IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of:	Juhyung Son, et al.	Attorney Docket No. 39843-0195IP1
U.S. Patent No.:	11,159,210	
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Title:	WIRELESS COMMUNICATION METHOD AND WIRELESS COMMUNICATION TERMINAL FOR SIGNALING MULTI-USER PACKET	

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PETITION FOR *INTER PARTES* REVIEW OF UNITED STATES PATENT NO. 11,159,210 PURSUANT TO 35 U.S.C. §§ 311–319, 37 C.F.R. § 42

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SAMSUNG-1005	IEEE P802.11ax/D0.5 Draft Standard for Information technology– Telecommunications and information exchange between systems Local and metropolitan area networks– Specific requirements. Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications. Amendment 6: Enhancements for High Efficiency WLAN (September 2016) ("802.11ax_D0.5")
SAMSUNG-1006	IEEE P802.11ax/D0.4 Draft Standard for Information technology– Telecommunications and information exchange between systems Local and metropolitan area networks– Specific requirements. Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications. Amendment 6: Enhancements for High Efficiency WLAN (August 2016) ("802.11ax_D0.4")
SAMSUNG-1007	IEEE P802.11ax/D0.3 Draft Standard for Information technology– Telecommunications and information exchange between systems Local and metropolitan area networks– Specific requirements. Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications. Amendment 6: Enhancements for High Efficiency WLAN (August 2016) ("802.11ax_D0.3")

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SAMSUNG-1009	IEEE P802.11ax/D0.1 Draft Standard for Information technology– Telecommunications and information exchange between systems Local and metropolitan area networks– Specific requirements. Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications. Amendment 6: Enhancements for high efficiency in frequency bands between 1GHz and 6 GHz (March 2016) ("802.11ax_D0.1")
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LISTING OF CHALLENGED CLAIMS

Claim 1	
[1pre]	A wireless communication terminal, the terminal comprising:
[1.1]	a communication unit; and
[1.2]	a processor configured to process signals transmitted and received through the communication unit, wherein the processor is configured to:
[1.3]	receive, through the communication unit, a high efficiency multi-user PHY protocol data unit (HE MU PPDU), wherein a preamble of the HE MU PPDU includes high efficiency signal A field (HE-SIG-A) and high efficiency signal B field (HE-SIG-B), and
[1.4]	decode the received HE MU PPDU based on information obtained from the preamble,
[1.5]	wherein when a SIG-B compression field of the HE-SIG-A indicates full bandwidth multi User-Multiple Input Multiple Output (MU-MIMO) transmission, a format of user field(s) included in a user specific field of the HE-SIG-B is identified based on a number of MU-MIMO users indicated by a subfield of the HE-SIG-A,
[1.6]	wherein when the number of MU-MIMO users indicates two or more users, the user specific field of the HE-SIG-B includes user fields for MU-MIMO allocation, and
[1.7]	wherein when the number of MU-MIMO users indicates a single user, the user specific field of the HE-SIG-B includes one user field for non-MU-MIMO allocation.
Claim 2	
[2pre]	The wireless communication terminal of claim 1,
[2.1]	wherein the user field(s) for MU-MIMO allocation includes a spatial configuration field indicating the total number of spatial streams in an MU-MIMO allocation and the number of spatial streams for each terminal in the MU-MIMO allocation, and
[2.2]	wherein the user field for non-MU-MIMO allocation includes a number of space time streams (NSTS) field.

Claim 3	
[3]	The wireless communication terminal of claim 1, wherein the user field(s) for non-MU-MIMO allocation is a user field based on orthogonal frequency division multiple access (OFDMA) allocation.
Claim 4	
[4]	The wireless communication terminal of claim 1, wherein the number of MU-MIMO users is indicated by a number of HE-SIG-B symbols field in the HE-SIG-A.
Claim 5	
[5]	The wireless communication terminal of claim 1, wherein the HE-SIG-A includes the SIG-B compression field and the specific subfield, and wherein the SIG-B compression field indicates whether full bandwidth MU-MIMO transmission is used, and when the SIG-B compression field indicates full bandwidth MU-MIMO transmission, the specific subfield indicates the number of MU-MIMO users.
Claim 6	
[6pre]	A wireless communication method of a wireless communication terminal, the method comprising:
[6.1]	receiving a high efficiency multi-user PHY protocol data unit (HE MU PPDU), wherein a preamble of the HE MU PPDU includes high efficiency signal A field (HE-SIG-A) and high efficiency signal B field (HE-SIG-B); and
[6.2]	decode the received HE MU PPDU based on information obtained from the preamble,
[6.3]	wherein when a SIG-B compression field of the HE-SIG-A indicates full bandwidth multi User-Multiple Input Multiple Output (MU-MIMO) transmission, a format of user field(s) included in a user specific field of the HE-SIG-B is identified based on a number of MU-MIMO users indicated by a subfield of the HE-SIG-A,
[6.4]	wherein when the number of MU-MIMO users indicates two or more users, the user specific field of the HE-SIG-B includes user fields for MU-MIMO allocation, and
[6.5]	wherein when the number of MU-MIMO users indicates a single user, the user specific field of the HE-SIG-B includes one user field for non-MU-MIMO allocation.

Claim 7	
[7pre]	The wireless communication method of claim 6,
[7.1]	wherein the user field(s) for MU-MIMO allocation includes a spatial configuration field indicating the total number of spatial streams in an MU-MIMO allocation and the number of spatial streams for each terminal in the MU-MIMO allocation, and
[7.2]	wherein the user field for non-MU-MIMO allocation includes a number of space time streams (NSTS) field.
Claim 8	
[8]	The wireless communication method of claim 6, wherein the user field(s) for non-MU-MIMO allocation is a user field based on orthogonal frequency division multiple access (OFDMA) allocation.
Claim 9	
[9]	The wireless communication method of claim 6, wherein the number of MU-MIMO users is indicated by a number of HE-SIG-B symbols field in the HE-SIG-A.

Samsung Electronics Co., Ltd. ("Petitioner" or "Samsung") petitions for *Inter Partes* Review ("IPR") of claims 1-9 ("the Challenged Claims") of U.S. Patent No. 11,159,210 ("the '210 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 '210 Patent is available for IPR. This Petition is being filed within one year of service of a complaint against Samsung. *See* SAMSUNG-1024. 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 noted below. Grounds 1A-2 are supported by the expert declaration of Dr. Christopher Hansen. SAMSUNG-1003, ¶¶24-28.

Ground	Claim(s)	35 U.S.C. § 103 Basis
1A	6-9	§103: 802.11ax_D1.0
1B	1-5	§103: 802.11ax_D1.0 + Bharadwaj
2	1-9	§103: Bharadwaj + Sun

As shown in the table below, all references presented in this Petition pre-

date January 9, 2017 (the alleged "Critical Date") and, thus, constitute prior art.

Reference	Filing Date	Publication Date
801.11ax_D1.0	N/A	12/01/2016
Bharadwaj	12/21/2016	06/22/2017
Sun	01/08/2016	07/14/2016

802.11ax_D1.0 was publicly available at least as early as December 1, 2016, and is prior art at least under 35 U.S.C. § 102(a)(1). SAMSUNG-1026, ¶¶59-63; *Infra*, §II.A.6.

Bharadwaj is prior art at least as of its filing date under 35 U.S.C. § 102(a)(2). Sun is prior art under 35 U.S.C. § 102(a)(1)-(2).

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 offered by Patent Owner or adopted by the Board. Petitioner is not conceding that each challenged claim satisfies all statutory requirements, nor is Petitioner 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 3 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. SAMSUNG-1003, ¶¶29-31. Increased educational experience can make up for less work experience, and vice versa. *Id*.

II. BACKGROUND OF THE TECHNOLOGY

Wi-Fi technology employs protocols defined by the IEEE 802.11 family of standards. SAMSUNG-1003, ¶¶55-64. These standards describe the signaling necessary for data transmission between devices that are produced by different vendors. *Id*. The original 802.11 standard was published in 1997, but the standard has been updated multiple times through amendments and maintenance by the IEEE 802.11 working group to add or refine functionality. For example, in 2016, the IEEE working group began developing a new framework for the 802.11 standard to add functionality for supporting high-efficiency (HE) multi-user (MU) multiple-input multiple-output (MIMO) (HE MU-MIMO).[1] *E.g.*, SAMSUNG-

[1] A list of acronym definitions is provided in Dr. Hansen's Declaration.

1010. MIMO refers to a communication method that increases data throughput by multiplying the capacity of a radio link by way of utilizing multiple transmission and receiving antennas, and resulting in more than one data signal sent simultaneously over the same radio channel. *E.g.*, SAMSUNG-1027, ¶¶[0014], [0019]-[0020]; SAMSUNG-1003, ¶¶55-64.

The primary mechanism for driving higher efficiency was the use of simultaneous transmissions on one or both of the downlink and the uplink.[2] Simultaneous transmission requires partitioning the radio channel by frequency into sub-channels, called resource units (RUs), or by spatial streams using MIMO, such as single-user (SU)-MIMO or MU-MIMO. MU-MIMO takes advantage of the fact that modern Wi-Fi APs use multiple antennas to transmit to one or more stations at the same time. Multiple antennas facilitate multiple simultaneous transmission paths called spatial streams. With MU-MIMO, the access point can partition its spatial streams among multiple client devices. SAMSUNG-1003, ¶¶55-64.

SAMSUNG-1003, §VII.A.

[2] The downlink (or DL) refers to the communication path from the access point (AP) to the station (STA or client device); the uplink (or UL) refers to the communication path from the station to the AP.

Early versions of MU-MIMO used the entire channel bandwidth—this configuration is often referred to as full bandwidth MU-MIMO. *E.g.*, 802.11ac-2013, §22.3.11; SAMSUNG-1003, ¶¶55-64. Developments to the 802.11 standard that began in 2016 enhanced MU-MIMO to allow its use on either the full bandwidth or by allocating RUs to different stations. *E.g.*, SAMSUNG-1009, 172; SAMSUNG-1003, ¶¶55-64. To facilitate this enhancement, updates to the standard also introduced new signaling techniques that are incorporated into each packet preamble. SAMSUNG-1004, 298, 312; SAMSUNG-1003, ¶¶55-64.

IEEE 802.11 uses the term physical layer (PHY) protocol data unit (PPDU) to describe the packet that is transmitted from one station to another. The High Efficiency (HE) Multi-user (MU) PPDU is typically used by an AP to send data to multiple client stations simultaneously, but may also be used to send data to one client. *E.g.*, 802.11_D1.0, 239; SAMSUNG-1003, ¶¶55-64.

PPDUs include a preamble and a payload. Fields in the PPDU preamble are used by a receiver for synchronization, wireless channel estimation, and determination of the type and format of the PPDU. The receiver uses this information to demodulate and decode the portions of the PPDU for which it is the intended recipient. The preamble of the HE MU PPDU consists of signaling fields

HE-SIG-A and HE-SIG-B.[3] *See, e.g.*, SAMSUNG-1004, 298, 312 (The "HE-SIG-A field carries information required to interpret HE PPDUs"; and the HE-SIG-B includes one or more User Block fields for one or two stations to "decode their payloads"); SAMSUNG-1003, ¶¶55-64

The HE-SIG-A field carries information including the PPDU bandwidth (20, 40, 80, or 160 MHz), BSS Color (an identifier for the particular Basic Service Set, which is a collection of wireless devices that are able to communicate with each other within the network, or cell where the transmitter is located), and TXOP duration (a measure of the time the wireless channel will be in use). *E.g.*, SAMSUNG-1004, §28.3.10.7; SAMSUNG-1003, ¶¶55-64. The HE-SIG-B field is only used in an HE MU PPDU and signals the general layout of the channel in terms of number and type of RUs as well as the assignment of RUs and spatial streams to individual users. SAMSUNG-1004, 267, 278; SAMSUNG-1003, ¶¶55-64.

The HE-SIG-B can contain multiple parts, including a Common field and a User Specific field. If present in the HE-SIG-B, the Common field is used to indicate the arrangement of RUs for the PPDU. For example, a 20 MHz HE MU PPDU can be divided into 2 to 9 smaller RUs with different combinations of sizes.

[3] HE-SIG-B is also referred to as the content channel.

The transmitter signals the particular format with an allocation value that corresponds to Table 27-25 in IEEE 802.11ax.

For Full Bandwidth mode of operation, the common field is not needed since there is no arrangement of smaller RUs. SAMSUNG-1003, ¶¶55-64. In this case, the HE-SIG-B only contains the User Specific field. Full Bandwidth is signaled using the "HE-SIG-B Compression bit" being set to 1 in the HE-SIG-A field, and when Full Bandwidth is indicated, the common field is not included in the HE-SIG-B. 802.11_D1.0, 264, When operating in Full Bandwidth MU-MIMO mode, an entire channel is employed for transmission to multiple devices using different allocations of spatial streams. SAMSUNG-1003, ¶¶55-64.

The HE-SIG-B always contains a User Specific field, which consists of one or more User Block fields. A User Block field can include one or more user fields that contains detailed information for one particular station. SAMSUNG-1004, 312. This includes addressing information (STA-ID), MCS (modulation and coding set) information, and details of the user's spatial allocation. *Id*., 312, 320-324. The number of User Block fields is determined by the number of stations indicated. *Id*., 312; SAMSUNG-1003, ¶¶55-64.

A. 802.11ax_D1.0

In January 2016, the 802.11ax Task Group (TGax) opened the framework for the development of the 802.11ax standard, which was an amendment to the

previous version of the wireless networking standard. SAMSUNG-1010, *passim*. Through October 2016, TGax received contributions from voting members, conducted meetings to discuss proposed amendments, and published iterations of the 802.11ax drafts. Every two months, the task group would release a working draft of the new amendment (these are 802.11ax_D0.1 through 802.11ax_D0.5). *E.g.*, SAMSUNG-1009-SAMSUNG-1005; SAMSUNG-1003, ¶¶65-79. The various iterations and updates thereto culminated in the 802.11ax_D1.0 version, which is the first draft that the TGax considered to be ready for voting on by the larger working group. 802.11ax_D1.0 was publicly available at least as early as December 1, 2016, and was released to the 802.11 working group for its first letter ballot. SAMSUNG-1026, ¶¶59-63. The timeline of the dates of the documents I discuss below are as follows:

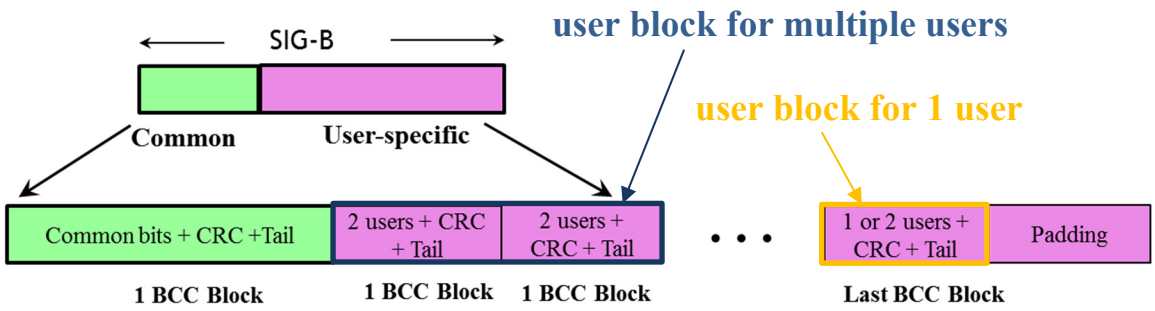
Document	Date
Robert Stacey, Specification Framework for TGax, IEEE 802.11-15/0132r15, SAMSUNG-1010	January 2016
802.11ax_D0.1, SAMSUNG-1009	March 2016
802.11ax_D0.2, SAMSUNG-1008	June 2016
802.11ax_D0.3, SAMSUNG-1007	August 15, 2016
802.11ax_D0.4, SAMSUNG-1006	August 30, 2016
802.11ax_D0.5, SAMSUNG-1005	October 2016
802.11ax_D1.0, SAMSUNG-1004	December 1, 2016

SAMSUNG-1026, ¶¶24, 59-63; SAMSUNG-1003, ¶¶65-79. The letter ballot process is used to correct errors and improve the overall quality of the draft amendment. Each working group member is expected to read the draft and vote "yes" or "no" on whether the draft is ready to move forward to the next stage of approval. If a person votes no, he or she is required to make one or more letter ballot comments on the particular portions of the draft that need to be changed. The letter ballot comments are collected together and the task group reviews them and develops solutions. Once, every comment is addressed, the editor produces a new draft. This process is repeated over several cycles until the number of "no" votes is very small and the task group agrees that no further changes to the draft are needed. SAMSUNG-1003, ¶¶65-79; SAMSUNG-1026, ¶¶17-36, 56-63.

1. The Specification Framework

The Specification Framework for TGax ("the Framework") was a reference document maintained by the 802.11ax editor to keep track of 802.11ax task group motions and their corresponding technical contributions. The Framework helped both the editor and the entire task group keep track of the features that would be incorporated into the 802.11ax drafts. SAMSUNG-1003, ¶¶65-79. The Framework included many of the features claimed by the Challenged Claims. For example, the Framework introduced the HE MU PPDU format, and HE-SIG-A and HE-SIG-B fields (SAMSUNG-1010, 3, 7-17). Also, the Framework discloses how

the HE-SIG-B user blocks can support one or more stations, as shown in Figure 5 below:



SAMSUNG-1010, Figure 5 (annotated)

The Framework describes the common field that includes Resource Unit (RU) allocation. The Framework also describes the user specific field, which contains the per user dedicated information, "where **one** or multiple of those **sub-field**s are for each designated receiving STA." SAMSUNG-1010, 12-13 (emphasis added).

