

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE**

In re Patent of:      Juhyung Son, et al.      Attorney Docket No. 39843-0200IP1  
U.S. Patent No.:      10,687,281  
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Appl. Serial No.:      16/016,520  
Filing Date:      June 22, 2018  
Title:      WIRELESS COMMUNICATION METHOD AND WIRELESS  
                 COMMUNICATION TERMINAL, WHICH USE  
                 DISCONTINUOUS CHANNEL

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**PETITION FOR *INTER PARTES* REVIEW OF UNITED STATES**  
**PATENT NO. 10,687,281 PURSUANT TO 35 U.S.C. §§ 311–319,**  
**37 C.F.R. § 42**

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**EXHIBITS**

- SAMSUNG-1001 U.S. Patent No. 10,687,281 to Son, et al. (“the ’281 Patent”)
- SAMSUNG-1002 Excerpts from the Prosecution History of the ’281 Patent (“the Prosecution History”)
- SAMSUNG-1003 Declaration and Curriculum Vitae of Dr. R. Michael Buehrer
- SAMSUNG-1004 Complaint, *Wilus Institute of Standards and Technology Inc., v. Samsung Electronics Co., Ltd., et al.*, 2-24-cv-00746 (EDTX) filed September 11, 2024
- SAMSUNG-1005 Korean Priority Applications for the ’281 Patent (in Korean)
- SAMSUNG-1006 Certified Translation of Korean Priority Application No. 10-2015-0186871 (filed Dec. 24, 2015)
- SAMSUNG-1007 Certified Translation of Korean Priority Application No. 10-2016-0004471 (filed Jan. 13, 2016)
- SAMSUNG-1008 Certified Translation of Korean Priority Application No. 10-2016-0005835 (filed Jan. 18, 2016)
- SAMSUNG-1009 Certified Translation of Korean Priority Application No. 10-2016-0026683 (filed Mar. 4, 2016)
- SAMSUNG-1010 Certified Translation of Korean Priority Application No. 10-2016-0030006 (filed Mar. 13, 2016)
- SAMSUNG-1011 Certified Translation of Korean Priority Application No. 10-2016-0059182 (filed May 14, 2016)
- SAMSUNG-1012 Certified Translation of Korean Priority Application No. 10-2016-0062422 (filed May 20, 2016)
- SAMSUNG-1013 Certified Translation of Korean Priority Application No. 10-2016-0083756 (filed Jul. 1, 2016)
- SAMSUNG-1014 US Patent Publication No. 2017/0006608A1 (“Josiam”)
- SAMSUNG-1015 US Provisional Application No. 62/187,301 (“Josiam July 1,

2015 Provisional”)

SAMSUNG-1016 US Provisional Application No. 62/277,780 (“Josiam Jan. 12, 2016 Provisional”)

SAMSUNG-1017 US Provisional Application No. 62/328,106 (“Josiam Apr. 27, 2016 Provisional”)

SAMSUNG-1018 US Patent Publication No. 2018/0375632A1 (“Kim”)

SAMSUNG-1019 Certified Translation of US Provisional Application No. 62/311,929 (“Kim Provisional”)

SAMSUNG-1020 US Provisional Application No. 62/311,929 (in Korean)

SAMSUNG-1021 US Patent Publication No. 2017/0181129A1 (“Bharadwaj”)

SAMSUNG-1022 US Provisional Application No. 62/270,562 (“Bharadwaj Provisional”)

SAMSUNG-1023 US Patent Publication No. US2017/0041171 (“Li”)

SAMSUNG-1024 US Provisional Application No. 62/200,368 (“Li Provisional”)

SAMSUNG-1025 US Patent Publication No. 2016/0330058A1 (“Chen”)

SAMSUNG-1026 Aug. 2016 IEEE 802.11ax Draft Specification

SAMSUNG-1027 IEEE 802.11-15/0132r13 (“December 2015 802.11ax Specification Framework”)

SAMSUNG-1028 IEEE 802.11-15/0132r15 (“March 2016 802.11ax Specification Framework”)

SAMSUNG-1029 IEEE 802.11-16/0024r1 (“March 2016 Draft 802.11ax Specification”)

SAMSUNG-1030 Evgeny Khorov et al., *A Tutorial on IEEE 802.11ax High Efficiency WLANs*, 21 IEEE COMMS. SURVEYS & TUTORIALS 197 (2019)

SAMSUNG-1031 Sanghyun Kim et al., *Wider-Bandwidth Operation of IEEE 802.11 for Extremely High Throughput: Challenges and Solutions for Flexible Puncturing*, 8 IEEE ACCESS 213840

(2020).

- SAMSUNG-1032 Yunbo Li et al., *Non-Contiguous Channel Bonding in 11ax* (Jan. 17, 2016) IEEE 802.11-16/0059r1
- SAMSUNG-1033 IEEE 802.11ac-2013 Specification
- SAMSUNG-1034 Joonsuk Kim et al., *HE-SIG-B Structure* (Jul. 11, 2015) IEEE 802.11-15/0821r2
- SAMSUNG-1035 Katsuo Yunoki & B. Zhao, *Considerations on HE-SIG-A/B* (Jul. 15, 2015) IEEE 802.11-15/827r2
- SAMSUNG-1036 Yunbo Li et al., *BW Indication for Non-Contiguous Channel Bonding* (May 15, 2016) IEEE 802.11-16/0635r2
- SAMSUNG-1037 Kaushik Josiam et al., *HE-SIG-B Mapping and Compression* (Nov. 9, 2015) IEEE 802.11-15/1315r1
- SAMSUNG-1038 Kaushik Josiam et al., *HE-SIG-B Compression Mode* (Mar. 14, 2016) IEEE 802.11-15/0349r1
- SAMSUNG-1039 Suhwook Kim et al., *Efficient Wider Bandwidth Operation* (Sep. 11, 2013) IEEE 802.11-13/1058r0
- SAMSUNG-1040 Jinsoo Ahn et al., *OFDMA Non-Contiguous Channel Utilization* (Mar. 10, 2015) IEEE 802.11-15/0353r1
- SAMSUNG-1041 US Patent Publication No. 2018/0279371A1 (“Li-371”)
- SAMSUNG-1042 US Provisional Application No. 62/244,603 (“Li-371 Provisional”)
- SAMSUNG-1043 Jiayin Zhang et al., *Preamble Structure for 11ax System* (Jan. 2015) IEEE 802.11-15/0101r1
- SAMSUNG-1044 Jianhan Liu et al., *SIG-A Structure in 11ax Preamble* (Jul. 11, 2015) IEEE 802.11-15/0822r2
- SAMSUNG-1045 Hongyuan Zhang et al., *BW Field in HE-MU Format* (Jul. 25, 2016) IEEE 802.11-16/0898
- SAMSUNG-1046 US Patent No. 8,971,213 B1 (“Hart”)

- SAMSUNG-1047 Fed. Commc'ns Comm., *Revision to Part 15 of the Commission's Rules to Permit Unlicensed National Information Infrastructure (U-NII) Devices in the 5 GHz Band* (Feb. 20, 2013)
- SAMSUNG-1048 Andreas F. Molisch, *Wireless Communications* (2nd ed. 2011)
- SAMSUNG-1049 Coke Morgan Stewart, *Interim Processes for PTAB Workload Management* (Mar. 26, 2025)
- SAMSUNG-1050 Patent Trial and Appeal Board (PTAB) Boardside Chat: Interim Processes Relating to institution in AIA Proceedings (Apr. 17, 2025)
- SAMSUNG-1051 *Fintiv* Stipulation

## LISTING OF CHALLENGED CLAIMS

| Claim 1 |                                                                                                                                                                                                                                                           |
|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [1.pre] | A wireless communication terminal, the terminal comprising:                                                                                                                                                                                               |
| [1.1]   | a processor; and                                                                                                                                                                                                                                          |
| [1.2]   | a communication unit,                                                                                                                                                                                                                                     |
| [1.3]   | wherein the processor is configured to:                                                                                                                                                                                                                   |
| [1.4]   | receive a wireless packet through the communication unit,                                                                                                                                                                                                 |
| [1.5]   | obtain bandwidth information indicated via a bandwidth field of HE-SIG-A of the received packet,                                                                                                                                                          |
| [1.6]   | obtain information of an unassigned resource unit via at least one of the bandwidth field of the HE-SIG-A and a subfield of HE-SIG-B of the received packet, and                                                                                          |
| [1.7]   | decode the received packet based on the bandwidth information and the information of the unassigned resource unit,                                                                                                                                        |
| [1.8]   | wherein the information of the unassigned resource unit is indicated via a combination of the bandwidth field of the HE-SIG-A and a resource unit allocation field of the HE-SIG-B, and                                                                   |
| [1.9]   | wherein the bandwidth field of the HE-SIG-A indicates channel information to be punctured within the bandwidth, and the resource unit allocation field indicates additional puncturing information for the unassigned resource unit within the bandwidth. |
| Claim 2 |                                                                                                                                                                                                                                                           |
| [2]     | The wireless communication terminal of claim 1, wherein the resource unit allocation field indicates a specific resource unit not assigned to a user through a predetermined index                                                                        |
| Claim 3 |                                                                                                                                                                                                                                                           |
| [3]     | The wireless communication terminal of claim 2, wherein the specific resource unit not assigned to a user is at least one of a 242-tone resource unit, a 484-tone resource unit, and a 996-tone resource unit.                                            |
| Claim 4 |                                                                                                                                                                                                                                                           |
| [4]     | The wireless communication terminal of claim 1, wherein the information of the unassigned resource unit is obtained through resource unit arrangement information indicated by the resource unit                                                          |

|                |                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|----------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                | allocation field of the HE-SIG-B and a Null STA ID contained in a user field corresponding to a specific resource unit in the resource unit arrangement.                                                                                                                                                                                                                                                                                      |
| <b>Claim 5</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| [5]            | The wireless communication terminal of claim 1, wherein the specific resource unit is at least one of a 26-tone resource unit, a 52-tone resource unit, and a 106-tone resource unit.                                                                                                                                                                                                                                                         |
| <b>Claim 6</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| [6]            | The wireless communication terminal of claim 1, wherein when the bandwidth field indicates puncturing of one of two 20 MHz channels in a secondary 40 MHz channel within a bandwidth of 80 MHz or puncturing of at least one of two 20 MHz channels in a secondary 40 MHz channel within a bandwidth of 160 MHz or 80+80 MHz, the resource unit allocation field indicates which 20 MHz channel in the secondary 40 MHz channel is punctured. |
| <b>Claim 7</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| [7]            | The wireless communication terminal of claim 1, wherein when the bandwidth field indicates puncturing of a secondary 20 MHz channel within a bandwidth of 160 MHz or 80+80 MHz or puncturing of at least one of two 20 MHz channels in a secondary 40 MHz channel within a bandwidth of 160 MHz or 80+80 MHz, the resource unit allocation field indicates additional puncturing in a secondary 80 MHz channel.                               |
| <b>Claim 8</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                               |
| [8.pre]        | A wireless communication method of a wireless communication terminal, the method comprising:                                                                                                                                                                                                                                                                                                                                                  |
| [8.1]          | receiving a wireless packet;                                                                                                                                                                                                                                                                                                                                                                                                                  |
| [8.2]          | obtaining bandwidth information indicated via a bandwidth field of HE-SIG-A of the received packet;                                                                                                                                                                                                                                                                                                                                           |
| [8.3]          | obtaining information of an unassigned resource unit via at least one of the bandwidth field of the HE-SIG-A and a subfield of HE-SIG-B of the received packet; and                                                                                                                                                                                                                                                                           |
| [8.4]          | decoding the received packet based on the bandwidth information and the information of the unassigned resource unit,                                                                                                                                                                                                                                                                                                                          |

|                 |                                                                                                                                                                                                                                                                                                                                                                                                                                             |
|-----------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [8.5]           | wherein the information of the unassigned resource unit is indicated via a combination of the bandwidth field of the HE-SIG-A and a resource unit allocation field of the HE-SIG-B, and                                                                                                                                                                                                                                                     |
| [8.6]           | wherein the bandwidth field of the HE-SIG-A indicates channel information to be punctured within the bandwidth, and the resource unit allocation field indicates additional puncturing information for the unassigned resource unit within the bandwidth.                                                                                                                                                                                   |
| <b>Claim 9</b>  |                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| [9]             | The wireless communication method of claim 8, wherein the resource unit allocation field indicates a specific resource unit not assigned to a user through a predetermined index.                                                                                                                                                                                                                                                           |
| <b>Claim 10</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| [10]            | The wireless communication method of claim 9, wherein the specific resource unit not assigned to a user is at least one of a 242-tone resource unit, a 484-tone resource unit, and a 996-tone resource unit.                                                                                                                                                                                                                                |
| <b>Claim 11</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| [11]            | The wireless communication method of claim 8, wherein the information of the unassigned resource unit is obtained through resource unit arrangement information indicated by the resource unit allocation field of the HE-SIG-B and a Null STA ID contained in a user field corresponding to a specific resource unit in the resource unit arrangement.                                                                                     |
| <b>Claim 12</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| [12]            | The wireless communication method of claim 8, wherein the specific resource unit is at least one of a 26-tone resource unit, a 52-tone resource unit, and a 106-tone resource unit.                                                                                                                                                                                                                                                         |
| <b>Claim 13</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| [13]            | The wireless communication method of claim 8, wherein when the bandwidth field indicates puncturing of one of two 20 MHz channels in a secondary 40 MHz channel within a bandwidth of 80 MHz or puncturing of at least one of two 20 MHz channels in a secondary 40 MHz channel within a bandwidth of 160 MHz or 80+80 MHz, the resource unit allocation field indicates which 20 MHz channel in the secondary 40 MHz channel is punctured. |
| <b>Claim 14</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                             |

|      |                                                                                                                                                                                                                                                                                                                                                                                                               |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| [14] | The wireless communication method of claim 8, wherein when the bandwidth field indicates puncturing of a secondary 20 MHz channel within a bandwidth of 160 MHz or 80+80 MHz or puncturing of at least one of two 20 MHz channels in a secondary 40 MHz channel within a bandwidth of 160 MHz or 80+80 MHz, the resource unit allocation field indicates additional puncturing in a secondary 80 MHz channel. |
|------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

Samsung Electronics Co., Ltd. (“Petitioner” or “Samsung”) petitions for *Inter Partes* Review (“IPR”) of claims 1-14 (“the Challenged Claims”) of U.S. Patent No. 10,687,281 (“the ’281 patent”). Compelling evidence presented in this Petition demonstrates at least a reasonable likelihood that Samsung will prevail with respect to at least one of the Challenged Claims.

## **I. REQUIREMENTS FOR IPR**

### **A. Grounds for Standing**

Petitioner certifies that the ’281 patent is available for IPR. This petition is being filed within one year of service of a complaint against Samsung. Samsung is not barred or estopped from requesting review of the Challenged Claims on the below-identified grounds.

### **B. Challenge and Relief Requested**

Samsung requests an IPR of the Challenged Claims on the grounds below. Dr. Buehrer provides supporting testimony in his Declaration.

As described, *infra*, §II.B, the Challenged Claims are entitled to a priority claim no earlier than 5/14/2016 (“Critical Date”). However, this Petition presents grounds based on the Critical Date and based on the ’281 patent’s earliest provisional filing date of 12/24/2015 (“Earliest Filing Date”).

| Ground | Claim(s)      | §103                  | '281 Patent Priority Date Relied Upon |
|--------|---------------|-----------------------|---------------------------------------|
| 1A     | 1-5, 7-12, 14 | Josiam                | 5/14/2016                             |
| 1B     | 1-7, 13       | Josiam-Kim            | 5/14/2016                             |
| 2A     | 1-3, 7-10, 14 | Bharadwaj-Li          | 12/24/2015                            |
| 2B     | 1-5, 7-12, 14 | Bharadwaj-Li-Chen     | 12/24/2015                            |
| 2C     | 6, 13         | Bharadwaj-Li-Kim      | 5/14/2016                             |
| 2D     | 6, 13         | Bharadwaj-Li-Chen-Kim | 5/14/2016                             |

As shown, Grounds 1A-1B and 2C-2D rely on art that pre-dates the Critical Date. Grounds 2A-2B rely on art that pre-dates the Earliest Filing Date.

| Reference | Publication Date | Filing Date | Priority Date |
|-----------|------------------|-------------|---------------|
| Josiam    | 1/5/2017         | 6/24/2016   | 4/27/2016     |
| Kim       | 12/27/2018       | 12/9/2016   | 3/23/2016     |
| Bharadwaj | 6/22/2017        | 12/21/2016  | 12/21/2015    |
| Li        | 2/9/2017         | 12/26/2016  | 8/3/2015      |
| Chen      | 11/10/2016       | 9/25/2015   | N/A           |

Chen qualifies as prior art under AIA§102 based on its filing date. Josiam, Kim, Bharadwaj, and Li qualify as prior art under AIA§102 because the relied-upon subject matter is fully supported by provisional applications filed by the Critical Date (for Grounds 1A-1B and 2C-2D) or the Earliest Filing Date (for

Grounds 2A-2B). *Penumbra, Inc. v. Rapidpulse, Inc.*, IPR2021-01466, Paper 34, 28-35 (PTAB March 10, 2023) (precedential). Parallel citations to Josiam, Kim, Bharadwaj, and Li's respective provisional applications are included in Dr. Buehrer's Declaration, and Dr. Buehrer testifies that a POSITA would have understood the relied upon portions in these references are supported by their respective provisional applications. *See id.*; SAMSUNG-1003, [98]-[100]. Petitioner notes that Josiam, Kim, and Li explicitly incorporate the disclosures of the above provisional applications by reference. *See* SAMSUNG-1014, [0002]; SAMSUNG-1018, [0001]; SAMSUNG-1024, [0001].

### **C. Claim Construction**

Petitioner submits that no formal claim constructions are necessary because "claim terms need only be construed to the extent necessary to resolve the controversy." *Wellman, Inc. v. Eastman Chem. Co.*, 642 F.3d 1355, 1361 (Fed. Cir. 2011). Petitioner reserves the right to respond to any constructions Patent Owner offers or the Board adopts. Petitioner is not conceding that each challenged claim satisfies all statutory requirements or waiving any arguments concerning claim scope or grounds that can only be raised in district court. For this petition, Petitioner applies prior art in a manner consistent with Patent Owner's allegations of infringement before the district court.

#### **D. Level of Ordinary Skill in the Art**

For purposes of this IPR, a person of ordinary skill in the art (“POSITA”) would have had a Bachelor’s degree in electrical engineering, computer engineering, computer science, or a related field, and at least three years of experience in the research, design or development of wireless communication devices, systems, and/or networks, or the equivalent, as of the Critical Date (for Grounds 1A-1B and 2C-2D) or the Earliest Filing Date (for Grounds 2A-2B). SAMSUNG-1003, [27]. Increased educational experience can make up for less work experience, and vice versa. *Id.*

### **II. THE ’281 PATENT**

#### **A. Brief Description**

The ’281 patent generally relates to “a wireless communication method and a wireless communication terminal using a non-contiguous channel,” and more particularly to a method of indicating “non-contiguous channel allocation information via at least one of a subfield of HE-SIG-A and a subfield of HE-SIG-B of [a] received packet.” SAMSUNG-1001, Abstract, 3:43-45. The ’281 patent describes three ways to signal non-contiguous channel allocation information: (1) “via the bandwidth field of the HE-SIG-A”; (2) “via the RA field of the HE-SIG-B”; or (3) “by carrying a null STA ID in a specific user field of the HE-SIG-B.” *Id.*, 34:27-47.

The ’281 patent states that non-contiguous channel allocation information

may be signaled “solely via subfield(s) of the HE-SIG-A” (*id.*, 38:53-16), “solely via subfield(s) of the HE-SIG-B” (*id.*, 39:17-25), or “via a combination of the subfield(s) of the HE-SIG-A and subfield(s) of the HE-SIG-B” (*id.*, 39:26-51).

According to the '281 patent, “the bandwidth field [of HE-SIG-A] may indicate the total bandwidth information through which the PPDU is transmitted and some channel information to be punctured within the total bandwidth ... [and] additional puncturing information may be indicated via the RA field of the HE-SIG-B.” *Id.*, 41:36-39.

For example, “when the bandwidth field indicates puncturing of the S20 channel in the total bandwidth of 160 MHz or 80+80 MHz (e.g., the second channel configuration in FIG. 33(d)), the resource unit allocation field may indicate additional puncturing the S80 channel.” *Id.*, 41:66-42:4. “Channels in which puncturing is indicated as described above are not assigned to [a] user.” *Id.*, 42:5-6.

