IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent of:	Ko et al.	Attorney Docket No. 39843-0193IP1
U.S. Patent No.:	10,313,077	
Issue Date:	June 4, 2019	
Appl. Serial No.:	15/854,662	
Filing Date:	December 26, 2017	
Title:	WIRELESS COMMUNICATION METHOD AND WIRELESS COMMUNICATION TERMINAL FOR COEXISTENCE WITH LEGACY WIRELESS COMMUNICATION TERMINAL	

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PETITION FOR *INTER PARTES* REVIEW OF UNITED STATES PATENT NO. 10,313,077 PURSUANT TO 35 U.S.C. §§ 311–319, 37 C.F.R. § 42

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LISTING OF CHALLENGED CLAIMS

Claim 1	
1[pre]	A wireless communication terminal that communicates wirelessly, the terminal comprising:
1[1]	a transceiver; and a processor, wherein the processor is configured to
1[a]	receive a non-legacy physical layer frame by using the transceiver,
1[b]	obtain a legacy signaling field including information decodable by a legacy wireless communication terminal from the non-legacy physical layer frame,
1[c]	obtain length information indicating information on a duration of the non-legacy physical layer frame, from the legacy signaling field,
1[d]	obtain information other than information on the duration of the non-legacy physical layer frame through a remaining value obtained by dividing the length information by a data size transmittable by a symbol of a legacy physical layer frame, wherein the data size transmittable by a symbol of the legacy physical layer frame is 3 octets when a data rate of the legacy physical layer frame is 6 Mbps, and
1[e]	determine the number of symbols of data of the non-legacy physical layer frame according to a following equation, $N_{SYM} =$ $$\left\lfloor \left(\frac{\text{L\_LENGTH} + m + 3}{3} \times 4 - T_{HE\_PREAMBLE} \right) \Big/ T_{SYM} \right\rfloor - b_{PE\_Disambiguity}$$ where $\lfloor x \rfloor$ denotes a largest integer less than or equal to x, L_LENGTH denotes the length information, m denotes a value obtained by subtracting the remaining value from the data size transmittable by a symbol of the legacy physical layer frame, $b_{PE\_Disambiguity}$ denotes a value of PE Disambiguity field, $T_{HE\_PREAMBLE}$ denotes a duration of non-legacy preamble of the non-legacy physical layer frame, T_{SYM} denotes a duration of a symbol of the data of the non-legacy physical layer frame,

	wherein the PE Disambiguity field is set based on the duration of a symbol of the data of the non-legacy physical layer frame and an increment of duration to set a value of the length information based on a duration of a symbol of the legacy physical layer frame.
Claim 2	
2[a]	The wireless communication terminal of claim 1, wherein the processor is configured to obtain a duration of a packet extension which is a padding of the non-legacy physical layer frame, according to a following equation, $T_{PE} = \left\lfloor \frac{\left(\frac{\text{L\_LENGTH} + m + 3}{3} \times 4 - T_{HE\_PREAMBLE}\right) - N_{SYM} \times T_{SYM}}{4} \right\rfloor \times 4$ where $\lfloor x \rfloor$ denotes a largest integer less than or equal to x, L_LENGTH denotes the length information, m denotes the value obtained by subtracting the remaining value from the data size transmittable by a symbol of the legacy physical layer frame, $T_{HE\_PREAMBLE}$ denotes the duration of non-legacy preamble of the non-legacy physical layer frame, T_{SYM} denotes the duration of a symbol of the data of the non-legacy physical layer frame.
Claim 3	
3	The wireless communication terminal of claim 1, wherein the increment of duration is a value obtained by multiplying a difference between a value obtained by performing a ceiling operation on a value obtained by dividing the duration of the non-legacy physical layer frame after the legacy signaling field by the duration of a symbol of the legacy physical layer frame and the value obtained by dividing the duration of the non-legacy physical layer frame after the legacy signaling field by the duration of a symbol of the legacy physical layer frame by the duration of a symbol of the legacy physical layer frame.
Claim 4	
4	The wireless communication terminal of claim 1, wherein the processor is configured to determine a format of a non-legacy

	signaling field included in the non-legacy physical layer frame based on the length information.
Claim 5	
5	The wireless communication terminal of claim 4, wherein the processor is configured to determine whether the non-legacy physical layer frame comprises a predetermined signaling field based on the length information.
Claim 6	
6	The wireless communication terminal of claim 1, wherein the processor is configured to obtain the information other than the information on the duration of the non-legacy physical layer frame based on the remaining value and a modulation method of a third symbol after the legacy signaling field.
Claim 7	
7	The wireless communication terminal of claim 6, wherein the modulation method is Binary Phase Shift Keying (BPSK) or Quadrature Binary Phase Shift Keying (QBPSK).
Claim 8	
8[pre]	An operation method of a wireless communication terminal that communicates wirelessly, the method comprising:
8[a]	receiving a non-legacy physical layer frame by using the transceiver,
8[b]	obtaining a legacy signaling field including information decodable by a legacy wireless communication terminal from the non-legacy physical layer frame,
8[c]	obtaining length information indicating information on a duration of the non-legacy physical layer frame after the legacy signaling field, from the legacy signaling field,
8[d]	obtaining information other than information on the duration of the non-legacy physical layer frame through a remaining value obtained by dividing the length information by a data size transmittable by a symbol of a legacy physical layer frame, wherein the data size transmittable by a symbol of the legacy physical layer frame is 3

	octets when a data rate of the legacy physical layer frame is 6 Mbps, and
8[e]	determining the number of symbols of data of the non-legacy physical layer frame according to a following equation, N_{SYM} = $$\left\lfloor \left(\frac{\text{L\_LENGTH} + m + 3}{3} \times 4 - T_{HE\_PREAMBLE} \right) \Big/ T_{SYM} \right\rfloor - b_{PE\_Disambiguity}$$ where ⌊x⌋ denotes a largest integer less than or equal to x, L_LENGTH denotes the length information, m denotes a value obtained by subtracting the remaining value from the data size transmittable by a symbol of the legacy physical layer frame, $b_{PE\_Disambiguity}$ denotes a value of PE Disambiguity field, $T_{HE\_PREAMBLE}$ denotes a duration of non-legacy preamble of the non-legacy physical layer frame, T_{SYM} denotes a duration of a symbol of the data of the non-legacy physical layer frame, wherein the PE Disambiguity field is set based on the duration of a symbol of the data of the non-legacy physical layer frame and an increment of duration to set a value of the length information based on a duration of a symbol of the legacy physical layer frame.
Claim 9	
9[a]	The method of claim 8, the method further comprises obtaining a duration of a packet extension which is a padding of the non-legacy physical layer frame, according to a following equation, $$T_{PE} = \left\lfloor \frac{\left(\frac{\text{L\_LENGTH} + m + 3}{3} \times 4 - T_{HE\_PREAMBLE} \right) - N_{SYM} \times T_{SYM}}{4} \right\rfloor \times 4$$ where ⌊x⌋ denotes a largest integer less than or equal to x, L_LENGTH denotes the length information, m denotes the value obtained by subtracting the remaining value from the data size transmittable by a symbol of the legacy physical layer frame, $T_{HE\_PREAMBLE}$ denotes the duration of non-legacy preamble of the non-legacy physical layer frame,

	T_{SYM} denotes the duration of a symbol of the data of the non-legacy physical layer frame.
Claim 10	
10	The method of claim 8, wherein the increment of duration is a value obtained by multiplying a difference between a value obtained by performing a ceiling operation on a value obtained by dividing the duration of the non-legacy physical layer frame after the legacy signaling field by the duration of a symbol of the legacy physical layer frame and the value obtained by dividing the duration of the non-legacy physical layer frame after the legacy signaling field by the duration of a symbol of the legacy physical layer frame by the duration of a symbol of the legacy physical layer frame.
Claim 11	
11	The method of claim 8, the method further comprises determining a format of a non-legacy signaling field included in the non-legacy physical layer frame based on the length information.
Claim 12	
12	The method of claim 11, wherein determining the format of a non-legacy signaling field included in the non-legacy physical layer frame comprises determining whether the non-legacy physical layer frame comprises a predetermined signaling field based on the length information.
Claim 13	
13	The method of claim 8, wherein the obtaining the information other than the information on the duration of the non-legacy physical layer frame comprises obtaining the information other than the information on the duration of the non-legacy physical layer frame based on the remaining value and a modulation method of a third symbol after the legacy signaling field.
Claim 14	
14	The method of claim 13, wherein the modulation method is Binary Phase Shift Keying (BPSK) or Quadrature Binary Phase Shift Keying (QBPSK).

Samsung Electronics Co., Ltd. ("Petitioner" or "Samsung") petitions for *Inter Partes* Review ("IPR") of claims 1-14 ("the Challenged Claims") of U.S. Patent No. 10,313,077 ("the '077 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 '077 patent is available for IPR. This Petition is being filed within one year of service of a complaint against Samsung. SAMSUNG-1004. 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 IPR of the Challenged Claims on the grounds indicated below. Grounds 1A-2C are supported and corroborated by evidence cited throughout this Petition, including by the expert declaration of Dr. Zhi Ding. SAMSUNG-1003, ¶40.

Ground	Claim(s)	35 U.S.C. § 103
1A	1-5, 8-12	Bharadwaj in view of Yu
1B	4-5, 11-12	Bharadwaj in view of Yu and Azizi
1C	6-7, 13-14	Bharadwaj in view of Yu and Kenney

Ground	Claim(s)	35 U.S.C. § 103
2A	1-5, 8-12	Bharadwaj
2B	4-5, 11-12	Bharadwaj in view of Azizi
2C	6-7, 13-14	Bharadwaj in view of Kenney

As discussed below, the ’077 patent is not entitled to the filing date of Korean Application 10-2015-0092525 and, as such, the earliest effective filing date of the ’077 patent is no earlier than August 20, 2015 (“Critical Date”). Each of the references in Grounds 1A-2C pre-date the Critical Date. Even if the ’077 patent was entitled to its earliest alleged priority date (June 29, 2015), each of the references in Grounds 1A-2C likewise pre-dates the earliest alleged priority date.

Reference	Filed	Published	AIA Prior Art Basis
Bharadwaj	6/2/2015	11/24/2016	§102(a)(2)
Yu	3/25/2015	9/29/2016	§102(a)(2)
Azizi	12/22/2014	5/5/2016	§102(a)(2)
Kenney	6/13/2014	5/21/2015	§102(a)(1)-(2)

Bharadwaj claims priority to a pair of provisional applications including U.S. Provisional Application 62/170,059 (“Bharadwaj-Prov059”, SAMSUNG-1007), filed June 2, 2015. Bharadwaj-Prov059 fully supports the disclosures of Bharadwaj relied upon in this Petition. SAMSUNG-1003, ¶55. Bharadwaj-

Prov059 also readily supports claims of Bharadwaj, and would have qualified under no-longer applicable *Dynamic Drinkware* jurisprudence. *Penumbra, Inc. v. RapidPulse, Inc.*, IPR2021-01466, Paper 34 (March 10, 2023) (precedential as to §II.E.3). In fact, the following claims of Bharadwaj-Prov059 were carried forward into Bharadwaj demonstrating direct claim-level support:

Bharadwaj-Prov059	Bharadwaj
Claim 1	Claim 1
Claim 12	Claim 9
Claim 13	Claim 17
Claim 14	Claim 25
Claim 7	Claim 33
Claim 16	Claim 39
Claim 17	Claim 45
Claim 18	Claim 51

SAMSUNG-1003, ¶55.

Yu claims priority to a pair of provisional applications including U.S. Provisional Application 62/138,294 (“Yu-Prov294”, SAMSUNG-1021), filed March 25, 2015 and U.S. Provisional Application 62/145,428 (“Yu-Prov428” SAMSUNG-1020) filed Apr. 9, 2015. Yu-Prov428 fully supports the disclosures of Yu relied upon in this Petition. SAMSUNG-1003, ¶59. Yu-Prov294 also readily supports claims of Yu, and would have qualified under no-longer applicable *Dynamic Drinkware* jurisprudence. *Id*. In fact, at least the following claims of Yu are supported by Yu-Prov294 demonstrating direct claim-level support:

Yu	Exemplary disclosure from Yu-Prov294
Claim 1	"To begin the UL transmission, any kind of a trigger frame from an AP should initiate the UL transmission of STAs. This trigger frame is sent by the AP and TXOP for UL transmission will start. With this trigger frame, each UL STA can estimate the carrier frequency offset with L-STF and L-LTF, and further track the frequency offset with pilots in each DATA OFDM symbols as shown in Fig. 1. This CFO estimate is calculated in PHY layer and this value can be used as a pre-compensation CFO without any aid of MAC layer when the next transmitted packet is sent to an AP, i.e. an UL MU packet. … To this end, the estimated CFO value should be included in RXVECTOR delivered by PHY layer to MAC layer. … Next, MAC layer delivers the CFO value to PHY layer for CFO and SFO precompensation. … When non-zero CFO value is delivered from MAC, PHY performs precompensation of CFO and SFO (sampling frequency offset) with the value in time and frequency domains, respectively, as shown in Fig. 3." SAMSUNG-1021, 25-26[1]. "CFO value should be defined in TXVECTOR and RXVECTOR." SAMSUNG-1021, 27. "In receiver operation, PHY layer calculates the CFO value to decode the received packet." SAMSUNG-1021, 28.

[1] Citations to SEC-1021 are to page numbers of the PDF document.

Claim 9	"Then CFO in TXVECTOR can be used both SFO precompensation block and CFO precompensation block. These two precompensation can be applied in time domain (after IDFT) and frequency domain (before IDFT). Because CFO is an incremental phase in time domain, it can be applied in time domain as in Fig. 3. SFO is an incremental phase in frequency domain if the accumulated offset does exceed the sample boundary, i.e., SFO is in fractional sample level. Therefore, SFO pre-compensation is done in frequency domain." SAMSUNG-1021, 26-29.

SAMSUNG-1003, ¶59.

Further, at least the following claim of Yu is supported by Yu-Prov428 demonstrating direct claim-level support:

Yu	Exemplary disclosure from Yu-Prov428
Claim 13	"The number of used data tones in the last OFDM symbol can be obtained by the payload size (the number of bytes)…. and then the waveforms of the IDFT output have the repetition property…. To save the transmission time, the transmitter sends the only one repeated waveform with CP for the last OFDM symbol." SAMSUNG-1020, 10-14[2].

SAMSUNG-1003, ¶60.

[2] Citations to SEC-1020 are to page numbers of the PDF document.

II. THE ’077 PATENT

A. Brief Description

The ’077 patent describes “a wireless communication environment in which a legacy wireless communication terminal and a non-legacy wireless communication terminal coexist.” SAMSUNG-1001, 1:21-25. The wireless communication environment can include a “wireless LAN system” “following a regulation of an IEEE 802.11 standard.” SAMSUNG-1001, 7:41-8:24. The system includes a station that “transmits and receives a wireless signal such as a wireless LAN physical layer frame.” SAMSUNG-1001, 8:43-50; SAMSUNG-1003, ¶45.

In the ’077 patent, a “non-legacy wireless communication terminal may transmit signaling information decodable by a legacy wireless communication terminal through a physical layer frame. Signaling information decodable by a legacy wireless communication terminal, which is transmitted through a physical layer frame, is also referred to as L-SIG.” SAMSUNG-1001, 11:25-31. The L-SIG includes “an L_LENGTH field indicating a length of a physical layer frame” after L-SIG. SAMSUNG-1001, 19:49-53, 28:48-51. “The non-legacy wireless communication terminal may set the value of L_LENGTH through the equation of FIG. 24” below.

$$L\_LENGTH = \left\lceil \frac{TXTIME - 20}{4} \right\rceil \times 3 - 3$$

SAMSUNG-1001, FIG. 24; SAMSUNG-1003, ¶46.

If a non-legacy physical layer frame includes a packet extension, "information that disambiguates ambiguity on whether or not the packet extension of the non-legacy physical layer frame is included may be included in the non-legacy signaling field of the non-legacy physical layer frame." SAMSUNG-1001, 30:38-67. Information that "disambiguates ambiguity on whether a packet extension is included is referred to as a PE-Disambiguity field." *Id.* "The wireless communication terminal receiving the non-legacy physical layer frame may obtain the number of symbols N_{SYM} including data based on the value of the L_LENGTH field and the value $b_{PE\_Disambiguity}$ of the PE disambiguity field" according to the following equation.

$$N_{SYM} = \left\lfloor \left(\frac{L\_LENGTH + 3}{3} \times 4 - T_{HE\_PREAMBLE} \right) / T_{SYM} \right\rfloor - b_{PE\_Disambiguity}$$

SAMSUNG-1001, 31:65-32:22, FIG. 26; SAMSUNG-1003, ¶47.

