

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. IPR2025-01207

U.S. Patent No. 12,015,933

**PETITION FOR *INTER PARTES* REVIEW
OF U.S. PATENT NO. 12,015,933**

TABLE OF CONTENTS

	<u>Page</u>
I. INTRODUCTION	1
II. MANDATORY NOTICES.....	1
A. Real Party-in-Interest (37 C.F.R. § 42.8(b)(1))	1
B. Related Matters (37 C.F.R. § 42.8(b)(2)).....	1
1. Related Patent Office Proceedings.....	1
2. Related Litigation.....	1
C. Lead and Backup Counsel and Service Information (37 C.F.R. §§ 42.8(b)(3)-(4)).....	1
D. Payment of Fees (37 C.F.R. § 42.15(a))	2
E. Requirements For <i>Inter Partes</i> Review (37 C.F.R. §§ 42.101(A)-(C), 42.104(A), AND 42.018).....	3
III. STATEMENT OF RELIEF REQUESTED AND IDENTIFICATION OF CHALLENGE (37 C.F.R. § 42.104(B)).....	3
IV. BACKGROUND	3
A. '933 Patent (EX1002 ¶¶43-51)	3
1. Priority Date.....	3
2. Specification	3
3. Prosecution History.....	5
B. Asserted Prior Art (EX1002 ¶¶60-67)	6
1. Chincholi (EX1005).....	6
2. Riggert (EX1006).....	8
3. Clegg (EX1009).....	8
V. PERSON OF ORDINARY SKILL.....	9
VI. CLAIM CONSTRUCTION.....	9
VII. GROUND 1: CHINCHOLI IN COMBINATION WITH RIGGERT AND CLEGG RENDERS CLAIMS 1-30 OBVIOUS.....	10
A. Overview and Motivation to Combine	10
B. Limitation-By-Limitation Analysis	16
1. Claim 1	16
2. Claim 2: The method of claim 1, wherein the wireless networking device comprises a wireless access point.....	46

3.	Claim 3: The method of claim 1, wherein the first and second frequency bands are specified in at least one member of the family of IEEE 802.11 standards that was in existence as of Oct. 30, 2013.....	47
4.	Claim 4: The method of claim 1, wherein the at least one virtual MAC interface includes a decision block.	47
5.	Claim 5: The method of claim 1, wherein the at least one virtual MAC interface includes a processing block.	48
6.	Claim 6: The method of claim 1, wherein the at least one virtual MAC interface includes an ultra-streaming block.	49
7.	Claim 7: The method of claim 1, wherein the first virtual PHY interface includes an RF block.....	50
8.	Claim 8: The method of claim 1, wherein the second virtual PHY interface includes an RF block.....	51
9.	Claim 9: The method of claim 1, wherein the processing interface comprises multiple virtual MAC interfaces.....	51
10.	Claim 10: The method of claim 1, wherein the processing interface includes a bandwidth allocator.....	53
11.	Claim 11: The method of claim 1, wherein the first identified actual bandwidth portion is contiguous.	54
12.	Claim 12: The method of claim 1, wherein the first virtual PHY interface is not contiguous with the at least one virtual MAC interface.....	54
13.	Claim 13: The method of claim 1, wherein the second virtual PHY interface is not contiguous with the at least one virtual MAC interface.....	55
14.	Claim 14: The method of claim 1, ...	56
15.	Claim 15: The method of claim 14, wherein the second identified actual bandwidth portion is contiguous.	57
16.	Claim 16: The method of claim 14, ...	57
17.	Claim 17: The method of claim 14, ...	59
18.	Claim 18: The method of claim 1, ...	60
19.	Claim 19: The method of claim 18, ...	63
20.	Claim 20: The method of claim 19, wherein the data transfer characteristics are representative of one or more environmental conditions where the wireless networking device is used.	66
21.	Claim 21: The method of claim 1, wherein the processing interface is configured to, after the circuitry has been connected to the application interface and when the wireless networking device is being used, and in a manner transparent to any layer of the wireless	

	networking device above the processing interface, aggregate the first identified actual bandwidth portion of the first wireless transceiver with an identified first portion of an available bandwidth of the second wireless transceiver to at least partially simultaneously transmit the first data stream to the first recipient from both of the first and second wireless transceivers.....	66
22.	Claim 22: The method of claim 21, wherein the first data stream is substantially simultaneously transmitted to the recipient from both of the first and second wireless transceivers.....	69
23.	Claim 23: The method of claim 21, wherein the processing interface is configured to, after the circuitry has been connected to the application interface and when the wireless networking device is being used, and in a manner transparent to any layer of the wireless networking device above the processing interface, aggregate the first identified actual bandwidth portion of the first wireless transceiver with an identified first portion of an available bandwidth of the second wireless transceiver to cause the first and second wireless transceivers to at least partially simultaneously receive a second data stream from the recipient.	69
24.	Claim 24: The method of claim 23, wherein the second data stream is substantially simultaneously received by both of the first and second wireless transceivers.	71
25.	Claim 25: The method of claim 1, ...	71
26.	Claim 26: The method of claim 25, wherein the second data stream is received by the second wireless transceiver substantially simultaneously with the transmission of the first data stream from the first wireless transceiver.....	76
27.	Claim 27: The method of claim 25, wherein the start of the reception of the second data stream by the second wireless transceiver is substantially simultaneous with the start of the transmission of the first data stream from the first wireless transceiver.	76
28.	Claim 28: The method of claim 25, wherein the end of the reception of the second data stream by the second wireless transceiver is substantially simultaneous with the end of the transmission of the first data stream from the first wireless transceiver.	77
29.	Claim 29: The method of claim 25, ...	77
30.	Claim 30: The method of claim 29, ...	79
VIII.	CONCLUSION.....	81

EXHIBIT LIST

Exhibit	Description
EX1001	U.S. Patent No. 12,015,933 (“the ’933 patent”)
EX1002	Declaration of Kevin Almeroth, Ph.D.
EX1003	Intentionally Omitted
EX1004	File History of U.S. Patent No. 12,015,933
EX1005	WO 2013/126859 (“Chincholi”)
EX1006	Published U.S. Patent Application 2011/0320625 (“Riggert”)
EX1007	U.S. Patent Application 2009/0141691 (“Jain”)
EX1008	U.S. Patent 9,379,868 (“Wang”)
EX1009	U.S. Patent 9,055,592 (“Clegg”)
EX1010	U.S. Patent 10,567,147 (“DiFazio”)
EX1011	Curriculum Vitae of Kevin Almeroth Ph.D.
EX1012	PO’s District Court Invalidity Contentions Cover Pleading
EX1013	PO’s District Court Invalidity Chart for US Patent No. 12,015,933
EX1014	U.S. Patent 5,345,599 (“Paulraj”)
EX1015	Gerard J. Foschini, “Layered Space-Time Architecture” (Foschini, Bell Labs Technical Journal, 1(2), 41-59) (1996).
EX1016	Intentionally Omitted
EX1017	File History of U.S. Patent No. 11,818,591

LIST OF CHALLENGED CLAIMS

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

Claim	Limitation
1[g]	(a) request or create (i) a first association between a recipient and the first actual MAC and PHY interfaces and (ii) a second association between the recipient and the second actual MAC and PHY interfaces,
1[h]	(b) identify at least one first portion of the first actual bandwidth of the first wireless transceiver, the identified at least one first portion comprising a set of given resources,
1[i]	(c) evaluate whether any of the given resources of the first identified actual bandwidth portion are unavailable for communication, and
1[j]	(d) use the first wireless transceiver to transmit the first data stream to the recipient, without requiring disassociation of the recipient from either or both of the first and second actual MAC and PHY interfaces, using a subset of frequencies corresponding to only the given resources of the first bandwidth portion that are not unavailable for communication to thereby at least partially satisfy the first wireless bandwidth requirement of the first application; and
1[k]	wherein, after the circuitry has been connected to the application interface and when the wireless networking is being used, the wireless networking device's utilization of the first available bandwidth portion of the first wireless transceiver does not prevent any wireless networking device devices from utilizing a range of frequencies corresponding to the remaining portion of the bandwidth availability of the first wireless transceiver for data transmission or reception purposes at the same time that the first bandwidth portion is being used for data transmission purposes.
2	The method of claim 1, wherein the wireless networking device comprises a wireless access point.
3	The method of claim 1, wherein the first and second frequency bands are specified in at least one member of the family of IEEE 802.11 standards that was in existence as of Oct. 30, 2013.
4	The method of claim 1, wherein the at least one virtual MAC interface includes a decision block.

Claim	Limitation
5	The method of claim 1, wherein the at least one virtual MAC interface includes a processing block.
6	The method of claim 1, wherein the at least one virtual MAC interface includes an ultra-streaming block.
7	The method of claim 1, wherein the first virtual PHY interface includes an RF block.
8	The method of claim 1, wherein the second virtual PHY interface includes an RF block.
9	The method of claim 1, wherein the processing interface comprises multiple virtual MAC interfaces
10	The method of claim 1, wherein the processing interface includes a bandwidth allocator.
11	The method of claim 1, wherein the first identified actual bandwidth portion is contiguous.
12	The method of claim 1, wherein the first virtual PHY interface is not contiguous with the at least one virtual MAC interface.
13	The method of claim 1, wherein the second virtual PHY interface is not contiguous with the at least one virtual MAC interface.
14[a]	The method of claim 1, wherein the processing interface is configured to, after the circuitry has been connected to the application interface and when the wireless networking device is being used, and in a manner transparent to any layer of the wireless networking device above the processing interface,
14[b]	(a) identify at least one second portion of the first actual bandwidth of the first wireless transceiver, the identified second bandwidth portion comprising a set of given resources, the first and second identified actual bandwidth portions not being contiguous with each other,
14[c]	(b) evaluate whether any of the given resources of the second identified actual bandwidth portion are unavailable for communication, and

Claim	Limitation
14[d]	(c) use the first wireless transceiver to transmit the first data stream to the recipient, without requiring disassociation of the recipient from either or both of the first and second actual MAC and PHY interfaces, using a subset of frequencies corresponding to only the given resources of the first and second bandwidth portions that are not unavailable for communication to thereby at least partially satisfy the first wireless bandwidth requirement of the first application.
15	The method of claim 14, wherein the second identified actual bandwidth portion is contiguous.
16[a]	The method of claim 14, wherein the processing interface is configured to, after the circuitry has been connected to the application interface and when the wireless networking device is being used, and in a manner transparent to any layer of the wireless networking device above the processing interface,
16[b]	(a) if all of the given resources of the first identified bandwidth portions are unavailable, identify at least one third portion of the first actual bandwidth of the first wireless transceiver, the third identified bandwidth portion comprising a set of given resources,
16[c]	(b) evaluate whether any of the given resources of the third identified bandwidth portion are unavailable for communication, and
16[d]	(c) use the first wireless transceiver to transmit the first data stream to the recipient, without requiring disassociation of the recipient from either or both of the first and second actual MAC and PHY interfaces, using a subset of frequencies corresponding to only the given resources of the third identified bandwidth portion that are not unavailable for communication to thereby at least partially satisfy the first wireless bandwidth requirement of the first application.
17[a]	The method of claim 14, wherein the processing interface is configured to, after the circuitry has been connected to the application interface and when the wireless networking device is being used, and in a manner transparent to any layer of the wireless networking device above the processing interface,

Claim	Limitation
17[b]	(a) if all of the given resources of the second actual bandwidth portion are unavailable, identify at least one fourth portion of the actual bandwidth of the first wireless transceiver, the fourth identified bandwidth portion comprising a set of given resources,
17[c]	(b) evaluate whether any of the given resources of the fourth identified bandwidth portion are unavailable for communication, and
17[d]	(c) use the first wireless transceiver to transmit the first data stream to the recipient, without requiring disassociation of the recipient from either or both of the first and second actual MAC and PHY interfaces, using a subset of frequencies corresponding to only the given resources of the fourth identified bandwidth portion that are not unavailable for communication to thereby at least partially satisfy the first wireless bandwidth requirement of the first application.
18[a]	The method of claim 1, wherein the processing interface is configured to, after the circuitry has been connected to the application interface and when the wireless networking device is being used, and in a manner transparent to any layer of the wireless networking device above the processing interface,
18[b]	(a) identify at least one first portion of the second actual bandwidth of the second wireless transceiver, the first identified portion of the second wireless transceiver comprising a set of given resources,
18[c]	(b) evaluate whether any of the given resources of the first identified actual bandwidth portion of the second wireless transceiver are unavailable for communication, and
18[d]	(c) if none of the given resources of the first identified bandwidth portion of the first wireless transceiver are available for communication and if the first identified bandwidth portion of the second wireless transceiver is available for communication, use the second wireless transceiver to transmit the first data stream to the recipient, without requiring disassociation of the recipient from either or both of the first and second actual MAC and PHY interfaces, using a subset of frequencies corresponding only to the given resources of the first identified actual bandwidth portion of the second wireless transceiver

Claim	Limitation
	that are not unavailable for communication to thereby at least partially satisfy the first wireless bandwidth requirement of the first application; and
18[e]	wherein, after the circuitry has been connected to the application interface and when the wireless networking device is being used, the wireless networking device's utilization of the first identified actual bandwidth portion of the second wireless transceiver does not prevent any other wireless networking device from utilizing a range of frequencies corresponding to the remaining portion of the bandwidth availability of the second wireless transceiver for data transmission or reception purposes.
19[a]	The method of claim 18, wherein the processing interface is configured to, after the circuitry has been connected to the application interface and when the wireless networking device is being used, and in a manner transparent to any layer of the wireless networking device above the processing interface,
19[b]	(a) if both the first identified actual bandwidth portions of the first and second wireless transceivers are available for communication, evaluate the data transfer characteristics of both,
19[c]	(b) if the data transfer characteristics of the first identified bandwidth portion of the first wireless transceiver are better than those of the first identified bandwidth portion of the second wireless transceiver, use the first wireless transceiver to transmit the first data stream to the recipient, without requiring disassociation of the recipient from either or both of the first and second actual MAC and PHY interfaces, using a subset of frequencies corresponding to only the given resources of the first identified bandwidth portion of the first wireless transceiver that are not unavailable for communication to thereby at least partially satisfy the first wireless bandwidth requirement of the first application, and
19[d]	(c) if the data transfer characteristics of the first identified portion of the second wireless transceiver are better than those of the first identified bandwidth portion of the first wireless transceiver, use the second wireless transceiver to transmit the first data stream to the recipient, without requiring disassociation of the recipient from either or both of

Claim	Limitation
	the first and second actual MAC and PHY interfaces, using a subset of frequencies corresponding to only the given resources of the first identified bandwidth portion of the second wireless transceiver that are not unavailable for communication to thereby at least partially satisfy the first wireless bandwidth requirement of the first application.
20	The method of claim 19, wherein the data transfer characteristics are representative of one or more environmental conditions where the wireless networking device is used.
21	The method of claim 1, wherein the processing interface is configured to, after the circuitry has been connected to the application interface and when the wireless networking device is being used, and in a manner transparent to any layer of the wireless networking device above the processing interface, aggregate the first identified actual bandwidth portion of the first wireless transceiver with an identified first portion of an available bandwidth of the second wireless transceiver to at least partially simultaneously transmit the first data stream to the first recipient from both of the first and second wireless transceivers.
22	The method of claim 21, wherein the first data stream is substantially simultaneously transmitted to the recipient from both of the first and second wireless transceivers.
23	The method of claim 21, wherein the processing interface is configured to, after the circuitry has been connected to the application interface and when the wireless networking device is being used, and in a manner transparent to any layer of the wireless networking device above the processing interface, aggregate the first identified actual bandwidth portion of the first wireless transceiver with an identified first portion of an available bandwidth of the second wireless transceiver to cause the first and second wireless transceivers to at least partially simultaneously receive a second data stream from the recipient.
24	The method of claim 23, wherein the second data stream is substantially simultaneously received by both of the first and second wireless transceivers.

Claim	Limitation
25[a]	The method of claim 1, wherein the processing interface is configured to, after the circuitry has been connected to the application interface and when the wireless networking device is being used, in a manner transparent to any layer of the wireless networking device above the processing interface,
25[b]	(a) identify at least one first portion of bandwidth available for communication of the second wireless transceiver, the identified at least one first portion of the second wireless transceiver comprising a set of given resources,
25[c]	(b) evaluate whether any of the given resources of the at least one first identified portions of the first and second wireless transceivers are not unavailable for communication,
25[d]	(c) use the first wireless transceiver to transmit the first data stream to the recipient, without requiring disassociation of either or both of the first and second associations, using a specific subset of frequencies corresponding to the given resources of the identified at least one first bandwidth portion of the first wireless transceiver that are not unavailable for communication to thereby at least partially satisfy the first wireless bandwidth requirement of the first application, and
25[e]	(d) use the second wireless transceiver to receive a second data stream from the recipient at least partially simultaneously with the first data stream being transmitted to the recipient from the first wireless transceiver, without requiring disassociation of either or both of the first and second associations, using a specific subset of frequencies corresponding to only the given resources of the identified at least one first bandwidth portion of the second wireless transceiver that are not unavailable for communication to thereby at least partially satisfy a second wireless bandwidth requirement associated with the second data stream; and
25[f]	wherein, after the circuitry has been connected to the application interface and when the wireless networking device is being used, the wireless networking device's utilization of the at least one first bandwidth portions of the first and second wireless transceivers does not prevent any wireless networking device from utilizing a range of

Claim	Limitation
	frequencies corresponding to the remaining portion of the bandwidth availabilities of the first and second wireless transceivers for data transmission or reception purposes at the same time that data is being transmitted from or received by the first and second wireless transceivers.
26	The method of claim 25, wherein the second data stream is received by the second wireless transceiver substantially simultaneously with the transmission of the first data stream from the first wireless transceiver.
27	The method of claim 25, wherein the start of the reception of the second data stream by the second wireless transceiver is substantially simultaneous with the start of the transmission of the first data stream from the first wireless transceiver.
28	The method of claim 25, wherein the end of the reception of the second data stream by the second wireless transceiver is substantially simultaneous with the end of the transmission of the first data stream from the first wireless transceiver.
29[a]	The method of claim 25, wherein the processing interface is configured to, after the circuitry has been connected to the application interface and when the wireless networking device is being used, in a manner transparent to any layer of the wireless networking device above the processing interface,
29[b]	(a) identify at least one second portion of bandwidth available for communication of the first wireless transceiver, the identified at least one second portion of the first second wireless transceiver comprising a set of given resources,
29[c]	(b) evaluate whether any of the given resources of the at least one first and identified portions of the first wireless transceiver are not unavailable for communication, and
29[d]	(c) use the first wireless transceiver to transmit the first data stream to the recipient, without requiring disassociation of either or both of the first and second associations, using a specific subset of frequencies corresponding to the given resources of the identified at least one first

Claim	Limitation
	and second bandwidth portion of the first wireless transceiver that are not unavailable for communication to thereby at least partially satisfy the first wireless bandwidth requirement of the first application.
30[a]	The method of claim 29, wherein the processing interface is configured to, after the circuitry has been connected to the application interface and when the wireless networking device is being used, in a manner transparent to any layer of the wireless networking device above the processing interface,
30[b]	(a) identify at least one second portion of bandwidth available for communication of the second wireless transceiver, the identified at least one second portion of the second wireless transceiver comprising a set of given resources,
30[c]	(b) evaluate whether any of the given resources of the at least one first and identified portions of the second wireless transceiver are not unavailable for communication, and
30[d]	(c) use the second wireless transceiver to receive the second data stream from the recipient, without requiring disassociation of either or both of the first and second associations, using a specific subset of frequencies corresponding to the given resources of the identified at least one first and second bandwidth portion of the second wireless transceiver that are not unavailable for communication to thereby at least partially satisfy the first wireless bandwidth requirement of the second application.

I. INTRODUCTION

Petitioners Samsung Electronics Co., Ltd. and Samsung Electronics America, LLC (“Petitioner”) request *Inter Partes* Review of claims 1-30 of U.S. Patent No. 12,003,933 (“’933 patent”) assigned to XiFi Networks R&D Inc. (“Patent Owner”).