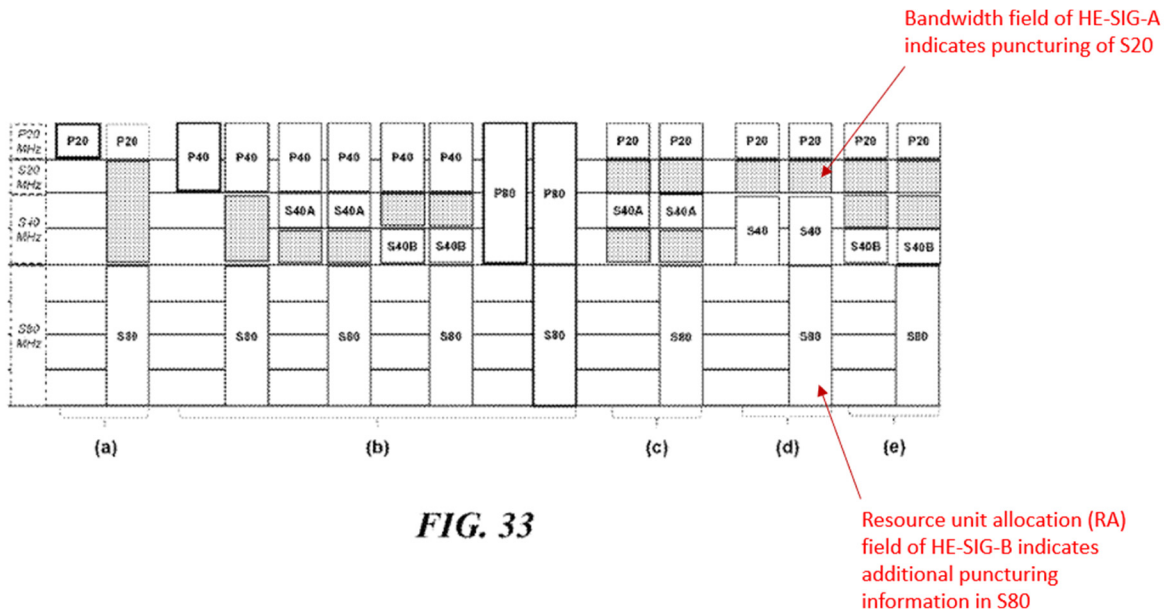


**FIG. 33**

SAMSUNG-1001, Fig. 33 (annotated)

## B. Priority Claims

The '281 patent claims priority to eight Korean applications:

| Korean App.                    | Filing Date |
|--------------------------------|-------------|
| 10-2015-0186871 (SAMSUNG-1006) | 12/24/2015  |
| 10-2016-0004471 (SAMSUNG-1007) | 1/13/2016   |
| 10-2016-0005835 (SAMSUNG-1008) | 1/18/2016   |
| 10-2016-0026683 (SAMSUNG-1009) | 3/4/2016    |
| 10-2016-0030006 (SAMSUNG-1010) | 3/13/2016   |
| 10-2016-0059182 (SAMSUNG-1011) | 5/14/2016   |
| 10-2016-0062422 (SAMSUNG-1012) | 5/20/2016   |
| 10-2016-0083756 (SAMSUNG-1013) | 7/1/2016    |

SAMSUNG-1001, [0001]; *see* SAMSUNG-1005 (original priority applications); SAMSUNG-1006-SAMSUNG-1013 (certified translations). However, the Challenged Claims are not entitled to a priority claim before 5/14/2016.

**1. No Challenged Claim is entitled to pre-5/14/2016 priority**

The '281 patent includes only two independent claims, 1 and 8. The subject matter of [1.9] and [8.6] is not supported by the pre-5/14/2016 applications (SAMSUNG-1006-SAMSUNG-1010). SAMSUNG-1003, [87]-[93]. A POSITA reviewing these documents would not have reasonably concluded that they demonstrate possession of the last limitation of claims 1 and 8, which require that the bandwidth field of HE-SIG-A indicates channel puncturing information and the resource unit allocation field of HE-SIG-B indicates *additional* puncturing information. SAMSUNG-1003, [89].

According to Dr. Buehrer, “none of these documents explicitly, implicitly, or inherently discloses using both the bandwidth field of the HE-SIG-A and the resource unit allocation field of the HE-SIG-B to indicate channel puncturing information as the claim elements require.” SAMSUNG-1003, [90]. At best, these documents discuss indicating unused channels using either HE-SIG-A or HE-SIG-B fields—but not both. SAMSUNG-1003, [91] (discussing SAMSUNG-1010, [278], [288], which state that the “BW subfield of HE-SIG-A indicates *only the BW of the entire PPDU*”). The pre-5/14/2016 filings are similarly lacking for

claims 6-7 and 13-14, which recite more specific requirements for the puncturing information (e.g., indicating which channel(s) is punctured) already unsupported by SAMSUNG-1006 to SAMSUNG-1010. *Id.*, [89], [90].

Because a POSITA would not have reasonably concluded that the inventors had possession of the claimed subject matter in [1.9], [8.6], 6-7, and 13-14 in SAMSUNG-1006 to SAMSUNG-1010 and because claims 2-7 and 9-14 depend from claim 1 or 8, no Challenged Claim is entitled to a priority date earlier than 5/14/2016. SAMSUNG-1003, [93].

### **C. Prosecution History**

During prosecution, the Office rejected the claims rejected based on Hedayat (US10,219,271) and on Hedayat, Josiam, and Yang (US2016/0366666), finding that Hedayat taught limitations equivalent to those in recited in [1.pre]-[1.8], [2]-[3], [8.pre]-[8.5], and [9]-[10]. SAMSUNG-1002, 57-67. The examiner relied on Josiam only as teaching features of claims 4-5 and 11-12.<sup>1</sup> *Id.*, 62-63. The examiner relied on Yang as teaching features recited in [1.9] and [8.6] and claims

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<sup>1</sup> Petitioner treats claims 5 and 11 as depending on claims 4 and 10, respectively, consistent with the examiner. SAMSUNG-1002, 62-63; SAMSUNG-1003, [94] n.1.

6-7 and 13-14 of the '281 patent. *Id.*, 63-66.

Applicant responded by amending the pending independent claims to include the limitations in [1.9] and [8.6], relating to channel puncturing. *Id.*, 39-42. Applicant did not address the examiner's findings regarding Josiam. *Id.*, 43-50, 57-67. Thereafter, the examiner allowed the claims. *Id.*, 25-28.

No evidence exists that the examiner substantively considered Josiam for any limitations other than claims 4-5 and 11-12, nor did Applicant challenge Josiam's prior art status. *See generally* SAMSUNG-1002.

### **III. THE CHALLENGED CLAIMS ARE UNPATENTABLE**

#### **A. [GROUND 1A] – Josiam**

##### **1. Josiam**

Josiam relates to “enabl[ing] efficient wideband operations in [wireless] local area network[s] using OFDMA.” SAMSUNG-1014, [0005]. Josiam describes signaling nulled (unused) resource units (RUs) in a high efficiency (HE) multi-user (MU) physical layer convergence protocol (PLCP) protocol data unit (PPDU). SAMSUNG-1014, [0145]-[0168], [0294]-[0305]. “[W]hen a segment of the bandwidth is sensed busy,” e.g., another station is using a particular channel, “the [RUs] spanning the channel sensed busy are unused and left empty.” SAMSUNG-1014, [0139]. Specifically, “the tones corresponding to [a] channel segment being used [by others] are nulled” and “a PHY preamble is not carried in the channel being nulled.” SAMSUNG-1014, [0154].

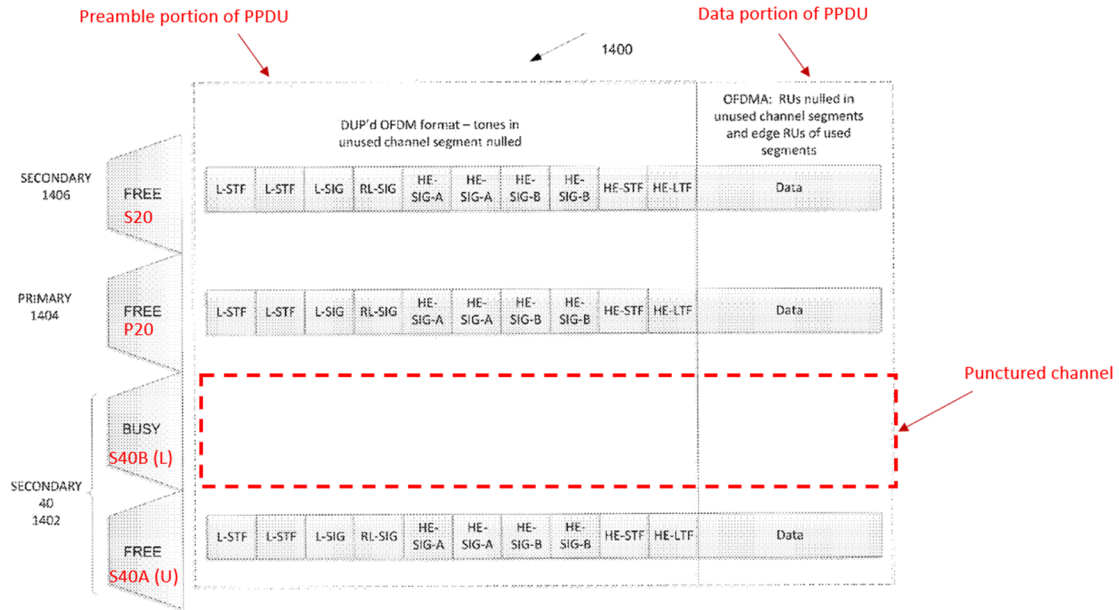


FIG. 14

SAMSUNG-1014, Fig. 14 (annotated)

Josiam discloses splitting signaling of a nulled channel between HE-SIG-A and HE-SIG-B in 80 and 160 (80 + 80)MHz PPDU's. SAMSUNG-1014, [0145]-[0168]. "Some segments that are unused in the primary 80 MHz are indicated by the bandwidth signaling in HE-SIG-A." SAMSUNG-1014, [0164]. Additional signaling of "the use or disuse of a 20 MHz segment in both 80 MHz and 160 MHz PPDU" may be transmitted using the "RU signaling field of the HE-SIG-B common field." SAMSUNG-1014, [0156].

## 2. Claim 8

[8.pre]

To the extent the preamble is limiting, Josiam describes a method of "transmitting to a station (STA), a bandwidth signaling sub-field in high efficiency signal-A (HE-SIG-A) field included in a high efficiency multi-user PPDU (HE MU

PPDU).” SAMSUNG-1014, Abstract; SAMSUNG-1003, [159].

**[8.1]**

Josiam teaches receiving a wireless packet (HE PPDU). SAMSUNG-1014, Abstract, [0006], [0264]-[0267], Fig. 38, claim 1; SAMSUNG-1003, [160]. For example, Josiam discloses “a station (STA) in a wireless local area network (WLAN) is provided. The STA includes a transceiver configured to receive, from an access point (AP), a bandwidth signaling sub-field in high efficiency signal-A (HE-SIG-A) field included in a high efficiency multi-user PPDU (HE MU PPDU) indicating availability of at least one content channel.” SAMSUNG-1014, [0006]. A POSITA would have understood that a PPDU is a wireless packet. SAMSUNG-1003, [160]; SAMSUNG-1023, [0015]; SAMSUNG-1046, 6:29-49; SAMSUNG-1001, 34:11-13 (“the received wireless packet may be an HE MU PPDU”).

**[8.2]**

Josiam teaches obtaining bandwidth information (PPDU bandwidth) indicated via a bandwidth field of HE-SIG-A of the received packet (HE PPDU). SAMSUNG-1014, Abstract, [0006], [0154]-[0156], [0264]-[0267], Figs. 13, 38, Claim 1; SAMSUNG-1003, [161]-[162]. For example, Josiam teaches an HE MU PPDU including, among other fields, HE-SIG-A and HE-SIG-B fields. *Id.*

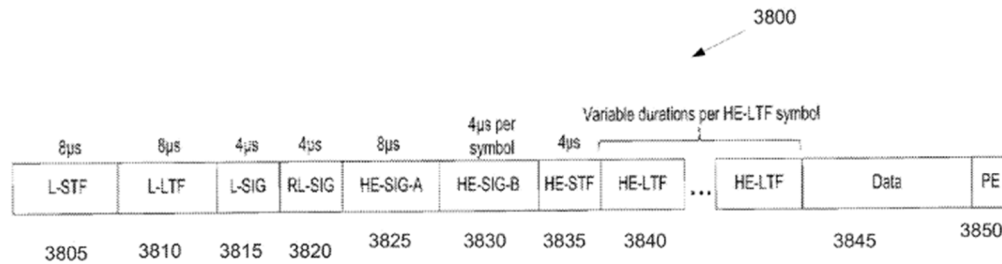


FIG. 38

SAMSUNG-1014, Fig. 38

Josiam teaches that the HE-SIG-A includes a bandwidth field that indicates the PPDU bandwidth. SAMSUNG-1014, [0154]-[0155], [0161]-[0165]. For example, a station “may use the *indication in the bandwidth field signaled in the HE-SIG-A to decipher* both the *bandwidth of the PPDU* and the location of the content channel that it may decode in the HE-SIG-B.” SAMSUNG-1014, [0161].

### [8.3]

For similar reasons to those discussed in [8.5], Josiam renders obvious that information of an unassigned resource unit is indicated via a combination of the bandwidth field of the HE-SIG-A and a resource unit allocation field in the HE-SIG-B common field (“subfield of HE-SIG-B”). See [8.5].

### [8.4]

Josiam renders obvious decoding the received packet based on the PPDU bandwidth (“bandwidth information”) and the information of the unassigned resource unit. SAMSUNG-1003, [164]-[175].

Josiam teaches decoding a received PPDU (“wireless packet”). SAMSUNG-1003, [165]; SAMSUNG-1014, [0161] (“STA may use the indication in the bandwidth field signaled in the HE-SIG-A to decipher both the bandwidth of the PPDU and the location of the content channel that it may decode in the HE-SIG-B.”), [0164].

A POSITA would have understood that a received PPDU is decoded based on the PPDU bandwidth. SAMSUNG-1003, [166]-[171]; SAMSUNG-1014, [0161], [0164]. For example, Josiam teaches that the PPDU bandwidth is used to determine the length of the HE-SIG-B common field (specifically, the number of resource unit allocation fields) of the PPDU. SAMSUNG-1014, [0285]-[0287] (*“The number of RU allocation sub-fields in the HE-SIG-B common block field depends on the total PPDU bandwidth.”*). Additionally, Josiam teaches that the PPDU bandwidth indicates the overall OFDMA tone plan (e.g., possible RU arrangements, guard tone locations, DC tone locations) of the PPDU. SAMSUNG-1014, [0133]-[0150], [0249]-[0263], Figs. 9-13, 35-37 (illustrating different OFDMA tone plans for different PPDU bandwidths). Additionally, a POSITA would have understood that the PPDU bandwidth informs a receiving station to which channels it should tune its receiver to receive the PPDU. SAMSUNG-1003, [167]-[168]; SAMSUNG-1023, [0027]; SAMSUNG-1031, 3-5; SAMSUNG-1034, 9; SAMSUNG-1040, 9. Based on Josiam’s teachings relating to the use of the

PPDU bandwidth of the PPDU, a POSITA would have understood that the PPDU is decoded based on the PPDU bandwidth—specifically, the information it provides (e.g., length of the HE-SIG-B common field, the overall OFDMA tone plan, which channels to use to receive the PPDU). SAMSUNG-1003, [171].

Josiam also renders obvious that a received PPDU (“wireless packet”) is decoded based on the information of an unassigned RU (e.g., nulled RU).

SAMSUNG-1003, [172]-[175]; *see* [8.5]. For example, a POSITA would have understood that a station decodes a received PPDU based on its RU assignment. SAMSUNG-1003, [172]-[173]; SAMSUNG-1025, [0101]-[0103], Fig. 17; SAMSUNG-1021, [0101]; SAMSUNG-1031, 4-5.

Specifically, Josiam teaches that a station determines its RU assignment by comparing the position of a user-field that matches its station ID to the RU arrangement indicated by the 8-bit RU allocation subfield. SAMSUNG-1014, [0279]-[0289]; *see* SAMSUNG-1025, [0090]-[0093], Figs. 12-14. In PPDUs larger than 40MHz, user fields are split between the HE-SIG-B content channels. SAMSUNG-1014, [0286]-[0287]. When a RU is nulled (unassigned), a POSITA would have recognized two options for adjusting the HE-SIG-B user-specific field in response to a nulled RU. SAMSUNG-1003, [174]-[175].

First, a POSITA would have understood that no user fields corresponding to the nulled RU may be transmitted. SAMSUNG-1003, [174]; SAMSUNG-1014,

[0294]-[0296]; SAMSUNG-1025, [0089]-[0093], Figs. 12-14; SAMSUNG-1028, 13 (“*no STA-specific information field assigned by the RU allocation subfield*”).

In this case, a receiving station would adjust the alignment between its position in the user-specific field and the RU arrangement information based on the information of an unassigned RU as part of decoding a received PPDU.

SAMSUNG-1003, [174]; SAMSUNG-1014, [0294]-[0296]; SAMSUNG-1025, [0089]-[0093], Figs. 12-14.

Second, a POSITA would have understood that a null or unassigned station ID may be included in the user field corresponding to the unassigned RU.

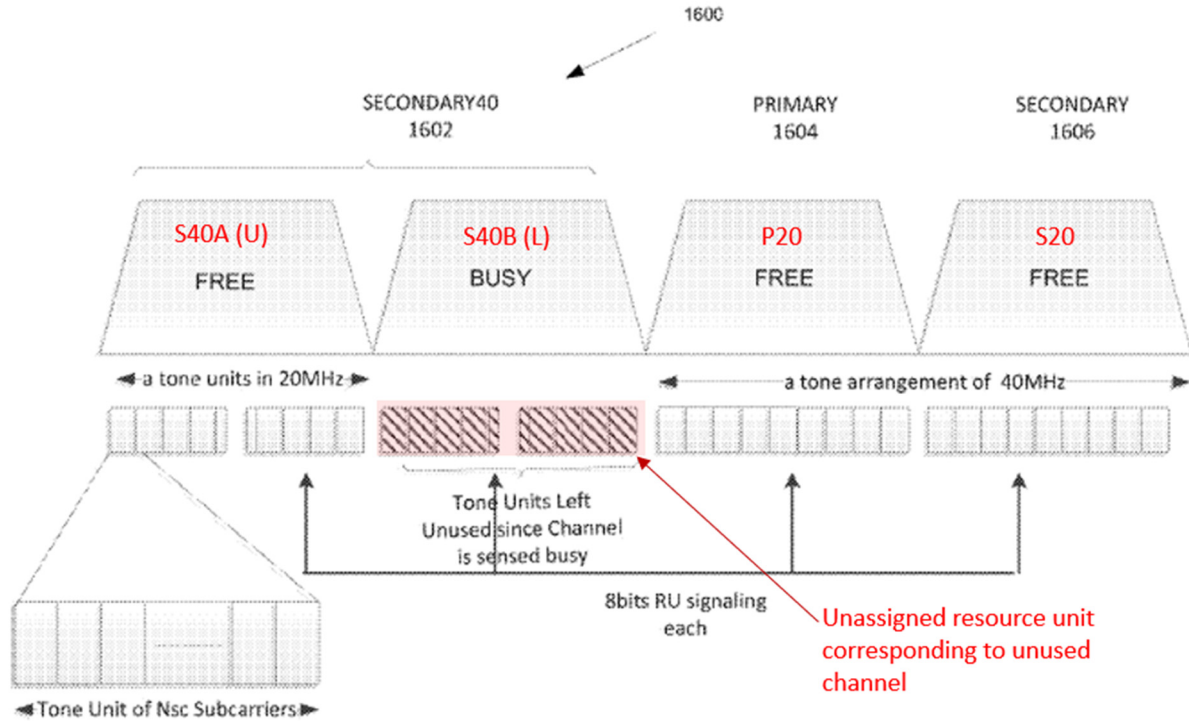
SAMSUNG-1003, [175]; SAMSUNG-1014, [0304]-[0306]; SAMSUNG-1025, [0089]-[0093], Figs. 12-14; SAMSUNG-1032, 14; §III.A.5. Here, too, a POSITA would have understood that a receiving station uses the information of an unassigned RU to decode a received PPDU by skipping over the user field corresponding to the unassigned RU, and thus not attempt to decode the data in that RU. *Id.*

### **[8.5]**

Josiam renders obvious this limitation in at least two ways. SAMSUNG-1003, [176]-[183]. First, as discussed for [8.6], Josiam teaches indicating null channel information via the bandwidth field of HE-SIG-A and the RU signaling field in the HE-SIG-B common field. SAMSUNG-1003, [176]-[180]; SAMSUNG-

1014, [0155]-[0168]; *see* [8.6]. Josiam teaches that information of a null channel indicates information of an unassigned RU corresponding to the nulled channel because the RUs that fall under the channel segment left unused are not assigned to any user (nulled). SAMSUNG-1003, [176]; SAMSUNG-1014, [0139], [0151], [0154]; SAMSUNG-1017, 8 (“***Resource units of OFDMA that full [sic] under the channel segment left unused are nulled. The nulling is always in units of resource units and not smaller.***”); *see* SAMSUNG-1032, 11-15; SAMSUNG-1045, 11-17.

For example, Dr. Buehrer explains that information of an unassigned RU may be indicated by the bandwidth field of HE-SIG-A indicating an 80MHz transmission and the number and location of the HE-SIG-B content channels. SAMSUNG-1003, [177]; SAMSUNG-1014, [0155]-[0168]; *see* [8.6]. In a RU allocation field corresponding to a punctured channel (e.g., S40B in the illustration below), the 8-bit RU signaling information may signal that the punctured channel is unoccupied “by signaling ***an unused 242-tone RU.***” SAMSUNG-1014, [0167].



SAMSUNG-1014, Fig. 16 (annotated)

Josiam also renders obvious the information of an unassigned RU corresponding to a punctured channel is indicated via a combination of the bandwidth field of HE-SIG-A and the resource allocation field in the HE-SIG-B common field. SAMSUNG-1003, [178].

