IN THE 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.

Case No. IPR2025-001204

U.S. Patent No. 11,818,591

PETITION FOR *INTER PARTES* REVIEW

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EXHIBIT LIST

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EX1001	U.S. Patent No. 11,818,591 ("the '591 patent")
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EX1004	File History of U.S. Patent No. 11,818,591
EX1005	WO 2013/126859 ("Chincholi")
EX1006	Published U.S. Patent Application 2011/0320625 ("Riggert")
EX1007	U.S. Patent Application 2009/0141691 ("Jain")
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LIST OF CHALLENGED CLAIMS

Claim	Limitation
1[pre]	A wireless networking device, comprising:
1[a]	an application interface connected 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, provides a first data stream and having a first wireless bandwidth requirement;
1[b]	first, second, and third actual MAC interfaces connected to the processing interface;
1[c]	first, second, and third actual PHY interfaces connected to the first, second, and third actual MAC interfaces;
1[d]	first, second, and third wireless transceivers respectively associated with the first, second, and third actual PHY interfaces, wherein each one of the first, second, and third wireless transceivers (i) is suitable for use in a wireless local area network, (ii) has a first, second, and third bandwidth availability up to a first, second, and third actual bandwidth, and (iii) is adapted to emit radio waves in first, second, and third different bands of frequencies, the second, and third frequency bands both being higher in frequency than the first frequency band;
1[e]	wherein the processing interface comprises (i) at least one virtual MAC interface and (ii) first, second, and third virtual PHY interfaces that, during operation of the wireless networking device, feed information regarding the bandwidth availabilities of the first, second, and third wireless transceivers back to the at least one virtual MAC interface;
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,
1[g]	(a) request or create (i) a first association between a recipient and the first actual MAC and PHY interfaces, (ii) a second association between the recipient and the second actual MAC and PHY interfaces and (iii) a third association between the recipient and the third actual MAC and PHY interfaces, and

Claim	Limitation
1[h]	(b) (i) identify at least one portion of each one of the first, second, and third bandwidths of the first, second, and third wireless transceivers that are available for communication, and
1[i]	(ii) evaluate the identified bandwidth availabilities of the first, second, and third wireless transceivers with respect to the first bandwidth requirement of the first application;
1[j]	wherein, if the first bandwidth requirement is at least partially satisfied by the bandwidth availabilities of a selected two transceivers of the first, second, and third wireless transceivers, preparing the first data stream for simultaneous transmission to the recipient from both the selected transceivers of the first, second, and third wireless transceivers using a specific subset of frequencies corresponding to the identified portions of their available bandwidth and causing the prepared first data to be transmitted from the selected two transceivers of the first, second, and third wireless transceivers to thereby at least partially satisfy the first wireless bandwidth requirement of the first application; and
1[k]	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 the selected one of the first, second, and third wireless transceivers.
2	The wireless networking device of claim 1, wherein the wireless networking device comprises a wireless access point.
3	The wireless networking device of claim 1, wherein the wireless networking device comprises a handheld computing device.
4	The wireless networking device of claim 1, wherein at least one of the first, second and third wireless frequency bands are specified in at least one member of the family of IEEE 802.11 standards.
5	The wireless networking device of claim 4, wherein the at least one member of the family of IEEE 802.11 standards was in existence as of Oct. 30, 2013.

Claim	Limitation
6	The wireless networking device of claim 1, wherein, if the first bandwidth requirement is not at least partially satisfied by the bandwidth availabilities of the selected transceivers of the first, second, and third wireless transceivers, preparing the first data stream for simultaneous transmission to the recipient from all of the first, second, and third wireless transceivers using a specific subset of frequencies corresponding to the identified portions of their available bandwidth and causing the prepared first data stream to be transmitted from the first, second, and third transceivers to thereby at least partially satisfy the first wireless bandwidth requirement of the first application.
7	The wireless networking device of claim 6, wherein, if the identified bandwidth of the first wireless transceiver becomes unavailable during use of the wireless networking device, the processing interface is adapted to, as a result of the unavailability and in a manner transparent to any layer of the wireless networking device above the processing interface, identify another at least one portion of the bandwidth of any of the first, second or third wireless transceivers and prepare the first data stream for transmission to the recipient additionally using a specific subset of frequencies corresponding to the newly identified at least one portion of bandwidth of any of the first, second or third wireless transceivers to thereby continue to at least partially satisfy the first wireless bandwidth requirement of the first application.
8	The wireless networking device of claim 7, wherein, if the identified bandwidth of the second wireless transceiver becomes unavailable during use of the wireless networking device, the processing interface is adapted to, as a result of the unavailability and in a manner transparent to any layer of the wireless networking device above the processing interface, identify another at least one portion of the bandwidth of any of the first, second or third wireless transceivers and prepare the first data stream for transmission to the recipient additionally using a specific subset of frequencies corresponding to the newly identified at least one portion of bandwidth of any of the first, second or third wireless transceivers to thereby continue to at least partially satisfy the first wireless bandwidth requirement of the first application.
9	The wireless networking device of claim 8, wherein, if the identified bandwidth of the third wireless transceiver becomes

Claim	Limitation
	unavailable during use of the wireless networking device, the processing interface is adapted to, as a result of the unavailability and in a manner transparent to any layer of the wireless networking device above the processing interface, identify another at least one portion of the bandwidth of any of the first, second or third wireless transceivers and prepare the first data stream for transmission to the recipient additionally using a specific subset of frequencies corresponding to the newly identified at least one portion of bandwidth of any of the first, second or third wireless transceivers to thereby continue to at least partially satisfy the first wireless bandwidth requirement of the first application.
10[pre]	The wireless networking device of claim 1,
10[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;
10[b]	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, (i) identify at least one portion of each one of the first, second, and third bandwidths of the first, second, and third wireless transceivers that are available for communication, and (ii) evaluate the identified bandwidth availabilities of the first, second, and third wireless transceivers with respect to the first and second bandwidth requirements of the first and second applications; and
10[c]	wherein if the bandwidth requirements of the first and second applications are at least partially satisfied by the bandwidth availabilities of the selected transceivers of the first, second, and third wireless transceivers, preparing the first and second data streams for simultaneous transmission to the recipient from both the selected transceivers of the first, second, and third wireless transceivers using a specific subset of frequencies corresponding to the identified portions of their available bandwidth and causing the prepared first and second data streams to be transmitted from the selected transceivers of the first, second, and third transceivers to thereby at least partially satisfy the first and second wireless bandwidth requirements of the first and second applications.
11	The wireless networking device of claim 10, wherein if the bandwidth requirements of the first and second applications are

Claim	Limitation
	not at least partially satisfied by the bandwidth availabilities of the selected transceivers of the first, second, and third wireless transceivers, preparing the first and second data streams for simultaneous transmission to the recipient from all of the first, second, and third wireless transceivers using a specific subset of frequencies corresponding to the identified portions of their available bandwidth and causing the prepared first and second data streams to be transmitted from the first, second, and third transceivers to thereby at least partially satisfy the first and second wireless bandwidth requirements of the first and second applications.
12	The wireless networking device of claim 11, wherein at least one of the first, second, and third wireless transceivers are adapted to communicate with the recipient via a programmable variable duplex link that exhibits an asymmetric transmit and receive profile.
13	The wireless networking device of claim 1, wherein the at least one portion of the first bandwidth of the first transceiver comprises a single portion.
14	The wireless networking device of claim 1, wherein the at least one portion of the first bandwidth of the first transceiver is contiguous.
15	The wireless networking device of claim 1, wherein the at least one portion of the second bandwidth of the second transceiver comprises a single portion.
16	The wireless networking device of claim 1, wherein the at least one portion of the second bandwidth of the second transceiver is contiguous.
17	The wireless networking device of claim 1, wherein the at least one portion of the third bandwidth of the third transceiver comprises a single portion.
18	The wireless networking device of claim 1, wherein the at least one portion of the third bandwidth of the third transceiver is contiguous.
19	The wireless networking device of claim 1, wherein the first virtual PHY interface is not contiguous with the virtual MAC interface.

Claim	Limitation
20	The wireless networking device of claim 1, wherein the virtual MAC interface includes a decision block.
21	The wireless networking device of claim 1, wherein the virtual MAC interface includes a processing block.
22	The wireless networking device of claim 1, wherein the virtual MAC interface includes an ultra-streaming block.
23	The wireless networking device of claim 1, wherein the second virtual PHY interface is not contiguous with the virtual MAC interface.
24	The wireless networking device of claim 1, wherein the third virtual PHY interface is not contiguous with the virtual MAC interface.
25	The wireless networking device of claim 1, wherein the processing interface includes multiple virtual MAC interfaces.
26	The wireless networking device of claim 1, wherein the processing interface includes a bandwidth allocator.

I. INTRODUCTION

Petitioners Samsung Electronics Co., Ltd. and Samsung Electronics America, LLC ("Petitioner") request *Inter Partes* Review of claims 1-26 of U.S. Patent No. 11,818,591 ("'591 patent") assigned to XiFi Networks R&D Inc. ("Patent Owner"). The '591 patent is directed to a "wireless networking system" with multiple wireless transceivers and a processing layer to allocate bandwidth of the transceivers based on a wireless bandwidth requirement. (EX1001 at Abstract.) As demonstrated below, this basic architecture involving multi-transceiver devices was ubiquitous in the prior art, and the '591 patent claims no non-obvious features or implementation.

II. MANDATORY NOTICES

A. Real Party-in-Interest (37 C.F.R. § 42.8(b)(1))

The real parties-in-interest for Petitioner are Samsung Electronics Co., Ltd. and Samsung Electronics America, Inc.

B. Related Matters (37 C.F.R. § 42.8(b)(2))

1. Related Patent Office Proceedings

The '591 patent is in the same family as U.S. Patent Nos. 11,849,337 ("'337 patent"), 11,856,414 ("'414 patent"), 11,974,143 ("'143 patent"), 11,950,105 ("'105 patent"), 12,003,976 ("'976 patent"), 12,015,933 ("'933 patent"), 12,114,177 ("'177 patent"), 12,169,756 ("'756 patent"), 12,190,198 ("'198 patent"), and 12,250,564 ("'564 patent"). Petitioner has or expects to soon file IPR petitions against the '337,

’414, ’143, ’105, ’976, ’933, and ’177 patents. Petitioner has or expects to soon file PGR petitions against the ’756, ’198, and ’564 patents.

2. Related Litigation

Patent Owner is currently asserting the ’591 patent against Petitioner in *XiFi Networks R&D, Inc. v Samsung Electronics Co., Ltd. and Samsung Electronics America, Inc.*, Case No. 2:24-cv-01057-JRG (E.D. Tex.).

C. Lead and Backup Counsel and Service Information (37 C.F.R. §§ 42.8(b)(3)-(4))

Electronic service may be made on the email addresses identified below and in the accompanying Power of Attorney.

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D. Payment of Fees (37 C.F.R. § 42.15(a))

The Office is authorized to charge the fee required for this Petition (and any additional fees) to Deposit Account No. 50-5708.

E. Requirements For *Inter Partes* Review (37 C.F.R. §§ 42.101(A)-(C), 42.104(A), AND 42.018)

Petitioner certifies that the '591 patent is available for *inter partes* review, that Petitioner is not barred or estopped from challenging the '591 claims on the grounds identified herein, and that the prohibitions of 35 U.S.C. §§ 315(a)-(b) are inapplicable.

III. STATEMENT OF RELIEF REQUESTED AND IDENTIFICATION OF CHALLENGE (37 C.F.R. § 42.104(B))

Petitioner respectfully requests that *inter partes* review of claims 1-26 ("Challenged Claims) on the following grounds

Ground	Basis	References	Claims
1	§103	WO 2013/126859 ("Chincholi") in combination with US 2011/0320625 ("Riggert")	1-26

IV. BACKGROUND

A. ’591 Patent (EX1002, ¶¶43-51)

1. Earliest Priority Date

The ’591 patent is a post-AIA patent whose earliest possible priority date is October 30, 2013, via U.S. Provisional Application Nos. 61/897,216 and 61/897,219.

2. Specification

The ’591 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. (EX1001 at Abstract).

The wireless networking architecture described in the ’591 patent “includes an application layer, actual MAC and PHY layers, and a processing layer between the actual MAC and PHY layers.” *Id.* at 2:41-44. The patent describes how the processing layer may comprise “virtual MAC and PHY layers” that “enable simultaneous allocation of multiple PHY resources for different signal types associated with different applications.” *Id.* at 3:36-38.

For example, in the embodiment of Figure 6, 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 for a single recipient device using asymmetric transmit and receive cycles. *Id.* at 5:31-50.

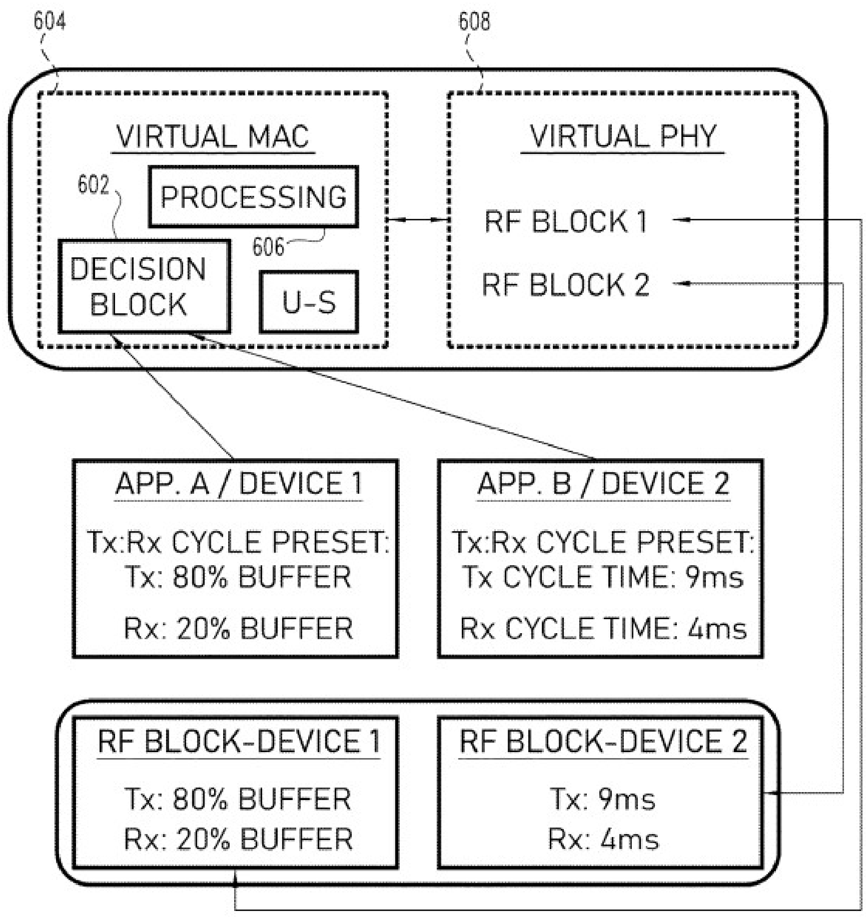

Fig. 6

3. Prosecution History

The ’591 patent was filed on September 7, 2021, as application 17/468,509, which was a continuation of application 16/039,660 now US Patent 11,115,834 (“’834 patent”). During prosecution, the Examiner issued a single non-final rejection on February 8, 2023, asserting double patenting in light of the ’834 patent and obviousness over US 2008/084855 ("Rahman"), US 2011/0128919 ("Kim") and US 2006/0140123 ("Conner"). In response, applicant filed a terminal disclaimer, amended the specification and drawings, cancelled all then-pending claims and filed all new claims. The Examiner then issued a notice of allowance on August 30, 2023. Two-post issuance certificate of corrections have been filed.