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 ‘933 patent is in the same family as U.S. Patent Nos. 11,818,591 (“’591 patent”), 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”), 12,114,177 (“’177 patent”), 12,169,756 (“’756 patent”), 12,190,198 (“’198 patent”), and 12,250,564 (“’564 patent”). Petitioner is concurrently filing IPRs against the first six patents.

2. Related Litigation

Patent Owner is currently asserting the ’933 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.

LEAD COUNSEL	BACK-UP COUNSEL
James M. Glass (Reg. No. 46,729) jimglass@quinnemanuel.com QUINN EMANUEL URQUHART & SULLIVAN, LLP 295 5 th Avenue New York, NY 10016 Tel: (212) 849-7000	Patrick Schmidt (<i>pro hac vice</i> to be requested upon grant authorization) patrickschmidt@quinnemanuel.com QUINN EMANUEL URQUHART & SULLIVAN, LLP 865 S. Figueroa St., 10th Floor Los Angeles, CA 90017 Tel: (213) 443-3000 Benjamin Kleinman (Reg. No. 66,856) benjaminkleinman@quinnemanuel.com QUINN EMANUEL URQUHART & SULLIVAN, LLP 50 California Street, 22nd Floor San Francisco, California 94111 Tel: (415) 875-6600 Quincy Lu (Reg. No. 76,954) quincylu@quinnemanuel.com QUINN EMANUEL URQUHART & SULLIVAN, LLP 1109 First Avenue, Suite 210 Seattle, WA 98101 Tel: (206) 905-7000

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 '933 patent is available for *inter partes* review, Petitioner is not barred or estopped from challenging the '933 claims on the grounds identified herein, and 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 *inter partes* review of claims 1-30 (“Challenged Claims”) on the following grounds

Ground	Basis	References	Claims
1	§103	WO 2013/126859 (“Chincholi”) in combination with US 2011/0320625 (“Riggert”) and US 9,055,592 (“Clegg”)	1-30

IV. BACKGROUND

A. '933 Patent (EX1002 ¶¶43-51)

1. Priority Date

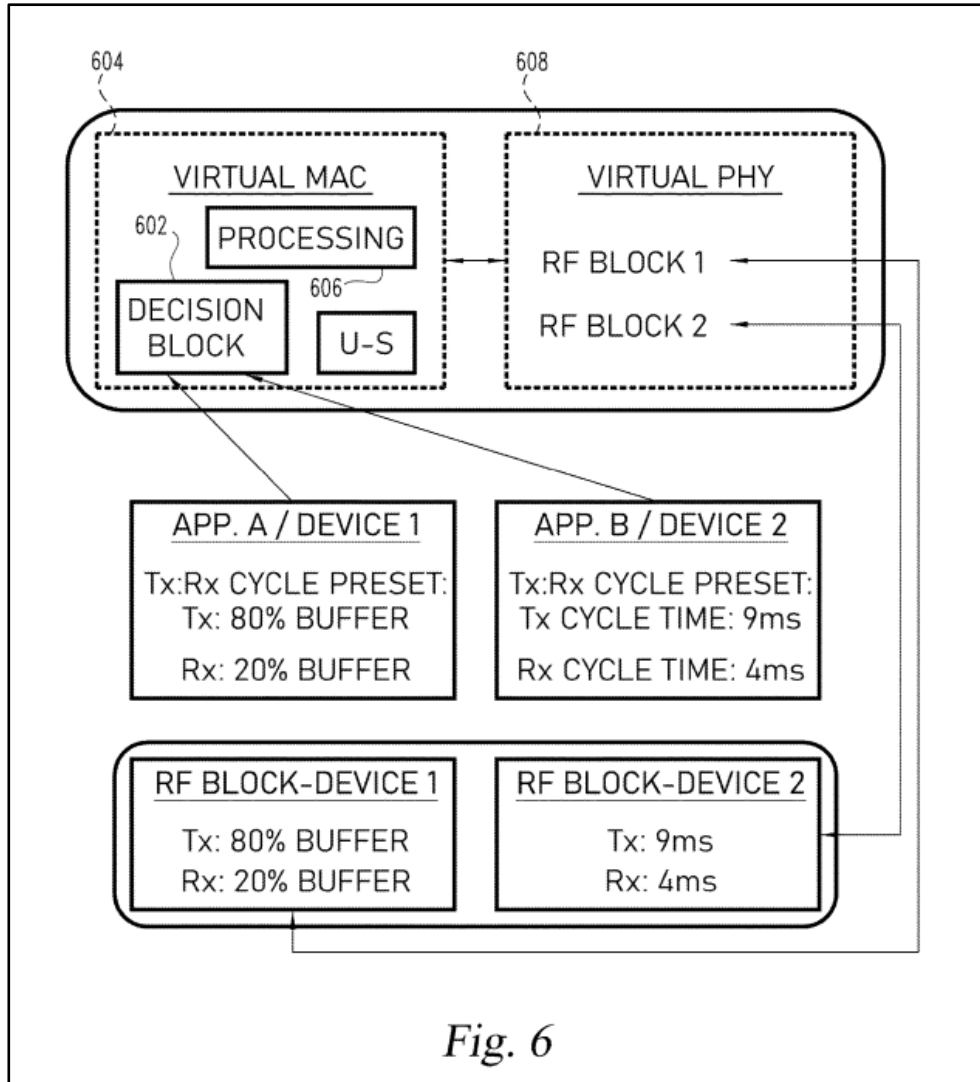
The '933 patent is a post-AIA patent whose earliest possible priority date is October 30, 2013 via U.S. Provisional Applications 61/897,216 and 61/897,219.

2. Specification

The '933 patent relates to evaluating the bandwidth requirements of applications and the bandwidth availabilities of wireless transceiver resources, and allocating available bandwidth to satisfy the requirements. (EX1001 Abstract).

The architecture “includes an application layer, actual MAC and PHY layers, and a processing layer between the actual MAC and PHY layers. *Id.* 2:59-62. 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.* 3:51-54.

For example, in the embodiment of Figure 6, the wireless networking device is stated to use the virtual MAC and PHY layers 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.* 5:48-67.



3. Prosecution History

The '933 patent was filed on March 4, 2024 as application 18/594,375, a continuation of application 18/532,175 (now US Patent 11,950,105). The applicant's Track One Request was granted on April 9, 2024 and a notice of allowance was issued on May 1, 2024, without any rejections. The patent issued on June 18, 2024.

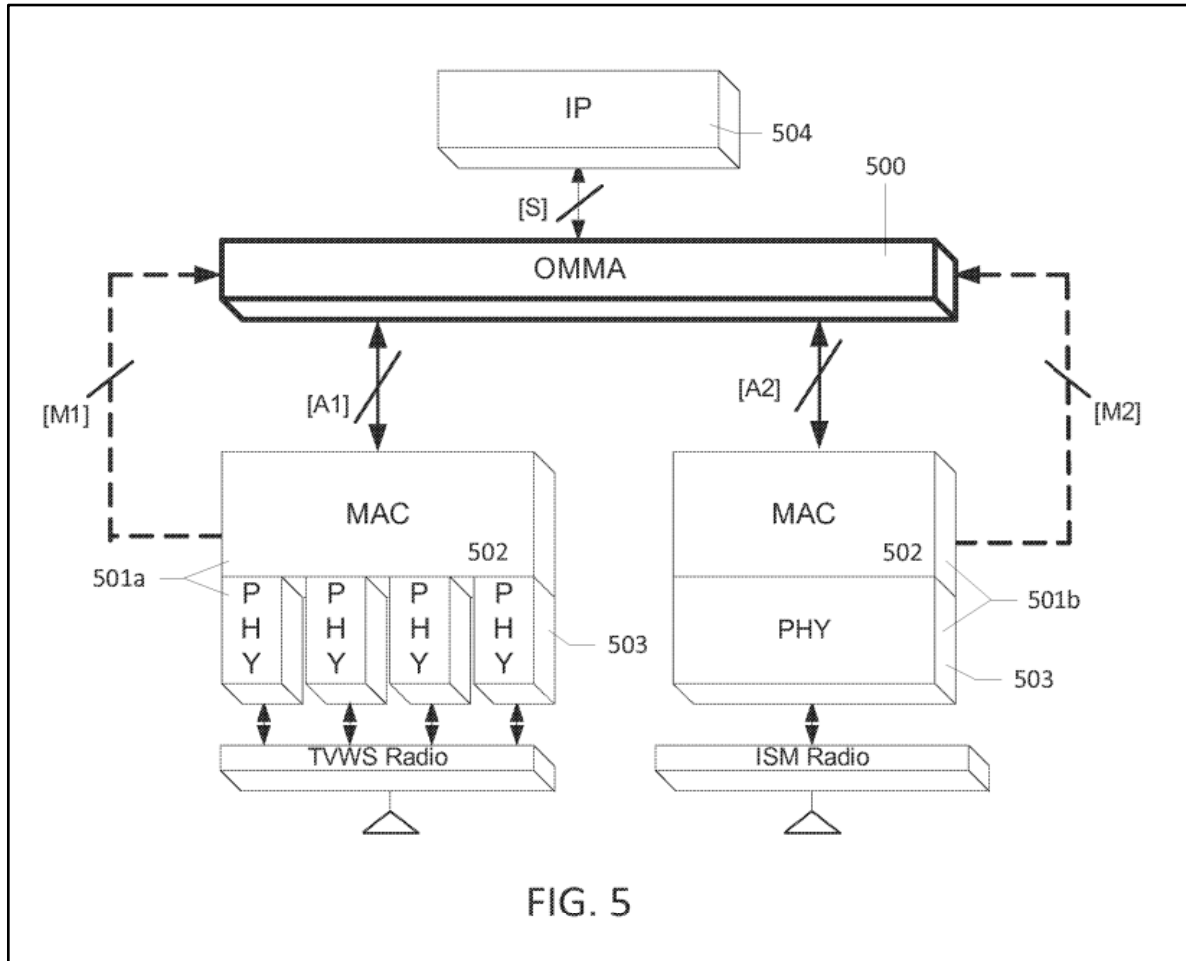
B. Asserted Prior Art (EX1002 ¶¶60-67)

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 “manag[ing] multiple radio access technology (RAT) interfaces to enable opportunistic RAT selection and aggregation for sending data traffic over the RAT interfaces.” (EX1005 [0003].) 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 [0115].) An 802.11 access point configured according to Chincholi enables “multiple RATs simultaneously [to] provide increased bandwidth and/or increased reliability for an application.” (EX1005 [0194].)

Chincholi discloses an “Opportunistic Multiple-Medium Access Control (MAC) Aggregation (OMMA) layer,” a “single thin software layer” that “enable[s] one RAT to operate over industrial scientific medical (ISM) and another RAT to operate over a TVWS band for the same IP flow.” (EX1005 [0120].) Figure 5 shows an OMMA layer enabling a dual-RAT aggregation device in an 802.11n network:



The OMMA layer processes single or multiple IP flows (*i.e.*, application data streams) and uses feedback from each RAT to best allocate transceiver resources to meet the IP flows' bandwidth requirements. The OMMA layer may aggregate available bandwidth of multiple transceivers, enabling communication paths between network devices using one or more RATs. (EX1005 [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 [0385].)

Chincholi was not before the examiner during prosecution of the '933 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 improving bandwidth efficiency and throughput in a multi-transceiver wireless communication network. (EX1006 [0004].) Riggert teaches “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 [0049].) The “bondable virtual interface” may be used generically in the framework, allowing easy substitution of one virtual interface with another without changing interface requirements. (EX1006 [0065].) As an example, Riggert describes a virtual interface pairing together two 802.11g wireless interfaces. (EX1006 [0057].)

Riggert was not before the examiner during prosecution of the ’933 patent.

3. Clegg (EX1009)

U.S. Patent 9,055,592 (“Clegg”) was filed on January 7, 2013. It is prior art under 102(a)(2).

Clegg discloses systems and methods for IEEE 802.11 communication using carrier specific interference mitigation. Clegg “utilize[s] carriers across multiple sub-channels, even across disjointed bands (e.g., 2.4 GHz, 5 GHz, and or 60 GHz

bands), without regard to whether those carriers are within an otherwise unavailable sub-channel, allowing an 802.11 device to “fully utilize the available spectrum.” (EX1009 1:32-37.)

Clegg was not before the examiner during prosecution of the '933 patent. It was first disclosed in an October 11, 2024 supplemental IDS, filed during prosecution of a related patent after the '933 patent issued.

V. PERSON OF ORDINARY SKILL

A person of ordinary skill in the art as of the asserted priority date (“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 ¶¶51-54.)

Petitioner’s expert, Dr. Almeroth, met this level by the priority date. (EX1002 ¶55.)

VI. CLAIM CONSTRUCTION

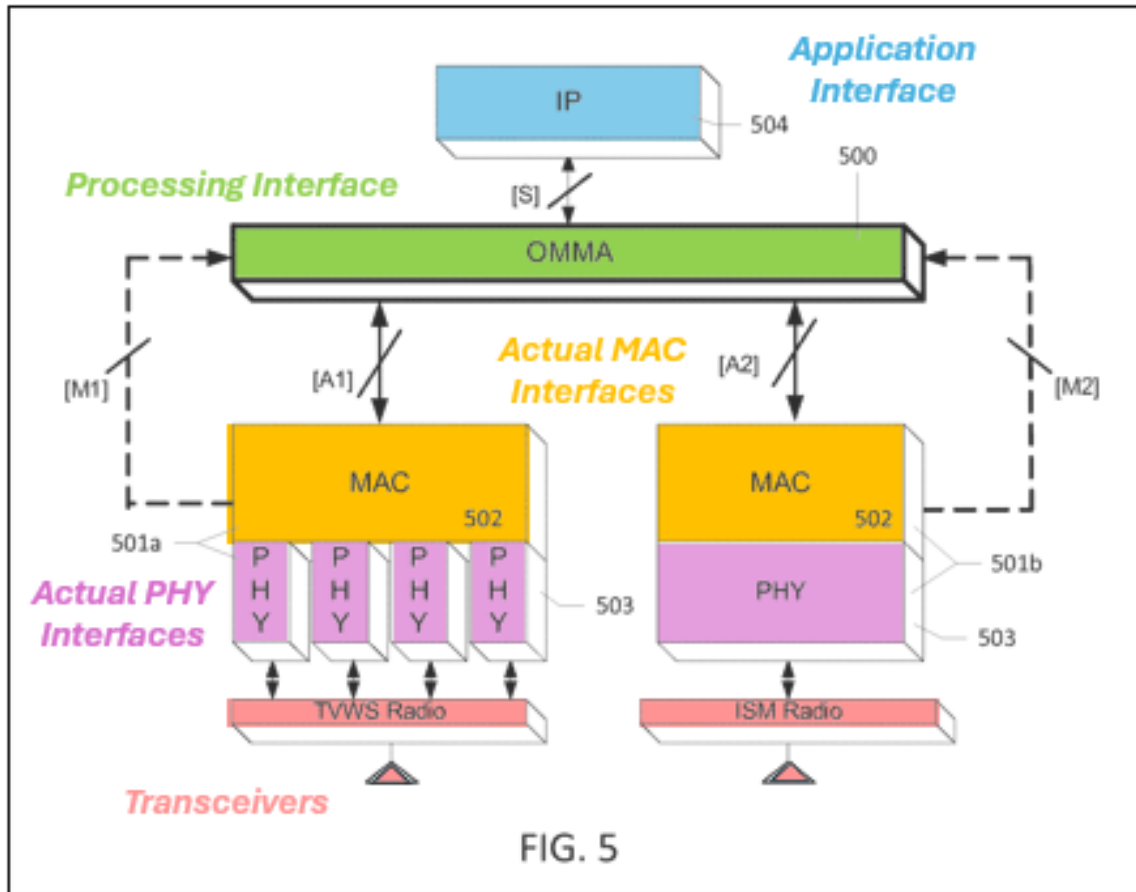
No express constructions are required to find the '933 patent claims invalid. As relevant, Petitioner addresses the plain meaning of certain terms in the analysis for the presented Grounds. (EX1002 ¶¶56-58.) The challenged claims have not been construed in other proceedings.

VII. GROUND 1: Chincholi in Combination With Riggert And Clegg Renders Claims 1-30 Obvious¹

A. Overview and Motivation to Combine

Chincholi in combination with Riggert and Clegg renders claims 1-30 obvious. (EX1002 ¶¶68-76.) As discussed in more detail below, Chincholi teaches the same architecture as the '933 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 [0122-0123].)

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

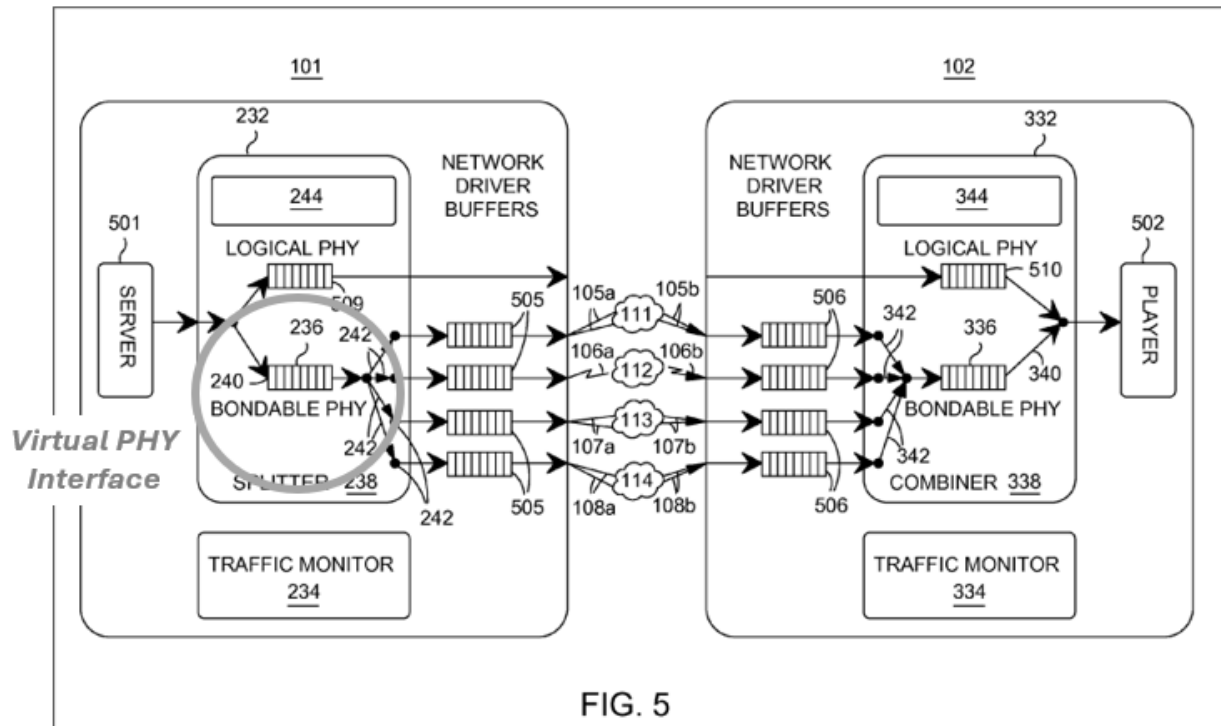


Chincholi expressly discloses receiving, at the OMMA layer, feedback information regarding bandwidth availability on a per-transceiver basis and feeding that information back to the OMMA layer's virtual MAC function. (EX1002 ¶69; EX1005 [0137].) Because Chincholi already discloses a partial virtualization of the MAC function at the OMMA layer, a POSITA would have been motivated leverage this virtualization at the OMMA/transceiver interfaces to further increase flexibility in the system. (EX1002 ¶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.

“Virtual” 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 virtual PHY interfaces would have allowed the system to accommodate communication channels with wireless devices that operate using different generations of the 802.11 standards. (EX1002 ¶70; EX1005 [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 [0034-0037]); EX1002 ¶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 recipient devices and networks. (EX1002 ¶70; EX1007 (Jain) [0033].).