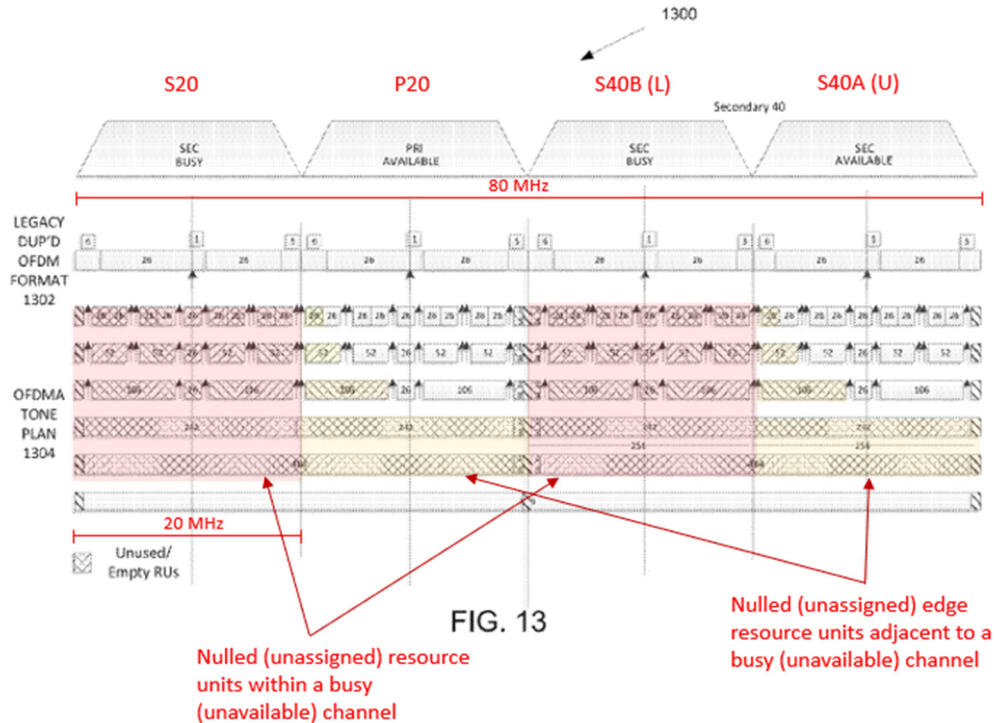
For example, Josiam teaches that a receiving station determines the number and arrangement of the RU allocation fields based on the total PPDU bandwidth (indicated by the bandwidth field), and a resource unit allocation field indicates a null 242-tone RU corresponding to a nulled channel within the PPDU bandwidth indicated by HE-SIG-A. SAMSUNG-1014, [0285]-[0287]. As another example, Josiam teaches that the bandwidth field of HE-SIG-A indicates the number,

location, and length (number of resource unit allocation fields) of the HE-SIG-B content channels, which may contain a resource unit allocation field that indicates a null 242-tone RU corresponding to a nulled channel within the PPDU bandwidth indicated by HE-SIG-A. SAMSUNG-1014, [0155]-[0168], [0285]-[0287]; *see* [8.4], [8.6]. This mapping is consistent with Patent Owner's infringement contentions. SAMSUNG-1003, [179].

Moreover, Josiam teaches that, e.g., when S20 and/or S40B is punctured, the information of the punctured channel is indicated by *both* the bandwidth field of HE-SIG-A and the resource unit allocation field of HE-SIG-B. SAMSUNG-1014, [0167].

Second, Josiam teaches that the information of a nulled RU ("unassigned resource unit") adjacent to an unavailable channel is obtained via the bandwidth field of HE-SIG-A and the resource unit allocation field in the HE-SIG-B common field. SAMSUNG-1003, [181]-[183]; SAMSUNG-1014, [0139]-[0150], [0168], Figs. 10-12. Josiam explains, "[s]ome RUs in the segment adjacent to the channel sensed busy, especially those that are closest to the channel segment sensed busy are also nulled to ensure compliance with spectral masks and out of band emission requirements. ... [T]he amount of nulling in the used channel segment adjacent to the one being left unused depends on the type of RUs used to compose the OFDMA PPDU." SAMSUNG-1014, [0139].

Josiam explains, “the nulling of RUs on the edge of the occupied bands to align the tone-plan is derived based on the bandwidth signaling in the HE-SIG-A and the 8-bit RU signaling information [of the RU signaling field in the common field of HE-SIG-B].” SAMSUNG-1014, [0167]-[0168]; SAMSUNG-1003, [182]. For example, Josiam teaches that, when the bandwidth field indicates puncturing of some channels (e.g., S20 and S40B) (SAMSUNG-1014, [0155]-[0166]), and the RU signaling field in the HE-SIG-B common field indicates the partitioning in used (available) channels adjacent to the punctured channel (e.g., into nine 26-tone RUs) (SAMSUNG-1014, [0138], [0156], [0165], [0168], [0281]-[0285]), nulling of some of those RUs adjacent to the punctured channels may be “derived based on the bandwidth signaling in the HE-SIG-A [“bandwidth field”] and the 8-bit RU signaling information” in the resource unit allocation field in HE-SIG-B common field. SAMSUNG-1003, [182]; SAMSUNG-1014, [0168]; *see* SAMSUNG-1014, [0143] (“[Nulling requirements] can be defined or implied.”); §III.A.5.



SAMSUNG-1014, Fig. 13 (annotated)

Moreover, as discussed for [11], the information of a nulled edge RU may be additionally or alternatively obtained by way of a null station ID in the user-field of HE-SIG-B. SAMSUNG-1014, [0304]; §III.A.5. Here, too, Josiam teaches that the information of the nulled edge RU (“unassigned resource unit”) is also indicated via a combination of (1) the bandwidth field of HE-SIG-A, which indicates the number and arrangement of the resource unit allocation fields based on the total PPDU bandwidth and the number and location of the HE-SIG-B content channels (as discussed above), and (2) the RU signaling field in the HE-SIG-B common field, which indicates RU arrangement information. SAMSUNG-1014, [0154]-[0168], [0250]-[0287].

[8.6]

Josiam teaches a method for indicating whether one or more 20MHz channel segments that comprise an 80MHz or larger PPDU cannot be used because the channels are busy by nulling the RU corresponding to the busy channel. SAMSUNG-1014, [0134]-[0139]; SAMSUNG-1003, [184]-[192]. A POSITA would have understood that the channels indicated as unused within the PPDU bandwidth correspond to the claimed “channel information to be punctured” and “puncturing information.” SAMSUNG-1003, [184]; SAMSUNG-1001, 42:5-15; SAMSUNG-1030, 211; SAMSUNG-1031, 4-5; SAMSUNG-1045, 11-17.

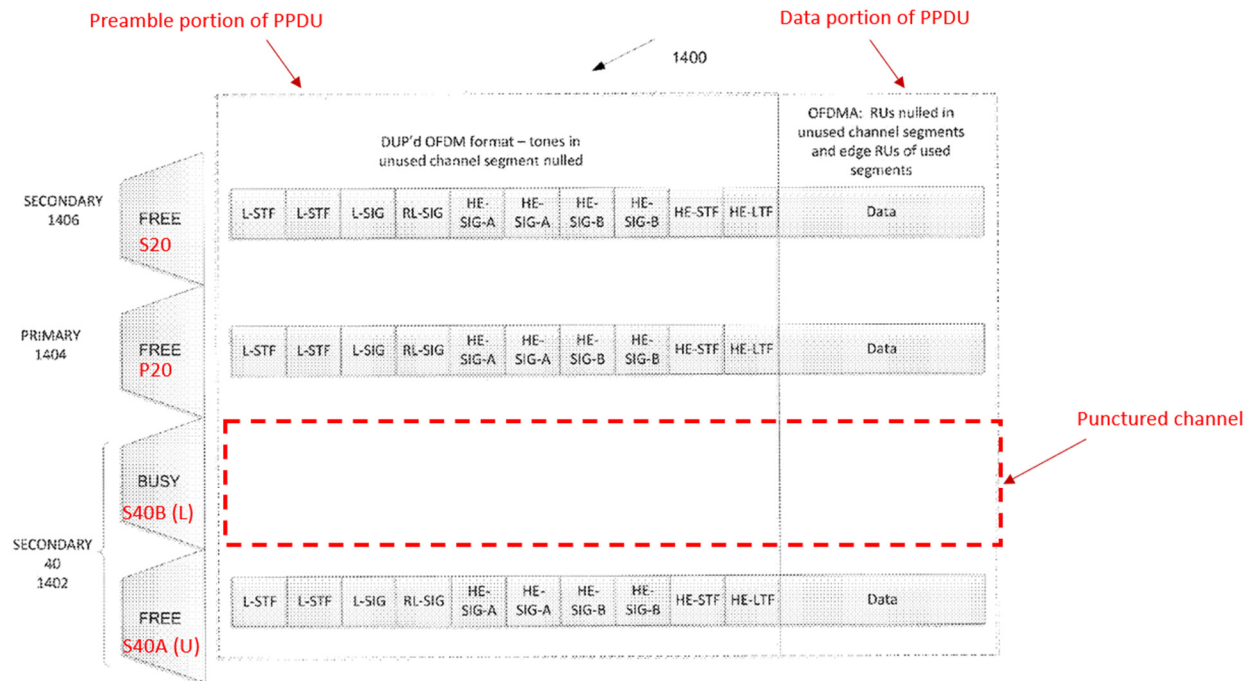


FIG. 14

SAMSUNG-1014, Fig. 14 (annotated)

Josiam teaches using the “bandwidth signaling sub-field [‘bandwidth field’] in HE-SIG-A field of a HE-multi-user (MU) PPDU [to] indicate[] both the PPDU bandwidth being used for OFDMA and availability of the HE-SIG-B content channels.” SAMSUNG-1014, [0163]. As one example, Josiam proposes using a 3-bit bandwidth field, which maps “to the PPDU bandwidth and the HE-SIG-B content channel indication.” SAMSUNG-1014, [0163]-[0166], Table 1.

TABLE 1

3 bit bandwidth signaling sub-field in HE-SIG-A and mapping to the PPDU bandwidth + HE-SIG-B channel indication

| BW Signaling | PPDU          | HE-SIG-B Content Channel Indication |                                   | Description                                                                                                                                                                                                                                                                                 |
|--------------|---------------|-------------------------------------|-----------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| in HE-SIG-A  | Bandwidth     | Content Channel 1                   | Content Channel 2                 |                                                                                                                                                                                                                                                                                             |
| 000          | 20 MHz        | Primary                             | NA                                |                                                                                                                                                                                                                                                                                             |
| 001          | 40 MHz        | Primary                             | Secondary                         |                                                                                                                                                                                                                                                                                             |
| 010          | 80 MHz        | Primary                             | Secondary                         |                                                                                                                                                                                                                                                                                             |
| 011          | 80 MHz        | Primary                             | 20 MHz in L20 of the Secondary 40 | Secondary channel not used. HE-SIG-B Content channel 2 in secondary is not available. Secondary channel and L-20 MHz in secondary 40 MHz not used. HE-SIG-B content channel 2 is not transmitted. No change in the size of the RU indication fields for the HE-SIG-B common.                |
| 100          | 80 MHz        | Primary                             | Not available                     |                                                                                                                                                                                                                                                                                             |
| 101          | 160 (80 + 80) | Primary                             | Secondary                         |                                                                                                                                                                                                                                                                                             |
| 110          | 160 (80 + 80) | Primary                             | 20 MHz in L20 if the Secondary 40 | Secondary channel not used. HE-SIG-B Content channel 2 in secondary is not transmitted. Secondary channel and L-20 MHz in secondary 40 MHz not used. HE-SIG-B content channel 2 is not transmitted. HE-SIG-B content channel 1 carries information for all 20 MHz segments of secondary 80. |
| 111          | 160 (80 + 80) | Primary                             | Not available                     |                                                                                                                                                                                                                                                                                             |

**Annotations:**

- Bandwidth of the PPDU:** Points to the BW Signaling column.
- 3-bit indication in BW field of HE-SIG-A:** Points to the BW Signaling column.
- Variable location of HE-SIG-B Content Channel 2 (CC2):** Points to the Content Channel 2 column.
- 80 MHz PPDU with CC2 in lower 20 MHz of S40 (S40B):** Points to the 011 row.
- 80 MHz PPDU with CC2 in S20:** Points to the 011 row.
- 160 MHz PPDU with CC2 in lower 20 MHz of S40 (S40B):** Points to the 111 row.
- 160 MHz PPDU with CC2 in S20:** Points to the 110 row.
- HE-SIG-B content channel 1 always available on P20:** Points to the Content Channel 1 column.

SAMSUNG-1014, Table 1 (annotated)

Josiam explains that “[t]he bandwidth and content channel indication together tell the STA where the signaling for the OFDMA RUs is carried in the HE-SIG-B.” SAMSUNG-1014, [0164]-[0166]. For example, “[w]hen the

bandwidth signaling field indicates 011 (e.g., the PPDU bandwidth is 80 MHz and the secondary 20 MHz channel is not used), HE-SIG-B content channel 2 is carried in the [L]<sup>2</sup>-20 MHz segment of the secondary 40.” *Id.* “Further information on the 20 MHz segment (e.g., [U]-20) used or unused [*additional puncturing information*] is carried in RU signaling of the HE-SIG-B common channel.” *Id.*

Josiam explains, the “8-bit RU signaling information [carried in the RU signaling field (‘resource unit allocation field’)] signals an unoccupied 20 MHz segment by signaling an *unused 242 tone RU*.” SAMSUNG-1014, [0167].

According to Dr. Buehrer,

Using 3 bits for the bandwidth field of HE-SIG-A, a total of eight channel configurations may be indexed. Josiam’s bandwidth indication scheme includes two options for 20 and 40 MHz contiguous PPDUs. SAMSUNG-1014, [0154]-[0168], Table 1; SAMSUNG-1017, 13-15. That leaves six options remaining. As depicted below, for 80 and 160 MHz PPDUs, Josiam’s scheme chooses to include three options for decoding the HE-SIG-B

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<sup>2</sup> Josiam states, “HE-SIG-B content channel 2 is carried in the U-20 MHz segment of the secondary 40.” SAMSUNG-1014, [0165]. Petitioner contends that “U” is errata and should read “L” as is it does in the corresponding entry in Table 1.

SAMSUNG-1014, Table 1; SAMSUNG-1003, [188] n.2. In Josiam’s notation, the lower 40MHz corresponds to the 20MHz channel in the S40 (S40B), which carries SIG-B content channel 2. *See* SAMSUNG-1014, Fig. 15.

content channel 2: (1) decode the content channel from the secondary 20 MHz (S20), (2) decode the content channel from the lower 20 MHz of S80 (S40B), or (3) both S20 and S40B are busy, so no content channel 2 is transmitted. *Id.* In some cases, such as indication “100,” the remaining channels may be deduced considering the other bandwidth options, e.g., if S40A was additionally punctured, a 20 MHz PPDU would be indicated using “000.” *Id.* In other cases, the additional unused channels are indicated using the RU signaling field of HE-SIG-B. *Id.*

| Josiam's<br>BW<br>Signaling in<br>HE-SIG-A | P20  | S20  | S40A<br>(U-20) | S40B<br>(L-20) | S80                                                        | PPDU<br>Bandwidth |
|--------------------------------------------|------|------|----------------|----------------|------------------------------------------------------------|-------------------|
| 000                                        | Used |      |                |                |                                                            | 20 MHz            |
| 001                                        | Used | Used |                |                |                                                            | 40 MHz            |
| 010                                        | Used | Used |                |                |                                                            | 80 MHz            |
| 011                                        | Used | Punc |                | Used           |                                                            |                   |
| 100                                        | Used | Punc | Used           | Punc           |                                                            |                   |
| 101                                        | Used | Used |                |                |                                                            | 160 MHz           |
| 110                                        | Used | Punc |                | Used           | Channel use indicated by RU<br>signaling field of HE-SIG-B |                   |
| 111                                        | Used | Punc |                | Punc           |                                                            |                   |
| HE-SIG-B<br>Content<br>Channel             | 1    | 2    | 1              | 2              | 1 2 1 2                                                    |                   |

SAMSUNG-1003, [190]

A POSITA would have understood Josiam’s method of splitting signaling between HE-SIG-A and HE-SIG-B as teaching this limitation. SAMSUNG-1003, [191]. Specifically, Josiam teaches that the bandwidth field indicates a PPDU bandwidth and whether some of the channels in the primary 80MHz bandwidth are not available (“channel information to be punctured within the bandwidth”). SAMSUNG-1003, [191]; SAMSUNG-1014, [0164]. Josiam further teaches that the RU signaling field (“resource unit allocation field”) may indicate additional unavailable 20MHz segments by signaling an unused 242-tone RU within the

bandwidth of the PPDU (resource unit allocation field indicates additional puncturing information for the unassigned RU within the bandwidth). SAMSUNG-1003, [191]; SAMSUNG-1014, [0156], [0165]-[0167]. Additionally, where the unassigned RU is a nulled edge RU, a POSITA would have understood that the additional puncturing information is for the unassigned RU within the bandwidth (e.g., nulled edge RU is adjacent to the nulled (punctured) channel). SAMSUNG-1003, [192]; *see* [8.5].

### 3. Claim 9

Josiam renders obvious that the resource unit allocation field (e.g., RU signaling field) indicates a specific RU not assigned to a user (e.g., unused 242 tone RU) through a predetermined index (e.g., RU allocation index). SAMSUNG-1003, [193]-[198].

As discussed for [8.6], Josiam teaches indicating that a particular 20MHz channel within a PPDU is not available “by using the RU signaling field [***resource unit allocation field***] of the HE-SIG-B common field.” SAMSUNG-1014, [0156], [0165]-[0167]; §III.A.2. For example, the “8-bit RU signaling information signals an unoccupied 20 MHz segment by signaling an unused 242 tone RU” (***a specific resource unit not assigned to a user***). SAMSUNG-1014, [0167]; *see also* SAMSUNG-1014, [0139]; SAMSUNG-1017, 8 (“***The nulling is always in units of resource units and not smaller.***”).

A POSITA would have understood that Josiam's 8-bit RU signaling field signals this unused 242-tone RU through a predetermined index. SAMSUNG-1003, [195]. Josiam elsewhere teaches that the RU allocation field may indicate an 8-bit value corresponding to an entry in a RU allocation index (predetermined index), and one such entry corresponds to a null allocation. SAMSUNG-1014, [0279], [0281], [0285]-[0286], [0294]-[0296]. For example, "the RU allocation index 11111111 signals a null allocation." SAMSUNG-1014, [0295], Table 6.

TABLE 6

| 8-bit<br>indices | RU size | Number of<br>entries |                                |
|------------------|---------|----------------------|--------------------------------|
| 11 0 01yyy       | 484     | 8                    |                                |
| 11 0 10yyy       | 996     | 8                    |                                |
| 11 0 11yyy       | 2*996   | 8                    |                                |
| 11 1 11111       | Null    | 1                    | ← No load balancing is<br>used |
| Allocation       |         |                      |                                |

SAMSUNG-1014, Table 6

A POSITA would have understood that this RU allocation index may signal a null 242 tone RU corresponding to a punctured 20MHz channel, as Josiam teaches earlier. SAMSUNG-1003, [196]; SAMSUNG-1014, [0167]. Indeed, this technique would have been well known to a POSITA. SAMSUNG-1003, [196]; SAMSUNG-1027, 8-12; SAMSUNG-1028, 10-13; SAMSUNG-1023, [0044].

Alternatively, it would have been obvious for a POSITA to include one or more special entries in the RU allocation index to indicate that a specific size RU is

nulled. SAMSUNG-1003, [197]. Josiam teaches that RU allocation signaling indices may indicate “RU sizes whose width span larger than 20 MHz” (larger than 242-tones). SAMSUNG-1014, [0292]. For example, Josiam teaches that the RU allocation index may include RU sizes corresponding to 242, 484, and 996-tone RUs. SAMSUNG-1014, Table 4. A POSITA would have found it obvious to include entries that indicate a specific RU of 242-tone or larger is punctured. SAMSUNG-1003, [197]-[198]; *see also* SAMSUNG-1016, 10.

#### **4. Claim 10**

As discussed for [8.6] and [9], Josiam teaches that the specific RU not assigned to a user (“unused 242 tone RU”) is at least a 242-tone RU. SAMSUNG-1014, [0167]; §III.A.2-3. Additionally, for the reasons discussed for [9], it would have been obvious that the specific RU is a 242, 484, or 996-tone RU. SAMSUNG-1003, [199]; SAMSUNG-1014, Table 4; §III.A.3.