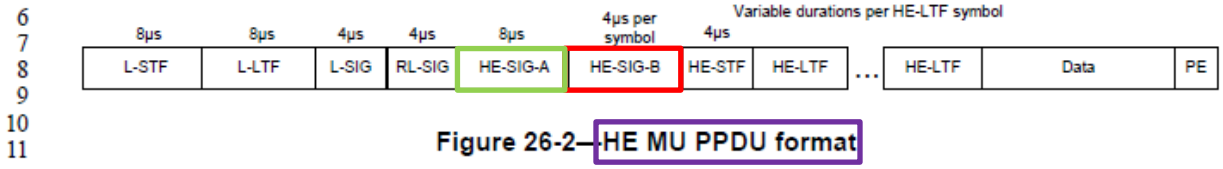
The Framework also included the HE-SIG-A SIGB Compression Mode field to indicate full BW MU-MIMO. SAMSUNG-1010, Table 2. When SIGB compression mode is enabled, the number of symbols are re-purposed to indicate the number of MU-MIMO users. *Id.*; SAMSUNG-1003, ¶¶65-79.

And, importantly, the Framework described the two different HE-SIG-B user field formats for SU allocation versus MU allocations. SAMSUNG-1010, 13-15. Specifically, the Framework describes that the HE-SIG-B user specific field format for SU allocations includes the number of spatial streams (NSTS) field and

transmit beamforming (TxBF) field; and the HE-SIG-B user specific field format for MU allocation includes spatial configuration fields (SCF). SAMSUNG-1010, 13-15. Likewise, the Framework describes the Spatial Configuration subfield encoding. SAMSUNG-1010, Table 5; SAMSUNG-1003, ¶¶65-79.

2. 802.11ax_D0.1

The draft 802.11ax_D0.1, dated March 2016, included the **HE MU PPDU** format for supporting MU-MIMO that included the **HE-SIG-A** and **HE-SIG-B** fields. SAMSUNG-1009, 92-93. The **HE MU PPDU** with **HE-SIG-B** field is shown below:



SAMSUNG-1009, Figure 26-2 (annotated)

SAMSUNG-1003, ¶¶65-79. Note that 802.11ax_D0.1 describes that the "**HE-SIG-B** field is present only in the **HE MU PPDU**." SAMSUNG-1009, 93. Thus, discussions of the HE-SIG-B field, and any subfield, fall in the context of **HE MU PPDU**s, including the fields for supporting SU allocations. SAMSUNG-1003, ¶¶65-79.

802.11ax_D0.1 described that the Common Block field contains information regarding the resource unit allocation such as the RU arrangement in frequency domain, the RUs allocated for MU-MIMO and the number of users in MU-MIMO

allocations. SAMSUNG-1009, 129, 132. 802.11ax_D0.1 also describes the HE-SIG-B to consist of "multiple User Block fields." *Id*., 129. "Each User Block field contains information for two STAs to decode their payloads." *Id*. As described in 802.11ax_D0.1, the "contents of the user field differ based on whether the field **addresses a single-STA** … **or a STA in a MU-MIMO allocation**." *Id*., 135 (emphasis added); *see also*, SAMSUNG-1030 & SAMSUNG-1032 for contribution document. Some of these differences are shown in Tables 26-19 and 26-20, reproduced below:

Table 26-19—Fields of the HE-SIG-B user field for a SU allocation

Bit	Field	Number of bits	Description
TBD	STA-ID	11	The STA identifier that addresses a STA – reference to MAC section(?). For RUs that carry a broadcast allocation: For single BSS AP, the STAID for Broadcast will be 0; For Multiple BSS AP, the STAID for Broadcast to a specific BSS will follow the group addressed AID assignment in the TIM according to the existing Multi-BSSID TIM operation; For Multiple BSS AP, the STAID for Broadcast to all BSS of the AP will have a special STAID value reserved.
TBD	NSTS	3	Number of spatial streams
TBD	Tx Beam-forming	1	Use of transmit beamforming
TBD	MCS	4	Modulation and Coding Scheme
TBD	DCM	1	Indication for use of dual carrier modulation
TBD	Coding	1	Indication for use of LDPC

Table 26-20—Fields of the HE-SIG-B user field for a MU-MIMO allocation

Bit	Field	Number of bits	Description
TBD	STA-ID	11	The STA identifier that addresses an STA – reference to MAC section(?)
TBD	Spatial Con-figuration	4	Indication for the number of spatial streams for a STA in a MU-MIMO allocation. See Table 26-21 (Spatial Configuration subfield encoding).
TBD	MCS	4	Modulation and Coding Scheme
TBD	DCM	1	Use of dual carrier modulation
TBD	Coding	1	Use of LDPC

SAMSUNG-1009, Tables 26-19 & 26-20 (annotated)

SAMSUNG-1003, ¶¶65-79. Table 26-19 included the **Number of Spatial Streams (NSTS) field**, whereas Table 26-20 included the **Spatial Configuration Field (SCF)**. *Id*. Thus, as early as March 2016, the 802.11 draft already contemplated 1) using the MU-MIMO PPDU for the single-STA (SU or non-MU-MIMO) use-case and 2) that the format for the user field in the HE-SIG-B was different for the single-STA use-case (SU or non-MU-MIMO) versus the MU-MIMO use-case. SAMSUNG-1003, ¶¶65-79. Note that the use of the term "SU"

in Table 26-19 is understood to imply the non-MU-MIMO allocation when the number of users is 1 because the table represents the format of the user field of a HE-SIG-B, which is only in a HE MU PPDU. *E.g.*, SAMSUNG-1009, 93; SAMSUNG-1003, ¶¶65-79.

Likewise, the 802.11ax_D0.1 draft described using the SIG-B (or SIGB) compression field in HE-SIG-A to indicate that there would be no need for RU signaling in the common field of the HE-SIG-B. SAMSUNG-1009, 173. Instead, when the SIGB compression field was set to 1, the "number of STAs in the MU-MIMO group is indicated" in a field "in HE-SIG-A." *Id.*; SAMSUNG-1003, ¶¶65-79.

3. 802.11ax_D0.2

802.11ax_D0.2 clarified that the SIGB compression field in HE-SIG-A being set to 1 indicates full bandwidth, and in that case, the HE-SIG-B did not include a common field. SAMSUNG-1008, 177; *see also* SAMSUNG-1031 for contribution document. 802.11ax_D0.2 also expressly clarified that the number of STAs in the MU-MIMO group is indicated in the Number Of HE-SIG-B Symbols Or MU-MIMO Users field in HE-SIG-A. SAMSUNG-1008, 177 (*cf.* SAMSUNG-1010, Table 5); *see also* SAMSUNG-1033 & SAMSUNG-1034 for contribution document. Table 26-16—**HE-SIG-A** field of an **HE MU PPDU** included the SIGB Compression field for indicating full bandwidth and a field for indicating the

number of MU-MIMO users when operating in full bandwidth:

Table 26-16—Fields in the HE-SIG-A for an HE MU PPDU

Two Parts of HE-SIG-A	Bit	Field	Number of bits	Description
			...	
	TBD	Number Of HE-SIG-B Symbols Or MU-MIMO Users	4	If the SIGB Compression field is 0, indicates the number of OFDM symbols in the HE-SIG-B field minus 1.(#821) If the SIGB Compression field is 1, indicates the number of MU-MIMO users.(#296)
	TBD	SIGB Compression	1	Set to 1 for full BW MU-MIMO. Set to 0 otherwise.

SAMSUNG-1008, Table 26-16 (annotated).

SAMSUNG-1003, ¶¶65-79. In addition, Table 26-19 was clarified to refer to non-MU-MIMO, linking the SU scenario to the term "non-MU-MIMO." SAMSUNG-1008, 138. SAMSUNG-1003, ¶¶65-79.

4. 802.11ax_D0.3 & 802.11ax_D0.4

802.11ax_D0.3 clarified that the HE-SIG-B field consisted of "one or more" User Block fields, indicating updated support for the single STA use case. SAMSUNG-1007, 177; *see also* SAMSUNG-1036 for contribution document. 802.11ax_D0.4 did not add anything pertinent to the challenged claims. SAMSUNG-1003, ¶¶65-79.

5. 802.11ax_D0.5

By the time 802.11ax_D0.5 was released, the draft standard amendment included the following:

- the **HE MU PPDU** including the **HE-SIG-B** structure to include one or more User Blocks. SAMSUNG-1005, 215, 254;
- the description and bitmapping in **HE-SIG-A** for SIGB compression set to 1 to indicate full bandwidth. *Id*., 212-213, Table 26-17;
- the description and bitmapping in **HE-SIG-A** for the Number of MU-MIMO Users indicated when in full bandwidth, which was mapped to the same field as the Number of HE-SIG-B Symbols. *Id*., Table 26-17;
- the common field being absent from the **HE-SIG-B** structure when in full bandwidth, meaning that in full bandwidth, no RU allocation signal was included in the **HE-SIG-B**. *Id*., 212-213, 254; and
- the formats for the user fields of the **HE-SIG-B** are identified based on the number of MU-MIMO users, where the **non-MU-MIMO** format includes **NSTS**, while the format for **MU-MIMO** includes the **SCF**. *Id*., 262-266, Tables 26-22–26-24.

SAMSUNG-1003, ¶¶65-79. 802.11ax_D1.0 describes all of the features of the HE MU-PPDU described above, and included other refinements that placed the draft in a condition for consideration by the working group in a letter ballot. 802.11ax_D1.0 renders the Challenged Claims unpatentable as obvious. SAMSUNG-1003, ¶¶65-79.

6. Public Availability of 802.11ax_D1.0

Compelling evidence shows that 802.11ax_D1.0 published at least as early as December 1, 2016—i.e., more than a month before the alleged Critical Date of the '210 Patent (Jan. 9, 2017). *See* SAMSUNG-1026, ¶¶17-78. As Dr. Hansen explains in detail, 802.11ax_D1.0 was developed by the IEEE 802.11ax Task Group (TGax), and was the culmination of work on a series of earlier draft amendments to the 802.11 wireless standard. SAMSUNG-1026, ¶¶25, 57. TGax created and submitted 802.11ax_D1.0 to letter balloting for consideration and approval by the broader IEEE 802.11 Working Group, and 802.11ax_D1.0 was officially released on December 1, 2016, when it was made available online to members of the IEEE 802.11 Working Group, who were notified by email of the same. *Id.*, ¶24, 56-63. Interested members of the public would have gained access to 802.11ax_D1.0 either by following IEEE's straightforward procedures for joining the ranks of voting members of the IEEE 802.11 Working Group by the Critical Date of the '210 Patent, or simply by obtaining a copy of 802.11ax_D1.0 from a voting member (or an intermediary who obtained a copy from a voting member). *Id.*, ¶¶64-77. IEEE invited any interested member of the public to be involved in development of the 802.11 standard, and any such interested individual could become a voting a member, thereby obtaining direct access to drafts such as 802.11ax_D1.0, merely by attending three public IEEE standards meetings, which

occurred every two months leading up to the Critical Date. *Id.*, ¶¶64-70. Indeed, ~600 IEEE 802 Working Group members would have received notice of and access to 802.11ax_D1.0, immediately upon its posting on December 1, 2016. *Id.*

Moreover, voting members of the IEEE 802.11 Working Group commonly shared standard amendment drafts with non-voting members, as well as individuals who did not attend 802.11 Working Group or task group meetings at all. SAMSUNG-1026, ¶¶71-77. According to Dr. Hansen, who has decades of experience participating in the activities of the IEEE Standards Association ("IEEE-SA"), it was common for voting members to share draft standards with academic colleagues or industry engineers who were not voting members, nor even IEEE members at all. *Id.*, ¶¶71-77. For example, beyond the ~600 IEEE 802 Working Group members who would have had direct access to 802.11ax_D1.0 on the IEEE's website when it was posted on December 1, 2016, the document would have been freely distributed to many more interested members of the public by the Critical Date. *Id.*, ¶73. There simply was no expectation of confidentiality with respect to 802.11ax_D1.0. *Id.* Moreover, there was a clear motivation for broadly distributing draft standard amendments like 802.11ax_D1.0 in that Wi-Fi standardization impacts a broad range of stakeholders (manufacturers, researchers, inventors, etc.) that may not be able to actively participate in the standardization process. *Id.*. The standardization process is meant to be open and collaborative,

and the goals of Wi-Fi standardization are (1) to create a high-quality technical specification and (2) garner support for the standard from key stakeholders. These goals are most effectively achieved by soliciting input from stakeholders that are unable to actively participate in the standardization process, and members facilitated this process by sharing draft amendments with broader audiences of the interested public beyond those who could directly participate in the standards meetings. This understanding is reflected in the IEEE-SA's policy toward sharing drafts with non-voting members. *Id.* For at least these reasons, and as described in further detail by Dr. Hansen, 802.11ax_D1.0 was publicly accessible and qualified as a printed publication at least as early as December 1, 2016. *Id.*; *see also id.*, 1-55.

B. Bharadwaj

Bharadwaj describes preamble designs for HE MU PPDUs for supporting MU-MIMO operations. *E.g.*, SAMSUNG-1013, ¶[0065]. Bharadwaj describes stations (STAs 110) and access points (APs 105), shown in FIG. 1, for communicating according to the 802.11 (e.g., 802.11ax) baseband protocol including physical (PHY) and medium access control (MAC) layers. *Id.*, ¶[0064]. FIG. 1, depicting an HE-WLAN, is reproduced below:

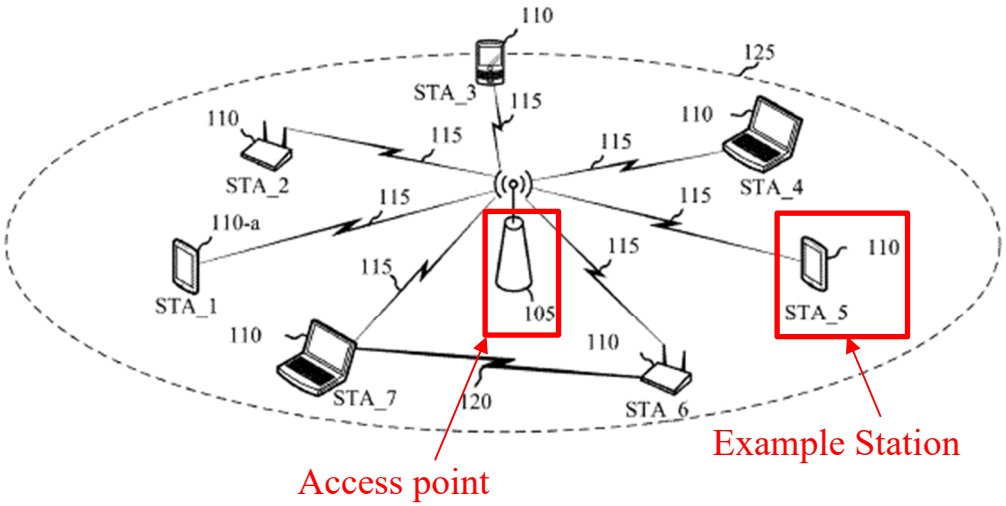


FIG. 1

100

SAMSUNG-1013, FIG. 1 (annotated)

SAMSUNG-1003, ¶¶80-83.

The AP 105 can support MU-MIMO and can transmit to multiple stations 110 simultaneously, or to one station. *E.g.*, SAMSUNG-1013, ¶[0097]. The stations 110 can be "mobile handsets, tablet computers, personal digital assistants (PDAs), other handheld devices, netbooks, notebook computers, tablet computers, laptops, desktop computers, … etc." *Id.*, ¶[0093]. The stations include a processor, such as a hardware processor, a central processing unit (CPU), micro-controller, or application-specific integrated circuit (ASIC), and a transceiver 1320, to facilitate bi-directional communications. *Id.*, ¶[0150], [0152]. Antenna(s) are communicatively coupled with the transceiver(s). *Id.*, ¶[0149]. "The processor 1305 processes information received through the transceiver(s) …." *Id.*, ¶[0150];

SAMSUNG-1003, ¶¶80-83.

Bharadwaj teaches that high-efficiency wireless local area network (HE-WLAN) preambles "enable an AP to simultaneously transmit to multiple stations (e.g., MU-MIMO)." SAMSUNG-1013, ¶¶[0064], [0069], [0097]. HE-WLAN preambles can include HE WLAN signaling fields, such as HE-SIG-A and HE-SIG-B fields, for providing user fields with user-specific information. *Id*., ¶¶[0093], [0097], [0117], [0125]; SAMSUNG-1003, ¶¶80-83.

For example, the station can decode the HE-SIG-B content channels to distinguish between single-user and MU-MIMO allocations. SAMSUNG-1013, ¶[0128]. In addition, the HE-SIG-A field can be used to indicate compression mode and another field can be used to indicate the number of MU-MIMO users. *E.g*., *id*., ¶[0129], FIG. 18B (Fields in HE-SIG-A for HE MU PPDU), FIGS. 21A-C. In one specific example, a "user field for an MU-MIMO allocation, e.g. in a HE-SIG-B field, may include a spatial configuration subfield …." *Id*., ¶[0093]; SAMSUNG-1003, ¶¶80-83.

