards the packets to the IP layer." (EX1005 at [0192], [0126].)

c) *(ii) cause the prepared first and second data streams to be simultaneously transmitted from the selected wireless transceivers to thereby at least partially satisfy the first and second wireless bandwidth requirements of the first and second applications.*

138. In my opinion, Chincholi/Riggert discloses this limitation. Chincholi discloses the use of buffers at the MAC layer of each transceiver to independently queue data streams from multiple IP flows. (EX1005 at [0352].) Further, as discussed above, Chincholi discloses that each transceiver may operate in an OFDMA fashion, with different portions of their bandwidth availability allocated

for separate, independent transmissions. (EX1005 at [0161]; Table 2.) A POSITA would have recognized that Chincholi's OFDMA techniques can enable each transceiver to simultaneously transmit IP packets from multiple IP flows.

139. Additionally, Chincholi discloses preparing and transmitting a data stream across multiple transceivers simultaneously, for example in a multiplexing mode. (EX1005 at [0152].) Chincholi further discloses the use of feedback metrics for optimizing distribution of packets across multiple transceivers in a multi-IP flow (QoS) case. (EX1005 at [0353]-[0356].)

140. From the foregoing disclosures, a POSITA would have understood that Chincholi discloses the capability to prepare and transmit both first and second data streams for simultaneous transmission to the recipient from selected wireless transceivers using specific subsets of frequencies corresponding to the identified portions of their available bandwidth, to thereby at least partially satisfy the bandwidth requirements of both applications.

3. Claim 3: The method of claim 2,

a) *3[a]: wherein, if the identified at least one portion of the bandwidth of the first wireless transceiver becomes unavailable during use of the wireless networking device or if it has an unidentified portion of bandwidth availability that is greater than its identified at least one portion of bandwidth availability during use of the wireless networking device, the processing interface is configured to, as a result of the unavailability or the increased bandwidth availability and in a manner transparent to any layer of the wireless networking device above the processing interface, (i) identify at least one new portion of the bandwidth of the first wireless transceiver that is available for communication and then select that wireless transceiver,*

141. In my opinion, Chincholi/Riggert discloses the limitations of claim 3. Chincholi teaches that the OMMA layer continuously monitors the availability and quality of bandwidth for each transceiver. Chincholi explains that the OMMA layer may "continuously update . . . the available RAT capability of a device . . . based on feedback metrics from each RAT." (EX1005 at [0235].) These feedback metrics include both channel quality and the number of available resources on the medium. (EX1005 at [0161].)

142. Chincholi further discloses that the OMMA layer may dynamically select a new bandwidth portion of the first transceiver upon the originally identified bandwidth portion becoming unavailable or a new portion with greater bandwidth availability becoming available. Chincholi discloses that for a given data stream, its

MAC Resource Reservation module "may determine an amount of time duration and/or spectral fragment/bandwidth required by ***a packet or a set of packets***." (EX1005 at [0142].) In other words, a POSITA would have understood that Chincholi discloses the capability to reserve a new spectral fragment for a given data stream in response to changes in bandwidth availability, and thus discloses identifying at least one new portion of bandwidth of the first transceiver, as claimed.

143. Chincholi discloses that this selection, preparation, and transmission of the two data streams is performed by the OMMA layer in a manner transparent to higher layers: "[t]he OMMA layer ***may be transparent***, in that it distributes and/or combines packets from different RATs and forwards the packets to the IP layer." (EX1005 at [0192], [0126].) It is my opinion that a POSITA would have understood that the plain meaning of resource "unavailability" in the context of the '337 patent broadly includes resources that are partially or completely unavailable or that have less bandwidth availability than another resource. This is consistent with the applicant's use of the term during prosecution of the prior related '591 patent, where in arguing patentability to overcome a prior art rejection, the applicant expressly stated that "[i]t is applicant's intention that these words ["unavailable" and "unavailability"] refer to, for example, a partial or complete loss of certain transceiver resources as well as a situation where a different band than the one

currently in use provides more bandwidth available for transmission." (EX1017, Aug. 8, 2023 Applicant Remarks.)

b) *3[b]: (ii) prepare the first and second data streams, without requiring the disassociation of the recipient from the actual MAC and PHY interfaces associated with any wireless transceiver, for transmission to the recipient from the first wireless transceiver using a specific subset of frequencies corresponding to its newly identified at least one portion of available bandwidth, and*

144. In my opinion, Chincholi/Riggert discloses this limitation. After selecting a new bandwidth portion, Chincholi discloses that the OMMA layer's processor may prepare both first and second data streams for transmission using a specific subset of frequencies corresponding to the newly identified portion of the available bandwidth. As discussed above, *see* limitation 2[b], a POSITA would have understood that in the multi-IP flow scenario, Chincholi's MAC Resource Reservation module would reserve a specific subset of frequencies from the selected transceiver for *each* of the first and second applications. Again, preparing the data streams includes segmenting the data, mapping the data streams to the allocated resources, and applying modulation, encoding, and physical layer processing for transmission.

145. Additionally, for the reasons discussed above, *see* limitation 1[k] Chincholi does not "require" disassociation of recipient WTRUs from actual MAC and PHY interfaces of any wireless transceiver during operation, including during

preparation of first and second data streams for transmission using a newly identified bandwidth portion. A POSITA would have recognized that it would be desirable to avoid disassociation of recipients from the actual MAC and PHY interfaces of any wireless transceiver during operation including throughout any process of reallocating transceiver, channel, and/or bandwidth resources to a recipient.

c) *3[c]: (iii) cause the prepared first and second data streams to be transmitted to the recipient from the first transceiver, without requiring the disassociation of the recipient from the actual MAC and PHY interfaces of any wireless transceiver, to thereby continue to at least partially satisfy the first and second wireless bandwidth requirements of the first and second applications.*

146. In my opinion, Chincholi/Riggert discloses this limitation. As discussed above, *see* limitation 2[c], Chincholi discloses that prepared first and second data streams are transmitted to the recipient from a selected transceiver using the bandwidth resources reserved by the MAC Resource Reservation Module, thereby continuing to at least partially satisfy both applications' bandwidth requirements. (EX1005 at [0194].) As discussed above, *see* limitation 3[b], Chincholi does not require disassociation of the recipient from the actual MAC and PHY interfaces of any wireless transceiver during its reallocation of transceiver, bandwidth, or channel operations.