#### **5. Claim 11**

Josiam renders obvious [11]. SAMSUNG-1003, [200]-[206]. As discussed for [8.5], Josiam teaches that a station may determine that a specific RU is assigned to the station by comparing the position of a user field that matches its station ID to RU arrangement information indicated by a resource unit allocation field. SAMSUNG-1014, [0279]-[0289], Table 4; §III.A.2.

|     | #1 | #2 | #3  | #4 | #5    | #6 | #7 | #8  | #9 | Num<br>User |
|-----|----|----|-----|----|-------|----|----|-----|----|-------------|
| 1   | 26 | 26 | 26  | 26 | 26    | 26 | 26 | 26  | 26 | 1           |
| 2   | 52 |    |     | 52 | 26    |    | 52 |     | 52 | 1           |
| 3   |    |    | 106 |    | 26    |    |    | 106 |    | 64          |
| 66  | 52 |    | 26  | 26 | 26    | 26 | 26 | 26  | 26 | 1           |
| 67  | 26 | 26 |     | 52 | 26    | 26 | 26 | 26  | 26 | 1           |
| 68  | 26 | 26 | 26  | 26 | 26    |    | 52 | 26  | 26 | 1           |
| 69  | 26 | 26 | 26  | 26 | 26    | 26 | 26 |     | 52 | 1           |
| 70  | 52 |    |     | 52 | 26    | 26 | 26 | 26  | 26 | 1           |
| 71  | 52 |    | 26  | 26 | 26    |    | 52 | 26  | 26 | 1           |
| 72  | 52 |    | 26  | 26 | 26    | 26 | 26 |     | 52 | 1           |
| 73  | 26 | 26 |     | 52 | 26    |    | 52 | 26  | 26 | 1           |
| 74  | 26 | 26 |     | 52 | 26    | 26 |    | 52  |    | 1           |
| 75  | 26 | 26 | 26  | 26 | 26    |    | 52 |     | 52 | 1           |
| 76  | 52 |    |     | 52 | 26    |    | 52 | 26  | 26 | 1           |
| 77  | 52 |    |     | 52 | 26    | 26 | 26 |     | 52 | 1           |
| 78  | 52 |    | 26  | 26 | 26    |    | 52 |     | 52 | 1           |
| 79  | 26 | 26 |     | 52 | 26    |    | 52 |     | 52 | 1           |
| 87  |    |    | 106 |    | 26    | 26 | 26 | 26  | 26 | 8           |
| 95  |    |    | 106 |    | 26    | 26 | 26 |     | 52 | 8           |
| 103 |    |    | 106 |    | 26    |    | 52 | 26  | 26 | 8           |
| 111 |    |    | 106 |    | 26    |    | 52 |     | 52 | 8           |
| 119 | 26 | 26 | 26  | 26 | 26    |    |    | 106 |    | 8           |
| 127 | 26 | 26 |     | 52 | 26    |    |    | 106 |    | 8           |
| 135 | 52 |    | 26  | 26 | 26    |    |    | 106 |    | 8           |
| 143 | 52 |    | 52  | 26 | 26    |    |    | 106 |    | 8           |
| 151 |    |    |     |    | 242   |    |    |     |    | 8           |
| 159 |    |    |     |    | 484   |    |    |     |    | 8           |
| 167 |    |    |     |    | 996   |    |    |     |    | 8           |
| 175 |    |    |     |    | 2*996 |    |    |     |    | 8           |

8-bit index values carried in RU allocation subfield

Resource allocation index

Resource unit arrangement information

SAMSUNG-1016, Fig. 8 (annotated)<sup>3</sup>

Josiam further teaches that the station ID corresponding to a specific RU may be set to a null station ID to indicate that the RU is nulled (unassigned). SAMSUNG-1014, [0304]. Specifically, Josiam explains that “a null allocation is indicated in the user subfields,” which “may be done by indicating a null STA-ID or a[] STA-ID determined [] by the AP that is not yet allocated.” *Id.* Indeed,

<sup>3</sup> This figure is reproduced in SAMSUNG-1014 as Table 4 but is provided here for readability.

according to Dr. Buehrer, a POSITA would have understood that, by setting the station ID to a null value or an ID not assigned to any station, no stations would attempt to decode the corresponding RU. SAMSUNG-1003, [201]; SAMSUNG-1025, [0089]-[0093], Figs. 12-14; SAMSUNG-1032, 14. Applicant did not dispute the Examiner's finding that Josiam teaches this limitation during prosecution. SAMSUNG-1002, 62-63 (citing SAMSUNG-1014, [0304]-[0306]).

Here, a POSITA would have found it obvious to use Josiam's null station ID method to indicate information of an unassigned RU (nulled edge RU). SAMSUNG-1003, [202]. As discussed for [8.5], the information of an unassigned RU may be information of a nulled edge RU adjacent to a channel to be punctured, and this information may be "derived based on the bandwidth signaling in the HE-SIG-A and the 8-bit RU signaling information of the RU signaling field in the common field of HE-SIG-B]." SAMSUNG-1014, SAMSUNG-1014, [0168]; §III.A.2. Additionally or alternatively, a POSITA would have found it obvious to obtain information of a nulled RU by way of a null station ID corresponding to a specific RU in the RU arrangement, as taught by Josiam. SAMSUNG-1003, [202]; SAMSUNG-1014, [0304].

Particularly, a POSITA would have understood that, where an edge RU is nulled, it would have been advantageous to nonetheless include a user-field for that edge RU to preserve the HE-SIG-B structure and thus simplify receiver

implementation. SAMSUNG-1003, [203]. While information of a nulled edge RU may be derived from predefined rules based on the channel puncturing information, this would require additional decoding steps (and thus processing power) for a receiving station to properly decode the received PPDU. SAMSUNG-1003, [203]. By contrast, when information of a nulled edge RU is indicated via a null station ID, no additional decoding steps would be needed at the receiving station. SAMSUNG-1003, [203]. Instead, a receiving station would simply skip the unassigned RU because it is not assigned to that station as it does for RUs assigned to other stations. SAMSUNG-1003, [203]; SAMSUNG-1025, [0089]-[0093], Figs. 12-14.

A POSITA would have been further motivated to indicate a null edge RU using a null station ID because it would offer more flexibility compared to relying on predefined rules to derive the null edge RU from the punctured channel information. SAMSUNG-1003, [204]. For example, a POSITA would have understood that out-of-band emission requirements may vary based on a jurisdiction's regulatory requirements (such as the specific frequency sub-band, indoor versus outdoor use, and presence of military and civilian radar systems) and that these regulations may change over time. SAMSUNG-1003, [204]; SAMSUNG-1047, 16-17, 20-24, 31-32, 42. By indicating a nulled edge RU using a null station ID, the nulling requirement may be determined by the AP based on

the specific operating environment. SAMSUNG-1003, [204]. Applicant did not dispute the Examiner’s finding that using a null station ID “would allow flexibility in managing RU allocation.” SAMSUNG-1002, 62-63.

A POSITA would have also found it obvious to indicate a nulled edge RU using a null station ID because it merely reflects the simple substitution of one known element for another, and the result would have been predictable because a receiving station behaves in the same way as if unassigned RU was assigned to another station. SAMSUNG-1003, [205]. Indeed, using a blank or null station ID to indicate a nulled or otherwise unassigned RU was well known in the field well before 5/14/2016. SAMSUNG-1003, [205]; SAMSUNG-1025, [0090]-[0092]; SAMSUNG-1032, 14. For example, Chen describes two alternative methods for indicating an unassigned RU: using a “special (e.g. blank or null) PAID”<sup>4</sup> or using additional non-allocation information to indicate an unassigned RU and then deriving the station’s correct RU allocation based on this information.

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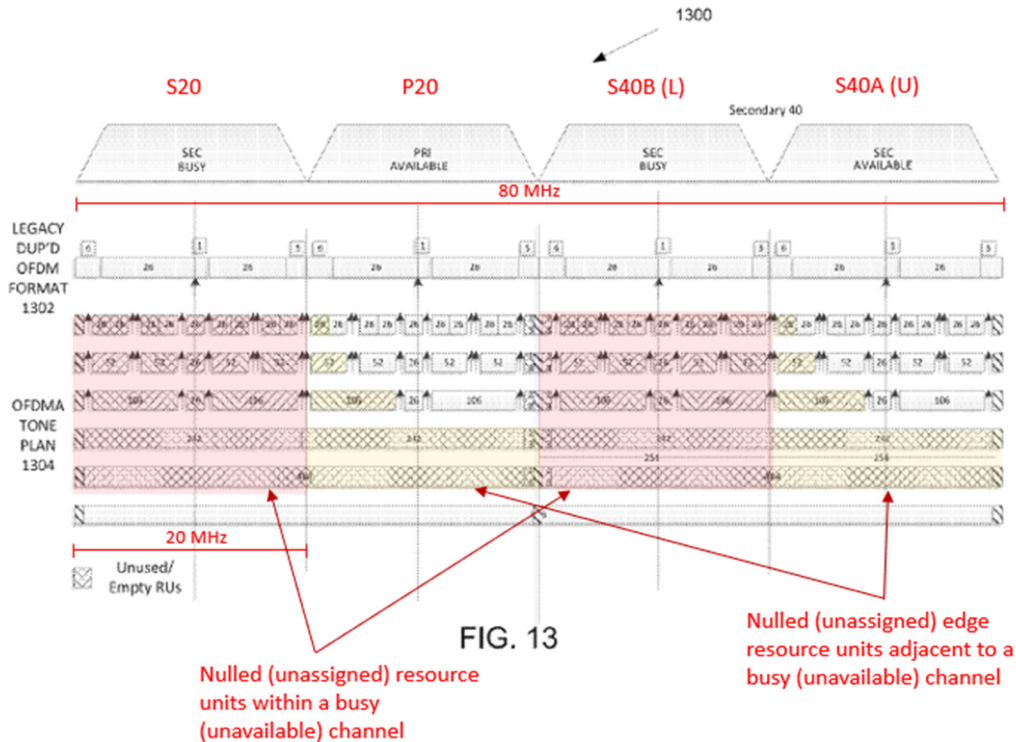
<sup>4</sup> A POSITA would have understood that a null PAID corresponds to the claimed “Null STA ID.” SAMSUNG-1003, [205] n.4 (citing SAMSUNG-1001, 12:50-54; SAMSUNG-1025; SAMSUNG-1046).

SAMSUNG-1025, [0089]-[0093], Figs. 12-14.

Thus, a POSITA would have understood Josiam as rendering obvious that the information of the unassigned RU is obtained through RU arrangement information indicated by the resource unit allocation field of the HE-SIG-B and a Null STA ID contained in a user field corresponding to a specific RU in the RU arrangement. SAMSUNG-1003, [206].

## **6. Claim 12**

Josiam teaches that the RUs in the RU arrangement may indicate a specific RU of 26, 52, or 106 tones. SAMSUNG-1014, Table 4. Moreover, where the information of an unassigned RU is information of a nulled edge RU, Josiam teaches that the specific RU would correspond to at least a 26-tone, 52-tone, or 106-tone RU. SAMSUNG-1003, [207]; SAMSUNG-1014, [0137]-[0148] (“***A 26 tone[] RU that is the closest to the edge of the channel being nulled is the smallest RU size that needs to be nulled or left unused in the used band.***”), Figs. 9-10 (illustrating nulled edge RUs of 26, 52, and 106-tone sizes).

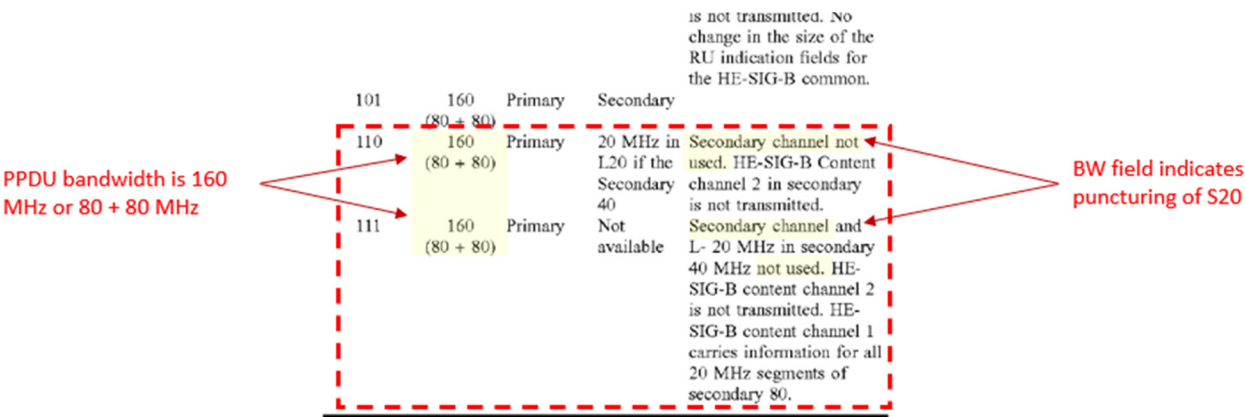


SAMSUNG-1014, Fig. 13 (annotated)

## 7. Claim 14

Josiam teaches this limitation. SAMSUNG-1003. [208]-[213]. As discussed for [8.6], Josiam teaches that the bandwidth field of HE-SIG-A indicates channel information to be punctured within the bandwidth, and the RU signaling field (resource unit allocation field) indicates additional puncturing information. SAMSUNG-1014, [0155]-[0168]; §III.A.2. A POSITA would have understood that, when Josiam's bandwidth field indicates puncturing of a secondary 20MHz channel within a bandwidth of 160MHz or 80 + 80MHz (Josiam's bandwidth indication is set to "110" or "111"), Josiam's RU signaling field indicates additional puncturing in the S80 channel. SAMSUNG-1003, [208]; SAMSUNG-

1014, [0155]-[0168], Table 1.



SAMSUNG-1014, Table 1 (annotated)

| Josiam's BW Signaling in HE-SIG-A | P20  | S20  | S40A (U-20)                                             | S40B (L-20) | S80  |   |   |   | PPDU Bandwidth |        |
|-----------------------------------|------|------|---------------------------------------------------------|-------------|------|---|---|---|----------------|--------|
| 000                               | Used |      |                                                         |             |      |   |   |   | 20 MHz         |        |
| 001                               | Used | Used |                                                         |             |      |   |   |   |                | 40 MHz |
| 010                               | Used | Used |                                                         |             |      |   |   |   | 80 MHz         |        |
| 011                               | Used | Punc |                                                         |             | Used |   |   |   |                |        |
| 100                               | Used | Punc | Used                                                    | Punc        |      |   |   |   | 160 MHz        |        |
| 101                               | Used | Used | Channel use indicated by RU signaling field of HE-SIG-B |             |      |   |   |   |                |        |
| 110                               | Used | Punc |                                                         |             | Used |   |   |   |                |        |
| 111                               | Used | Punc |                                                         |             | Punc |   |   |   |                |        |
| HE-SIG-B Content Channel          | 1    | 2    | 1                                                       | 2           | 1    | 2 | 1 | 2 |                |        |

BW field indicates puncturing of S20

RU signaling field of HE-SIG-B indicates additional puncturing in S80

SAMSUNG-1003, [208]

Additionally or alternatively, a POSITA would have understood that, when Josiam’s bandwidth field indicates puncturing of at least one of two 20MHz channels in a secondary 40MHz channel within a bandwidth of 160MHz or 80 + 80MHz (e.g., Josiam’s bandwidth indication is set to “111”), Josiam’s RU

signaling field indicates additional puncturing in the S80 channel. SAMSUNG-

1003, [209]; SAMSUNG-1014, [0155]-[0168], Table 1.

the HE-SIG-B common.

|     |                  |         |                                                                                                          |                                                                                                                                                                                                      |
|-----|------------------|---------|----------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 101 | 160<br>(80 + 80) | Primary | Secondary                                                                                                |                                                                                                                                                                                                      |
| 110 | 160<br>(80 + 80) | Primary | 20 MHz in Secondary channel not used. HE-SIG-B Content channel 2 in secondary 40 MHz is not transmitted. |                                                                                                                                                                                                      |
| 111 | 160<br>(80 + 80) | Primary | Not available                                                                                            | Secondary channel and L- 20 MHz in secondary 40 MHz not used. HE-SIG-B content channel 2 is not transmitted. HE-SIG-B content channel 1 carries information for all 20 MHz segments of secondary 80. |

PPDU bandwidth is 160 MHz or 80 + 80 MHz

BW field indicates puncturing of L-20 MHz (S40B) in secondary 40 MHz

SAMSUNG-1014, Table 1 (annotated)

| Josiam's BW Signaling in HE-SIG-A | P20  | S20  | S40A (U-20) | S40B (L-20) | S80                                                     | PPDU Bandwidth |
|-----------------------------------|------|------|-------------|-------------|---------------------------------------------------------|----------------|
| 000                               | Used |      |             |             |                                                         | 20 MHz         |
| 001                               | Used | Used |             |             |                                                         | 40 MHz         |
| 010                               | Used | Used |             |             |                                                         | 80 MHz         |
| 011                               | Used | Punc |             | Used        |                                                         |                |
| 100                               | Used | Punc | Used        | Punc        |                                                         |                |
| 101                               | Used | Used |             |             | Channel use indicated by RU signaling field of HE-SIG-B | 160 MHz        |
| 110                               | Used | Punc |             | Used        |                                                         |                |
| 111                               | Used | Punc |             | Punc        |                                                         |                |
| HE-SIG-B Content Channel          | 1    | 2    | 1           | 2           | 1 2 1 2                                                 |                |

BW field indicates puncturing of lower 20 MHz of S40 (S40B)

RU signaling field of HE-SIG-B indicates additional puncturing in S80

SAMSUNG-1003, [209]

## 8. Claims 1-5 and 7

Claims 1-5 and 7 require “[a] wireless communications terminal, the terminal comprising: a processor; and a communication unit, wherein the processor

is configured to” perform steps corresponding to the methods [8]-[12] and [14], respectively. To the extent the preamble of [1] is limiting, Josiam discloses “a station (STA) in a wireless local area network (WLAN).” SAMSUNG-1014, [0006]. Josiam further discloses that the station includes “a radio frequency (RF) transceiver 210” and “a controller/processor 240.” *Id.*, [0095]. The RF transceiver 210 is configured to receive a PPDU. SAMSUNG-1014, [0097]. The controller/processor 240 includes “processing circuitry configured to provide efficient wideband operations in WLANs.” SAMSUNG-1014, [0103]. Although Josiam’s provisional applications (SAMSUNG-1015-SAMSUNG-1017) do not explicitly disclose that the stations have a processor and a communications unit, a POSITA would have understood that the stations described in Josiam’s provisional applications require a processor. SAMSUNG-1003, [210]-[213].

For example, Josiam’s January 12, 2016 and April 27, 2016 provisional applications state that the stations receive and decode a wireless packet. SAMSUNG-1016, 1-6, 9-10; SAMSUNG-1017, 1-2, 7-8, 11-13. Josiam’s April 27 disclosure specifically teaches that a STA “process[es] a 160MHz PPDU.” SAMSUNG-1017, 13. Based on these disclosures in the Josiam provisional applications, a POSITA would have understood that a station necessarily has a communication device (e.g., RF transceiver 210) to receive a wireless packet (e.g., PPDU) and a processor (e.g., controller/processor 240) to perform at least the

decoding of the received wireless packet. SAMSUNG-1003, [211]-[212].

Moreover, a POSITA would have found it obvious to include a processor and a communications device to perform the methods disclosed in Josiam's provisional applications. SAMSUNG-1003, [212]. A POSITA would have understood that, without such hardware, the station would be unable to perform the functions described in the Josiam provisional applications. SAMSUNG-1003, [213].

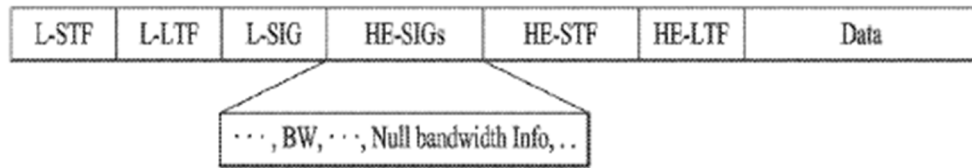
For similar reasons as described for [8]-[12] and [14], a POSITA would have understood Josiam as rendering obvious a wireless communication terminal (station) having a processor (controller/processor), a communications unit (RF transceiver), wherein the processor is configured to perform the steps recited in the remaining limitations of [1]-[4] and [7]. SAMSUNG-1003, [213].

## **B. [GROUND 1B] – Josiam in view of Kim**

### **1. Kim**

Kim describes “a method of receiving a signal, which is received by an STA (station) operating in a wireless LAN (WLAN) system using a multi user (MU) scheme.” SAMSUNG-1018, [0020]. Kim explains that “an 11ax radio frame may include HE-SIG A and HE-SIG B as HE-SIG fields.” SAMSUNG-1018, [0092].

FIG. 15



SAMSUNG-1018, Fig. 15

Kim teaches including “information on an unused bandwidth and information on a null indicator (e.g., null bandwidth/channel/sub-channel information or non-contiguous bandwidth/channel/subchannel information) in a HE-SIG-B field. ... [T]he HE-SIG field includes bandwidth information indicated whether or not the whole bandwidth corresponds to 20, 40, 80, or 160 (or 80+80)MHz and information on a null indicator indicating a channel region not used for transmitting data among the whole bandwidth.” SAMSUNG-1018, [0087].

Kim discloses indicating “primary channel information (information indicating whether or not a BW includes primary 20 or primary 40) is included in HE-SIG-A and detail[ed] null bandwidth information (or non-contiguous channel allocation information) is included in HE-SIG-B.” SAMSUNG-1018, [0143]-[0159]. For example, the bandwidth field of HE-SIG-A may be a 3-bit bandwidth index. SAMSUNG-1018, [0144]-[0145], Table 22.

TABLE 22

|   |                                                                                       |
|---|---------------------------------------------------------------------------------------|
| * | Bandwidth index (3 bits, b0b1b2) in HE-SIG A                                          |
| * | 000: 20MHz                                                                            |
| * | 001: 40MHz                                                                            |
| * | 010: 80MHz (preamble fully populated on all 4 channels and OFDMA uses 80MHz design)   |
| * | 011: 160MHz (preamble fully populated on all 8 channels and OFDMA uses 160MHz design) |
| * | 100: 80MHz channel bonding with preamble on P40                                       |
| * | 101: 80MHz channel bonding with preamble on P20 (no preamble on S20)                  |
| * | 110: 160MHz channel bonding with preamble on P40                                      |
|   | 111: 160MHz channel bonding with preamble on P20 (no preamble on S20) }               |

Indicate contiguous PPDU's

Indicate non-contiguous with preamble either on P40 or P20

SAMSUNG-1018, Table 22 (annotated)

When channel bonding is indicated (bandwidth field is set to one of the last four entries), “detail[ed] null bandwidth information (or non-contiguous channel information) can be included in the HE-SIG-B common part.” SAMSUNG-1018, [0146]. “[A]mong the reserved values in the RU allocation field, a specific value indicates that the 242 RU corresponding to that channel is Null, allowing the STA to determine which 242 RU is Null based on this value.” SAMSUNG-1018, [0155]-[0156], [0158]-[0159]. For example, when the BW index in HE-SIG A is 101, “the RU allocation field included in HE-SIG B of CH 1 for CH3 indicates that the 242-tone RU corresponding to CH3 is null.” SAMSUNG-1018, [0159].

## 2. Josiam-Kim

In Josiam-Kim, a bandwidth and content channel indication scheme for the bandwidth field of HE-SIG-A, per Josiam, is modified to include four contiguous PPDU options and four non-contiguous PPDU options, per Kim. SAMSUNG-1003, [107]-[121]; SAMSUNG-1014, [0154]-[0168]; SAMSUNG-1018, [0144]-[0145], Table 22.