C. Sun

Sun describes techniques for generating a physical layer (PHY) data unit for downlink signaling in a wireless network, such as those compliant with 802.11ax. SAMSUNG-1015, ¶¶[0011]-[0012], [0031], Abstract. Sun describes that the PHY data unit includes HE-SIG-A and HE-SIG-B fields and supports MU-MIMO

transmissions. *E.g.*, SAMSUNG-1015, ¶¶[0043], [0049], FIGS. 2-5. Sun describes that the HE-SIG-B structure includes a common portion and one or more user blocks corresponding to one or more users. *E.g.*, SAMSUNG-1015, ¶¶[0072]-[0073], FIGS. 13A-B. The HE-SIG-B structure, including the one or more user blocks, is shown below:

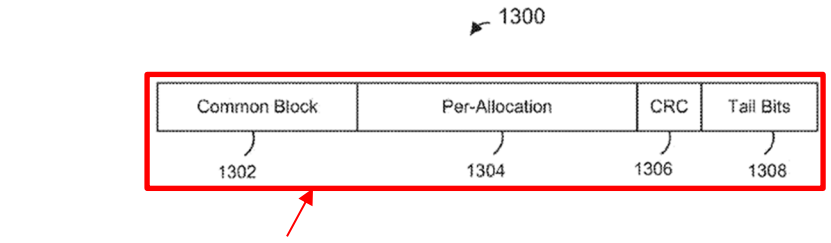


Fig. 13A

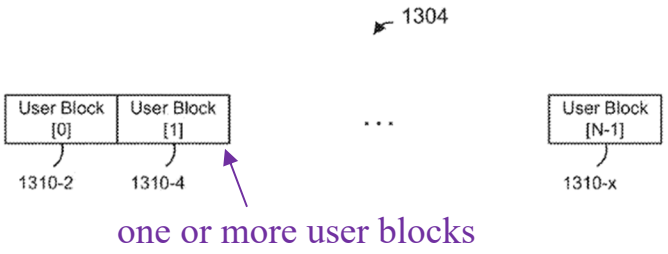


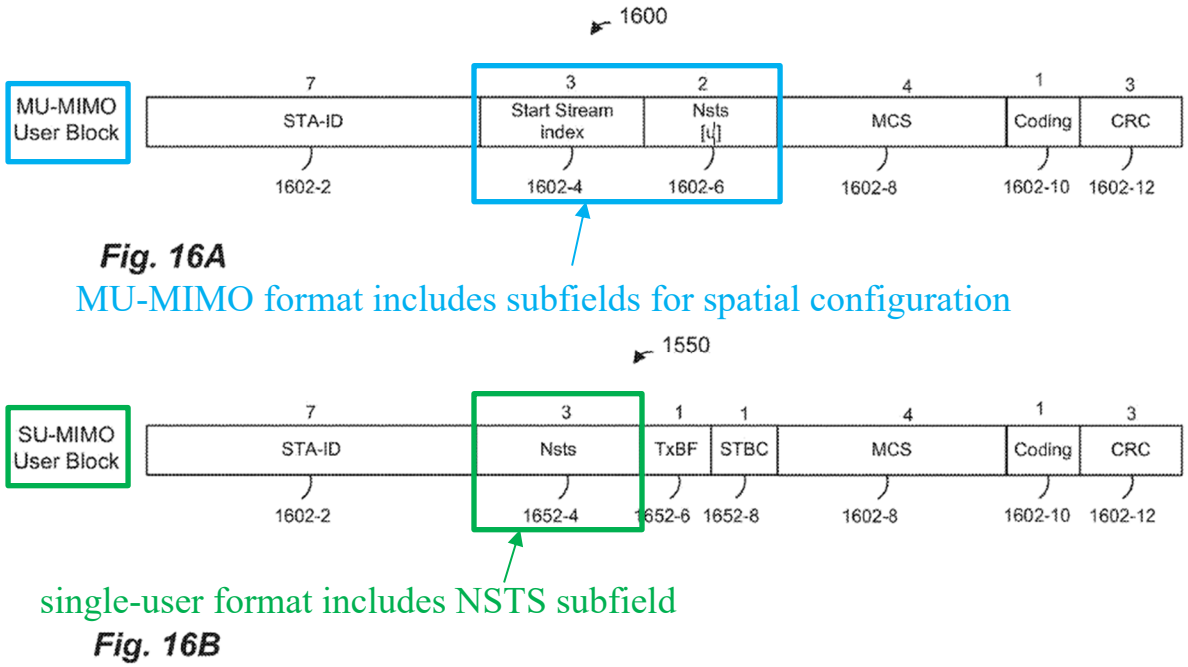
Fig. 13B

SAMSUNG-1015, FIGS. 13A-B (annotated)

SAMSUNG-1003, ¶¶84-87.

Sun provides examples of the user block formats for single-user (SU) and MU-MIMO allocations. SAMSUNG-1015, ¶[0082]-[0087], FIGS. 13A-B, 16A-D. According to Sun, "each of the user blocks 1310 of FIG. 13B corresponds to one of the user blocks 1600, 1650" of FIGS. 16A-B, respectively. SAMSUNG-1015,

¶[0082]. "FIGS. 16A and 16B are block diagrams of user blocks 1600, 1650[4] that correspond to an MU-MIMO resource unit and an SU resource unit, respectively. Sun's MU-MIMO and single-user formats are shown in FIGS. 16A-B, below:



SAMSUNG-1015, FIGS. 16A-B (annotated)

SAMSUNG-1003, ¶¶84-87.

The MU-MIMO format includes subfields for spatial configuration, including "a start stream index 1604-4" and "a number of space time streams corresponding to the user (Nsts[u]) subfield 1602-6." SAMSUNG-1015, ¶[0083].

[4] The text of Sun recites that FIG. 16B shows "the SU user block 1650," SAMSUNG-1015, ¶[0084]. FIG. 16B has a typographical error, mislabeling FIG. 16B as user block 1550.

"The start stream index 1602 includes an indication of a first spatial stream, e.g., of eight possible spatial streams or of four possible spatial streams, allocated to the client station 2 indicated by the STA-ID subfield 1602." *Id*. "The Nsts[u] subfield 1602-6 indicates a number of spatial streams allocated to the client station 25 indicated by the STA-ID subfield 1602." *Id*.; SAMSUNG-1003, ¶¶84-87.

FIG. 16B illustrates an example single-user user block, which differs from the MU-MIMO user block in that "bits used for the start stream index subfield 1602-4 and bits used for the Nsts[u] subfield 1602-6 in the MU-MIMO user block 1600 are used for Nsts subfield 1652-4, a transmit beamforming (TxBF) subfield 1652-6 and space time block coding (STBC) subfield 1652-8." SAMSUNG-1015, ¶[0084]; SAMSUNG-1003, ¶¶84-87.

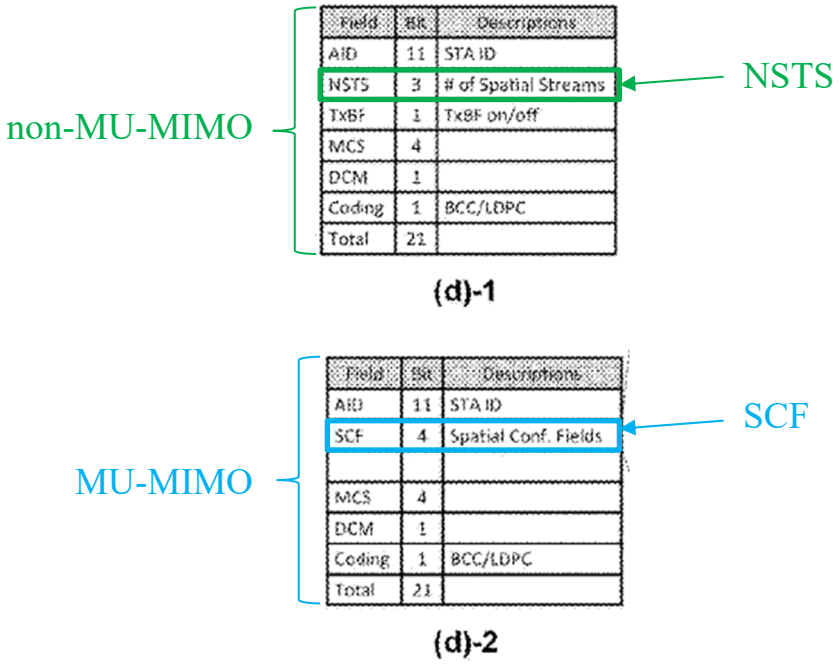
III. THE '210 PATENT

A. The Prior Art Teaches the '210 Patent Claims

Viewed against the backdrop of this prior art, the '210 Patent describes "a wireless communication method and a wireless communication terminal for signaling a multi-user packet" that uses an HE MU PPDU with an HE-SIG-B user field with formats identified based on the number of MU-MIMO users. SAMSUNG-1001, Abstract, cl.1. Much like 802.11ax_D1.0 and Bharadwaj+Sun, claim 1 of the '210 Patent recites identifying the format of user field(s) included in a user specific field of the HE-SIG-B based on the number of MU-MIMO users

indicated by a HE-SIG-A subfield when in full bandwidth. As discussed herein, and as recognized by the examiner during prosecution, this feature was described in 802.11 as early as the 802.11ax_D0.5 draft. *E.g.*, SAMSUNG-1001, cl.1; SAMSUNG-1002, 112; SAMSUNG-1005, §§26.3.3.7.4, 26.3.10.8.1; SAMSUNG-1004, §§28.3.3.8.3, 28.3.10.8.1–28.3.10.8.1.5; SAMSUNG-1013, ¶[0093]; SAMSUNG-1015, ¶¶[0082]-[0084]. The formats described by the '210 Patent were also known, as early as the Framework, where the single-user case included the number of spatial streams and transmission beam forming, while the multi-user format included a spatial configuration field. *E.g.*, SAMSUNG-1010, 12; SAMSUNG-1009, 135-136; SAMSUNG-1004, 320-324; SAMSUNG-1001, 20:33-21:54 (describing two formats shown in FIGS. 13(d)-1–2); SAMSUNG-1013, ¶¶[0093], [0157]; SAMSUNG-1015, ¶¶[0082]-[0084]; SAMSUNG-1003, ¶¶88-91.

The '210 Patent illustrates user fields in FIGS. 13(d)-1–(d)-2, which are reproduced below:



'210 Patent, FIGS. 13(d)1-(d)2

The '210 Patent describes that when "one user is allocated to one resource unit (i.e., **non-MU-MIMO allocation**), the user field includes the **NSTS** field. When a plurality of users are allocated to one resource unit (i.e., **MU-MIMO allocation**), the user field includes a **spatial configuration field**. These formats are the same as what are described in 802.11ax_D1.0 and in Bharadwaj and Sun. Indeed, even the '210 Patent's FIG. 13(e) showing the SCF encoding is the same as SAMSUNG-1004, Table 28-24 and SAMSUNG-1013, FIG. 7; SAMSUNG-1003, ¶¶88-91.

The '210 Patent refers to FIG. 13(d)-1 as the user field for an OFDMA transmission, and, by contrast, refers to FIG. 13(d)-2 as the user field for MU-MIMO transmission. But the differences between FIG. 13(d)-1 and FIG. 13(d)-2

are the same differences that exist between the user formats described in, e.g., 802.11ax_D1.0 Tables 28-22 (non-MU-MIMO) and 28-23 (MU-MIMO). Thus, a POSITA would have understood that, for the purposes of the '210 Patent, a user field for an OFDMA transmission is shown in FIG. 13(d)-1, and has the same format as a user field for a non-MU-MIMO allocation, as taught by 802.11ax_D1.0. SAMSUNG-1003, ¶¶88-91.

B. Prosecution History

During prosecution, the Applicant submitted an IDS that included, among other things, 802.11ax_D0.5_IDS,[5] which was applied in the Extended European Search Report of the corresponding European application to reject those claims. SAMSUNG-1002, 123; SAMSUNG-1017, 23-25. The examiner applied 802.11ax_D0.5_IDS in a final rejection, in combination with other references, to show that when in full bandwidth, the format of the user fields of the HE-SIG-B is identified based on a number of MU-MIMO users indicated by a subfield of the HE-SIG-A. SAMSUNG-1002, 108-113 (citing SAMSUNG-1018, §26.3.3.7.4). Despite rejecting the independent claims with 802.11ax_D0.5_IDS, the examiner erroneously allowed dependent claims 23-25 and 29-31. *Id*., 118. The Applicant

[5] 802.11ax_D0.5 (SAMSUNG-1018) is an incomplete version of 802.11ax_D0.5 (SAMSUNG-1005).

amended independent claims 21 and 27 to include the wherein clauses in claims 23 and 29, respectively. *Id*., 95-101; SAMSUNG-1003, ¶¶92-100.

As described herein, the features of claims 23 and 29 were also included in 802.11ax_D0.5_IDS. For example, claim 23 recited "wherein when the number of MU-MIMO users indicates two or more users, the user specific field of the HE-SIG-B includes user fields for MU-MIMO allocation." *E.g*., SAMSUNG-1002, 126. But the examiner failed to recognize that 802.11ax_D0.5 describes the features of this wherein clause. For example, 802.11ax_D0.5 describes that the "User Specific field of a HE-SIG-B content channel … consists of **one or more** … user Block fields." SAMSUNG-1018, §26.3.10.8.1, Figure 26-20 (emphasis added); SAMSUNG-1003, ¶¶92-100.

802.11ax_D0.5 also describes the format for the user field for the MU-MIMO allocation as including the **Spatial Configuration field (SCF)**. SAMSUNG-1018, §26.3.10.8.5, Table 26-23. Table 26-23 is reproduced below:

The HE-SIG-B user field for an STA in MU-MIMO allocation contain the subfields shown in Fields of the HE-SIG-B user field for an.

Table 26-23—Fields of the HE-SIG-B user field for an(#2817) MU-MIMO allocation(#2037)

Bit	Field	Number of bits	Description
B0-B10	STA-ID	11	The STA-ID refers to the AID described in 9.4.1.8 (AID field). The 11 LSBs of the AID field are used to address STAs in this field.(#1003)
B11-B14	Spatial Configuration	4	Indication for the number of spatial streams for a STA in an(#2817) MU-MIMO allocation. See Spatial Configuration subfield encoding .
B15-B18	MCS	4	Modulation and coding scheme. Set to n for MCS*n*, where *n* = 0, 1, 2,.....11 Values 12 to 15 are reserved
B19	DCM	1	Indicates whether or not dual carrier modulation is used. Set to 1 to indicate that the payload of the HE MU PPDU is modulated with dual carrier modulation for the MCS. Set to 0 indicates that the payload of the PPDU is not modulated with dual carrier modulation for the MCS.
B20	Coding	1	Indicates whether BCC or LDPC is used. Set to 0 for BCC Set to 1 for LDPC
NOTE—Integer fields are transmitted in unsigned binary format, LSB first, where the LSB is in the lowest numbered bit position.(#1010)			

SAMSUNG-1018, Table 26-23 (annotated)

SAMSUNG-1003, ¶¶92-100.

Claim 23 also recited, "wherein when the number of MU-MIMO users indicates a single user, the user specific field of the HE-SIG-B includes one user field for non-MU-MIMO allocation." SAMSUNG-1002, 126. But the examiner again did not appreciate that 802.11ax_D0.5_IDS discloses this feature. For example, 802.11ax_D0.5_IDS describes that the "last User Block field may contain information for **one** or two STAs depending on" the number of users indicated. SAMSUNG-1018, §26.3.10.8.1 (emphasis added); SAMSUNG-1003,

¶¶92-100.

802.11ax_D0.5_IDS also describes that when "the SIGB Compression field in the HE-SIG-A field of an HE MU PPDU is set to 1 (indicating full bandwidth MU-MIMO transmission), the Common Block field is not present and the content channel consists of only the User Specific field." SAMSUNG-1018, §26.3.10.8.1. And 802.11ax_D0.5_IDS describes indicating the number of MU-MIMO users in the HE-SIG-A "Number of HE-SIG-B or MU-MIMO Users" field when SIGB Compression field is 1. *Id*., Table 26-17; SAMSUNG-1003, ¶¶92-100.

The format for the HE-SIG-B user field for the non-MU-MIMO allocation is shown in Table 26-22 and includes the NSTS field:

The HE-SIG-B user field for an(#916) SU allocation contain the subfields shown in Fields of the HE-SIG-B user field for an.

Table 26-22—Fields of the HE-SIG-B user field for an(#916) non-MU-MIMO(#1101) allocation(#2037)

Bit	Field	Number of bits	Description
B0-B10	STA-ID	11	The STA-ID refers to the AID described in 9.4.1.8 (AID field). The 11 LSBs of the AID field are used to address the STAs in this field.(#1002) For RUs that carry a broadcast allocation: — For single BSS AP, the STAID for broadcast will be 0 — For Multiple BSS AP, the STAID for broadcast to a specific BSS will follow the group addressed AID assignment in the TIM according to the existing Multi-BSSID TIM operation — For multiple BSS AP, the STAID for broadcast to all BSS of the AP is set to 2047(#2681) — STAID value 2046 is used to indicate that the RU carries no data — When a STA transmits on the uplink using the HE MU PPDU format, the STA-ID field is populated by the AID of the transmitter assigned by the AP
B11-B13	NSTS	3	Number of spatial streams. Set to the number of space time streams minus 1.(#Ed)
B14	Tx Beam-forming	1	Use of transmit beamforming. Set to 1 if a beamforming steering matrix is applied to the waveform in an SU transmission. Set to 0 otherwise.
B15-B18	MCS	4	Modulation and coding scheme

SAMSUNG-1018, Table 26-22 (annotated)

SAMSUNG-1003, ¶¶92-100.

Because 802.11ax_D0.5_IDS included all of the elements of claim 23, the examiner committed clear error by allowing claims 23 (and 29) over 802.11ax_D0.5_IDS. Likewise, the examiner erred by allowing claims 24 and 30. As shown above, the user field for single-user operation includes **NSTS** and the user field for multi-user operation includes **SCF**. SAMSUNG-1003, ¶¶92-100.