A POSITA would have understood that one way of implementing virtualized PHY interfaces to further enhance Chincholi is taught in Riggert. (EX1002 ¶71.) Riggert’s “bondable virtual interface” 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 [0065].)



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 ¶72.) The references arise in the same field of endeavor and are similarly addressed to increasing bandwidth efficiency and throughput in multi-transceiver, wireless communication networks. (EX1005 [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 specifically address 802.11 type systems. (See, e.g., EX1005 [0138]; EX1006 [0057].) Riggert’s “bondable virtual interface” improved the system of Chincholi by providing a flexible, universal interface

between the OMMA layer and the actual transceiver resources. (EX1002 ¶72; EX1006 [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 improved 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 ¶72.) This combination allowed Chincholi’s system to operate seamlessly with a wider variety of recipient devices operating on different 802.11 standards. (*Id.*)

Implementing Riggert’s virtualized PHY interfaces into Chincholi would have been 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 ¶73.) A POSITA would have recognized that the combination could be accomplished with a reasonable expectation of success. (*Id.*)

Also, Chincholi teaches continuous monitoring of the “number of available resources on the medium” and distributing IP packets across the RATs accordingly. (EX1005 [0161].) Chincholi’s approach enables the system to respond to bandwidth channels, or portions of channels, becoming unavailable during transmission of a data stream. (EX1002 ¶74.) A POSITA would have understood this approach could be further enhanced by Clegg. (EX1002 ¶74.) Clegg teaches techniques for

addressing carrier-specific interference within bandwidth channels, which allows any given channel the ability to use the full channel bandwidth that is not unavailable for communication. Like Chincholi and Riggert, Clegg arises in the field 802.11 wireless communication networks and is addressed to increasing bandwidth efficiency. (EX1009 1:25-37.)

A POSITA would have been motivated to incorporate Clegg to improve Chincholi/Riggert by allowing it to more flexibly and efficiently utilize available channels that may experience carrier-specific interference. (EX1002 ¶75.) Chincholi teaches dynamic allocation of contiguous or non-contiguous channels, and Clegg provides additional detail on how to mitigate carrier-specific interference within any given channel. (EX1002 ¶75.) Clegg compliments Chincholi, and a POSITA would have recognized Clegg's teachings could be implemented into Chincholi without technical challenge. (EX1002 ¶75.)

The combined system and methods improve Chincholi/Riggert by allowing, for any given channel, full usage of the channel bandwidth that is not unavailable for communication, a benefit not achieved alone by Chincholi/Riggert. The combination (Chincholi/Riggert/Clegg) allows the resulting systems and methods to operate seamlessly with a wider variety of recipient devices operating on different versions of the 802.11 standards. (EX1002 ¶75.)

B. Limitation-By-Limitation Analysis

1. Claim 1

a) 1[pre]: A method of improving the performance of circuitry, comprising the steps of:

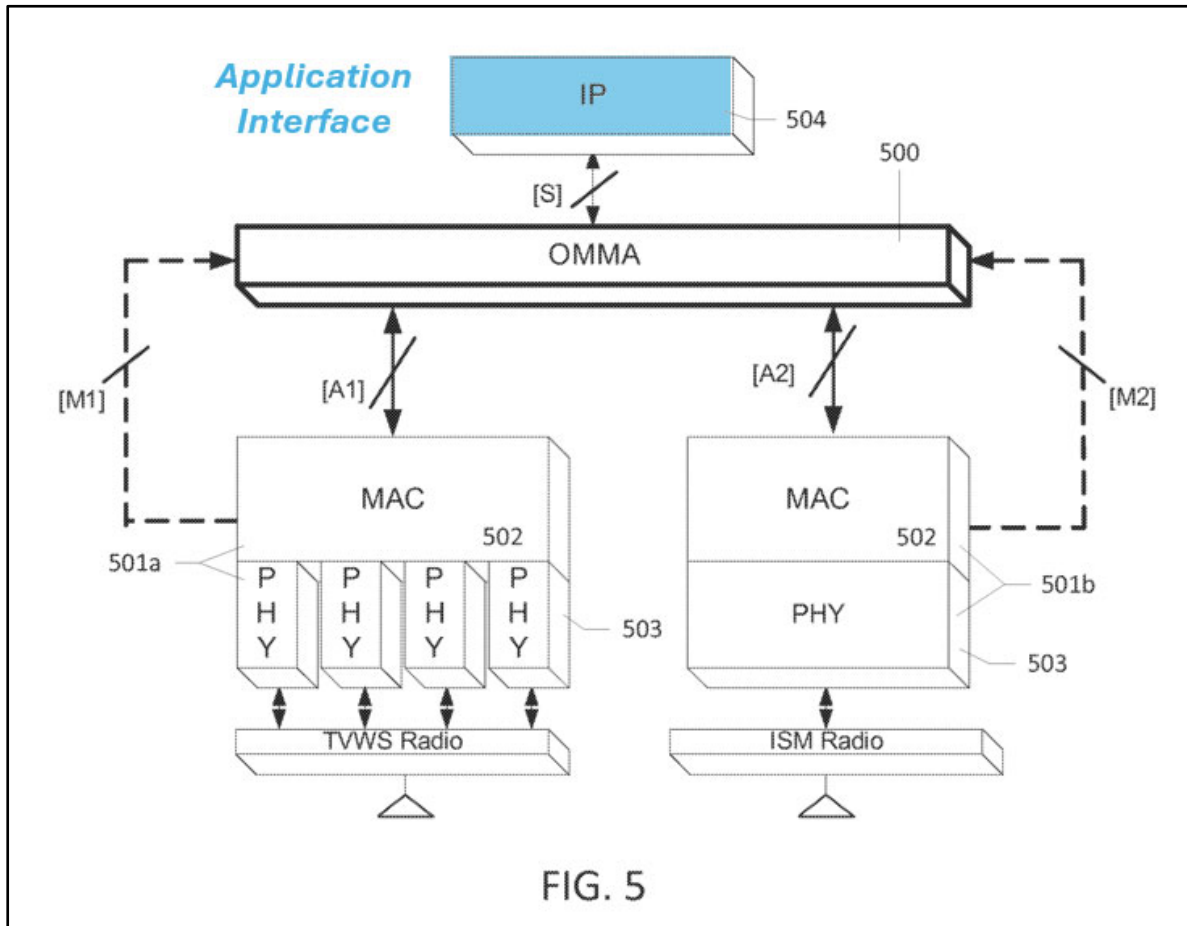
Chincholi discloses “[s]ystems, methods, and instrumentalities . . . for managing multiple radio access technology (RAT) interfaces ...” (EX1005, Abstract; [0003]) and “enabl[ing] opportunistic RAT selection and aggregation for sending data traffic over the RAT interfaces.” (EX1005 [0003]; EX1002 ¶77.) “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 [0002].)

Chincholi’s use of “multiple RATs simultaneously may provide *increased bandwidth and/or increased reliability* for an application. For example, a system comprising an OMMA layer may intelligently manage data traffic across multiple RATs for *improved performance*.” (EX1005 [0194].) A POSITA would have understood Chincholi’s disclosure for improving the bandwidth, reliability, and performance of data is a *method of improving the performance of circuitry*. (EX1002 ¶78.) Thus, as discussed in the below limitations, Chincholi/Riggert/Clegg discloses a method for improving the performance of circuitry.

- b) **1[a]: providing a processing interface that is adapted to be connected to an application interface of a wireless networking device, the application interface being associated with a first application, the first application providing, after the circuitry has been connected to the application interface and when the wireless networking device is being used, a first data stream and having a first wireless bandwidth requirement;**

“application interface being associated with a first application... providing, after the circuitry has been connected to the application interface and when the wireless networking device is being used, a first data stream”: Chincholi discloses “[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 [0191]; EX1002 ¶¶79-80.) The first data stream of a first application is referred to as an “IP flow.” (EX1005 [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 after the circuitry has been connected to the application interface when the wireless networking device is being used. (EX1005 [0138], Table 1 (“S” interface is for “Incoming/Outgoing IP Packets”).) The interface from the IP layer for the IP stream “[S]” is therefore an *application interface being associated with a first application*.

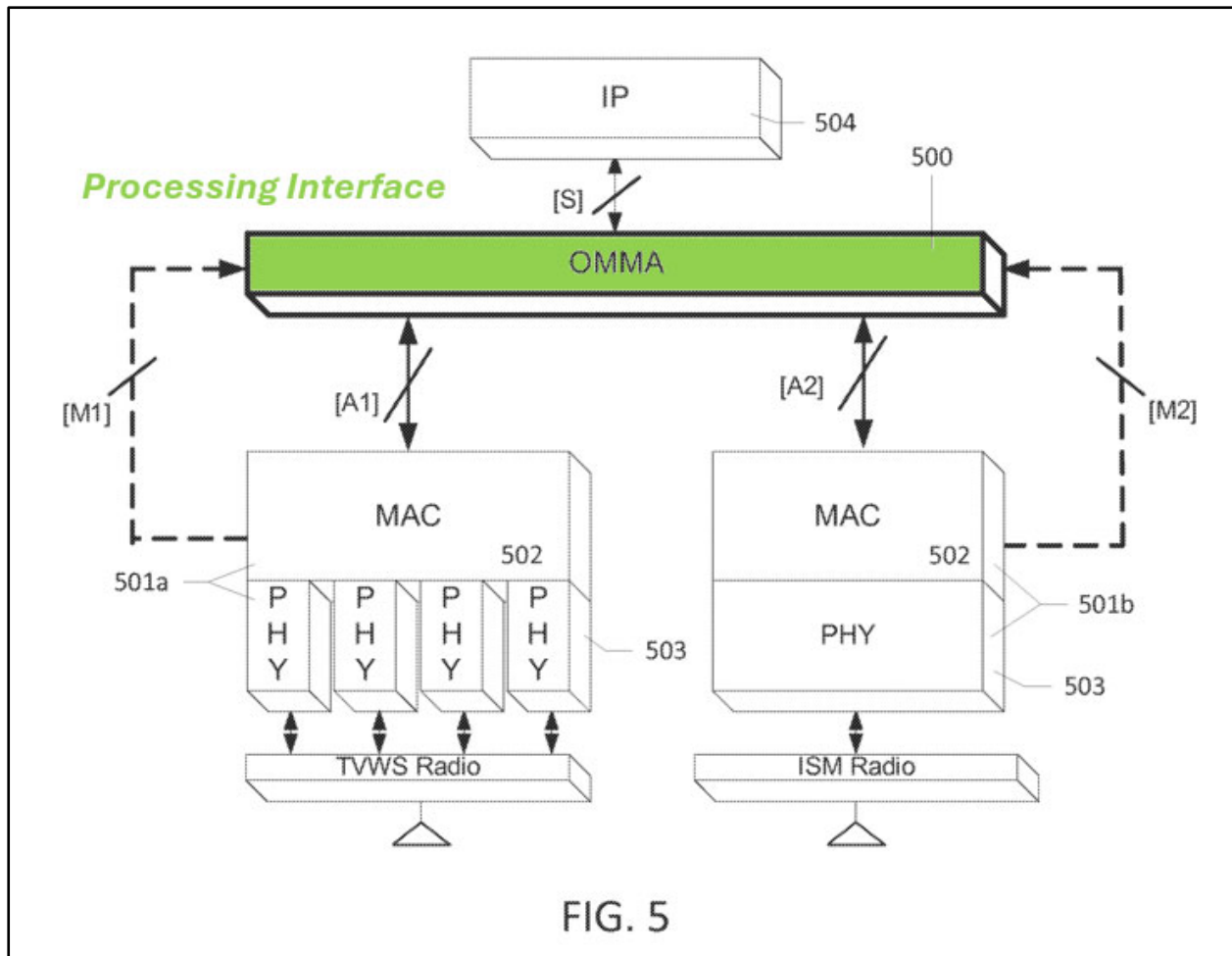
A POSITA would have understood Chincholi's "S" interface for Incoming/Outgoing IP Packets (*i.e.*, *application interface*) cannot transmit or receive data without *the circuitry ha[ving] been connected to the application interface*. (EX1002 ¶81.)



“a processing interface that is adapted to be connected to application interface of a wireless networking device”: Chincholi discloses a “processing interface” that is connected to its “application interface.” Chincholi’s *processing interface* is its *“Opportunistic Multiple-Medium Access Control (MAC) Aggregation (OMMA) layer.”* (EX1005 [0003].) This is a common layer/module

between the IP layer/module and the multiple RAT layers/modules. (EX1005 [0137]; [0120].) A POSITA would have understood that the plain meanings of “interface” and “layer” in the context of the ’933 patent are congruent, as underscored by the specification describing layers having the same functionality as the claimed interfaces and by the prosecution history of the prior related ’591 patent, where Applicant interchangeably used the terms to describe Figure 1. (EX1002 ¶82; EX1017, Aug. 8, 2023 Response to Non-Final Office Action.)

Figure 5 shows an OMMA layer enabling a dual-RAT aggregation device in a 802.11n network:



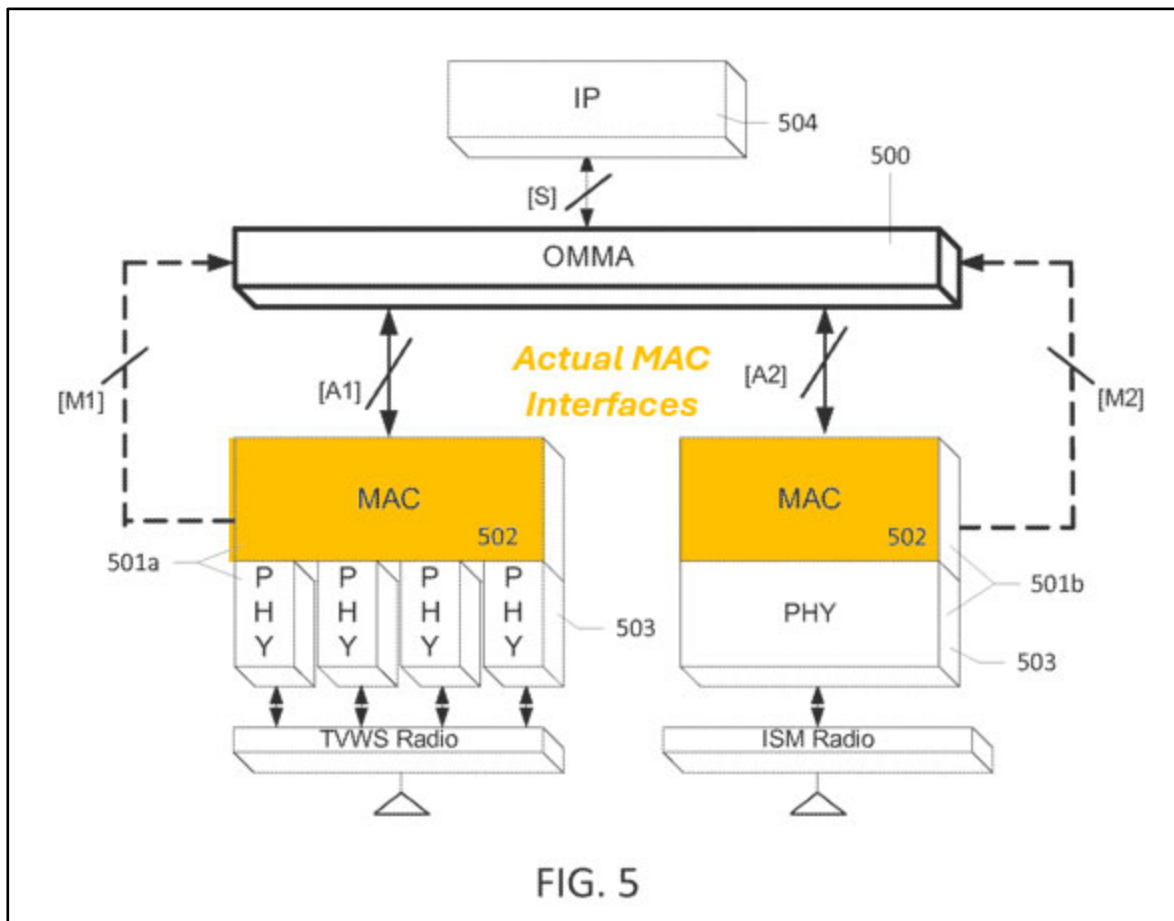
The IP layer is connected to the OMMA layer and provides IP packets the OMMA layer processes. (EX1005 [0137]; EX1002 ¶¶83-85.) The OMMA “may allow for enhanced throughput and reduced latency for a single IP flow.” (EX1005 [0120].) The OMMA layer is therefore a processing layer, which processes IP packets and provides an *interface* between the IP layer and actual MAC layers, *i.e.*, a *processing interface*.

“first application ... having a first wireless bandwidth requirement”: Chincholi teaches “a bandwidth requirement for an IP flow.” (EX1005 [260];

EX1002 ¶86.)

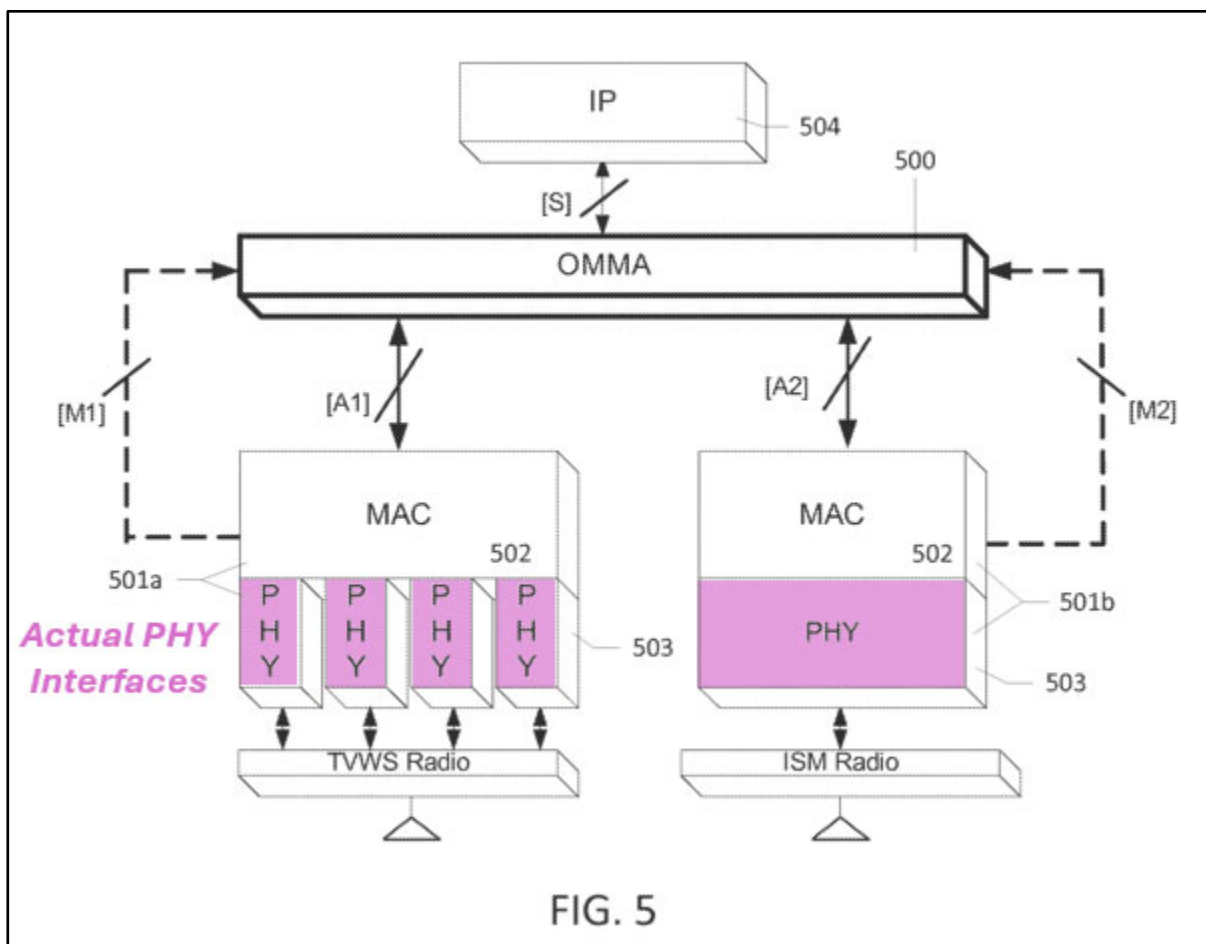
c) 1[b]: connecting first and second actual MAC interfaces to the processing interface:

Chincholi discloses connecting first and second *actual MAC interfaces* to the processing interface (*i.e.*, the OMMA layer). (EX1002 ¶¶87-88.) Figure 5 depicts a “dual-RAT aggregation” with the common OMMA layer above and connected to two RATs 501a and 501b, which respectively comprise first and second actual MAC interfaces 502. (EX1005 [0138] (“*The RATs 501a, 501b may comprise a MAC layer/module 502 and one or more physical layers/modules 503.*”).)