"The legacy wireless communication terminal obtains the duration RXTIME of the non-legacy physical layer frame based on L_LENGTH" according to the following equation.

$$RXTIME = \left\lceil \frac{L\_LENGTH + 3}{3} \right\rceil \times 4 + 20$$

SAMSUNG-1001, 32:41-33:48, FIG. 27. Because "the legacy wireless communication terminal performs a ceiling operation…, the legacy wireless communication terminal may process L_LENGTH having different lengths… even if the value of the L_LENGTH changes from 31 to 32 or 33. With this feature, the non-legacy physical wireless communication terminal may signal information other than the duration of the non-legacy physical layer frame… through the remainder when the L-LENGTH is divided by 3." SAMSUNG-1001, 33:28-65, 36:43-37:11. "For this, when the non-legacy wireless communication terminal sets the length of the L_LENGTH, the non-legacy wireless communication terminal should add or subtract a positive integer less than the size of data transmittable by… the legacy physical layer frame in the length set based on the duration of the non-legacy physical layer frame." SAMSUNG-1001, 34:27-39; SAMSUNG-1003, ¶48.

The '077 patent describes an embodiment where a transmitting wireless communication terminal "subtracts a predetermined integer according to the format of a non-legacy signaling field while setting L_LENGTH." SAMSUNG-1001, 36:13-16, FIG. 30. The predetermined integer is "a positive integer m smaller than the size of data transmittable by one symbol of the legacy physical layer frame" and “may be 1 or 2” when “the data rate of the legacy physical layer frame is 6 Mbps” and “the size of data that one symbol of the legacy physical layer frame may transmit is 3 bytes.” SAMSUNG-1001, 36:17-42. In this embodiment, a wireless communication terminal sets the value of L_LENGTH through the equation below.

$$L\_LENGTH_{fairness} = \left\lceil \frac{TXTIME - 20}{4} \right\rceil \times 3 - 3 - m, \qquad m = 1\ or\ 2$$

SAMSUNG-1001, FIG. 30. The “wireless communication terminal receiving the non-legacy physical layer frame may obtain the number of symbols N_{SYM} including data based on the value of the L_LENGTH field and the value $b_{PE\_Disambiguity}$ of the PE disambiguity field” according to the equation below.

$$N_{SYM} = \left\lfloor \left(\frac{L\_LENGTH + m + 3}{3} \times 4 - T_{HE\_PREAMBLE} \right) / T_{SYM} \right\rfloor - b_{PE\_Disambiguity}$$

SAMSUNG-1001, 37:12-51, FIG. 31; SAMSUMG-1003, ¶49.

B. Prosecution History

The application that issued as the ’077 patent was allowed with no prior art rejections. As reasons for allowance, the examiner stated that no prior art discloses elements 1[d]/8[d] and 1[e]/8[e]. SAMSUNG-1002, 259-260. The examiner noted that some prior art was made of record but not relied upon in a rejection. *Id.* As demonstrated below in Grounds 1A-2C, however, the prior art and evidence cited in this Petition would have rendered obvious the claim elements that the examiner apparently believed to be missing from the prior art. SAMSUNG-1003, ¶50.

C. 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, ¶42. Increased educational experience can make up for less work experience, and vice versa. *Id*.

D. 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.

E. Priority Date of the Challenged Claims

A U.S. patent application is entitled to assert priority to the filing date of an earlier-filed foreign application "for the same invention." 35 U.S.C. §119(a). This requires that the earlier-filed foreign application must, among other requirements, provide written description support under 35 U.S.C. §112 for the claimed subject matter in the later-filed U.S. application. *See In re Ziegler*, 992 F.2d 1197, 1200 (Fed. Cir. 1993) ("A foreign patent application must meet the requirements of 35 U.S.C. § 112, first paragraph, in order for a later filed United States application to be entitled to the benefit of the foreign filing date under 35 U.S.C. § 119."). "To satisfy the written description requirement, a patent's specification must 'reasonably convey[] to those skilled in the art that the inventor had possession of the claimed subject matter as of the filing date.'" *Novartis Pharms. Corp. v. Accord Healthcare, Inc.*, 38 F.4th 1013, 1016 (Fed. Cir. 2022) (alteration in original) (quoting *Ariad Pharms., Inc. v. Eli Lily & Co*., 598 F.3d 1336, 1351 (Fed. Cir. 2010) (en banc)).

Here, the Challenged Claims are not entitled to the benefit of the June 29, 2015 filing date of Korean Application No. 10-2015-0092525 ("the KR-525 Application") because claims 1-14 lack written description support in the KR-525 Application. *See Falko-Gunter Falkner v. Inglis*, 448 F.3d 1357 (Fed. Cir. 2006); SAMSUNG-1003, ¶¶51-54. As Dr. Ding explains, the KR-525 Application fails to disclose either expressly or inherently all elements of any Challenged Claim, and further fails to reasonably convey to a POSITA that the inventors were in possession of the claimed subject matter. SAMSUNG-1003, ¶51; *PowerOasis, Inc. v. T-Mobile USA, Inc.*, 522 F.3d 1299, 1306-07 (Fed. Cir. 2008). For example, each of the Challenged Claims requires a wireless communication terminal that obtains "information other than information on the duration of the non-legacy physical layer frame through a remaining value obtained by dividing the length information by a data size transmittable by a symbol of a legacy physical layer frame" (elements 1[d]/8[d]) and determines "the number of symbols of data of the non-legacy physical layer frame according to a following equation,

$$N_{SYM} = \left\lfloor \left(\frac{\text{L\_LENGTH} + m + 3}{3} \times 4 - T_{HE\_PREAMBLE} \right) \Big/ T_{SYM} \right\rfloor - b_{PE\_Disambiguity},$$

" (elements 1[e]/8[e]). The KR-525 Application discloses no such wireless communication terminal that performs these functions. SAMSUNG-1003, ¶52.

For example, although KR-525 Application's paragraphs 48-50, 64, 69, and 88 mention length information and paragraphs 52, 54, 57, 60-61, 87, 89, 94 mention symbols, nothing in the KR-525 Application discloses or conveys possession of the specific features recited in elements 1[d], 1[e], 8[d], and 8[e] of the '077 patent. *See generally,* SAMSUNG-1005. Consequently, the KR-525

Application fails to provide written description support for the Challenged Claims. SAMSUNG-1003, ¶53. The introduction of these features into the claims resulted in the ’077 patent claims not being entitled to the KR-525 Application filing date of June 29, 2015, the Challenged Claims are, at most, entitled to an effective filing date no earlier than August 20, 2015.[3]

III. THE CHALLENGED CLAIMS ARE UNPATENTABLE

A. GROUND 1A—Obvious based on Bharadwaj in view of Yu (Claims 1-5 and 8-12)

1. Overview of Bharadwaj

Bharadwaj (SAMSUNG-1006) claims priority to Bharadwaj-Prov059 (SAMSUNG-1007), which Bharadwaj “expressly incorporate[s] by reference herein for all purposes.” SAMSUNG-1006, [0001]. Accordingly, Bharadwaj unambiguously incorporates the entire contents of Bharadwaj-Prov059, making Bharadwaj-Prov059 part of Bharadwaj’s disclosure. *Advanced Display Sys., Inc. v.*

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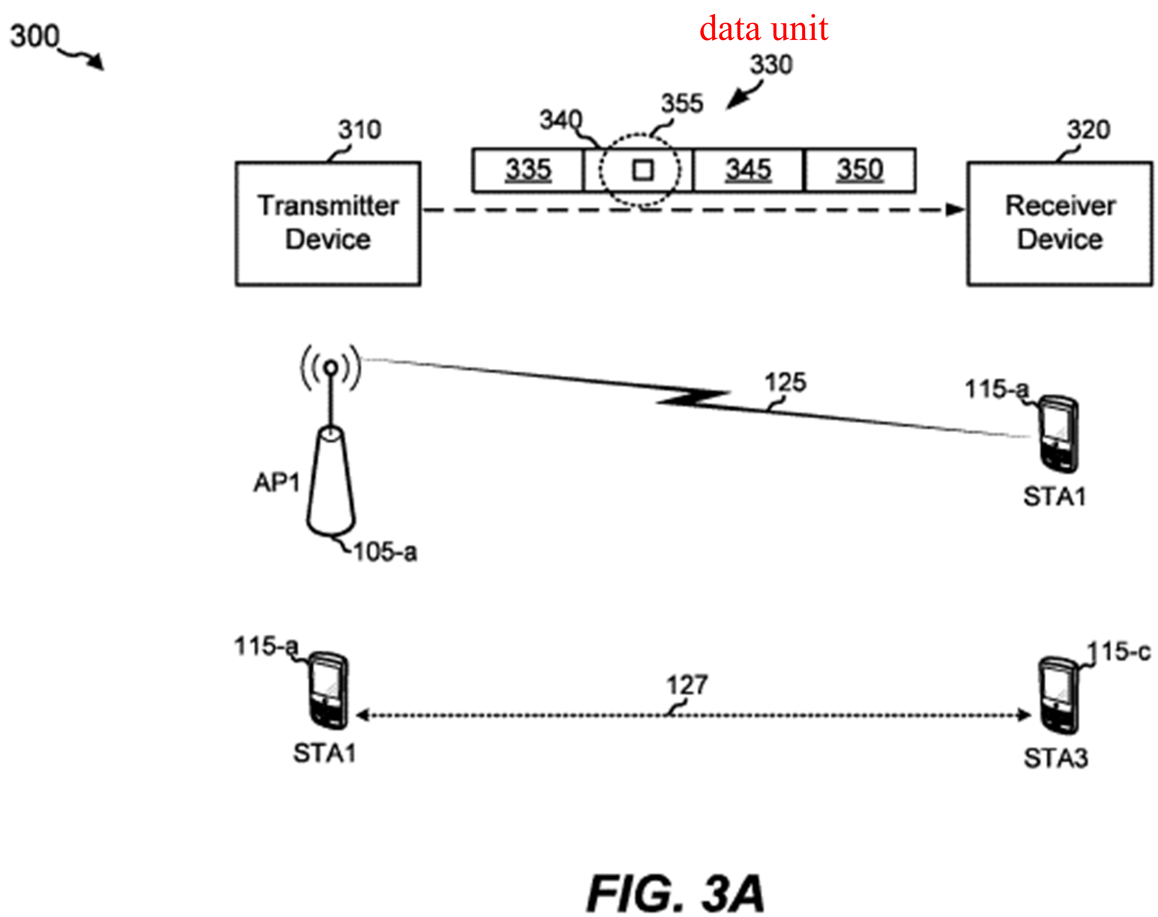
[3] The prior art cited in this Petition all pre-dates the August 20, 2015 filing date of Korean Application No. 10-2015-0117434 (“the KR-434 Application”). Petitioner does not presently take a position on whether the Challenged Claims are entitled to the benefit of the KR-434 Application’s filing date since that question need not be resolved for purposes of applying the prior art cited in this Petition.

Kent State Univ., 212 F.3d 1272, 1282 (Fed. Cir. 2000) ("Material not explicitly contained in the single, prior art document may still be considered for purposes of anticipation if that material is incorporated by reference into the document."); *Apple, Inc. v. Realtime Data LLC*, IPR2016-01365, Paper 26, 37-39 (PTAB Jan. 17, 2018) (holding that the statement "incorporated by reference in its entirety as though fully and completely set forth herein" in a reference, Dye, to incorporate the teachings of Dye '284 was sufficient to establish that Dye '284 is effectively part of Dye); 37 C.F.R. 1.57(d); SAMSUNG-1003, ¶56.

Bharadwaj-Prov059, and thus Bharadwaj itself through its incorporation of Bharadwaj-Prov059, describes "techniques for signal extension signaling." SAMSUNG-1007, [0001]. Bharadwaj-Prov059 illustrates in FIG. 3A "a conceptual diagram 300 illustrating an example of signal extension signaling from a transmitter device 310 to a receiver device 320" where "data unit 330 is shown to generally include a legacy preamble 335, a high efficiency (HE) preamble 340, which typically includes the single signaling bit 335 [sic] used for the single-bit signaling scheme, data portion 345, and signal extension 350." SAMSUNG-1007, [0043]-[0044]; SAMSUNG-1003, ¶57.



SAMSUNG-1007, FIG. 3A

In Bharadwaj-Prov059, the "value of the duration of the data unit 330 in number of bytes is determined by the transmitter device 310 based on the time duration of the data unit 300 (TXTIME)" according to the following equation:

$$L_{LENGTH} = \left\lceil \frac{TXTIME - 20}{4} \right\rceil \times 3 - 3 + m \text{ where } m = 1, 2$$

(SAMSUNG-1007, [0051]), and the "time duration of the data unit 330 is determined by the receiver device 320 based on the duration of the data unit 330 in number of bytes (L_LENGTH). That is, at the receiver device 320, the duration

RXTIME of the data unit 330 is computed from L_LENGTH in the L-SIG as follows (Equation 5).” SAMSUNG-1007, [0055].

$$RXTIME = \left\lceil \frac{L_{LENGTH} - m + 3}{3} \right\rceil \times 4 + 20$$

SAMSUNG-1007, [0056]. Bharadwaj-Prov059 explains that once “the RXTIME is known, the number of data symbols, Nsym, is computed or determined by the receiver device 320 using the following expression (Equation 6):”

$$N_{sym} = \left\lfloor \frac{RXTIME - T_{L\_PREAMBLE} - T_{HE\_PREAMBLE}}{T_{sym}} \right\rfloor - SE_{disambiguation\_bit}.$$

SAMSUNG-1007, [0057]. When $T_{L\_PREAMBLE}$ = 20 μs (SAMSUNG-1007, [0059]), Equation 6 can be written to incorporate Equation 5 as follows:

$$N_{sym} = \left\lfloor \frac{\left\lceil \frac{L_{LENGTH} - m + 3}{3} \right\rceil \times 4 - T_{HE\_PREAMBLE}}{T_{SYM}} \right\rfloor - SE_{disambiguation\_bit}$$

SAMSUNG-1003, ¶58.

2. Overview of Yu

Yu (SAMSUNG-1019) claims priority to Yu-Prov428 (SAMSUNG-1020), “the entire contents of which are incorporated [into Yu] by reference.” SAMSUNG-1019, [0001]. Accordingly, Yu unambiguously incorporates the entire contents of Yu-Prov428, making Yu-Prov428 part of Yu’s disclosure. 37 C.F.R. 1.57(d); SAMSUNG-1003, ¶61.

Yu-Prov428, and thus Yu by virtue of its incorporation of Yu-Prov428, describes a padding scheme for IEEE 802.11ax (also referred to as "HEW" or "High Efficiency WLAN"). SAMSUNG-1020, 5. Yu-Prov428 proposes "different OFDM subcarrier mapping and modulation methods depending on the payload size." SAMSUNG-1020, 10; SAMSUNG-1019, [0230]. Because "the symbol structure can be changed depending on the payload size," Yu-Prov428 describes a "way to indicate the structure of the last symbol." SAMSUNG-1020, 16; SAMSUNG-1019, [0230]. Yu-Prov428 explains that "HE-SIG field can be used" and "dedicated bits can be assigned for the purpose." SAMSUNG-1020, 16; SAMSUNG-1019, [0231]. But if "the dedicated bits in HE-SIG is not available," "the L-LENGTH field, the LENGTH [field] in the legacy SIG, can be used" to indicate the structure of the last symbol by using "L-LENGTH information with M in the following equation." SAMSUNG-1020, 16; SAMSUNG-1019, [0232].

$$\text{Length} = \frac{\text{TXTIME-20}}{4} \times 3 - 3 - M, \; 0 \le M \le 2$$

Id. Yu-Prov428 discloses that this "L-LENGTH can imply three different states with the value of M without changing the operation of the legacy receiver" because "the legacy receiver [will] identify the same length (the same packet duration) because one OFDM symbol with the lowest rate includes 3 bytes data." *Id.*; SAMSUNG-1003, ¶62.

3. Combination of Bharadwaj in view of Yu

While Bharadwaj-Prov059 explicitly discloses the following examples for calculating L_{LENGTH} and Nsym using the following equations,

$$L_{LENGTH} = \left\lceil \frac{TXTIME-20}{4} \right\rceil \times 3 - 3 + m \text{ where } m = 1,2$$

$$N_{sym} = \left\lfloor \frac{\left\lceil \frac{L_{LENGTH} - m + 3}{3} \right\rceil \times 4 - T_{HE\_PREAMBLE}}{T_{SYM}} \right\rfloor - SE_{disambiguation\_bit}$$

Bharadwaj-Prov059 also discloses that the value of m is merely used to "ensure that L_{LENGTH} is not exactly a multiple of 3 and is therefore used to distinguish between IEEE 802.11ax and IEEE 802.11ac transmissions (e.g., auto-detections)." SAMSUNG-1007, [0051]-[0052]. Noticeably, Bharadwaj-Prov059's transmitter device 310 signals whether the transmission is an 802.11ax or 802.11ac transmission by *adding* m=+1 or +2 to the value of L_{LENGTH} communicated to the receiver device 320. *Id.* Because the addition of m in the L_{LENGTH} equation would potentially cause the receiver device 320 to miscalculate the number of data symbols N_{sym} as being greater than the actual number of data symbols in the transmission, the receiver device 320 compensates by determining m as the remaining value of L_{LENGTH} / 3 and then *subtracting* m from L_{LENGTH} in the N_{sym} equation, thereby recovering the actual transmission length apart from m. *Id.*; SAMSUNG-1003, ¶63.