4. Claim 4: The method of claim 3,

a) *wherein, if the identified at least one portion of the bandwidth of the second wireless transceiver becomes unavailable during use of the wireless networking device or if it has an unidentified portion of bandwidth availability that is greater than its identified at least one portion of bandwidth availability during use of the wireless networking device, the processing interface is configured to, as a result of the unavailability or the increased bandwidth availability and in a manner transparent to any layer of the wireless networking device above the processing interface, (i) identify at least one new portion of the bandwidth of the second wireless transceiver that is available for communication and then select that wireless transceiver,*

147. In my opinion, Chincholi/Riggert discloses the limitations of claim 4. Just as Chincholi discloses the ability to dynamically identify a new bandwidth portion of the first transceiver in response to changes in availability, *see* limitation 3[a], a POSITA would have understood that Chincholi also discloses this capability with respect to the second wireless transceiver.

b) *(ii) prepare the first and second data streams, without requiring the disassociation of the recipient from the actual MAC and PHY interfaces associated with any wireless transceiver, for transmission to the recipient from the second wireless transceiver using a specific subset of frequencies corresponding to its newly identified at least one portion of available bandwidth, and*

148. In my opinion, Chincholi/Riggert discloses this limitation. Just as Chincholi discloses the ability to prepare the first and second data streams, without

requiring disassociation of the recipient, for transmission using frequencies of the newly identified bandwidth portion, *see* limitation 3[b], a POSITA would have understood that Chincholi also discloses this capability with respect to the second wireless transceiver.

c) *(iii) cause the prepared first and second data streams to be transmitted to the recipient from the second transceiver, without requiring the disassociation of the recipient from the actual MAC and PHY interfaces of any wireless transceiver, to thereby continue to at least partially satisfy the first and second wireless bandwidth requirements of the first and second applications.*

149. In my opinion, Chincholi/Riggert discloses this limitation. Just as Chincholi discloses the ability to cause the first and second data streams to be transmitted to the recipient from the first transceiver, without requiring disassociation of the recipient, *see* limitation 3[c], a POSITA would have understood that Chincholi also discloses this capability with respect to the second wireless transceiver.

5. Claim 5: The method of claim 4,

a) *wherein the processing interface is configured to, when the wireless networking device is being used, in a manner transparent to any layer of the wireless networking device above the processing interface, evaluate the identified bandwidth availabilities of the first and second wireless transceivers with respect to the first and second bandwidth requirements of the first and second applications; and*

150. In my opinion, Chincholi/Riggert discloses the limitations of claim 5. As discussed above, *see* claim 2, Chincholi discloses that a "single IP flow may refer to a stream of IP packets belong[ing] to a particular application." (EX1005 at [0132].) Chincholi further discloses scenarios involving multiple WTRUs and multiple IP flows. (EX1005 at [0328].) For example, "[a] system may comprise multiple WTRUs, a single NT, and multiple IP flows from the NT to one or more WTRUs." (*Id.*)

151. Chincholi teaches the use of transmission buffers (Q_{ik}) to store data from multiple IP flows for each WTRU. (EX1005 at [0352].) The OMMA layer receives feedback metrics from each RAT, including bandwidth availability and channel quality metrics. (EX1005 at [0161], [0353]-[0356].) A POSITA would have understood that this allows the OMMA layer to evaluate the bandwidth availabilities of both transceivers with respect to the bandwidth requirements of both applications.

152. Finally, Chincholi discloses that this evaluation of bandwidth availabilities with respect to application requirements is performed by the OMMA

layer in a manner transparent to higher layers: "[t]he OMMA layer ***may be transparent***, in that it distributes and/or combines packets from different RATs and forwards the packets to the IP layer." (EX1005 at [0192], [0126].) Accordingly, a POSITA would have understood that Chincholi allows for evaluating the bandwidth availabilities of multiple transceivers for multiple applications in a manner that is transparent to higher level layers.

> **b)** *wherein, if, during operation of the wireless networking device, the first and second bandwidth requirements of the first and second applications are at least partially satisfied by the bandwidth availability of the selected transceiver, preparing the first and second data streams for simultaneous transmission to the recipient from both of the first and second wireless transceivers using a specific subset of frequencies corresponding to the identified at least one portion of their available bandwidth and causing the prepared first data stream to be transmitted from the first and second wireless transceivers to thereby at least partially satisfy the first and second wireless bandwidth requirements of the first and second applications.*

153. In my opinion, Chincholi/Riggert discloses this limitation. Chincholi discloses that if sufficient bandwidth is available across both transceivers, the OMMA layer may prepare the first and second data streams for simultaneous transmission using subsets of the available frequencies. For example, Chincholi's MAC Resource Reservation module "may determine an amount of time duration and/or spectral fragment/bandwidth required by a packet or a set of packets" for transmission. (EX1005 at [0142].) A POSITA would have understood that preparing

the data streams includes segmenting the data, mapping each stream to allocated bandwidth resources, applying modulation and coding, and generating the signals for physical transmission.

154. Further, Chincholi discloses that the RATs may operate using OFDMA, allowing available bandwidth to be divided into separate, non-overlapping subcarriers for simultaneous transmission of different data streams without interference. (EX1005 at [0161], Table 2.) A POSITA would have understood that Chincholi's OFDMA-based transmission allows simultaneous use of bandwidth portions on both transceivers to transmit data streams from both applications.

155. Chincholi also discloses multiplexing modes where data streams may be distributed across RATs based on link quality and bandwidth availability. (EX1005 at [0152], [0353]-[0356].) From these disclosures, a POSITA would have recognized that Chincholi discloses preparing and transmitting both first and second data streams for simultaneous transmission from both transceivers using subsets of their available bandwidth, thereby at least partially satisfying both bandwidth requirements.

6. Claim 6: The method of claim 4, further comprising the steps of:

a) *connecting a third actual MAC interface to the processing interface; connecting a third actual PHY interface to the third actual MAC interface; associating a third wireless transceiver with the third actual PHY interface, wherein the third wireless transceiver (i) is suitable for use in a wireless local area network, (ii) has a third bandwidth availability up to a third actual bandwidth, and (iii) is adapted to emit radio waves in a third band of frequencies;*

156. In my opinion, Chincholi/Riggert discloses the limitations of claim 6. Chincholi discloses multi-RAT aggregation that may include any number of RATs comprising an actual MAC interface, actual PHY interface, and transceivers. Chincholi teaches a "multi-RAT aggregation" in Figure 4, which includes any number (up to "n") RATs operating on potentially different frequency bands (e.g., 2.4 GHz, 5 GHz, TVWS, LTE bands, etc.). (EX1005 at [0132]–[0135]; Figs. 4 and 5.) In an 802.11 system, each RAT shown in Figure 4 would correspond to an actual MAC-PHY pair, thus disclosing first, second and third actual PHY interfaces connected to first, second, and third actual MAC interfaces. (EX1005 at [0135].)

157. In its disclosed implementations of an 802.11 device, Chincholi discloses that its OMMA layer connects to the actual MAC and PHY interfaces of each RAT and receives bandwidth feedback metrics from each transceiver. (EX1005 at [0138], [0205]; Fig. 28.) Thus, Chincholi contemplates that the addition of a third transceiver to an 802.11 enabled device would entail connecting a third actual MAC

to the processing interface, a third actual PHY interface to the third actual MAC interface, and the third transceiver to the third actual PHY interface.

158. An additional third transceiver would be suitable for use in a wireless local area network, have a fourth bandwidth availability up to a third actual bandwidth, and would be adapted to emit radio waves in a third band of frequencies.

b) *forming in the processing interface a third virtual PHY interface that is configured to, during operation of the wireless networking device, feed information regarding the bandwidth availability of the third wireless transceiver back to the at least one virtual MAC interface;*

159. In my opinion, Chincholi/Riggert discloses this limitation. As discussed above, *see* limitation 1[e], a POSITA would have understood from Riggert that virtual PHY interfaces may be implemented to provide a logical abstraction layer between the OMMA layer and the actual MAC and PHY interfaces for each RAT. A POSITA would have understood that the addition of a third RAT/transceiver could entail the additional of a third virtualized interface (a "virtual PHY") to accommodate its interface to the OMMA layer.