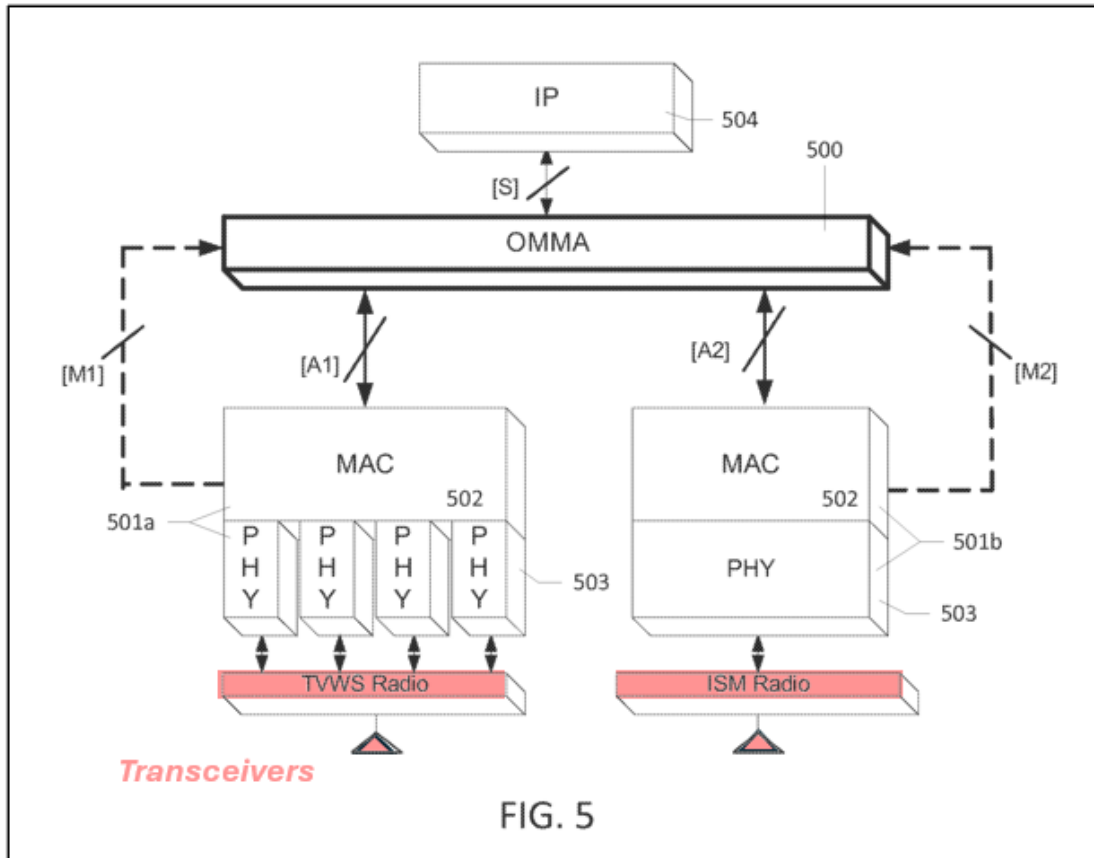
d) 1[c]: connecting first and second actual PHY interfaces respectively to the first and second actual MAC interfaces:

Each RAT comprises *one or more physical layers*. (EX1005 [0138] (“The RATs 501a, 501b may comprise a MAC layer/module 502 and *one or more physical layers/modules 503*.”); EX1002 ¶¶89-90.) Chincholi discloses connecting the actual PHY layers to the actual MAC interfaces:



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

“respectively associating first and second wireless transceivers with the first and second actual PHY interfaces... suitable for use in a wireless local area network”: Chincholi Figure 5 associates each actual PHY interface of each RAT with an *antenna/radio frequency (RF) front-end pair*. (EX1005 [0133]; EX1002 ¶¶91-92.) The *antenna/radio frequency (RF) front-end pairs* in Figure 5 includes *first and second transceivers*.



A POSITA would have understood a “transceiver” is a physical device that can transmit and receive information. (EX1002 ¶93.) Each of Chincholi’s disclosed “antenna/RF front-end pairs” is a transceiver because each operates on wireless protocols that both transmit and receive data, such as IEEE802.11, IEEE802.11ac, IEEE802.11af, LTE, WCDMA, etc. (EX1005 [0134].) A POSITA would have understood the transceivers in Figure 5 are associated with the actual PHY layer of each respective RAT, because the PHY layer is the physical connection between a transceiver and the rest of the RAT. (EX1002 ¶93.)

Chincholi teaches each RAT may be a Wi-Fi RAT, and thus their associated

transceivers are suitable for use in a wireless local area network. (EX1005 [0134], EX1002 ¶94.)

“each one of the first and second wireless transceivers... has a first and second bandwidth availability up to a first and second actual bandwidth”:

The plain meaning of this limitation is that each wireless transceiver has at least two bandwidth availabilities and two actual bandwidths. (EX1002 ¶95.) However, Patent Owner alleges in the parallel litigation that this limitation is met if each of the two wireless transceivers has only one bandwidth availability up to an actual bandwidth. (EX1013 20-21.) Chincholi discloses or renders obvious this limitation under either interpretation. (EX1002 ¶96.)

A POSITA would have recognized each transceiver has an “actual” bandwidth (total bandwidth of the transceiver) with a “bandwidth availability” that may be a subset of the actual bandwidth (sub-portions of the total bandwidth are available for use). (EX1002 ¶97.) Chincholi teaches that 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 [0138]; [0161] (listing “Channel bandwidth(s)” sent by the PHY layer as an example of “feedback metric[] used by an OMMA layer”); [0167] (“At startup, the OMMA layer may receive the ***available bandwidth of each of the one or more RATs.***”).) Thus, Chincholi discloses each of the two transceivers have a bandwidth availability

up to an actual bandwidth.

Chincholi also discloses multiple available bandwidths for each transceiver. A transceiver's feedback metrics include available "[c]hannel bandwidth(s)" in the form of a "Vector/list of elements which are multiple of 0.5 MHz." (EX1005 [0161], Table 2.) A POSITA would have understood a "vector" or "list" is a data structure for transferring multiple data elements of indeterminate count, and would therefore have understood the number of available "channel bandwidths" stored in it could and would exceed two. (EX1002 ¶98.)

"each of the first and second wireless transceivers... is adapted to emit radio waves in first and second different band of frequencies": The plain meaning of this limitation is each transceiver emits radio waves in two frequency bands. Patent Owner has read this limitation to require each transceiver emit on a single frequency band, different from that used by the other. (EX1013 20-21; EX1002 ¶99.) Chincholi discloses or renders obvious this limitation under either interpretation.

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 "[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 [0135].) Thus, a POSITA would have understood Chincholi discloses this limitation under PO’s interpretation. (EX1002 ¶100.)

Chincholi discloses each transceiver can emit radio waves within the same at least two frequency bands. For example, Chincholi describes that an NT and WTRU “may communicate with each other over a single radio frequency (RF) spectral band” such as “2.4 GHz ISM band, *or* 5 GHz ISM band,” even when the devices are “multi-RAT capable devices,” *i.e.* comprising multiple transceivers. (EX1005 [0118].) Chincholi further describes the frequency band is comprised of “multiple contiguous or noncontiguous channels” within the band over which the devices communicate. *Id.* Accordingly, a POSITA have understood each transceiver operating on the 2.4 GHz ISM band is adapted to emit radio waves in any one of two contiguous channels, *i.e.* the *first and second different bands of frequencies*. (EX1002 ¶101.)

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

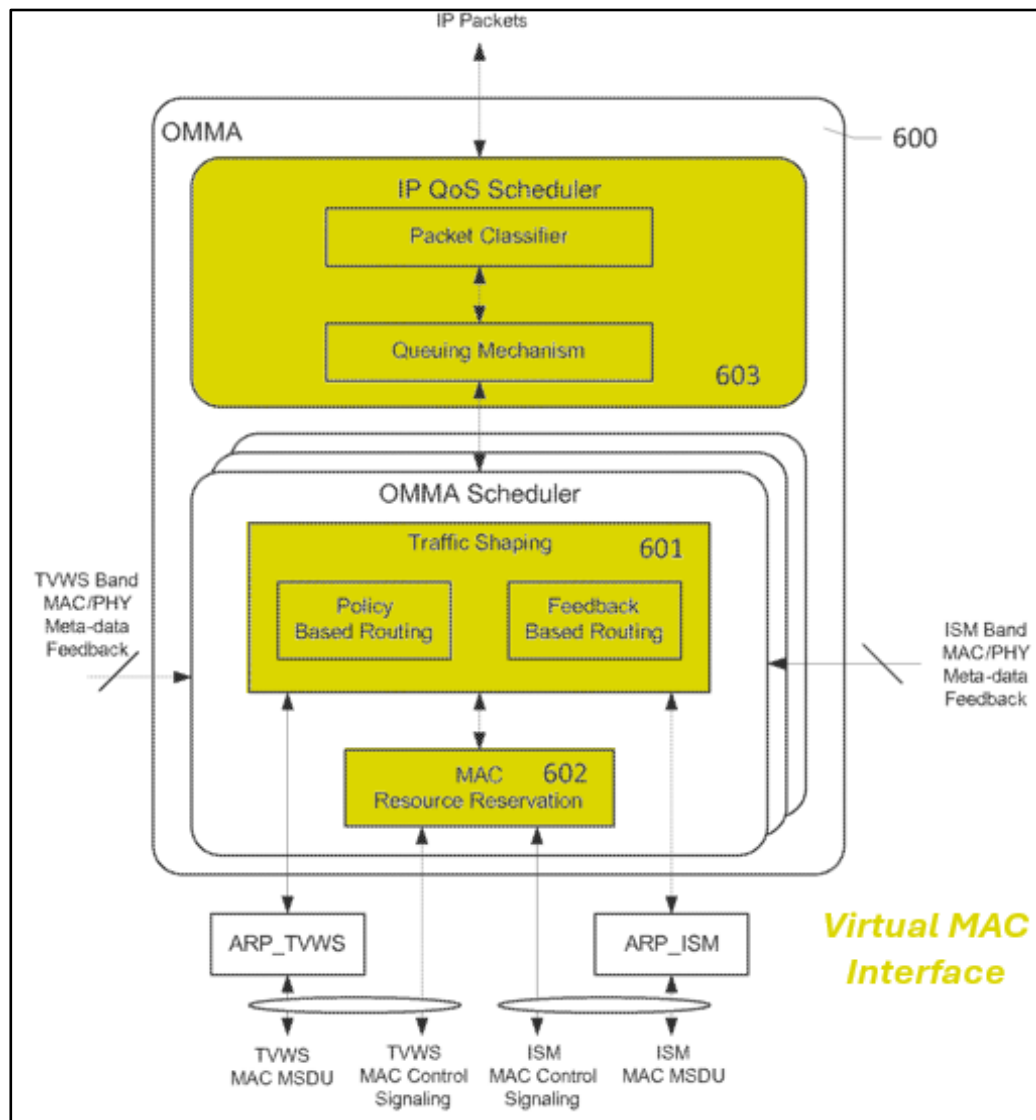
According to the '933 patent, the claimed virtual MAC and PHY layers

“enable simultaneous allocation of multiple PHY resources for different signal types associated with different applications.” (EX1001 3:52-54.) 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 4:49-52; EX1002 ¶¶102-103.) The virtual PHY layer may include multiple RF blocks, each representing the virtual use of some set of allocated transceiver resources. (EX1001 4:52-54; 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 6:4-8.)

First, Chincholi discloses the OMMA (*i.e.*, the processing interface) includes the claimed “*virtual MAC interface*.” “OMMA” is an abbreviation for “opportunistic multi-medium access control (*MAC*) *aggregation*,” referring to the OMMA layer aggregating multiple MAC interfaces, as depicted in Figure 5. (EX1005 [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 [0120].) A POSITA would have recognized 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 ¶104.)

Chincholi's OMMA layer also includes all of the functionality the patent associates with the "virtual MAC interface." 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 [0139].)



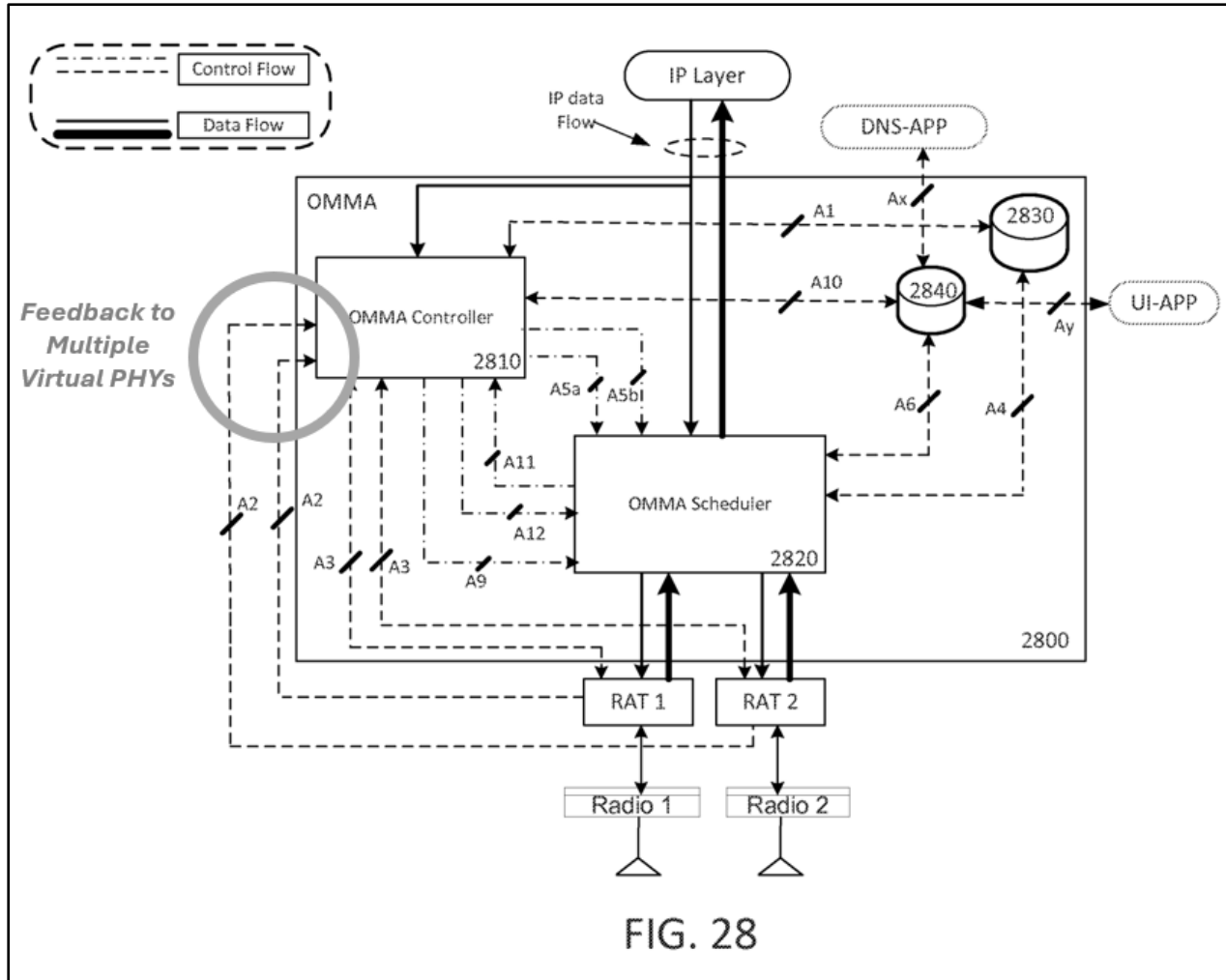
The IP QoS Scheduler classifies incoming packets of a packet stream, and may segregate them into distinct IP QoS streams (EX1005 [0143]), which a POSITA

would have recognized as the functionality of the “decision block” of the patent’s “virtual MAC interface” (EX1002 ¶106; EX1001 3:31-34). The MAC Resource Reservation module determines the time duration or spectral fragment/bandwidth required by a packet or set of packets (EX1005 [0142]), which a POSITA would have recognized as the functionality of the “processing block” of the patent’s “virtual MAC interface” (EX1002 ¶106; EX1001 3:34-36). The Traffic Shaping module determines the way packets are routed across RATs using either policy based routing or feedback based routing (EX1005 [0139]), which a POSITA would have recognized as the functionality of the “ultra-streaming block” of the patent’s “virtual MAC interface” (EX1002 ¶106; EX1001 3:36-40). Thus, a POSITA would have recognized Chincholi’s OMMA layer includes a “*virtual MAC interface*.” (EX1002 ¶106.)

Second, Chincholi discloses its processing interface comprises the “*forming in the processing interface...first and second virtual PHY interfaces*” to feed information regarding the bandwidth availabilities of the first and second wireless transceivers back to the at least one virtual MAC interface. (EX1002 ¶107.) Chincholi discloses the traffic shaping module of the OMMA (*i.e.*, part of the “virtual MAC interface”) may determine packet routing using “feedback based routing.” (EX1005 [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 [0161].)