The need identified by Bharadwaj-Prov059 to "distinguish between IEEE 802.11ax and IEEE 802.11ac transmissions," as well as the use of a remaining value applied to the L_{LENGTH} equation to signal this distinction, was also recognized by others in the field before the '077 patent. SAMSUNG-1010, [0017] ("a technique to identify each transmission as either a HEW packet or a legacy packet is needed"), [0018]-[0020], [0024], [0036], [0038]-[0042], [0059]-[0060], [0063], [0065]; SAMSUNG-1012, [0057], [0068] ("a LENGTH field whose value is not divisible by 3 is a differentiating factor between for example, a WLAN 802.11ax and a WLAN 802.11ac frame"), [0073], [0080]-[0081]; SAMSUNG-1013, [0055]-[0056]; SAMSUNG-1014, [0039], [0077] ("determine whether a received frame is an HEW frame or a legacy frame based on whether a value in the length field of the L-SIG is divisible three"); SAMSUNG-1015, [0051]-[0052] ("The HEW device 104 needs a way to recognize HE packets and a way to indicate to legacy devices 106"); SAMSUNG-1003, ¶64.

A POSITA would have understood that there were only a small number of values for m that could be applied to L_{LENGTH} by the transmitter and that could be uniquely recovered by the receiver through calculation of the remainder L_{LENGTH} / 3—namely, a non-zero remainder could only equal 1 or 2, which are the only values less than the divisor of 3. Any larger values of m added to L_{LENGTH} by the transmitter (e.g., m=4, 5, 7, or 8) would still produce only remainder values of m=1 or 2 at the receiver. SAMSUNG-1003, ¶65. A POSITA likewise would have understood that the values of m=1 or 2 could only be applied as a constant offset by *addition* to the L_{LENGTH} equation at the transmitter (as disclosed in Bharadwaj-Prov059) or *subtraction* from the L_{LENGTH} equation at the transmitter (as disclosed in Yu-Prov428). *Id.* Indeed, Yu-Prov428, which also pre-dates the '077 patent, discloses the following Length equation that *subtracts* a value of M=0, 1, or 2 depending on the signaling state:

$$\text{Length} = \frac{TXTIME - 20}{4} \times 3 - 3 - M,\ 0 \le M \le 2$$

SAMSUNG-1020, 16; SAMSUNG-1019, [0232]. Yu-Prov428 explains that this "L-LENGTH can imply three different states with the value of M without changing the operation of the legacy receiver" because "the legacy receiver [will] identify the same length (the same packet duration) because one OFDM symbol with the lowest rate includes 3 bytes data." *Id.* In other words, Yu-Prov428 recognized a benefit to signaling additional information in the Length equation in a manner that involves *subtracting* m because it would not disturb the operation of legacy receivers that did not recognize m as additional signaling information and that were not configured to compensate for the transmitter's application of m before making use of the Length value (only non-legacy receivers would be capable of recognizing m or reversing its application when using the Length value at the receiver).[4] SAMSUNG-1003, ¶65.

Based on Yu-Prov428's teachings, a POSITA would have found it obvious and straightforward to implement Bharadwaj-Prov059's transmitter device such that it would signal information distinguishing "between IEEE 802.11ax and IEEE 802.11ac transmissions" by *subtracting* m in the L_{LENGTH} equation, rather than *adding* m as Bharadwaj-Prov059 originally proposed:

$$L_{LENGTH} = \left\lceil \frac{TXTIME - 20}{4} \right\rceil \times 3 - 3 - m$$

SAMSUNG-1003, ¶66; SAMSUNG-1020, 16; SAMSUNG-1019, [0232]; *see also* SAMSUNG-1007, [0051]. A POSITA would have been motivated to apply Yu-Prov428's suggestion in this regard to Bharadwaj-Prov059's receiver device to provide additional information (e.g., information distinguishing between 802.11ax and 802.11ac transmissions) through L_LENGTH "without changing the operation of the legacy receiver" and to allow legacy devices to correctly calculate Nsym and RXTIME so that the legacy devices need not defer transmissions for a longer

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[4] Yu-Prov428's concerns with legacy compatibility and coexistence are fundamentally the same concerns that later motivated the proposal to subtract "m" in the length equation of the '077 patent. SEC-1001, 35:56-36:42; SEC-1003, ¶65.

duration than required. SAMSUNG-1003, ¶66; SAMSUNG-1020, 16; SAMSUNG-1019, [0232]; SAMSUNG-1008, 818-819; SAMSUNG-1010, [0017]-[0020], [0024]-[0025], [0036], [0041]; SAMSUNG-1015, [0048], [0051].

For example, for legacy devices that operate according to the 802.11ac standard like those described in Bharadwaj-Prov059 (SAMSUNG-1007, [0003], [0062])), the receiver calculates the duration of the transmitted data unit using the following equation:

$$RXTIME = \left\lceil \frac{LENGTH + 3}{3} \right\rceil \times 4 + 20$$

SAMSUNG-1009, 313-314. As an example, when LENGTH = 240, the desired RXTIME for legacy 802.11ac devices would be computed as follows:

$$RXTIME = \left\lceil \frac{240 + 3}{3} \right\rceil \times 4 + 20 = 344$$

SAMSUNG-1003, ¶67. For the L_LENGTH equation that uses m = +1 or +2 as disclosed in Bharadwaj-Prov059, L_LENGTH = LENGTH + m, and the RXTIME calculated by the legacy 802.11ac devices would be:

$$RXTIME = \left\lceil \frac{(240 + m) + 3}{3} \right\rceil \times 4 + 20 = 348$$

Id.; SAMSUNG-1007, [0056]. As shown above, the RXTIME calculated by the legacy 802.11ac devices based on received L_LENGTH is not the correct or desired RXTIME because legacy 802.11ac devices do not compensate for the m value added to the LENGTH by the transmitter. SAMSUNG-1003, ¶67. On the other hand, for the L_LENGTH equation that uses m = −1 or −2 (*i.e.*, "−m"), the RXTIME calculated by the legacy 802.11ac devices would be as follows:

$$RXTIME = \left\lceil \frac{(240 - m) + 3}{3} \right\rceil \times 4 + 20 = 344$$

SAMSUNG-1003, ¶67. In this case, the RXTIME calculated by the legacy 802.11ac devices based on received L_LENGTH would be the desired RXTIME even though the legacy 802.11ac devices do not compensate for the m value subtracted from the LENGTH by the transmitter. *Id.* Thus, a POSITA would have been motivated to use m = −1 or −2 (*i.e.*, "−m") to allow legacy 802.11ac devices to correctly calculate RXTIME and other parameters based on L_LENGTH, e.g., so that the legacy devices would avoid deferring transmissions for a longer duration than required based on an incorrect RXTIME or other parameter incorrectly derived from an L_LENGTH value to which m had been added at the transmitter. *Id.*; SAMSUNG-1008, 818-819; SAMSUNG-1010, [0017]-[0020], [0024]-[0025], [0036], [0041]; SAMSUNG-1015, [0048], [0051].

Similarly, for legacy devices that operate according to the 802.11n standard (*i.e.*, according to IEEE Std 802.11-2012), L_LENGTH and Nsym are calculated according to the following equations:[5]

$$L\_LENGTH = \left\lceil \frac{TXTIME - 20}{4} \right\rceil \times 3 - 3$$

$$N_{SYM} = \left\lceil \frac{16 + 8 \times LENGTH + 6}{N_{DBPS}} \right\rceil$$

SAMSUNG-1008, 925, 1597. With $N_{DBPS} = 24$ (SAMSUNG-1008, 1590) and substituting LENGTH with the L_LENGTH equation, the desired Nsym value for 802.11n devices is as follows:

$$N_{SYM} = \left\lceil \frac{16 + 8 \times \left(\left\lceil \frac{TXTIME - 20}{4} \right\rceil \times 3 - 3 \right) + 6}{24} \right\rceil = \left\lceil \frac{TXTIME - 20}{4} \right\rceil$$

SAMSUNG-1003, ¶68. For the L_LENGTH equation that adds m = +1 or +2 as disclosed in Bharadwaj-Prov059, the Nsym value that would be calculated by a legacy device would be incorrect and would exceed than the desired Nsym value as indicated by the "+ 1" in the simplified equation:

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[5] A POSITA would have understood 802.11n to be another legacy variant of the 802.11 standard. SEC-1007, [0003] ("earlier or legacy Wi-Fi standards"); SEC-1003, ¶68.

$$N_{SYM} = \left\lceil \frac{8 \times \left(\left\lceil \frac{TXTIME - 20}{4} \right\rceil \times 3 - 3 + m \right) + 22}{24} \right\rceil$$

$$= \left\lceil \left\lceil \frac{TXTIME - 20}{4} \right\rceil - 1 + \frac{m}{3} + \frac{22}{24} \right\rceil$$

$$= \left\lceil \left\lceil \frac{TXTIME - 20}{4} \right\rceil + \frac{m}{3} - 0.08 \right\rceil = \left\lceil \frac{TXTIME - 20}{4} \right\rceil + 1$$

Id. On the other hand, for the L_LENGTH equation that uses m = −1 or −2 (*i.e.*, subtracting m=+1 or +2), the calculated Nsym value would yield the correct, desired Nsym value:

$$N_{SYM} = \left\lceil \frac{8 \times \left(\left\lceil \frac{TXTIME - 20}{4} \right\rceil \times 3 - 3 - m \right) + 22}{24} \right\rceil$$

$$= \left\lceil \left\lceil \frac{TXTIME - 20}{4} \right\rceil - 1 - \frac{m}{3} + \frac{22}{24} \right\rceil$$

$$= \left\lceil \left\lceil \frac{TXTIME - 20}{4} \right\rceil - \frac{m}{3} - 0.08 \right\rceil = \left\lceil \frac{TXTIME - 20}{4} \right\rceil$$

Id. By performing these calculations of Nsym for 802.11n devices, a POSITA would have recognized that an L_LENGTH equation that adds m = +1 or +2 would result in an error in the legacy device's calculation of Nsym whereas an L_LENGTH equation using m = −1 or −2 (*i.e.*, "−m") would result in the desired Nsym value. *Id.* 802.11-2012 discloses that reception is "terminated after the reception of the final symbol of the last PSDU octet indicated by the PLCP header's LENGTH field." SAMSUNG-1008, 1494. The number of symbols is denoted by the Nsym value. SAMSUNG-1008, 1596-1597. Thus, a POSITA would have been motivated to use m = −1 or −2 (*i.e.*, "−m") to allow legacy 802.11n devices to correctly calculate Nsym so that the legacy devices need not defer transmissions for a duration longer than required. SAMSUNG-1003, ¶68; SAMSUNG-1008, 818-819; SAMSUNG-1010, [0017]-[0020], [0024]-[0025], [0036], [0041]; SAMSUNG-1015, [0048], [0051].

Additional contemporaneous evidence[6] also confirms that using m = −1 or

[6] A reference need not qualify as prior art to demonstrate what would have been known to the ordinarily skilled artisan at the time the invention was made. *See Thomas & Betts Corp. v. Litton Sys., Inc.*, 720 F.2d 1572, 1580–81 & n.5 (Fed. Cir. 1983) (the trial court properly relied upon unpublished internal criteria as evidence of what "would have been within the knowledge of one of ordinary skill in the art" at the time of the invention); *In re Farrenkopf*, 713 F.2d 714, 719–20 (Fed. Cir. 1983) (affidavit evidence provided during a reissue proceeding is competent when offered as "evidence of the level of knowledge in the art at the time the invention

−2 (i.e., *subtracting* m from the length equation) would have been within the knowledge and skill of a POSITA, and a POSITA would have pursued this approach with a reasonable expectation of success. For example, Lee, which pre-dates the ’077 patent, discloses yet another L_LENGTH equation that subtracts a constant “*n*” value of 0, 1, or 2, similar to Yu-Prov428 (i.e., using *n* = -1 or -2):

$$L\_LENGTH = \left\lceil \frac{((TXTIME - \text{Signal Extension}) - 20))}{4} \right\rceil \times 3 - 3 - n$$

SAMSUNG-1018, [0078]-[0079]; SAMSUNG-1003, ¶69.

As another example, IEEE submission document IEEE 802.11-15/1372, titled “L-LENGTH Equation Update” and dated Nov. 2015, proposed to change the L-LENGTH equation from

$$L\_LENGTH = \left\lceil \frac{TXTIME - 20}{4} \right\rceil \times 3 - 3 + m,\ m = 1 \text{ or } 2$$

to

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was made”); *see also Ex Parte Erlich*, 22 U.S.P.Q.2d 1463, 1465 (BPAI 1992) (“the Sevier publication itself is not prior art…. To the extent that Sevier establishes the level of ordinary skill in this art at and around the time of the present invention, i.e., 1980-81, it is properly relied upon by the examiner.”).

$$L\_LENGTH = \left\lceil \frac{TXTIME - 20}{4} \right\rceil \times 3 - 3 - \boldsymbol{m}, m = 1 \text{ or } 2$$

resulting in the Nsym equation changing to

$$N_{SYM} = \left\lfloor \frac{\left(\frac{L\_LENGTH + m + 3}{3} \times 4 - T_{HE\_PREAMBLE}\right)}{T_{SYM}} \right\rfloor - b_{PE\_\boldsymbol{Disambiguity}}.$$

SAMSUNG-1016, 2, 4-5 (red text in original). 802.11-15/1372 indicates that this change provides the benefit of allowing legacy devices to correctly calculate the desired Nsym. SAMSUNG-1016, 3-4; SAMSUNG-1003, ¶70.

Indeed, Bharadwaj, the non-provisional application of Bharadwaj-Prov059, implemented this same predictable change to its L_{LENGTH} equation when it was filed on May 19, 2016, and the updated equations likewise solves the need to "ensure that L_{LENGTH} is not exactly a multiple of 3 and therefore can be used to distinguish between IEEE 802.11ax and IEEE 802.11ac transmissions":

$$L_{LENGTH} = \left\lceil \frac{TXTIME - 20}{4} \right\rceil \times 3 - 3 - m,$$

where

$$m = 1, 2.$$

SAMSUNG-1006, [0050]. From this updated L_{LENGTH} equation, Bharadwaj teaches that the receiver correspondingly computes RXTIME and Nsym as follows:

$$RXTIME = \left\lceil \frac{L_{LENGTH} + m + 3}{3} \right\rceil \times 4 + 20$$

$$N_{sym} = \left\lfloor \frac{RXTIME - T_{L\_PREAMBLE} - T_{HE\_PREAMBLE}}{T_{SYM}} \right\rfloor - SE_{disambiguation\_bit}$$

$$= \left\lfloor \frac{\left\lceil \frac{L_{LENGTH} + m + 3}{3} \right\rceil \times 4 - T_{HE\_PREAMBLE}}{T_{SYM}} \right\rfloor - SE_{disambiguation\_bit}$$

SAMSUNG-1006, [0054]-[0055], [0060][7]; SAMSUNG-1003, ¶71.

Bharadwaj's Nsym calculation is noticeably equivalent to the Nsym equation provided in claim 1 of the '077 Patent. The only difference in expression of the Nsym equation as written above and the Nsym equation recited in claim 1 is that claim 1 lacks the ceiling operator around $\frac{L_{LENGTH}+m+3}{3}$. But this is immaterial because $\frac{L_{LENGTH}+m+3}{3}$ will always produce an integer for valid values of L_{LENGTH} and m in which L_{LENGTH} + m is a multiple of 3, thereby rendering the ceiling operator unnecessary. For example, a POSITA would have understood that because L_{LENGTH} is calculated by subtracting m=1 or 2 from a multiple of 3 as

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[7] Bharadwaj's equation for RXTIME includes a typographical error in which "–20" should be "+20" as evident by the calculation of RXTIME = 344 µs. SEC-1006, [0054]-[0055], [0060].

disclosed at paragraph [0050] of Bharadwaj, the natural consequence is that L_{LENGTH} + m +3 will also be a multiple of 3, and dividing L_{LENGTH} +m + 3 by 3 will produce an integer that makes the ceiling operator moot:

$$L_{LENGTH} = \left\lceil \frac{TXTIME - 20}{4} \right\rceil \times 3 - 3 - m$$

$$\frac{L_{LENGTH} + 3 + m}{3} = \left\lceil \frac{TXTIME - 20}{4} \right\rceil$$

$$\left\lceil \frac{L_{LENGTH} + 3 + m}{3} \right\rceil = \left\lceil \left\lceil \frac{TXTIME - 20}{4} \right\rceil \right\rceil = \left\lceil \frac{TXTIME - 20}{4} \right\rceil$$

$$= \frac{L_{LENGTH} + 3 + m}{3}$$

and because $\lceil x \rceil$ is an integer, $\lceil \lceil x \rceil \rceil = \lceil x \rceil = \lceil \text{integer} \rceil = \text{integer}$. Using, for example, if m=1 and

$$L_{LENGTH} = \left\lceil \frac{TXTIME - 20}{4} \right\rceil \times 3 - 3 - m = 239$$

a POSITA would have recognized that:

$$\left\lceil \frac{L_{LENGTH} + m + 3}{3} \right\rceil = \left\lceil \frac{239 + 1 + 3}{3} \right\rceil = \frac{239 + 1 + 3}{3} = \frac{L_{LENGTH} + m + 3}{3}$$

and therefore:

$$N_{sym} = \left\lfloor \frac{\left\lceil \frac{L_{LENGTH} + m + 3}{3} \right\rceil \times 4 - T_{HE\_PREAMBLE}}{T_{SYM}} \right\rfloor - SE_{disambiguation\_bit}$$

$$= \left\lfloor \frac{\frac{L_{LENGTH} + m + 3}{3} \times 4 - T_{HE\_PREAMBLE}}{T_{SYM}} \right\rfloor - SE_{disambiguation\_bit}$$

SAMSUNG-1003, ¶72; SEC-1006, [0057]-[0058].