160. A POSITA would have further understood that Chincholi's OMMA architecture readily extends to adding a third transceiver in an 802.11 wireless network by adding third actual MAC and PHY interfaces and forming a corresponding virtual PHY interface to collect and manage feedback metrics for the third transceiver.

c) *wherein the processing interface is configured to, when the wireless networking device is being used in a manner transparent to any layer of the wireless networking device above the processing interface, request or create a third association between the recipient and the third actual MAC and PHY interfaces;*

161. In my opinion, Chincholi/Riggert discloses this limitation. Chincholi describes modifying association request/response frames to include OMMA-specific discovery parameters (EX1005 at [0127].) A POSITA would have understood that, by incorporating a third RAT/transceiver into the system of Chincholi, the system would have the capability to create a corresponding association between the recipient and the actual MAC and PHY interfaces for the third transceiver.

162. Chincholi discloses that the creation of associations between the actual MAC and PHY interfaces and a recipient is performed by the OMMA layer in a manner transparent to higher layers: "[t]he OMMA layer ***may be transparent***, in that it distributes and/or combines packets from different RATs and forwards the packets to the IP layer." (EX1005 at [0192], [0126].) Accordingly, a POSITA would have understood that Chincholi allows for forming associations between actual MAC/PHY pair and a recipient in a manner transparent to higher layers.

d) *wherein the selected transceiver comprises one of the first, second and third wireless transceivers and the unselected transceivers comprise the remaining two transceivers of the first, second and third transceivers;*

163. In my opinion, Chincholi/Riggert discloses this limitation. A POSITA would have further recognized that Chincholi's multi-RAT capabilities, such as continuously monitoring bandwidth availability and selecting amongst RATs based on their bandwidth availability, (EX1005 at [0235], [0154], [0161], [0235]), could be readily extended to accommodate a three-transceiver system in which the system would select between one of three transceivers and the unselected transceiver would comprise the remaining two transceivers. The OMMA architecture readily accommodates these additional RATs through its layered structure. (EX1005 at [0138], [0205]; Fig. 28.)

e) *wherein, if one of the unselected wireless transceivers has more bandwidth availability than the selected transceiver during use of the wireless networking device, the processing interface is adapted to, as a result of the increased bandwidth availability and in a manner transparent to any layer of the wireless networking device above the processing interface, (i) identify at least one portion of the bandwidth of at least of the one of the unselected wireless transceivers that has more bandwidth availability than the selected transceiver and select that new transceiver,*

164. In my opinion, Chincholi/Riggert discloses this limitation. As discussed above, *see* limitation 1[i], Chincholi teaches that the OMMA layer dynamically monitors bandwidth availability and may select a transceiver with greater bandwidth

availability as conditions change. A POSITA would recognize that Chincholi's disclosure of dynamically selecting between transceivers based on bandwidth availability extends to a three RAT/transceiver device.

165. Applicable to a three RAT/transceiver implementation, Chincholi discloses that the processing interface (i.e., the OMMA layer) is adapted to select an unselected transceiver if its bandwidth availability exceeds that of the selected transceiver. Chincholi teaches that "[a]s the channel quality/availability of RATs 1301a, 1301b changes, the best RAT may be selected which may be different from the one previously used." (EX1005 at [0154].) A POSITA would have understood that this includes situations where bandwidth availability (i.e., the amount of available spectrum or channel resources on a RAT) increases relative to the previously selected transceiver, prompting the OMMA layer to switch and select the RAT with more bandwidth availability.

166. Finally, Chincholi discloses that this dynamic transceiver selection, preparation, and transmission is performed by the OMMA layer in a manner transparent to higher layers: "[t]he OMMA layer may be transparent, in that it distributes and/or combines packets from different RATs and forwards the packets to the IP layer." (EX1005 at [0192], [0126].) Accordingly, a POSITA would have understood that the OMMA's transparent routing of packets across RATs allows the

switching to occur without requiring disassociation and reassociation at the MAC/PHY level.

f) *(ii) prepare the first and second data streams, without requiring the disassociation of the recipient from the actual MAC and PHY interfaces of any wireless transceiver, for transmission to the recipient from the new transceiver using a specific subset of frequencies corresponding to its identified at least one portion of available bandwidth, and*

167. In my opinion, Chincholi/Riggert discloses this limitation. As discussed above, *see* limitation 1[k], Chincholi discloses that after a new transceiver is selected, the OMMA layer prepares the data stream for transmission to the recipient from the transceiver using a specific subset of frequencies corresponding to its identified at least one portion of available bandwidth. For example, Chincholi teaches that the MAC Resource Reservation module "may determine an amount of time duration and/or spectral fragment/bandwidth required by a packet or a set of packets." (EX1005 at [0142].) A POSITA would have understood that, once bandwidth and spectral fragments have been allocated, preparing the data stream for transmission further includes segmenting the data, mapping the data stream to the allocated bandwidth resources, applying appropriate modulation and coding schemes, and generating the physical-layer signals for transmission over the selected transceiver.

168. Additionally, for the same reasons discussed above, *see* limitation 1[k], Chincholi does not "require" disassociation of recipient WTRUs from actual MAC and PHY interfaces of any wireless transceiver during operation, including during preparation of the first data stream for transmission and transmission by a newly selected transceiver.

g) *(iv) cause the prepared first and second data streams to be transmitted to the recipient from the new transceiver, without requiring the disassociation of the recipient from the actual MAC and PHY interfaces of any wireless transceiver, to thereby continue to at least partially satisfy the first and second bandwidth requirements of the first and second applications; and*

169. In my opinion, Chincholi/Riggert discloses this limitation. Chincholi further discloses causing the prepared first data stream to be transmitted from the selected transceiver, thereby continuing to at least partially satisfy the application's bandwidth requirement. As Chincholi explains, "[u]sing multiple RATs simultaneously may provide increased bandwidth and/or increased reliability for an application." (EX1005 at [0194].)

170. As discussed above in the prior limitation, Chincholi does not require disassociation of the recipient from the actual MAC and PHY interfaces of any wireless transceiver during operation including throughout any process of reallocating transceiver, channel, and/or bandwidth resources to a recipient.

h) *wherein the wireless networking device's utilization of the available bandwidth of the first, second and third wireless transceivers does not prevent other wireless networking devices from utilizing a range of frequencies corresponding to the remaining portion of the bandwidth availability of the first, second and third wireless transceivers for data transmission purposes at the same time that processed data is being sent from one or more of the first, second and third wireless transceivers.*

171. In my opinion, Chincholi/Riggert discloses this limitation. As discussed above, *see* limitation 1[j], Chincholi discloses examples of "***multi-WTRU*** multi-IP flow cases." (EX1005 at [0328].) For example, "[a] system may comprise ***multiple WTRUs***, a single NT, and multiple IP flows from the NT to one or more WTRUs." (EX1005 at [0328].) Chincholi discloses OFDMA techniques that allow multiple wireless devices to simultaneously utilize different portions of available bandwidth across the RATs. (EX1005 at [0161]; Table 2.)

7. Claim 7: The method of claim 6, wherein the at least one portion of the third bandwidth of the first transceiver comprises a single portion.

172. In my opinion, Chincholi/Riggert discloses the limitations of claim 7. Chincholi discloses that a "NT and WTRU may communicate with each other over a single radio frequency (RF) spectral band, for example, 2.4GHz ISM band, or 5GHz ISM band, or TVWS band or 60GHz band, using ***a channel within the band*** or aggregating multiple contiguous or noncontiguous channels." (EX1005 at [0118].) A POSITA would have understood that each "channel" within Chincholi is

a "single portion" and where Chincholi identifies a single channel within the bandwidth of a transceiver, that portion comprises a single portion.