In the combination, a 3-bit bandwidth index, per Josiam, includes four contiguous options and four non-contiguous options that indicate, for each bandwidth of 80 or 160 (or 80 + 80)MHz, whether the S20 channel is transmitted, per Kim. SAMSUNG-1003, [108]; SAMSUNG-1014, [0154]-[0168]; SAMSUNG-1018, [0144]-[0145], Table 22.

TABLE 22

|   |                                                                                       |
|---|---------------------------------------------------------------------------------------|
| * | Bandwidth index (3 bits, b0b1b2) in HE-SIG A                                          |
| * | 000: 20MHz                                                                            |
| * | 001: 40MHz                                                                            |
| * | 010: 80MHz (preamble fully populated on all 4 channels and OFDMA uses 80MHz design)   |
| * | 011: 160MHz (preamble fully populated on all 8 channels and OFDMA uses 160MHz design) |
| * | 100: 80MHz channel bonding with preamble on P40                                       |
| * | 101: 80MHz channel bonding with preamble on P20 (no preamble on S20)                  |
| * | 110: 160MHz channel bonding with preamble on P40                                      |
|   | 111: 160MHz channel bonding with preamble on P20 (no preamble on S20) }               |

SAMSUNG-1018, Table 22

|                                | P20  | S20  | S40A<br>(U-20) | S40B<br>(L-20) | S80                                                     |   |   |   | PPDU<br>Bandwidth |      |         |      |      |      |      |         |
|--------------------------------|------|------|----------------|----------------|---------------------------------------------------------|---|---|---|-------------------|------|---------|------|------|------|------|---------|
| 000                            | Used |      |                |                |                                                         |   |   |   | 20 MHz            |      |         |      |      |      |      |         |
| 001                            | Used |      |                |                |                                                         |   |   |   | Used              |      |         |      |      |      |      | 40 MHz  |
| 010                            | Used |      |                |                |                                                         |   |   |   | Used              | Used | Used    |      |      |      |      | 80 MHz  |
| 011                            | Used |      |                |                |                                                         |   |   |   | Used              | Used | Used    | Used | Used | Used | Used | 160 MHz |
| 100                            | Used | Used |                |                |                                                         |   |   |   | 80 MHz            |      |         |      |      |      |      |         |
| 101                            | Used | Punc |                |                |                                                         |   |   |   | 80 MHz            |      |         |      |      |      |      |         |
| 110                            | Used | Used |                |                |                                                         |   |   |   | 160 MHz           |      |         |      |      |      |      |         |
| 111                            | Used | Punc |                |                | Channel use indicated by RU signaling field of HE-SIG-B |   |   |   |                   |      | 160 MHz |      |      |      |      |         |
| HE-SIG-B<br>Content<br>Channel | 1    | 2    | 1              | 2              | 1                                                       | 2 | 1 | 2 |                   |      |         |      |      |      |      |         |

### SAMSUNG-1003, [108]

If the S20 channel is transmitted, a receiving station may read both HE-SIG-B content channels from the primary 40MHz (P20 and S20), per Josiam.

SAMSUNG-1014, [0164]. If the S20 channel is not transmitted (e.g., the channel is busy and must be punctured), a POSITA would have recognized several known or obvious methods to transmit HE-SIG-B information for the channels that ordinary fall into HE-SIG-B content channel 2, discussed below. SAMSUNG-1003, [109].

For example, HE-SIG-B content channel 1 could carry HE-SIG-B information for all channels in the bandwidth (per Josiam). SAMSUNG-1014, [0161], [0166]. Alternatively, the HE-SIG-B content channel 1 could include a channel bonding field in the common field that indicates which channels are being used, and the HE-SIG-B content channel 1 could carry information for the channels according to the default mapping plus any additional used channels that

would otherwise be carried in the HE-SIG-B content channel 2 (per Kim).

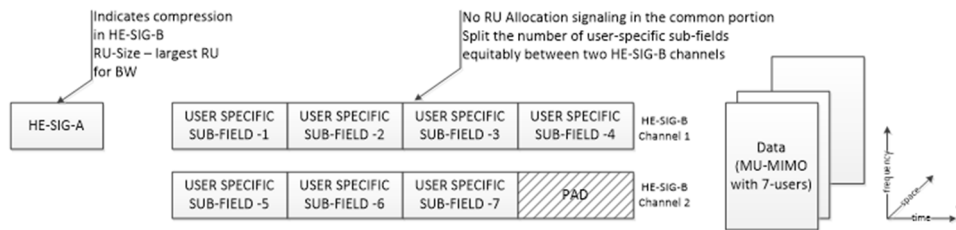
SAMSUNG-1018, [0143]-[0159], Tables 23-24. More simply, a POSITA would have understood that bandwidth configurations in which both S20 and S40B are not transmitted could be proscribed, and thus at least one channel carrying each HE-SIG-B content channel would always be present in the P80. SAMSUNG-1003, [110].

Josiam-Kim would have been obvious to a POSITA for several reasons. SAMSUNG-1003, [111]-[121]. First, a POSITA would have been motivated to modify Josiam's methods to include separate indications for contiguous and non-contiguous PPDUs, per Kim. SAMSUNG-1003, [111]. A POSITA would have been motivated to include separate indications for contiguous bandwidths to (1) enable HE-SIG-B compression mode to be used for full bandwidth MIMO transmissions and (2) make non-contiguous channel bonding optional for operating environments where the benefit of non-contiguous channel bonding is low. *Id.*

By 5/14/2016, an HE-SIG-B compression mode was introduced for full bandwidth MU-MIMO, in which RU allocation signaling information is no longer transmitted in the HE-SIG-B field because the entire bandwidth will be used for MU-MIMO. SAMSUNG-1029, 131-132; SAMSUNG-1037, 14-15; SAMSUNG-1038, 11-13; SAMSUNG-1021, [0129].

## HE-SIG-B Compression for MU-MIMO

- For MU-MIMO over the entire BW, 1 bit in HE-SIG-A indicates compression.
  - No RU signaling information transmitted in HE-SIG-B
    - RU Size is set to the largest RU for the BW (20MHz – 242 tone RU, 40 – 484, 80 – 996, 160 – 2x996)
  - The user specific sub-fields are split equitably between the two HE-SIG-B Channels for efficient load-balancing
    - For  $k$  user MU-MIMO PPDU,  $1, \dots, \left\lceil \frac{k}{2} \right\rceil$  user specific sub-fields in HE-SIG-B channel 1 and  $\left\lceil \frac{k}{2} \right\rceil + 1, \dots, k$  user specific sub-fields in HE-SIG-B channel 2
    - Pad to end contents in both channels at same OFDM symbol



SAMSUNG-1037, 14

However, Josiam's method does not include bandwidth indications for full bandwidth (contiguous) 80 and 160MHz transmissions. SAMSUNG-1003, [113]; SAMSUNG-1014, [0155]-[0166], Table 1. A POSITA would have understood that one obvious solution would have been to include the four contiguous options from 802.11ac and use the remaining four options for non-contiguous operation, per Kim. SAMSUNG-1003, [113]; SAMSUNG-1018, [0144]-[0145], Table 22. Moreover, a POSITA would have understood that, by retaining the bandwidth signaling options from 802.11ac, implementation details for full bandwidth MU-MIMO may be reused from previously developed 802.11ac receivers. SAMSUNG-1003, [113]; SAMSUNG-1037, 15; SAMSUNG-1038, 12; SAMSUNG-1033, 259-261, 293-295; SAMSUNG-1029, 91-93, 131-132; SAMSUNG-1043, 8-9, 13.

A POSITA would have also been motivated to include separate indications for contiguous and non-contiguous bandwidth operation to the reduce physical layer design complexity and encoding/decoding complexity in less dense operating environments. SAMSUNG-1003, [114]. Specifically, a POSITA would have recognized that, when the probability of the channel being busy is low, the benefit of non-contiguous channel bonding can be small. SAMSUNG-1003, [114]; SAMSUNG-1039, 3-10.

In such cases, a POSITA would have understood that the additional complexity required to implement non-contiguous channel bonding would not be justified. SAMSUNG-1003, [115]. Specifically, a POSITA would have understood that the benefits of non-contiguous channel bonding should be considered against the added burdens put on the physical layer design. SAMSUNG-1003, [115]; SAMSUNG-1040, 7-12 (“***Complexity and AP/STA capability needs to be considered.***”). A POSITA would have also understood that more complex processing may be needed to encode and decode non-contiguous PPDU. SAMSUNG-1003, [115]; SAMSUNG-1040, 8 (“***STAs’ capability for non-contiguous channel support might vary[.] CCA, contention and back-off and other channel access schemes might be required to be re-defined for non-contiguous channel[.]***”). For example, a POSITA would have recognized that it may be desirable to revert to the existing contiguous channel bonding scheme from

802.11ac to reduce the number of clear channel assessments required, with each extra assessment consuming additional power. SAMSUNG-1003, [115]; SAMSUNG-1041, [0043]-[0050].

A POSITA would have understood that, by retaining the four existing contiguous channel bonding options from 802.11ac and including the new non-contiguous channel bonding options as four separate options of a 3-bit bandwidth field, the non-contiguous channel bonding modes may be made optional. SAMSUNG-1003, [116]. Thus, in less dense operating environments, the existing contiguous channel bonding scheme may be used. *Id.* A POSITA would have also understood that having four contiguous options maintains a level of backwards compatibility with previous version of 802.11 as well as SU operation. SAMSUNG-1003, [116]; SAMSUNG-1043, 8-9, 13; SAMSUNG-1033, 259-261; SAMSUNG-1029, 91-93. This further allows for implementation details to be reused from previously developed 802.11 receivers and reused between SU and MU modes. *Id.*; SAMSUNG-1044, 12 (“HE-SIG-A is encoded [the] same as VHT-SIG-A in 11ac, therefore there is ***no extra implementation and verification works needed.***”); SAMSUNG-1021, [0112] (noting that the use of similar formats of HE-SIG-A may “increase simplicity of implementation”).

A POSITA would have found Josiam-Kim obvious and predictable because the combination merely reflects the simple substitution of one set of indications of

a 3-bit bandwidth field in HE-SIG-A for another set of indications of a 3-bit bandwidth field in HE-SIG-A, where both sets of indications include information of the total bandwidth of the PPDU and puncturing information for the S20 channel. SAMSUNG-1003, [117]; SAMSUNG-1014, [0154]-[0168]; SAMSUNG-1018, [0144]-[0145], Table 22.

Additionally, the Josiam-Kim bandwidth and content channel indication scheme for the bandwidth field of HE-SIG-A would have been obvious to try. SAMSUNG-1003, [118]. Indeed, a POSITA would have understood that there was a need to indicate which channels were used or unused in the preamble of an HE MU PPDU when non-contiguous PPDU's are transmitted and that there was insufficient space in the HE-SIG-A field to indicate all possible channel combinations. SAMSUNG-1003, [118]; SAMSUNG-1014, [0150]-[0156]; SAMSUNG-1023, [0028]-[0031]; SAMSUNG-1035, 5; SAMSUNG-1036, 13-15.

It was known in the art that this information may be split between HE-SIG-A and HE-SIG-B fields to reduce the signaling burden in HE-SIG-A, specifically by using the HE-SIG-A to indicate the total bandwidth of the PPDU and whether certain channels in the primary 80MHz carrying the HE-SIG-B content channel 2 are transmitted. SAMSUNG-1003, [119]; SAMSUNG-1014, [0150]-[0156]; SAMSUNG-1021, [0131]-[0132], [0138]; SAMSUNG-1034, 9; SAMSUNG-1035, 9; SAMSUNG-1036, 13-14.

Within the eight values of a 3-bit bandwidth field, a POSITA would have appreciated that two of the values should correspond to contiguous 20 and 40MHz PPDU. SAMSUNG-1003, [119]. This is because the P20 channel is required (SAMSUNG-1023, [0027]), and if other channels are not available, only a 20MHz PPDU would be transmitted. SAMSUNG-1003, [119]. A POSITA would have recognized a finite number of predictable ways to indicate the remaining combinations of HE-SIG-B content channel 2 locations across 80 and 160MHz bandwidths using the remaining six indices. *Id.* One obvious and predictable solution would have been to use four values of the 3-bit field to indicate the existing contiguous bandwidth options carried over from 802.11ac (and used in 80.211ax for single-user HE PPDU), and the remaining four values to indicate the use of the S20 channel in non-contiguous 80 and 160MHz bandwidths, as taught by Kim. SAMSUNG-1003, [119]-[120]; SAMSUNG-1018, [0144]-[0145], Table 22; SAMSUNG-1033, 259-261; SAMSUNG-1029, 91-93; SAMSUNG-1036, 13-15.

Thus, a POSITA would have found Josiam-Kim obvious and predictable. SAMSUNG-1003, [121].

### **3. Claim 13**

As discussed in Ground 1A, Josiam teaches that the bandwidth field of HE-SIG-A indicates channel information to be punctured within the bandwidth and the

RU signaling field (resource unit allocation field) indicates additional puncturing information. SAMSUNG-1014, [0155]-[0168]; §III.A.2. In Josiam-Kim, a POSITA would have understood that, when the bandwidth field indicates a non-contiguous PPDU with a bandwidth of 80MHz (the bandwidth indication is set to “100”), the bandwidth field indicates puncturing of either S40A or S40B (per Kim). SAMSUNG-1018, [0144]-[0145], Table 22; SAMSUNG-1003, [215]. This is because, if neither S40A nor S40B is transmitted, a 40MHz PPDU (e.g., bandwidth indication “001”) would be indicated, and if both S40A and S40B are transmitted, a continuous 80MHz PPDU (e.g., bandwidth indication “010”) would be transmitted. *Id.*

TABLE 22

|                                                                                         |  |
|-----------------------------------------------------------------------------------------|--|
| * Bandwidth index (3 bits, b0b1b2) in HE-SIG A                                          |  |
| * 000: 20MHz                                                                            |  |
| * 001: 40MHz                                                                            |  |
| * 010: 80MHz (preamble fully populated on all 4 channels and OFDMA uses 80MHz design)   |  |
| * 011: 160MHz (preamble fully populated on all 8 channels and OFDMA uses 160MHz design) |  |
| * 100: 80MHz channel bonding with preamble on P40                                       |  |
| * 101: 80MHz channel bonding with preamble on P20 (no preamble on S20)                  |  |
| * 110: 160MHz channel bonding with preamble on P40                                      |  |
| * 111: 160MHz channel bonding with preamble on P20 (no preamble on S20) }               |  |

If both S40 channels punctured, a contiguous 40 MHz PPDU may be signaled

If both S40 channels are used for the transmission, a contiguous 80 MHz PPDU may be signaled

BW field indicates non-contiguous 80 MHz PPDU

SAMSUNG-1018, Table 22 (annotated)

If both S40 channels punctured, a contiguous 40 MHz PPDU may be signaled

If both S40 channels are used for the transmission, a contiguous 80 MHz PPDU may be signaled

| Kim's 3-bit BW index     | P20  | S20  | S40A (U-20) | S40B (L-20) | S80  |      |      |      | PPDU Bandwidth |
|--------------------------|------|------|-------------|-------------|------|------|------|------|----------------|
| 000                      | Used |      |             |             |      |      |      |      | 20 MHz         |
| 001                      | Used | Used |             |             |      |      |      |      | 40 MHz         |
| 010                      | Used | Used | Used        | Used        |      |      |      |      | 80 MHz         |
| 011                      | Used | Used | Used        | Used        | Used | Used | Used | Used | 160 MHz        |
| 100                      | Used | Used |             |             |      |      |      |      | 80 MHz         |
| 101                      | Used | Punc |             |             |      |      |      |      | 80 MHz         |
| 110                      | Used | Used |             |             |      |      |      |      | 160 MHz        |
| 111                      | Used | Punc |             |             |      |      |      |      | 160 MHz        |
| HE-SIG-B Content Channel | 1    | 2    | 1           | 2           | 1    | 2    | 1    | 2    |                |

BW field indicates non-contiguous 80 MHz PPDU (per Kim); RU signaling field indicates which of S40A or S40B is punctured (per Josiam)

### SAMSUNG-1003, [215]

In this case, the RU arrangement field would indicate which 20MHz channel in the S40 is punctured (S40A or S40B), per Josiam. SAMSUNG-1014, [0156], [0165]-[0167], Table 1. For example, in Josiam-Kim, if the bandwidth field of HE-SIG-A signals an 80MHz non-contiguous PPDU, the RU signaling field in HE-SIG-B content channel 1 may indicate a null 242-tone RU for the bandwidth corresponding to S40A or the RU signaling field in HE-SIG-B content channel 2 may indicate a null 242-tone RU for the bandwidth corresponding to S40B. SAMSUNG-1003, [216].

In this way, a POSITA would have understood Josiam-Kim as rendering obvious that, when the bandwidth field indicates puncturing of one of two 20MHz channels (e.g., S40A or S40B) in a secondary 40MHz channel within a bandwidth

of 80MHz, the resource unit allocation field indicates which 20MHz channel in the secondary 40MHz channel (e.g., S40A or S40B) is punctured. SAMSUNG-1003, [217]. During prosecution of the '281 patent, the examiner considered claim 13 to be satisfied if one of the two indications of puncturing information was shown. SAMSUNG-1002, 65-66. Applicant did not dispute the examiner's interpretation. *Id.*, 43-51.

#### **4. Claims 1-7**

Claims 1-7 require “[a] wireless communications terminal, the terminal comprising: a processor; and a communication unit, wherein the processor is configured to” perform steps corresponding to the methods of [8]-[14], respectively. To the extent [1]’s preamble is limiting, Kim discloses a “STA (station) operating in a wireless LAN (WLAN).” SAMSUNG-1018, [0008]; SAMSUNG-1018, 2-3. Kim further discloses that the station (e.g. STA 150) includes “a processor 160, a memory 170, and a transceiver 180.” SAMSUNG-1018, [0161]. Transceiver 180 “may transmit/receive radio signals.” SAMSUNG-1018, [0162]. Processor 160 may be connected to transceiver 180 to “implement a physical layer and/or a MAC layer according to the IEEE 802 system.” *Id.*

A POSITA would have found it obvious for Josiam-Kim to include a processor (e.g., processor 160) and communications device (e.g., transceiver 180) to perform Josiam’s methods described in Ground 1A and Josiam-Kim’s methods

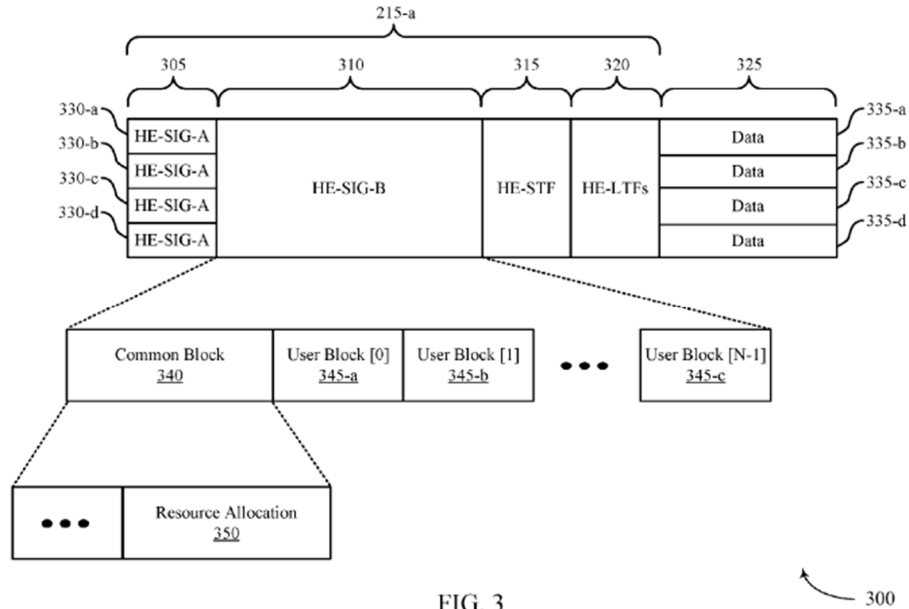
described with respect to [6] and [13]. SAMSUNG-1003, [219]. A POSITA would have recognized the processor and transceiver, per Kim, as a suitable and predictable solution to implement Josiam and Josiam-Kim's methods. *Id.* Such a combination would have yielded expected results and was within the skill of a POSITA. *Id.*

For similar reasons to those discussed in Ground 1A and [13], a POSITA would have understood Josiam-Kim as rendering obvious a wireless communication terminal (e.g., station) having a processor (e.g., processor 160), a communications unit (e.g., transceiver 180), wherein the processor is configured to perform the steps recited in the remaining limitations of [1]-[6]. SAMSUNG-1003, [220].

### **C. [GROUND 2A] – Bharadwaj in view of Li**

#### **1. Bharadwaj**

Bharadwaj describes “supporting preamble design aspects of high efficiency WLANs.” SAMSUNG-1021, [0007]. Bharadwaj discloses a “WLAN protocol data unit 200,” which includes a preamble having HE-SIG-A and HE-SIG-B fields. SAMSUNG-1021, [0098]-[0101].



SAMSUNG-1021, Fig. 3

Bharadwaj discloses two ways of indicating puncturing of 20MHz subchannels using the HE-SIG-A and HE-SIG-B fields, depending on which channels are being punctured. SAMSUNG-1021, [0130]-[0132], [0138]-[0142].