The *KSR* Court recognized that "[w]hen there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 421 (2007). In such circumstances, "the fact that a combination was obvious to try might show that it was obvious under § 103." *Id*. Here, it would have been obvious to try other predictable potential values for m, including m = −1 or −2, to address the need to "ensure that L_{LENGTH} is not exactly a multiple of 3… to distinguish between IEEE 802.11ax and IEEE 802.11ac transmissions" and to ensure compatibility with legacy devices. SAMSUNG-1006, [0050]; SAMSUNG-1007, [0051]; SAMSUNG-1010, [0017]-[0020], [0024], [0036], [0038]-[0042], [0059]-[0060], [0063], [0065]; SAMSUNG-1012, [0057], [0068], [0073], [0080]-[0081]; SAMSUNG-1013, [0055]-[0056]; SAMSUNG-1014, [0039], [0077]; SAMSUNG-1015, [0051]-[0052]; SAMSUNG-1016, 2, 4-5; SAMSUNG-1003,

¶73.

4. Claim Element Analysis

(a) Claims 1 and 8

1[pre]. A wireless communication terminal that communicates wirelessly, the terminal comprising:
8[pre]. An operation method of a wireless communication terminal that communicates wirelessly, the method comprising:

To the extent the preambles are limitations, the Bharadwaj-Yu combination renders obvious 1[pre] and 8[pre]. SAMSUNG-1003, ¶¶84-85. For example, Bharadwaj-Prov059 describes "a wireless local area network (WLAN)" that includes "one or more mobile stations (STAs)" in connection with "techniques for signal extension signaling." SAMSUNG-1007, [0011], [0034], [0001]-[0002], [0005]-[0008], [0012]-[0026], [0029]-[0031], [0036]-[0038], [0046], FIGS. 1-13. The STAs "utilize the backhaul services of their respective AP to connect to a network, such as the Internet" and can be "a cellular phone, a smart phone, a laptop computer, a desktop computer, a personal digital assistant (PDA), a personal communication system (PCS) device, a personal information manager (PIM), personal navigation device (PND), a global positioning system, a multimedia device, a video device, an audio device, a device for the Internet-of-Things (IoT), or any other suitable wireless apparatus requiring the backhaul services of an AP." SAMSUNG-1007, [0035]. In Bharadwaj-Prov059, a receiver device, such as a

STA, processes a received data unit and generates a response to the received data unit within a SIFS (short interframe space) duration in IEEE 802.11ax using signal extension signaling techniques. SAMSUNG-1007, [0029]-[0031], [0043], FIGS. 3A-3B. Each STA is **a wireless communication terminal that communicates wirelessly** using signal extension signaling techniques (**an operation method**). SAMSUNG-1003, ¶84.

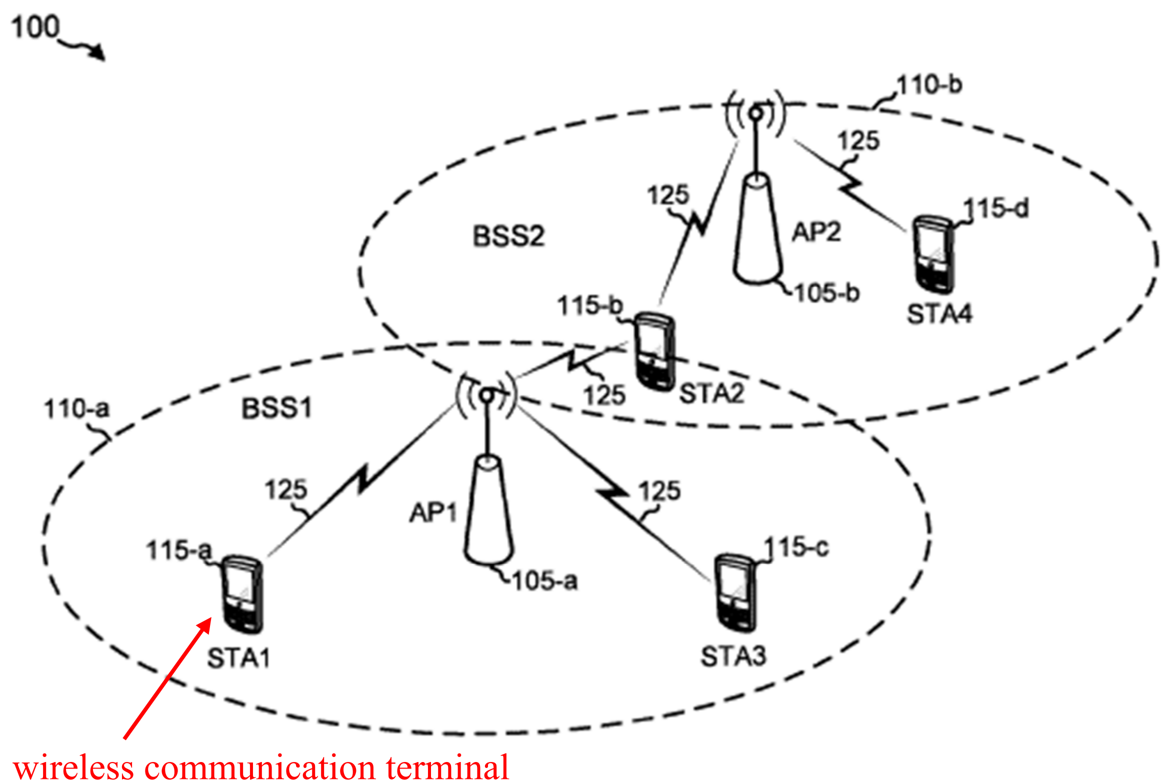


FIG. 1

SAMSUNG-1007, FIG. 1

Bharadwaj-Prov059 illustrates in FIG. 3A "signal extension signaling from a transmitter device 310 to a receiver device 320." SAMSUNG-1007, [0043]. In one example, the receiver device 320 is the STA1 115-a. *Id.*; SAMSUNG-1003,

¶85.

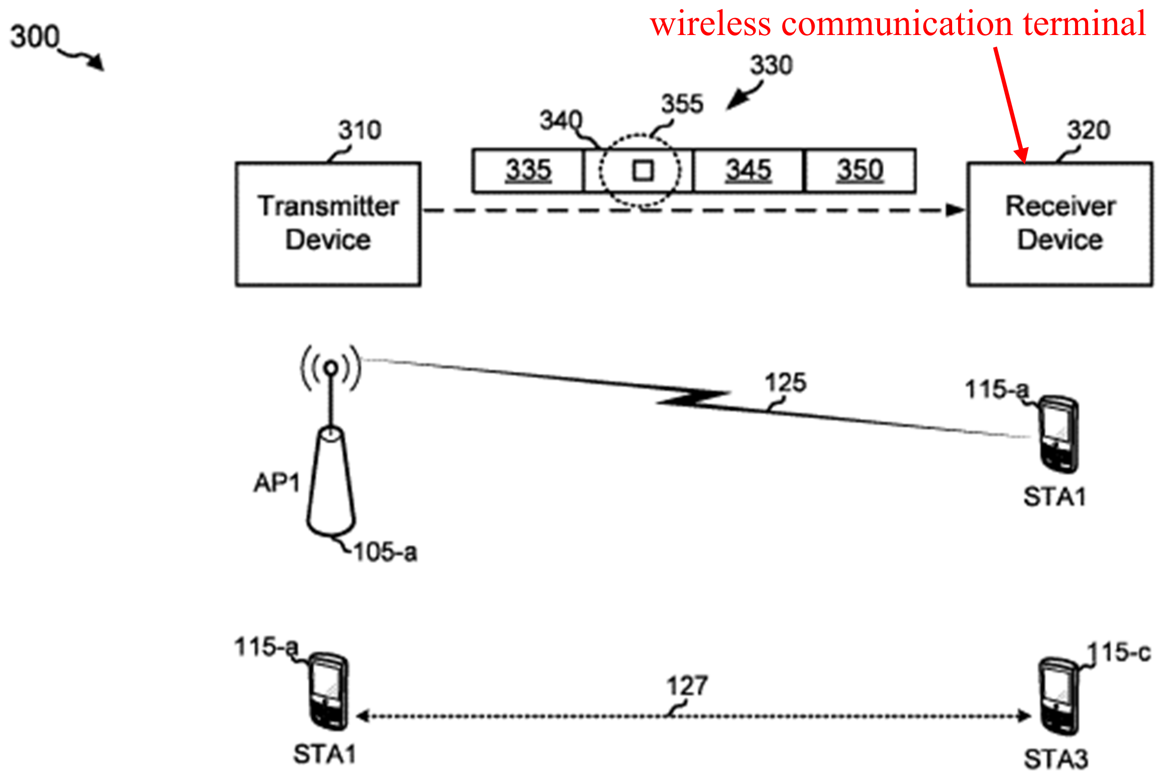


FIG. 3A

SAMSUNG-1007, FIG. 3A

1[1]. a transceiver; and a processor, wherein the processor is configured to

The Bharadwaj-Yu combination renders obvious 1[1]. SAMSUNG-1003, ¶86. For example, Bharadwaj-Prov059 discloses that the "various elements, components, or modules" of "the receiver device 320 in FIG. 8 may be implemented in hardware, software, or a combination of hardware and software" and "the functionality of each of the various elements, components, or modules" of "the receiver device 320 in FIG. 8 can be implemented or performed by a **processor** (see e.g., processor 1304 in FIG. 13) in connection with instructions or code… programmed to implement the **methods** shown in FIGS. 9-12… through use of the equations and functionality for signal extension signaling." SAMSUNG-1007, [0080]. Bharadwaj-Prov059 further illustrates in FIG. 13 "an example of a processing system 1314 that supports signal extension signaling operations." SAMSUNG-1007, [0027], [0099]. "The processing system 1314 may be coupled to a **transceiver** 1310." SAMSUNG-1007, [00100]. "The transceiver 1310 may receive a signal from the one or more antennas 1320, may extract information from the received signal, and may provide the extracted information to the processing system 1314, specifically the **processor** 1304." *Id.* "The processor 1304 is responsible for general processing, including the execution of software stored on the computer-readable medium/memory 1306. The software, when executed by the processor 1004, causes the processing system 1314 to perform the various functions described in the disclosure for signal extension signaling." *Id.*

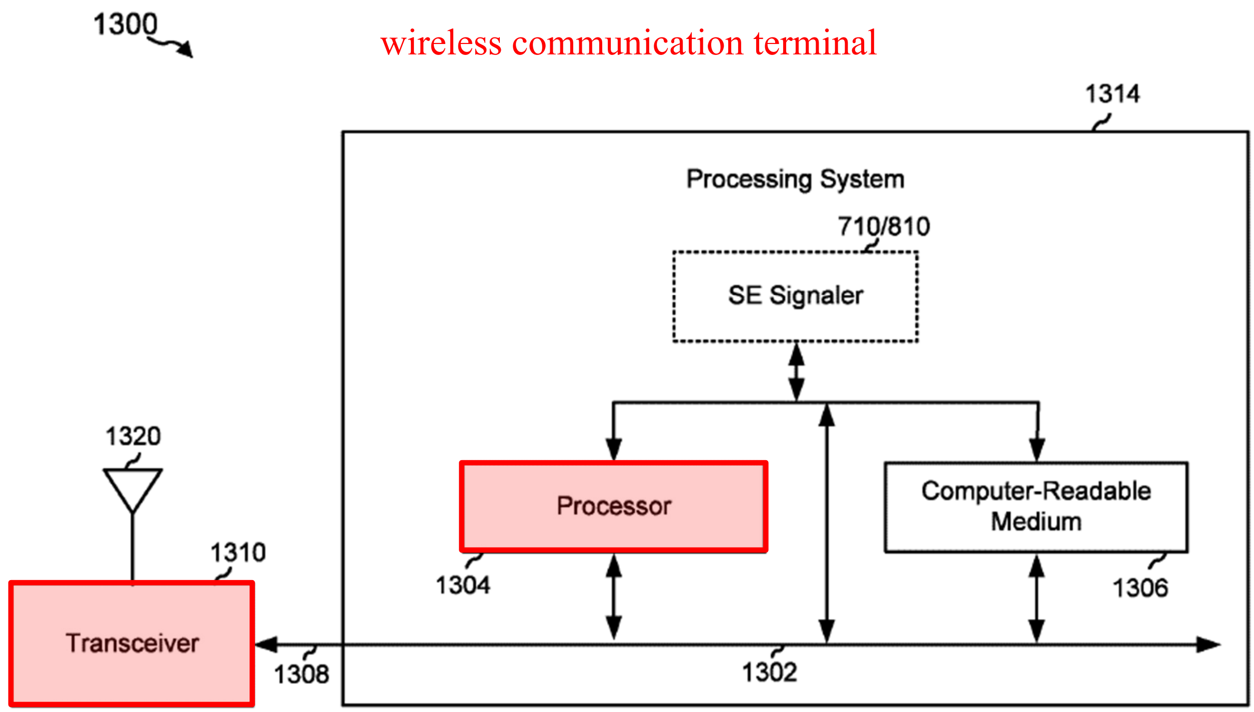


FIG. 10

SAMSUNG-1007, FIG. 13[8]

1[a]/8[a]. receive/receiving a non-legacy physical layer frame by using the transceiver,

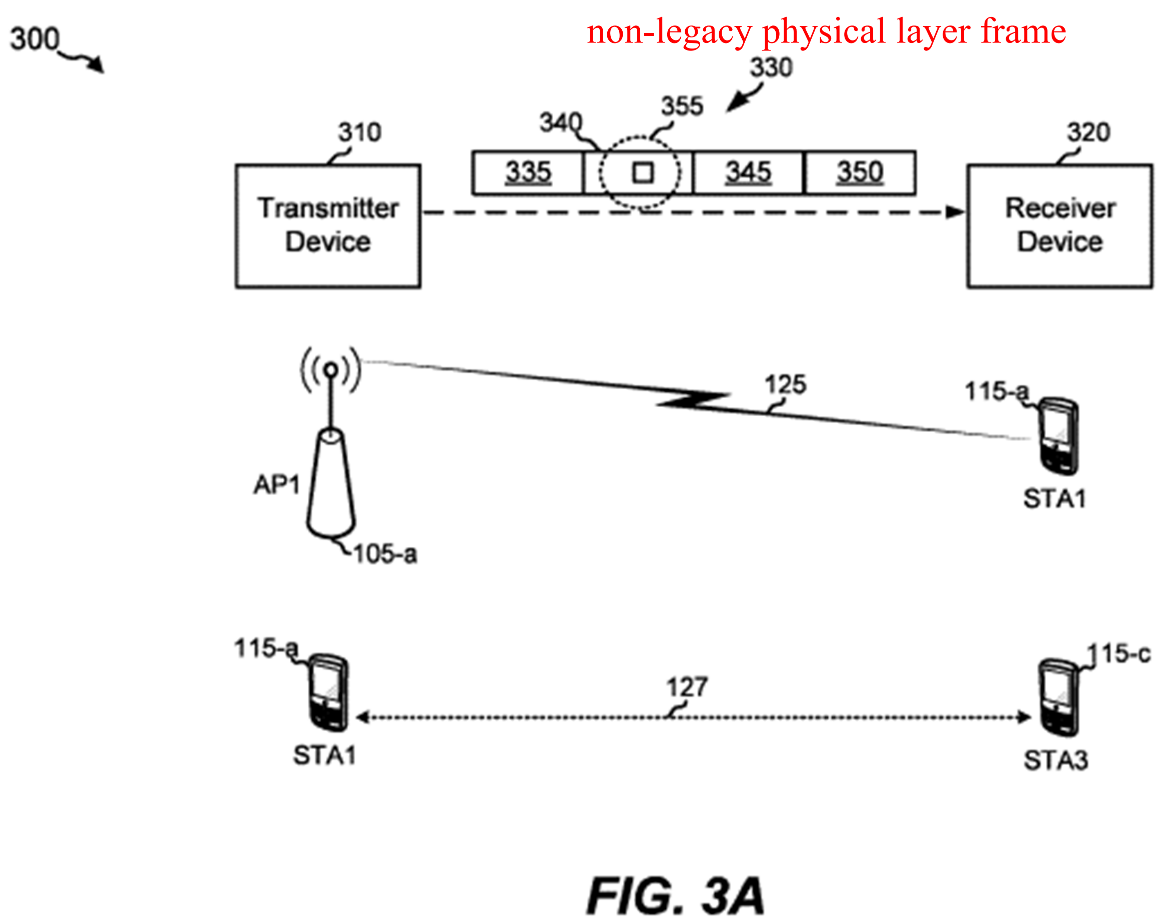
The Bharadwaj-Yu combination renders obvious 1[a] and 8[a].