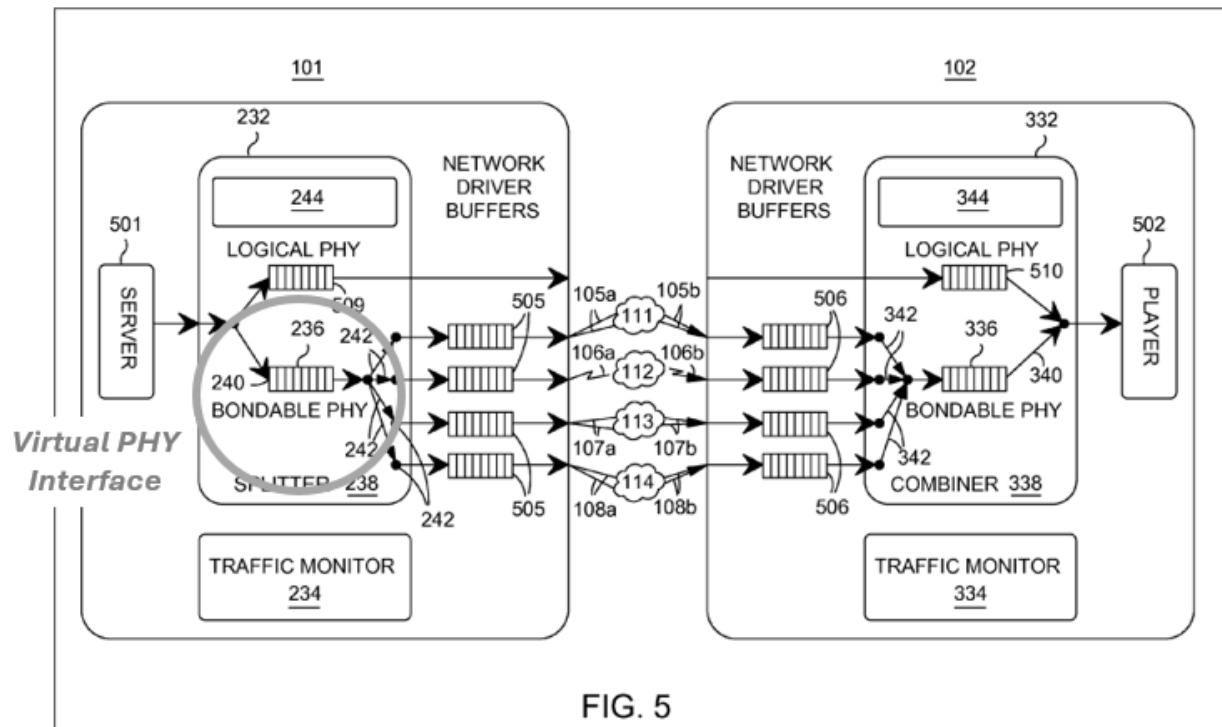
Figures 28, 29, and their associated descriptions describe how Chincholi collects feedback from each RAT for the traffic shaping module. Figure 28 illustrates how the OMMA layer includes an OMMA Controller, which interfaces with each RAT to collect metrics regarding the channel quality and number of resources available on the medium. Specifically, using interface A2 in Figure 28, “[a] RAT (*e.g., each RAT*) may provide feedback metrics (*e.g., a vector comprising a value of serving rate, jitter, packet delay, and packet loss rate on its MAC*) to the OMMA Controller 2900 ***per device (e.g., WTRU or NT) per access category supported at that RAT.***” (EX1005 [0205].) It would have been obvious to a POSITA to incorporate first and second virtual PHY interfaces into the OMMA Controller of Chincholi to collect the disclosed feedback metrics from the RATs over the “A2” interface and feed it back to the virtual MAC interface. (EX1002 ¶108.)



Further details regarding the implementation of virtual PHY interfaces is disclosed by Riggert. (EX1002 ¶109.) 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 [0065].) Providing this sort of virtualized physical interface for transceivers in an 802.11 system is particularly beneficial as it allows an access point to accommodate communication channels with wireless devices that may operate using various

different generations of the 802.11 standards. (EX1002 ¶112.) Virtualization of the physical interface for this purpose is taught, for example, in background reference U.S. Patent Application 2009/0141691 (“Jain”). (See EX1007 [0034-0037]); (EX1002 112).

Figure 5 teaches the basic architecture for implementing “bondable virtual interfaces” in the wireless network devices of a multi-channel network:



The “bondable virtual interface” in Figure 5 on the server side is denoted as a “bondable PHY” (240). (EX1002 ¶¶110-111.) While the exemplary architecture depicts only a single “bondable virtual interface” associated with four actual transceiver resources, Riggert teaches *multiple* physical bondable interfaces are possible in a single device. For example, each network endpoint may comprise a

“plurality of bondable virtual interface connectors 244 and 344, respectively,” each one of which may be associated with specific bondable virtual interface. (EX1006 [0069]; EX1002 ¶¶110-111.)

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. 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. (EX1002 ¶112.)

- g) **1[f]: wherein the processing interface is configured to, after the circuitry has been connected to the application interface and when the wireless networking device is being used, and in a manner transparent to any layer of the wireless networking device above the processing interface,**

Chincholi discloses its OMMA layer (*i.e.*, processing interface) is configured to operate in a manner transparent to any higher layer. (EX1002 ¶¶113-114.) For example, Chincholi discloses “[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 [0192], [0126].) This is as opposed to a “non-transparent” configuration in which the OMMA layer would “add[] additional headers [] at the

transmitter, and reads and/or removes the headers at the receiver.” (EX1005 [0192], [0126].)

- h) 1[g]: (a) request or create (i) a first association between a recipient and the first actual MAC and PHY interfaces and (ii) a second association between the recipient and the second actual MAC and PHY interfaces:**

Chincholi discloses techniques for network terminals and WTRUs to discover one another using active and passive scanning procedures. (EX1005 [0145]; (EX1002 ¶¶115-116.) After an authentication procedure, Chincholi discloses WTRUs may transmit a request to associate with one or more RATs of the network terminal and the network terminal may provide an association response signal accepting or rejecting the request of the WTRU. (EX1005 [0149].) A POSITA would have recognized 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 ¶116.)

When operating transparently with respect to higher layers, *see* limitation [1f], Chincholi’s OMMA layer handles the request/response and creation of associations with WTRUs. (EX1005 [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 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 ¶117.)

- i) **1[h]: (b) identify at least one first portion of the first actual bandwidth of the first wireless transceiver, the identified at least one first portion comprising a set of given resources,**

Chincholi teaches NTs and WTRUs communicate with one another over “channels,” which are portions of a transceiver bandwidth availability. (EX1002 ¶¶118-119.) 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 [0118]; [0121] (“An 802.11 based system may operate in a time division duplexing (TDD) mode, for example, *on a band over a single 20/40MHz channel in the case of ISM band or a single 5/10/20 MHz channel in television white space (TVWS) band* using contiguous/non-contiguous carrier aggregation.”).)

Chincholi also discloses identifying available bandwidth channels for communication. (EX1002 ¶120.) The OMMA layer receives various feedback information from each RAT. (EX1005 [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 [0161].) Amongst the available resources provided as part of the feedback information are the “number of channels” and “channel bandwidth” (*i.e.*, the width of the channel, such as 20/40 MHz in the case of the ISM band). (EX1005 [0161].)

A POSITA would have understood the ability of Chincholi’s OMMA layer to receive from each RAT a number of channels and channel bandwidth is an identification of “at least one portion” (*i.e.*, at least one available channel, or an aggregation of multiple contiguous or non-contiguous channels) of the first actual bandwidth of the first wireless transceiver. (EX1002 ¶121.) A POSITA would have further understood each identified channel bandwidth is comprised of a number of frequency carriers, which are a set of given communication resources for the identified channel. (EX1002 ¶121.)

Chincholi further discloses the OMMA layer allocates bandwidth resources to the transceiver resources. (EX1002 ¶122.) As Chincholi teaches, “the OMMA layer may determine a time duration and a bandwidth requirement for an IP flow.” (EX1005 [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 [0194].)

Specifically, Chinchoi 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 [0260]; EX1002 ¶123.) “The resources are characterized by the time duration and the bandwidth requirement.” (EX1005 [0260].) 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 [0142].)

Chincholi goes on to detail multiple feedback-based OMMA algorithms for allocating IP packets across respective RATs based on their bandwidth availability. (EX1005 [0162]; EX1002 ¶124.) 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 [1063].) 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 [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 [0164]-[0165]; EX1002 ¶125).

Indeed, consistent with the purported technological advance of the '933 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 ¶126.) 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 [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 [259].)

j) 1[i]: (c) evaluate whether any of the given resources of the first identified actual bandwidth portion are unavailable for communication, and

A POSITA would have understood that the plain meaning of resource “unavailable” in the context of the '933 patent broadly includes resources that are partially or completely unavailable or that have less bandwidth availability than another resource. (EX1002 ¶¶127-128.) Indeed, during prosecution of the prior related '591 patent, 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.”(See EX1002 ¶128; EX1017 Aug. 8, 2023 Applicant Remarks.) As discussed above, *see* limitation 1[h], Chincholi discloses “feedback based routing” wherein the “number of available resources on the medium” of each RAT is monitored and IP packets are distributed across the RATs accordingly. (EX1005 [0161].) The OMMA layer may, for example, maintain a “RAT capability database” storing the available RAT capability for an associated WTRU/NT (EX1005 [0233], and “continuously updat[ing]” this information based on feedback metrics, (EX1005 [235].) A POSITA would have understood Chincholi’s ability to use feedback metrics to continuously monitor available resources to disclose the capability to evaluate whether any given resources of the first identified bandwidth portion are unavailable for communication. (EX1002 ¶128.)

In addition, evaluating unavailability of given resources within the first identified bandwidth portion is further taught by Clegg. (EX1002 ¶¶129-130.) Clegg teaches a technique for a multi-band 802.11 device to “increase data throughput by aggregating one or more of the available sub-channels for simultaneous use in transmitting and receiving data.” (EX1009 1:25-28.) To accomplish this, Clegg teaches the use of an “ultra-wideband tuner to *evaluate* the entire available spectrum between several communication bands.” (EX1009 3:60-63.) Specifically, an 802.11

access point may “search across 1) available bands (e.g., the 2.4 GHz, 5 GHz, and/or 60 GHz bands), and 2) sub-channels within each band, and measure interference on a carrier-by-carrier basis across those bands and sub-channels.” (EX1009 4:5-9.) Each carrier is evaluated to determine whether interference is “too high or above a threshold amount.” (EX1009 7:16-17.) Clegg can use this information to create a “channel map” identifying the available carriers across entire communication bands or discrete sub-channels “so that a user can select subcarriers from across those bands to form a cluster for communication.” (EX1009 7:19-22.)

A POSITA would have understood Clegg’s carrier-by-carrier evaluation of interference to disclose an evaluation of whether any of the given resources of the first identified bandwidth portion are unavailable for communication. (EX1002 ¶131.)

For the reasons discussed above, *see* Section VII.A, a POSITA would have been motivated to combine Clegg’s teachings about how to mitigate carrier-specific interference into the combined Chincholi/Riggert system. The resulting combination would implement Chincholi’s ability to dynamically allocate contiguous or non-contiguous bandwidth channels along with Clegg’s ability to mitigate interference within channels on a carrier-by-carrier basis, thus increasing the bandwidth efficiency of the combined system. (EX1002 ¶132.)

- k) **1[j]: (d) use the first wireless transceiver to transmit the first data stream to the recipient, without**

requiring disassociation of the recipient from either or both of the first and second actual MAC and PHY interfaces, using a subset of frequencies corresponding to only the given resources of the first bandwidth portion that are not unavailable for communication to thereby at least partially satisfy the first wireless bandwidth requirement of the first application; and

Clegg teaches the ability of an 802.11 network terminal to use a first wireless transceiver, without requiring disassociation of the recipient from the access point, to transmit a data stream using only the subset of frequencies that are not unavailable for communication. (EX1002 ¶¶133-134.)

Specifically, after evaluating the interference levels of each carrier across the available spectrum, Clegg teaches a capability for “notching out” specific OFDM subcarriers that suffer an unduly high amount of interference. (EX1009 7:15-19.) The remaining carriers, which are suitable for communication, are selected to comprise a “cluster of carriers for communication.” (EX1009 4:9-10.) The cluster of carriers may comprise: “1) contiguous carriers in a single sub-channel, 2) contiguous carriers spanning across more than one sub-channel, 3) discontinuous carriers in a single sub-channel, or 4) discontinuous carriers spanning across more than one sub-channel.” (EX1009 4:11-15.) A POSITA would have recognized Clegg’s selection of a cluster of carriers enables transmission of the first data stream using only the subset of frequencies/given resources of the first identified bandwidth portion that are not unavailable. (EX1002 ¶135.)

Chincholi also does not “require” disassociation of recipient WTRUs from either or both of the actual MAC and PHY interfaces during operation. (EX1002 ¶136.)

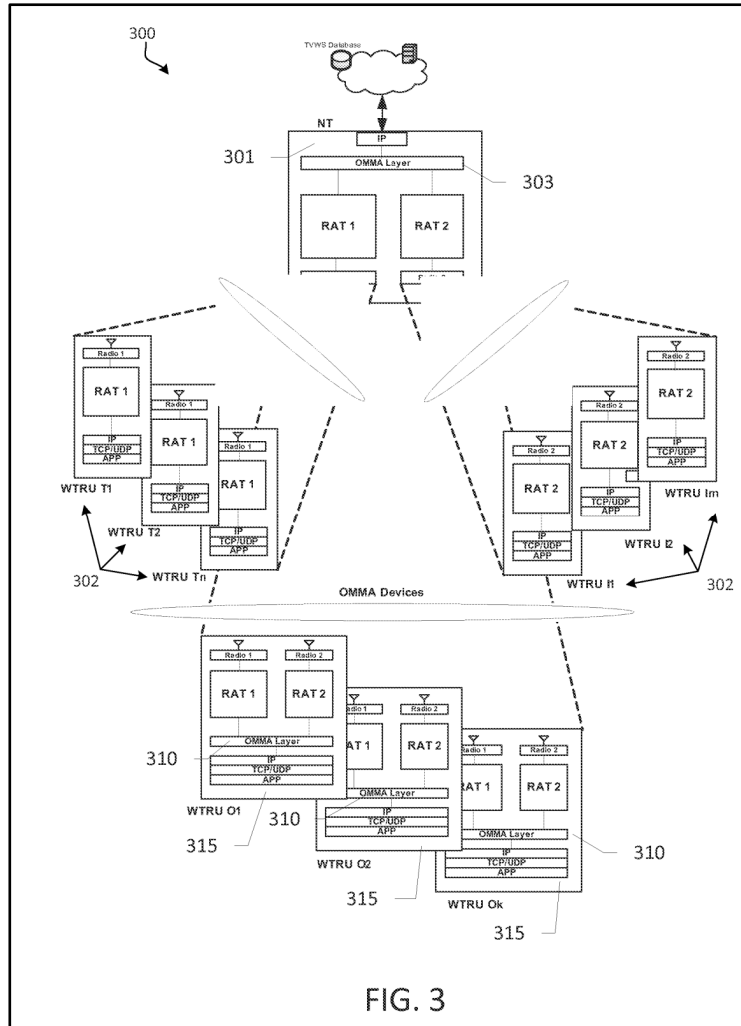
Indeed, a POSITA would have also recognized the desirability of implementing Chincholi combined with the teachings of Riggert and Clegg to transmit the first data stream to the recipient without requiring “disassociation” of the recipient from either or both of the first and second actual MAC and PHY interfaces. For example, in the field of 802.11 systems—where each associated terminal is assigned a unique association identifier (“AID”)—it was well-known avoiding disassociation after initial association was desirable, as repeatedly re-forming associations was inefficient and disruptive. (EX1002 ¶137; EX1008 (U.S. Patent 9,379,868) (“Wang”) 24:42-43 (“This approach is undesirable, can be blunt and can disrupt the on-going services (e.g., requires disassociation)”), 24:57-62 (“The lack of update/change of the AID values . . . after an initial AID assignment is inherently inflexible and can prevent the realization power saving, among other considerations, that an update/change of the AID values can provide.”).) Indeed, recognizing this issue, background prior art reference Wang described techniques in a multiple transceiver/MIMO system for effectuating an update to a recipient’s unique association identifier (“AID”) through various interactions with the system without requiring a disassociation of a wireless device from an access point.

(EX1008 24:63-25:57.)

In light of this background art, a POSITA would have recognized in implementing the Chincholi/Riggert/Clegg combination, it would be desirable implement known dynamic AID reassignment techniques to avoid disassociation of recipients during operation including throughout any process of reallocating transceiver, channel, and/or bandwidth resources to a recipient. (EX1002 ¶138.)

- l) **1[k]: wherein, after the circuitry has been connected to the application interface and when the wireless networking is being used, the wireless networking device's utilization of the first available bandwidth portion of the first wireless transceiver does not prevent any wireless networking device devices from utilizing a range of frequencies corresponding to the remaining portion of the bandwidth availability of the first wireless transceiver for data transmission or reception purposes at the same time that the first bandwidth portion is being used for data transmission purposes.**

Chincholi discloses examples of “*multi-WTRU* multi-IP flow cases.” (EX1005 [0328]; EX1002 ¶¶139-140.) For example, “[a] system may comprise *multiple WTRUs*, a single NT, and multiple IP flows from the NT to one or more WTRUs.” (EX1005 [0328].) This is disclosed, for example in Figure 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 [0351]-[0356]; EX1002 ¶141.) 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 [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. As discussed above, Chincholi's OMMA layer receives feedback metrics from each RAT. (EX1005 [0161].) Amongst the feedback metrics are the "MAC Type," for example "OFDMA." (EX1005 [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 ¶144.) These subcarriers are described as orthogonal because they do not interfere with each other when simultaneously transmitted. A POSITA would have recognized OFDMA techniques would allow multiple WTRUs to access different channels of the transceiver resources simultaneously and without interference. (EX1002 ¶142.)

Because Chincholi's RATs may provide feedback to the OMMA indicating they are operating as an OFDMA MAC Type, a POSITA would have recognized Chincholi discloses the capability to allow multiple WTRUs to simultaneously utilize different portions of a transceiver's available bandwidth. (EX1002 ¶143.)

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

Chincholi discloses the method of claim 1 comprises a "wireless access point." Chincholi teaches wireless communication between a network terminal (NT)

and a wireless transmit/receive unit (WTRU). (EX1005 [0002]; EX1002 ¶¶144-145.) An example of a NT is an “*access point*” (AP). (*Id.*) Indeed, Chincholi discloses a node of its wireless communication network may include a “*WiFi access point*.” (EX1005 [0115].)

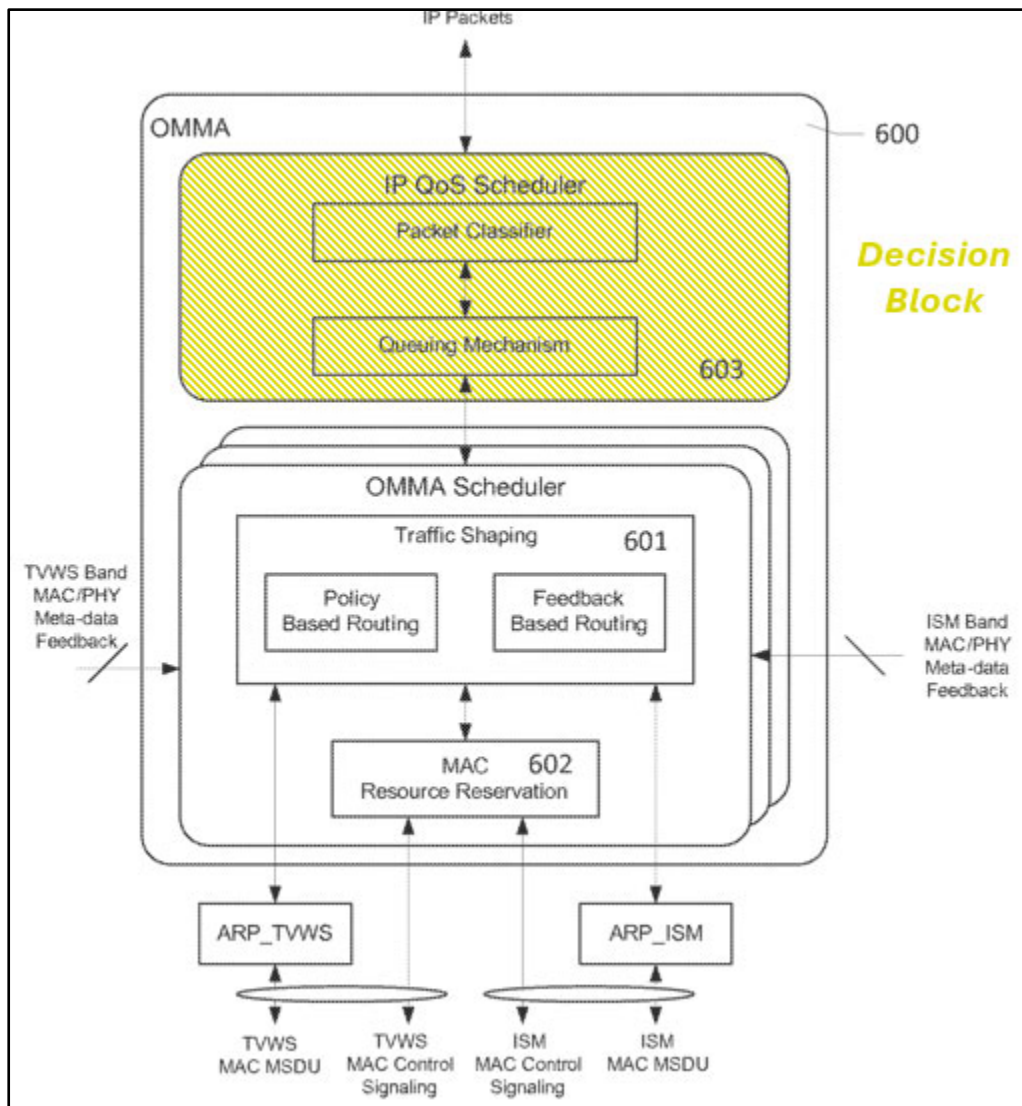
3. Claim 3: The method of claim 1, wherein the first and second frequency bands are specified in at least one member of the family of IEEE 802.11 standards that was in existence as of Oct. 30, 2013.