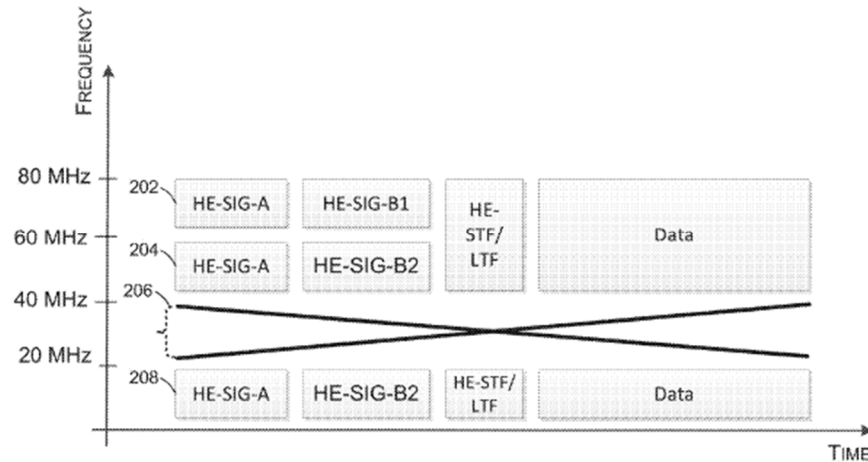
First, Bharadwaj teaches that, when a secondary 20MHz channel is punctured, two different indicators may be included in HE-SIG-A. SAMSUNG-1021, [0131]-[0132], [0138]. For example, “information/contents of the SIG-B that was found in the secondary 20 MHz channel may be transmitted on the primary 20 MHz channel. In such case an indication of the puncturing of the 20 MHz channel may be signaled in the SIG-A field, for example by including an indicator.” SAMSUNG-1021, [0132]. Alternatively, “information/contents of the SIG-B that was found in the secondary 20 MHz channel may be decoded from a 4<sup>th</sup> 20 MHz

channel,” where “an indication of the SIG-B decoding may be signaled in the SIG-A field, for example by including an indicator.” SAMSUNG-1021, [0138].

Next, Bharadwaj explains that, when “other 20 MHz channels are punctured” (not the secondary 20MHz channel), “an HE-SIG-B design may be different.” SAMSUNG-1021, [0139]-[0142]. For example, “a special or dedicated [resource unit] allocation bit sequence may be used to indicate that a 20 MHz channel is punctured. The indication may be made by adding an additional entry in a [resource unit] allocation table.” SAMSUNG-1021, [0141]-[0142]. In this case, “an explicit indication of the punctured 20 MHz channel may not be needed” in the HE-SIG-A field. SAMSUNG-1021, [0140].

## **2. Li**

Li relates “to a bandwidth and sub-channel indications system in wireless communications.” SAMSUNG-1023, [0002]. Li describes a high efficiency preamble including HE-SIG-A and HE-SIG-B fields. SAMSUNG-1023, [0023]. Li explains that, 20MHz subchannels of a frequency band may need to be “removed or punctured out (e.g., subchannel 206) because the subchannel may be unusable,” e.g., due to interference from “adjacent channels, noise, obstacles, etc.” SAMSUNG-1023, [0026].



SAMSUNG-1023, Fig. 2

A “transmitting device may need to signal [to] the receiving device which 20 MHz subchannels are used (e.g., 20 MHz subchannels 202, 204 and 208).”

SAMSUNG-1023, [0027]. Li teaches “a bandwidth subchannel indication system may allocate one or more indication bits of the HE-SIG-A field to be used as an indication of the bandwidth of the transmission and/or an indication of the subchannels that are used and/or not used for the transmission.” SAMSUNG-1023, [0030]-[0032].

Li explains that the primary 20MHz channel is always used (because stations listen on the prearranged P20 channel), so, for a 160MHz channel, “a transmitting device may need to utilize around 7 bits to indicate the presence of the 7 secondary 20 MHz subchannels.” SAMSUNG-1023, [0027]-[0028]. But, “utilizing 7 bits within the HE-SIG-A field may incur additional overhead in the HE-SIG-A field.” SAMSUNG-1023, [0028]. Thus, Li proposes using a 4-bit bandwidth indication in

HE-SIG-A “that accounts for a subset of useful configurations.” SAMSUNG-1023, [0030]-[0033].

|    | P | S1 | S2 | S3 | S4 | S5 | S6 | S7 |
|----|---|----|----|----|----|----|----|----|
| 1  | X |    |    |    |    |    |    |    |
| 2  | X | X  |    |    |    |    |    |    |
| 3  | X |    | X  |    |    |    |    |    |
| 4  | X | X  | X  |    |    |    |    |    |
| 5  | X |    |    | X  |    |    |    |    |
| 6  | X | X  |    | X  |    |    |    |    |
| 7  | X |    | X  | X  |    |    |    |    |
| 8  | X | X  | X  | X  |    |    |    |    |
| 9  | X | X  | X  | X  | X  | X  | X  | X  |
| 10 | X |    | X  | X  | X  | X  | X  | X  |
| 11 | X | X  |    | X  | X  | X  | X  | X  |
| 12 | X | X  | X  |    | X  | X  | X  | X  |
| 13 | X | X  | X  | X  |    | X  | X  | X  |
| 14 | X | X  | X  | X  | X  |    | X  | X  |
| 15 | X | X  | X  | X  | X  | X  |    | X  |
| 16 | X | X  | X  | X  | X  | X  | X  |    |

SAMSUNG-1023, Fig. 3

### 3. Bharadwaj-Li

In Bharadwaj-Li, the bandwidth field of HE-SIG-A indicates both the bandwidth of the PPDU and a subset of channel puncturing configurations (per Li) and the resource unit allocation field of the HE-SIG-B common field would indicate additional puncturing information through a special RU allocation sequence (per Bharadwaj). SAMSUNG-1003, [129]-[135]; SAMSUNG-1021, [0130]-[0132], [0138]-[0142]; SAMSUNG-1023, [0030]-[0032]. In the

combination, the bandwidth field of HE-SIG-A takes the form of an index, which maps to the total bandwidth of the PPDU and a subset of channel configurations (per Li) with the subset of channel configurations indicating whether the S20 or S40B channels are transmitted (per Bharadwaj). *Id.* In this sense, the indications described in paragraphs [0132] and [0138] of Bharadwaj take the form of index values of the bandwidth field of HE-SIG-A. *Id.*

As one obvious example, the bandwidth field (per Bharadwaj) would be expanded by one bit to indicate both the total bandwidth of the PPDU and a subset of “useful configurations” of used channels (per Li). SAMSUNG-1003, [130]; SAMSUNG-1021, [0111]; SAMSUNG-1023, [0027]-[0031]. Within the subset of channel configurations indexed by the bandwidth field, two configurations (depicted below as (b) and (c)) indicating the availability of S20 and S40B, per Bharadwaj, would be included for both 80 and 160MHz PPDUs. SAMSUNG-1021, [0131]-[0132], [0138].

With the remaining four indices, a POSITA would have found it obvious to include indications for 20 and 40MHz (in which non-contiguous channel bonding is not used) and indications for 80 and 160MHz with no puncturing of the secondary 40MHz (depicted below as (a)). SAMSUNG-1003, [131]; SAMSUNG-1021, [0131]. The use of other channels would be indicated using a special RU allocation bit sequence in a corresponding resource unit allocation field in the HE-

SIG-B common field, per Bharadwaj.” SAMSUNG-1021, [0141]-[0142];

SAMSUNG-1003, [131].

|                                | P20  | S20  | S40A<br>(U-20)                                             | S40B<br>(L-20) | S80 |   |   |   | PPDU<br>Bandwidth |      |      |  |  |  |  |        |
|--------------------------------|------|------|------------------------------------------------------------|----------------|-----|---|---|---|-------------------|------|------|--|--|--|--|--------|
| 20                             | Used |      |                                                            |                |     |   |   |   | 20 MHz            |      |      |  |  |  |  |        |
| 40                             | Used |      |                                                            |                |     |   |   |   | Used              |      |      |  |  |  |  | 40 MHz |
| 80(a)                          | Used |      |                                                            |                |     |   |   |   | Used              |      |      |  |  |  |  | 80 MHz |
| 80(b)                          | Used |      |                                                            |                |     |   |   |   | Punc              |      | Used |  |  |  |  |        |
| 80(c)                          | Used |      |                                                            |                |     |   |   |   | Punc              | Used | Punc |  |  |  |  |        |
| 160(a)                         | Used | Used | Channel use indicated by RU<br>signaling field of HE-SIG-B |                |     |   |   |   | 160<br>MHz        |      |      |  |  |  |  |        |
| 160(b)                         | Used | Punc |                                                            |                |     |   |   |   |                   |      | Used |  |  |  |  |        |
| 160(c)                         | Used | Punc |                                                            |                |     |   |   |   |                   |      | Punc |  |  |  |  |        |
| HE-SIG-B<br>Content<br>Channel | 1    | 2    | 1                                                          | 2              | 1   | 2 | 1 | 2 |                   |      |      |  |  |  |  |        |

SAMSUNG-1003, [131]

A POSITA would have found it obvious to use the bandwidth field of HE-SIG-A to indicate the total bandwidth of the PPDU and some channel puncturing information (per Li) and use the resource unit allocation field of the HE-SIG-B common field to indicate additional puncturing information (per Bharadwaj) for several reasons. SAMSUNG-1003, [132]-[136]. First, because the relied upon portions of Bharadwaj (i.e., those supported by the Bharadwaj provisional) do not explicitly teach where in the HE-SIG-A field the indications of unused S20 and S40B channels are carried, a POSITA would have looked to known methods of indicating channel use in HE-SIG-A, such as a joint bandwidth and subchannel indication (per Li). SAMSUNG-1003, [132].

Moreover, a POSITA would have been motivated to indicate both the bandwidth of the PPDU and the use of the S20 and S40B channels using the same field to save space in HE-SIG-A. SAMSUNG-1003, [133]. For example, if the indications described in Bharadwaj paragraphs [0132] and [0138] were included in a separate field of HE-SIG-A, a POSITA would have understood that at least two additional bits would be used to indicate three options for the location of HE-SIG-B content channel 2:

(1) no HE-SIG-B content channel 2 transmitted, information is copied on HE-SIG-B content channel 1 (SAMSUNG-1021, [0132]);

(2) HE-SIG-B content channel 2 is located in the fourth 20MHz channel (S40B) (SAMSUNG-1021, [0138]), and

(3) neither of the above applies and the HE-SIG-B content channel 2 is located in S20 (SAMSUNG-1021, [0131]). SAMSUNG-1003, [133].

It would have been obvious to a POSITA to include information of the location of the second HE-SIG-B content channel (per Bharadwaj) as channel configurations in a bandwidth and subchannel indication field (per Li) to save one bit in the bandwidth field of HE-SIG-A. SAMSUNG-1003, [134]; SAMSUNG-1021, [0131]-[0132], [0138]; SAMSUNG-1023, [0027]-[0031]. A POSITA would have had a reasonable expectation of success in the combination because the known elements in the combination perform known functions. SAMSUNG-1003,

[134]. Moreover, Bharadwaj-Li would have been predictable considering it was known that the bandwidth field of HE-SIG-A in a multi-user PPDU may be extended to indicate additional information. *Id.*; SAMSUNG-1027, 6-8. Indeed, the December 2015 Draft IEEE 802.11ax Framework noted that the bandwidth field of HE-SIG-A may be larger than the two bits used for the bandwidth field in a single user transmission “to take advantage of OFDMA.” SAMSUNG-1027, 6-8.

*Table 2 - HE-SIG-A field for an HE MU PPDU*

| Field                  | Length (bits) | Description                                                     | Encoding                                            |
|------------------------|---------------|-----------------------------------------------------------------|-----------------------------------------------------|
| DL/UL                  | 1             |                                                                 |                                                     |
| BSS Color              | 6             | Base station identifier.                                        |                                                     |
| Spatial Reuse          | TBD           |                                                                 |                                                     |
| TXOP Duration          | TBD           | Indicates the remaining time in the current TXOP. See [14].     |                                                     |
| Bandwidth              | $\geq 2$      | May accommodate more than in SU case to take advantage of OFDMA |                                                     |
| SIGB MCS               | 3             | See [15].                                                       | MCS0, MCS1, MCS2, MCS3, MCS4, MCS5<br>Other MCS TBD |
| SIGB DCM               | 1             |                                                                 |                                                     |
| SIGB Number Of Symbols | 4             | Support about 16 users using MCS0 per BCC                       |                                                     |
| SIGB                   | $\geq 1$      | Differentiates full bandwidth MU-                               |                                                     |

SAMSUNG-1029, 6-7 (annotated)

A POSITA would have further understood that the combination reflects the use of a known technique—e.g., bandwidth and subchannel indication system (per Li)—to improve a similar method—e.g., method of indicating some channel puncturing information using an indication in HE-SIG-A and additional puncturing information through a special RU allocation sequence (per Bharadwaj)—to arrive at an improved and predictable method of indicating channel puncturing

information using the bandwidth field of HE-SIG-A and the resource unit allocation field of HE-SIG-B. SAMSUNG-1003, [135]; SAMSUNG-1023, [0030]-[0032]; SAMSUNG-1021, [0130]-[0132], [0138]-[0142].

Additionally, a POSITA would have understood that the combination reflects the simple substitution of one known method (e.g., two-bit field that indicates PPDU bandwidth) for another (e.g., three-bit bandwidth field that indicates PPDU bandwidth and channel puncturing information) to arrive at the predictable result of a bandwidth field that indicates bandwidth and some channel puncturing information. SAMSUNG-1003, [136]; SAMSUNG-1021, [0111]; SAMSUNG-1023, [0030]-[0032].

#### **4. Claim 8**

##### ***[8.pre]***

To the extent the preamble is limiting, Bharadwaj describes “design aspects of high efficiency wireless local area networks (WLANs),” which may include “an access point (AP) that may communication with one or more (STAs) or mobile devices.” SAMSUNG-1021, [0003]-[0005].

##### ***[8.1]***

Bharadwaj teaches receiving a “WLAN protocol data unit (PDU) 200 (e.g., physical layer convergence PDU (PPDU)).” SAMSUNG-1021, [0024], [0090], [0092]-[0101], Fig. 2. A POSITA would have understood that a PPDU is a wireless packet. SAMSUNG-1003, [223]; SAMSUNG-1023, [0015]; SAMSUNG-

1046, 6:29-49; SAMSUNG-1001, 34:11-13.

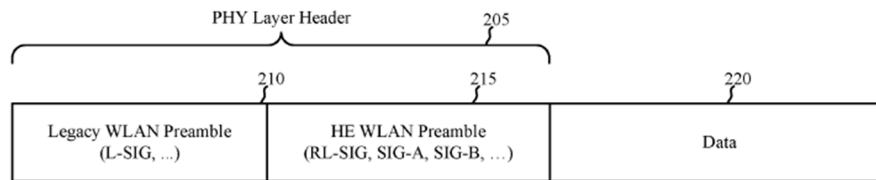
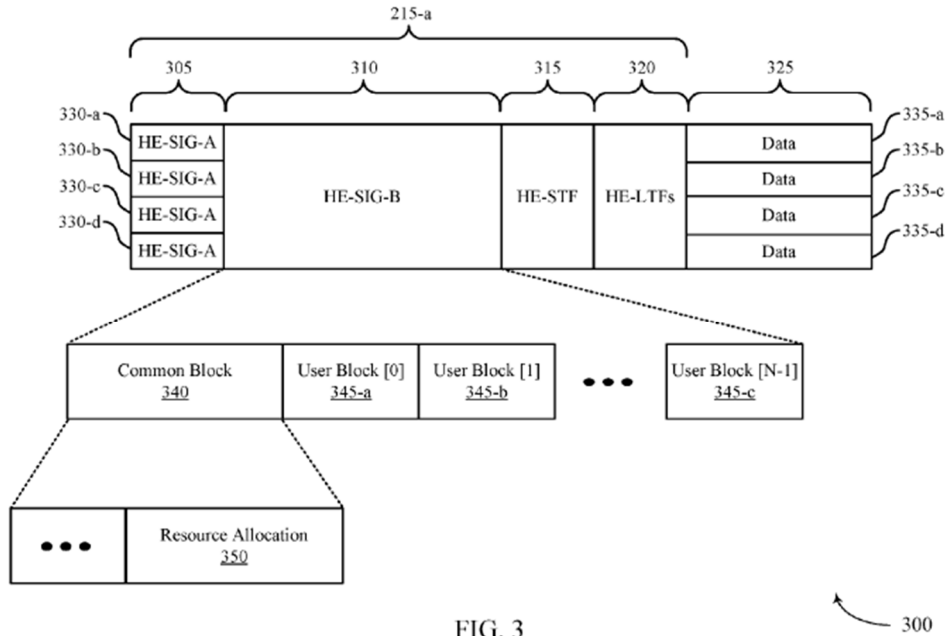


FIG. 2

200

SAMSUNG-1021, Fig. 2

Bharadwaj teaches that WLAN protocol data unit 200 includes a high efficiency WLAN preamble 215, which may include “a first high efficiency WLAN signaling field [305] such as HE-SIG-A [330]” and “a second high efficiency WLAN signaling field [310] such as HE-SIG-B [310-a].” SAMSUNG-1021, [0101]-[0104], [0117].

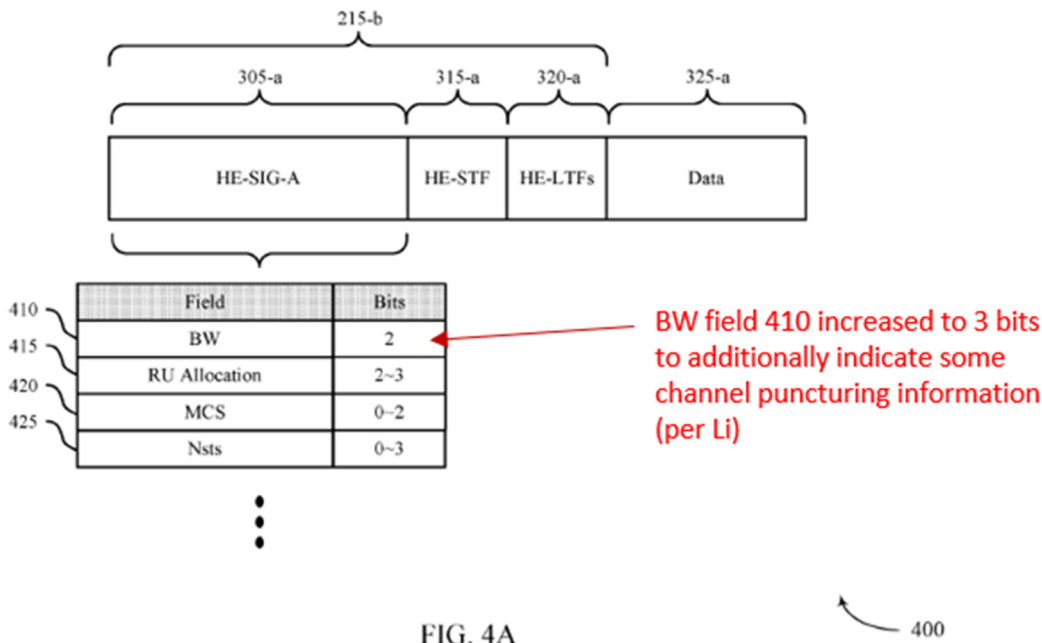


SAMSUNG-1021, Fig. 3

[8.2]

Bharadwaj teaches that HE-SIG-A field 305-a includes a bandwidth field (e.g., BW field 410) that indicates “the bandwidth of [the] PPDU.” SAMSUNG-1021, [0111]. Bharadwaj teaches that “BW field 410 may be used to indicate that the PPDU uses one of four different bandwidths,” e.g., 20, 40, 80, or 160MHz. *Id.* Li teaches “a bandwidth and subchannel indication system [that] may allocated one or more indication bits of the HE-SIG-A field to be used as an indication of the bandwidth of the transmission and/or an indication of the subchannels that are used and/or not used for the transmission,” where the “bandwidth indication may have the same format for all channel band sizes (e.g., 20/40/80/160MHz channel bands) since the receiving device ... may not know the bandwidth before decoding the

HE-SIG-A field.” SAMSUNG-1023, [0031].



SAMSUNG-1021, Fig. 4A (annotated)

As discussed in §III.C.3, Bharadwaj-Li includes a bandwidth field (e.g., BW field 410) that indicates overall PPDU bandwidth information and channel puncturing information. SAMSUNG-1021, [0111]; SAMSUNG-1023, [0030]-[0032].

**[8.3]**

For similar reasons to those discussed for [8.5], Bharadwaj-Li renders obvious obtaining information of an unassigned resource unit via at least one of the bandwidth field (e.g., BW field 410) and a subfield (e.g., resource allocation field 350 in common block field 340) of HE-SIG-B. SAMSUNG-1003, [227]; *see* [8.5].

**[8.4]**

Bharadwaj-Li renders obvious decoding the received PPDU (“wireless packet”) based on the PPDU bandwidth (“bandwidth information”) and the information of the unassigned resource unit. SAMSUNG-1003, [228]-[233].

Bharadwaj teaches that “[t]ransmissions to/from STAs 110 and APs 105 oftentimes include control information within a header that is transmitted prior to data transmissions” and ***“used by a device to decode the subsequent data.”*** SAMSUNG-1021, [0097]. “High efficiency (HE) WLAN preambles can be used to schedule multiple devices, such as STAs 110, for single-user simultaneous transmission (e.g., single-user orthogonal frequency division multiple access (SU OFDMA)) and/or MU-MIMO transmissions (e.g., multiple input/multiple-output MU-MIMO).” *Id.* For example, “a HE WLAN signaling field is used to signal a resource allocation pattern to multiple receiving STAs 110.” *Id.* Additionally, ***“[a] device uses the scheduling [information] to determine which resource units associated with the frequency spectrum utilized by data field 220 have been allocated to the device for forthcoming communications.”*** SAMSUNG-1021, [0101].