SAMSUNG-1003, ¶¶87-90. For example, Bharadwaj-Prov059 describes IEEE

[8] Bharadwaj-Prov059 label of FIG. 10 is a typographical error and should be FIG. 13 as evident from the accompanying description.

802.11ac as an "earlier or legacy" Wi-Fi standard before the IEEE 802.11ax Wi-Fi standard. SAMSUNG-1007, [0003], [0040]. Bharadwaj-Prov059 explains that the receiver device "has to process a received data unit and generate a response to the received data unit under IEEE 802.11ax in the same amount of time as it would have under the legacy IEEE 802.11ac… even though it now has to process four times the number of tones." SAMSUNG-1007, [0029]. In Bharadwaj-Prov059, a receiver device, such as a STA, processes a received data unit and generates a response to the received data unit within a SIFS (short interframe space) duration in IEEE 802.11ax using signal extension signaling techniques. SAMSUNG-1007, [0029]-[0031], [0043], FIGS. 3A-3B. The IEEE 802.11ax data unit, such as data unit 330 depicted in FIG. 3A, is **a non-legacy physical layer frame**. SAMSUNG-1007, [0043], FIG. 3A; *see also id.*, FIGS. 4A-4B, 6A-6C; SAMSUNG-1003, ¶87.

Bharadwaj-Prov059 illustrates in FIG. 3A "a conceptual diagram 300 illustrating an example of signal extension signaling from a transmitter device 310 to a receiver device 320." SAMSUNG-1007, [0043]. In one example, the transmitter device 310 is AP1 105-a, and the receiver device 320 is the STA1 115-a. *Id.* The "AP1 105-a determines that signal extension is to be applied to a data unit (e.g., data unit 330) and the duration of the signal extension to be applied. The AP1 105-a then signals (e.g., using a communications link 125) the signal extension to the STA1 115-a using the single-bit signaling scheme." *Id.* "The data unit 330 is shown to generally include a legacy preamble 335, a high efficiency (HE) preamble 340, which typically includes the single signaling bit 335 used for the single-bit signaling scheme, data portion 345, and signal extension 350." SAMSUNG-1007, [0044]. FIG. 3A shows the receiver device 320 receiving a data unit 330; SAMSUNG-1003, ¶88.



SAMSUNG-1007, FIG. 3A

Bharadwaj-Prov059's "FIG. 8 is a block diagram 800 illustrating an example of an SE signaler 810 in the receiver device 320. The SE signaler 810 may include a frame/data unit communicator 820 configured to receive a data unit (e.g., the data unit 330 in FIG. 3A) from a transmitter device (e.g., the transmitter device 310 in FIG. 3A)." SAMSUNG-1007, [0076]. Bharadwaj-Prov059's "FIG. 10 is a flow diagram illustrating an example of a method 1000 for signal extension signaling by a receiver device (e.g., the receiver device 320 in FIGS. 3A and 8). At 1011, a data unit is received from a transmitter device. In an example, the frame/data unit communicator 820 in the SE signaler 810 receives a data unit from a transmitter device (e.g., the transmitter device 310 in FIGS. 3A and 7)." SAMSUNG-1007, [0086]; SAMSUNG-1003, ¶89.

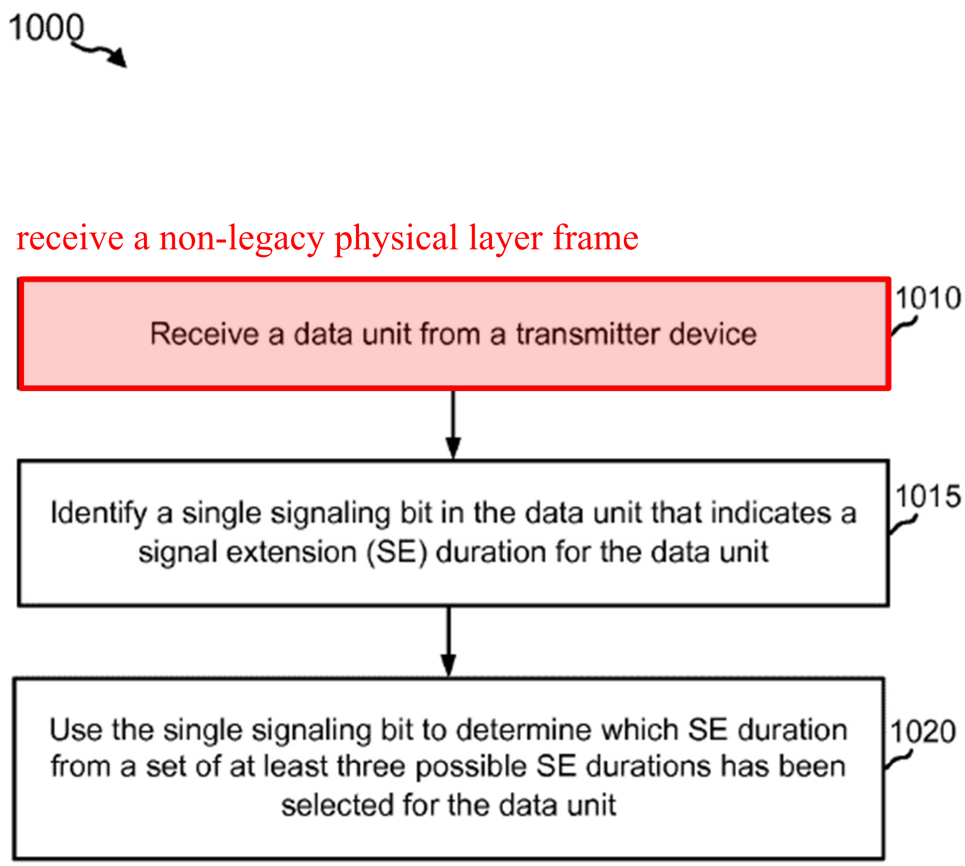


FIG. 10

SAMSUNG-1007, FIG. 10

As discussed above in 1[1], the receiver device 320 includes a "transceiver 1310" that "receive[s] a signal from the one or more antennas 1320." SAMSUNG-1007, [00100]. In Bharadwaj-Prov059, the receiver device 320 would receive the data unit from the transmitter device using the transceiver 1310. *Id.*; SAMSUNG-1003, ¶90.

1[b]/8[b]. obtain/obtaining a legacy signaling field including information decodable by a legacy wireless communication terminal from the non-legacy physical layer frame,

The Bharadwaj-Yu combination renders obvious 1[b] and 8[b]. SAMSUNG-1003, ¶¶91-92. As discussed above in 1[a]/8[a], Bharadwaj-Prov059's data unit 330 (**non-legacy physical layer frame**) includes a legacy preamble 335. SAMSUNG-1007, [0044], FIG. 3A. Bharadwaj-Prov059 discloses that "signaling bits are included in a preamble of the data unit and the preamble is not transmitted at a high data rate in part to maintain compatibility with legacy devices." SAMSUNG-1007, [0033]. "In IEEE 802.11ac, the reason that the transmitter device 310 provides L_{LENGTH} and TXTIME is for the receiver device 320 to know the number of data symbols (Nsym) that need to be decoded. In IEEE 802.11ax, for the receiver device 320 to know the number of data symbols (Nsym) to be decoded, the transmitter device 310 may provide L_LENGTH, TXTIME, and T_{SE}." SAMSUNG-1007, [0052], [0048] ("In IEEE 802.11ax, the Length field (L_LENGTH) transmitted through the legacy signal (L-SIG) field in the legacy preamble can be used to indicate[] both the data unit (e.g., data unit 330) duration (TXTIME) and the signal extension."), [0051]. The legacy signal (L-SIG) field including the Length field (L_LENGTH) is a **legacy signaling field including information decodable by a legacy wireless communication terminal**.

SAMSUNG-1003, ¶91.

Bharadwaj-Prov059 discloses the "time duration of the data unit 330 is determined by the receiver device 320 based on the duration of the data unit 330 in number of bytes (L_LENGTH). That is, at the receiver device 320, the duration RXTIME of the data unit 330 is computed from L_LENGTH in the L-SIG." SAMSUNG-1007, [0055]. Accordingly, the receiver device 320 obtains the L-SIG (**legacy signaling field**) including L_LENGTH (**information decodable by a legacy wireless communication terminal**) from the data unit 330 (**non-legacy physical layer frame**) to compute the RXTIME of the data unit 330. SAMSUNG-1003, ¶92.

1[c]. obtain length information indicating information on a duration of the non-legacy physical layer frame, from the legacy signaling field,
8[c]. obtaining length information indicating information on a duration of the non-legacy physical layer frame after a legacy signaling field, from the legacy signaling field,

The Bharadwaj-Yu combination renders obvious 1[c] and 8[c]. SAMSUNG-1003, ¶¶93-95. For example, Bharadwaj-Prov059 discloses that in "IEEE 802.11ax, the Length field (L_LENGTH) transmitted through the legacy signal (L-SIG) field in the legacy preamble can be used to indicate[] both the data unit (e.g., data unit 330) duration (TXTIME) and the signal extension." SAMSUNG-1007, [0048]. "The duration of the data unit 330, in number of bytes, is determined by the following expression (Equation 2):

$$L_{LENGTH} = \left\lceil \frac{TXTIME - 20}{4} \right\rceil \times 3 - 3 + m \text{ where } m = 1, 2$$

where TXTIME = $T_{L\_PREAMBLE} + T_{HE\_PREAMBLE} + T_{DATA} + T_{SE}$. $T_{L\_PREAMBLE}$ is the duration of the legacy preamble 335 of the data unit 330…. $T_{HE\_PREAMBLE}$ is the duration of the high efficiency (HE) or IEEE 802.11ax preamble 340 of the data unit 330…. The value of T_{DATA} is the duration of the data portion 345 of the data unit 330 and can be determined by the transmitter device 310 based on the following expression (Equation 3):

$$T_{DATA} = N_{sym} \times T_{sym} = N_{sym} \times (12.8 + T_{GI})$$

where Nsym is the number of data symbols, Tsym is the duration of a data symbol, and T_{GI} is the guard time of a data symbol…. Finally, T_{SE} is the duration of the… signal extension 350….” SAMSUNG-1007, [0051]; SAMSUNG-1003, ¶93.

In Bharadwaj-Prov059, the “time duration of the data unit 330 is determined by the receiver device 320 based on the duration of the data unit 330 in number of bytes (L_LENGTH). That is, at the receiver device 320, the duration RXTIME of the data unit 330 is computed from L_LENGTH in the L-SIG as follows (Equation 5).” SAMSUNG-1007, [0055].

$$RXTIME = \left\lceil \frac{L_{LENGTH} - m + 3}{3} \right\rceil \times 4 + 20$$

SAMSUNG-1007, [0056]. Accordingly, the receiver device 320 obtains, from the L-SIG (**legacy signaling field**), L_LENGTH, which is based on TXTIME = $T_{L\_PREAMBLE} + T_{HE\_PREAMBLE} + T_{DATA} + T_{SE}$, and which indicates a duration of the data unit 330 in number of bytes (**length information indicating information on a duration of the non-legacy physical layer frame**) to compute the RXTIME of the data unit 330. Moreover, because the receiver device 320 knows that the length of the legacy preamble ($T_{L\_PREAMBLE}$) that includes the legacy signaling field (L-SIG) is 20 μs (SAMSUNG-1007, [0059]), the value of L_LENGTH that the receiver device 320 obtains from the legacy signaling field is indicative of information on a duration of the non-legacy physical layer frame **after the legacy signaling field** at least because L_LENGTH is further set based on the duration of a portion of the frame after the legacy signaling field including $T_{HE\_PREAMBLE} + T_{DATA} + T_{SE}$ (i.e., TXTIME – 20 μs), which is a **duration of the non-legacy physical layer frame after a legacy signaling field**. SAMSUNG-1003, ¶94. The receiver device 320 also calculates a time duration of the frame after the preamble(s), for example, by determining RXTIME – $T_{L,PREAMBLE}$ – $T_{HE,PREAMBLE}$ to calculate the number of data symbols N_{sym}. *Id.*; SAMSUNG-1007, [0057]-[0063].

As discussed above in Section III.A.3, the Bharadwaj-Yu combination renders obvious a L_LENGTH equation with a "– m" instead of a "+m":

$$L_{LENGTH} = \left\lceil \frac{TXTIME - 20}{4} \right\rceil \times 3 - 3 - m$$

SAMSUNG-1003, ¶95; SAMSUNG-1020, 16; SAMSUNG-1019, [0232]; SAMSUNG-1007, [0051]-[0052]. From this updated L_{LENGTH} equation, the receiver would also have correspondingly changed the sign of the "m" value and compute RXTIME as follows:

$$RXTIME = \left\lceil \frac{L_{LENGTH} + m + 3}{3} \right\rceil \times 4 + 20$$

SAMSUNG-1006, [0054]-[0055], [0060][9].

1[d]/8[d]. obtain/obtaining information other than information on the duration of the non-legacy physical layer frame through a remaining value obtained by dividing the length information by a data size transmittable by a symbol of a legacy physical layer frame, wherein the data size transmittable by a symbol of the legacy physical layer frame is 3 octets when a data rate of the legacy physical layer frame is 6 Mbps, and

The Bharadwaj-Yu combination renders obvious 1[d] and 8[d].

---

[9] Bharadwaj's equation for RXTIME includes a typographical error in which "–20" should be "+20" as evident by the calculation of RXTIME = 344 µs. SEC-1006, [0054]-[0055], [0060].

SAMSUNG-1003, ¶¶96-98. For example, Bharadwaj-Prov059 discloses that the "duration of the data unit 330, in number of bytes, is determined by the following expression (Equation 2):

$$L_{LENGTH} = \left\lceil \frac{TXTIME - 20}{4} \right\rceil \times 3 - 3 + m \text{ where } m = 1, 2$$

where TXTIME = $T_{L\_PREAMBLE}$ + $T_{HE\_PREAMBLE}$ + T_{DATA} + T_{SE}… The value *m* shown above has been added in IEEE 802.11ax to ensure that L_{LENGTH} is not exactly a multiple of 3 and is therefore used to distinguish between IEEE 802.11ax and IEEE 802.11ac transmissions (e.g., auto-detections)." SAMSUNG-1007, [0051]. Based on Bharadwaj-Prov059's explanation that the value *m* "has been added in IEEE 802.11ax" to "distinguish" IEEE 802.11ax from IEEE 802.11ac transmissions based on whether L_LENGTH is "a multiple of 3," a POSITA would have understood and found obvious that the receiver device 320 would determine whether a received physical layer frame (e.g., data unit 33) is a non-legacy frame (e.g., 11ax frame) or a legacy frame (e.g., 11ac frame) based on whether L_LENGTH / 3 yields a remaining value (*i.e.*, a non-zero remainder). SAMSUNG-1003, ¶96. A POSITA also would have understood from general knowledge of the legacy 802.11 standards that L_{LENGTH} in 802.11ac is determined by the expression:

$$L_{LENGTH} = \left\lceil \frac{TXTIME - 20}{4} \right\rceil \times 3 - 3$$

See, e.g., SAMSUNG-1008, 925; SAMSUNG-1009, 256; SAMSUNG-1010, [0039]; SAMSUNG-1011, [0067]; SAMSUNG-1003, ¶96. A POSITA would have understood from general knowledge of the legacy 802.11 standards referenced in Bharadwaj that the above 802.11ac L_{LENGTH} equation is a simplified version of the following equation:

$$\text{L\_LENGTH} = \left\lceil \frac{((\text{TXTIME} - \text{Signal Extension}) - (\text{aPreambleLength} + \text{aPLCPHeaderLength}))}{\text{aSymbolLength}} \right\rceil \times N_{OPS} - \left\lceil \frac{\text{aPLCPServiceLength} + \text{aPLCPConvolutionalTailLength}}{8} \right\rceil$$

where "N_{OPS} is the number of octets transmitted during a period of aSymbolLength at the rate specified by L_DATARATE" "set to the value of 6 Mb/s." SAMSUNG-1008, 925; SAMSUNG-1009, 236, 256. As evident from the above L_{LENGTH} and L_LENGTH equations, N_{OPS} (**data size transmittable by a symbol of the legacy physical layer frame**) **is 3 octets when the data rate of the legacy physical layer frame is 6 Mb/s**. *Id.*

$$L\_LENGTH = \left\lceil \frac{((TXTIME - \text{Signal Extension}) - (aPreambleLength + aPLCPHeaderLength))}{aSymbolLength} \right\rceil \times N_{OPS} - \left\lceil \frac{aPLCPServiceLength + aPLCPConvolutionalTailLength}{8} \right\rceil$$

$$L_{LENGTH} = \left\lceil \frac{TXTIME - 20}{4} \right\rceil \times 3 - 3$$

$$L_{LENGTH} = \left\lceil \frac{TXTIME - 20}{4} \right\rceil \times 3 - 3 + m \text{ where } m = 1, 2$$

Yu-Prov428 also discloses that "one OFDM symbol with the lowest rate includes 3 bytes of data" (**data size… is 3 octets**). SAMSUNG-1020, 16; SAMSUNG-1003, ¶96.