B. Asserted Prior Art (EX1002, ¶¶60-67)

1. Chincholi (EX1005)

WO 2013/126859 ("Chincholi") has an international filing date of February 24, 2013, and was published on August 29, 2013. It is prior art under § 102(a)(1) and § 102(a)(2).

Chincholi discloses systems "to manage multiple radio access technology (RAT) interfaces to enable opportunistic RAT selection and aggregation for sending data traffic over the RAT interfaces." (EX1005 at [0003].) In one embodiment, Chincholi discloses a network terminal, such as an "access point," that "may be configured to work in an infrastructure mode or an adhoc mode, for example, in an IEEE 802.11 based Wi-Fi system." (EX1005 at [0115].) An 802.11 access point configured according to Chincholi enables the use of "multiple RATs simultaneously [to] provide increased bandwidth and/or increased reliability for an application." (EX1005 at [0194].)

Chincholi discloses the use of an "Opportunistic Multiple-Medium Access

Control (MAC) Aggregation (OMMA) layer," (EX1005 at [0003]), which is a "single thin software layer" which "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," (EX1005 at [0120]). An exemplary OMMA layer enabling a dual-RAT aggregation device in an 802.11n network is shown in Figure 5 with actual MAC and physical interfaces enabling dual transceivers:

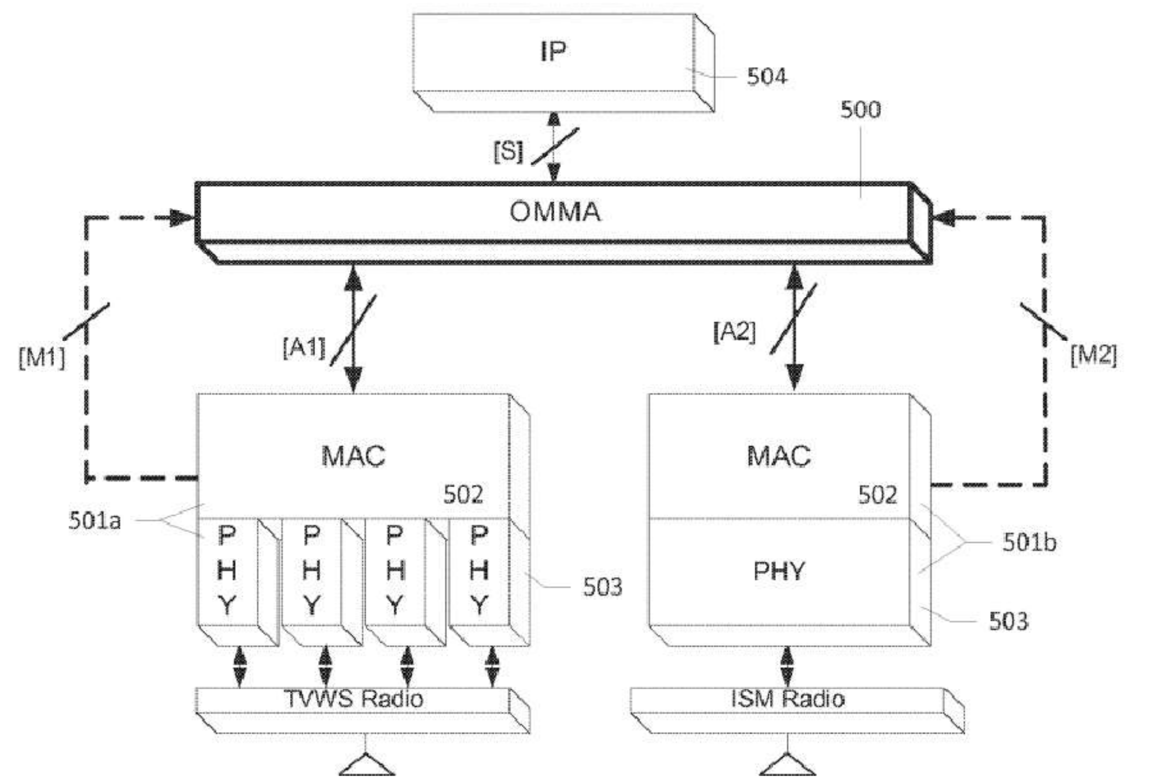

FIG. 5

The OMMA layer processes single or multiple IP flows (*i.e.*, application data streams) and is capable of using feedback information from each RAT to make decisions about how best to allocate transceiver resources to meet the bandwidth requirement of the IP flows. The OMMA layer may "aggregate" the available bandwidth of multiple transceivers, enabling communication paths between network devices using one or more RATs. (EX1005 at [0383].) For example, first and second packets of a single IP flow may be scheduled for simultaneous transmission to a recipient across the first and second RAT. (EX1005 at [0385].)

Chincholi was not before the examiner during prosecution of the '591 patent.

2. Riggert (EX1006)

Published U.S. Patent Application 2011/0320625 (Riggert) was filed on June 28, 2010 and published on December 29, 2011. It is prior art under § 102(a)(1) and § 102(a)(2).

Riggert is directed to techniques for improving bandwidth efficiency and throughput in a multi-transceiver wireless communication network. (EX1006 at [0004].) 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].) An important benefit of the "bondable virtual interface" is that it may be used generically in the framework, allowing easy substitution of one virtual interface with another without changing interface requirements. (EX1006 at [0065].) As an example, Riggert describes a virtual interface pairing together two 802.11g wireless interfaces. (EX1006 at [0057].)

Riggert was not before the examiner during prosecution of the ’591 patent.

V. PERSON OF ORDINARY SKILL

A person of ordinary skill in the art at the time of the ’591 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. (EX1002 at ¶54.)

Petitioner’s expert, Dr. Almeroth, met this level by the priority date. (*Id.,* ¶55.)

VI. CLAIM CONSTRUCTION

No express constructions are required to find the ’591 patent claims invalid. To the extent relevant, Petitioner addresses the plain meaning of certain terms in the analysis for the presented Ground. (EX1002 at ¶¶56-58.) The challenged claims have not been construed in other proceedings.

VII. GROUND: Chincholi In Combination With Riggert Renders Claims 1-26 Obvious[1]

A. Overview and Motivation to Combine

Chincholi in combination with Riggert renders claims 1-26 obvious. (EX1002 at ¶¶68-74.) As discussed in more detail below, Chincholi teaches the same architecture as the '591 patent, including a wireless networking device with multiple transceivers, each having actual MAC and PHY interfaces. (*Id.*) 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].)

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

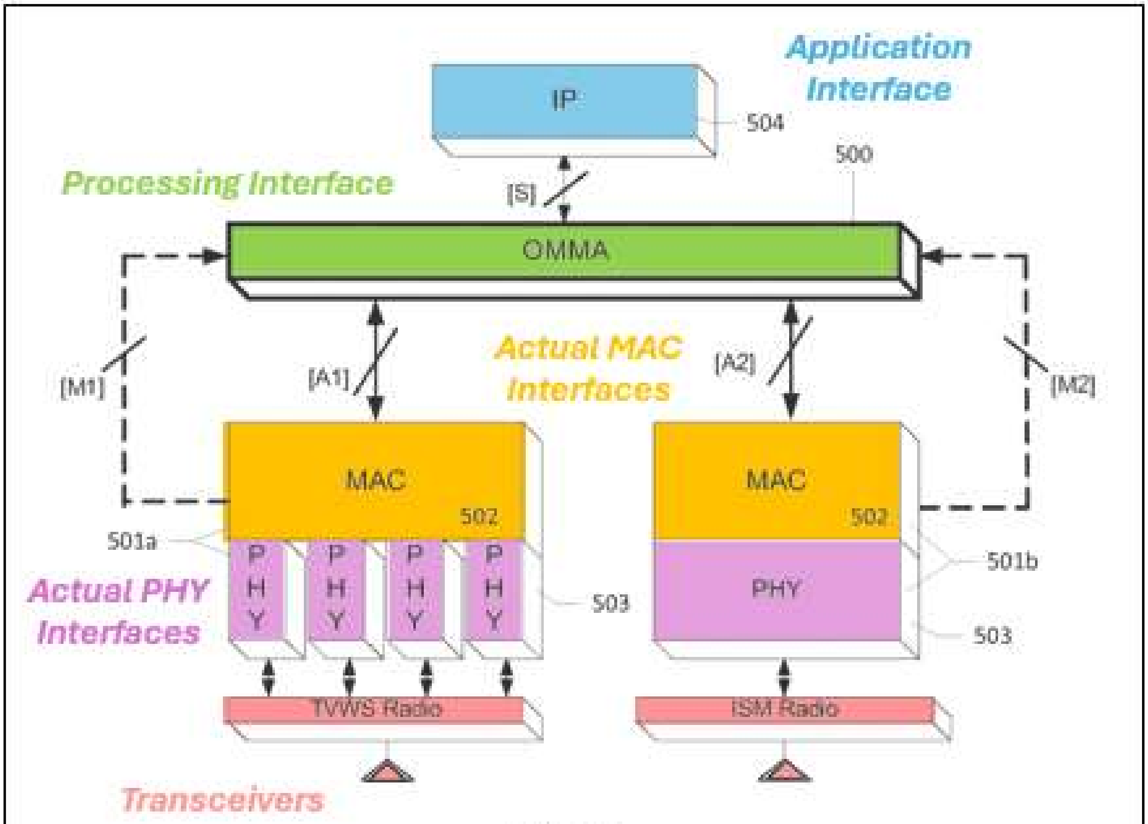

FIG. 5

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. (EX1002 at ¶69; *see also* EX1005 at [0137].) 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. (EX1002 at ¶69.) Specifically, rather than implement static (and limited) interfaces between Chincholi's OMMA layer and each RAT, a POSITA would have recognized the opportunity to implement "virtual

PHY" interfaces.

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. (EX1002 at ¶70; *see also* 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 background reference U.S. Patent Application 2009/0141691 ("Jain"). (*See* EX1007 at [0034-0037]); (EX1002 at ¶70). 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. (EX1002 at ¶70; *see also* EX1007 (Jain) at [0033].).

A POSITA would have understood that one way of implementing virtualized PHY interfaces to further enhance Chincholi is taught in Riggert. (EX1002 at ¶71.) 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. (EX1006 at

[0065].)

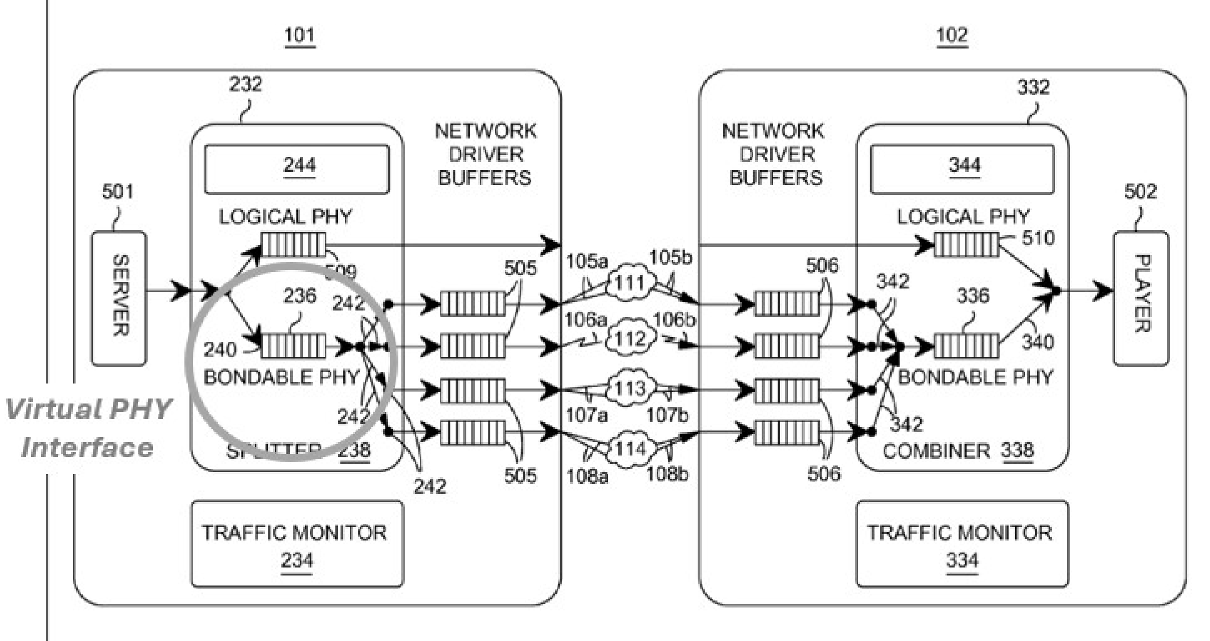

FIG. 5

A POSITA would have been motivated to modify Chincholi according to the teachings of Riggert's "virtual PHY" to improve the system of Chincholi. (EX1002 at ¶72.) 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 [0138]; EX1006 at [0057].) 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. (EX1002 at ¶72; 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. (EX1002 at ¶72.) 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. (*Id.*)

Implementing Riggert's virtualized PHY interfaces into Chincholi would be straight-forward, 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. (EX1002 at ¶73.) Based on the above, a POSITA would have recognized that the combination could be accomplished with a reasonable expectation of success. (*Id.*)

In the analysis below, the combined prior art system will be referred to as Chincholi/Riggert.