IV. THE CHALLENGED CLAIMS ARE UNPATENTABLE

A. [GROUND 1A] – 802.11ax_D1.0 Renders Claims 6-9 Obvious

1. Analysis – Claim 6

[6pre] A wireless communication method of a wireless communication terminal, the method comprising:

802.11ax_D1.0 renders obvious a wireless communication method of a wireless communication terminal (station or STA). SAMSUNG-1003, ¶101. 802.11ax_D1.0 describes the standards for STAs to "decode their payloads." *E.g.*, SAMSUNG-1004, 286. A POSITA would have recognized that 802.11ax_D1.0 described standard structures and methods for implementing High Efficiency Wireless LAN MAC and PHY features. SAMSUNG-1004, 1; SAMSUNG-1003, ¶101. For instance, 802.11ax_D1.0 describes that "Mandatory support for DL MU-MIMO by an HE AP supports 4 or more spatial streams when MU-MIMO is done on the entire PPDU bandwidth." SAMSUNG-1004, 35.

[6.1] receiving a high efficiency multi-user PHY protocol data unit (HE MU PPDU), wherein a preamble of the HE MU PPDU includes high efficiency signal A field (HE-SIG-A) and high efficiency signal B field (HE-SIG-B); and

802.11ax_D1.0 renders obvious a STA receiving an HE MU PPDU in the downlink (DL). *E.g.*, SAMSUNG-1004, §27.5 (MU operation); SAMSUNG-1003, ¶¶102-103. 802.11ax_D1.0 describes a "DL MU transmission allows an AP to simultaneously transmit to more than one non-AP STA. The AP uses the HE MU PPDU for DL MU transmission." SAMSUNG-1004, 264, 188. A POSITA would

have recognized that after the AP transmits the HE MU PPDU, a non-AP STA receives it. *Id.*; SAMSUNG-1003, ¶¶102-103.

The **HE MU PPDU** includes a preamble with **HE-SIG-A** and **HE-SIG-B** fields. SAMSUNG-1004, 293. The **HE MU PPDU** format that includes the **HE-SIG-A** and **HE-SIG-B** fields is shown in FIG. 28-6, reproduced below:

Figure 28-6—HE MU PPDU format

SAMSUNG-1004, Figure 28-6 (annotated)

SAMSUNG-1003, ¶¶102-103. As shown in Figure 28-6 above, the HE MU PPDU format includes a preamble (with HE-SIG-A and HE-SIG-B fields) and the data (or payload). SAMSUNG-1003, ¶¶102-103.

[6.2] decode the received HE MU PPDU based on information obtained from the preamble,

802.11ax_D1.0 renders obvious the receiving STA decodes the HE MU PPDU based on information obtained from the preamble. SAMSUNG-1003, ¶¶104-106. 802.11ax_D1.0 describes that at the receiver, "the PHY preamble is processed to aid in the detection, demodulation, and delivery of the PSDU," which is the data payload of the HE MU PPDU that is decoded. SAMSUNG-1004, 253; SAMSUNG-1003, ¶¶104-106.

Specifically, the "HE-SIG-A field carries information required to interpret HE PPDUs." SAMSUNG-1004, 298. And the HE-SIG-B includes one or more User Block fields for one or two stations to "decode their payloads." *Id*., 312. For example, HE-SIG-B may include RU allocation signaling (when the Common field is present), and user-specific information. *Id*., 264-265; SAMSUNG-1003, ¶¶104-106.

For at least the above reasons, 802.11ax_D1.0 renders obvious [6.2]. To the extent it is argued that 802.11ax_D1.0 does not expressly disclose decoding the received HE MU PPDU based on the claimed information, a POSITA would have found it obvious that the receiver decodes the HE MU PPDU based on information obtained from the preamble, which includes the HE-SIG-A and HE-SIG-B fields. SAMSUNG-1003, ¶¶104-106. For example, a POSITA would have recognized that the preamble of the HE MU PPDU includes information necessary to decode the payload, such as the MCS scheme indicated by the HE-SIG-B user field. *E.g*., SAMSUNG-1004, 321-322; SAMSUNG-1003, ¶¶104-106.

[6.3] wherein when a SIG-B compression field of the HE-SIG-A indicates full bandwidth multi User-Multiple Input Multiple Output (MU-MIMO) transmission, a format of user field(s) included in a user specific field of the HE-SIG-B is identified based on a number of MU-MIMO users indicated by a subfield of the HE-SIG-A,

802.11ax_D1.0 renders obvious [6.3]. SAMSUNG-1003, ¶¶107-115. First, 802.11ax_D1.0 describes that the SIG-B compression field of the HE-SIG-A is set

to 1 to indicate full bandwidth. *E.g.*, SAMSUNG-1004, 264-265, 303, Table 28-17, 312, 324.

Table 28-17—HE-SIG-A field of an HE MU PPDU *(continued)*

...

B18-B21	Number Of HE-SIG-B Symbols Or MU-MIMO Users	4	If the SIGB Compression field is 0, indicates the number of OFDM symbols in the HE-SIG-B field minus 1 If the SIGB Compression field is 1, indicates the number of MU-MIMO users minus 1.
B22	SIGB Compression	1	Set to 1 for full BW MU-MIMO Set to 0 otherwise.

SAMSUNG-1004, Fields of HE MU PPDU HE-SIG-A (annotated)

SAMSUNG-1003, ¶¶107-115. 802.11ax_D1.0 describes that "[w]hen the SIGB Compression field in the HE-SIG-A field of an HE MU PPDU is set to 1 (indicating full bandwidth MU-MIMO transmission), the number of STAs in the MU-MIMO group is indicated in the SIGB Number of Symbols/Number of MU-MIMO Users field in the HE-SIG-A field." *Id.*, 324; *see also id.*, §28.3.3.8.3; SAMSUNG-1003, ¶¶107-115.

Next, 802.11ax_D1.0 explains that the "contents of the User field differ based on whether the field **addresses a single STA** in an RU or **a STA in an MU-MIMO allocation** in an RU." SAMSUNG-1004, 320. Put simply, when the number of MU-MIMO users indicated is one (the value of the HE-SIG-A field is zero), then the receiver identifies the format of the HE-SIG-B user field for a single-user (SU) allocation, the subfields of which are shown in Table 28-22.

SAMSUNG-1004, 320-324. By contrast, when the number of MU-MIMO users indicated is more than one (the value of the HE-SIG-A field is non-zero), then the receiver identifies the format of the HE-SIG-B user field for a MU-MIMO allocation, the subfields of which are shown in Table 28-22. SAMSUNG-1004, 320-324. Note that when in full bandwidth, the HE-SIG-B does not include a Common field, and, consequently, does not include RU allocation signaling. *E.g.*, SAMSUNG-1004, §28.3.3.8.3. Thus, the number of MU-MIMO users is indicated in the HE-SIG-A field. SAMSUNG-1004, 324, §28.3.3.8.3; SAMSUNG-1003, ¶¶107-115.

The two formats for the HE-SIG-B user fields are shown in Tables 28-22 (non-MU-MIMO) and 28-23 (MU-MIMO) below:

Table 28-22—Fields of the HE-SIG-B user field for an non-MU-MIMO allocation

Bit	Field	Number of bits	Description
B0-B10	STA-ID	11	The STA-ID refers to the AID described in 9.4.1.8 (AID field). The 11 LSBs of the AID field are used to address the STAs in this field. For RUs that carry a broadcast allocation: — For single BSS AP, the STAID for broadcast will be 0 — For Multiple BSS AP, the STAID for broadcast to a specific BSS will follow the group addressed AID assignment in the TIM according to the existing Multi-BSSID TIM operation — For multiple BSS AP, the STAID for broadcast to all BSS of the AP is set to 2047 And further: — STAID value 2046 is used to indicate that the RU carries no data — When a STA transmits on the uplink using the HE MU PPDU format, the STA-ID field is populated by the AID of the transmitter assigned by the AP
B11-B13	NSTS	3	Number of spatial streams. Set to the number of space time streams minus 1.
B14	Tx Beam-forming	1	Use of transmit beamforming. Set to 1 if a beamforming steering matrix is applied to the waveform in an SU transmission. Set to 0 otherwise.
B15-B18	MCS	4	Modulation and coding scheme Set to *n* for MCS*n*, where *n* = 0, 1 ,2 …., 11 Values 12 to 15 are reserved

SAMSUNG-1004, Table 28-22 (annotated highlighting **NSTS** field)

Table 28-23—Fields of the HE-SIG-B user field for an MU-MIMO allocation

Bit	Field	Number of bits	Description
B0-B10	STA-ID	11	The STA-ID refers to the AID described in 9.4.1.8 (AID field). The 11 LSBs of the AID field are used to address STAs in this field.
B11-B14	Spatial Configuration	4	Indication for the number of spatial streams for a STA in an MU-MIMO allocation. See Table 28-24 (Spatial Configuration subfield encoding).
B15-B18	MCS	4	Modulation and coding scheme. Set to n for MCS*n*, where $n = 0, 1, 2, \ldots 11$ Values 12 to 15 are reserved
B19	DCM	1	Indicates whether or not dual carrier modulation is used. Set to 1 to indicate that the payload of the HE MU PPDU is modulated with dual carrier modulation for the MCS. Set to 0 indicates that the payload of the PPDU is not modulated with dual carrier modulation for the MCS.
B20	Coding	1	Indicates whether BCC or LDPC is used. Set to 0 for BCC Set to 1 for LDPC
NOTE—Integer fields are transmitted in unsigned binary format, LSB first, where the LSB is in the lowest numbered bit position.			

SAMSUNG-1004, Table 28-23 (highlighting **SCF**)

SAMSUNG-1003, ¶¶107-115. As shown above, and in 802.11ax_D1.0, the format for the user field for the MU-MIMO allocation includes the SCF. *Id.*, 265, 323. The SCF is indicated by Table 28-24, and shows that the minimum number of users is 2. *Id.* Thus, the user field format for MU-MIMO cannot support the single-user scenario. *Id.*; SAMSUNG-1003, ¶¶107-115. The format for the user field for the non-MU-MIMO allocation includes fields for number of spatial streams **NSTS** and for TX beamforming that are not provided in the format for the MU-MIMO allocation. SAMSUNG-1004, 321-322; SAMSUNG-1003, ¶¶107-115.

802.11ax_D1.0 describes that the format of the user fields (shown in Tables 28-22 and 28-23 above) are identified based on the number of MU-MIMO users indicated by a subfield of the HE-SIG-A when operating in full bandwidth. SAMSUNG-1004, 320-324; SAMSUNG-1003, ¶¶107-115. Specifically, 802.11ax_D1.0 explains that "[w]hen the SIGB Compression field in the HE-SIG-A field of an HE MU PPDU is set to 1 (indicating full bandwidth MU-MIMO transmission), the number of STAs in the MU-MIMO group is indicated in the SIGB Number of Symbols/Number of MU-MIMO Users field in the HE-SIG-A field." SAMSUNG-1004, 324; *see also id*., 264-265. Thus, in 802.11ax_D1.0, when in full bandwidth, the user field for a non-MU-MIMO allocation is identified and used if the HE-SIG-A field indicates one user; whereas the format of the user field for a MU-MIMO allocation is identified and used if the HE-SIG-A field indicates more than one user. SAMSUNG-1003, ¶¶107-115. Put differently, if the station receives data via a non-MU-MIMO allocation, the station interprets the user field depending on the format for non-MU-MIMO allocation per Table 28-22. SAMSUNG-1004, 320-324, Table 28-22. But if the station receives data via MU-MIMO allocation, the station interprets the user field depending on the format for MU-MIMO allocation per Table 28-23. *Id*., 320-324, Table 28-23–28-24; SAMSUNG-1003, ¶¶107-115.

To the extent it is argued that 802.11ax_D1.0 does not describe [6.3],, a

POSITA would have found it obvious from 802.11ax_D1.0 that, when SIGB compression indicates full bandwidth, the format of the HE-SIG-B user field is identified based on the number of MU-MIMO users indicated by the HE-SIG-A field. SAMSUNG-1003, ¶¶107-115. Indeed, a POSITA would have recognized that 802.11ax_D1.0 describes all of the following:

- The HE-SIG-B user specific field includes user blocks for one or multiple stations, depending on the number of users indicated by RU allocation signaling. SAMSUNG-1004, 312.
- SIGB Compression field in HE-SIG-A set to 1 indicates full bandwidth, and when operating in full bandwidth, HE-SIG-B does not include a Common field or RU allocation signaling. *Id*., 264-265.
- When operating in full bandwidth, "the number of STAs in the MU-MIMO group is indicated in the SIGB Number of Symbols/Number of MU-MIMO Users field in the HE-SIG-A field." *Id*., 324.
- The contents of the User field differ based on whether the field addresses a single station or a station in an MU-MIMO allocation. *Id*., 320.
- The HE-SIG-B user field for a single-user (SU) allocation contain the subfields shown in Table 28-22 (Fields of the HE-SIG-B user field for an non-MU-MIMO allocation). *Id*., 321-322.

- The HE-SIG-B user field for an STA in MU-MIMO allocation contain the subfields shown in Table 28-23 (Fields of the HE-SIG-B user field for an MU-MIMO allocation). *Id*., 322.
- The HE-SIG-B user field for a STA in MU-MIMO allocation contains the SCF subfield, which only supports two or more stations. *Id*., 323-324, Table 28-24.

SAMSUNG-1003, ¶¶107-115.

A POSITA reviewing 802.11ax_D1.0 would have understood and found obvious that when a single-user is indicated in the HE-SIG-A field, the receiver would have identified the HE-SIG-B user field format for the single-user (SU) allocation, which in 802.11ax_D1.0 includes the subfields shown in Table 28-22 for a non-MU-MIMO allocation. SAMSUNG-1004, 321-322; SAMSUNG-1003, ¶¶107-115. A POSITA would have recognized that 1) the user field format for MU-MIMO allocation did not support the single-user use case because it included NSTS encoding for a minimum of two stations; and 2) the only use field format that supported the single-use use case was the format for non-MU-MIMO allocation, shown in Table 28-22. SAMSUNG-1004, 320-322, Table 28-22, Table 28-23–28-24 (showing that the minimum number of users supported for the SCF field is 2); SAMSUNG-1003, ¶¶107-115.

Likewise, a POSITA would have found it obvious that when multiple users

are indicated in the HE-SIG-A field, the receiver would have identified the HE-SIG-B user field format for the MU-MIMO allocation, which includes the subfields shown in Table 28-23 for MU-MIMO allocation. SAMSUNG-1004, 322; SAMSUNG-1003, ¶¶107-115. A POSITA would have recognized that the SCF encoding for the NSTS was for a minimum of two stations. *E.g.*, SAMSUNG-1004, Table 28-23–28-24; SAMSUNG-1003, ¶¶107-115. Thus, the only description for the MU-MIMO format for the user field in 802.11ax_D1.0 was the format shown in Table 28-23. SAMSUNG-1004, Table 28-23–28-24; SAMSUNG-1003, ¶¶107-115.

[6.4] wherein when the number of MU-MIMO users indicates two or more users, the user specific field of the HE-SIG-B includes user fields for MU-MIMO allocation, and

See, *supra*, [6.3] for a discussion of the user field format for the MU-MIMO allocation. 802.11ax_D1.0 renders obvious [6.4]. SAMSUNG-1003, ¶116. For example, 802.11ax_D1.0 explains that the "User Specific field of the HE-SIG-B content channel consists of one or more User Block fields" and "[e]ach User Block field is made up of two user fields that contain information for two STAs to decode their payloads." SAMSUNG-1004, 312.

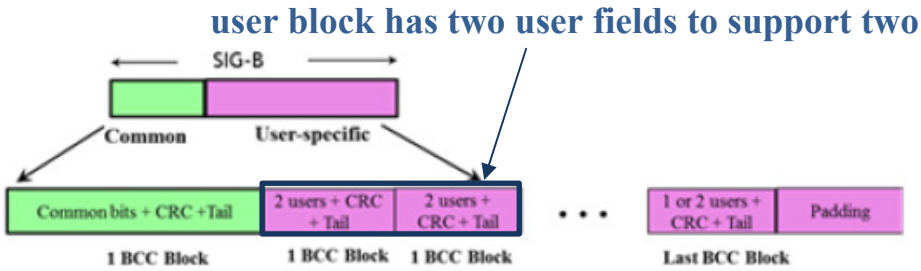


Figure 28-20—HE-SIG-B field encoding structure in each 20 MHz

SAMSUNG-1004, FIG. 28-20 (annotated)

As discussed above, when multiple users are indicated by the HE-SIG-A subfield, the format of the user field for MU-MIMO allocation is used. *Supra*, §IV.A.1.[6.3]. The format of the user field for MU-MIMO allocation is shown in Table 28-23. SAMSUNG-1004, 265, 320-324. The user field for MU-MIMO allocation includes a **SCF** derived from the (minimum of 2) MU-MIMO users indicated by the HE-SIG-A subfield. SAMSUNG-1004, 322-324; *supra*, §IV.A.1.[6.3]. Thus, 802.11ax_D1.0 teaches element [6.4]. SAMSUNG-1003, ¶116.

[6.5] wherein when the number of MU-MIMO users indicates a single user, the user specific field of the HE-SIG-B includes one user field for non-MU-MIMO allocation.