In Bharadwaj-Prov059, the "value *m* shown above has been added in IEEE 802.11ax to ensure that L_{LENGTH} is not exactly a multiple of 3 and is therefore used to distinguish between IEEE 802.11ax and IEEE 802.11ac transmissions (e.g., auto-detections)." SAMSUNG-1007, [0051]. Based on Bharadwaj-Prov059's disclosure and a POSITA's general knowledge, a POSITA would have understood and found it obvious that the receiver device 320 divides the L_{LENGTH} by 3 (**dividing the length information by a data size transmittable by a symbol of a legacy physical layer frame**) to "distinguish between IEEE 802.11ax and IEEE 802.11ac transmissions" (**obtain information other than information on the duration of the non-legacy physical layer frame**) **through a remaining value** was well known as of the Critical Date of the '077 patent. *Id.*; SAMSUNG-1010,

[0017]-[0020], [0024], [0036], [0038]-[0042], [0059]-[0060], [0063], [0065]; SAMSUNG-1012, [0057], [0068], [0073], [0080]-[0081]; SAMSUNG-1013, [0029], [0032], [0035], [0055]-[0056], [0085]; SAMSUNG-1014, [0039], [0077]; SAMSUNG-1015, [0051]-[0052]; SAMSUNG-1003, ¶97. A remaining value of 0 would indicate an 802.11ac transmission, and a remaining value of either 1 or 2 would indicate an 802.11ax transmission. *Id*. A POSITA also would have sought to obtain a remaining value that results from dividing L_{LENGTH} by 3 to implement the auto-detection feature and thereby distinguish 801.11ac from 802.11ax transmissions as expressly contemplated in Bharadwaj-Prov059. *Id*. A POSITA would reasonably expected success because the use of such operations for this purpose well established in the prior art before the Critical Date. *Id.*

As discussed above in Section III.A.3, the Bharadwaj-Yu combination renders obvious a L_LENGTH equation with a "– m" instead of a "+m":

$$L_{LENGTH} = \left\lceil \frac{TXTIME - 20}{4} \right\rceil \times 3 - 3 - m$$

SAMSUNG-1003, ¶98; SAMSUNG-1020, 16; SAMSUNG-1019, [0232]; SAMSUNG-1007, [0051]-[0052]. This L_LENGTH equation with a "– m" would likewise "distinguish" IEEE 802.11ax from IEEE 802.11ac transmissions based on whether L_LENGTH is "a multiple of 3" (an example of **information other than information on the duration**). *Id.* As discussed, a POSITA would have understood and found obvious that the receiver device 320 would determine whether a received physical layer frame (e.g., data unit 33) is a non-legacy frame (e.g., 11ax frame) or a legacy frame (e.g., 11ac frame) based on whether L_LENGTH / 3 yields a zero or non-zero remaining value. *Supra*, §III.A.3; SAMSUNG-1003, ¶98. Yu-Prov428 also describes using the remaining value "to indicate the structure of the last symbol" (another example of **information other than information on the duration**). SAMSUNG-1020, 16; SAMSUNG-1019, [0230].

1[e]/8[e]. determine/determining the number of symbols of data of the non-legacy physical layer frame according to a following equation,

$$N_{SYM} = \left\lfloor \left(\frac{\text{L\_LENGTH} + m + 3}{3} \times 4 - T_{HE\_PREAMBLE} \right) \Big/ T_{SYM} \right\rfloor - b_{PE\_Disambiguity}$$

where ⌊x⌋ denotes a largest integer less than or equal to x,
L_LENGTH denotes the length information,
m denotes a value obtained by subtracting the remaining value from the data size transmittable by a symbol of the legacy physical layer frame,
$b_{PE\_Disambiguity}$ denotes a value of PE Disambiguity field,
$T_{HE\_PREAMBLE}$ denotes a duration of non-legacy preamble of the non-legacy physical layer frame,
T_{SYM} denotes a duration of a symbol of the data of the non-legacy physical layer frame,
wherein the PE Disambiguity field is set based on the duration of a symbol of the data of the non-legacy physical layer frame and an increment of duration to set a value of the length information based on a duration of a symbol of the legacy physical layer frame.

The Bharadwaj-Yu combination renders obvious 1[e] and 8[e].

SAMSUNG-1003, ¶¶99-105. For example, Bharadwaj-Prov059 explains that once "the RXTIME is known, the number of data symbols, Nsym, is computed or determined by the receiver device 320 using the following expression (Equation 6):

$$N_{sym} = \left\lfloor \frac{RXTIME - T_{L\_PREAMBLE} - T_{HE\_PREAMBLE}}{T_{sym}} \right\rfloor - SE_{disambiguation\_bit}$$
.

SAMSUNG-1007, [0057]. As discussed above in 1[c]/8[c],

$$RXTIME = \left\lceil \frac{L_{LENGTH} - m + 3}{3} \right\rceil \times 4 + 20$$

SAMSUNG-1007, [0056]. Because $T_{L\_PREAMBLE}$ = 20 μs (SAMSUNG-1007, [0059]), Equation 6 can be expressed as reduced to:

$$N_{sym} = \left\lfloor \frac{\left\lceil \frac{L_{LENGTH} - m + 3}{3} \right\rceil \times 4 - T_{HE\_PREAMBLE}}{T_{SYM}} \right\rfloor - SE_{disambiguation\_bit}$$

which uses "a flooring function to obtain Nsym. In an example, if a number is 3.4, the flooring function rounds the number down to 3." SAMSUNG-1007, [0048]. In the Nsym equation, L_{LENGTH} denotes the "duration of the data unit 330, in number of bytes" (**length information**), "$T_{HE\_PREAMBLE}$ is the duration of the high efficiency (HE) or IEEE 802.11ax preamble 340 of the data unit 330" (**duration of non-legacy preamble of the non-legacy physical layer frame**), and "Tsym is the duration of a data symbol" (**duration of a symbol of the data of the non-legacy physical layer frame**). SAMSUNG-1007, [0051]-[0052]; SAMSUNG-1003, ¶99.

In Bharadwaj-Prov059, when "signal extension is applied to the end of the data unit,… there may be a rounding error 'Δ' caused by $L_{\_LENGTH}$ quantization…. Because of the rounding error 'Δ' caused by $L_{\_LENGTH}$ quantization, an ambiguity as to the signal extension duration occurs when $T_{SE} + \Delta > Tsym$ (data symbol duration)." SAMSUNG-1007, [0049]. The "SE disambiguation bit is introduced into IEEE 802.11ax to resolve the ambiguities in the Nsym and T_{SE} computation. As Equation 6 above illustrates, when SE disambiguation bit = 1, the number of data symbols according to the IEEE 802.11ax computation is reduced by one (1)." SAMSUNG-1007, [0057], [0030]-[0031], [0033], [0041]-[0043], [0047]. "The transmitter 310 may be configured to set or determine the SE disambiguation bit (e.g., the single signaling bit 355) as follows. In an example, if the condition in expression shown below (Equation 4) is TRUE, then the SE disambiguation bit is set to 'l,' else it is set to '0.'"

$$T_{SE} + \underbrace{4 \times \left(\left\lceil \frac{TXTIME - 20}{4} \right\rceil - \left(\frac{TXTIME - 20}{4} \right) \right)}_{\text{Computes rounding error } \Delta} \geq T_{sym}$$

SAMSUNG-1007, [0054], [0072], [0078], [0082]. Accordingly, the location/field (**PE Disambiguity field)** provided for the SE disambiguation bit 355 (**a value of PE Disambiguity field**) is set based on Tsym (**duration of a symbol of the data of the non-legacy physical layer frame**) and an **increment of duration**, which can include the rounding error Δ. SAMSUNG-1007, [0049], [0051]-[0052], [0054]; SAMSUNG-1003, ¶100.

Bharadwaj-Prov059's FIGS. 4A and 4B show that the "Total TXTIME reported through L-SIG" includes the "Rounding error 'Δ' due to L-SIG Quantization" (**increment of duration**). SAMSUNG-1003, ¶101.

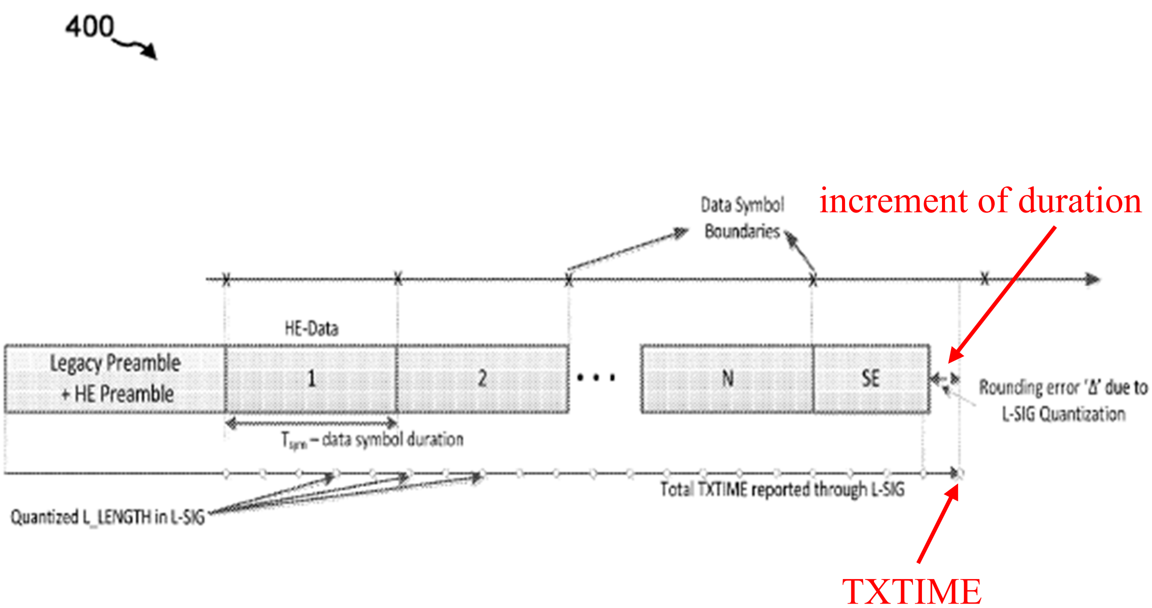


FIG. 4A

SAMSUNG-1007, FIG. 4A

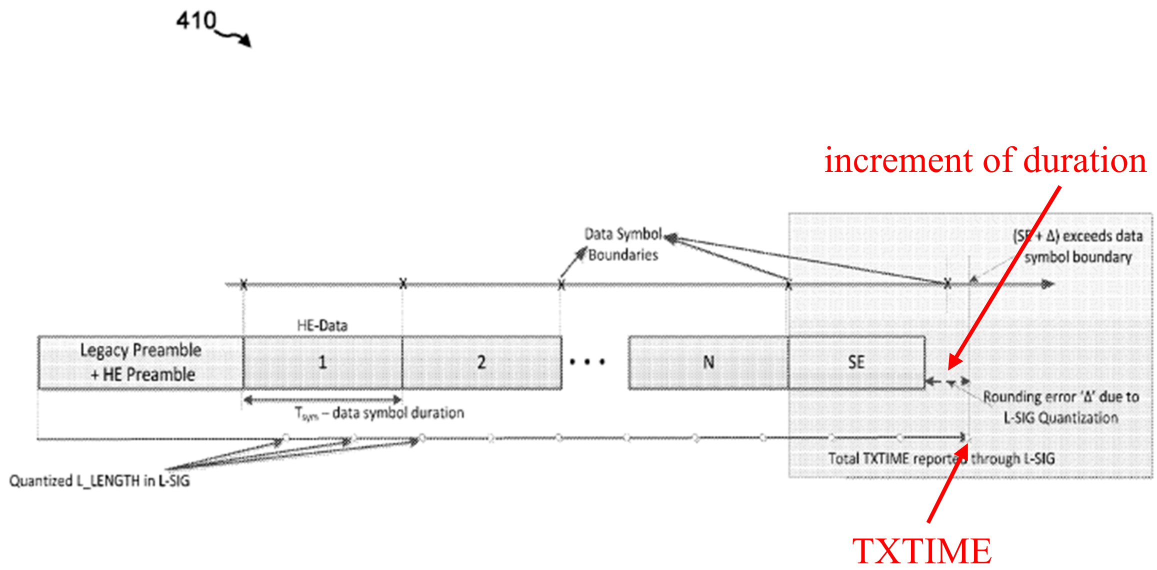


FIG. 4B

SAMSUNG-1007, FIG. 4B

As discussed above in 1[d]/8[d], a POSITA would have understood from general knowledge of the legacy 802.11 standards referenced in Bharadwaj that the above 802.11ac L_{LENGTH} equation is a simplified form of the following equation:

$$\text{L\_LENGTH} = \left\lceil \frac{((\text{TXTIME} - \text{Signal Extension}) - (\text{aPreambleLength} + \text{aPLCPHeaderLength}))}{\text{aSymbolLength}} \right\rceil \times N_{OPS} - \left\lceil \frac{\text{aPLCPServiceLength} + \text{aPLCPConvolutionalTailLength}}{8} \right\rceil$$

where "aSymbolLength is the duration of a symbol (in microseconds)" of the 802.11ac frame. SAMSUNG-1008, 925, 363. As evident from the above L_{LENGTH} and L_LENGTH equations, aSymbolLength is 4 µs (**a duration of a symbol of the legacy physical layer frame**). *Id.*

$$L\_LENGTH = \left\lceil \frac{((TXTIME - Signal\ Extension) - (aPreambleLength + aPLCPHeaderLength))}{aSymbolLength} \right\rceil \times N_{OPS} - \left\lceil \frac{aPLCPServiceLength + aPLCPConvolutionalTailLength}{8} \right\rceil$$

$$L_{LENGTH} = \left\lceil \frac{TXTIME-20}{4} \right\rceil \times 3 - 3$$

$$L_{LENGTH} = \left\lceil \frac{TXTIME-20}{4} \right\rceil \times 3 - 3 + m \text{ where } m = 1,2$$

SAMSUNG-1003, ¶102.

Also discussed above, in Bharadwaj-Prov059, the "duration of the data unit 330, in number of bytes, is determined by the following expression (Equation 2):

$$L_{LENGTH} = \left\lceil \frac{TXTIME-20}{4} \right\rceil \times 3 - 3 + m \text{ where } m = 1,2$$

where TXTIME = $T_{L\_PREAMBLE} + T_{HE\_PREAMBLE} + T_{DATA} + T_{SE}$…. The value of T_{DATA} is the duration of the data portion 345 of the data unit 330 and can be determined by the transmitter device 310 based on the following expression (Equation 3):

$$T_{DATA} = N_{sym} \times T_{sym} = N_{sym} \times (12.8 + T_{GI})$$

where… Tsym is the duration of a data symbol…." SAMSUNG-1007, [0051]. Accordingly, Tsym (**duration of a symbol of the data of the non-legacy physical layer frame**) and the rounding error Δ (**increment of duration**) are also used to set TXTIME reported through L_{LENGTH} (**a value of the length information**) based on aSymbolLength (**duration of a symbol of the legacy physical layer frame**). SAMSUNG-1003, ¶103.