B. Limitation-By-Limitation Analysis

1. Claim 1

a) 1[pre]: A wireless networking device, comprising:

To the extent limiting, Chincholi/Riggert discloses the preamble of claim 1. (EX1002 at ¶¶75.) Chincholi discloses a system of wireless networking devices configured "to manage multiple radio access technology (RAT) interfaces" and "enable opportunistic RAT selection and aggregation for sending data traffic over the RAT interfaces." (EX1005 at [0003].) "In multi-RAT systems reception and/or transmission may be performed over multiple RATs. For example, ***a network terminal (NT)*** (e.g., an ***access point (AP)*** . . .) and ***a wireless transmit/receive unit (WTRU)*** . . . may communicate over multiple parallel paths." (EX1005 at [0002].)

Chincholi discloses that a network terminal ("NT"), such as an access point, or a wireless transmit/receive unit ("WTRU") "may be configured to work in an infrastructure mode or an adhoc mode, for example, in an IEEE802.11 based Wi-Fi system," *i.e.*, both are a ***wireless networking device***. (EX1005 at [0115]; EX1002 at ¶76.)

b) 1[a]: An application interface connected 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:[2]

"application interface being associated with a first application ... providing, when the wireless networking device is being used, ... a first data stream": 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]; EX1002 at ¶¶77-81.) 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 to a particular application***.").) In an 802.11 embodiment (Figure 5), IP packets associated with an application data stream come from or are destined to an IP layer 504, and thus the IP flow (*i.e.* ***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.*** (EX1002 at ¶78.)

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[2] This reproduction of element 1[a] reflects the Certificates of Correction. (EX1003.)

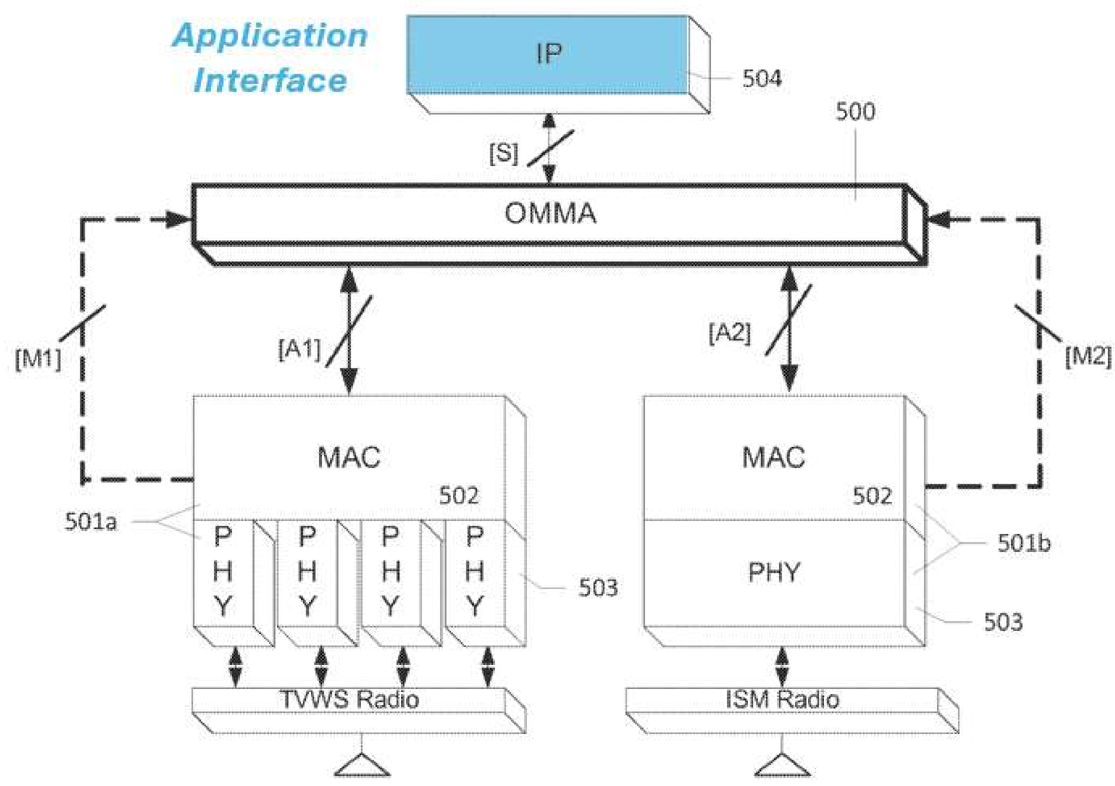


FIG. 5

"application interface connected to a processing interface": Chincholi further discloses that its "application interface" is connected to a "processing interface." (EX1002 at ¶79.) 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 '591 patent are congruent, which is underscored by the specification describing layers having the same functionality as the claimed interfaces, and the prosecution history, where Applicant interchangeably used the terms "layer" and "interface" to describe Figure 1. (EX1002 at ¶79; EX1004, 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:

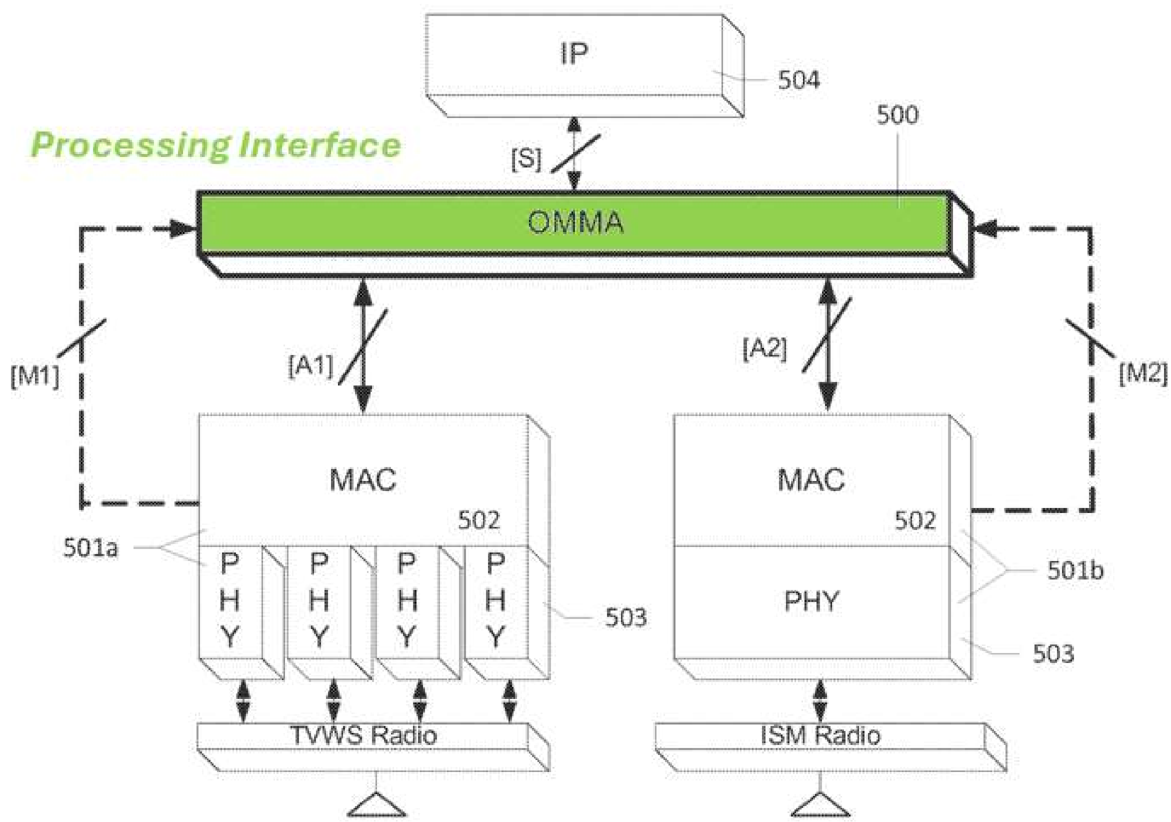


FIG. 5

The IP layer is connected to the OMMA layer and provides IP packets that the OMMA layer processes. (EX1005 at [0137]; EX1002 at ¶80.) The OMMA "may allow for enhanced throughput and reduced latency for a single IP flow." (EX1005 at [0120].) The OMMA layer is therefore a processing layer, which processes IP packets and provides an ***interface*** between the IP layer and actual MAC layers, *i.e.*, a ***processing interface***. (EX1002 at ¶80.)

"first application … having a first wireless bandwidth requirement": Chincholi teaches "a bandwidth requirement for an IP flow." (EX1005 at [260]; EX1002 at ¶81.)

c) 1[b]: first, second, and third actual MAC interfaces connected to the processing interface:

Chincholi discloses first, second, and third ***actual MAC interfaces*** connected to the processing interface (*i.e.*, the common OMMA layer). (EX1002 at ¶¶82-84.) 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.").)

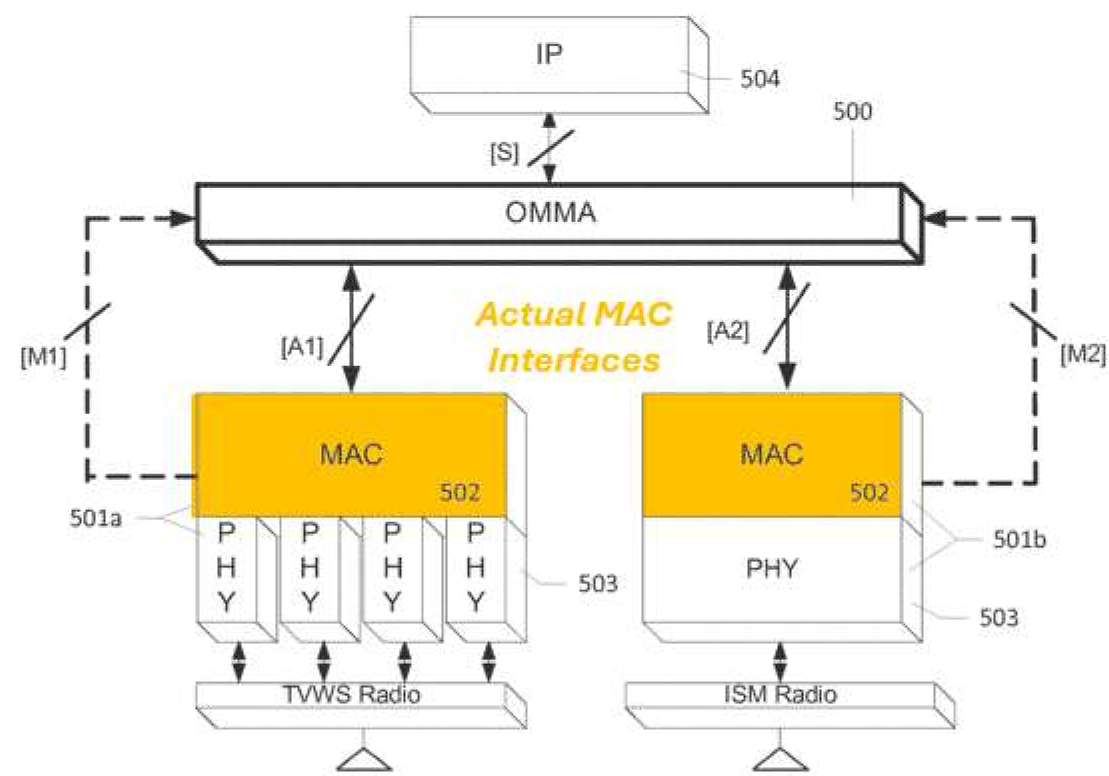


FIG. 5

While Figure 5 depicts only first and second actual MAC interfaces, Chincholi discloses that there can be any number of MAC interfaces in an 802.11 implementation. (*Id.* at ¶83.) For example, Figure 4—a more general block diagram of the architecture set forth in Figure 5—depicts the OMMA layer existing above any number of RATs. (*Id.*)

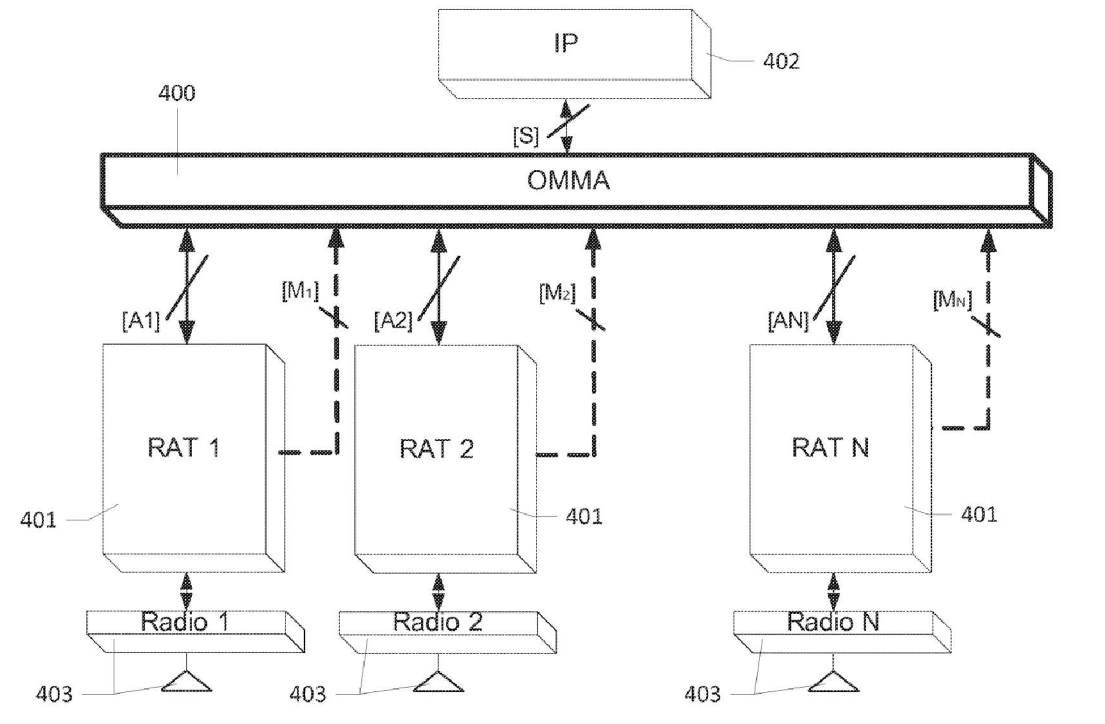


FIG. 4

Consistent with Figure 5, Chincholi explains that a given "RAT 401" 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 one of the three RATs would have actual MAC and PHY interfaces. (EX1002 at ¶84.)