8. Claim 8: The method of claim 6, wherein the at least one portion of the third bandwidth of the third transceiver is contiguous.

173. In my opinion, Chincholi/Riggert discloses the limitations of claim 8. Chincholi discloses that a "NT and WTRU may communicate with each other over a single radio frequency (RF) spectral band, for example, 2.4GHz ISM band, or 5GHz ISM band, or TVWS band or 60GHz band, using a channel within the band ***or aggregating multiple contiguous or noncontiguous channels***." (EX1005 at [0118].) A POSITA would have understood that where Chincholi identifies multiple contiguous channels within the bandwidth of a transceiver as the at least one portion, that portion is contiguous.

9. Claim 9: The method of claim 6, wherein the third virtual PHY interface is not contiguous with the virtual MAC interface.

174. In my opinion, Chincholi/Riggert discloses or renders obvious the limitations of claim 9. As discussed above, *see* limitation 1[e], the Chincholi/Riggert combination renders obvious multiple virtual PHY interfaces in Chincholi's OMMA controller. Additionally, as discussed above, *see* limitation 1[e], the OMMA Scheduler comprises the "virtual MAC interface."

175. As shown in Figure 28, the OMMA Controller and the OMMA Scheduler are distinct modules that communicate via control flow interfaces. A POSITA would have understood that, as modified by Riggert's teachings, Chincholi's OMMA Controller comprises the virtual PHY interface, and the OMMA Scheduler comprises the virtual MAC interface. Accordingly, a POSITA would have understood that the third virtual PHY interface is not contiguous with the virtual MAC interface.

10. Claim 10: The method of claim 6 further comprising the step of coupling first and second buffer memories respectively to the first and second actual PHY layers, the first and second buffer memories being configured to, during use of the wireless networking device, store data prior to its actual transmission to the recipient via the first and second actual PHY layers, the capacity of the first and second buffer memories being programmable.

176. In my opinion, Chincholi/Riggert discloses the limitations of claim 10. Chincholi teaches that the MAC layer of each RAT may implement multiple transmission buffers, denoted Q_{ik}, which store data destined for WTRU *i* for IP flow *k* (or access category *k*). (EX1005 at [0352].) Because multiple transmission queues are implemented to handle multiple WTRUs and multiple IP flows, each queue Q_{ik} operates independently for the corresponding WTRU and flow. (*Id.*)

177. A POSITA would have understood that these buffers store data prior to its actual transmission via the PHY layer, as data processed by the MAC queues is passed to the PHY interface for physical layer transmission. A POSITA would have

further understood that the buffer memories would be coupled to the respective PHY interfaces to hold data prior to modulation and radio transmission.

178. A POSITA also would have understood that such buffers may be implemented using hardware or software memory resources, including programmable registers or dynamically allocated memory, to support varying queue capacities based on system needs, application demands, or QoS requirements.

11. Claim 11: The method of claim 10, wherein each of the first and second buffer memories comprises a programmable register.

179. In my opinion, Chincholi/Riggert discloses the limitations of claim 11. As discussed above, *see* claim 10, Chincholi teaches that data is queued prior to transmission using transmission buffers Q_{ik} for each WTRU and IP flow. (EX1005 at [0352].)

180. A POSITA would have understood that such transmission buffers may be implemented in hardware or software, and that a common way to configure or control the capacity, address pointers, and storage management for such buffers is by using programmable registers or register-based control structures. Thus, a POSITA would have recognized that Chincholi discloses or renders obvious the use of programmable registers to manage the buffer memories.

12. Claim 12: The method of claim 10, further comprising the steps of:

a) *connecting a fourth actual MAC interface to the processing interface; connecting a fourth actual PHY interface to the fourth actual MAC interface; associating a fourth wireless transceiver with the actual PHY interface, wherein the fourth wireless transceiver (i) is suitable for use in a wireless local area network, (ii) has a fourth bandwidth availability up to a fourth actual bandwidth, and (iii) is adapted to emit radio waves in a fourth band of frequencies; and*

181. In my opinion, Chincholi/Riggert discloses or renders obvious the limitations of claim 12. As discussed above in Claim 6, Chincholi discloses multi-RAT aggregation that may include any number of RATs comprising an actual MAC interface, actual PHY interface, and transceivers. Chincholi teaches a "multi-RAT aggregation" in Figure 4, which includes any number (up to "n") RATs operating on potentially different frequency bands (e.g., 2.4 GHz, 5 GHz, TVWS, LTE bands, etc.). (EX1005 at [0132]–[0135]; Figs. 4 and 5.)

182. In its disclosed implementations of an 802.11 device, Chincholi discloses that its OMMA layer connects to the actual MAC and PHY interfaces of each RAT and receives bandwidth feedback metrics from each transceiver. (EX1005 at [0138], [0205]; Fig. 28.) Thus, Chincholi contemplates that the addition of a fourth transceiver to an 802.11 enabled device would entail connecting a fourth actual MAC to the processing interface, a fourth actual PHY interface to the fourth actual MAC interface, and the fourth transceiver to the fourth actual PHY interface. An

additional fourth transceiver would be suitable for use in a wireless local area network, have a fourth bandwidth availability up to a fourth actual bandwidth, and would be adapted to emit radio waves in a fourth band of frequencies.

> **b)** *forming in the processing interface a fourth virtual PHY interface that is configured to, during operation of the wireless networking device, feed information regarding the bandwidth availability of the fourth wireless transceiver back to the at least one virtual MAC interface.*

183. In my opinion, Chincholi/Riggert discloses or renders this limitation obvious. As discussed above in limitation 1[e], a POSITA would have understood from Riggert that virtual PHY interfaces may be implemented to provide a logical abstraction layer between the OMMA layer and the actual MAC and PHY interfaces for each RAT.

184. Additionally, as discussed above, *see* limitation 1[e], a POSITA would have understood from Riggert that virtual PHY interfaces may be implemented to provide a logical abstraction layer between the OMMA layer and the actual MAC and PHY interfaces for each RAT. A POSITA would have understood that the addition of a fourth RAT/transceiver could entail the additional of a fourth virtualized interface (a "virtual PHY") to accommodate its interface to the OMMA layer.

185. A POSITA would have further understood that Chincholi's OMMA architecture readily extends to adding a fourth transceiver in an 802.11 wireless

network by adding fourth actual MAC and PHY interfaces and forming a corresponding fourth virtual PHY interface to collect and manage feedback metrics for the newly added fourth transceiver.

13. **Claim 13: The method of claim 12, wherein the processing interface is configured to, when the wireless networking device is being used in a manner transparent to any layer of the wireless networking device above the processing interface, request or create a fourth association between the recipient and the fourth actual MAC and PHY interfaces; and wherein the selected transceiver comprises one of the first, second, third and fourth wireless transceivers and the unselected transceivers comprise the remaining three transceivers of the first, second, third and fourth transceivers.**

186. In my opinion, Chincholi/Riggert discloses the limitations of claim 13. As discussed above, *see* claim 12, Chincholi teaches that its OMMA layer enables multi-RAT aggregation, where multiple transceivers operate simultaneously on potentially different frequency bands. (EX1005 at [0132]–[0135]; Fig. 4.) Further, Chincholi describes modifying association request/response frames to include OMMA-specific discovery parameters (EX1005 at [0127].) A POSITA would have understood that, by incorporating a fourth RAT/transceiver into the system of Chincholi, the system would have the capability to create a corresponding association between the recipient and the actual MAC and PHY interfaces for the fourth transceiver.