See, *supra* [6.3]. 802.11ax_D1.0 renders obvious [6.5]. SAMSUNG-1003, ¶¶117-126. When the number of MU-MIMO users indicates one user, the user-specific field of HE-SIG-B includes one user block, which in turn includes a user field for non-MU-MIMO allocation. SAMSUNG-1003, ¶¶117-126. For example,

802.11ax_D1.0 explains that the "User Specific field of the HE-SIG-B content channel consists of **one** or more User Block fields." SAMSUNG-1004, 312 (emphasis added). Additionally, the "last User Block field may contain information for **one** or two STAs depending on the number of users indicated" by the HE-SIG-A field. *Id*. (emphasis added). Thus, when a single user is indicated, the user-specific field of HE-SIG-B would include just a single (i.e., one) user block field containing information for one STA, which information would be provided in a user field according to the format for non-MU-MIMO allocation. SAMSUNG-1003, ¶¶117-126. Figure 28-20 illustrates the last User Block for a single user allocation:

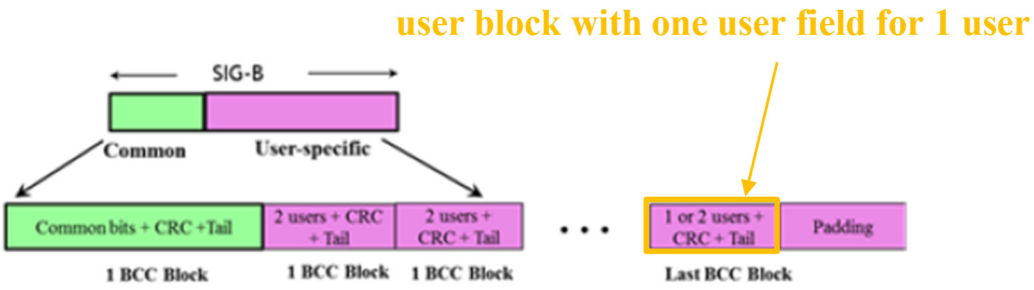


Figure 28-20—HE-SIG-B field encoding structure in each 20 MHz

SAMSUNG-1004, FIG. 28-20 (annotated)

SAMSUNG-1003, ¶¶117-126.

A POSITA would have recognized that 802.11ax_D1.0 does not require multiple of the user block fields reserved for 2 users (purple annotation in [6.4]) when there is only one user. SAMSUNG-1004, 312 ("User Specific field of the

HE-SIG-B content channel consists of **one** or more User Block fields.") (emphasis added). The number of users indicated in the HE-SIG-A field starts from zero, which indicates one user, and goes up to indicate additional users. SAMSUNG-1004, Table 28-17. The transmission of an HE MU PPDU can thus be directed to just a single user, which a POSITA would have understood and found obvious 802.11ax_D1.0 to require just a single (i.e. one) user block in the user-specific field of HE-SIG-B. SAMSUNG-1004, 312, 321; SAMSUNG-1003, ¶¶117-126.

Despite the depiction in FIG. 28-20 of multiple user blocks that can be used in some examples for a MU-MIMO allocation, the figure nonetheless shows how the number of user block fields is not fixed, but instead varies depending on the number of indicated users. SAMSUNG-1003, ¶¶117-126. Likewise, a POSITA would have recognized that HE-SIG-B supports transmissions to fewer than 3 users, which also means that the HE-SIG-B would have included just one User block field (i.e., for 1 or 2 users). *E.g.*, SAMSUNG-1004, 312, 321-324; SAMSUNG-1003, ¶¶117-126. A POSITA thus would have recognized that only a single (i.e., one) user block would be provided for the case where a single user is indicated for non-MU-MIMO allocation. *Id.*; SAMSUNG-1004, 312 ("User Specific field of the HE-SIG-B content channel consists of **one** or more User Block fields") (emphasis added).

Likewise, for transmissions to single users, the one user block field would

have included a single (i.e., one) user field.[6] SAMSUNG-1003, ¶¶117-126. The provision of a one user field for a single-user transmission would have been obvious, for example, to reduce the overhead of the HE MU PPDU preamble, to avoid wasting bandwidth as a result of including unused user fields, and to increase throughput. *E.g.*, SAMSUNG-1031, slide 15; SAMSUNG-1003, ¶¶117-126. That

[6] As Dr. Hansen explains, in light of 802.11ax_D1.0's description that the last user block field may contain information for only "one" STA depending on the number of users indicated, a POSITA would have understood and found obvious that the last (and only) user block field for the case of a single user would not include two user fields for two STAs as would ordinarily be the case for multiple users for MU-MIMO allocation. 802.11ax_D1.0, 312; SAMSUNG-1003, ¶¶117-126. This was in fact recognized in official comments on the draft by the Critical Date of the '210 Patent. SAMSUNG-1035, CID5264; *see also* SAMSUNG-1036, 3 (adding clarification concerning single user field in HE-SIG-B). While not prior art, SAMSUNG-1035 is evidence of how a POSITA at that time was interpreting 802.11ax-D1.0. SAMSUNG-1003, ¶¶117-126. Regardless, even if the user block included two user fields when a single user is indicated (e.g., including one unused user field), it would still include among them one user field for non-MU-MIMO allocation for the reasons explained above. SAMSUNG-1003, ¶¶117-126.

the last user block field would only include one user field for single-user transmissions is also evident from its very existence: if both user fields of the last user block were transmitted for the single-user transmission, then any of the user block fields could support a single user, and a special "last user block" would not have been necessary. SAMSUNG-1003, ¶¶117-126. That 802.11ax_D1.0 designates the last user block field for supporting one user means that it would not require both user fields to be transmitted when supporting a single user. *Id*.

As discussed above, when one user is indicated by the HE-SIG-A subfield, the format of the user field for non-MU-MIMO allocation is used. *Supra*, §IV.A.1.[6.3]-[6.4]; SAMSUNG-1004, 320-324. The user field format for non-MU-MIMO allocation is shown in Table 28-22. SAMSUNG-1004, 264-265, 320-322, Table 28-22. In Table 28-22, the user field for non-MU-MIMO allocation includes a **NSTS** field and TxBF field, but does not include the **SCF** field. *Id*., 264-265, 320-322; SAMSUNG-1003, ¶¶117-126.

802.11ax_D1.0 describes that, in full bandwidth operation, the number of MU-MIMO users is indicated by the HE-SIG-A field, and that "there is no RU signaling in the HE-SIG-B common field." SAMSUNG-1004, 264-265. Thus, a POSITA would have understood and found it obvious that when a single user is indicated by the HE-SIG-A, there would be no need for multiple User Blocks in the user-specific field of the HE-SIG-B, and the only User Block field provided in

this scenario would be the last User Block field that would have contained information for the single (one) STA. SAMSUNG-1004, 312, 342; SAMSUNG-1003, ¶¶117-126.

Likewise, a POSITA would have understood and found it obvious that when a single user is indicated by the HE-SIG-A, the receiver would identify the non-MU-MIMO format for the HE-SIG-B user field as described in detail in Table 28-22 of 802.11ax_D1.0. SAMSUNG-1004, 320-321 ("The HE-SIG-B user field for an SU allocation contain the subfields shown in Table 28-22 (Fields of the HE-SIG-B user field for an non-MU-MIMO allocation)."). Recall that the HE-SIG-B field is only in the HE MU-PPDU. *Id*., 267-268. Thus, the reference to "SU" in the paragraphs introducing Table 28-22 refer to the single-user recipient of the HE MU-PPDU. SAMSUNG-1004, 321; SAMSUNG-1003, ¶¶117-126.

2. Claim 7

[7pre] The wireless communication method of claim 6,

[7.1] wherein the user field(s) for MU-MIMO allocation includes a spatial configuration field indicating the total number of spatial streams in an MU-MIMO allocation and the number of spatial streams for each terminal in the MU-MIMO allocation, and

See, *supra*, §IV.A.1.[6.3]-[6.4] for the discussion of MU-MIMO user field format. Table 28-23 shows that the user field for MU-MIMO allocation includes the **SCF**. SAMSUNG-1004, 265, 320-324, Tables 28-23 & 28-24.

802.11ax_D1.0 describes that a "user field for an MU-MIMO allocation

includes a Spatial Configuration subfield" that "indicates the number of spatial streams for each STA and the total number of spatial streams in the MU-MIMO allocation." SAMSUNG-1004, 323. This subfield shown in Tables 28-23-28-24. *Id*., 323. Likewise, 802.11ax_D1.0 explains that the "total number of spatial streams (total NSTS) is computed by summing all columns for the row signaled by the spatial configuration subfield and is indicated in Table 28-24 (Spatial Configuration subfield encoding) under the column Total Nsts." *Id*., 324; SAMSUNG-1003, ¶¶127-128.

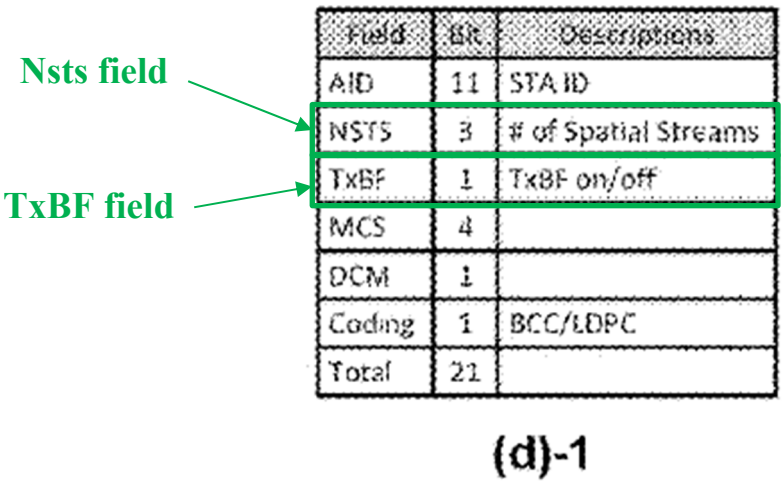
[7.2] wherein the user field for non-MU-MIMO allocation includes a number of space time streams (NSTS) field.

See, *supra*, §IV.A.1.[6.3]&[6.5] for the discussion of non-MU-MIMO user field format. Table 28-22 shows that the user field for non-MU-MIMO allocation includes the **NSTS**. SAMSUNG-1004, 265, 320-322, Tables 28-22. "The number of spatial streams … is indicated by the NSTS field in user specific block as defined in Table 28-22 (Fields of the HE-SIG-B user field for an non-MU-MIMO allocation)." *Id*., 265. SAMSUNG-1003, ¶129.

3. Claim 8

[8] The wireless communication method of claim 6, wherein the user field(s) for non-MU-MIMO allocation is a user field based on orthogonal frequency division multiple access (OFDMA) allocation.

The '210 Patent describes FIG. 13(d)-1 as "a user field for an OFDMA transmission." '210 Patent, 20:35-36. FIG. 13(d)-1 is reproduced below:



(d)-1

’210 Patent, FIG. 13(d)-1 (annotated)

The ’210 Patent describes that “when one user is allocated to one resource unit (i.e., non-MU-MIMO allocation), the user field includes a number of space time streams (NSTS) field, a TxBF field,” etc. ’210 Patent, 20:33-53. The ’210 Patent provides no further description of what the user field based on OFDMA would include beyond the description of FIG. 13(d)-1. SAMSUNG-1003, ¶¶130-131.

Like the ’210 Patent’s description of FIG. 13(d)-1, the 802.11ax_D1.0’s describes that the user field format for the non-MU-MIMO allocation includes the NSTS and TxBF fields. SAMSUNG-1004, 321. These fields, among others, are shown in Table 28-22:

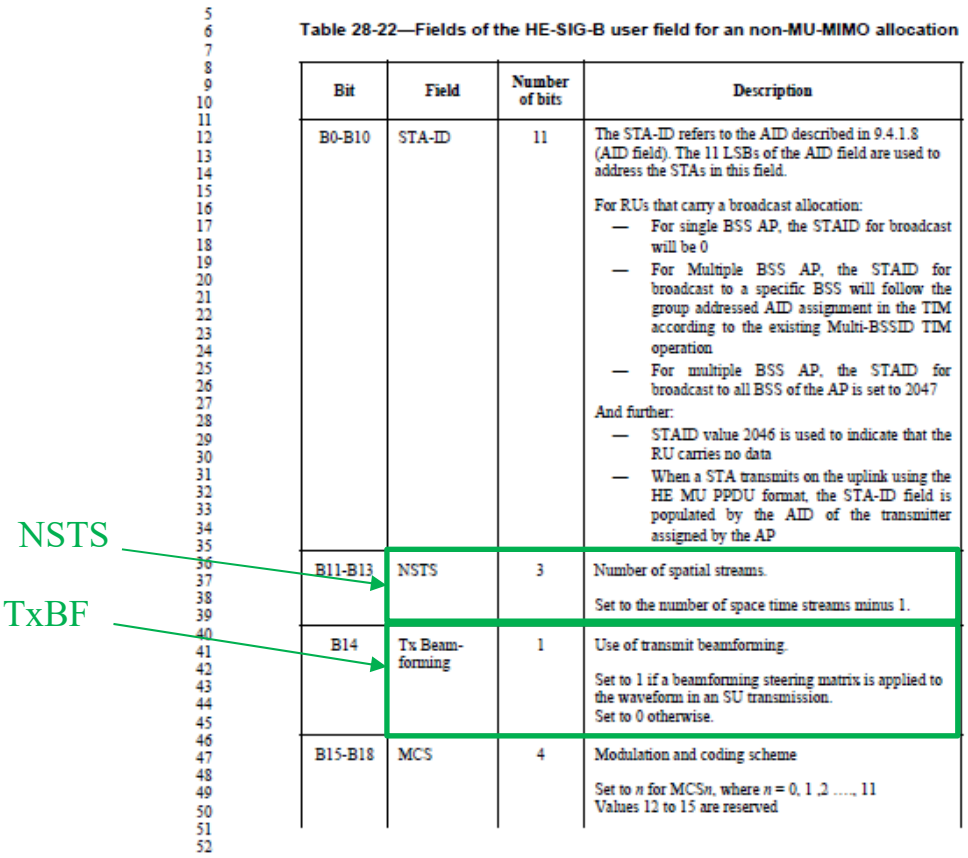


Table 28-22—Fields of the HE-SIG-B user field for an non-MU-MIMO allocation

Bit	Field	Number of bits	Description
B0-B10	STA-ID	11	The STA-ID refers to the AID described in 9.4.1.8 (AID field). The 11 LSBs of the AID field are used to address the STAs in this field. For RUs that carry a broadcast allocation: — For single BSS AP, the STAID for broadcast will be 0 — For Multiple BSS AP, the STAID for broadcast to a specific BSS will follow the group addressed AID assignment in the TIM according to the existing Multi-BSSID TIM operation — For multiple BSS AP, the STAID for broadcast to all BSS of the AP is set to 2047 And further: — STAID value 2046 is used to indicate that the RU carries no data — When a STA transmits on the uplink using the HE MU PPDU format, the STA-ID field is populated by the AID of the transmitter assigned by the AP
B11-B13	NSTS	3	Number of spatial streams. Set to the number of space time streams minus 1.
B14	Tx Beam-forming	1	Use of transmit beamforming. Set to 1 if a beamforming steering matrix is applied to the waveform in an SU transmission. Set to 0 otherwise.
B15-B18	MCS	4	Modulation and coding scheme Set to *n* for MCS*n*, where *n* = 0, 1 ,2 ...., 11 Values 12 to 15 are reserved

SAMSUNG-1004, Table 28-22 (annotated)

Thus, the '210 Patent's description of the user field based on OFDMA allocation aligns with the non-MU-MIMO user field format described in SAMSUNG-1004, Table 28-22. SAMSUNG-1003, ¶¶130-131.

4. Claim 9

[9] The wireless communication method of claim 6, wherein the number of MU-MIMO users is indicated by a number of HE-SIG-B symbols field in the HE-SIG-A.

See, *supra*, §IV.A.1.[6.3]. 802.11ax_D1.0 describes that the SIG-B compression field of the HE-SIG-A being set to 1 indicates full bandwidth. *E.g.*, SAMSUNG-1004, 264-265, 303, Table 28-17, 312, 324; SAMSUNG-1003, ¶132.

In that scenario, the "number of STAs in the MU-MIMO group is indicated in the Number Of HE-SIG-B Symbols Or MU-MIMO Users field in HE-SIG-A." *Id.*, 265.

Table 28-17—HE-SIG-A field of an HE MU PPDU *(continued)*

...

B18-B21	Number Of HE-SIG-B Symbols Or MU-MIMO Users	4	If the SIGB Compression field is 0, indicates the number of OFDM symbols in the HE-SIG-B field minus 1. If the SIGB Compression field is 1, indicates the number of MU-MIMO users minus 1.
B22	SIGB Compression	1	Set to 1 for full BW MU-MIMO. Set to 0 otherwise.

SAMSUNG-1004, Fields of HE MU PPDU HE-SIG-A

SAMSUNG-1003, ¶132. 802.11ax_D1.0 describes that "[w]hen the SIGB Compression field in the HE-SIG-A field of an HE MU PPDU is set to 1 (indicating full bandwidth MU-MIMO transmission), the number of STAs in the MU-MIMO group is indicated in the SIGB Number of Symbols/Number of MU-MIMO Users field in the HE-SIG-A field." SAMSUNG-1004, 324; *see also id.*, §28.3.3.8.3; SAMSUNG-1003, ¶132.

B. [GROUND 1B] – 802.11ax_D1.0 and Bharadwaj Render Claims 1-5 Obvious

1. The Predictable Combination of 802.11ax_D1.0 and Bharadwaj

802.11ax_D1.0 discloses stations that perform various functions for supporting MU-MIMO. *E.g.*, SAMSUNG-1004, 35. To the extent 802.11ax_D1.0

does not expressly disclose specific circuitry of the stations, including a communication unit and a processor, a POSITA would have found it obvious to include this circuitry in stations to perform the processing and radio communications, including receiving and decoding transmissions to support HE MU-MIMO operations, per Bharadwaj. SAMSUNG-1003, ¶¶133-138; *supra* §II.C.