Chincholi teaches its techniques can be used to implement an IEEE 802.11 based Wi-Fi system. (EX1005 [0121].) Thus, “[t]he NT 201 may operate using one flavor of the 802.11 system (*e.g.*, 11a/b/g/n) at any given time over a specific band (*e.g.*, 2.4GHz or 5GHz) when communicating with a WTRU.” (EX1005 [0121].) Chincholi was filed prior to October 30, 2013. Moreover, a POSITA would have recognized the 802.11 standards expressly disclosed (“11a/b/g/n”) were in existence as of October 30, 2013. (EX1002 ¶¶146-147.)

4. Claim 4: The method of claim 1, wherein the at least one virtual MAC interface includes a decision block.

Chincholi discloses the claimed *decision block* in the form of the *IP QoS Scheduler module 603*. (EX1002 ¶¶148-149.) 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 [0143].)

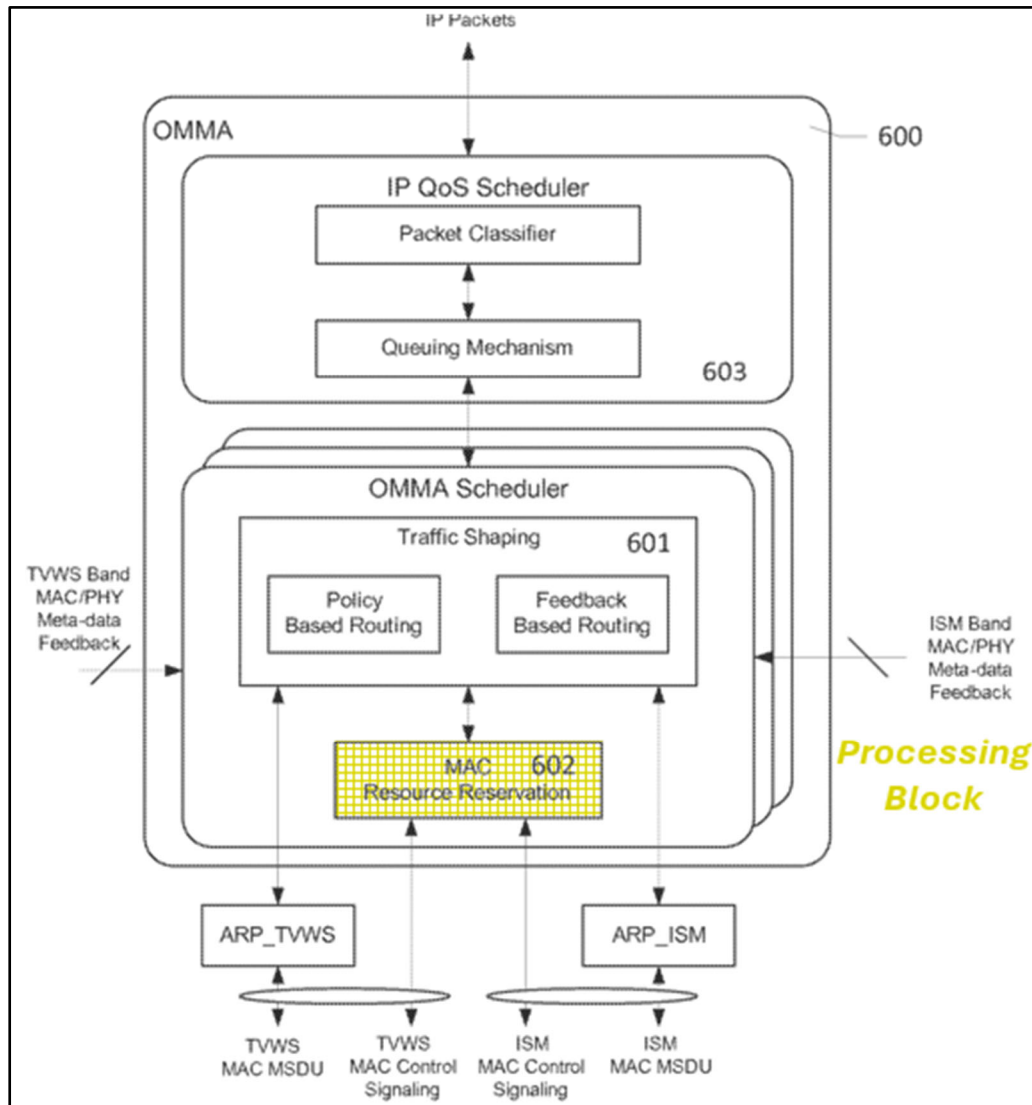


5. **Claim 5: The method of claim 1, wherein the at least one virtual MAC interface includes a processing block.**

Chincholi discloses the claimed *processing block* in the form of the *MAC Resource Reservation module 602*. (EX1002 ¶¶150-151.) 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 [0142].)

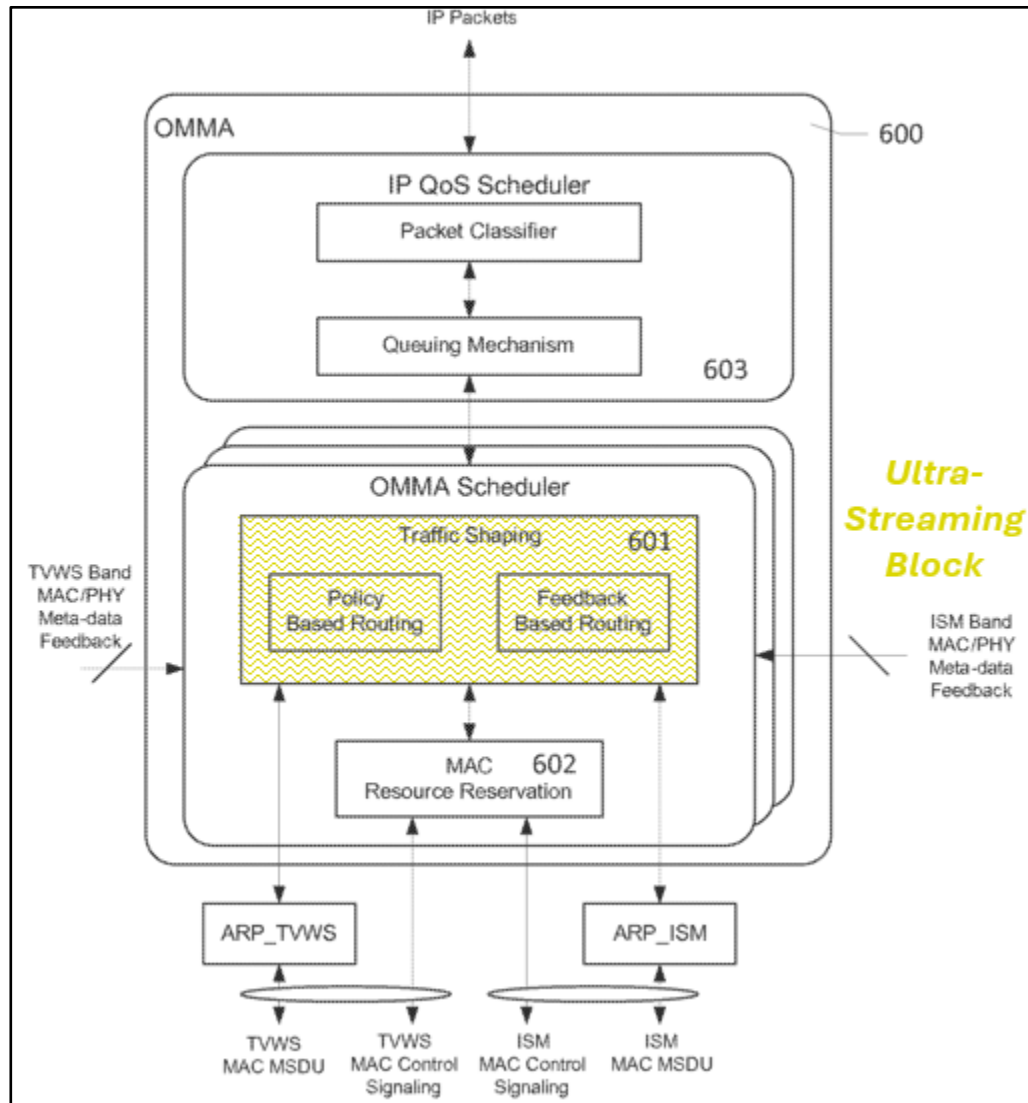


6. **Claim 6: The method of claim 1, wherein the at least one virtual MAC interface includes an ultra-streaming block.**

Chincholi discloses the claimed *ultra-streaming block* in the form of the *Traffic Shaping Module 601*. (EX1002 ¶¶152-153.) 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 [0139].)



7. Claim 7: The method of claim 1, wherein the first virtual PHY interface includes an RF block.

A POSITA would have understood the claimed “RF block” to merely be a component of a virtual PHY capable of receiving and reporting information about

the availability of RF resources. (EX1002 ¶¶154-155.)

As discussed *re* 1[e], Chincholi discloses the OMMA Controller receives feedback metrics regarding resource availability from RATs over the “A2” interface. It would have been obvious in view of Riggert to implement virtual PHY interfaces in the OMMA Controller to receive this feedback information on a per RAT basis, and use those virtual PHY interfaces to provide the information about resource availability to Chincholi’s “traffic shaping module” (*i.e.*, the “ultra-streaming” block). A POSITA would have recognized the obvious Chincholi/Riggert/Clegg combination discloses virtual PHYs that include an RF block (*i.e.*, a component capable of receiving and reporting information about the availability of RF resources.) (EX1002 ¶156.)

8. Claim 8: The method of claim 1, wherein the second virtual PHY interface includes an RF block.

As discussed above, *see* claim 7, the obvious Chincholi/Riggert/Clegg combination discloses virtual PHYs that include an RF block. It would be obvious to incorporate an RF block for the virtual PHY interface to both the first and second transceiver so as to enable receipt of feedback from both. (EX1002 ¶¶157-158.)

9. Claim 9: The method of claim 1, wherein the processing interface comprises multiple virtual MAC interfaces.

Chincholi discloses a method wherein the processing interface comprises multiple base stations operating in a radio access network (RAN) that communicate

with wireless devices using a multiple input, multiple output (“MIMO”) architecture.

(EX1005 [0109]; EX1002 ¶¶159-160.) This is disclosed, for example, in Figure 1E.

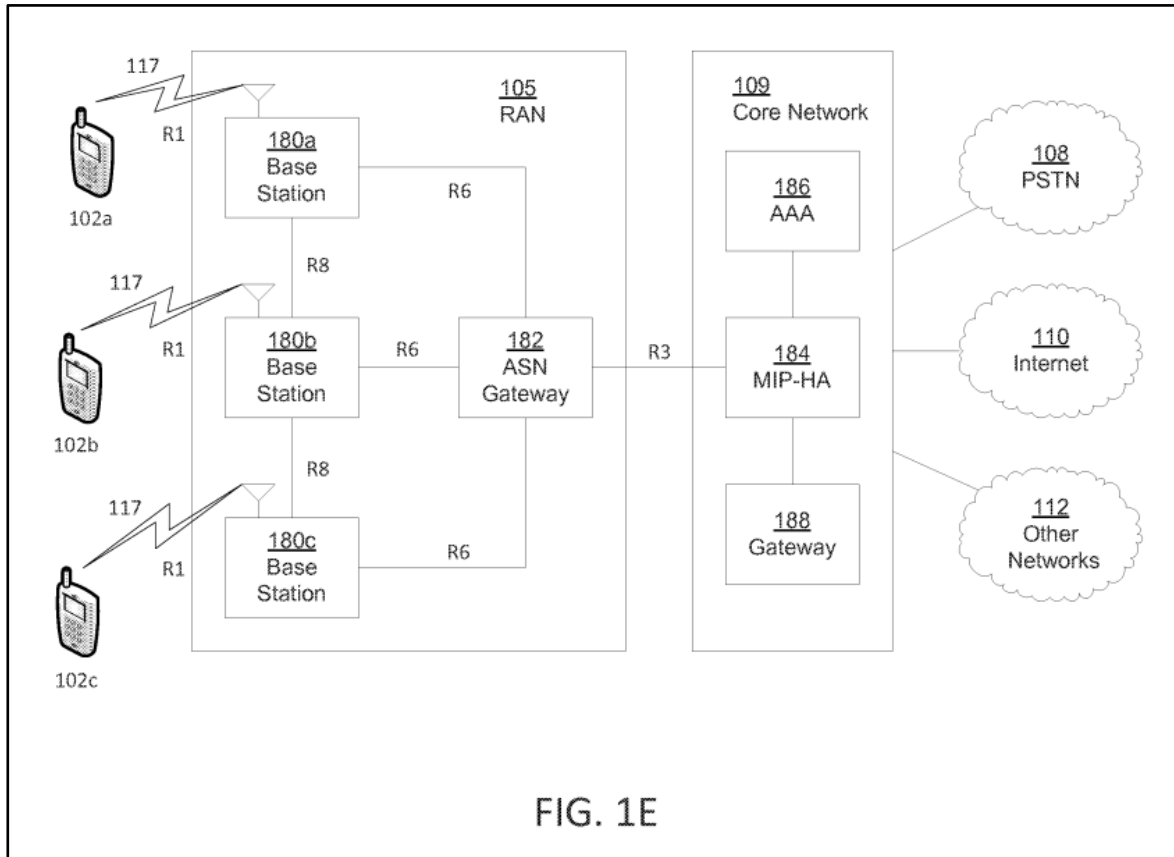


FIG. 1E

A POSITA would have recognized each base station in Figure 1E would comprise its own OMMA layer (*i.e.*, virtual MAC interface). (EX1002 ¶161.) A POSITA would have further recognized an additional obvious implementation would have been a method to combine the multiple virtual MAC interfaces of the system in Figure 1E into a single wireless communication device to improve the performance of circuitry. (EX1002 ¶161.) Combining this functionality into a single device could, for example, leverage common hardware increasing the efficiency of a base station. (EX1002 ¶161.)

10. Claim 10: The method of claim 1, wherein the processing interface includes a bandwidth allocator.

A POSITA would have understood a *bandwidth allocator* refers to functionality within the processing layer capable of allocating the bandwidth availabilities of multiple transceivers to meet a bandwidth requirement of one or more data streams. (EX1002 ¶¶162-163.)

Chincholi discloses the functionality of the claimed “bandwidth allocator.” (EX1002 ¶164.) Specifically, Chincholi teaches “the traffic shaping module may determine how a packet is routed using policy based routing *or feedback based routing*.” (EX1005 [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 [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 [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 [0196].) Thus, the “OMMA layer may utilize MAC resource reservation to achieve *globally optimal resource allocation across RATs*.” (EX1005 [0196].)

From these disclosures, a POSITA would have recognized Chincholi discloses a processing layer capable of allocating bandwidth availabilities of

multiple transceivers to meet a bandwidth requirement of one or more data streams.

(EX1002 ¶165.) Chincholi thus discloses a bandwidth allocator.

11. Claim 11: The method of claim 1, wherein the first identified actual bandwidth portion is contiguous.

Chincholi discloses 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 [0118].). A POSITA would have understood where Chincholi identifies multiple contiguous channels within the band of the first identified actual bandwidth portion, that portion is contiguous. (EX1002 ¶¶166-167.)

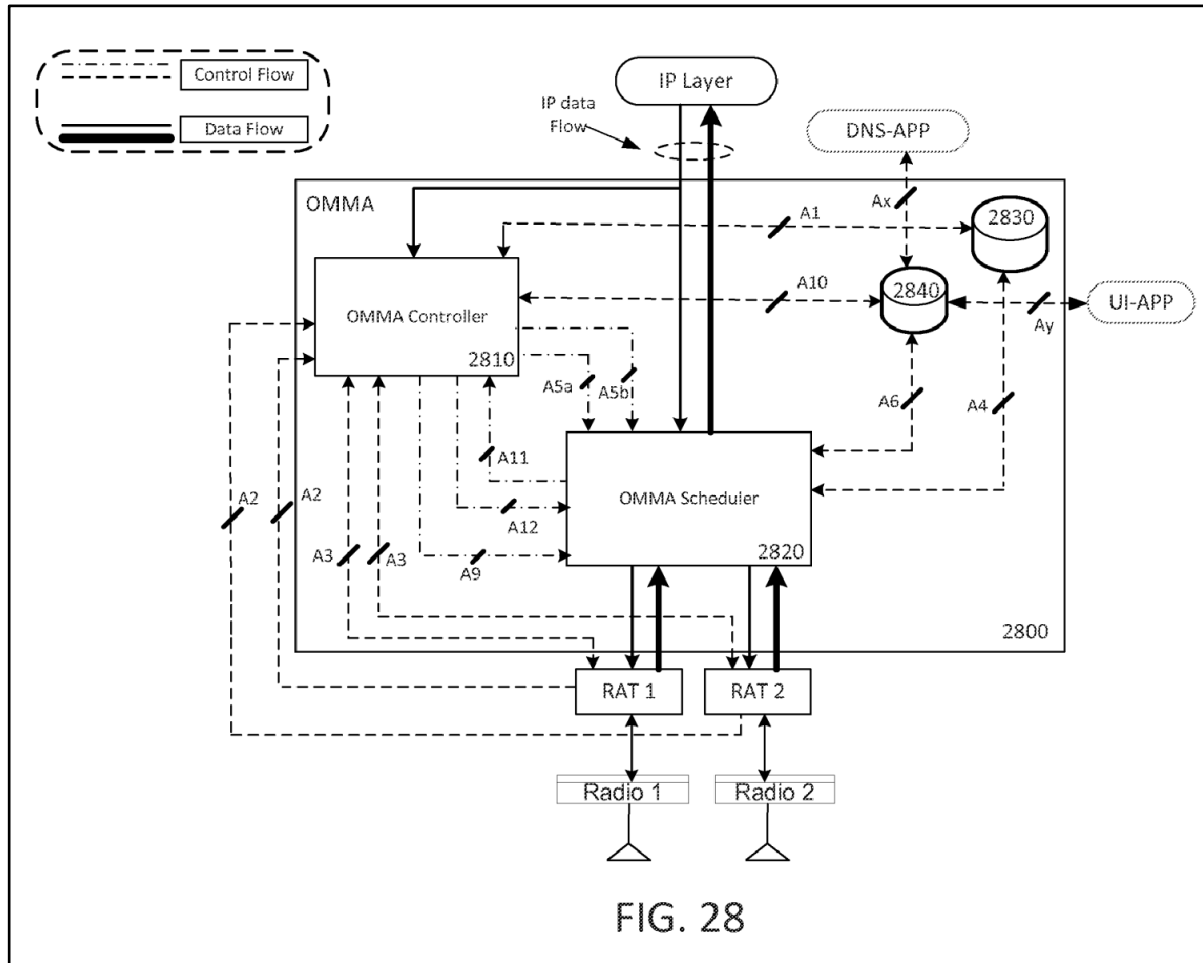
Clegg further teaches how a “cluster of carriers” for communication may comprise: “1) *contiguous carriers in a single sub-channel*, 2) *contiguous carriers spanning across more than one sub-channel...*” (EX1009 4:11-15; (EX1002 ¶168.)