187. Chincholi discloses that the creation of associations between the actual MAC and PHY interfaces and a recipient is performed by the OMMA layer in a manner transparent to higher layers: "[t]he OMMA layer ***may be transparent***, in that it distributes and/or combines packets from different RATs and forwards the packets to the IP layer." (EX1005 at [0192], [0126].) Accordingly, a POSITA would have understood that Chincholi allows for forming associations between actual MAC/PHY pair and a recipient in a manner transparent to higher layers.

188. A POSITA would have further recognized that Chincholi's multi-RAT capabilities, such as continuously monitoring bandwidth availability and selecting amongst RATs based on their bandwidth availability, (EX1005 at [0235], [0154], [0161], [0235]), could be readily extended to accommodate a four-transceiver system in which the system would select between one of four transceivers and the unselected transceiver would comprise the remaining three transceivers. The OMMA architecture readily accommodates these additional RATs through its layered structure. (EX1005 at [0138], [0205]; Fig. 28.)

14. Claim 14: The method of claim 12, wherein the fourth virtual PHY interface is not contiguous with the virtual MAC interface.

189. In my opinion, Chincholi/Riggert discloses or renders obvious the limitations of claim 14. As discussed above, *see* limitation 1[e] and claim 9, Riggert teaches virtual PHY interfaces that are implemented separately from the virtual

MAC interface, and Chincholi discloses that the OMMA Controller and virtual MAC function are implemented in separate modules that communicate via control interfaces. (EX1005, Fig. 28; see also [0201], [0205]; EX1006.) A POSITA would have understood that the fourth virtual PHY interface likewise would not be contiguous with the virtual MAC interface.

15. Claim 15: The method of claim 1, wherein the wireless networking device comprises a wireless access point.

190. In my opinion, Chincholi/Riggert discloses the limitations of claim 15. Chincholi teaches wireless communication between a network terminal (NT) and a wireless transmit/receive unit (WTRU). (EX1005 at [0002].) An example of a NT is an "***access point***" (AP). (*Id.*) Indeed, Chincholi discloses that a node of its wireless communication network may include a "***WiFi access point***." (EX1005 at [0115].)

16. Claim 16: The method of claim 1, wherein the wireless networking device comprises a handheld computing device.

191. In my opinion, Chincholi/Riggert discloses the limitations of claim 16. The OMMA layer of Chincholi may be implemented in both the NTs and the WTRUs. (EX1005 at [0122].) Specifically, in "an IEEE 802.11 based Wi-Fi system, the NT ***and/or a WTRU*** may be configured to work in the infrastructure mode of the adhoc mode." (Ex. 1005 at [0121].) Thus, Chincholi's NTs and WTRUs may each comprise the wireless networking device of claim 1.

192. Chincholi discloses that the WTRUs of its wireless communication networks may comprise any one of a "user equipment (UE), a mobile station, a fixed or mobile subscriber unit, a ***pager***, a ***cellular telephone***, a ***personal digital assistant (PDA)***, a ***smartphone***, a laptop, a netbook, a personal computer, a wireless sensor, consumer electronics, and the like." (EX1005 at [0074].) Thus, a POSITA would have recognized that Chincholi discloses that the wireless networking device of claim 1 comprises a handheld computing device.

17. Claim 17: The method of claim 1, wherein each one of the first and second frequency bands are specified in at least one member of the family of IEEE 802.11 standards.

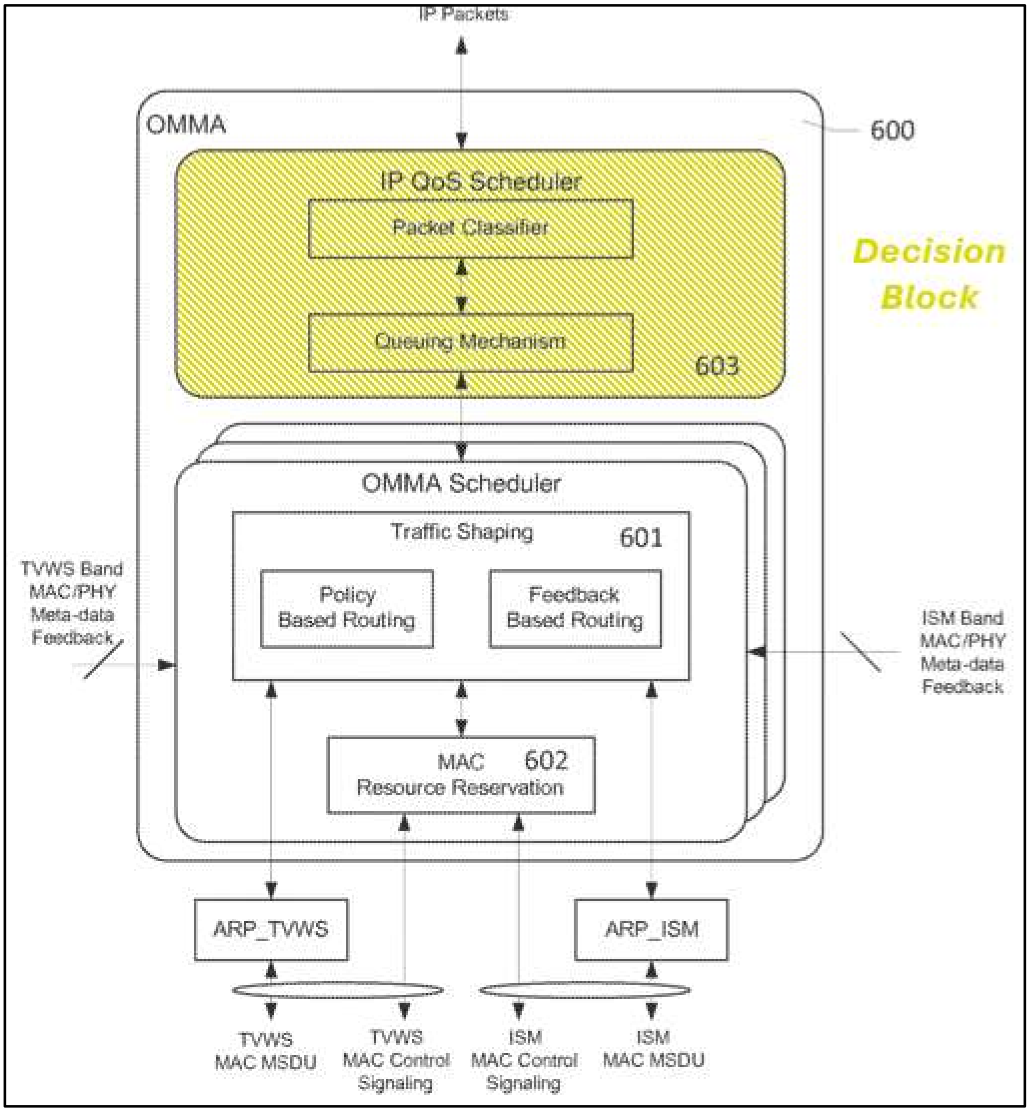
193. In my opinion, Chincholi/Riggert discloses the limitations of claim 17. Chincholi teaches that its techniques can be used to implement an IEE 802.11 based Wi-Fi system. (EX1005 at [0121].) Thus, "[t]he NT 201 may operate using one flavor of the 802.11 system (*e.g.*, 11a/b/g/n) at any given time over a specific band (*e.g.*, 2.4GHz or 5GHz) when communicating with a WTRU." (EX1005 at [0121].)