d) 1[c]: first, second, and third actual PHY interfaces connected to the first, second, and third actual MAC interfaces:

Each RAT in Chincholi 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***."); EX1002 at ¶85.) The actual PHY layers are connected to the actual MAC interfaces:

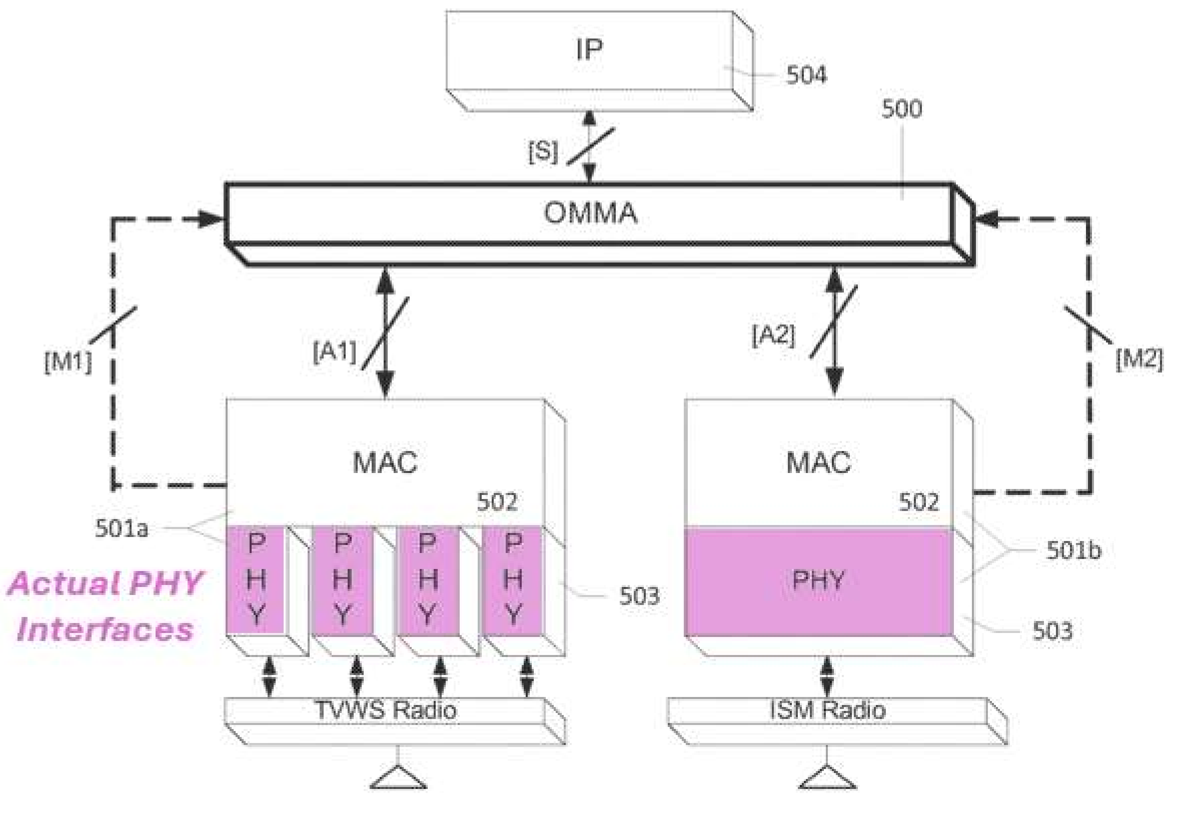


FIG. 5

As discussed above, limitation 1[b], Chincholi Figure 4 and its associated description discloses a common OMMA layer existing above any number of RATs. (*Id.* at ¶86.) 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]; EX1002 at ¶86.)

e) 1[d]: first, second, and third wireless transceivers respectively associated with the first, second, and third actual PHY interfaces, wherein each one of the first, second, and third wireless transceivers (i) is suitable for use in a wireless local area network, (ii) has a first, second, and third bandwidth availability up to a first, second, and third actual bandwidth, and (iii) is adapted to emit radio waves in first, second, and third different bands of frequencies, the second, and third frequency bands both being higher in frequency than the first frequency band:

"first, second, and third wireless transceivers respectively associated with the first, second, and third actual PHY interfaces ... suitable for use in a wireless local area network": Chincholi Figures 4 and 5 illustrate how each actual PHY interface of each RAT is associated with an ***antenna/radio frequency (RF) front-end pair***. (EX1005 at [0133]; EX1002, ¶¶87-96.)

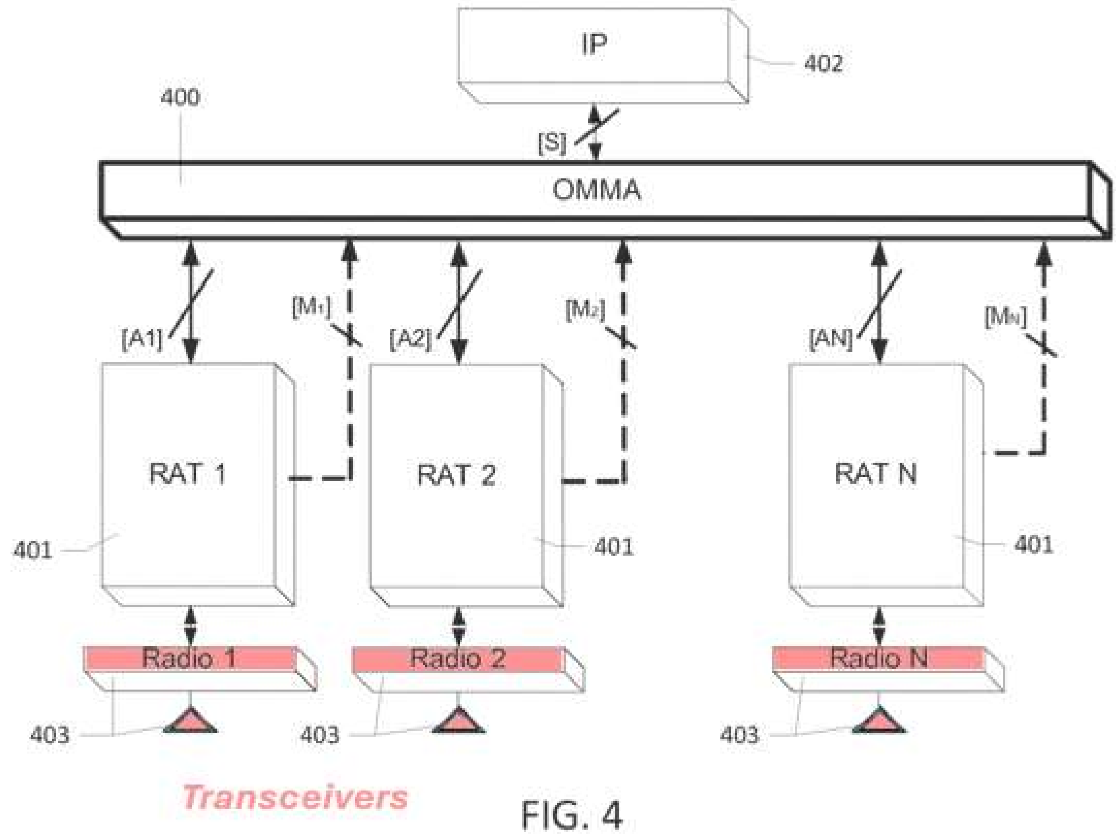


FIG. 4

The ***antenna/radio frequency (RF) front-end pairs*** in Figures 4 and 5 are ***first, second, and third transceivers***. A POSITA would have understood that a "transceiver" is a physical device that can both transmit and receive information. (EX1002 at ¶89.) Thus, each of Chincholi's disclosed "antenna/RF front-end pairs" are a transceiver because they operate on wireless protocols that both transmit and receive data, such as IEEE802.11, IEEE802.11ac, IEEE802.11af, LTE, WCDMA, etc. (EX1005 at [0134].) A POSITA would have further understood that the transceivers in Figures 4 and 5 would be associated with the actual PHY layer of each respective RAT, as the PHY layer is understood as the physical connection between a transceiver and the rest of the RAT. (EX1002 at ¶89.)

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. (EX1005 at [0134]; EX1002 at ¶90.)

"each one of the first, second, and third wireless transceivers ... has a first, second, and third bandwidth availability up to a first, second, and third actual bandwidth": The plain meaning of this limitation is that each of the wireless transceivers has at least three bandwidth availabilities and three respective actual bandwidths. (EX1002 at ¶91.) However, Patent Owner has alleged in the parallel litigation that this limitation may be met by each of the three wireless transceivers having one respective bandwidth availability up to an actual bandwidth. (EX1012; EX1013 at 18-19.) Regardless, Chincholi discloses or renders obvious this limitation under either interpretation. (EX1002 at ¶91.)

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). (EX1002 at ¶92.) 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 three transceivers has a bandwidth availability up to an actual bandwidth. (EX1002 at ¶92.)

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 at [0161], Table 2.) A POSITA would understand 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. (EX1002 at ¶93.)

"each one of the first, second, and third wireless transceivers ... is adapted to emit radio waves in first, second, and third different bands of frequencies": The plain meaning of this limitation is that each of the three transceivers emit radio waves in all three frequency bands. (EX1002 at ¶94.) 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" and the third is "the other one of the 5 GHz and 6 GHz transceivers." (EX1012; EX1013 at 19.) Regardless, Chincholi discloses or renders obvious this limitation under either interpretation. (EX1002 at ¶94.)

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. (EX1002 at ¶95.)

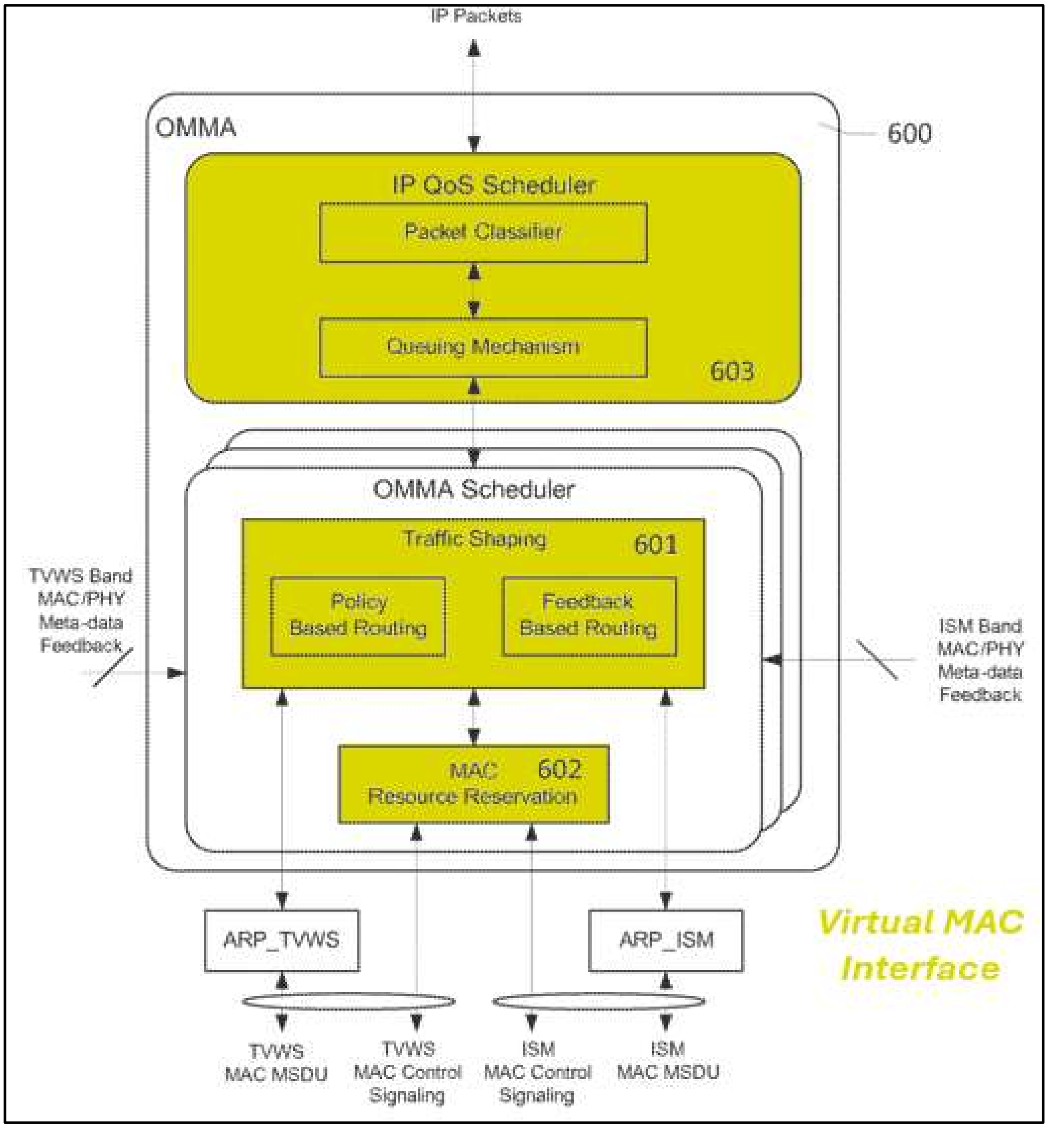
Chincholi also discloses that each transceiver can emit radio waves within all of the at least three frequency bands. For example, Chincholi describes that an NT and WTRU "may communicate with each other over a single radio frequency (RF) spectral band" such as "2.4 GHz ISM band, ***or*** 5 GHz ISM band," 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 three contiguous channels, *i.e.* the ***first, second, and third different bands of frequencies***, and thus satisfies the claim limitation under the alternative interpretation. (EX1002 at ¶96.)