As discussed above in Section III.A.3, while Bharadwaj-Prov059 explicitly discloses the following examples for calculating L_{LENGTH} and Nsym using the following equations,

$$L_{LENGTH} = \left\lceil \frac{TXTIME-20}{4} \right\rceil \times 3 - 3 + m \text{ where } m = 1,2$$

$$N_{sym} = \left\lfloor \frac{\left\lceil \frac{L_{LENGTH} - m + 3}{3} \right\rceil \times 4 - T_{HE\_PREAMBLE}}{T_{SYM}} \right\rfloor - SE_{disambiguation\_bit}$$

a POSITA would have found it obvious in the alternative to *subtract* rather than add m in the L_{LENGTH} equation for reasons discussed in detail above in the overview of the Bharadwaj-Yu combination, including, to address the need to "ensure that L_{LENGTH} is not exactly a multiple of 3… to distinguish between IEEE 802.11ax and IEEE 802.11ac transmissions" and to ensure that application of m in the L_{LENGTH} equation does not disturb the operation of legacy receivers. *Supra*, §III.A.3; SAMSUNG-1006, [0050]; SAMSUNG-1007, [0051]; SAMSUNG-1010, [0017]-[0020], [0024], [0036], [0038]-[0042], [0059]-[0060], [0063], [0065]; SAMSUNG-1012, [0057], [0068], [0073], [0080]-[0081]; SAMSUNG-1013, [0055]-[0056]; SAMSUNG-1014, [0039], [0077]; SAMSUNG-1015, [0051]-[0052]; SAMSUNG-1016, 2, 4-5. Indeed, Yu-Prov428, which also pre-dates the

’077 patent and is incorporated by reference in Yu, discloses the following Length equation that *subtracts* a value of M=0, 1, or 2 depending on the signaling state:

$$\text{Length} = \frac{TXTIME - 20}{4} \times 3 - 3 - M,\ 0 \le M \le 2$$

SAMSUNG-1020, 16; SAMSUNG-1019, [0001], [0232]; SAMSUNG-1003, ¶104.

By applying Yu-Prov428’s suggestion to *subtract* m, a POSITA would have found it obvious for Bharadwaj’s transmitter to set L_{LENGTH} according to the equation,

$$L_{LENGTH} = \left\lceil \frac{TXTIME - 20}{4} \right\rceil \times 3 - 3 - m$$

which also solves the need to “ensure that L_{LENGTH} is not exactly a multiple of 3 and therefore can be used to distinguish between IEEE 802.11ax and IEEE 802.11ac transmissions.” SAMSUNG-1003, ¶105; SAMSUNG-1020, 16; SAMSUNG-1019, [0232]; SAMSUNG-1007, [0051]-[0052]; SAMSUNG-1006, [0050]. From this updated L_{LENGTH} equation, the receiver computes RXTIME and Nsym as follows:

$$RXTIME = \left\lceil \frac{L_{LENGTH} + m + 3}{3} \right\rceil \times 4 + 20$$

$$N_{sym} = \left\lfloor \frac{\left\lceil \frac{L_{LENGTH} + m + 3}{3} \right\rceil \times 4 - T_{HE\_PREAMBLE}}{T_{SYM}} \right\rfloor - SE_{disambiguation\_bit}$$

SAMSUNG-1006, [0054]-[0055], [0060][10]. As discussed above in Section III.A.3, the above Nsym equation is equivalent to:

$$N_{sym} = \left\lfloor \frac{\frac{L_{LENGTH} + m + 3}{3} \times 4 - T_{HE\_PREAMBLE}}{T_{SYM}} \right\rfloor - SE_{disambiguation\_bit}$$

where **m denotes a value obtained by subtracting the remaining value from** 3 (**the data size transmittable by a symbol of the legacy physical layer frame** (per 1[d]/8[d])), as shown below using, for example, m = 1 and L_{LENGTH} = 240 – m = 240 – 1 = 239:

$$m = 3 - L_{LENGTH} \bmod 3 = 3 - 239 \bmod 3 = 3 - 2 = 1$$

where L_{LENGTH} mod 3 denotes the remaining value of dividing L_{LENGTH} by 3. SAMSUNG-1003, ¶105. As demonstrated by the prior art equations, a POSITA would have understood and found obvious that it would be necessary for the receiver to subtract L_{LENGTH} mod 3 from 3 to recover the value of m that the transmitter applied by subtraction in the L_{LENGTH} equation as taught in Yu-Prov248.

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[10] Bharadwaj's equation for RXTIME includes a typographical error in which "–20" should be "+20" as evident by the calculation of RXTIME = 344 µs. SEC-1006, [0054]-[0055], [0060].

Id. By contrast, in the case where the transmitter adds m in the L_{LENGTH} equation, the receiver can recover m by taking L_{LENGTH} mod 3 without subtracting this value from 3. *Id.* The receiver's method of deriving m to recover the same value of m that the transmitter used to set L_{LENGTH} is a straightforward mathematical calculation that would have been readily recognized by a POSITA since it flows directly from the transmitter's method of either adding or subtracting m in the L_{LENGTH} equation. *Id.*

(b) Claims 2 and 9

2. The wireless communication terminal of claim 1, wherein the processor is configured to obtain …
9. The method of claim 8, the method further comprises obtaining
a duration of a packet extension which is a padding of the non-legacy physical layer frame, according to a following equation,

$$T_{PE} = \left\lfloor \frac{\left(\frac{\text{L\_LENGTH} + m + 3}{3} \times 4 - T_{HE\_PREAMBLE}\right) - N_{SYM} \times T_{SYM}}{4} \right\rfloor \times 4$$

where $\lfloor x \rfloor$ denotes a largest integer less than or equal to x,
L_LENGTH denotes the length information,
m denotes the value obtained by subtracting the remaining value from the data size transmittable by a symbol of the legacy physical layer frame,
$T_{HE\_PREAMBLE}$ denotes the duration of non-legacy preamble of the non-legacy physical layer frame,
T_{SYM} denotes the duration of a symbol of the data of the non-legacy physical layer frame.

The Bharadwaj-Yu combination renders obvious claims 2 and 9. SAMSUNG-1003, ¶¶106-108. For example, Bharadwaj-Prov059 discloses that "[a]fter the value of Nsym is obtained, the duration of the signal extension 350 (e.g., T_{SE}) applied to the data unit 330 is determined or computed by the receiver device 320 based on the following expression (Equation 7):"

$$T_{SE} = \left\lfloor \frac{RXTIME - T_{L\_PREAMBLE} - T_{HE\_PREAMBLE} - (N_{sym} \times T_{sym})}{4} \right\rfloor \times 4$$

SAMSUNG-1007, [0058]. Further, as discussed above in 1[c]/8[c], Bharadwaj-Prov059 teaches that the receiver calculates RXTIME as follows (Equation 5):

$$RXTIME = \left\lceil \frac{L_{LENGTH} - m + 3}{3} \right\rceil \times 4 + 20$$

SAMSUNG-1007, [0056]; *see also id.*, FIGS. 2, 4, 6 (depicting durations of a packet extension as a padding of the 802.11ax non-legacy physical layer frame), [0047], [0064]; SAMSUNG-1003, ¶106.

As discussed above in Section III.A.3, it would have been obvious to use m = −1 or −2 to "ensure that L_{LENGTH} is not exactly a multiple of 3… to distinguish between IEEE 802.11ax and IEEE 802.11ac transmissions." SAMSUNG-1006, [0050]; SAMSUNG-1007, [0051]; SAMSUNG-1010, [0017]-[0020], [0024], [0036], [0038]-[0042], [0059]-[0060], [0063], [0065]; SAMSUNG-1012, [0057], [0068], [0073], [0080]-[0081]; SAMSUNG-1013, [0055]-[0056]; SAMSUNG-1014, [0039], [0077]; SAMSUNG-1015, [0051]-[0052]; SAMSUNG-1016, 2, 4-5. Applying Equation 5 for RXTIME with m = −1 or −2 to Equation 7, and cancelling out terms of +/- 20 (since $T_{L\_PREAMBLE}$ = 20 µs (SAMSUNG-1007, [0059])), Equation 7 can be expressed as follows:

$$T_{SE} = \left\lfloor \frac{\left\lceil \frac{L_{LENGTH} + m + 3}{3} \right\rceil \times 4 - T_{HE\_PREAMBLE} - (N_{sym} \times T_{sym})}{4} \right\rfloor \times 4$$

SAMSUNG-1016, 4-5; SAMSUNG-1006, [0056], [0061]; SAMSUNG-1003, ¶107.

A POSITA would have understood that for valid values of L_{LENGTH} and m where L_{LENGTH} +m is a multiple of 3 (*see supra*, §III.A.3), $\left\lceil \frac{L_{LENGTH}+3+m}{3} \right\rceil = \frac{L_{LENGTH}+3+m}{3}$. For example:

$$L_{LENGTH} = \left\lceil \frac{TXTIME - 20}{4} \right\rceil \times 3 - 3 - m$$

$$\frac{L_{LENGTH} + 3 + m}{3} = \left\lceil \frac{TXTIME - 20}{4} \right\rceil$$

$$\left\lceil \frac{L_{LENGTH} + 3 + m}{3} \right\rceil = \left\lceil \left\lceil \frac{TXTIME - 20}{4} \right\rceil \right\rceil = \left\lceil \frac{TXTIME - 20}{4} \right\rceil$$

$$= \frac{L_{LENGTH} + 3 + m}{3}$$

and because $\lceil x \rceil$ is an integer, $\lceil \lceil x \rceil \rceil = \lceil x \rceil = \lceil \text{integer} \rceil = \text{integer}$. Using, for example, if m=1 and

$$L_{LENGTH} = \left\lceil \frac{TXTIME - 20}{4} \right\rceil \times 3 - 3 - m = 239$$

a POSITA would have recognized that:

$$\left\lceil \frac{L_{LENGTH} + m + 3}{3} \right\rceil = \left\lceil \frac{239 + 1 + 3}{3} \right\rceil = \frac{239 + 1 + 3}{3} = \frac{L_{LENGTH} + m + 3}{3}$$

and therefore:

$$T_{SE} = \left\lfloor \frac{\left\lceil \frac{L_{LENGTH} + m + 3}{3} \right\rceil \times 4 - T_{HE\_PREAMBLE} - (N_{sym} \times T_{sym})}{4} \right\rfloor \times 4$$

$$= \left\lfloor \frac{\frac{L_{LENGTH} + m + 3}{3} \times 4 - T_{HE\_PREAMBLE} - (N_{sym} \times T_{sym})}{4} \right\rfloor \times 4$$

SAMSUNG-1003, ¶108; SEC-1006, [0057]-[0058].

(c) Claims 3 and 10

3. The wireless communication terminal of claim 1,
10. The method of claim 8,
wherein the increment of duration is a value obtained by multiplying a difference between a value obtained by performing a ceiling operation on a value obtained by dividing the duration of the non-legacy physical layer frame after the legacy signaling field by the duration of a symbol of the legacy physical layer frame and the value obtained by dividing the duration of the non-legacy physical layer frame after the legacy signaling field by the duration of a symbol of the legacy physical layer frame by the duration of a symbol of the legacy physical layer frame.

The Bharadwaj-Yu combination renders obvious claims 3 and 10. SAMSUNG-1003, ¶109. As discussed above in 1[e]/8[e], the SE disambiguation bit (**a value of PE Disambiguity field**) is set based on Tsym (**duration of a**

symbol of the data of the non-legacy physical layer frame) and the T_{SE} in connection with the rounding error Δ (**increment of duration**). SAMSUNG-1007, [0049], [0054]. "The transmitter 310 may be configured to set or determine the SE disambiguation bit (e.g., the single signaling bit 355) as follows" using Equation 4:

$$T_{SE} + \underbrace{4 \times \left(\left\lceil \frac{TXTIME - 20}{4} \right\rceil - \left(\frac{TXTIME - 20}{4} \right) \right)}_{\text{Computes rounding error } \Delta} \geq T_{sym}$$

SAMSUNG-1007, [0054], [0072], [0078], [0082]. In Equation 4, TXTIME − 20 is **the duration of the non-legacy physical layer frame after the legacy signaling field** (per 1[c]/8[c]) and 4 is **the duration of a symbol of the legacy physical layer frame** (per 1[e]/8[e]), and therefore the rounding error Δ of Bharadwaj-Prov059's **increment of duration** is a value obtained by the claimed mathematical operations. SAMSUNG-1003, ¶109.

(d) Claims 4-5 and 11-12

4. The wireless communication terminal of claim 1, wherein the processor is configured to determine …
11. The method of claim 8, the method further comprises determining a format of a non-legacy signaling field included in the non-legacy physical layer frame based on the length information.
5. The wireless communication terminal of claim 4, wherein the processor is configured to determine …
12. The method of claim 11, wherein determining the format of a non-legacy

signaling field included in the non-legacy physical layer frame comprises determining whether the non-legacy physical layer frame comprises a predetermined signaling field based on the length information.

The Bharadwaj-Yu combination renders obvious claims 4-5 and 11-12. SAMSUNG-1003, ¶110. As discussed above in 1[d]/8[d], in Bharadwaj-Prov059, the "value *m* shown above has been added in IEEE 802.11ax to ensure that L_{LENGTH} is not exactly a multiple of 3 and is therefore used to distinguish between IEEE 802.11ax and IEEE 802.11ac transmissions (e.g., auto-detections)." SAMSUNG-1007, [0051]. Based on Bharadwaj-Prov059's disclosure and a POSITA's general knowledge, a POSITA would have found it obvious that the receiver device 320 divides the L_{LENGTH} by 3 to "distinguish between IEEE 802.11ax and IEEE 802.11ac transmissions" through a remaining value as was well known as of the Critical Date of the '077 patent. *Id.*; SAMSUNG-1010, [0017]-[0020], [0024], [0036], [0038]-[0042], [0059]-[0060], [0063], [0065]; SAMSUNG-1012, [0057], [0068], [0073], [0080]-[0081]; SAMSUNG-1013, [0029], [0032], [0035], [0055]-[0056], [0085]; SAMSUNG-1014, [0039], [0077]; SAMSUNG-1015, [0051]-[0052]. A remaining value of 0 would indicate that the transmission is an 802.11ac transmission, and a remaining value of either 1 or 2 would indicate that the transmission is an 802.11ax transmission. SAMSUNG-1003, ¶110. From the remaining value of dividing L_{LENGTH} by 3 and thus the length information L_{LENGTH}, the receiver device determines the format of the signaling field included in the frame. *Id.* For example, from the remaining value of either 1 or 2, the receiver determines that the format of the frame is an 802.11ax frame (**non-legacy physical layer frame**) including a legacy preamble 335, a high efficiency (HE) preamble 340, data portion 345, and signal extension 350. SAMSUNG-1007, [0044], [0051], [0053]-[0054], [0085], [0090]. The HE preamble that includes an RL-SIG, an HE-SIG-A, an HE-SIG-B, an HE-STF, an HE-LTF, and a single signaling bit 355 used for the single-bit signaling scheme 340 includes a **non-legacy signaling field/predetermined signaling field**. *Id.*; SAMSUNG-1003, ¶110.

B. GROUND 1B—Obvious based on Bharadwaj in view of Yu and Azizi (Claims 4-5 and 11-12)

1. Overview of Azizi

Azizi relates to "high efficiency (HE) wireless local area networks (WLANs) including networks operating in accordance with the Institute of Electronic and Electrical Engineers (IEEE) 802.11 family of standards, such as the IEEE 802.11a/g/n/ac standard or the IEEE 802.11ax standard" and describes "using different size preambles." SAMSUNG-1015, [0002]. In Azizi, HE packets can be configured to have either a short preamble format 200 or a long preamble format 300 as shown in FIGS. 2 and 3, respectively. SAMSUNG-1015, [0028]-[0043]. A "HEW device 104 and/or AP 102 may determine whether to use the short preamble format 200 or the long preamble format 300 based on characteristics of the wireless medium. For example a lot of errors may indicate that the long preamble format 300 should be used." SAMSUNG-1015, [0049], [0055], [0071]. The "length field of the L-SIG field 206 may indicate whether the preamble is the short preamble format 200 or the long preamble format 300. For example, a length field that has a length of 1 modulo 3 may indicate a short preamble format 200 and a length of 2 modulo 3 may indicate a long preamble format 300." SAMSUNG-1015, [0031], [0037], [0045], [0049], [0064], [0068]-[0069], [0079]-[0080]; SAMSUNG-1003, ¶74.

Azizi further explains that "legacy devices 106 and HEW devices 104 co-exist in the same WLAN." SAMSUNG-1015, [0051]. Therefore, the "HEW device 104 needs a way to recognize HE packets and a way to indicate to legacy devices 106 to defer if the packet is HE packet. The HEW device 104 may be able to determine based on the L-SIG whether or not the packet may be a HE packet. For example, a length 406 field may indicate that the packet may be an HE packet if the length 406 field is not equal to 0 modulo 3." *Id*. If "the L-SIG indicates that the packet is or may be an HE packet" then the HEW device determines "the preamble format. For example, the length 406 field of the L-SIG 400 may indicate based on the modulus 3 the preamble configuration." SAMSUNG-1015, [0053]; SAMSUNG-1003, ¶75.