2. Reasons to Combine

Bharadwaj describes being compatible with 802.11ax, so a POSITA would have found it obvious to combine Bharadwaj with the standardized teachings of 802.11ax_D1.0. SAMSUNG-1003, ¶¶133-138. Like SAMSUNG-1004, Bharadwaj describes preamble designs for enabling MU-MIMO communications between an access point (AP) and a station in a high-efficiency wireless local area network (HE-WLAN). SAMSUNG-1013, ¶[0065]; SAMSUNG-1003, ¶¶133-138. As discussed above, in §II.C, *supra*, Bharadwaj discloses a HE-WLAN that includes an AP 105 and a station 110. SAMSUNG-1013, ¶¶[0060]-[0065]. Bharadwaj's station performs functions, including receiving and decoding HE MU PPDUs transmissions. SAMSUNG-1013, ¶¶[0094], [0129], [0132]. To perform these functions, Bharadwaj provides various components included in the station. SAMSUNG-1013, ¶¶[0060]-[0065], [0149]-[0160]; SAMSUNG-1003, ¶¶133-138.

In FIG. 13A, Bharadwaj's station (STA 110) includes a processor 1305,

memory 1310, and transceiver 1320. SAMSUNG-1013, ¶¶[0150]-[0160]. The processor 1305 processes information received through the transceiver(s) 1320. *Id*., ¶[0150]. The transceiver(s) 1320 communicate bi-directionally with other wireless devices. *Id*., ¶[0152]. The station includes modules implemented in hardware, software stored in memory 1310, or a combination of hardware and software for performing various MU-MIMO functions, including decoding a transmission frame (¶[0008]), decoding the HE-SIG-B fields, specifically, (¶[0085]), determining a number of MU-MIMO users (¶[0157]), and determining the number of spatial streams for the station (¶[0156]). *E.g*., SAMSUNG-1013, ¶¶[0008], [0149]-[0160]; SAMSUNG-1003, ¶¶133-138.

Combining the teachings of 802.11ax_D1.0 with Bharadwaj would have merely involved combining prior art elements according to known methods to yield predictable results. SAMSUNG-1003, ¶¶133-138. Bharadwaj discloses communication devices, stations and APs in an IEEE802.11ax Wi-Fi network (e.g., HE-WLAN). SAMSUNG-1013, ¶¶[0005], [0060]-[0065]. Bharadwaj specifically discusses implementation of the HE MU-MIMO preamble designs with the HE-SIG-A and the HE-SIG-B fields, as well as the format for the user field in HE-SIG-B for MU-MIMO allocation. *E.g*., SAMSUNG-1013, ¶¶[0069], [0093], [0157]. A POSITA would have been motivated to combine the teachings of 802.11ax_D1.0 with Bharadwaj to realize implementation details and to achieve an operable

station that would be capable of carrying out the techniques described in 802.11ax_D1.0, *e.g.*, through the inclusion of processing circuitry and radio circuitry for receiving and processing transmissions that include HE MU PPDUs. SAMSUNG-1003, ¶¶133-138.

The combination would have been predictable and foreseeable, at least because:

1) Bharadwaj discloses communications between a station and an AP within a HE-WLAN environment, consistent with IEEE802.11; and

2) the combination merely involves incorporating known hardware and software elements expressly disclosed by Bharadwaj to implement the various HE MU PPDU described by 802.11ax_D1.0. SAMSUNG-1003, ¶¶133-138; SAMSUNG-1013, ¶¶[0005], [0060]-[0065], [0149]-[0160].

The combination also would have been obvious and predictable at least because elements of the combined system would each perform similar functions they had been known to perform prior to the combination. SAMSUNG-1003, ¶¶133-138. For example, the station in the 802.11ax_D1.0-Bharadwaj combination would perform the same functions contemplated by 802.11ax_D1.0, but would include specific circuitry like that disclosed in Bharadwaj to carry out those functions. *Id*. Thus, a POSITA would have had a reasonable expectation of success implementing the combination. *Id.*

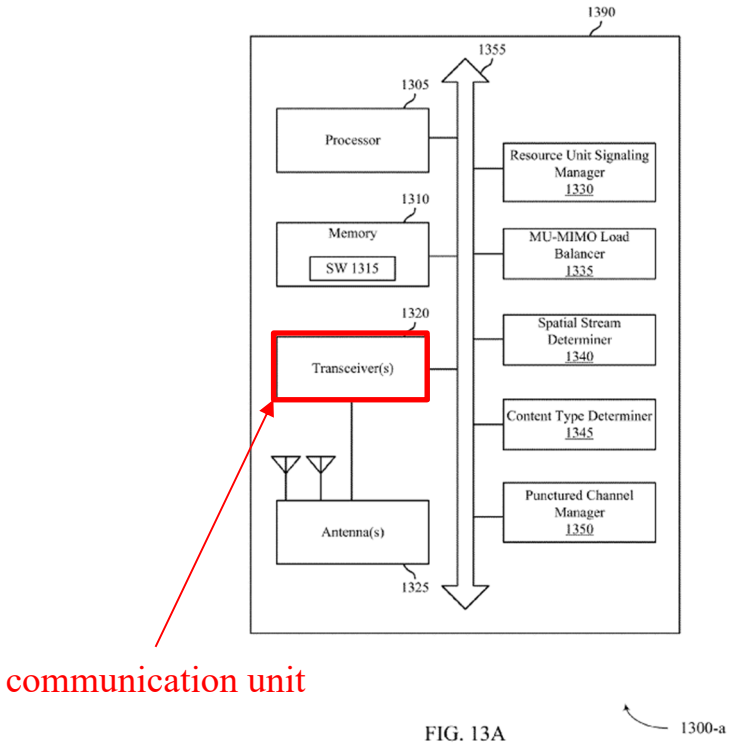
3. Analysis – Claim 1

[1pre] A wireless communication terminal, the terminal comprising:

The 802.11ax_D1.0-Bharadwaj combination renders [1pre] obvious. SAMSUNG-1003, ¶139. 802.11ax_D1.0 describes a wireless communication terminal (station or STA). SAMSUNG-1004, 35. 802.11ax_D1.0 describes the standards for STAs to "decode their payloads." *E.g.*, SAMSUNG-1004, 286. A POSITA would have recognized that 802.11ax_D1.0 described standard structures and methods for implementing High Efficiency Wireless LAN MAC and PHY features. SAMSUNG-1004, 1; SAMSUNG-1003, ¶139. Specifically, 802.11ax_D1.0 describes that "Mandatory support for DL MU-MIMO by an HE AP supports 4 or more spatial streams when MU-MIMO is done on the entire PPDU bandwidth." SAMSUNG-1004, 35. Bharadwaj also teaches stations in communication with an AP in a HE-WLAN compliant with 802.11ax. SAMSUNG-1013, ¶¶[0060]-[0065]. SAMSUNG-1003, ¶139.

[1.1] a communication unit; and

The 802.11ax_D1.0-Bharadwaj combination renders [1.1] obvious. In the combination, Bharadwaj teaches that the station includes a communication unit, including transceiver(s) 1320. SAMSUNG-1003, ¶140. The components of the station are shown in FIG. 13A:



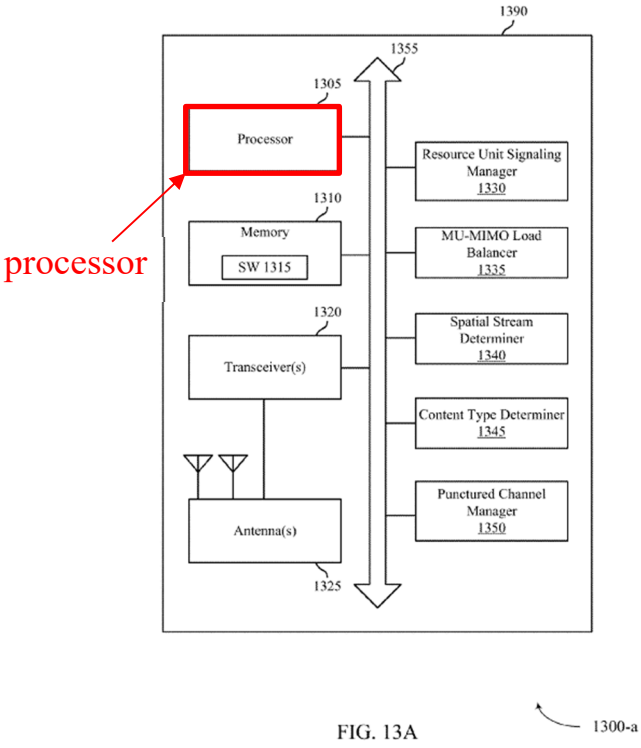
SAMSUNG-1013, FIG. 13A (annotated)

"The transceiver(s) 1320 communicate bi-directionally with other wireless devices, such as APs 105, STAs 110, or other devices." SAMSUNG-1013, ¶[0151]. "The processor 1305 processes information received through the transceiver(s) 1320 and information to be sent to the transceiver(s) 1320 for transmission through the antenna (s) 1325." *Id.*, ¶[0150]; SAMSUNG-1003, ¶140.

[1.2] a processor configured to process signals transmitted and received through the communication unit, wherein the processor is configured to:

The 802.11ax_D1.0-Bharadwaj combination renders [1.2] obvious. In the combination, Bharadwaj teaches that the station includes a processor configured to process signals transmitted and received through the communication unit.

SAMSUNG-1003, ¶141. The components of the station are shown in FIG. 13A:



SAMSUNG-1013, FIG. 13A (annotated)

"The processor 1305 processes information received through the transceiver(s) 1320 and information to be sent to the transceiver(s) 1320 for transmission through the antenna (s) 1325." *Id.*, ¶[0150]; SAMSUNG-1003, ¶141.

[1.3] receive, through the communication unit, a high efficiency multi-user PHY protocol data unit (HE MU PPDU), wherein a preamble of the HE MU PPDU includes high efficiency signal A field (HE-SIG-A) and high efficiency signal B field (HE-SIG-B), and

See, *supra*, §IV.A.1.[6.1]; SAMSUNG-1003, ¶142.

[1.4] decode the received HE MU PPDU based on information obtained from the preamble,

See, *supra*, §IV.A.1.[6.2]; SAMSUNG-1003, ¶143.

[1.5] wherein when a SIG-B compression field of the HE-SIG-A indicates full bandwidth multi User-Multiple Input Multiple Output(MU-MIMO) transmission, a format of user field(s) included in a user specific field of the HE-SIG-B is identified based on a number of MU-MIMO users indicated by a subfield of the HE-SIG-A,

See, supra, §IV.A.1.[6.3]; SAMSUNG-1003, ¶144.

[1.6] wherein when the number of MU-MIMO users indicates two or more users, the user specific field of the HE-SIG-B includes user fields for MU-MIMO allocation, and

See, *supra*, §IV.A.1.[6.4]; SAMSUNG-1003, ¶145.

[1.7] wherein when the number of MU-MIMO users indicates a single user, the user specific field of the HE-SIG-B includes one user field for non-MU-MIMO allocation.

See, *supra*, §IV.A.1.[6.5]; SAMSUNG-1003, ¶146.

4. Claim 2

[2pre] The wireless communication terminal of claim 1,

[2.1] wherein the user field(s) for MU-MIMO allocation includes a spatial configuration field indicating the total number of spatial streams in an MU-MIMO allocation and the number of spatial streams for each terminal in the MU-MIMO allocation, and

See, *supra*, §IV.A.2.[7.1]; SAMSUNG-1003, ¶147.

[2.2] wherein the user field for non-MU-MIMO allocation includes a number of space time streams (NSTS) field.

See, *supra*, §IV.A.2.[7.2]; SAMSUNG-1003, ¶148.

5. Claim 3

[3] The wireless communication terminal of claim 1, wherein the user field(s) for non-MU-MIMO allocation is a user field based on orthogonal frequency division multiple access (OFDMA) allocation.

See, *supra*, §IV.A.3 (Claim 8); SAMSUNG-1003, ¶149.

6. Claim 4

[4] The wireless communication terminal of claim 1, wherein the number of MU-MIMO users is indicated by a number of HE-SIG-B symbols field in the HE-SIG-A.

See, *supra*, §IV.A.4 (Claim 9); SAMSUNG-1003, ¶150.

7. Claim 5

[5] The wireless communication terminal of claim 1, wherein the HE-SIG-A includes the SIG-B compression field and the specific subfield, and wherein the SIG-B compression field indicates whether full bandwidth MU-MIMO transmission is used, and when the SIG-B compression field indicates full bandwidth MU-MIMO transmission, the specific subfield indicates the number of MU-MIMO users.

See, *supra*, §IV.A.1.[6.3]. The 802.11ax_D1.0-Bharadwaj combination renders [5] obvious. 802.11ax_D1.0 describes that the SIG-B compression field of the HE-SIG-A being set to 1 indicates full bandwidth. *E.g.*, SAMSUNG-1004, 264-265, 303, Table 28-17, 312, 324; SAMSUNG-1003, ¶151.

Table 28-17—HE-SIG-A field of an HE MU PPDU *(continued)*

...

B18-B21	Number Of HE-SIG-B Symbols Or MU-MIMO Users	4	If the SIGB Compression field is 0, indicates the number of OFDM symbols in the HE-SIG-B field minus 1. If the SIGB Compression field is 1, indicates the number of MU-MIMO users minus 1.
B22	SIGB Compression	1	Set to 1 for full BW MU-MIMO. Set to 0 otherwise.

SAMSUNG-1004, Fields of HE MU PPDU HE-SIG-A

802.11ax_D1.0 describes that "[w]hen the SIGB Compression field in the HE-SIG-

A field of an HE MU PPDU is set to 1 (indicating full bandwidth MU-MIMO transmission), the number of STAs in the MU-MIMO group is indicated in the SIGB Number of Symbols/Number of MU-MIMO Users field in the HE-SIG-A field." *Id*., 324; *see also id*., §28.3.3.8.3. As shown in Table 28-17, both the SIGB Compression field and the "Number of HE-SIG-B Symbols or MU-MIMO Users" field are subfields of the HE-SIG-A. SAMSUNG-1003, ¶151.

C. [GROUND 2] – Bharadwaj and Sun Render Claims 1-9 Obvious

1. The Predictable Combination of Bharadwaj and Sun

Bharadwaj describes 1) in full bandwidth, determining the number of MU-MIMO users from a HE-SIG-A field, and 2) that the user field in HE-SIG-B for a MU-MIMO allocation indicates a spatial configuration for a number of users indicated by the common field of the HE-SIG-A. Bharadwaj, however, does not expressly disclose the format of the user field in HE-SIG-B for single-user allocation. In the same field of endeavor, Sun teaches that the user specific field of the HE-SIG-B has two possible structures: one for the single-user mode and one for the multi-user mode. In the Bharadwaj-Sun combination ("Bharadwaj/Sun"), it would have been obvious to apply to Bharadwaj the format for the user field for the non-MU-MIMO (SU) allocation, as suggested by Sun, based on the number of users determined from the HE-SIG-A field indicating a single user. SAMSUNG-1003, ¶152.

2. Reasons to Combine

Multiple reasons would have prompted a POSITA to implement the Bharadwaj-Sun combination. SAMSUNG-1003, ¶¶153-158. As an initial matter, Bharadwaj and Sun are both analogous art to the '210 Patent in that that they are both concerned with the design of the PHY data unit for supporting MU-MIMO transmissions in the downlink. SAMSUNG-1003, ¶¶153-158. Bharadwaj describes preamble designs for HE MU PPDUs for supporting MU-MIMO operations. *E.g.*, SAMSUNG-1013, ¶[0065]. Likewise, Sun describes the design of the PHY data unit for downlink signaling, including HE-SIG-B formats. SAMSUNG-1015, ¶¶[0011]-[0012], [0031], [0082]-[0087], Abstract. In addition, both Bharadwaj and Sun describe MU-MIMO downlink PHY data unit structures in the context of 802.11ax. SAMSUNG-1013, ¶[0064]; SAMSUNG-1015, ¶[0031]; SAMSUNG-1003, ¶¶153-158.

Bharadwaj describes preamble designs for supporting HE MU-MIMO operations, and such preamble designs include details pertaining to the HE-SIG-A and HE-SIG-B fields. SAMSUNG-1013, ¶¶[0064]-[0065], [0069], [0093], [0097], [0117], [0125]. Bharadwaj specifically describes the "user field for an MU-MIMO allocation, e.g., in a HE-SIG-B field" that includes the "spatial configuration subfield." SAMSUNG-1013, ¶[0093], FIG. 7 (spatial configuration subfield encoding). Despite also contemplating that the HE MU PPDU would have also

supported the single-user scenario, Bharadwaj does not expressly describe the user field format for the non-MU-MIMO allocation. SAMSUNG-1013, ¶[0096] (describing that "the station may differentiate between SU and MU-MIMO allocations" and that "the content of the SU and MU dedicated portions of a HE-SIG-B field may be different"), FIGS. 15C (B8:B9 full BW MU-MIMO or MU PPDU targeted to single user), 18B (B0:B4 SIGB Compression and Number of HE-SIG-B Symbols/MU-MIMO users, B8:B9 full BW MU-MIMO or MU PPDU targeted to single user), 21A-C. Thus, a POSITA implementing Bharadwaj's preamble designs would have been motivated to look to another reference, like Sun, for an understanding of the format of the user field that would support non-MU-MIMO allocations and the single-user transmission scenario. SAMSUNG-1003, ¶¶153-158. A POSITA would have combined the teachings of Bharadwaj with Sun to realize implementation details for the HE-SIG-A and HE-SIG-B fields of the HE MU PPDU to better support both MU-MIMO and non-MU-MIMO allocations. SAMSUNG-1003, ¶¶153-158.

Sun describes multiple different formats for HE-SIG-B user blocks, including describing formats for supporting the non-MU-MIMO allocation. SAMSUNG-1015, ¶¶[0082]-[0087], FIGS. 16A-D. Specifically, Sun describes the contents of each field for the user block for the single-user mode, which includes the Nsts field and the TxBF field. SAMSUNG-1015, ¶[0084], FIG. 16B. A

POSITA would have found it obvious to look to Sun for modifying Bharadwaj to include the user field format for SU (non-MU-MIMO) allocation to complement Bharadwaj's disclosure of the MU-MIMO user field format and to provide a more complete system that would allow HE MU PPDUs to support both MU-MIMO allocations for multiple users and non-MU-MIMO allocations for a single user. SAMSUNG-1003, ¶¶153-158.