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

According to the '591 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 3:35-41.) 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 4:33-36.) The virtual PHY layer may include multiple RF blocks, each representing the virtual use of some set of allocated transceiver resources. (EX1001 at 4:37-39; *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 5:54-58.)

First, Chincholi discloses that the OMMA (*i.e.*, the processing interface) includes the claimed "***virtual MAC interface***." (EX1002 at ¶¶98-106.) 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. (EX1002 at ¶98.)

Chincholi's OMMA layer also includes all of the functionality that the '591 patent associates with the "virtual MAC interface." (*Id.* at ¶99.) 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].)



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 '591 patent's "virtual MAC interface" (EX1002 at ¶100; *see also* EX1001 at 3:15-18). 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 '591 patent's "virtual MAC interface" (EX1002 at ¶100; *see also* EX1001 at 3:18-20). 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 '591 patent's "virtual MAC interface" (EX1002 at ¶100; *see also* EX1001 at 3:20-24). Thus, a POSITA would have recognized that Chincholi's OMMA layer includes a "***virtual MAC interface***." (EX1002 at ¶100.)

Second, Chincholi discloses that its processing interface comprises the "***first, second, and third virtual PHY interfaces formed in the processing interface***" to feed information regarding the bandwidth availabilities of the first, second, and third, wireless transceivers back to the at least one virtual MAC interface. (EX1002 at ¶101.) 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].)

Figures 28, 29, and their associated descriptions describe how Chincholi collects feedback from each RAT for the traffic shaping module. (EX1002 at ¶102.)

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, second, and third virtual PHY interfaces into the OMMA Controller of Chincholi to collect the disclosed feedback metrics from each RAT over the "A2" interface and feed it back to the virtual MAC interface.

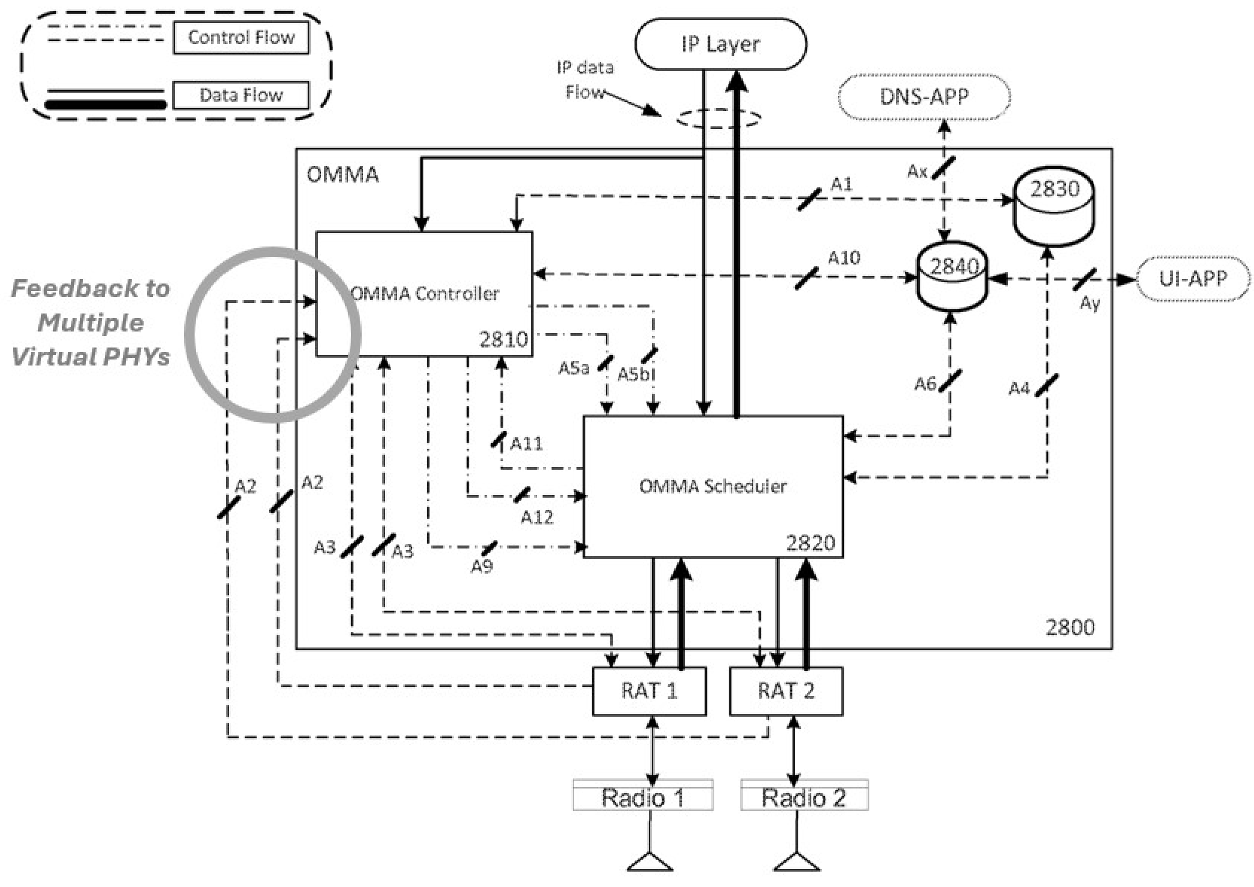


FIG. 28

Further details regarding the implementation of virtual PHY interfaces is disclosed by Riggert. As discussed above, *supra* Section IV.B.2, 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]; EX1002 at ¶103.) 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. (EX1002 at ¶103.) 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]); (EX1002 at ¶103.)

Figure 5 teaches the basic architecture for implementing "bondable physical interfaces" in the wireless network devices of a multi-channel network (EX1002 at ¶¶104-105):

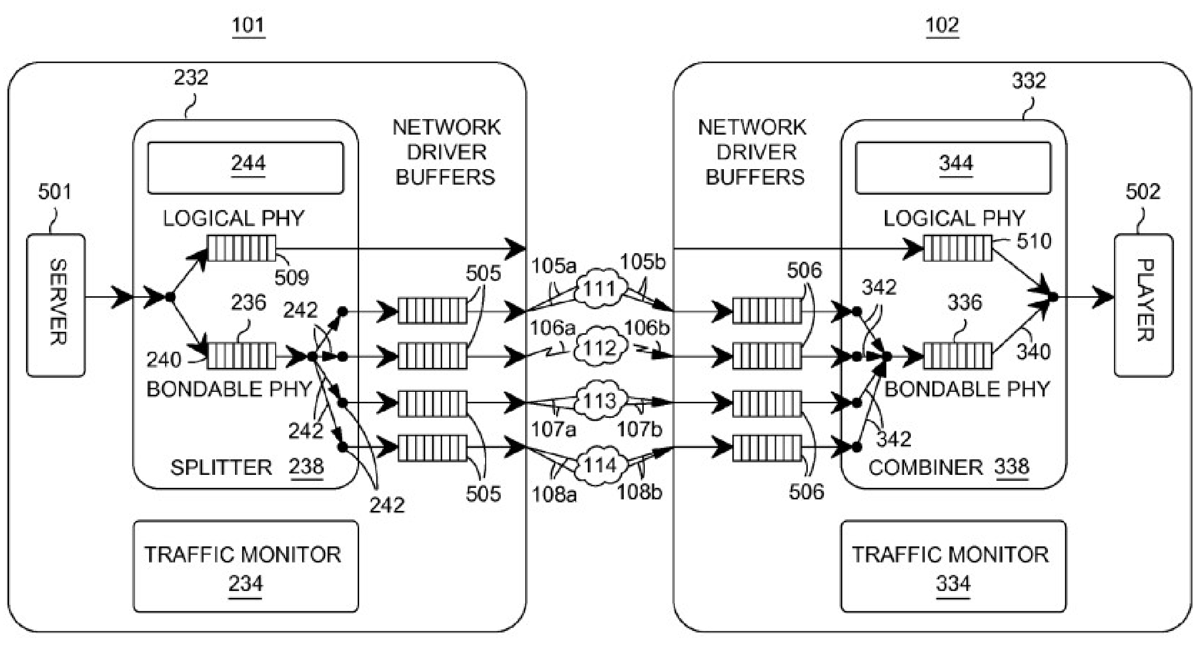


FIG. 5

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. (EX1002 at ¶105.) 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].)

For the reasons discussed above, *see* Section VII.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. (EX1002 at ¶106.) 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. (*Id.*)

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:

Chincholi discloses that its OMMA layer (*i.e.*, processing interface) is configured to operate in a manner transparent to any higher layer. (EX1002 at ¶107.) 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]: (a) request or create (i) a first association between a recipient and the first actual MAC and PHY interfaces, (ii) a second association between the recipient and the second actual MAC and PHY interfaces and (iii) a third association between the recipient and the third actual MAC and PHY interfaces, and:

Chincholi discloses techniques for network terminals and WTRUs to discover one another using active and passive scanning procedures. (EX1005 at [0145]; EX1002 at ¶¶108-109.) After an authentication procedure, Chincholi discloses that WTRUs may transmit a request to associate with one or more RATs of the network terminal and that the network terminal may provide an association response signal accepting or rejecting the request of the WTRU. (EX1005 at [0149].) A POSITA would have recognized that these scanning procedures disclose the ability of Chincholi's OMMA layer to request or create associations between recipients and first, second, and third actual MAC and PHY interfaces. (EX1002 at ¶108.)

When operating transparently with respect to higher layers, *see* limitation [1g], Chincholi's OMMA layer handles the request/response and creation of associations with WTRUs. (EX1005 at [0127] ("[A]ssociation request/response frames may be updated by the OMMA layer to include OMMA device discovery parameters, for example, such as but not limited to OMMA modes, OMMA schemes, OMMA packet distribution modes, etc.”). Thus, a POISTA would have recognized that the request or creation by Chincholi’s OMMA layer of associations between recipients and the actual MAC and PHY interfaces would be performed in a manner transparent to higher level layers. (EX1002 at ¶109.)

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

Chincholi teaches that NTs and WTRUs communicate with one another over “channels,” which are portions of a transceiver bandwidth availability. (EX1002 at ¶¶110-112.) 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 802.1 1 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.”).)

Chincholi also discloses identifying available bandwidth channels for communication. (EX1002 at ¶111.) 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].)

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 "at least one portion" (*i.e.*, at least one available channel, or an aggregation of multiple contiguous or non-contiguous channels) of the first, second, and third bandwidths of the respective transceivers that are available for communication. (EX1002 at ¶112.)

j) 1[i]: (ii) evaluate the identified bandwidth availabilities of the first, second, and third wireless transceivers with respect to the first bandwidth requirement of the first application;

Chincholi discloses that the OMMA layer evaluates the identified channel availabilities with respect to the first bandwidth requirement of the first application and allocates bandwidth resources accordingly. (EX1002 at ¶¶113-117.) As Chincholi teaches, "the OMMA layer may determine a time duration and a bandwidth requirement for an IP flow." (EX1005 at [260].) With knowledge of this total bandwidth requirement, as well as the feedback information indicating the number of channels available on each RAT, Chincholi teaches how its "OMMA layer may intelligently manage data traffic across multiple RATs . . . as a function of the link quality of each RAT." (EX1005 at [0194].)

Specifically, Chincholi discloses how "[t]he OMMA layer may request resources on a first RAT and on a second RAT based on the time duration and the bandwidth requirement for the first IP packet and the second IP packet of the IP flow." (EX1005 at [0260]; EX1002 at ¶114.) "The resources are characterized by the time duration and the bandwidth requirement." (*Id.*) This functionality may be performed, for example, by a "MAC Resource Reservation module 602" of the OMMA layer, which "determine[s] an amount of time duration and/or spectral fragment/bandwidth required by a packet or a set of packets." (EX1005 at [0142].)

Chincholi goes on to detail multiple feedback-based OMMA algorithms for allocating IP packets across respective RATs based on their bandwidth availability. (EX1005 at [0162]; EX1002 at ¶115.) 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 then 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]).

Based on the foregoing, a POSITA would have understood that Chincholi discloses evaluating the identified bandwidth availabilities of the wireless transceivers with respect to the bandwidth requirement of the first application. (EX1002 at ¶116.)

Indeed, consistent with the purported technological advance of the '591 patent, Chincholi teaches how the common OMMA layer, situated above the actual MAC interfaces, is uniquely positioned to make a global evaluation of the bandwidth requirement for an IP flow with respect to available transceiver resources. (EX1002 at ¶117.) An individual actual MAC, for example, "may be unaware of the resource allocation to the NT and WTRU by other MACs," and thus permitting multi-RAT resource allocation would "not be globally optimal." (EX1005 at [259].) "Since the OMMA layer may be the common entity which is aware of the link quality metrics on each RAT for a device and QoS class . . . , a globally optimal resource allocation may be performed at the OMMA layer, and the optimal resource allocation may be signaled to the MAC on each RAT." (EX1005 at [259].)

k) 1[j]: wherein, if the first bandwidth requirement is at least partially satisfied by the bandwidth availabilities of a selected two transceivers of the first, second, and third wireless transceivers, preparing the first data stream for simultaneous transmission to the recipient from both the selected transceivers of the first, second, and third wireless transceivers using a specific subset of frequencies corresponding to the identified portions of their available bandwidth and causing the prepared first data to be transmitted from the selected two transceivers of the first, second, and third wireless transceivers to thereby at least partially satisfy the first wireless bandwidth requirement of the first application; and

Based on its evaluation of transceiver bandwidth availability with respect to application bandwidth requirement, Chincholi discloses using the bandwidth availabilities of a selected two transceivers to simultaneously transmit the first data stream to a recipient using a specific subset of frequencies corresponding to their identified potions. (EX1002 at ¶¶118-123.)

As discussed above, *see* limitation 1[h]-1[i], Chincholi reserves resources from the identified portions of available bandwidth of the transceivers to transmit the data stream. A POSITA understands that the reservation of resources from the available bandwidth portion of a given transceiver is a selection of that transceiver. (EX1002 at ¶119.)