12. Claim 12: The method of claim 1, wherein the first virtual PHY interface is not contiguous with the at least one virtual MAC interface.

As discussed *re* 1[e], the Chincholi/Riggert/Clegg combination renders obvious the implementation of multiple virtual PHY interfaces in Chincholi’s OMMA controller. (EX1002 ¶¶169-170.) Additionally, as discussed above, *see* claim limitation 1[e], the OMMA Scheduler comprises the “virtual MAC interface.”

As shown in Figure 28, OMMA Controller and OMMA Scheduler are distinct

blocks that communicate via control flow interfaces. A POSITA would have understood from this disclosure the first virtual PHY interface is not contiguous with the virtual MAC interface. (EX1002 ¶171.)



13. **Claim 13:** The method of claim 1, wherein the second virtual PHY interface is not contiguous with the at least one virtual MAC interface.

As discussed *re* claim 12, Chincholi discloses 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 the second virtual PHY interface is not contiguous with the virtual MAC interface. (EX1002 ¶¶172-173.)

14. Claim 14: The method of claim 1,

- a) **14[a]: wherein the processing interface is configured to, after the circuitry has been connected to the application interface and when the wireless networking device is being used, and in a manner transparent to any layer of the wireless networking device above the processing interface,**

See limitation 1[f]. (EX1002 ¶¶174-175).

- b) **14[b]: (a) identify at least one second portion of the first actual bandwidth of the first wireless transceiver, the identified second bandwidth portion comprising a set of given resources, the first and second identified actual bandwidth portions not being contiguous with each other,**

See limitations 1[h]. Just as Chincholi discloses identifying a first portion of the first actual bandwidth of the first transceiver, it discloses the same capability to identify a *second* actual bandwidth portion of the second transceiver, and that the first and second portions are not contiguous. (EX1002 ¶¶176-177.)

- c) **14[c]: (b) evaluate whether any of the given resources of the second identified actual bandwidth portion are unavailable for communication, and**

See limitations 1[i]. Just as Chincholi and Chincholi/Riggert/Clegg each discloses evaluating whether the resources of the first bandwidth portion are unavailable, they disclose the same capability for the second bandwidth portion.

(EX1002 ¶¶178-181).

- d) **14[d]:(c) use the first wireless transceiver to transmit the first data stream to the recipient, without requiring disassociation of the recipient from either or both of the first and second actual MAC and PHY interfaces, using a subset of frequencies corresponding to only the given resources of the first and second bandwidth portions that are not unavailable for communication to thereby at least partially satisfy the first wireless bandwidth requirement of the first application.**

See limitations 1[j]. Just as Chincholi and Chincholi/Riggert/Clegg each disclose using a subset of frequencies corresponding to only the given resources of the first bandwidth portion that are not unavailable, they disclose the same capability for the first and second bandwidth portions. (EX1002 ¶¶182-184.)

15. Claim 15: The method of claim 14, wherein the second identified actual bandwidth portion is contiguous.

Chincholi discloses NTs and WTRUs in its architecture communicate within one another either by using bandwidth “channels” or by “aggregating *multiple contiguous or noncontiguous channels*.” (EX1005 [0118]; [0121].) Thus, a POSITA would have understood Chincholi discloses an identification of the second portion of bandwidth that is contiguous with the first portion. (EX1002 ¶¶185-186.)

16. Claim 16: The method of claim 14,

- a) **16[a]: wherein the processing interface is configured to, after the circuitry has been connected to the application interface and when the wireless networking device is being used, and in a manner**

transparent to any layer of the wireless networking device above the processing interface,

See limitation 1[f]. (EX1002 ¶¶187-188).

- b) 16[b]: (a) if all of the given resources of the first identified bandwidth portions are unavailable, identify at least one third portion of the first actual bandwidth of the first wireless transceiver, the third identified bandwidth portion comprising a set of given resources,**

See limitations 1[h]. Just as Chincholi discloses identifying a second bandwidth portion of the first transceiver, it discloses the same capability for a third bandwidth portion. (EX1002 ¶¶189-190.)

- c) 16[c]: (b) evaluate whether any of the given resources of the third identified bandwidth portion are unavailable for communication, and**

See limitations 1[i]. Just as Chincholi and Chincholi/Riggert/Clegg each discloses evaluating whether the resources of a second bandwidth portion are unavailable, they disclose the same capability for a third bandwidth portion. (EX1002 ¶¶191-194.)

- d) 16[d]: (c) use the first wireless transceiver to transmit the first data stream to the recipient, without requiring disassociation of the recipient from either or both of the first and second actual MAC and PHY interfaces, using a subset of frequencies corresponding to only the given resources of the third identified bandwidth portion that are not unavailable for communication to**

thereby at least partially satisfy the first wireless bandwidth requirement of the first application.

See limitations 1[j]. Just as Chincholi and Chincholi/Riggert/Clegg each disclose using a subset of frequencies corresponding to only the given resources of the second identified bandwidth portion that are not unavailable, they disclose the same capability for a third bandwidth portion. (EX1002 ¶¶195-197.)

17. Claim 17: The method of claim 14,

- a) 17[a]: wherein the processing interface is configured to, after the circuitry has been connected to the application interface and when the wireless networking device is being used, and in a manner transparent to any layer of the wireless networking device above the processing interface,**

See limitation 1[f]. (EX1002 ¶¶198-199).

- b) 17[b]: (a) if all of the given resources of the second actual bandwidth portion are unavailable, identify at least one fourth portion of the actual bandwidth of the first wireless transceiver, the fourth identified bandwidth portion comprising a set of given resources,**

See limitations 1[h] and 16[b]. Just as Chincholi discloses identifying a third bandwidth portion of the first transceiver, it discloses the same capability for a fourth bandwidth portion. (EX1002 ¶¶200-201.)

- c) 17[c]: (b) evaluate whether any of the given resources of the fourth identified bandwidth portion are unavailable for communication, and**

See limitations 1[i] and 16[c]. Just as Chincholi and Chincholi/Riggert/Clegg

each disclose evaluating whether the resources of a third bandwidth portion are unavailable, they disclose the same capability for a fourth bandwidth portion.

(EX1002 ¶¶202-205.)

- d) 17[d]: (c) use the first wireless transceiver to transmit the first data stream to the recipient, without requiring disassociation of the recipient from either or both of the first and second actual MAC and PHY interfaces, using a subset of frequencies corresponding to only the given resources of the fourth identified bandwidth portion that are not unavailable for communication to thereby at least partially satisfy the first wireless bandwidth requirement of the first application.**

See limitations 1[j] and 16[d]. Just as Chincholi and Chincholi/Riggert/Clegg each disclose using a subset of frequencies corresponding to only the given resources of the third identified bandwidth portion that are not unavailable, they disclose the same capability for a fourth bandwidth portion. (EX1002 ¶¶206-208.)

18. Claim 18: The method of claim 1,

- a) 18[a]: wherein the processing interface is configured to, after the circuitry has been connected to the application interface and when the wireless networking device is being used, and in a manner transparent to any layer of the wireless networking device above the processing interface,**

See limitation 1[f]. (EX1002 ¶¶209-210).

- b) 18[b]: (a) identify at least one first portion of the second actual bandwidth of the second wireless transceiver, the first identified portion of the second**

wireless transceiver comprising a set of given resources,

See limitations 1[h]. Just as Chincholi discloses identifying a second portion of the first actual bandwidth of the first transceiver, it discloses the same capability for the second wireless transceiver. (EX1002 ¶¶211-212.)

- c) 18[c]: (b) evaluate whether any of the given resources of the first identified actual bandwidth portion of the second wireless transceiver are unavailable for communication, and**

See limitations 1[i]. Just as Chincholi and Chincholi/Riggert/Clegg each disclose evaluating whether any of the given resources of the first identified actual bandwidth of the first wireless transceiver 1[i], they also disclose the same capability for evaluating the first identified actual bandwidth portion of the second wireless transceiver. (EX1002 ¶213-216.)

- d) 18[d]: (c) if none of the given resources of the first identified bandwidth portion of the first wireless transceiver are available for communication and if the first identified bandwidth portion of the second wireless transceiver is available for communication, use the second wireless transceiver to transmit the first data stream to the recipient, without requiring disassociation of the recipient from either or both of the first and second actual MAC and PHY interfaces, using a subset of frequencies corresponding only to the given resources of the first identified actual bandwidth portion of the second wireless transceiver that are not unavailable for communication to thereby at least partially satisfy**

the first wireless bandwidth requirement of the first application; and

As discussed *re* 1[j], Clegg teaches a capability for “notching out” specific OFDM subcarriers that suffer an unduly high amount of interference. (EX1009 7:15-19.) A POSITA would have been motivated to combine Clegg’s selection of a cluster of carriers into the wireless communication system of Chincholi to enable transmission of the first data stream to a recipient, without requiring disassociation of the recipient, *re* 1[j], using only the subset of frequencies/given resources of the first identified bandwidth portion of the second transceiver that are not unavailable. (EX1002 ¶¶217-219.)

- e) **18[e]: wherein, after the circuitry has been connected to the application interface and when the wireless networking is being used, the wireless networking device’s utilization of the first identified actual available bandwidth portion of the second wireless transceiver does not prevent any other wireless networking device from utilizing a range of frequencies corresponding to the remaining portion of the bandwidth availability of the second wireless transceiver for data transmission or reception purposes.**

As discussed *re* limitation 1[k], Chincholi discloses examples of “*multi-WTRU* multi-IP flow cases,” (EX1005 [0328].) which, a POSITA would have recognized allow multiple WTRUs to access different channels of the transceiver resources simultaneously and without interference. (EX1002 ¶¶220-224.)

19. Claim 19: The method of claim 18,

- a) **19[a]: wherein the processing interface is configured to, after the circuitry has been connected to the application interface and when the wireless networking device is being used, and in a manner transparent to any layer of the wireless networking device above the processing interface,**

See limitation 1[f]. (EX1002 ¶¶225-226).

- b) **19[b]: (a) if both the first identified actual bandwidth portions of the first and second wireless transceivers are available for communication, evaluate the data transfer characteristics of both,**

Chincholi discloses allocating IP packets of a data flow according to a ratio calculated from available bandwidth and link quality on the transceiver resources. For example, in a “ramp up” phase, the RSSI metric may be assumed to have converged to provide a reliable indication of the instantaneous channel quality of each RAT, and packets are allocated according to the following ratio. (EX1005 [0164].)

$$\left[\frac{\text{avg}(RSSI_{ISM})}{\text{max}(RSSI_{ISM})} \times BW_{ISM} \right] : \left[\left[\sum_{k=1}^N \frac{\text{avg}(RSSI_{TV}^k)}{\text{max}(RSSI_{TV}^k)} \right] \times BW_{TVWS}^k \right]$$

“RSSI” stands for received signal strength and is a measure of the data transfer characteristics of the wireless transceivers associated with each RAT, and thus this calculation discloses an evaluation of the data transfer characteristics of the first and second transceivers when both are available. (EX1002 ¶¶227-228.) Chincholi also

measures data transfer characteristics (*e.g.*, frame error rate and medium access delay) in the “steady state phase.” (EX1005 [0165]; EX1002 ¶229.)

- c) **19[c]: (b) if the data transfer characteristics of the first identified bandwidth portion of the first wireless transceiver are better than those of the first identified bandwidth portion of the second wireless transceiver, use the first wireless transceiver to transmit the first data stream to the recipient, without requiring disassociation of the recipient from either or both of the first and second actual MAC and PHY interfaces, using a subset of frequencies corresponding to only the given resources of the first identified bandwidth portion of the first wireless transceiver that are not unavailable for communication to thereby at least partially satisfy the first wireless bandwidth requirement of the first application, and**

Chincholi uses feedback metrics indicating data transfer characteristics to calculate the ratio of IP packets to distribute between the first and second transceiver. (EX1002 ¶¶230-231.) For example, during the “ramp up” phase, Chincholi discloses the following calculation for determining the ratio:

$$\left[\frac{\text{avg}(RSSI_{ISM})}{\text{max}(RSSI_{ISM})} \times BW_{ISM} \right] : \left[\left[\sum_{k=1}^N \frac{\text{avg}(RSSI_{TV}^k)}{\text{max}(RSSI_{TV}^k)} \right] \times BW_{TVWS}^k \right]$$

(EX1005 [0164].) In the “steady state” phase, Chinchoi discloses the following calculation for determining the ratio:

$$\left[(1 - FER_{ISM}) \times BW_{ISM} \right] : \left[\left[\sum_{k=1}^N (1 - FER_{TVWS}^k) \right] \times BW_{TVWS}^k \right]$$

(EX1005 [0165].) A POSITA would have understood a higher ratio of IP packets will be allocated to the transceiver with better data transfer characteristics at a given time. (EX1002 ¶¶232-233.) Further, where the data transfer characteristics of the first transceiver are substantially better than those of the second transceiver, a POSITA would have understood the capability to transmit the entire first data stream using only the first transceiver. (EX1002 ¶233.)

Chincholi also does not “require” disassociation of recipient WTRUs from either or both of the actual MAC and PHY interfaces during operation, including during selection of a transceiver based on data transfer characteristics. Indeed, as discussed above, *see* limitation 1[j], a POSITA would have also recognized the desirability of implementing Chincholi combined with the teachings of Riggert and Clegg to transmit the first data stream to the recipient without requiring “disassociation” of the recipient from either or both of the first and second actual MAC and PHY interfaces. (EX1002 ¶¶234-235.)

- d) **19[d]: (c) if the data transfer characteristics of the first identified portion of the second wireless transceiver are better than those of the first identified bandwidth portion of the first wireless transceiver, use the second wireless transceiver to transmit the first data stream to the recipient, without requiring disassociation of the recipient from either or both of the first and second actual MAC and PHY interfaces, using a subset of frequencies corresponding to only the given resources of the first identified bandwidth portion of the second wireless transceiver that are not**

unavailable for communication to thereby at least partially satisfy the first wireless bandwidth requirement of the first application.

As discussed *re* 19[c], Chincholi discloses the evaluation of data transfer characteristics of the transceivers to make decisions on how to allocate IP packets between first and second transceivers. Where the data transfer characteristics of the second transceiver are substantially better than those of the first transceiver, a POSITA would have understood the capability to transmit the entire first data stream using only the second transceiver without requiring “disassociation” of the recipient from either or both of the first and second actual MAC and PHY interfaces. (EX1002 ¶¶236-237.)

20. Claim 20: The method of claim 19, wherein the data transfer characteristics are representative of one or more environmental conditions where the wireless networking device is used.

Chincholi discloses the availability/unavailability of a RAT may change based on “mobility of a WTRU or *fluctuation in link quality due to other environmental effects*.” (EX1005 [0263].) A POSITA would have recognized the link quality indicators used by Chincholi (RSSI, frame error rate, and medium access delay) are representative of one or more environmental conditions. (EX1002 ¶¶238-239.)

21. Claim 21: The method of claim 1, wherein the processing interface is configured to, after the circuitry has been connected to the application interface and when the wireless networking device is being used, and in a manner transparent to any layer of the wireless networking device

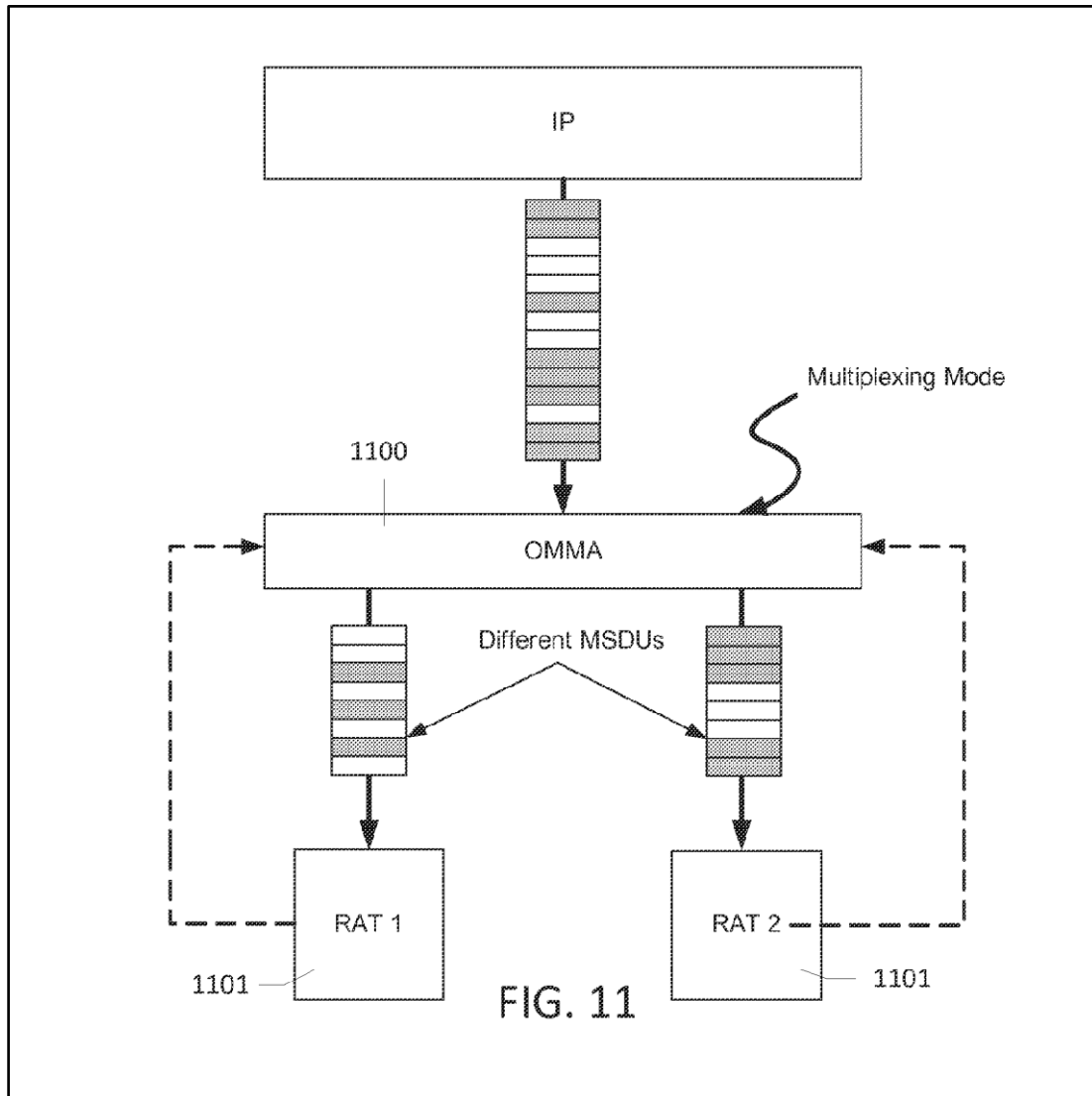
above the processing interface, aggregate the first identified actual bandwidth portion of the first wireless transceiver with an identified first portion of an available bandwidth of the second wireless transceiver to at least partially simultaneously transmit the first data stream to the first recipient from both of the first and second wireless transceivers.

Based on its evaluation of transceiver bandwidth availability with respect to application bandwidth requirement, Chincholi may “aggregate” the bandwidth availabilities of the first and second transceiver to simultaneously transmit the first data stream to the recipient using a specific subset of frequencies corresponding to their identified portions. (EX1005 [0120] (“A mechanism to aggregate two or more RATs operating independently on two or more bands to enhance the total IP throughput of the link may be described herein.”); EX1002 ¶¶240-241.)

Specifically, 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 [0152].) 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 and thereby aggregate the identified bandwidth portions of a first and second transceiver for simultaneous transmission. (EX1002 ¶242.)

Chincholi discloses simultaneous transmission of a first data stream using first

and second 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 ¶¶243-245.)



As Chincholi discloses, “[u]sing multiple RATs *simultaneously* may provide increased bandwidth and/or increased reliability for an application.” (EX1005 [0194]; EX1002 ¶244.)