18. Claim 18: The method of claim 17, wherein the at least one member of the family of IEEE 802.11 standards was in existence as of Oct. 30, 2013.

194. In my opinion, Chincholi/Riggert discloses the limitations of claim 18. Chincholi was filed on February 24, 2013 and published on August 29, 2013. Moreover, a POSITA would have recognized that the 802.11 standards expressly disclosed ("11a/b/g/n") were in existence as of October 30, 2013.

19. Claim 19: The method of claim 1, wherein the virtual MAC interface includes a decision block.

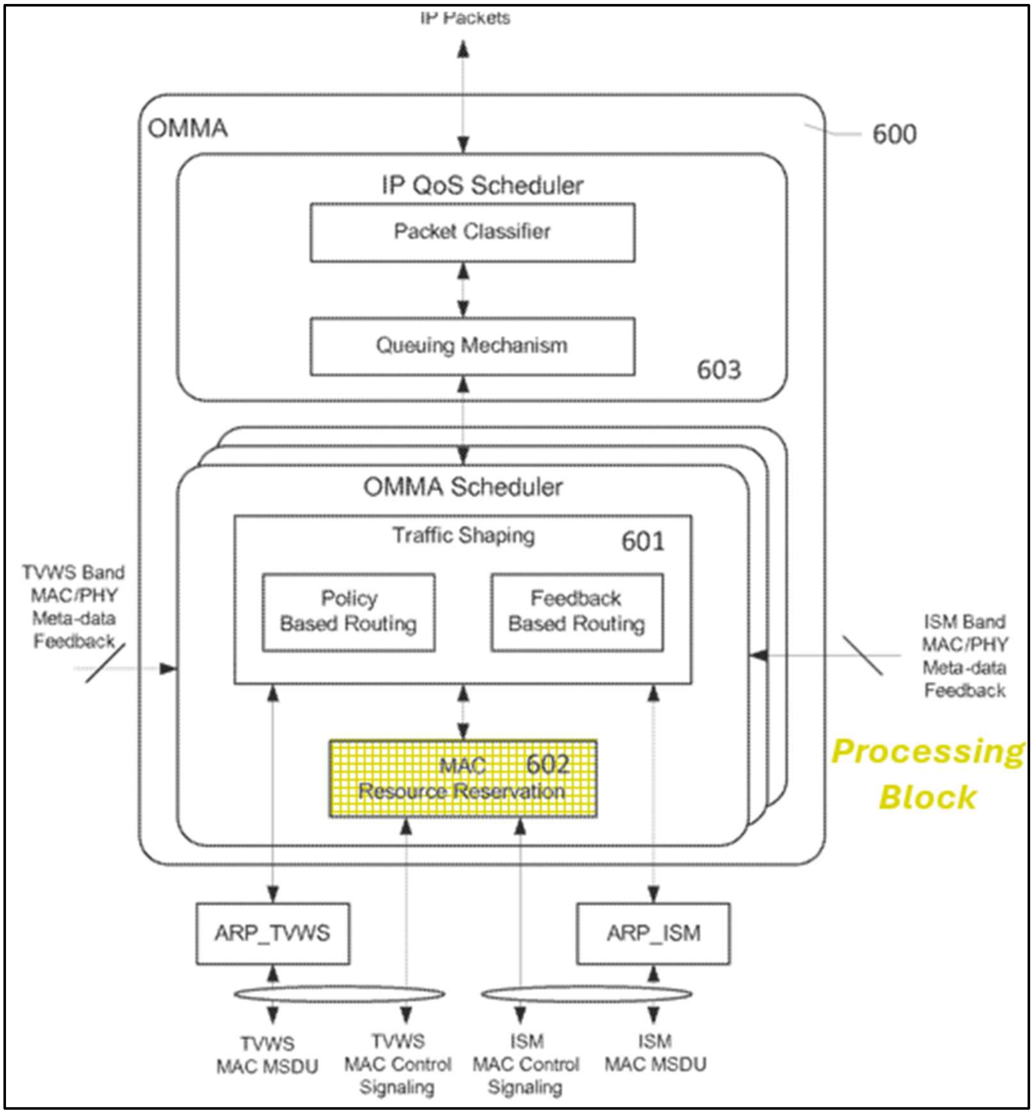
195. In my opinion, Chincholi/Riggert discloses the limitations of claim 19. The ’337 patent states that the claimed ***decision block*** “determines the size and type of data stream being received, and the type of processing necessary to put the stream in a format where it is capable of being transmitted.” (EX1001 at 3:21-24.) Chincholi discloses this same functionality in the form of the ***IP QoS Scheduler module 603***. As Chincholi teaches, “[t]he ***IP QoS Scheduler 603*** may segregate single IP packet stream comprising multiple IP QoS types into distinct IP QoS streams, for example, so that the traffic shaping module 601 may treat each IP QoS stream independently and satisfy the specific QoS requirements when routing IP packets.” (EX1005 at [0143].)