2. Combination of Bharadwaj and Yu in view of Azizi

A POSITA would have found it obvious and straightforward to implement Bharadwaj-Prov059's receiver device, as modified by Yu ("Bharadwaj-Yu"), such that the processor distinguishes between HE packets and legacy packets and determines the preamble format based on the length field of the L-SIG, based on Azizi's teachings. SAMSUNG-1015, [0051], [0053]; SAMSUNG-1003, ¶76. A POSITA would have been motivated to apply Azizi's suggestion in this regard to Bharadwaj-Yu's receiver device because Azizi explicitly describes a receiver device that performs such functionality. *Id.* A POSITA would have also been motivated to apply Azizi's suggestion (e.g., using a short preamble format or a long preamble format and determining the preamble format based on the length field of the L-SIG) to Bharadwaj-Yu's receiver device in order to use the wireless medium more efficiently. *Id.*; SAMSUNG-1015, [0049], [0055], [0071]. For example, "the short preamble 200 has less overhead and may be used indoors" and "the long preamble 300 may be used in the outdoors and may have more overhead but may be more reliable in some environments." *Id.*

A POSITA would have applied Azizi's functionality in the same way to Bharadwaj-Yu's receiver device, would have achieved predictable results, and would have reasonably expected success in achieving the combination. SAMSUNG-1003, ¶77. "It's enough… to show that there was a known problem…

in the art, that [another reference] … helped address that issue, and that combining the teachings of [the two references] wasn't beyond the skill of an ordinary artisan. Nothing more is required to show a motivation to combine under *KSR*." *See Intel Corp. v. PACT XPP Schweiz AG*, 61 F.4th 1373, 1380-81, (Fed. Cir. 2023) (finding that both prior art references "address the same problem and that [the secondary reference's] cache was a known way to address that problem is precisely the reason that there's a motivation to combine under *KSR* and our precedent.").

3. Claim Element Analysis

4. The wireless communication terminal of claim 1, wherein the processor is configured to determine …
11. The method of claim 8, the method further comprises determining a format of a non-legacy signaling field included in the non-legacy physical layer frame based on the length information.
5. The wireless communication terminal of claim 4, wherein the processor is configured to determine …
12. The method of claim 11, wherein determining the format of a non-legacy signaling field included in the non-legacy physical layer frame comprises determining whether the non-legacy physical layer frame comprises a predetermined signaling field based on the length information.

The Bharadwaj-Yu-Azizi combination renders obvious claims 4-5 and 11-12. SAMSUNG-1003, ¶111. As explained above in Section III.B.2, the processor of Bharadwaj-Yu-Azizi's device distinguishes between an HE packet and a legacy packet and determines the preamble format (e.g., a short preamble format or long preamble format) of an HE packet based on the length field of the L-SIG (**determine a format of a non-legacy signaling field included in the non-legacy**

physical layer frame based on the length information). SAMSUNG-1007, [0051]-[0052]; SAMSUNG-1020, 16; SAMSUNG-1019, [0232]; SAMSUNG-1015, [0051], [0053]. By determining whether the preamble format is a short preamble format or a long preamble format based on the length field of the L-SIG, the processor of Bharadwaj-Yu-Azizi's device determines whether the HE packet includes the predetermined signaling fields of the short preamble as shown in FIG. 2 or the predetermined signaling fields of the long preamble as shown in FIG. 3 (**determine whether the non-legacy physical layer frame comprises a predetermined signaling field**). SAMSUNG-1015, [0028]-[0043]; SAMSUNG-1003, ¶111.

C. GROUND 1C—Obvious based on Bharadwaj in view of Yu and Kenney (Claims 6-7 and 13-14)

1. Overview of Kenney

Kenney relates to "high-efficiency Wi-Fi (HEW) communications in accordance with the IEEE 802.11ax draft standard." SAMSUNG-1010, [0002]. In Kenney, "an HEW station" is "an IEEE 802.11ax configured station (STA) that is configured for HEW operation." SAMSUNG-1010, [0027]. "Legacy stations" include "non-HT stations 108 (e.g., IEEE 802.11 a/g stations), HT stations 110 (e.g., IEEE 802.11n stations), and VHT stations 112 (e.g., IEEE 802.11ac stations).” SAMSUNG-1010, [0024]; SAMSUNG-1003, ¶78.

Kenney describes “methods for distinguishing high-efficiency Wi-Fi (HEW) packets from legacy packets.” SAMSUNG-1010, Abstract, [0024], [0056], FIG. 4. Kenney discloses that an HEW device with a processor determines “whether a value for the length field is divisible by three” and identifies “the PPDU as an HEW PPDU when the value in the length field is not divisible three” and “the PPDU as a non-HEW PPDU (e.g., a VHT PPDU or HT PPDU) when the value in the length field is divisible three.” SAMSUNG-1010, [0065], Abstract, [0024], [0036], [0038]-[0041], [0059]-[0060], FIG. 4 (406, 408), claims 1, 13, 17. Kenney discloses that the HEW device’s processor also determines “whether the PPDU is a HT PPDU, a VHT PPDU or an HEW PPDU based on the phase rotation applied to the BPSK modulation of at least one of the first and second symbols of the subsequent signal field” following the L-SIG field. SAMSUNG-1010, Abstract, [0066], [0024], [0062], FIG. 4 (412), claims 3, 15, 17; SAMSUNG-1003, ¶79.

Kenney discloses that a data unit (PPDU) is configured “to include a subsequent/additional signal field 210 (e.g., HT-SIG 212, VHT-SIG 222, or HEW-SIG 232) following the L-SIG 206” that has “first and second symbols that are BPSK modulated.” SAMSUNG-1010, [0043], [0061], FIG. 4 (410). For “an HEW-PPDU, the first symbol 332A of the HEW-SIG 232 is rotated BPSK and the second symbol 332B is conventional (i.e., non-rotated) BPSK.” SAMSUNG-1010,

[0050]. For "a VHT-PPDU, the first symbol 322A of the VHT-SIG 222 is conventional BPSK and the second symbol 322B is rotated BPSK." SAMSUNG-1010, [0051]. For a HT PPDU, both symbols of the HT-SIG 222 are rotated BPSK. SAMSUNG-1010, [0052]. "The HT-SIG 212 uses rotated binary phase-shift keying (BPSK) in both symbols of the HT-SIG 212 so that IEEE 802.11n devices can distinguish it from non-rotated BPSK data 208 of an IEEE 802.11a/g transmission and allows those devices to detect the existence of an IEEE 802.11n packet" and this "modulation format may be used by an IEEE 802.11n device to detect those packets and identify them as IEEE 802.11n packets." SAMSUNG-1010, [0032], [0034]; SAMSUNG-1003, ¶80.

2. Combination of Bharadwaj in view of Yu and Kenney

A POSITA would have found it obvious and straightforward to implement Bharadwaj-Yu's receiver device such that the processor distinguishes "between IEEE 802.11ax and IEEE 802.11ac transmissions," "HEW PPDUs from non-HEW PPDUs," and "HT PPDUs, VHT PPDUs and HEW PPDUs" (SAMSUNG-1007, [0051]; SAMSUNG-1010, [0024], Abstract, [0036], [0038]-[0041], [0059]-[0060], [0062], [0064]-[0066]) based on whether a value for the length field is divisible by three and a phase rotation applied to the BPSK modulation of the first and second symbols of the HEW-SIG field following the L-SIG field, based on Kenney's teachings. SAMSUNG-1010, Abstract, [0024], [0036], [0038]-[0041], [0059]-

[0060], [0062], [0064]-[0066], FIG. 4 (406, 408, 412), claims 1, 3, 13, 15, 17; SAMSUNG-1003, ¶81.

A POSITA would have been motivated to apply Kenney's suggestion in this regard to Bharadwaj-Prov059's receiver device because Kenney explicitly describes a receiver device that determines whether a value for the length field is divisible by three "to distinguish HEW PPDUs from non-HEW PPDUs" and determines a phase rotation applied to the BPSK modulation of the first and second symbols of the HEW-SIG field following the L-SIG field "to distinguish HT PPDUs, VHT PPDUs and HEW PPDUs." SAMSUNG-1010, [0024], Abstract, [0036], [0038]-[0041], [0059]-[0060], [0062], [0064]-[0066]; SAMSUNG-1003, ¶82. By determining both (1) whether a value for the length field is divisible by three and (2) a phase rotation applied to the BPSK modulation of the first and second symbols of the HEW-SIG field, the HEW device is provided with a more robust and reliable determination that the PPDU is a HEW PPDU. *Id.*

A POSITA would have applied Kenney's functionality in the same way to Bharadwaj-Yu's receiver device, would have achieved predictable results, and would have reasonably expected success in achieving the combination. SAMSUNG-1003, ¶83. "It's enough… to show that there was a known problem… in the art, that [another reference] … helped address that issue, and that combining the teachings of [the two references] wasn't beyond the skill of an ordinary artisan.

Nothing more is required to show a motivation to combine under *KSR*." *See Intel Corp. v. PACT XPP Schweiz AG*, 61 F.4th 1373, 1380-81, (Fed. Cir. 2023) (finding that both prior art references "address the same problem and that [the secondary reference's] cache was a known way to address that problem is precisely the reason that there's a motivation to combine under *KSR* and our precedent.").

3. Claim Element Analysis

6. The wireless communication terminal of claim 1, wherein the processor is configured to obtain…
13. The method of claim 8, wherein the obtaining the information other than the information on the duration of the non-legacy physical layer frame comprises obtaining the information other than the information on the duration of the non-legacy physical layer frame based on the remaining value and a modulation method of a third symbol after the legacy signaling field.
7. The wireless communication terminal of claim 6,…
14. The method of claim 13, wherein the modulation method is Binary Phase Shift Keying (BPSK) or Quadrature Binary Phase Shift Keying (QBPSK).

The Bharadwaj-Yu-Kenney combination renders obvious claims 6-7 and 13-14. SAMSUNG-1003, ¶¶112-114. For example, in Bharadwaj-Prov059, the "data unit 330 is shown to generally include a legacy preamble 335, a high efficiency (HE) preamble 340, which typically includes the single signaling bit 335 used for the single-bit signaling scheme, data portion 345, and signal extension 350." SAMSUNG-1007, [0044]. The "legacy preamble 335 of the data unit 330… includes a legacy short training field (L-STF), a legacy long training field (L-LTF), and L-SIG." SAMSUNG-1007, [0051]. The "high efficiency (HE) or IEEE

802.11ax preamble 340 of the data unit 330… includes an RL-SIG, an HE-SIG-A, an HE-SIG-B, an HE-STF, and an HE-LTF." *Id.* As such, in Bharadwaj-Prov059, after L-SIG (**legacy signaling field**), RL-SIG is the first symbol, and HE-SIG includes a second and a third symbol (e.g., HE-SIG-A including two symbols, or HE-SIG-A having one symbol and HE-SIG-B having one symbol). SAMSUNG-1022, 11 (describing R-LSIG as a "symbol repeating the LSIG content"); SAMSUNG-1015, [0032] ("HE-SIG-A field 208 may be K1 number of symbols long" where "K1 may be one or more. The HE-SIG-B field 210 may be K2 symbols long" where "K2 may be one or more."), [0038] ("HE-SIG-A 310 may be one or more symbols.); SAMSUNG-1003, ¶112.

Kenney discloses that a data unit (PPDU) is configured "to include a subsequent/additional signal field 210 (e.g., HT-SIG 212, VHT-SIG 222, or HEW-SIG 232) following the L-SIG 206" that has "first and second symbols that are BPSK modulated." SAMSUNG-1010, [0043], [0061], FIG. 4 (410). For "an HEW-PPDU, the first symbol 332A of the HEW-SIG 232 is rotated BPSK and the second symbol 332B is conventional (i.e., non-rotated) BPSK." SAMSUNG-1010, [0050]; SAMSUNG-1003, ¶113.

As discussed above in Section III.C.2, the processor of Bharadwaj-Yu-Kenny's receiver device distinguishes "between IEEE 802.11ax and IEEE 802.11ac transmissions," "HEW PPDUs from non-HEW PPDUs," and "HT

PPDUs, VHT PPDUs and HEW PPDUs" (SAMSUNG-1007, [0051]; SAMSUNG-1010, [0024], Abstract, [0036], [0038]-[0041], [0059]-[0060], [0062], [0064]-[0066]) (**obtain information other than information on the duration of the non-legacy physical layer frame**) **based on a remaining value** (per 1[d]/8[d]) and a phase rotation applied to the **BPSK modulation** (**modulation method**) of the first and second symbols of the HE-SIG field after the L-SIG field (**legacy signaling field**) and the RL-SIG field. SAMSUNG-1010, Abstract, [0024], [0036], [0038]-[0041], [0059]-[0060], [0062], [0064]-[0066], FIG. 4 (406, 408, 412), claims 1, 3, 13, 15, 17. Here, the second symbol of the HE-SIG field is the **third symbol after the legacy signaling field** in Bharadwaj-Yu-Kenny's data unit. SAMSUNG-1003, ¶114.

D. GROUND 2A—Obvious based on Bharadwaj (Claims 1-5 and 8-12); GROUND 2B—Obvious based on Bharadwaj and Azizi (Claims 4-5 and 11-12); GROUND 2C—Obvious based on Bharadwaj and Kenney (Claims 6-7 and 13-14)

As articulated in Ground 1A in light of Yu's teaching of a Length equation with a "$-M$" value of 0, 1, or 2, a POSITA would have found it obvious for the processor of Bharadwaj-Prov059's receiver device to distinguish "between IEEE 802.11ax and IEEE 802.11ac transmissions" using the L_LENGTH equation with "−m" where m = 1 or 2. SAMSUNG-1020, 16; SAMSUNG-1019, [0232];

SAMSUNG-1003, ¶115. Bharadwaj and Yu is a combination in which Yu is offered to demonstrate a broader concept that is well understood by a POSITA, namely that the L_LENGTH equation with "−m" where m = 1 or 2 also serves to distinguish between IEEE 802.11ax and IEEE 802.11ac transmissions. *Id.* This concept is well known to a POSITA, and thus, for Grounds 2A-2C, the application of Bharadwaj alone reveals to a POSITA, based on their general knowledge and ordinary level of skill, that it would have been obvious to use the L_LENGTH equation with "−m" where m = 1 or 2 to distinguish between IEEE 802.11ax and IEEE 802.11ac transmissions. *Id.*

IV. 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-1023; SAMSUNG-1024; SAMSUNG-1025.

V. CONCLUSION AND FEES

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

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

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

Samsung Electronics Co., Ltd. and Samsung Electronics America, Inc. (collectively, "Samsung") are the real parties-in-interest.

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

The '077 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; *Wilus Institute of Standards and Technology Inc. v. Askey Computer Corporation et al.*, 2-24-cv-00753 (EDTX) filed September 13, 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 '077 Patent.

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

Petitioner provides the following designation of counsel.

Lead Counsel	Backup counsel
W. Karl Renner, Reg. No. 41,265 Fish & Richardson P.C. 60 South Sixth Street, Suite 3200 Minneapolis, MN 55402 Tel: 202-783-5070 Fax: 877-769-7945 Email: IPR39843-0193IP1@fr.com	Jeremy J. Monaldo, Reg. No. 58,680 Nicholas Stephens, Reg. No. 74,320 Kim H. Leung, Reg. No. 64,399 60 South Sixth Street, Suite 3200 Minneapolis, MN 55402 Tel: 202-783-5070 Fax: 877-769-7945 PTABInbound@fr.com

D. Service Information

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

Petitioner consents to electronic service by email at IPR39843-0193IP1@fr.com (referencing No. 39843-0193IP1 and cc'ing PTABInbound@fr.com).

Respectfully submitted,

Dated June 5, 2025

/Nicholas W. Stephens/
W. Karl Renner, Reg. No. 41,265
Jeremy J. Monaldo, Reg. No. 58,680
Nicholas Stephens, Reg. No. 74,320
Kim H. Leung, Reg. No. 64,399
Fish & Richardson P.C.
60 South Sixth Street, Suite 3200
Minneapolis, MN 55402
T: 202-783-5070
F: 877-769-7945

(Control No. IPR2025-01069)

Attorneys for Petitioner

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 12,849 words, which is less than the 14,000 allowed under 37 CFR § 42.24.

Dated June 5, 2025

/Nicholas W. Stephens/

W. Karl Renner, Reg. No. 41,265
Jeremy J. Monaldo, Reg. No. 58,680
Nicholas Stephens, Reg. No. 74,320
Kim H. Leung, Reg. No. 64,399
Fish & Richardson P.C.
60 South Sixth Street, Suite 3200
Minneapolis, MN 55402
T: 202-783-5070
F: 877-769-7945

Attorneys for Petitioner

CERTIFICATE OF SERVICE

Pursuant to 37 CFR §§ 42.6(e)(4)(i) et seq. and 42.105(b), the undersigned certifies that on June 5, 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:

Ladas & Parry
4525 Wilshire Boulevard, Suite 240
Los Angeles, CA 90010

/Diana Bradley/

Diana Bradley
Fish & Richardson P.C.
60 South Sixth Street, Suite 3200
Minneapolis, MN 55402
bradley@fr.com