A POSITA would have understood that the PPDU bandwidth is among the information used to decode a received PPDU. SAMSUNG-1003, [230]. For example, the PPDU bandwidth informs a receiving station to which channels it

should tune its receiver to receive the PPDU. *Id.*; SAMSUNG-1021, [0101]; SAMSUNG-1023, [0027]; SAMSUNG-1031, 3-5; SAMSUNG-1034, 9; SAMSUNG-1040, 9. A POSITA would have understood that the PPDU bandwidth indicates the length of the common field of HE-SIG-B, which a station decodes to obtain scheduling information of the resource units within the PPDU bandwidth. SAMSUNG-1021, [0101], [0117], [0141]; SAMSUNG-1023, [0034] (“[T]he common part only varies with the total bandwidth not total used bandwidth.”). Additionally, a POSITA would have understood that the PPDU bandwidth informs a receiving station to which channels it should tune its receiver to receive the PPDU. SAMSUNG-1003, [230]; SAMSUNG-1023, [0027]; SAMSUNG-1031, 3-5; SAMSUNG-1034, 9; SAMSUNG-1040, 9.

A POSITA would have further understood that a received PPDU is decoded based on the information of an unassigned resource unit. SAMSUNG-1003, [231]; *see* [8.5]. For example, Bharadwaj teaches that a station decodes a received PPDU based on its resource unit assignment (“which resource units associated with the frequency spectrum utilized by data field 220 have been allocated to the device for forthcoming communications”). SAMSUNG-1021, [0101], [0104]; SAMSUNG-1003, [231]; *see also* SAMSUNG-1025, [0101]-[0103], Fig. 17; SAMSUNG-1031, 4-5.

Bharadwaj teaches that a station determines its resource unit assignment by

comparing the position of a user-field that addressed to the station to the resource unit arrangement indicated by the resource allocation field. SAMSUNG-1021, [0104]; SAMSUNG-1003, [232].

In PPDU's larger than 40MHz (as indicated by the bandwidth field of HE-SIG-A), user fields are split between the HE-SIG-B content channels. SAMSUNG-1021, [0117]. Bharadwaj teaches that when a resource unit is unassigned (as discussed for [8.6]), no user fields are transmitted for the unassigned resource unit. SAMSUNG-1021, [0141]-[0142] ("SIG-B duplicated structure may be maintained, while the dedicated content for punctured channels are not transmitted."); SAMSUNG-1003, [233]; *see* SAMSUNG-1014, [0294]-[0296]; SAMSUNG-1028, 13. Thus, a receiving station would adjust the alignment between its position in the user-specific field and the resource unit arrangement information based on the information of an unassigned resource unit when decoding a received PPDU. SAMSUNG-1021, [0104]; SAMSUNG-1003, [233]; *see* SAMSUNG-1025, [0089]-[0093], Figs. 12-14; SAMSUNG-1014, [0294]-[0296].

#### ***/8.5/***

Bharadwaj-Li renders obvious that information of an unassigned resource unit is indicated via a combination of the bandwidth field of the HE-SIG-A (e.g., BW field 410) and a resource unit allocation field of the HE-SIG-B (e.g., resource allocation field 350 in common block field 340). SAMSUNG-1021, [0130]-[0132],

[0138]-[0142]; SAMSUNG-1023, [0030]-[0032]; SAMSUNG-1003, [234]-[238].

Specifically, a POSITA would have understood that information of an unassigned resource unit is indicated via the channel puncturing information discussed for [8.6]. *Id.*; *see* [8.6]; §III.C.3. Bharadwaj does not define the term “puncturing”; a POSITA would have understood the term as meaning that a certain channel within the PPDU bandwidth is not used, and thus the group of tones (resource unit) corresponding to the punctured channel is nulled (not transmitted nor assigned to any user). SAMSUNG-1003, [235]; SAMSUNG-1021, [0130]-[0132], [0138]-[0142]; SAMSUNG-1032, 11-15; SAMSUNG-1036, 13-15; SAMSUNG-1045, 11-17; SAMSUNG-1031, 4-5; SAMSUNG-1030, 15; SAMSUNG-1014, [0139], [0154]; SAMSUNG-1023, [0026], [0034]-[0035], [0051], [0057], [0071].

A POSITA would have understood or found obvious that nulling is indicated in units of resource units to maintain the structure of the overall OFDMA tone plan in the PPDU and the HE-SIG-B field and ensure that each station has a contiguous resource unit allocation. SAMSUNG-1021, [0145] (teaching that when an “RU allocation bit sequence” indicates a punctured channel, the common field, user field, and duplication structure of HE-SIG-B remain unchanged); SAMSUNG-1003, [236]; *see* SAMSUNG-1015, 8; SAMSUNG-1032, 12-15. Thus, a POSITA would have understood that when a punctured channel is indicated in Bharadwaj-

Li, this indicates to a receiving station that a 242-tone resource unit (which spans an entire 20MHz segment) corresponding to the punctured channel is not assigned to any user. SAMSUNG-1003, [236]; SAMSUNG-1021, [0108]-[0109], Figs. 4B-C; *see* SAMSUNG-1014, [0167].

Bharadwaj-Li also renders obvious that the information of an unassigned resource unit corresponding to a punctured channel is indicated via a combination of the bandwidth field of HE-SIG-A and the resource allocation field in the HE-SIG-B common field. SAMSUNG-1003, [237]-[238]. For example, Bharadwaj-Li renders obvious that a receiving station determines the number and arrangement of the resource unit allocation fields based on the total PPDU bandwidth, and the resource unit allocation field indicates a null 242-tone resource unit corresponding to a nulled channel within the PPDU bandwidth. SAMSUNG-1021, [0101], [0141]; SAMSUNG-1023, [0034], [0042]-[0043]; SAMSUNG-1027, 8-11.

As another example, Bharadwaj-Li renders obvious that the bandwidth field of HE-SIG-A indicates the number, location, and length (number of resource unit allocation fields) of the HE-SIG-B content channels, which may contain a resource unit allocation field that indicates a null 242-tone resource unit corresponding to a nulled channel within the PPDU bandwidth indicated by HE-SIG-A. SAMSUNG-1021, [0111], [0130]-[0132], [0138]-[0142]; SAMSUNG-1023, [0030]-[0032]; §III.C.3; *see* [8.6]. This mapping is consistent with Patent Owner's infringement

contentions. SAMSUNG-1003, [238].

**[8.6]**

As discussed in §III.C.1, Bharadwaj discloses a method of indicating puncturing of 20MHz subchannels using the HE-SIG-A and HE-SIG-B fields. SAMSUNG-1021, [0130]-[0132], [0138]-[0142]. Specifically, Bharadwaj teaches that HE-SIG-A may indicate that certain channels (e.g., S20 or S40B) in the primary 80MHz bandwidth responsible for carrying HE-SIG-B content channel 2 are punctured. SAMSUNG-1021, [0131]-[0132], [0138]. Based on this indication, a station may determine if and where an HE-SIG-B content channel 2 may be found. *Id.* Bharadwaj teaches that additional puncturing information for other 20MHz channels may be indicated through “a special or dedicated RU allocation bit sequence.” SAMSUNG-1021, [0139]-[0142]. Specifically, “the indication may be made by adding an additional entry in an RU allocation table.” *Id.* A POSITA would have understood that the RU allocation bit sequence would be indicated in a resource unit allocation field (e.g., resource allocation field 350), which indicates resource unit allocation information using a bit sequence corresponding to indices in a resource unit allocation table (e.g., lookup table 600). *Id.*; SAMSUNG-1021, [0124], Fig. 6; SAMSUNG-1003, [239]; SAMSUNG-1027, 8-11; SAMSUNG-1028, 13; SAMSUNG-1023, [0044].

In Bharadwaj-Li, the bandwidth field of HE-SIG-A (e.g., BW field 410)

contains an index value (per Li) corresponding to both PPDU bandwidth and whether the S20 and/or S40B channels are transmitted (per Bharadwaj). §III.C.3; SAMSUNG-1021, [0111], [0130]-[0132], [0138]-[0142]; SAMSUNG-1023, [0030]-[0032]. A POSITA would have understood this information as channel information to be punctured within the bandwidth. SAMSUNG-1003, [240]. Per Bharadwaj, puncturing information for other channels may be indicated using the resource unit allocation field (e.g., resource allocation field 350). SAMSUNG-1021, [0141]-[0142].

As one example, when the bandwidth field of HE-SIG-A indicates a total bandwidth of 80MHz and the HE-SIG-B content channel 2 is transmitted in S40B, this indicates that the S20 channel is punctured. SAMSUNG-1003, [241]; SAMSUNG-1021, [0138]. Otherwise, a POSITA would have understood that HE-SIG-B content channel 2 would be read from the S20. SAMSUNG-1003, [241]; SAMSUNG-1021, [0131]. Here, a POSITA would have understood that the bandwidth field of HE-SIG-B indicates information of a channel to be punctured (e.g., S20). SAMSUNG-1003, [241].

|                                | P20  | S20  | S40A<br>(U-20)                                             | S40B<br>(L-20) | S80 |   |   |   | PPDU<br>Bandwidth |            |      |      |  |  |  |        |  |  |  |        |
|--------------------------------|------|------|------------------------------------------------------------|----------------|-----|---|---|---|-------------------|------------|------|------|--|--|--|--------|--|--|--|--------|
| 20                             | Used |      |                                                            |                |     |   |   |   | 20 MHz            |            |      |      |  |  |  |        |  |  |  |        |
| 40                             | Used |      |                                                            |                |     |   |   |   | Used              |            |      |      |  |  |  | 40 MHz |  |  |  |        |
| 80(a)                          | Used |      |                                                            |                |     |   |   |   | Used              |            |      |      |  |  |  |        |  |  |  | 80 MHz |
| 80(b)                          | Used |      |                                                            |                |     |   |   |   | Punc              |            |      |      |  |  |  |        |  |  |  |        |
| 80(c)                          | Used |      |                                                            |                |     |   |   |   | Punc              | Used       | Punc |      |  |  |  |        |  |  |  |        |
| 160(a)                         | Used | Used | Channel use indicated by RU<br>signaling field of HE-SIG-B |                |     |   |   |   |                   | 160<br>MHz |      |      |  |  |  |        |  |  |  |        |
| 160(b)                         | Used | Punc |                                                            |                |     |   |   |   |                   |            |      | Used |  |  |  |        |  |  |  |        |
| 160(c)                         | Used | Punc |                                                            |                |     |   |   |   |                   |            |      | Punc |  |  |  |        |  |  |  |        |
| HE-SIG-B<br>Content<br>Channel | 1    | 2    | 1                                                          | 2              | 1   | 2 | 1 | 2 |                   |            |      |      |  |  |  |        |  |  |  |        |

### SAMSUNG-1003, [241]

Continuing with this example, the resource unit allocation field may indicate whether, e.g., the S40A is punctured by indicating a special RU allocation bit sequence in the resource unit allocation field corresponding to S40A.

SAMSUNG-1003, [242]; SAMSUNG-1021, [0139]-[0142]. Thus, a POSITA would have understood that the resource unit allocation field indicates additional puncturing information (e.g., special RU allocation bit sequence indicating S40A is punctured) for the unassigned resource unit within the PPDU bandwidth (e.g., null 242-tone resource unit corresponding to punctured channel). SAMSUNG-1003, [242].

Thus, a POSITA would have understood the combined teachings of Bharadwaj and Li as rendering obvious this limitation. SAMSUNG-1003, [243].

## 5. Claim 9

As discussed for [8.6], Bharadwaj-Li renders obvious that the resource unit allocation field of HE-SIG-B “may be used to indicate that a 20 MHz channel is punctured” through “a special or dedicated RU allocation bit sequence.”

SAMSUNG-1021, [0139]-[0142]; §III.C.4. Specifically, “the indication may be made by adding an additional entry in an RU allocation table.” *Id.* A POSITA would have understood that this “special or dedicated RU allocation bit sequence” in the RU allocation table (e.g., lookup table 600) indicates that a 242-tone resource unit corresponding to the 20MHz channel is nulled, and thus not assigned to a user. SAMSUNG-1003, [244]; *see* [8.5].

Alternatively, it would have been obvious for a POSITA to include one or more special entries in the RU allocation table to indicate that a specific size resource unit is punctured. SAMSUNG-1003, [245]; SAMSUNG-1021, [0104], [0124], Fig. 6. This would allow a single RU allocation entry may indicate that more than one 20MHz channel is punctured. SAMSUNG-1003, [246]. As Dr. Buehrer explains, this may be particularly useful in a 160MHz PPDU when both S20 and S40B are punctured, and HE-SIG-B content channel 1 carries HE-SIG-B information for all 8 channels. *Id.*; SAMSUNG-1021, [0132].

**6. Claim 10**

As discussed for [9], a POSITA would have understood Bharadwaj as teaching that the specific resource unit is a 242-tone resource unit, or alternatively, that it would have been obvious that the specific resource unit is a 242, 484, or 996-tone resource unit. SAMSUNG-1003, [247]; SAMSUNG-1021, [0104], [0124], [0141], Fig. 6; §III.C.5.

**7. Claim 14**

Bharadwaj-Li renders obvious this limitation. SAMSUNG-1003, [248]-[250]. As discussed for [8.6], Bharadwaj-Li renders obvious that the bandwidth field of HE-SIG-A indicates channel information to be punctured within the bandwidth, and the RU signaling field indicates additional puncturing information. *Id.*; §III.C.1-4.

In Bhardwaj-Li, a POSITA would have understood that, when the bandwidth field indicates puncturing of the secondary 20MHz channel within a bandwidth of 160MHz (e.g., 160(b) and (c) below), the resource unit allocation field may indicate additional puncturing in a secondary 80MHz channel. SAMSUNG-1003, [249]; SAMSUNG-1021, [0131]-[0132], [0138]; §III.C.1-4.

|                                | P20  | S20  | S40A<br>(U-20) | S40B<br>(L-20) | S80                                                        |   |   |   | PPDU<br>Bandwidth |
|--------------------------------|------|------|----------------|----------------|------------------------------------------------------------|---|---|---|-------------------|
| 20                             | Used |      |                |                |                                                            |   |   |   | 20 MHz            |
| 40                             | Used | Used |                |                |                                                            |   |   |   | 40 MHz            |
| 80(a)                          | Used | Used |                |                |                                                            |   |   |   | 80 MHz            |
| 80(b)                          | Used | Punc |                | Used           |                                                            |   |   |   |                   |
| 80(c)                          | Used | Punc | Used           | Punc           |                                                            |   |   |   |                   |
| 160(a)                         | Used | Used |                |                | Channel use indicated by RU<br>signaling field of HE-SIG-B |   |   |   | 160<br>MHz        |
| 160(b)                         | Used | Punc |                | Used           |                                                            |   |   |   |                   |
| 160(c)                         | Used | Punc |                | Punc           |                                                            |   |   |   |                   |
| HE-SIG-B<br>Content<br>Channel | 1    | 2    | 1              | 2              | 1                                                          | 2 | 1 | 2 |                   |

BW field indicates puncturing of S20

Resource unit allocation field of HE-SIG-B indicates additional puncturing in S80

SAMSUNG-1003, [249]

Additionally or alternatively, a POSITA would have understood that, when the bandwidth field indicates puncturing of at least one of two 20MHz channels (e.g., 160(c) below) in a secondary 40MHz channel within a bandwidth of 160MHz, the resource unit allocation field indicates additional puncturing in the S80 channel. SAMSUNG-1003, [250]; SAMSUNG-1021, [0131]-[0132], [0138]; §III.C.1-4.

|                                | P20  | S20  | S40A<br>(U-20) | S40B<br>(L-20) | S80                                                        |   |   |   | PPDU<br>Bandwidth |
|--------------------------------|------|------|----------------|----------------|------------------------------------------------------------|---|---|---|-------------------|
| 20                             | Used |      |                |                |                                                            |   |   |   | 20 MHz            |
| 40                             | Used | Used |                |                |                                                            |   |   |   | 40 MHz            |
| 80(a)                          | Used | Used |                |                |                                                            |   |   |   | 80 MHz            |
| 80(b)                          | Used | Punc |                | Used           |                                                            |   |   |   |                   |
| 80(c)                          | Used | Punc | Used           | Punc           |                                                            |   |   |   |                   |
| 160(a)                         | Used | Used |                |                | Channel use indicated by RU<br>signaling field of HE-SIG-B |   |   |   | 160<br>MHz        |
| 160(b)                         | Used | Punc |                | Used           |                                                            |   |   |   |                   |
| 160(c)                         | Used | Punc |                | Punc           |                                                            |   |   |   |                   |
| HE-SIG-B<br>Content<br>Channel | 1    | 2    | 1              | 2              | 1                                                          | 2 | 1 | 2 |                   |

BW field indicates puncturing of S40B

Resource unit allocation field of HE-SIG-B  
indicates additional puncturing in S80

SAMSUNG-1003, [250]

## 8. Claims 1-3 and 7

Claims 1-3 and 7 require “[a] wireless communications terminal, the terminal comprising: a processor; and a communication unit, wherein the processor is configured to” perform steps corresponding to the methods of [8]-[10] and [14], respectively. To the extent [1]’s preamble is limiting, Bharadwaj discloses “a wireless device 1390, which may be an example of a STA 110 or an AP 105.” SAMSUNG-1021, [0181], Fig. 13A. Bharadwaj further discloses that wireless device 1390 includes a processor 1305, “which may process information received through the transceiver(s) 1320.” *Id.* For similar reasons to those discussed for [8]-[10] and [14], a POSITA would have found obvious that Bharadwaj-Li includes a wireless communications terminal (e.g., wireless device 1390) having a processor (e.g., processor 1305), a communications unit (e.g., transceiver 1320), per

Bharadwaj, wherein the processor is configured to perform the steps recited in the remaining limitations of [1], [3], and [7]. SAMSUNG-1003, [251]-[252];

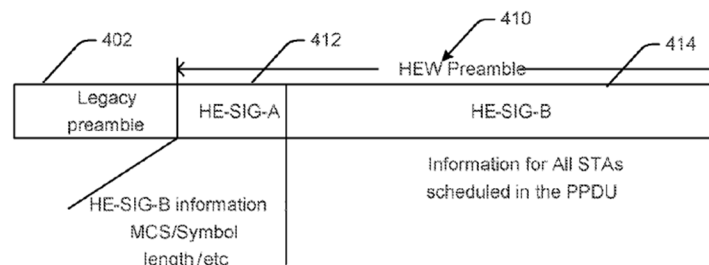
§§III.C.4-7.

## **D. [GROUND 2B] – Bharadwaj-Li in view of Chen**

### **1. Chen**

Chen relates to “resource unit (RU) allocation in high efficiency (HE) Wi-Fi preambles,” particularly in IEEE 802.11ax or High-Efficiency WLAN.

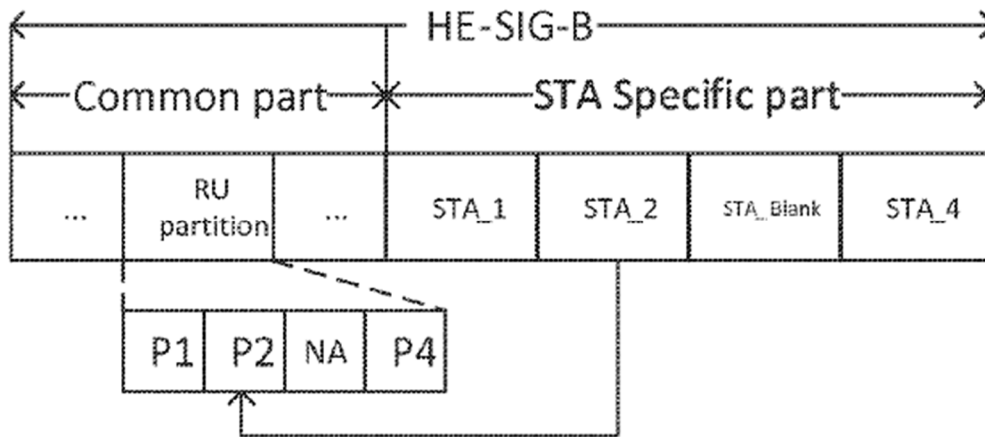
SAMSUNG-1025, [0002]-[0003]. Chen discloses “identifying an RU for transmitting and receiving data based at least in part on a received PPDU,” which includes HE-SIG-A and HE-SIG-B fields. SAMSUNG-1025, [0035], [0076], [0101]-[0104], Fig. 4.



SAMSUNG-1025, Fig. 4

Chen further discloses identifying an unassigned resource unit: “[i]f one RU is not allocated or is skipped, AP 110 may assign a special (e.g., blank or null)

PAID<sup>5</sup> which is not decodable by or known to any of the scheduled STA. As a result, all of the STAs 140 will skip that RU. FIG. 13 depicts a datagram illustrating an example HE-SIG-B 1300 portion indicating a sequence of RU allocation information with an unallocated RU.” SAMSUNG-1025, [0090]-[0093], Figs. 12-14.



SAMSUNG-1025, Fig. 13

## 2. Bharadwaj-Li-Chen

In Bharadwaj-Li-Chen, Bharadwaj-Li includes a method of indicating an unassigned resource unit using a null station ID in a user field corresponding to the resource unit not assigned to a user, per Chen. SAMSUNG-1003, [139]-[142]. SAMSUNG-1021, [0101]-[0104], [0117], Figs. 3, 5; SAMSUNG-1025, [0090]-[0093], Figs. 12-14. In the combination, the resource unit allocation field partitions

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<sup>5</sup> *Supra* note 4.

a specific 20MHz subchannel into multiple resource units, per Bharadwaj.

SAMSUNG-1021. [0104], [0117]. A specific resource unit within the 20MHz data region may be indicated as an unassigned resource unit using a null station ID, per Chen. SAMSUNG-1025, [0090]-[0093], Fig. 13.