20. Claim 20: The method of claim 1, wherein the virtual MAC interface includes a processing block.

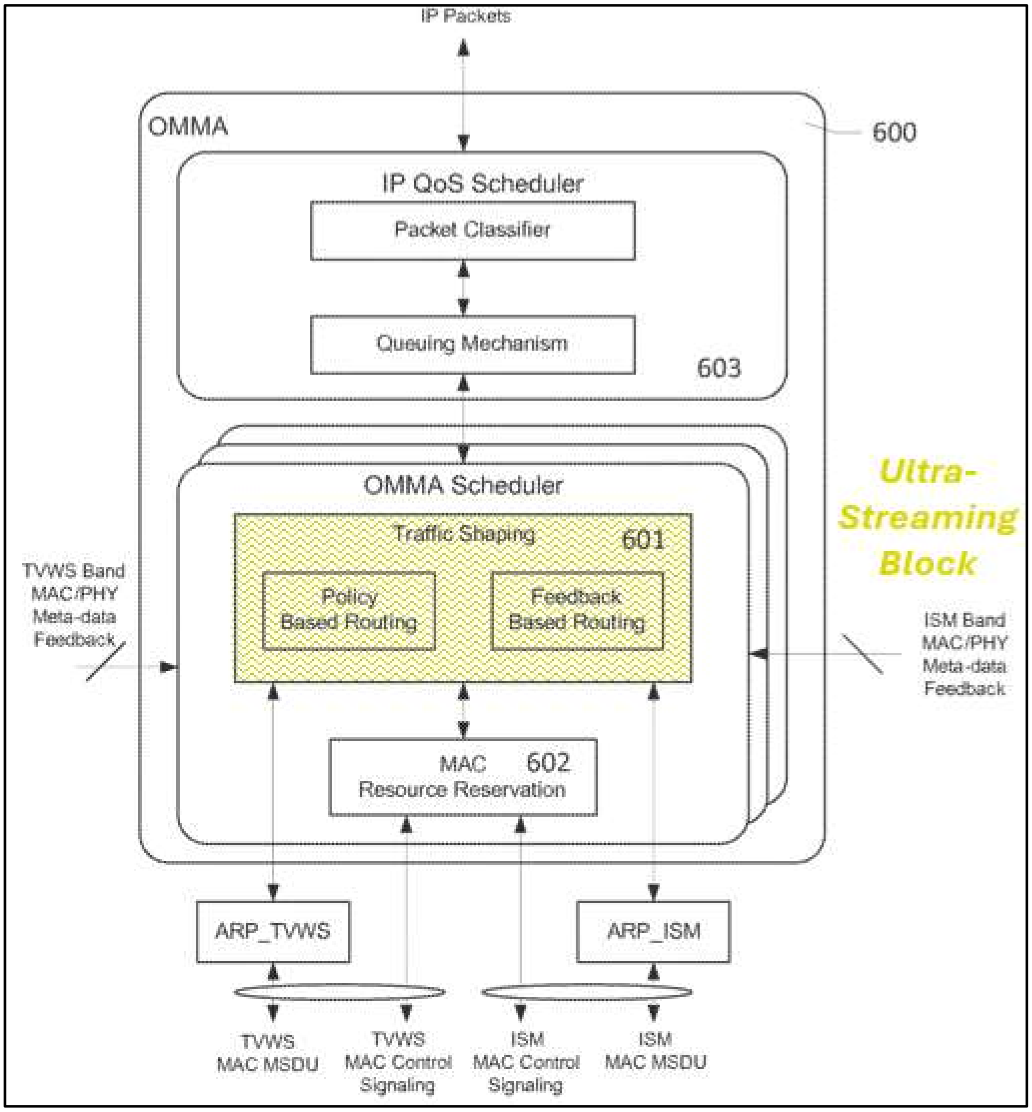
196. In my opinion, Chincholi/Riggert discloses the limitations of claim 20. The '337 patent states that the claimed ***processing block*** "processes the data stream as determined by the decision block, and couples to an ultra-streaming block." (EX1001 at 3:24-26.) Chincholi discloses this same functionality in the form of the ***MAC Resource Reservation module 602***. As Chincholi teaches, "[t]he ***MAC***

Resource Reservation module 602 may determine an amount of time duration and/or spectral fragment/bandwidth required by a packet or a set of packets. This module may transmit specific requests to the RATs over the A1/A2 interface." (EX1005 at [0142].)



21. Claim 21: The method of claim 1, wherein the virtual MAC interface includes an ultra-streaming block.

197. In my opinion, Chincholi/Riggert discloses the limitations of claim 21. The '337 patent states that the claimed ***ultra-streaming block*** "manages the processing of signal streams or sub-streams given the available resources (memory, processing speed number of available radios, etc.), and packetizes sufficient processed streams or sub-streams." (EX1001 at 3:26-30.) Chincholi discloses this same functionality in the form of the ***Traffic Shaping Module 601***. As Chincholi teaches, "[t]he ***traffic shaping module 601*** may [be] responsible for determining the way packets are routed across RATs. For example, the traffic shaping module may determine the way a packet is routed using policy based routing or feedback based routing." (EX1005 at [0139].)



22. Claim 22: The method of claim 1, wherein each of the virtual PHY interfaces includes an RF block.

198. In my opinion, Chincholi/Riggert discloses or renders obvious the limitations of claim 22. The '337 patent does not specifically define the functionality of the claimed "RF block." The patent teaches that the "the RF block" may "form[] a virtual PHY layer," (EX1001 at 8:26) and that a virtual PHY layer may comprise multiple RF blocks "denot[ing] the virtual use of two sets of allocated

transceiver resources." (EX1001 at 4:41-44.) The RF block may communicate with the ultra-streaming block "about actual resource availability" or alternatively may communicate directly with the virtual MAC decision block and/or processing block. (EX1001 at 4:44-50.) Thus, a POSITA would have understood the claimed "RF block" to merely be a component of a virtual PHY capable of receiving and reporting information about the availability of RF resources.

199. As discussed above, *see* limitation 1[e], Chincholi discloses that the OMMA Controller receives feedback metrics regarding resource availability from RATs over the "A2" interface. Also, as discussed, it would have been obvious in view of Riggert to implement virtual PHY interfaces in the OMMA Controller to receive this feedback information on a per RAT basis, and use those virtual PHY interfaces to provide the information about resource availability to Chincholi's "traffic shaping module" (*i.e.*, the "ultra-streaming" block). Thus, a POSITA would have recognized that the obvious Chincholi/Riggert combination discloses that each virtual PHY includes an RF block (*i.e.*, a component capable of receiving and reporting information about the availability of RF resources).

23. Claim 23: The method of claim 1, wherein the at least one portion of the first bandwidth of the first transceiver comprises a single portion.

200. In my opinion, Chincholi/Riggert discloses the limitations of claim 23. Chincholi discloses that a "NT and WTRU may communicate with each other over

a single radio frequency (RF) spectral band, for example, 2.4GHz ISM band, or 5GHz ISM band, or TVWS band or 60GHz band, using ***a channel within the band*** or aggregating multiple contiguous or noncontiguous channels." (EX1005 at [0118].) A POSITA would have understood that each "channel" within Chincholi is a "single portion" and where Chincholi identifies a single channel within the bandwidth of the first transceiver as the at least one portion of the first bandwidth, that portion comprises a single portion.

24. Claim 24: The method of claim 1, wherein the at least one portion of the first bandwidth of the first transceiver is contiguous.

201. In my opinion, Chincholi/Riggert discloses the limitations of claim 24. Chincholi discloses that a "NT and WTRU may communicate with each other over a single radio frequency (RF) spectral band, for example, 2.4GHz ISM band, or 5GHz ISM band, or TVWS band or 60GHz band, using a channel within the band ***or aggregating multiple contiguous or noncontiguous channels***." (EX1005 at [0118].). A POSITA would have understood that where Chincholi identifies multiple contiguous channels within the bandwidth of the first transceiver as the at least one portion of the first bandwidth, that portion is contiguous.

25. Claim 25: The method of claim 1, wherein the at least one portion of the second bandwidth of the second transceiver comprises a single portion.

202. In my opinion, Chincholi/Riggert discloses the limitations of claim 25. Chincholi discloses that a "NT and WTRU may communicate with each other over ***a single radio frequency (RF) spectral band***, for example, 2.4GHz ISM band, or 5GHz ISM band, or TVWS band or 60GHz band, using ***a channel within the band*** or aggregating multiple contiguous or noncontiguous channels." (EX1005 at [0118].). A POSITA would have understood that each "channel" within Chincholi is a "single portion" and where Chincholi identifies a single channel within the bandwidth of the second transceiver as the at least one portion of the second bandwidth, that portion comprises a single portion.

26. Claim 26: The method of claim 1, wherein the at least one portion of the second bandwidth of the second transceiver is contiguous.

203. In my opinion, Chincholi/Riggert discloses the limitations of claim 26. Chincholi discloses that a "NT and WTRU may communicate with each other over a single radio frequency (RF) spectral band, for example, 2.4GHz ISM band, or 5GHz ISM band, or TVWS band or 60GHz band, using a channel within the band ***or aggregating multiple contiguous or noncontiguous channels***." (EX1005 at [0118].). A POSITA would have understood that where Chincholi identifies

multiple contiguous channels within the bandwidth of the second transceiver as the at least one portion of the second bandwidth, that portion is contiguous.