Chincholi discloses selecting at least two transceivers that at least partially satisfy the application's bandwidth requirement to simultaneously transmit the first data stream and preparing the first data stream for simultaneous transmission using the selected two transceivers. (EX1002 at ¶120.) Chincholi discloses a "multiplexing mode" where, if the channel quality for one or more RATs is determined to exceed an upper threshold, the OMMA layer may transmit different independent IP packets from the same IP flow across one or more of the RATs. (EX1005 at [0152].) Chincholi further discloses that the reservation of resources on the one or more RATs is based on whether they satisfy the "bandwidth requirements" of the data stream. (EX1005 at [0007]). In this scenario, Chincholi is able to reserve resources (*i.e.*, a ***specific subset of frequencies corresponding to the identified portions of available bandwidth***) of multiple transceivers based on said resources partially satisfying bandwidth requirements and thereby prepare the first data stream for simultaneous transmission from the multiple transceivers. (EX1002 at ¶120.)

Chincholi discloses ***causing the prepared first data stream to be transmitted*** from the selected two transceivers. Figure 11, for example, shows how the OMMA layer splits a single IP stream of packets (*i.e.*, "MAC Service Data Units" or "MSDUs") for transmission across two RATs simultaneously. (EX1002 at ¶121.)

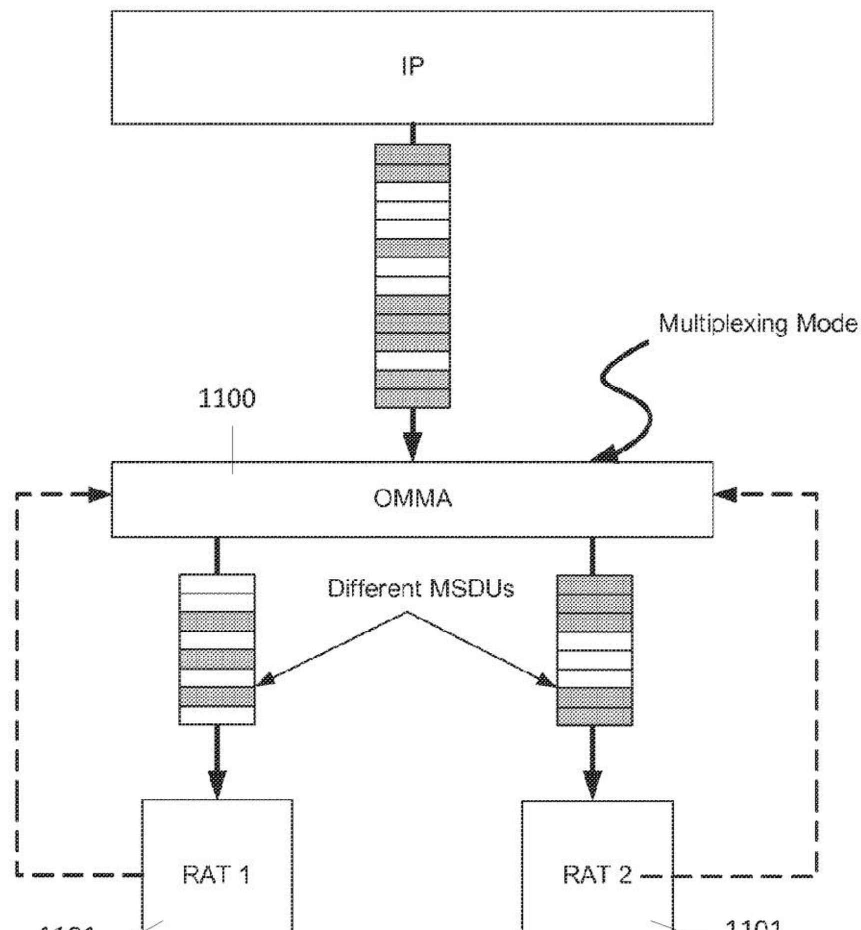


FIG. 11

As Chincholi discloses, "[u]sing multiple RATs ***simultaneously*** may provide increased bandwidth and/or increased reliability for an application." (EX1005 at [0194].) Since the transceivers were selected based on their ability to partially satisfy the application's bandwidth requirement, the transmission ***partially satisfies the bandwidth requirement***. (EX1002 at ¶122.)

Finally, Chincholi discloses that the transceiver selection, data stream preparation, and simultaneous transmission is all performed by the OMMA in a manner transparent to higher levels: "[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]; EX1002 at ¶123.)

l) 1[k]: 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 the selected one of the first, second, and third wireless transceivers.

Chincholi discloses examples of "***multi-WTRU*** multi-IP flow cases." (EX1005 at [0328]; EX1002 at ¶¶124-127.) 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.

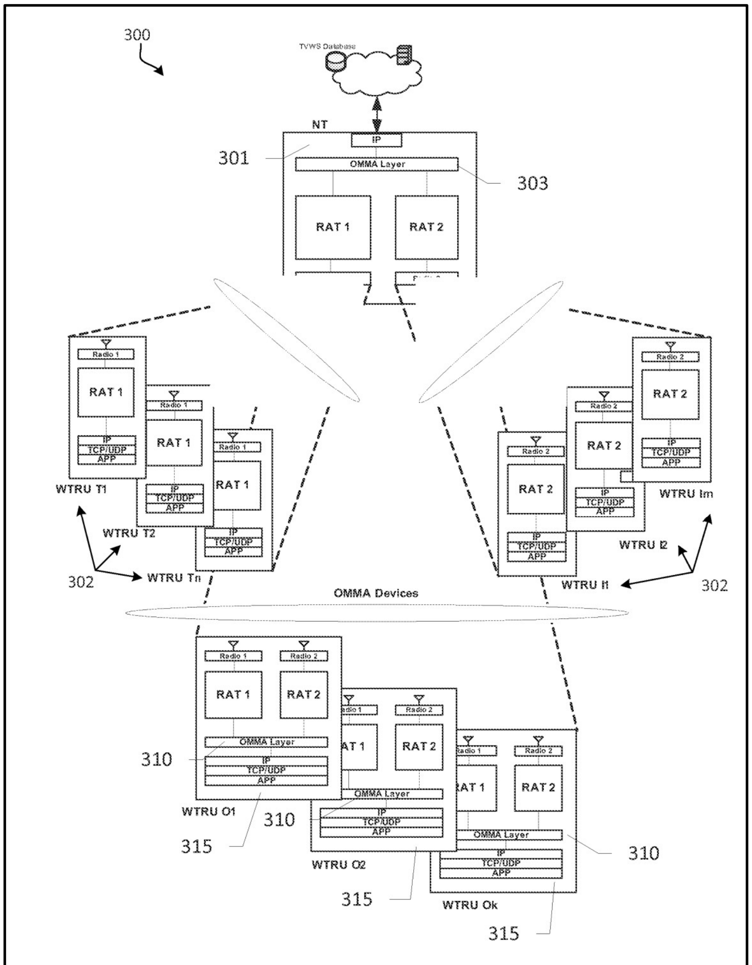


FIG. 3

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]; EX1002 at ¶125.) 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].)

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. (EX1002 at ¶126.) 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. (EX1002 at ¶126.) 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. (*Id*.)

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 a transceiver's available bandwidth. (*Id*. at ¶127.)

2. Claim 2: The wireless networking device of claim 1, wherein the wireless networking device comprises a wireless access point.

Chincholi discloses that the wireless networking device of claim 1 comprises a "wireless access point." (EX1002 at ¶128.) 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].)

3. Claim 3: The wireless networking device of claim 1, wherein the wireless networking device comprises a handheld computing device.

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." (*Id.* at [0121].) Thus, Chincholi's NTs and WTRUs may each comprise the wireless networking device of claim 1. (EX1002 at ¶129.)

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. (EX1002 at ¶130.)

4. Claim 4: The wireless networking device of claim 1, wherein at least one of the first, second and third wireless frequency bands are specified in at least one member of the family of IEEE 802.11 standards.

Chincholi teaches that its techniques can be used to implement an IEE 802.11 based Wi-Fi system. (EX1005 at [0121]; EX1002 at ¶131.) 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].)

5. Claim 5: The wireless networking device of claim 4, wherein the at least one member of the family of IEEE 802.11 standards was in existence as of Oct. 30, 2013.

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") where in existence as of October 30, 2013. (EX1002 at ¶132.)

6. Claim 6: The wireless networking device of claim 1, wherein, if the first bandwidth requirement is not at least partially satisfied by the bandwidth availabilities of the selected transceivers of the first, second, and third wireless transceivers, preparing the first data stream for simultaneous transmission to the recipient from all of the first, second, and third wireless transceivers using a specific subset of frequencies corresponding to the identified portions of their available bandwidth and causing the prepared first data stream to be transmitted from the first, second, and third transceivers to thereby at least partially satisfy the first wireless bandwidth requirement of the first application.

Chincholi discloses that its OMMA layer is "[a] mechanism to aggregate two ***or more*** RATs operating independently on two ***or more*** bands to enhance the total IP throughput of the link . . . ." (EX1005 at [0120].) Figure 4 discloses that Chincholi's techniques may be implemented in a system with more than two independent RATs. (EX1005 at [0132] & Fig. 4.) Thus, a POSITA would have recognized that Chincholi discloses the capability to simultaneously transmit the first data stream from all of the first, second, and third transceivers. (EX1002 at ¶133.)

7. Claim 7: The wireless networking device of claim 6, wherein, if the identified bandwidth of the first wireless transceiver becomes unavailable during use of the wireless networking device, the processing interface is adapted to, as a result of the unavailability and in a manner transparent to any layer of the wireless networking device above the processing interface, identify another at least one portion of the bandwidth of any of the first, second or third wireless transceivers and prepare the first data stream for transmission to the recipient additionally using a specific subset of frequencies corresponding to the newly identified at least one portion of bandwidth of any of the first, second or third wireless transceivers to thereby continue to at least partially satisfy the first wireless bandwidth requirement of the first application.

Chincholi discloses the use of "feedback based routing" wherein measurement metrics in the form of "channel quality metrics" and "the number of available resources on the medium" are continuously monitored. (EX1005 at [0161]; *see also id.* at [0235] ("The RAT Capability Database 2830 may store this available RAT information for an associated device (e.g., WTRU)). The OMMA Controller may update (e.g., continuously update) the available RAT capability of a device (e.g., WTRU) in this database 2830, for example, based on feedback metrics from each RAT."). Because these feedback metrics can be used by the MAC Resource Reservation Moule 602 to request a time duration and spectral fragment/bandwidth portion on a per-packet basis (EX1005 at [0142]), Chincholi discloses the capability to respond to a bandwidth portion becoming unavailable by identifying another bandwidth portion to satisfy the bandwidth requirement of the first application

(EX1002 at ¶134.) Indeed, Chincholi teaches that its OMMA layer 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].)

Chincholi also discloses the capability to respond to the total available bandwidth of a transceiver becoming unavailable. (EX1002 at ¶135.) In Figure 13 and its associated disclosure, Chincholi discloses a "dynamic RAT switching mode" in which the OMMA layer selects the best RAT possible at any given time based on the instantaneous channel quality/availability of the RATs. (Ex. 1005 at [0154].) "For example, if the channel quality of one RAT is 6 dB or lower than the channel quality of the other RATs, the RAT with the low channel quality may be disabled." (EX1005 at [0155].)

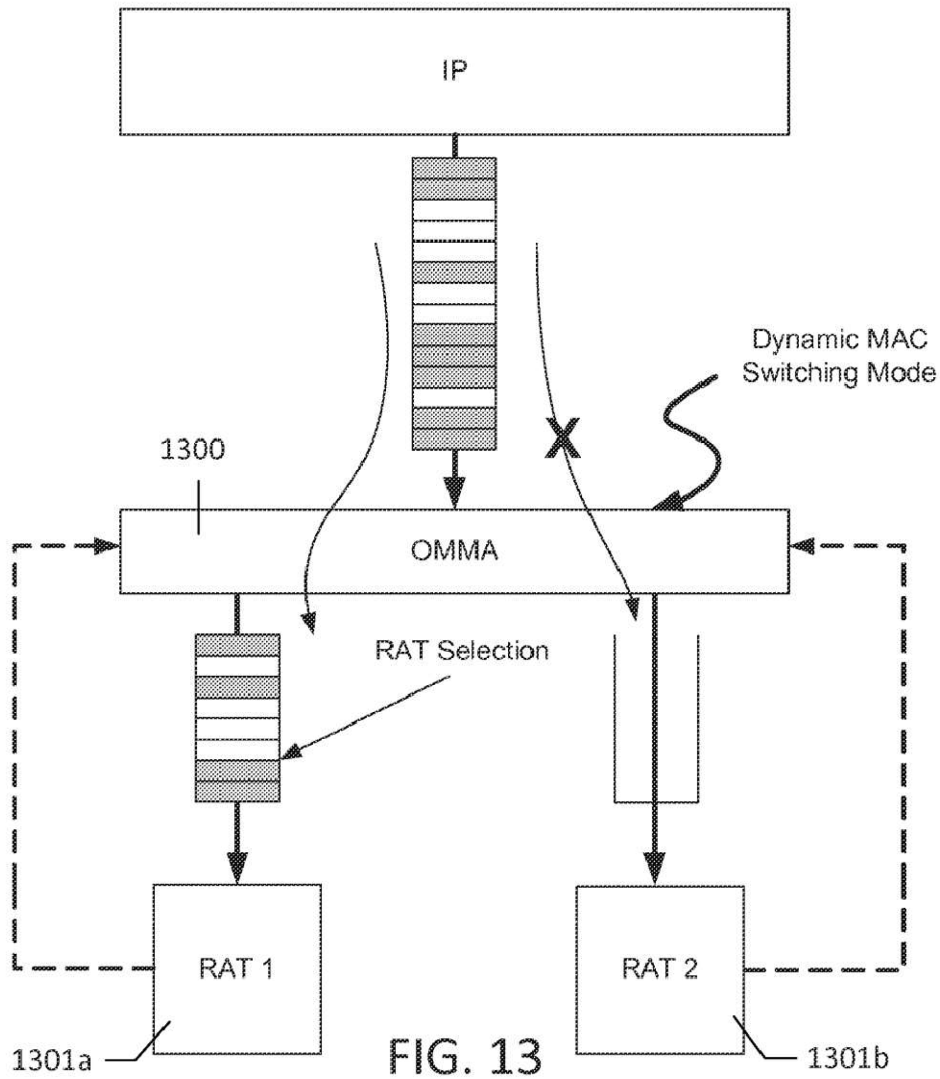


FIG. 13

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].) Thus, a POSITA would have recognized that Chincholi discloses the capability to, in a manner transparent to layers above the OMMA, identify another portion of bandwidth of the first, second, or third transceiver when the identified bandwidth of the first transceiver becomes unavailable to thereby continue to satisfy the bandwidth requirement of the application. (EX1002 at ¶136.) A POSITA would have understood that the plain meaning of resource "unavailability" in the context of the '591 patent broadly includes resources that are partially or completely unavailable or that have less bandwidth availability than another resource. *(Id.)* Indeed, during prosecution, the applicant expressly stated in arguing patentability to overcome a prior art rejection 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." (EX1004, Aug. 8, 2023 Response to Non-Final Office Action.)