Chincholi discloses 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 [0192], [0126]; EX1002 ¶245.)

Finally, Chincholi also does not “require” disassociation of recipient WTRUs from either or both of the actual MAC and PHY interfaces during operation, including during selection of a transceiver based on data transfer characteristics. *See* limitation 1[j]. (EX1002 ¶¶246-247.)

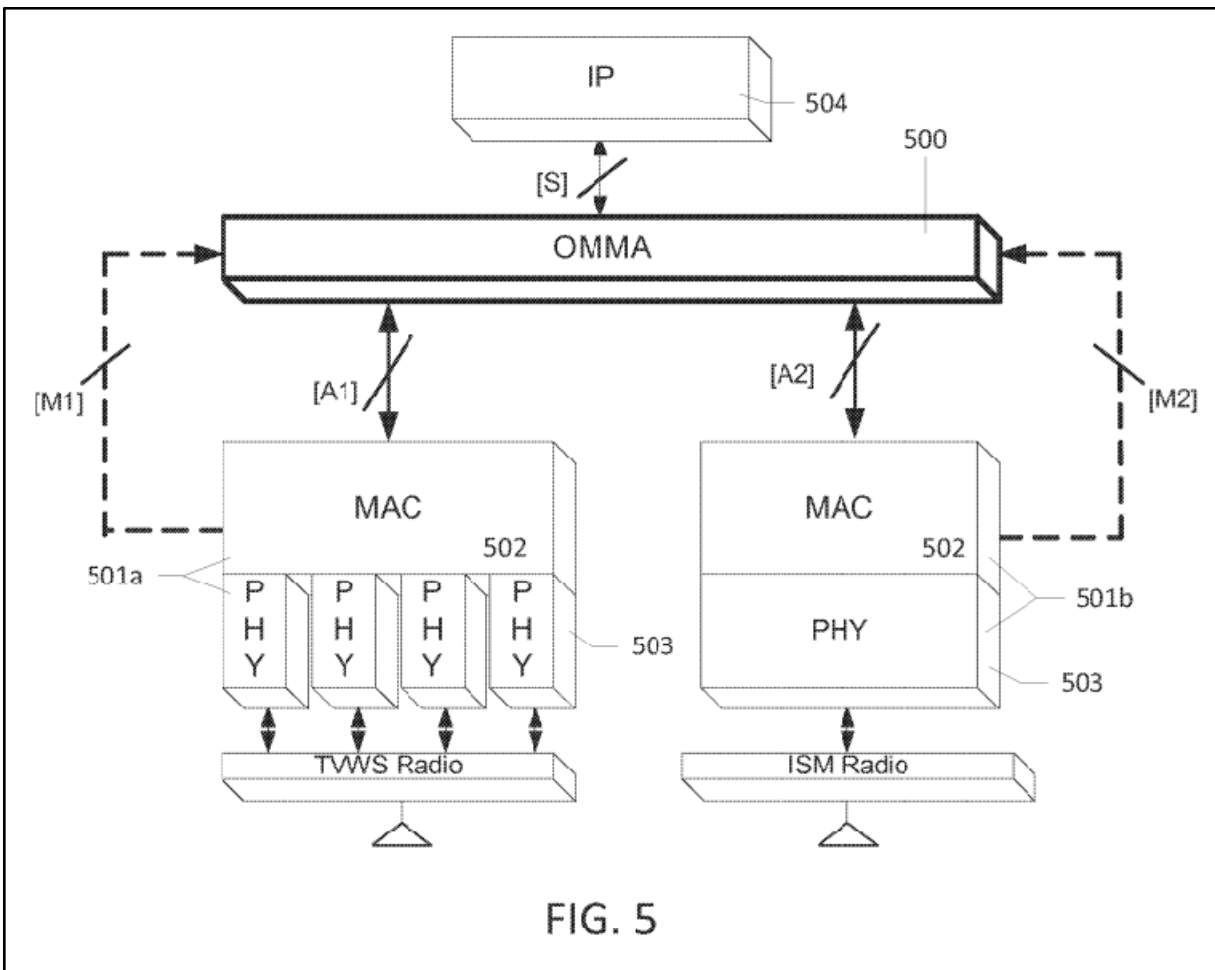
22. Claim 22: The method of claim 21, wherein the first data stream is substantially simultaneously transmitted to the recipient from both of the first and second wireless transceivers.

As discussed above, *see* claim 21, Chincholi’s multiplexing mode discloses simultaneous transmission of the first data stream from the first and second wireless transceivers. (EX1002 ¶¶248-249.)

23. Claim 23: The method of claim 21, wherein the processing interface is configured to, after the circuitry has been connected to the application interface and when the wireless networking device is being used, and in a manner transparent to any layer of the wireless networking device above the processing interface, aggregate the first identified actual bandwidth portion of the first wireless transceiver with an identified first portion of an available bandwidth of the second wireless transceiver to cause the first and second wireless transceivers to at least partially simultaneously receive a second data stream from the recipient.

In addition to enabling simultaneous transmission of an IP flow from two

separate transceivers, Chincholi discloses how its OMMA layer enables aggregation of the available bandwidth on two separate transceivers to, in a manner transparent to higher layers, provide for simultaneous receipt of an IP flow. (EX1002 ¶¶250-251.) Figure 5, for example, depicts a two-way data flow between the actual MAC layer and the OMMA layer on links “A1” and “A2”:



Further, Table 1 of Chincholi describes the “A1” and “A2” links of Figure 5 as involving both the “Incoming” and “Outgoing” MAC MSDUs (MAC service data units). (EX1005 [0138].) Indeed, Chincholi describes the OMMA layer aggregates

bandwidth across multiple RATs, in a manner transparent to higher levels, to either “distribute[]” or “*combine[]*” packets from different RATs. A POSITA would have understood the ability of the OMMA layer to “combine” packets relates to combining simultaneously received packets across multiple RATs from a single IP flow prior to transmission up to the IP layer. (EX1002 ¶252.)

24. Claim 24: The method of claim 23, wherein the second data stream is substantially simultaneously received by both of the first and second wireless transceivers.

As Chincholi discloses, “[u]sing multiple RATs *simultaneously* may provide increased bandwidth and/or increased reliability for an application. (EX1005 [0194].) Further, as discussed above, *see* claim 23, Chincholi’s OMMA enables the aggregation of bandwidth across multiple RATs for simultaneous operation applies both to transmission and receipt of data packets. (EX1002 ¶¶253-254.)

25. Claim 25: The method of claim 1,

- a) **25[a]: wherein the processing interface is configured to, after the circuitry has been connected to the application interface and when the wireless networking device is being used, in a manner transparent to any layer of the wireless networking device above the processing interface,**

See limitation 1[f]. (EX1002 ¶¶255-56.)

- b) **25[b]: (a) identify at least one first portion of bandwidth available for communication of the second wireless transceiver, the identified at least**

one first portion of the second wireless transceiver comprising a set of given resources,

See limitations 1[h]. Just as Chincholi discloses identifying a first portion of the first actual bandwidth of the first transceiver, it discloses the same capability of the second transceiver. (EX1002 ¶¶257-258.)

- c) 25[c]: (b) evaluate whether any of the given resources of the at least one first identified portions of the first and second wireless transceivers are not unavailable for communication,**

See limitations 1[i]. Just as Chincholi and Chincholi/Riggert/Clegg each disclose evaluating whether any of the given resources are unavailable, they also disclose the same capability for evaluating whether the given resources are not unavailable. (EX1002 ¶¶259-262.)

- d) 25[d]: (c) use the first wireless transceiver to transmit the first data stream to the recipient, without requiring disassociation of either or both of the first and second associations, using a specific subset of frequencies corresponding to the given resources of the identified at least one first bandwidth portion of the first wireless transceiver that are not unavailable for communication to thereby at least partially satisfy the first wireless bandwidth requirement of the first application, and**

As discussed above, *see* limitation 1[j], Clegg teaches a capability for “notching out” specific OFDM subcarriers that suffer an unduly high amount of interference. (EX1009 7:15-19; EX1002 ¶¶263-264.) The remaining carriers, which are suitable for communication, are selected to comprise a “cluster of carriers for

communication.” (EX1009 4:9-10.)

A POSITA would have been motivated to combine Clegg’s selection of a cluster of carriers into the wireless communication system of Chincholi to enable transmission of the first data stream to a recipient, without requiring disassociation of either or both of the first and second associations, *see* limitation 1[j], using only the subset of frequencies/given resources of the first identified bandwidth portion of the first transceiver that are not unavailable. (EX1002 ¶265.)

- e) **25[e]: (d) use the second wireless transceiver to receive a second data stream from the recipient at least partially simultaneously with the first data stream being transmitted to the recipient from the first wireless transceiver, without requiring disassociation of either or both of the first and second associations, using a specific subset of frequencies corresponding to only the given resources of the identified at least one first bandwidth portion of the second wireless transceiver that are not unavailable for communication to thereby at least partially satisfy a second wireless bandwidth requirement associated with the second data stream; and**

As discussed above, *see* limitation 1[j] and limitation 25[d], Clegg teaches an approach of using a cluster of only carriers in a bandwidth portion that are not unduly affected by interference. A POSITA would have been motivated to combine Clegg’s selection of a cluster of carriers into the wireless communication system of Chincholi to enable receipt of a second data stream by the second wireless transceiver at least partially simultaneously with the transmission of the first data stream using only the

given resources of the first bandwidth portion of the second transceiver not unavailable for communication. (EX1002 ¶¶266-267).

A POSITA would have also recognized the ability to implement Chincholi's system to simultaneously transmit the first data stream using the first transceiver and receive the second data stream using the second transceiver. (EX1002 ¶268.) Because Chincholi's system is capable of implementing multiple antenna/RF pairs, each operating on a different specific frequency band (EX1005 [0136]), a POSITA would recognize the ability to implement Chincholi as a simultaneous transmit and receive system. (EX1002 ¶¶268)

Operating a multi-transceiver system like Chincholi to simultaneously transmit from one transceiver and receive from another was well-known and obvious to a POSITA at the time of the patent. (EX1002 ¶269.) This is explained, for example, in background reference U.S. Patent 10,567,147 ("DiFazio") (EX1010). DiFazio, teaches a "full duplex" system is one that transmits and receives the radio frequency RF signal simultaneously. (EX1010 1:24-26.) This is most often accomplished by implementing "frequency division duplexing (FDD) where the Tx and RX bands may be sufficiently separated in frequency such that filters can adequately attenuate any energy from the Tx signal that would leak into the Rx signal path and otherwise corrupt the Rx signal and prevent proper operation." (EX1010 1:26-31; 16:51-67, 17:48-18:23.) Additionally, DiFazio teaches a "full duplex single

channel” (FDSC) capability, wherein a base station may even simultaneously transmit and receive data streams in a single frequency channel. (EX1010 13:31-56.)

A POSITA would have been motivated to implement a simultaneous transmit and receive functionality into the system taught by Chincholi to achieve greater network efficiency and throughput. (EX1002 ¶270.) As DiFazio teaches, for example, the ability to simultaneously transmit and receive using FDSC can achieve 70% greater throughput as compared to conventional half-duplex systems. (EX1010 16:29-30.) To the extent not explicitly disclosed by Chincholi, implementing a simultaneous transmit and receive functionality into its disclosed system would have been technologically feasible and could be accomplished in straightforward manner with a reasonable expectation of success. (EX1002 ¶270.)

Finally, Chincholi also does not “require” disassociation of recipient WTRUs from either or both of the actual MAC and PHY interfaces during operation, including during use of a second transceiver to simultaneously receive a second data stream from the recipient. Indeed, as discussed above, *see* limitation 1[j], a POSITA would have recognized the desirability of implementing Chincholi combined with the teachings of Riggert and Clegg to transmit the first data stream to the recipient without requiring “disassociation” of the recipient from either or both of the first and second actual MAC and PHY interfaces. (EX1002 ¶271.)

- f) **25[f]: wherein, after the circuitry has been connected to the application interface and when the**

wireless networking device is being used, the wireless networking device's utilization of the at least one first bandwidth portions of the first and second wireless transceivers does not prevent any wireless networking device from utilizing a range of frequencies corresponding to the remaining portion of the bandwidth availabilities of the first and second wireless transceivers for data transmission or reception purposes at the same time that data is being transmitted from or received by the first and second wireless transceivers.

As discussed above, *see* limitation 1[k], Chincholi discloses examples of “*multi-WTRU* multi-IP flow cases” (EX1005 [0328].) which a POSITA would have understood discloses the capability to allow multiple WTRUs to simultaneously utilize different portions of a transceiver’s available bandwidth simultaneously and without interference. (EX1002 ¶272-273.)

26. Claim 26: The method of claim 25, wherein the second data stream is received by the second wireless transceiver substantially simultaneously with the transmission of the first data stream from the first wireless transceiver.

As discussed, *see* claim 25, POSITA would have recognized Chincholi, in light of background reference DiFazio discloses the second data stream is received by the second transceiver simultaneously with the transmission of the first data stream from the first wireless transceiver. (EX1002 ¶¶274-275.)

27. Claim 27: The method of claim 25, wherein the start of the reception of the second data stream by the second wireless transceiver is substantially simultaneous with the start of

the transmission of the first data stream from the first wireless transceiver.

As discussed, *see* claim 25, POSITA would have recognized Chincholi, in light of background reference DiFazio discloses the second data stream is received by the second transceiver simultaneously with the transmission of the first data stream from the first wireless transceiver. This means the start of reception of the second data stream would be at least substantially simultaneous with the start of transmission of the first data stream. (EX1002 ¶¶276-277.)

28. Claim 28: The method of claim 25, wherein the end of the reception of the second data stream by the second wireless transceiver is substantially simultaneous with the end of the transmission of the first data stream from the first wireless transceiver.

As discussed, *see* claim 25, a POSITA would have recognized Chincholi, in light of background reference DiFazio discloses the second data stream is received by the second transceiver simultaneously with the transmission of the first data stream from the first wireless transceiver. This means the end of reception of the second data stream would be at least substantially simultaneous with the end of transmission of the first data stream. (EX1002 ¶¶278-279.)

29. Claim 29: The method of claim 25,

- a) 29[a]: wherein the processing interface is configured to, after the circuitry has been connected to the application interface and when the wireless networking device is being used, in a manner**

transparent to any layer of the wireless networking device above the processing interface,

See limitation 1[f]. (EX1002 ¶¶280-281.)

- b) 29[b]: (a) identify at least one second portion of bandwidth available for communication of the first wireless transceiver, the identified at least one second portion of the first second wireless transceiver comprising a set of given resources,**

See limitations 1[h]. Just as Chincholi discloses the capability to identify at least one first portion (1[h]) and one second portion (14[b]) of available bandwidth of the first wireless transceiver, Chincholi also discloses the capability to identify at least one second portion of bandwidth of the first transceiver having a set of given resources. (EX1002 ¶¶282-283.)

- c) 29[c]: (b) evaluate whether any of the given resources of the at least one first and identified portions of the first wireless transceiver are not unavailable for communication, and**

See limitations 1[i]. Just as Chincholi and Chincholi/Riggert/Clegg each disclose evaluating whether any of the given resources are unavailable, they also disclose the same capability for evaluating whether the given resources are not unavailable. (EX1002 ¶¶284-287.)

- d) 29[d]: (c) use the first wireless transceiver to transmit the first data stream to the recipient, without requiring disassociation of either or both of the first and second associations, using a specific subset of frequencies corresponding to the given resources of the identified at least one first and**

second bandwidth portion of the first wireless transceiver that are not unavailable for communication to thereby at least partially satisfy the first wireless bandwidth requirement of the first application.

See limitations 1[i]. Just as Chincholi and Chincholi/Riggert/Clegg each disclose using a specific subset of frequencies corresponding to the given resources of *the identified at least one first bandwidth portion* of the first wireless transceiver that are not unavailable for communication, they also disclose using frequencies corresponding to *the identified at least one first and one second bandwidth portion*. (EX1002 ¶¶288-291.)

30. Claim 30: The method of claim 29,

- a) 30[a]: wherein the processing interface is configured to, after the circuitry has been connected to the application interface and when the wireless networking device is being used, in a manner transparent to any layer of the wireless networking device above the processing interface,**

See limitation 1[f]. (EX1002 ¶¶292-293.)

- b) 30[b]: (a) identify at least one second portion of bandwidth available for communication of the second wireless transceiver, the identified at least one second portion of the second wireless transceiver comprising a set of given resources,**

See limitation 29[b]. Just as Chincholi discloses identifying a second portion of bandwidth of the first transceiver, it discloses the same capability for the second transceiver. (EX1002 ¶¶294-295.)

- c) **30[c]: (b) evaluate whether any of the given resources of the at least one first and identified portions of the second wireless transceiver are not unavailable for communication, and**

See limitation 29[c]. Just as Chincholi and Clegg disclose evaluating whether any resources of the first and second portions of the first transceiver are unavailable, they disclose the same capability for the second transceiver. (EX1002 ¶¶296-299.)

- d) **30[d]: (c) use the second wireless transceiver to receive the second data stream from the recipient, without requiring disassociation of either or both of the first and second associations, using a specific subset of frequencies corresponding to the given resources of the identified at least one first and second bandwidth portion of the second wireless transceiver that are not unavailable for communication to thereby at least partially satisfy the first wireless bandwidth requirement of the second application.**

As discussed in limitation 29[d], Chincholi and Clegg disclose using only those resources of the first and second portions of the first transceiver that are not unavailable, and the same capability is disclosed for the second transceiver. As discussed in limitation 25[e], a POSITA would have understood that one could operate transceivers in a simultaneous transmit/receive manner. As discussed in limitation 1[j], Chincholi does not require disassociation of recipients and a POSITA would have recognized avoiding disassociation would be desirable. (EX1002 ¶¶300-303.)

VIII. CONCLUSION

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

Respectfully submitted,

Date: July 3, 2025

/s/ James M. Glass

James M. Glass (Reg. No. 46729)
QUINN EMANUEL URQUHART &
SULLIVAN LLP
295 5th Avenue, 9th Floor
New York, NY 10016
Email: jimglass@quinnemanuel.com
Phone: 212-849-7142
Fax: 212-849-7100

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 13,925 words, which is within the word limit allowed under 37 C.F.R. § 42.24(a)(i).

Date: July 3, 2025

/s/ James M. Glass

James M. Glass (Reg. No. 46729)
QUINN EMANUEL URQUHART &
SULLIVAN LLP
295 5th Avenue, 9th Floor
New York, NY 10016
Email: jimglass@quinnemanuel.com
Phone: 212-849-7142
Fax: 212-849-7100

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. §§ 42.6(e), 42.105(a), the undersigned hereby certifies service on the PO of a copy of this Petition and its respective exhibits at the official correspondence address for the attorneys of record for the '933 patent as shown in USPTO PAIR via FedEx:

30565 - WOODARD, EMHARDT, HENRY, REEVES & WAGNER, LLP
111 MONUMENT CIRCLE, SUITE 3700
INDIANAPOLIS, IN 46204-5137
UNITED STATES

Courtesy copies were also sent via FedEx and electronic mail to Patent

Owner's counsel of record in the related district court proceeding:

Aaron R. Fahrenkrog
800 LaSalle Ave., Suite 2800
Minneapolis, MN 55402
Email: afahrenkrog@robinskaplan.com

Logan J. Drew
Email: ldrew@robinskaplan.com

Jessica L. Gutierrez
Email: jgutierrez@robinskaplan.com

Nicole R. Olson
Email: nolson@robinskaplan.com

Andrea L. Fair
E-mail: andrea@millerfairhenry.com

Blake R. Hartz
Email: bhartz@uspatent.com

Date: July 3, 2025

/s/ James M. Glass

James M. Glass (Reg. No. 46729)

QUINN EMANUEL URQUHART &

SULLIVAN LLP

295 5th Avenue, 9th Floor

New York, NY 10016

Email: jimglass@quinnemanuel.com

Phone: 212-849-7142

Fax: 212-849-7100