27. Claim 27: The method of claim 1, wherein the first virtual PHY layer is not contiguous with the virtual MAC interface.

204. In my opinion, Chincholi/Riggert discloses or renders obvious the limitations of claim 27. As discussed above, *see* limitation 1[e], the Chincholi/Riggert combination renders obvious the implementation of multiple virtual PHY interfaces in Chincholi's OMMA controller. Additionally, as discussed above, *see* claim limitation 1[e], the OMMA Scheduler comprises the "virtual MAC interface."

205. As shown in Figure 28, the OMMA Controller and the OMMA Scheduler are distinct blocks that communicate via control flow interfaces. A POSITA would have understood from this disclosure that the first virtual PHY layer is not contiguous with the virtual MAC interface.

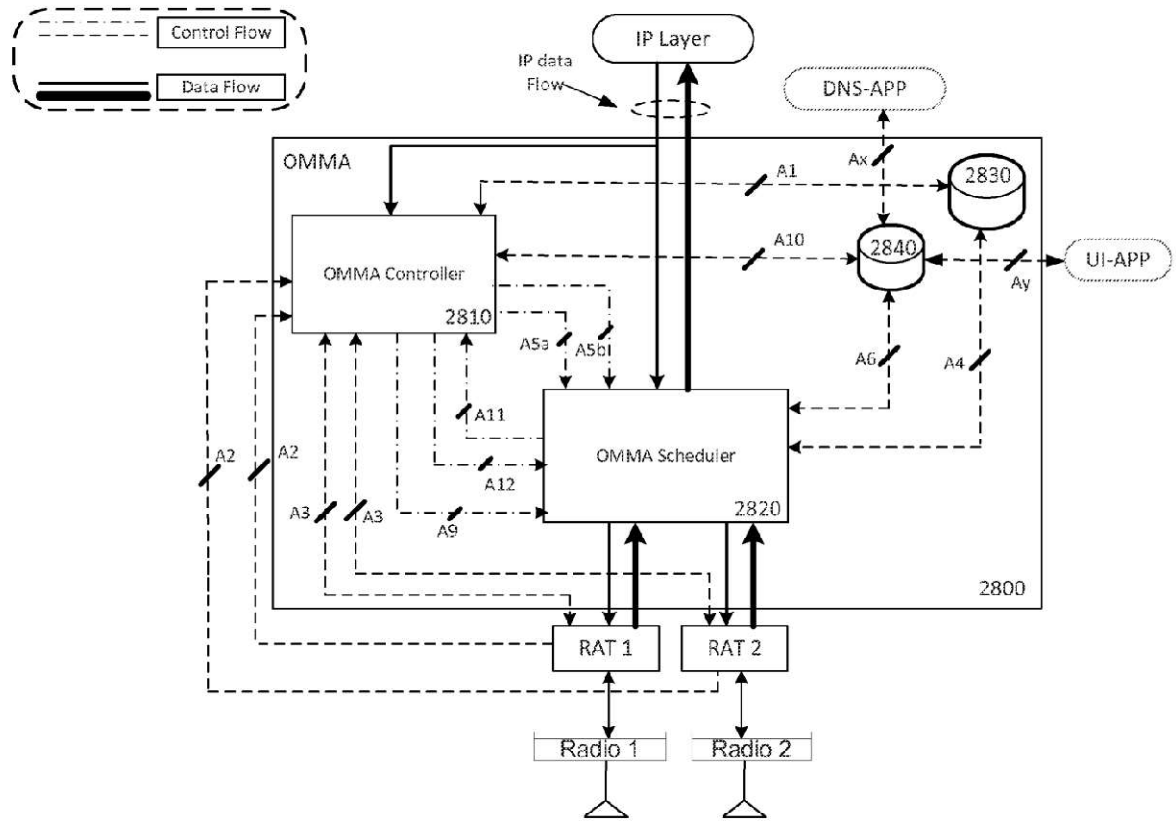


FIG. 28

28. Claim 28: The method of claim 1, wherein the second virtual PHY layer is not contiguous with the virtual MAC interface.

206. In my opinion, Chincholi/Riggert discloses or renders obvious the limitations of claim 28. As discussed above, *see* claim 27, Chincholi discloses that the virtual PHY interfaces in the OMMA Controller and the virtual MAC interface in the OMMA Scheduler are distinct blocks that communicate via control flow interfaces. A POSITA would have thus understood that the second virtual PHY layer is not contiguous with the virtual MAC interface.

29. Claim 29: The method of claim 1, wherein the processing interface comprises multiple virtual MAC interfaces.

207. In my opinion, Chincholi/Riggert discloses the limitations of claim 29. While Chincholi primarily discloses its OMMA layer in the context of a single NT communicating with WTRUs, Chincholi also discloses other wireless communication architectures involving multiple base stations in a radio access network (RAN) that communicate with wireless devices through a multiple input, multiple output (MIMO) architecture. (EX1005 at [0109].) This is disclosed, for example, in Figure 1E.

208. A POSITA would have recognized that each base station in Figure 1E would comprise its own OMMA layer (*i.e.*, virtual MAC interface). From these disclosures, a POSITA would have recognized that an obvious implementation would have been to combine the multiple virtual MAC interfaces of the system in Figure 1E into a single wireless communication device. Combining this functionality into a single device could, for example, leverage common hardware, increasing device efficiency.

30. Claim 30: The method of claim 1, wherein the processing interface includes a bandwidth allocator.

209. In my opinion, Chincholi/Riggert discloses the limitations of claim 30. The ’337 patent does not describe what additional specific functionality is performed by the claimed “bandwidth allocator.” A POSITA would have understood that a

bandwidth allocator refers to a processing layer that is capable of allocating the bandwidth availabilities of multiple transceivers to meet a bandwidth requirement of one or more data streams.

210. Chincholi discloses the functionality of the claimed "bandwidth allocator." Specifically, Chincholi teaches that "the traffic shaping module may determine how a packet is routed using policy based routing ***or feedback based routing***." (EX1005 at [0139].) In feedback based routing, "the OMMA transmitter may use measurement metrics fed back from each RAT," which include "channel quality metrics and the ***number of available resources on the medium***." (EX1005 at [0161].) Using this feedback mechanism, the "OMMA layer may intelligently manage data traffic across multiple RATs as a function of the link quality of each RAT." (EX1005 at [0194].) The OMMA layer also has the capability "to readjust the assigned medium resources to a WTRU on each RAT, for example, based on global knowledge of resource assignment on other RATs." (EX1005 at [0196].) Thus, the "OMMA layer may utilize MAC resource reservation to achieve ***globally optimal resource allocation across RATs***." (*Id.*)

211. From these disclosures, a POSITA would have recognized that Chincholi discloses a processing layer capable of allocating the bandwidth availabilities of multiple transceivers to meet a bandwidth requirement of one or more data streams. Chincholi thus discloses a bandwidth allocator as claimed.

VII. Conclusion

212. In signing this declaration, I recognize that the declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I also recognize that I may be subject to cross-examination in the case and that cross-examination will take place within the United States. If cross-examination is required of me, I will appear for cross-examination within the United States during the time allotted for cross-examination.

*   *   *

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

Respectfully submitted,

/s/ Kevin C. Almeroth

Date: July 3, 2025

Kevin C. Almeroth, Ph.D.