8. Claim 8: The wireless networking device of claim 7, wherein, if the identified bandwidth of the second wireless transceiver becomes unavailable during use of the wireless networking device, the processing interface is adapted to, as a result of the unavailability and in a manner transparent to any layer of the wireless networking device above the processing interface, identify another at least one portion of the bandwidth of any of the first, second or third wireless transceivers and prepare the first data stream for transmission to the recipient additionally using a specific subset of frequencies corresponding to the newly identified at least one portion of bandwidth of any of the first, second or third wireless transceivers to thereby continue to at least partially satisfy the first wireless bandwidth requirement of the first application.

As discussed above, *see* claim 7, Chincholi discloses the capability to identify another portion of bandwidth of the first, second, or third transceiver when the identified bandwidth of the first transceiver becomes unavailable. (EX1002 at ¶137.) Chincholi further discloses that its techniques may be implemented in a system with any number of independent RATs. (EX1005 at [0132] & Fig. 4.) Thus, a POSITA would have understood that Chincholi further discloses the ability of the OMMA (*i.e.*, the "processing layer") to, in a manner transparent to higher layers, identify another portion of bandwidth of the first, second, or third transceiver in response to the identified bandwidth of the second transceiver also becoming unavailable. (EX1002 at ¶137.)

9. Claim 9: The wireless networking device of claim 8, wherein, if the identified bandwidth of the third wireless transceiver becomes unavailable during use of the wireless networking device, the processing interface is adapted to, as a result of the unavailability and in a manner transparent to any layer of the wireless networking device above the processing interface, identify another at least one portion of the bandwidth of any of the first, second or third wireless transceivers and prepare the first data stream for transmission to the recipient additionally using a specific subset of frequencies corresponding to the newly identified at least one portion of bandwidth of any of the first, second or third wireless transceivers to thereby continue to at least partially satisfy the first wireless bandwidth requirement of the first application.

As discussed above, *see* claims 7 and 8, Chincholi discloses the capability to identify another portion of bandwidth of the first, second, or third transceiver when the identified bandwidth of ***both*** the first and second transceivers becomes unavailable. (EX1002 at ¶138.) Chincholi further discloses that its techniques may be implemented in a system with any number of independent RATs. (EX1005 at [0132] & Fig. 4.) Thus, a POSITA would have understood that Chincholi further discloses the ability of the OMMA (*i.e.*, the "processing layer") to, in a manner transparent to higher layers, identify another portion of bandwidth of the first, second, or third transceiver in response to the identified bandwidth of the third transceiver also becoming unavailable. (EX1002 at ¶138.)

10. Claim 10: The wireless networking device of claim 1,

a) 10[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;

Chincholi discloses that a "single IP flow may refer to a stream of IP packets belong[ing] to a particular application." (EX1005 at [0132]; EX1002 at ¶139.) 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].) 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) 10[b]: 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, (i) identify at least one portion of each one of the first, second, and third bandwidths of the first, second, and third wireless transceivers that are available for communication, and (ii) evaluate the identified bandwidth availabilities of the first, second, and third wireless transceivers with respect to the first and second bandwidth requirements of the first and second applications; and

As discussed above, *see* limitation 1[h]-1[i], Chincholi discloses the ability of wireless networking devices to use feedback mechanisms to identify channels (*i.e.*, portions of available transceiver bandwidth) that are available for communication. (EX1002 at ¶¶140-142.)

Chincholi further discloses that the OMMA layer evaluates the identified channel availabilities with respect to *both* the first bandwidth requirement of the first application and the second bandwidth of the second application. (*Id.* at ¶141.) As discussed above, *see* limitation 10[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].)

Based on the foregoing, a POSITA would have understood that Chincholi discloses evaluating the identified bandwidth availabilities of the wireless transceivers with respect to the bandwidth requirements of *both* the first and second applications. (EX1002 at ¶142.)

c) 10[c] wherein if the bandwidth requirements of the first and second applications are at least partially satisfied by the bandwidth availabilities of the selected transceivers of the first, second, and third wireless transceivers, preparing the first and second data streams for simultaneous transmission to the recipient from both the selected transceivers of the first, second, and third wireless transceivers using a specific subset of frequencies corresponding to the identified portions of their available bandwidth and causing the prepared first and second data streams to be transmitted from the selected transceivers of the first, second, and third transceivers to thereby at least partially satisfy the first and second wireless bandwidth requirements of the first and second applications.

Chincholi discloses the use of buffers at the MAC layer of each transceiver to independently queue data streams from multiple IP flows. *See* limitation 10[a]; EX1002 at ¶¶143-145. 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. *See* limitation 1[k]. A POSITA would have recognized that Chincholi's OFDMA techniques can enable each transceiver to simultaneously transmit IP packets from multiple IP flows. (EX1002 at ¶143.)

Additionally, as explained above, Chincholi discloses preparing and transmitting a data stream across multiple transceivers simultaneously, for example in a multiplexing mode. *See* limitation 1[i]; EX1002 at ¶144. As discussed above, Chincholi discloses the use of feedback metrics for optimizing distribution of packets across multiple transceivers in a multi IP flow (QoS) case. *See* limitation 1[b].

From the foregoing discloses, a POSITA would have recognized that Chincholi discloses the capability to prepare and transmit ***both first and second data streams*** for simultaneous transmission to the recipient from both ***a selected two transceivers*** using a specific subset of frequencies corresponding to the identified portions of their available bandwidth to thereby satisfy the bandwidth requirements of ***both the first and second applications***. (EX1002 at ¶145.)

11. Claim 11: The wireless networking device of claim 10, wherein if the bandwidth requirements of the first and second applications are not at least partially satisfied by the bandwidth availabilities of the selected transceivers of the first, second, and third wireless transceivers, preparing the first and second data streams for simultaneous transmission to the recipient from all of the first, second, and third wireless transceivers using a specific subset of frequencies corresponding to the identified portions of their available bandwidth and causing the prepared first and second data streams to be transmitted from the first, second, and third transceivers to thereby at least partially satisfy the first and second wireless bandwidth requirements of the first and second applications.

As discussed above, *see* claim 6, Chincholi discloses that its OMMA layer is "[a] mechanism to aggregate two ***or more*** RATs operating independently on two ***or***

more bands to enhance the total IP throughput of the link . . . ." (EX1005 at [0120].) Figure 4 discloses that Chincholi's techniques may be implemented in a system with more than two independent RATs. (EX1005 at [0132] & Fig. 4.)

Thus, a POSITA would have recognized that Chincholi discloses the capability to prepare and transmit ***both first and second data streams*** for simultaneous transmission to the recipient from ***all of three transceivers*** using a specific subset of frequencies corresponding to the identified portions of their available bandwidth to thereby satisfy the bandwidth requirements of ***both the first and second applications***. (EX1002 at ¶¶146-147.)

12. Claim 12: The wireless networking device of claim 11, wherein at least one of the first, second, and third wireless transceivers are adapted to communicate with the recipient via a programmable variable duplex link that exhibits an asymmetric transmit and receive profile.

The '591 patent states in allocating different PHY resources for different applications, it "may be beneficial in some circumstances" to use "asymmetric wireless links, where the transmit or receive times may be different to optimize wireless traffic." (EX1001 at 5:14-19.) The patent explains and depicts in Figure 5B how a "variable duplex link includes a transmit buffer 504 that is larger than a receive buffer," and thus a "programmable register" may be used to control respective transmit and receive times, either by specifying the storage capacity of the buffers or precise times for the RF cycles. (EX1001 at 5:21-30.) In other words, when a transmit buffer is larger than a receive buffer, more time is allocated to transmission than reception, and vice versa. A POSITA would understand that this description of asymmetric transmit and receive times describes time-division duplexing, which was a well-known wireless communication technique that involves allocating different times for transmission and reception. (EX1002 at ¶¶148-150.)

Chincholi discloses how "[a]n 802.11 based system may operate in a time division ***duplexing*** (TDD) mode . . . ." (EX1005 at [0121]; EX1002 at ¶149.) Further, in addition to teaching how the OMMA layer of a wireless networking device coordinates transmissions across multiple RATs, Chincholi discloses how the OMMA layer operates to coordinate reception by multiple RATs. (*E.g.*, EX1005 at [0126] (describing that OMMA layer may "distribute" ***or*** "combine" packets from different RATs and forward the packets to the IP layer).) Chincholi teaches how the feedback signals regarding RAT availability may be communicated from the OMMA Controller to *both* the OMMA transmitter and receiver. (EX1005 at [0167].)

Thus, Chincholi's OMMA is capable of dynamically scheduling both packet transmission and receipt in a time division duplex manner based on the availability of RATs which is communicated to both sending and receiving devices. (EX1002 at ¶150.) A POSITA would have recognized that the time allocated to a transmit/receive cycle may vary based on the demands of the system, and thus may be "asymmetric." (*Id.*) Thus, a POSITA would have recognized that Chincholi discloses the ability of a wireless networking device transceiver to communicate with a recipient via a programmable variable duplex link. (*Id.*)

13. Claim 13: The wireless networking device of claim 1, wherein the at least one portion of the first bandwidth of the first transceiver comprises a single portion.

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 band of the first transceiver as the at least one portion of the first bandwidth, that portion comprises a single portion. (EX1002 at ¶151.)

14. Claim 14: The wireless networking device of claim 1, wherein the at least one portion of the first bandwidth of the first transceiver is contiguous.

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 band of the first transceiver as the at least one portion of the first bandwidth, that portion is contiguous. (EX1002 at ¶152.)

15. Claim 15: The wireless networking device of claim 1, wherein the at least one portion of the second bandwidth of the second transceiver comprises a single portion.

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 band of the second transceiver as the at least one portion of the second bandwidth, that portion comprises a single portion. (EX1002 at ¶153.)

16. Claim 16: The wireless networking device of claim 1, wherein the at least one portion of the second bandwidth of the second transceiver is contiguous.

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 band of the second transceiver as the at least one portion of the second bandwidth, that portion is contiguous. (EX1002 at ¶154.)

17. Claim 17: The wireless networking device of claim 1, wherein the at least one portion of the third bandwidth of the third transceiver comprises a single portion.

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 band of the third transceiver as the at least one portion of the third bandwidth, that portion comprises a single portion. (EX1002 at ¶155.)

18. Claim 18: The wireless networking device of claim 1, wherein the at least one portion of the third bandwidth of the third transceiver is contiguous.

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 band of the third transceiver as the at least one portion of the third bandwidth, that portion is contiguous. (EX1002 at ¶156.)

19. Claim 19: The wireless networking device of claim 1, wherein the first virtual PHY interface is not contiguous with the virtual MAC interface.

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."

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 interface is not contiguous with the virtual MAC interface. (EX1002 at ¶¶157-158.)