A POSITA would have found it obvious to use a null station ID in the user field corresponding to a specific resource unit indicated by the resource unit allocation field, as Chen teaches, for several reasons. SAMSUNG-1003, [140]-[142]. First, a POSITA would have been motivated to include a method of indicating additional unassigned resource units (beyond entirely nulled channels), for example, resource units on the edge of a nulled channel. SAMSUNG-1003, [140]. Indeed, as Dr. Buehrer explains, a POSITA would have understood that it may be helpful to null resource units in an unpunctured channel adjacent to a punctured channel to ensure compliance with spectral masks and out of band emission requirements. *Id.*; SAMSUNG-1014, [0139], [0143], [0147], Figs. 11-13.

A POSITA would have understood Chen's method of indicating an unassigned resource unit using a null station ID as a known, predictable solution to indicate additional unassigned resource units, such as edge resource units in a used channel adjacent to a punctured busy channel. SAMSUNG-1003, [141]; SAMSUNG-1025, [0090]-[0093]. Thus, it would have been obvious to a POSITA to use Chen's method to further indicate information of an unassigned resource

unit, such as a resource unit adjacent to a busy channel, in Bharadwaj-Li. *Id.* A POSITA would have had a reasonable expectation of success in combining Chen with Bharadwaj-Li because the known elements in the combination merely perform the same functions and would have also found the combination predictable for similar reasons to those discussed above. *Id.*

A POSITA would have further understood that the combination reflects the use of a known technique—e.g., indicating an unassigned resource unit using a null station ID in a user specific field corresponding to the unassigned resource unit (per Chen)—to improve a similar method—e.g., method of indicating some channel puncturing via the bandwidth field of HE-SIG-A and the resource unit allocation field of HE-SIG-B (per Bharadwaj-Li)—to arrive at an improved and predictable method of indicating information of an unassigned resource unit (e.g., unassigned resource unit on the edge of a punctured channel) using a null station ID in a user field (e.g., Bharadwaj’s user block 345) corresponding to the unassigned resource unit. SAMSUNG-1003, [142]. SAMSUNG-1021, [0101]-[0104], [0117], Figs. 3, 5; SAMSUNG-1025, [0090]-[0093], Figs. 12-14.

### **3. Claim 8**

Bharadwaj-Li-Chen renders obvious [8] for the reasons discussed in Ground 2A. SAMSUNG-1003, [254]; §III.C.4. Bharadwaj-Li-Chen further renders obvious [8] based on Chen’s additional teachings relating to [8.3]-[8.6]. SAMSUNG-1003,

[254]-[261].

**[8.3]**

In Bharadwaj-Li-Chen, a POSITA would have understood that information of an unassigned resource unit may additionally be obtained via a subfield (a user field of HE-SIG-B), per Chen. SAMSUNG-1003, [255]; SAMSUNG-1025, [0090]-[0093], Figs. 12-14; §III.D.2.

**[8.4]**

For similar reasons to those explained in Ground 2A, a POSITA would have also understood that the information of an unassigned resource unit obtained using a null station ID (per Chen) is used to decode the PPDU. SAMSUNG-1003, [256]; §III.C.4. A POSITA would have understood that the receiving device uses the information of an unassigned resource unit obtained using a null station ID (per Chen) to decode the PPDU based on “which resource units associated with the frequency spectrum utilized by data field 220 have been allocated to the device for forthcoming communications.” SAMSUNG-1021, [0101]. For example, a POSITA would have understood that the null STA ID indicates that an unassigned resource unit should be skipped by receiving stations. SAMSUNG-1025, [0090]-[0092], Figs. 12-13; §III.D.2.

**[8.5]**

A POSITA would have further understood that the information of the unassigned resource obtained by a null station ID in the user field is also indicated

via a combination of the bandwidth field of the HE-SIG-A and a resource unit allocation field of the HE-SIG-B (e.g., the resource unit allocation field of the HE-SIG-B common field). SAMSUNG-1003, [257]; SAMSUNG-1021, [0101]-[0104], [0117], Figs. 3, 5; SAMSUNG-1025, [0090]-[0093], Figs. 12-14; §III.D.2.

For example, information of an unassigned resource unit indicated according using a null station ID (per Chen) is also indicated via a combination of:

- (1) the bandwidth field of HE-SIG-A, (*see* [8.5] in §III.C.4), and
- (2) the resource unit allocation field (e.g., resource allocation field 350) of the HE-SIG-B common field (e.g., common block field 340), which indicates the number, size, and position of one or more resource units within a particular 20MHz region of the bandwidth indicated by the bandwidth field of HE-SIG-A (SAMSUNG-1021, [0101]-[0104], [0117], Figs. 3, 5; SAMSUNG-1025, [0090]-[0093], Figs. 12-14). SAMSUNG-1003, [258].

Specifically, the resource unit allocation field (e.g., resource allocation field 350) partitions segments of the PPDU bandwidth into resource units, one or more of which may be indicated as an unassigned resource unit using a null STA ID in the user block (e.g., user block 345) corresponding to an unassigned resource unit. SAMSUNG-1003, [259]; SAMSUNG-1021, [0101]-[0104], [0117], Figs. 3, 5; SAMSUNG-1025, [0090]-[0093], Figs. 12-14; §III.D.2.

**[8.6]**

Bharadwaj-Li-Chen renders obvious this limitation for the reasons discussed in Ground 2A. *See* §III.C.4. Here, a POSITA would have understood that the additional puncturing information is for the unassigned resource unit within the bandwidth (e.g., nulled edge resource unit is adjacent to the punctured channel). SAMSUNG-1003, [260]; §III.D.2.

For these reasons, a POSITA would have understood Bharadwaj-Li-Chen as additionally rendering obvious [8]. SAMSUNG-1003, [261].

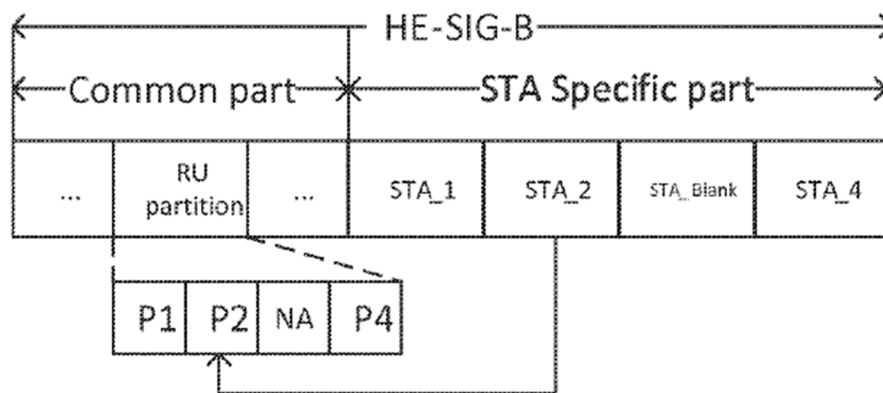
#### **4. Claim 11**

Bharadwaj-Li-Chen renders obvious this limitation. SAMSUNG-1003, [262]-[264]. Bharadwaj teaches that HE-SIG-B includes “a common block field 340 that signals information to a group of devices, such as high efficiency STAs within range of an AP, and user blocks 345-a to 345-c that signal information specific to specific high efficiency STAs. The common block includes a resource allocation field 350 that signals to the high efficiency device how the data field 325 is partitioned amongst devices (e.g., partitions the data field into resource units).” SAMSUNG-1021, [0104]. Bharadwaj explains that the “the order of the user blocks 345 provides a link between the device associated with the user block 345 and the resource unit that has been allocated to the device. As an example, the resource allocation field 350 partitions the data field into nine regions (e.g.,

20MHz data region is partitioned into nine sub-regions that each span 26 tones).

The STA addressed in the first user block corresponds to the first 26 tones, the second STA addressed in the second user block corresponds to the next 26 tones, etc.” *Id.*

Chen teaches a method of indicating an unassigned resource unit using the user fields of HE-SIG-B. SAMSUNG-1025, [0090]-[0093], Fig. 13. Specifically, Chen teaches that “[i]f one RU is not allocated or is skipped, AP 110 may assign a special (e.g., blank or null) PAID<sup>6</sup> which is not decodable by or known to any of the scheduled STA. As a result, all of the STAs 140 will skip that RU. FIG. 13 depicts a datagram illustrating an example HE-SIG-B 1300 portion indicating a sequence of RU allocation information with an unallocated RU.” SAMSUNG-1025, [0092].



SAMSUNG-1025, Fig. 13

<sup>6</sup> *Supra* note 4.

In Bharadwaj-Li-Chen, it would have been obvious to use Chen's method of indicating an unassigned resource unit using a null station ID in Bharadwaj-Li.

§III.D.2. In Bharadwaj-Li-Chen, a POSITA would have found it obvious that information of an unassigned resource unit is obtained through resource unit arrangement information (e.g., resource unit partitioning information) indicated by the resource unit allocation field (e.g., resource allocation field 350) of the HE-SIG-B and a Null STA ID (e.g., null PAID per Chen) contained in a user field (e.g., user block 345) corresponding to a specific resource unit in the resource unit arrangement (e.g., particular resource unit corresponding to the user block 345 based on the user block's position in the user-specific portion of HE-SIG-B). SAMSUNG-1003, [264]; SAMSUNG-1021, [0101]-[0104], [0117], Figs. 3, 5; SAMSUNG-1025, [0090]-[0093], Figs. 12-14; §III.D.2.

## **5. Claim 12**

Bharadwaj-Li-Chen renders obvious that the specific resource unit (e.g., particular resource unit corresponding to the user block 345 based on the user block's position in the user-specific portion of HE-SIG-B) is at least one of a 26-tone resource unit, a 52-tone resource unit, and a 106-tone resource unit.

SAMSUNG-1003, [265]; SAMSUNG-1021, [0104]; §III.D.4. For example, Bharadwaj teaches that resource allocation field 350 may partition the data field into nine 26-tone resource units and a corresponding user field to one of those

resource units may indicate that the specific 26-tone resource unit is not assigned to a user using a null STA ID, per Chen. *Id.*; SAMSUNG-1025, [0090]-[0093], Figs. 12-14; §III.D.4.

**6. Claims 1-5, 7, 9-10, and 14**

Bharadwaj-Li-Chen renders obvious [1]-[3], [7], [9]-[10], and [14] for the reasons discussed in Ground 2A. SAMSUNG-1003, [266]; §III.C. Bharadwaj-Li-Chen further renders obvious these claims and claims [4]-[5] based on Chen. SAMSUNG-1003, [266]. §III.D.1-5.

**E. [GROUND 2C] – Bharadwaj-Li in view of Kim**

**1. Bharadwaj-Li-Kim**

In Bharadwaj-Li-Kim, Bharadwaj-Li's bandwidth and subchannel indication in HE-SIG-B is modified to include four contiguous PPDU options and four non-contiguous PPDU options that indicate, for each bandwidth of 80 or 160 (or 80+80)MHz, whether the S20 channel is transmitted, per Kim. SAMSUNG-1003, [143]-[156]; SAMSUNG-1018, [0144]-[0145], Table 22; §III.C.3.

TABLE 22

---

|   |                                                                                       |
|---|---------------------------------------------------------------------------------------|
| * | Bandwidth index (3 bits, b0b1b2) in HE-SIG A                                          |
| * | 000: 20MHz                                                                            |
| * | 001: 40MHz                                                                            |
| * | 010: 80MHz (preamble fully populated on all 4 channels and OFDMA uses 80MHz design)   |
| * | 011: 160MHz (preamble fully populated on all 8 channels and OFDMA uses 160MHz design) |
| * | 100: 80MHz channel bonding with preamble on P40                                       |
| * | 101: 80MHz channel bonding with preamble on P20 (no preamble on S20)                  |
| * | 110: 160MHz channel bonding with preamble on P40                                      |
|   | 111: 160MHz channel bonding with preamble on P20 (no preamble on S20) }               |

---

SAMSUNG-1018, Table 22

|                                | P20  | S20  | S40A<br>(U-20)                                          | S40B<br>(L-20) | S80  |      |      |      | PPDU<br>Bandwidth |
|--------------------------------|------|------|---------------------------------------------------------|----------------|------|------|------|------|-------------------|
| 000                            | Used |      |                                                         |                |      |      |      |      | 20 MHz            |
| 001                            | Used | Used |                                                         |                |      |      |      |      | 40 MHz            |
| 010                            | Used | Used | Used                                                    | Used           |      |      |      |      | 80 MHz            |
| 011                            | Used | Used | Used                                                    | Used           | Used | Used | Used | Used | 160 MHz           |
| 100                            | Used | Used |                                                         |                |      |      |      |      | 80 MHz            |
| 101                            | Used | Punc |                                                         |                |      |      |      |      | 80 MHz            |
| 110                            | Used | Used |                                                         |                |      |      |      |      | 160 MHz           |
| 111                            | Used | Punc | Channel use indicated by RU signaling field of HE-SIG-B |                |      |      |      |      | 160 MHz           |
| HE-SIG-B<br>Content<br>Channel | 1    | 2    | 1                                                       | 2              | 1    | 2    | 1    | 2    |                   |

SAMSUNG-1003, [143]

If the S20 channel is transmitted, a receiving station may read both HE-SIG-B content channels from the primary 40MHz (P20 and S20), per Bharadwaj. SAMSUNG-1003, [144]; SAMSUNG-1021, [0131]. If the S20 channel is not transmitted (e.g., the channel is busy and must be punctured), a POSITA would

have recognized several known or obvious methods to transmit HE-SIG-B information for the channels that ordinary fall into HE-SIG-B content channel 2. SAMSUNG-1003, [144]; SAMSUNG-1021, [0131].

For example, HE-SIG-B content channel 1 could carry HE-SIG-B information for all channels in the bandwidth (per Bharadwaj). SAMSUNG-1003, [145]; SAMSUNG-1021, [0132]. Alternatively, the HE-SIG-B content channel 1 could include a channel bonding field in the common field that indicates which channels are being used, and the HE-SIG-B content channel 1 could carry information for the channels according to the default mapping plus any additional used channels that would otherwise be carried in the HE-SIG-B content channel 2 (per Kim). SAMSUNG-1003, [145]; SAMSUNG-1018, [0143]-[0159], Tables 23-24. Even more simply, bandwidth configurations in which both S20 and S40B are not transmitted could be proscribed, and thus at least one channel carrying each HE-SIG-B content channel would always be present in the P80. SAMSUNG-1003, [145].

A POSITA would have found it obvious to combine Bharadwaj-Li with Kim for similar reasons as described in Ground 1B. §III.B.2; SAMSUNG-1003, [146]-[156].

## 2. Claims 6 and 13

In Bharadwaj-Li-Kim, a POSITA would have understood that when the bandwidth field indicates a non-contiguous PPDU with a bandwidth of 80MHz (e.g., the bandwidth indication is set to “100”), the bandwidth field indicates puncturing of either S40A or S40B (per Kim). SAMSUNG-1018, [0144]-[0145], Table 22; SAMSUNG-1003, [268]. This is because, if neither S40A nor S40B is transmitted, a 40MHz PPDU (e.g., bandwidth indication “001”) would be indicated, and if both S40A and S40B are transmitted, a continuous 80MHz PPDU (e.g., bandwidth indication “010”) would be transmitted. *Id.*

TABLE 22

|                                                                                         |  |
|-----------------------------------------------------------------------------------------|--|
| * Bandwidth index (3 bits, b0b1b2) in HE-SIG A                                          |  |
| * 000: 20MHz                                                                            |  |
| * 001: 40MHz                                                                            |  |
| * 010: 80MHz (preamble fully populated on all 4 channels and OFDMA uses 80MHz design)   |  |
| * 011: 160MHz (preamble fully populated on all 8 channels and OFDMA uses 160MHz design) |  |
| * 100: 80MHz channel bonding with preamble on P40                                       |  |
| * 101: 80MHz channel bonding with preamble on P20 (no preamble on S20)                  |  |
| * 110: 160MHz channel bonding with preamble on P40                                      |  |
| * 111: 160MHz channel bonding with preamble on P20 (no preamble on S20) }               |  |

If both S40 channels punctured, a contiguous 40 MHz PPDU may be signaled

If both S40 channels are used for the transmission, a contiguous 80 MHz PPDU may be signaled

BW field indicates non-contiguous 80 MHz PPDU

SAMSUNG-1018, Table 22 (annotated)

If both S40 channels punctured, a contiguous 40 MHz PPDU may be signaled

If both S40 channels are used for the transmission, a contiguous 80 MHz PPDU may be signaled

| Kim's 3-bit BW index     | P20  | S20  | S40A (U-20) | S40B (L-20) | S80  |      |      |      | PPDU Bandwidth |
|--------------------------|------|------|-------------|-------------|------|------|------|------|----------------|
| 000                      | Used |      |             |             |      |      |      |      | 20 MHz         |
| 001                      | Used | Used |             |             |      |      |      |      | 40 MHz         |
| 010                      | Used | Used | Used        | Used        |      |      |      |      | 80 MHz         |
| 011                      | Used | Used | Used        | Used        | Used | Used | Used | Used | 160 MHz        |
| 100                      | Used | Used |             |             |      |      |      |      | 80 MHz         |
| 101                      | Used | Punc |             |             |      |      |      |      | 80 MHz         |
| 110                      | Used | Used |             |             |      |      |      |      | 160 MHz        |
| 111                      | Used | Punc |             |             |      |      |      |      | 160 MHz        |
| HE-SIG-B Content Channel | 1    | 2    | 1           | 2           | 1    | 2    | 1    | 2    |                |

BW field indicates non-contiguous 80 MHz PPDU (per Kim); resource allocation field indicates which of S40A or S40B is punctured (per Bharadwaj-Li)

### SAMSUNG-1003, [268]

In this case, the resource unit allocation field would indicate which 20MHz channel in the S40 is punctured (S40A or S40B), per Bharadwaj-Li. SAMSUNG-1003, [269]; SAMSUNG-1021, [0141]-[0142].

For example, if S40A is punctured, the resource unit allocation field in HE-SIG-B content channel 1 would include a special RU allocation bit sequence indicating that S40A is punctured. SAMSUNG-1003, [270]; SAMSUNG-1021, [0141]-[0142]. Similarly, if S40B is punctured, the resource unit allocation field in HE-SIG-B content channel 2 would include a special RU allocation bit sequence indicating that S40B is punctured. *Id.*

During prosecution of the '281 patent, the examiner considered claim 13 to be satisfied if one of the two indications of puncturing information was shown.

SAMSUNG-1002, 65-66. Applicant did not dispute the examiner's interpretation of claim 13. *Id.*, 43-51.

Bharadwaj-Li-Kim renders obvious [6] for similar reasons. SAMSUNG-1003, [272].

**F. [Ground 2D] – Bharadwaj-Li-Kim in view of Chen**

**1. Claims 6 and 13**

Bharadwaj-Li-Kim-Chen renders obvious [6] and [13] for the reasons discussed for Bharadwaj-Li-Kim in Ground 2C. §III.E; SAMSUNG-1003, [274]. For similar reasons as discussed in Ground 2B, Bharadwaj-Li-Kim-Chen further renders obvious [6] and [13] based on Chen. §III.F; SAMSUNG-1003, [274].

**IV. INSTITUTION SHOULD NOT BE DENIED ON DISCRETION**

Petitioner believes that discretionary denial is unwarranted, and yet, Petitioner intends to utilize the bifurcated briefing process contemplated by the March 26, 2025 Stewart Memorandum to rebut contentions if offered by Patent Owner to the contrary. *See* SAMSUNG-1049; SAMSUNG-1050; Video at <https://uspto.cosocloud.com/p9xpz6s4jn75/>; SAMSUNG-1051.

**V. CONCLUSION AND FEES**

The Challenged Claims are unpatentable. Petitioner authorizes charge of fees to Deposit Account 06-1050.

**VI. MANDATORY NOTICES UNDER 37 C.F.R. § 42.8(a)(1)**

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

Samsung Electronics Co., Ltd. and Samsung Electronics America, Inc.

(collectively, “Samsung”) are the real parties-in-interest.

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

The '281 Patent is the subject of civil action *Wilus Institute of Standards and Technology Inc., v. Samsung Electronics Co., Ltd., et al.*, 2-24-cv-00746 (EDTX) filed September 11, 2024; and *Wilus Institute of Standards and Technology Inc. v. HP Inc.*, 2-24-cv-00752 (EDTX) filed September 13, 2024. Petitioner is not aware of any disclaimers, reexamination certificates, or IPR petitions addressing the '281 patent.

**C. Lead And Back-Up Counsel Under 37 C.F.R. § 42.8(b)(3)**

Petitioner provides the following designation of counsel.

| Lead Counsel                                                                                                                                                                                                                                     | Backup counsel                                                                                                                                                                                                                                        |
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**D. Service Information**

Please address all correspondence and service to the address listed above.

Petitioner consents to electronic service by email at [IPR39843-0200IP1@fr.com](mailto:IPR39843-0200IP1@fr.com)

(referencing No. 39843-0200IP1 and cc'ing PTABInbound@fr.com).

Respectfully submitted,

Dated May 20, 2025

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**CERTIFICATION UNDER 37 CFR § 42.24**

Under the provisions of 37 CFR § 42.24(d), the undersigned hereby certifies that the word count for the foregoing Petition for Inter Partes Review totals 13,933 words, which is less than the 14,000 allowed under 37 CFR § 42.24.

Dated May 20, 2025

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**CERTIFICATE OF SERVICE**

Pursuant to 37 CFR §§ 42.6(e)(4)(i) et seq. and 42.105(b), the undersigned certifies that on May 20, 2025, a complete and entire copy of this Petition for Inter Partes Review and all supporting exhibits were provided by Express Mail, to the Patent Owner, by serving the correspondence address of record as follows:

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