The combination also would have been obvious and predictable for at least the following reasons:

1) both Bharadwaj and Sun describe designs for a PHY data unit (or PPDU) to support communications between an AP and a station within a high-efficiency Wi-Fi network, consistent with 802.11ax;

2) both Bharadwaj and Sun describe the PPDU design for supporting MU-MIMO downlink transmission as including HE-SIG-A and HE-SIG-B fields; and

3) Bharadwaj already describes the format for the user field for the MU-MIMO allocation, while also recognizing the single-user scenario, and the combination merely involves the addition to Bharadwaj of the user field format for the single-user allocation, as taught by Sun. SAMSUNG-1003, ¶¶153-158.

The combination is obvious also because elements of the combined system would each perform similar functions they had been known to perform in similar contexts outside the combination. SAMSUNG-1003, ¶¶153-158. For example, the

station in Bharadwaj would still perform the same or similar functions, including decoding the HE-SIG-A to determine the number of MU-MIMO users and decoding the HE-SIG-B to determine the MU-MIMO allocation, as it did prior to the combination with Sun. *Id*. After the combination, when the station of Bharadwaj determines that the MU PPDU HE-SIG-A indicates one user, the station would then recognize the format for the HE-SIG-B user field as structured for the single-user (or non-MU-MIMO) allocation. *Id*.

A POSITA would have reasonably expected success implementing the combination, especially considering the substantially similar 802.11ax techniques described in each reference. SAMSUNG-1003, ¶¶153-158. Additionally, combining the teachings of Bharadwaj with Sun would have merely involved combining prior art elements according to known methods to yield predictable results. SAMSUNG-1003, ¶¶153-158. Bharadwaj and Sun disclose communication devices, stations and APs in an IEEE 802.11ax Wi-Fi network (e.g., high-efficiency ("HE") WLAN). SAMSUNG-1013, ¶¶[0005], [0060]-[0065]; SAMSUNG-1015, ¶¶[0031]-[0040]. Bharadwaj specifically discusses implementation of the HE MU-MIMO preamble designs with the HE-SIG-A and the HE-SIG-B fields, as well as the format for the user field in HE-SIG-B for MU-MIMO allocation. *E.g.*, SAMSUNG-1013, ¶¶[0069], [0093], [0157]; SAMSUNG-1003, ¶¶153-158.

3. Analysis – Claim 1

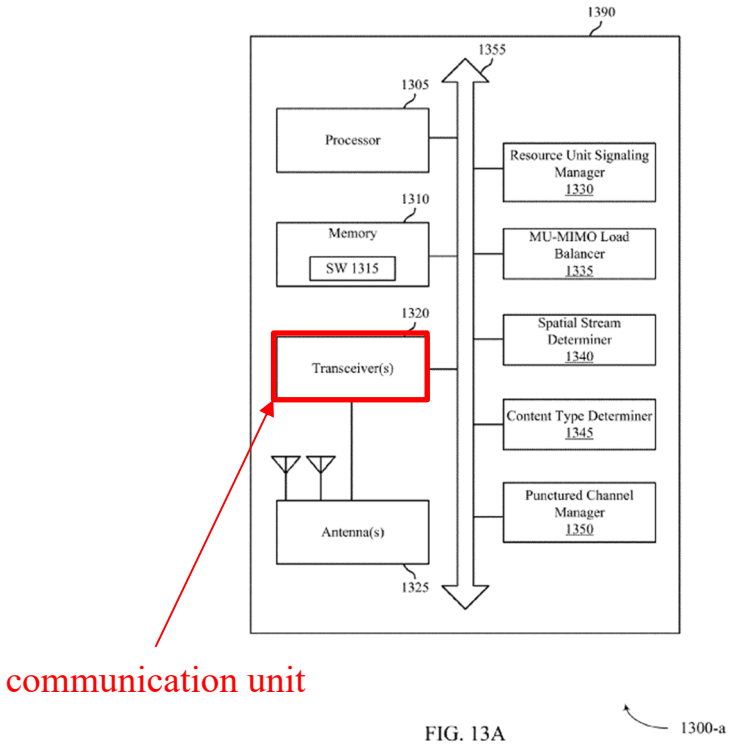
[1pre] A wireless communication terminal, the terminal comprising:

Bharadwaj/Sun renders [1pre] obvious. SAMSUNG-1003, ¶159. In Bharadwaj, the HE-WLAN 100 includes an AP 105 and wireless stations (wireless communication terminal). SAMSUNG-1013, ¶[0061]. The stations can be "mobile handsets, tablet computers, personal digital assistants (PDAs), other handheld devices, netbooks, notebook computers, tablet computers, laptops, desktop computers," etc. *Id*. Bharadwaj's stations and APs communicate in an HE-WLAN compliant with 802.11ax. *Id*., ¶¶[0064]-[0065].

[1.1] a communication unit; and

See, *supra*, §IV.B.3.[1.1].

Bharadwaj/Sun renders [1.1] obvious. SAMSUNG-1003, ¶¶160-162. In Bharadwaj, the station includes a communication unit, including transceiver(s) 1320. The components of the station are shown in FIG. 13A:



SAMSUNG-1013, FIG. 13A (annotated)

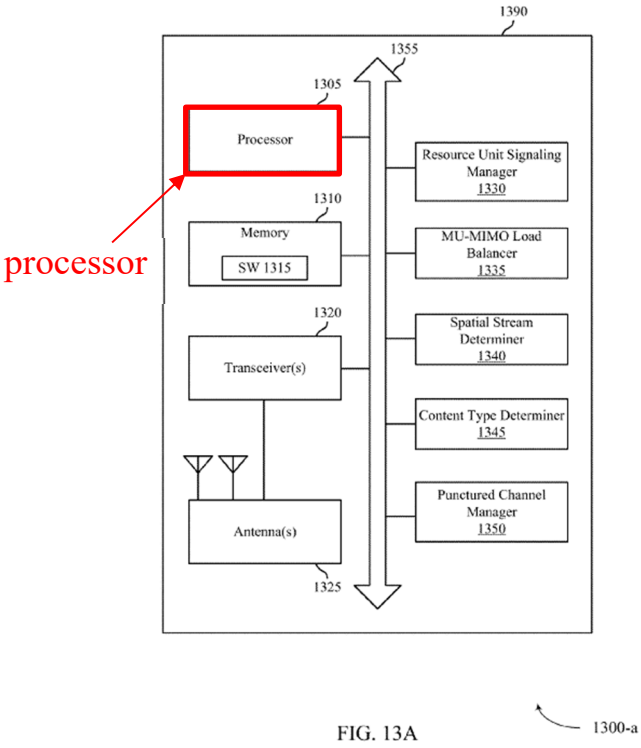
"The transceiver(s) 1320 communicate bi-directionally with other wireless devices, such as APs 105, STAs 110, or other devices." SAMSUNG-1013, ¶[0151]. "The processor 1305 processes information received through the transceiver(s) 1320 and information to be sent to the transceiver(s) 1320 for transmission through the antenna (s) 1325." *Id.*, ¶[0150]; SAMSUNG-1003, ¶¶160-162.

[1.2] a processor configured to process signals transmitted and received through the communication unit, wherein the processor is configured to:

See, *supra*, §IV.B.3.[1.2].

Bharadwaj/Sun renders [1.2] obvious. SAMSUNG-1003, ¶¶163-164. In

Bharadwaj, the station includes a processor configured to process signals transmitted and received through the communication unit. The components of the station are shown in FIG. 13A:



SAMSUNG-1013, FIG. 13A (annotated)

"The processor 1305 processes information received through the transceiver(s) 1320 and information to be sent to the transceiver(s) 1320 for transmission through the antenna (s) 1325." *Id.*, ¶[0150]; SAMSUNG-1003, ¶¶163-164.

[1.3] receive, through the communication unit, a high efficiency multi-user PHY protocol data unit (HE MU PPDU), wherein a preamble of the HE MU PPDU includes high efficiency signal A field (HE-SIG-A) and high efficiency signal B field (HE-SIG-B), and

See, *supra*, §IV.C.3.[1.1]-[1.2]. Bharadwaj/Sun renders [1.3] obvious.

SAMSUNG-1003, ¶165. Bharadwaj describes a processor (processor connected to transceiver) configured to receive an HE MU PPDU. *E.g.*, SAMSUNG-1013, ¶¶[0139], [0172], FIG. 25. As shown in FIG. 3, Bharadwaj also describes that the HE MU PPDU includes a preamble with **HE-SIG-A** and **HE-SIG-B** fields. *Id.*, ¶¶[0070]-[0072], [0095]-[0097], FIGS. 3, 21A-C; SAMSUNG-1003, ¶165.

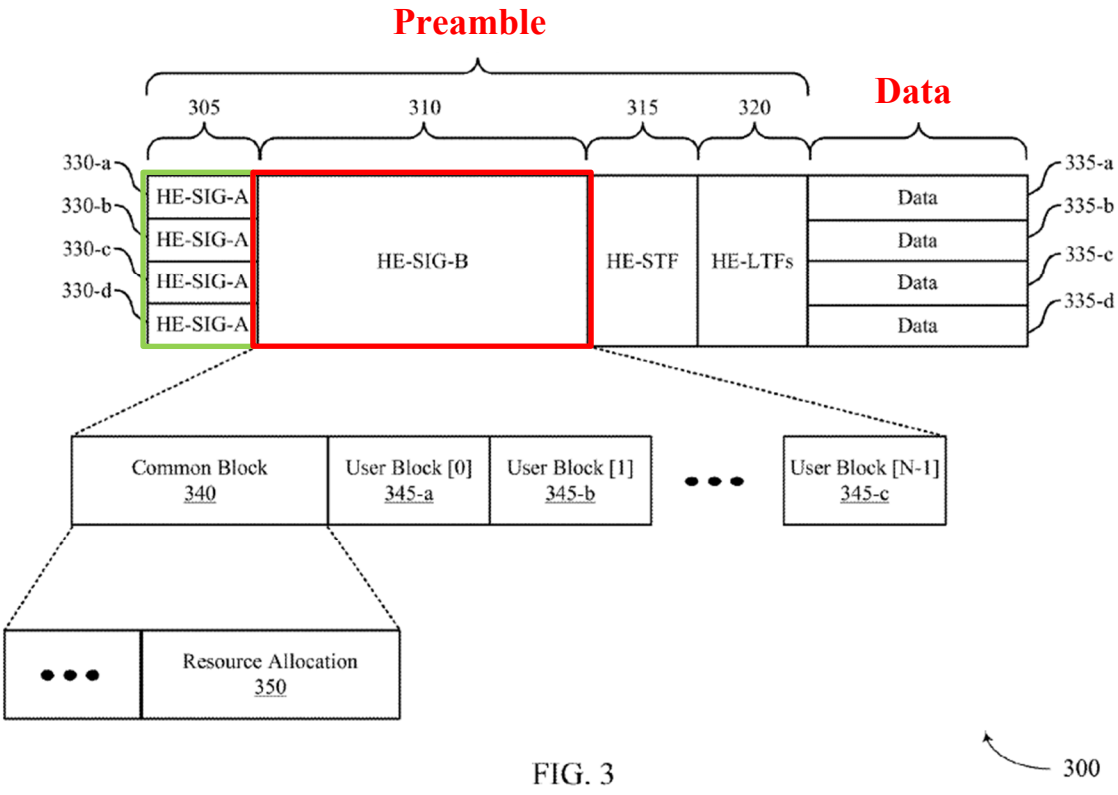


FIG. 3

SAMSUNG-1013, FIG. 3 (annotated)

Bharadwaj discloses that the User Blocks 345 are part of an HE MU PPDU. SAMSUNG-1013, ¶[0094]; SAMSUNG-1003, ¶165. A POSITA would have recognized that Bharadwaj disclosed the HE MU PPDU based on Bharadwaj's disclosure of the HE-SIG-B field, which only appears in the HE MU PPDU.

SAMSUNG-1003, ¶165.

[1.4] decode the received HE MU PPDU based on information obtained from the preamble,

Bharadwaj/Sun renders [1.4] obvious. SAMSUNG-1003, ¶166. Bharadwaj describes information provided in a preamble is used by a device to decode the subsequent data. SAMSUNG-1013, ¶[0065]. Per Bharadwaj, HE-WLAN preambles can be used to schedule multiple devices" for single-user simultaneous transmission and/or MU-MIMO transmissions. *Id*.; *see also id*., ¶[0069]; SAMSUNG-1003, ¶166. Bharadwaj also teaches that the first WLAN signaling field (i.e., the HE-SIG-A) includes information to decode the second WLAN signaling field (i.e., the HE-SIG-B). SAMSUNG-1013, ¶¶[0069]-[0071]. The second WLAN signaling field (i.e., the HE-SIG-B) includes information usable by the station to "decode data in the data field" of the HE MU PPDU. *Id*., ¶¶[0072], [0094]. Thus, a POSITA would have recognized, or found it obvious, that Bharadwaj teaches decoding the received HE MU PPDU based on information obtained from the preamble. SAMSUNG-1003, ¶166.

[1.5] wherein when a SIG-B compression field of the HE-SIG-A indicates full bandwidth multi User-Multiple Input Multiple Output(MU-MIMO) transmission, a format of user field(s) included in a user specific field of the HE-SIG-B is identified based on a number of MU-MIMO users indicated by a subfield of the HE-SIG-A,

Bharadwaj/Sun renders [1.5] obvious. SAMSUNG-1003, ¶¶167-168. Bharadwaj teaches that full bandwidth is indicated by the **SIGB Compression bit**

being set to 1 in the **HE-SIG-A**. SAMSUNG-1013, FIGS. 21A-B, shown below:

	B18: B21	SIGB Number of Symbols/ Number of MU-MIMO Users	4	When SIGB compression field=0, indicates the number of HE-SIG-B symbols. Set to n for n+1 HE-SIG-B symbol, where n = 0, 1, 2,.....15 When SIGB compression field=1, indicates the number of MU-MIMO users minus1.
Two parts of HE-SIG-A	**Bits**	**Field**	**# of bits**	**Description**
HE-SIG-A1	B22	SIGB Compression	1	Set to 1 for full BW MU-MIMO. Set to 0 otherwise.

SAMSUNG-1013, FIGS. 21A-B (annotated)

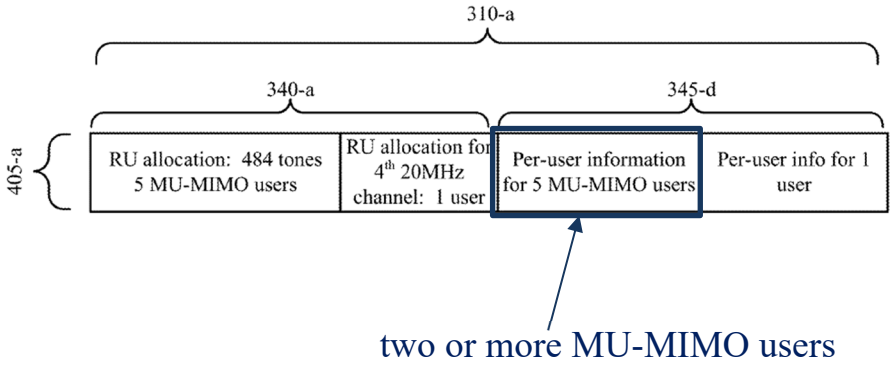
When **SIGB compression is set to 1**, the "**SIGB Number of Symbols/Number of MU-MIMO Users**" field indicates the number of MU-MIMO users. *Id.* Bharadwaj also teaches that in the full bandwidth mode, no RU signal information is transmitted in a HE-SIG-B field. *Id.*, ¶[0097]. A POSITA would have recognized, or found it obvious, therefore, that the number of MU-MIMO users was determined from the HE-SIG-A field when in full bandwidth. SAMSUNG-1003, ¶¶167-168.

Bharadwaj also describes that "the station may differentiate between SU and MU-MIMO allocations." Bharadwaj, ¶[0096]; SAMSUNG-1003, ¶¶167-168. In the combination, as described above, Bharadwaj differentiates the MU-MIMO user block from the SU (non-MU-MIMO) user block based on the number of MU-MIMO users identified in the HE-SIG-A field, where the MU-MIMO user block includes a spatial configuration subfield, and the SU (non-MU-MIMO) user block includes an Nsts subfield and a TxBF subfield. SAMSUNG-1013, ¶[0093];

SAMSUNG-1015, ¶[0084], FIG. 16B; *supra*, §IV.C.1-2. A POSITA would have understood and found it obvious that after Bharadwaj identifies the number of MU-MIMO users, it would have identified the corresponding format for the HE-SIG-B user field, as taught by both Bharadwaj (MU-MIMO) and Sun (non-MU-MIMO). SAMSUNG-1003, ¶¶167-168.