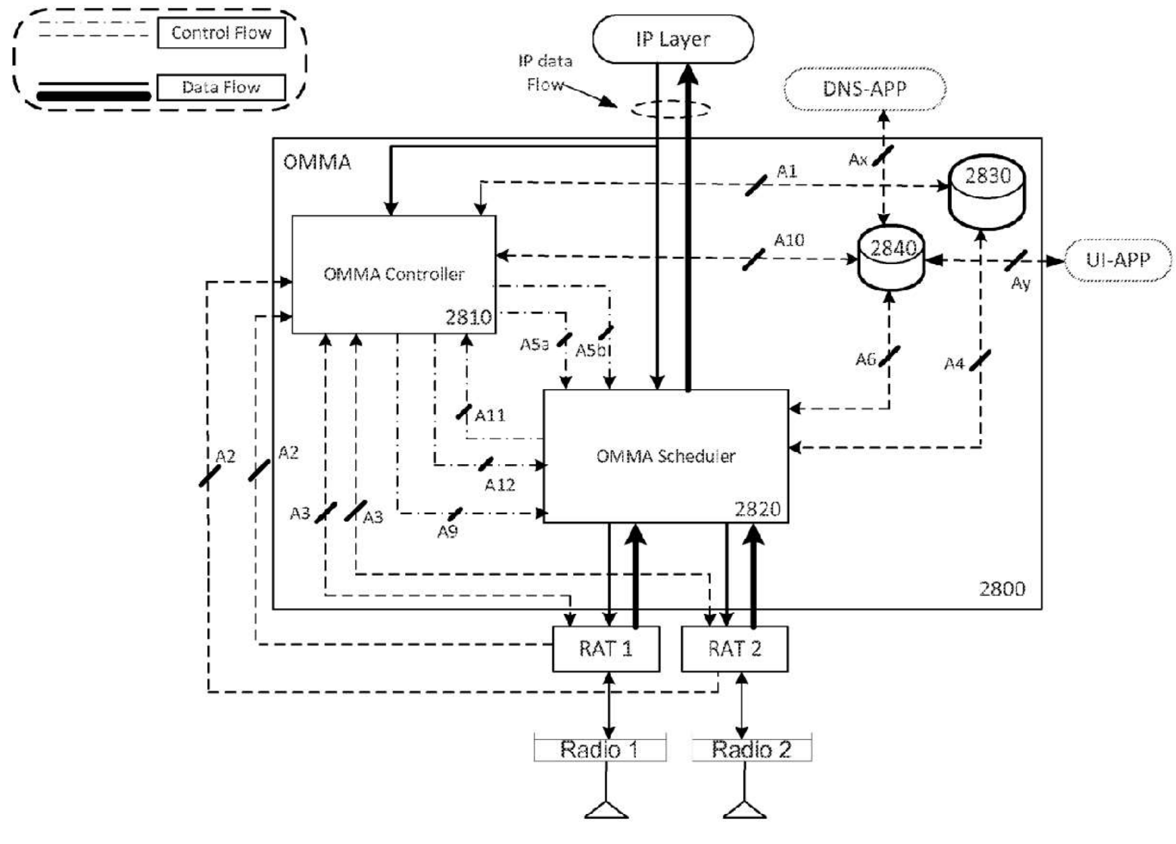
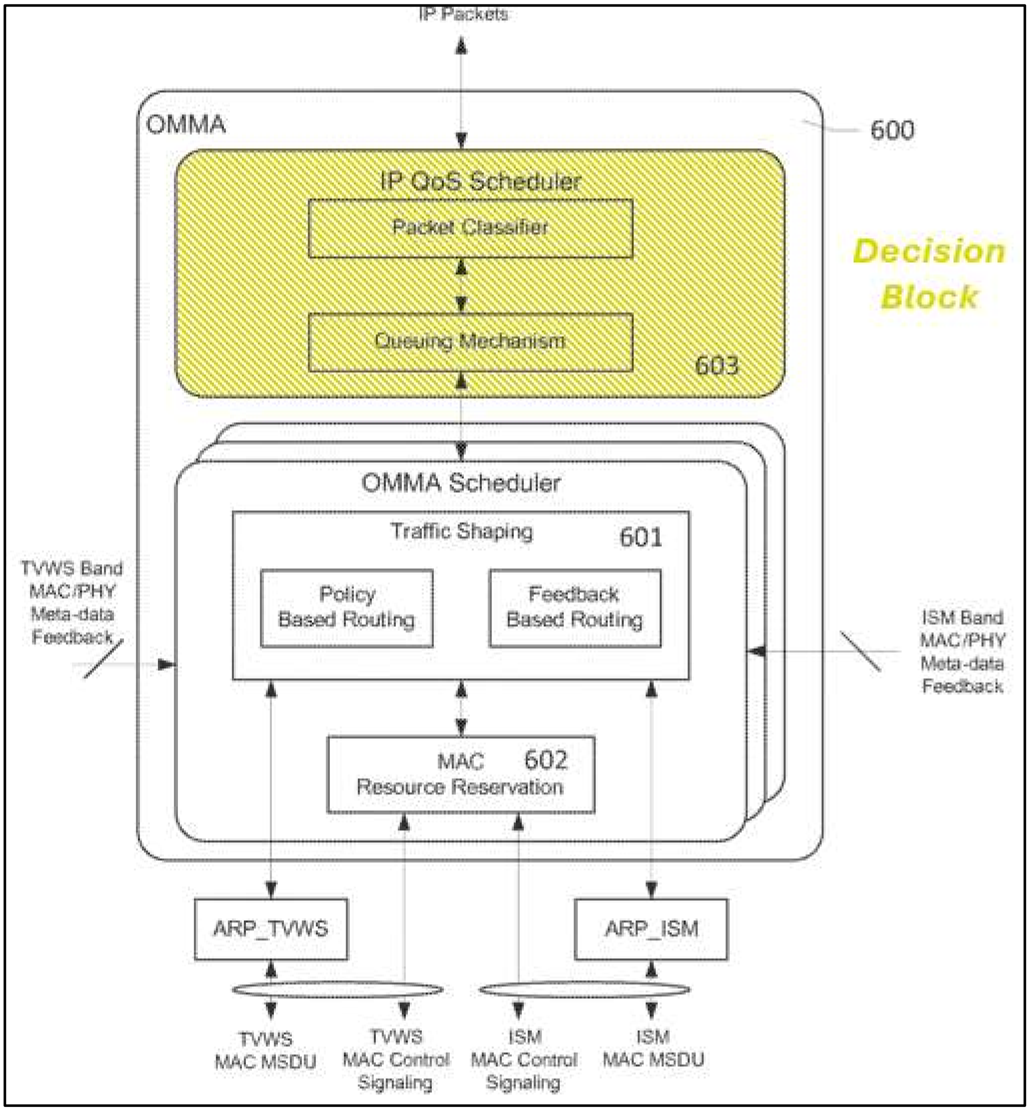


FIG. 28

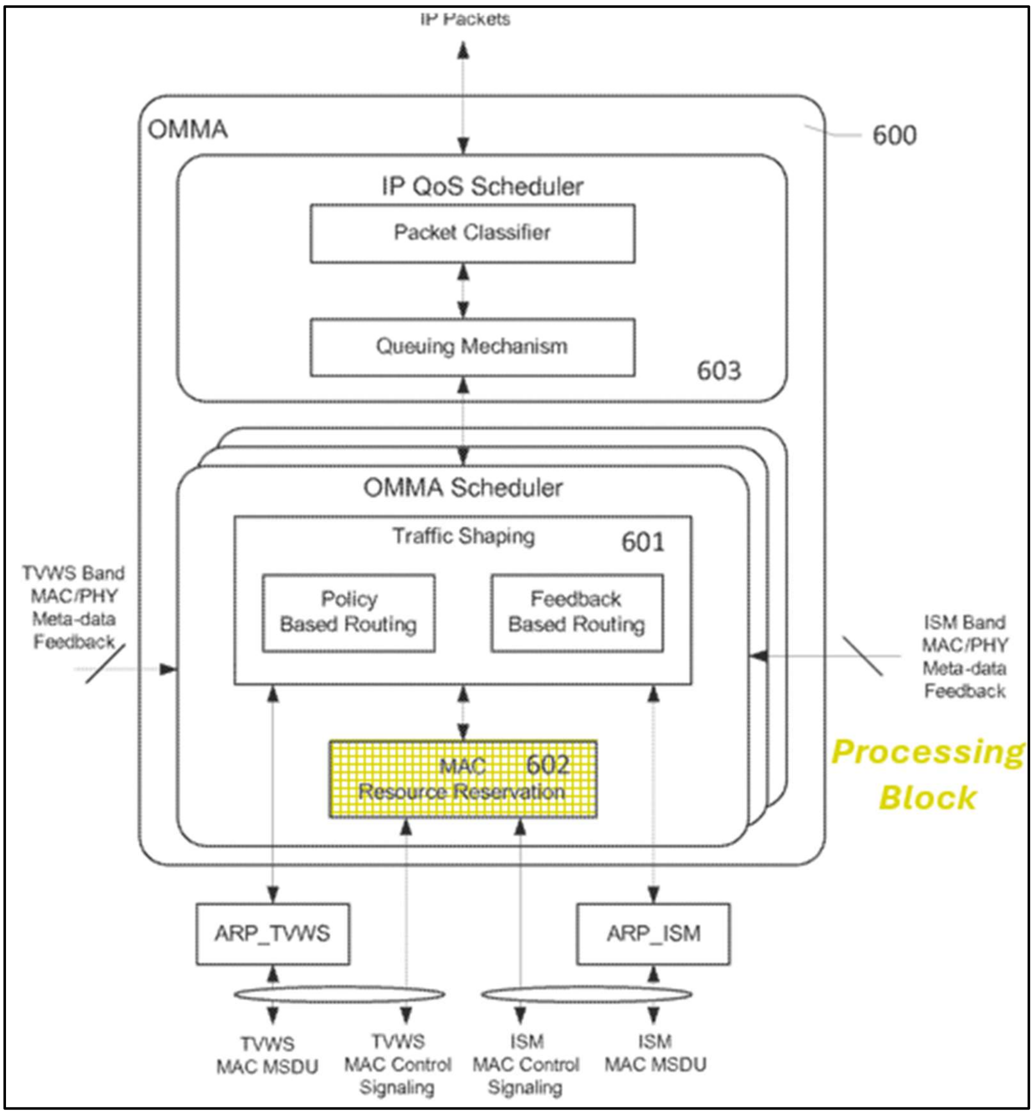
20. Claim 20: The wireless networking device of claim 1, wherein the virtual MAC interface includes a decision block.

The ’591 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 3:15-18.) Chincholi discloses this same functionality in the form of the ***IP QoS Scheduler module 603***. (EX1002 at ¶159.) 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].)



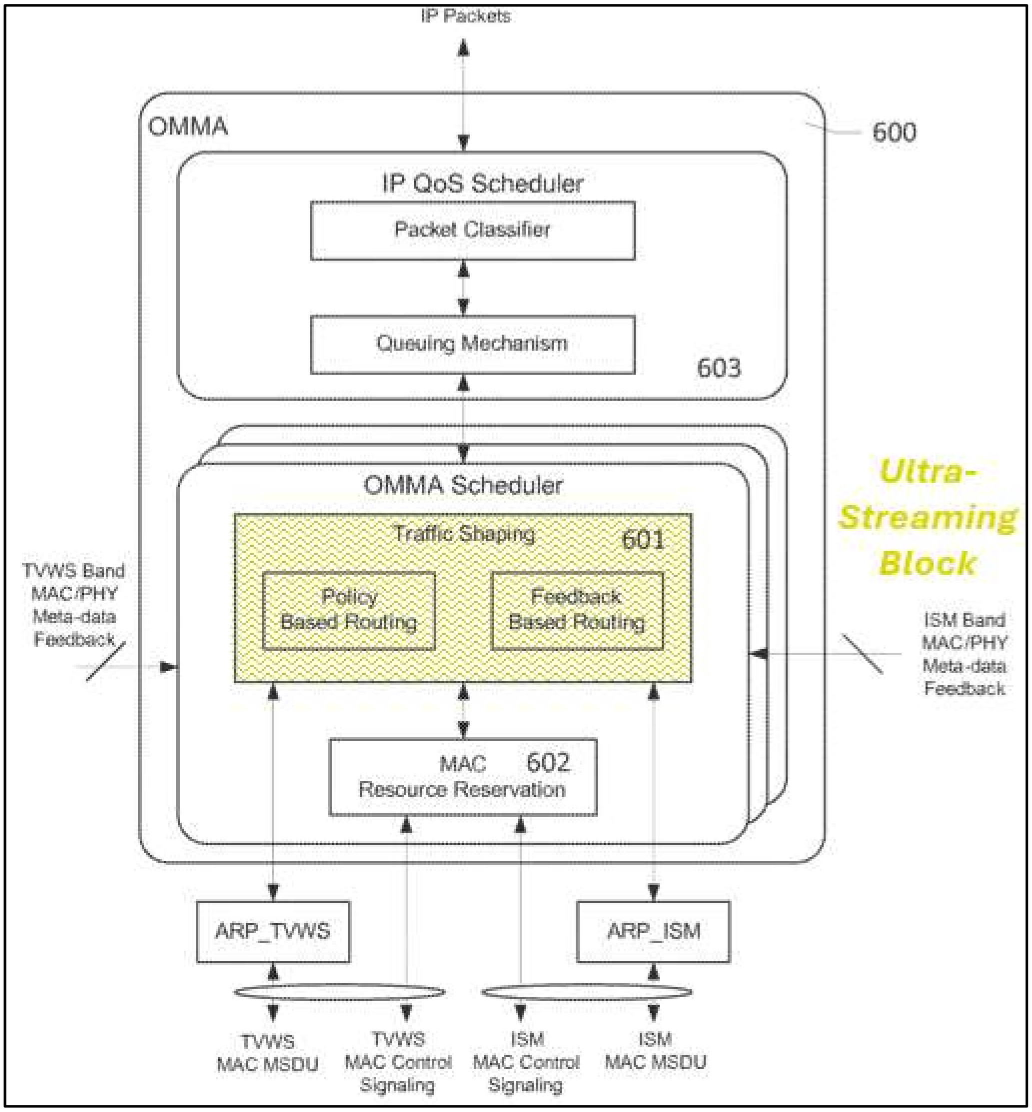
21. Claim 21: The wireless networking device of claim 1, wherein the virtual MAC interface includes a processing block.

The '591 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 3:18-20.) Chincholi discloses this same functionality in the form of the ***MAC Resource Reservation module 602***. (EX1002 at ¶160.) 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].)



22. Claim 22: The wireless networking device of claim 1, wherein the virtual MAC interface includes an ultra-streaming block.

The ’591 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 3:20-24.) Chincholi discloses this same functionality in the form of the ***Traffic Shaping Module 601***. (EX1002 at ¶161.) 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].)



23. Claim 23: The wireless networking device of claim 1, wherein the second virtual PHY interface is not contiguous with the virtual MAC interface.

As discussed above, *see* claim 19, 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 interface is not contiguous with the virtual MAC interface. (EX1002 at ¶162.)

24. Claim 24: The wireless networking device of claim 1, wherein the third virtual PHY interface is not contiguous with the virtual MAC interface.

As discussed above, *see* claim 19, 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 third virtual PHY interface is not contiguous with the virtual MAC interface. (EX1002 at ¶163.)

25. Claim 25: The wireless networking device of claim 1, wherein the processing interface includes multiple virtual MAC interfaces.

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 in and through a multiple input, multiple output (MIMO architecture). (EX1005 at [0109].) This is disclosed, for example, in Figure 1E.

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. (EX1002 at ¶¶164-165.)

Combining this functionality into a single device could, for example, leverage common hardware increasing device efficiency. (*Id.*)

26. Claim 26: The wireless networking device of claim 1, wherein the processing interface includes a bandwidth allocator

The '591 patent does not describe what additional specific functionality is performed by the claimed "bandwidth allocator." A POSITA would understand 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. (EX1002 at ¶¶166-168.)

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.*)

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. (EX1002 at ¶168.) Chincholi thus discloses a bandwidth allocator as claimed. (*Id.*)

VIII. CONCLUSION

For at least the foregoing reasons, this Petition should be instituted.

Respectfully submitted,

Date: July 3, 2025

/s/ James M. Glass

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CERTIFICATION UNDER 37 C.F.R. § 42.24

Under the provisions of 37 C.F.R. § 42.24, the undersigned hereby certifies that the word count for the foregoing Petition for *inter partes* review (excluding the table of contents, table of authorities, mandatory notices, certificate of service or word count, and appendix of exhibits or claim listing) totals 12,049 words, which is within the word limit allowed under 37 C.F.R. § 42.24(a)(i).

Date: July 3, 2025

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CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. §§ 42.6(e), 42.105(a), the undersigned hereby certifies service on the Patent Owner of a copy of this Petition and its respective exhibits at the official correspondence address for the attorneys of record for the '591 patent as shown in USPTO PAIR via FedEx:

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

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