[1.6] wherein when the number of MU-MIMO users indicates two or more users, the user specific field of the HE-SIG-B includes user fields for MU-MIMO allocation, and

Bharadwaj/Sun renders [1.6] obvious. SAMSUNG-1003, ¶¶170-169. In Bharadwaj, when the number of MU-MIMO users is two or more, the HE-SIG-B field includes user fields for MU-MIMO allocation. For example, Bharadwaj describes the HE-SIG-B field includes user blocks, as shown in FIG. 5:



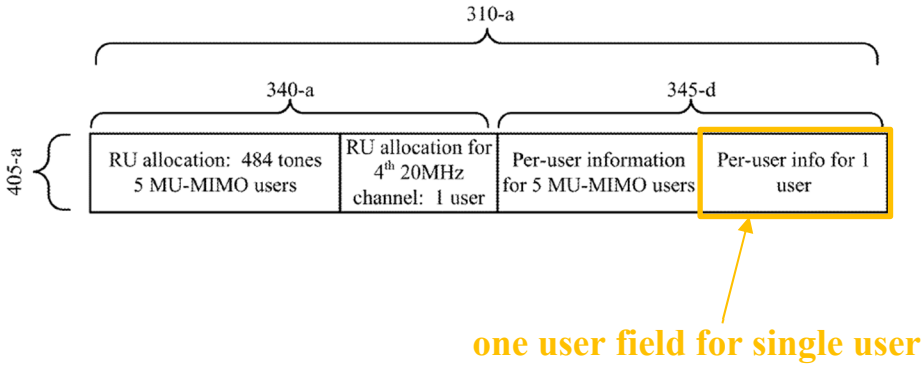
SAMSUNG-1013, FIG. 5 (annotated)

User blocks 345-d each include per user information for MU-MIMO users. SAMSUNG-1013, ¶¶[0085]-[0087], FIGS. 3, 5, 8 (full bandwidth mode); see also *id*., ¶¶[0118]-[0119], FIGS. 9A-B.

Bharadwaj also teaches that the "user field for an MU-MIMO allocation, e.g. in a HE-SIG-B field, may include a spatial configuration subfield of 4 bits indicating the number of spatial streams for each multiplexed STA, the index of the spatial stream, and the total number of spatial streams." SAMSUNG-1013, ¶[0093].

[1.7] wherein when the number of MU-MIMO users indicates a single user, the user specific field of the HE-SIG-B includes one user field for non-MU-MIMO allocation.

Bharadwaj/Sun renders [1.7] obvious. SAMSUNG-1003, ¶¶171-172. Bharadwaj describes that when the number of MU-MIMO users indicates a single user, the HE-SIG-B field includes a user-specific field for non-MU-MIMO (SU) allocation for one user. For example, Bharadwaj describes the HE-SIG-B field includes user block for a single user, as shown in FIG. 5:



SAMSUNG-1013, FIG. 5 (annotated)

SAMSUNG-1013, ¶¶[0086] ("User blocks 345-d and 345-e each include … per-user information for SU users in user blocks."), [0085], [0087], FIGS. 3, 5, 8 (full

bandwidth mode).

In the combination, Sun also describes the HE-SIG-B as including "***one*** or more user blocks 1310 respectively corresponding to ***one*** or more users (e.g., ***one*** or more client stations 25) that are scheduled to receive data." SAMSUNG-1015, ¶[0073] (emphasis added). When a single user is indicated, a single user block 1310 would thus provide a user field for a single user. *Id.*; SAMSUNG-1003, ¶¶171-172. The HE-SIG-B and user blocks are illustrated in FIGS. 13A-B, reproduced below. SAMSUNG-1015, ¶¶[0072]-[0073], FIGS. 13A-B:

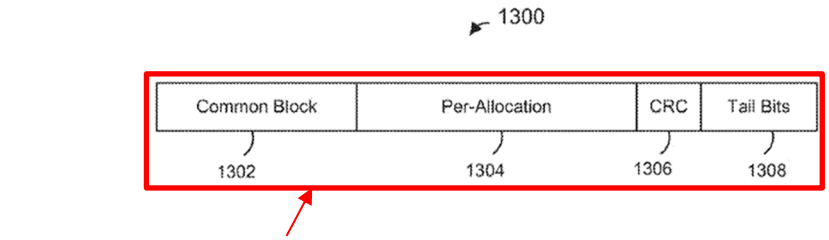


Fig. 13A

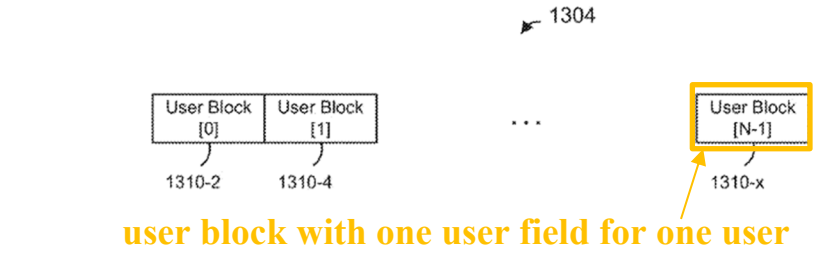


Fig. 13B

SAMSUNG-1015, FIGS. 13A-B (annotated)

4. Claim 2

[2pre] The wireless communication terminal of claim 1,

[2.1] wherein the user field(s) for MU-MIMO allocation includes a spatial

configuration field indicating the total number of spatial streams in an MU-MIMO allocation and the number of spatial streams for each terminal in the MU-MIMO allocation, and

Bharadwaj/Sun renders [2.1] obvious. SAMSUNG-1003, ¶173. Bharadwaj describes that the "user field for an MU-MIMO allocation, e.g. in a HE-SIG-B field, may include a spatial configuration subfield of 4 bits indicating the number of spatial streams for each multiplexed STA, the index of the spatial stream, and the total number of spatial streams." SAMSUNG-1013, ¶[0093].

[2.2] wherein the user field for non-MU-MIMO allocation includes a number of space time streams (NSTS) field.

Bharadwaj/Sun renders [2.2] obvious. SAMSUNG-1003, ¶¶174. Sun describes that the user field for the non-MU-MIMO allocation includes a number of space time streams field, as shown in FIG. 16B below:

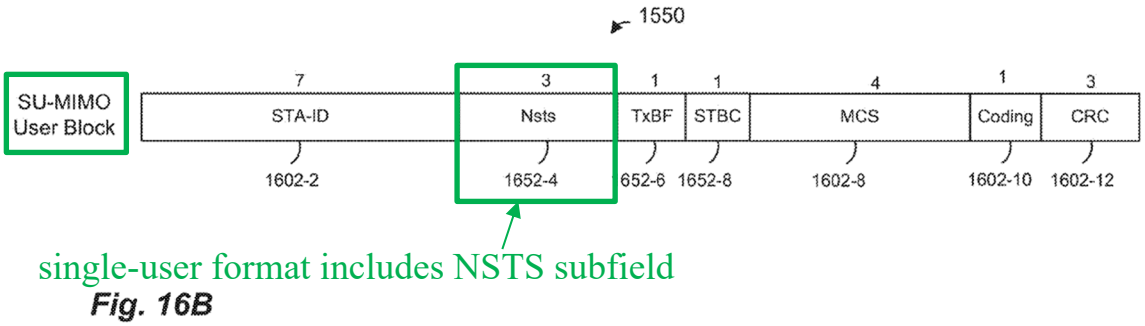


Fig. 16B

SAMSUNG-1015, FIG. 16B (annotated)

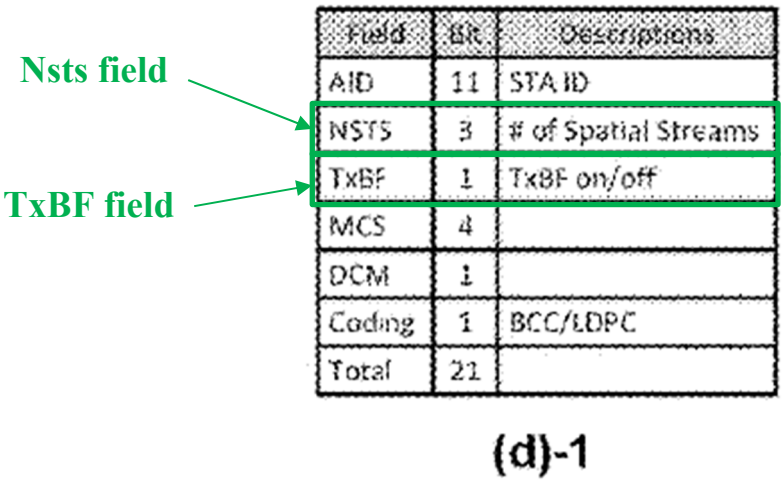
"The Nsts subfield 1652-4 includes an indication of a number of spatial or space time streams allocated to the station 25 indicated by the STA-ID subfield 1602-2 for SU transmission to the client station." SAMSUNG-1015, ¶[0084];

SAMSUNG-1003, ¶174.

5. Claim 3

The wireless communication terminal of claim 1, wherein the user field(s) for non-MU-MIMO allocation is a user field based on orthogonal frequency division multiple access (OFDMA) allocation.

Bharadwaj/Sun renders [3] obvious. SAMSUNG-1003, ¶¶175-177. In the '210 Patent, FIG. 13(d)-1 illustrates the user field for non-MU-MIMO allocation is a user field based on orthogonal frequency division multiple access (OFDMA) allocation. The '210 Patent describes FIG. 13(d)-1 as "a user field for an OFDMA transmission." '210 Patent, 20:35-36. FIG. 13(d)-1 is reproduced below:



'210 Patent, FIG. 13(d)-1 (annotated)

The '210 Patent describes that "when one user is allocated to one resource unit (i.e., non-MU-MIMO allocation), the user field includes a number of space time streams (NSTS) field, a TxBF field," etc., as illustrated in FIG. 13(d)-1. '210 Patent, 20:33-53. The '210 Patent does not provide further description of what the

user field based on OFDMA would include beyond the description of FIG. 13(d)-1.

Like the 210 Patent's description of FIG. 13(d)-1, Sun also describes the HE-SIG-B user block for SU (i.e., non-MU-MIMO) resource unit (allocation). And as shown in FIG. 16B, the user field includes subfields for NSTS and TxBF, among other things:

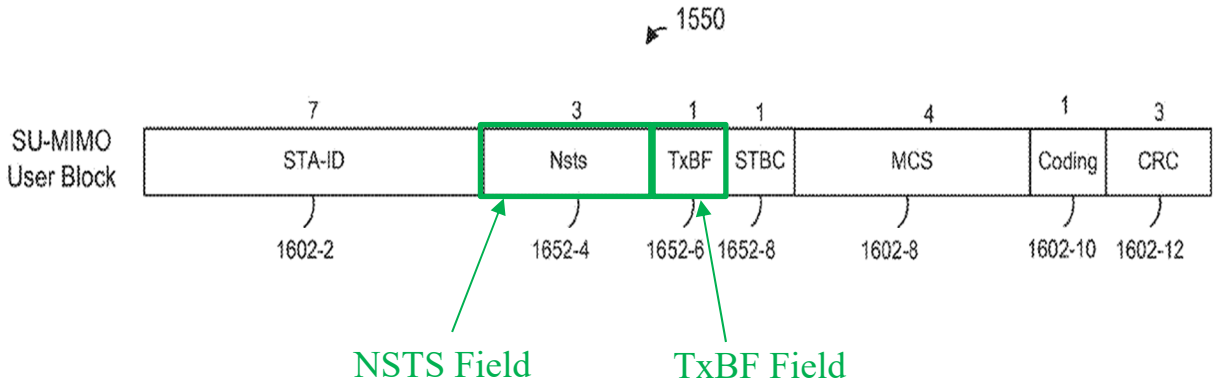


Fig. 16B

SAMSUNG-1015, FIG. 16B (annotated)

Thus, the '210 Patent's description of the user field based on orthogonal frequency division multiple access (OFDMA) allocation aligns with Sun's description of the SU-MIMO user block, which also includes the Nsts and TxBF fields. *E.g.*, SAMSUNG-1015, ¶[0084], FIG. 16B; SAMSUNG-1003, ¶¶175-177.

6. Claim 4

[4] The wireless communication terminal of claim 1, wherein the number of MU-MIMO users is indicated by a number of HE-SIG-B symbols field in the HE-SIG-A.

Bharadwaj/Sun renders [4] obvious. SAMSUNG-1003, ¶178. Bharadwaj

describes that "a **field** in the **SIG-A field** corresponding to the **number of SIG-B symbols** may be re-interpreted or repurposed" to indicate the number of MU-MIMO users. SAMSUNG-1013, ¶[0097], FIGS. 21A-B. The **HE-SIG-A** field is reproduced below:

	B18: B21	SIGB Number of Symbols/ Number of MU-MIMO Users	4	When SIGB compression field=0, indicates the number of HE-SIG-B symbols. Set to n for n+1 HE-SIG-B symbol, where n = 0, 1, 2,.....15 When SIGB compression field=1, indicates the number of MU-MIMO users minus1.
Two parts of HE-SIG-A	**Bits**	**Field**	**# of bits**	**Description**
HE-SIG-A1	B22	SIGB Compression	1	Set to 1 for full BW MU-MIMO. Set to 0 otherwise.

SAMSUNG-1013, FIGS. 21A-B (partial, annotated)

7. Claim 5

[5] The wireless communication terminal of claim 1, wherein the HE-SIG-A includes the SIG-B compression field and the specific subfield, and wherein the SIG-B compression field indicates whether full bandwidth MU-MIMO transmission is used, and when the SIG-B compression field indicates full bandwidth MU-MIMO transmission, the specific subfield indicates the number of MU-MIMO users.

See, *supra*, §IV.C.6. (claim 4). Bharadwaj/Sun renders [5] obvious. SAMSUNG-1003, ¶179. As shown in FIGS. 21A-B, Bharadwaj describes that the **HE-SIG-A** field includes the **SIGB Compression field** and the "**specific subfield**." SAMSUNG-1013, FIGS. 21A-B, reproduced below:

	B18: B21	SIGB Number of Symbols/ Number of MU-MIMO Users	4	When SIGB compression field=0, indicates the number of HE-SIG-B symbols. Set to n for n+1 HE-SIG-B symbol, where n = 0, 1, 2,.....15 When SIGB compression field=1, indicates the number of MU-MIMO users minus1.
Two parts of HE-SIG-A	**Bits**	**Field**	**# of bits**	**Description**
HE-SIG-A1	B22	SIGB Compression	1	Set to 1 for full BW MU-MIMO. Set to 0 otherwise.

SAMSUNG-1013, FIGS. 21A-B (partial, annotated)

As shown above, the SIGB compression field being set to 1 indicates "full BW MU-MIMO." Likewise, "[w]hen SIB compression field=1," the SIGB Number of Symbols/Number of MU-MIMO Users" field (specific subfield) of the HE-SIG-A "indicates the number of MU-MIMO users minus 1." SAMSUNG-1013, FIGS. 21A-B; ¶[0097].

8. Claim 6

[6pre] A wireless communication method of a wireless communication terminal, the method comprising:

See, *supra*, §IV.C.3.[1pre]; SAMSUNG-1003, ¶180.

[6.1] receiving a high efficiency multi-user PHY protocol data unit (HE MU PPDU), wherein a preamble of the HE MU PPDU includes high efficiency signal A field (HE-SIG-A) and high efficiency signal B field (HE-SIG-B); and

See, *supra*, §IV.C.3.[1.3]; SAMSUNG-1003, ¶181.

[6.2] decode the received HE MU PPDU based on information obtained from the preamble,

See, *supra*, §IV.C.3.[1.4]; SAMSUNG-1003, ¶182.

[6.3] wherein when a SIG-B compression field of the HE-SIG-A indicates full bandwidth multi User-Multiple Input Multiple Output (MU-MIMO)

transmission, a format of user field(s) included in a user specific field of the HE-SIG-B is identified based on a number of MU-MIMO users indicated by a subfield of the HE-SIG-A,

See, *supra*, §IV.C.3.[1.5]; SAMSUNG-1003, ¶183.

[6.4] wherein when the number of MU-MIMO users indicates two or more users, the user specific field of the HE-SIG-B includes user fields for MU-MIMO allocation, and

See, *supra*, §IV.C.3.[1.6]; ; SAMSUNG-1003, ¶184.

[6.5] wherein when the number of MU-MIMO users indicates a single user, the user specific field of the HE-SIG-B includes one user field for non-MU-MIMO allocation.

See, *supra*, §IV.C.3.[1.7]; SAMSUNG-1003, ¶185.

9. Claim 7

[7pre] The wireless communication method of claim 6,

[7.1] wherein the user field(s) for MU-MIMO allocation includes a spatial configuration field indicating the total number of spatial streams in an MU-MIMO allocation and the number of spatial streams for each terminal in the MU-MIMO allocation, and

See, *supra*, §IV.C.4.[2.1]; SAMSUNG-1003, ¶186.

[7.2] wherein the user field for non-MU-MIMO allocation includes a number of space time streams (NSTS) field.

See, *supra*, §IV.C.4.[2.2]; SAMSUNG-1003, ¶187.

10. Claim 8

[8] The wireless communication method of claim 6, wherein the user field(s) for non-MU-MIMO allocation is a user field based on orthogonal frequency division multiple access (OFDMA) allocation.

See, *supra*, §IV.C.5. (claim 3); SAMSUNG-1003, ¶188.

11. Claim 9

[9] The wireless communication method of claim 6, wherein the number of MU-MIMO users is indicated by a number of HE-SIG-B symbols field in the HE-SIG-A.

See, *supra*, §IV.C.6. SAMSUNG-1003, ¶189.

V. PTAB DISCRETION SHOULD NOT PRECLUDE INSTITUTION

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. SAMSUNG-1037.

VI. CONCLUSION AND FEES

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

VII. 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 '210 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 '210 Patent.

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

Petitioner provides the following designation of 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 IPR39843-0195IP1@fr.com (referencing No. 39843-0195IP1 and cc'ing PTABInbound@fr.com).

Respectfully submitted,

Dated 05/01/2025

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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 13,108 words, which is less than the 14,000 allowed under 37 CFR § 42.24.

Dated 05/01/2025

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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 1, 2025, a complete and entire copy of this Petition for Inter Partes Review and all supporting exhibits were provided by Federal Express, to the Patent Owner, by serving the correspondence address of record as follows:

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