

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD.,
Petitioner,

v.

G+ COMMUNICATIONS, LLC,
Patent Owner.

IPR2023-00171
Patent 10,736,130 B2

Before GREGG I. ANDERSON, SCOTT B. HOWARD, and
JASON M. REPKO, *Administrative Patent Judges*.

ANDERSON, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining All Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

Samsung Electronics Co., Ltd. (“Petitioner”) filed a Petition requesting *inter partes* review of claims 1–5, 7–9, 14, and 20 of U.S. Patent No. 10,736,130 B2 (Ex. 1001, “the ’130 patent”). Paper 1 (“Pet.”). We instituted *inter partes* review on May 31, 2023. Paper 10 (“Inst. Dec.”). G+ Communications, LLC (“Patent Owner”) filed a Response. Paper 16 (“PO Resp.”). Petitioner filed a Reply. Paper 19 (“Pet. Reply”). Patent Owner filed a Sur-reply. Paper 25 (“Sur-reply”).

A hearing was held on February 29, 2024, and a transcript has been made of record. Paper 33 (“Tr.”). After the hearing, we ordered supplemental briefing directed to construction of the claim term “on each of the M transmission symbols, one of the K predefined sequences is sent.” Paper 29 (“Construction Order”). Petitioner and Patent Owner filed simultaneously supplemental briefs per the Construction Order. Paper 32 (“Pet. Supp. Br.”); Paper 30 (“PO Supp. Br.”).

We have jurisdiction under 35 U.S.C. § 6. Upon considering the record, for the reasons discussed below, we find Petitioner has shown by a preponderance of the evidence that claims 1–5, 7–9, 14, and 20 are unpatentable.

II. BACKGROUND

A. *Real Parties in Interest*

Petitioner states it and Samsung Electronics America, Inc. are the real parties in interest. Pet. 1. Patent Owner asserts it is the real party in interest. Paper 4 (“G+ Communications LLC’s Mandatory Notices”), 1.

B. *Related Matters*

Both parties list a lawsuit filed by Patent Owner asserting the ’130 patent against Petitioner in the Eastern District of Texas captioned *G+*

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Patent 10,736,130 B2

Communications, LLC v. Samsung Electronics Co., Case No. 2:22-cv-00078-JRG (E.D. Tex.). Pet. 1; Paper 4, 1. Two related *inter partes* review proceedings between the same parties have been filed, both styled *Samsung Electronics Co., Ltd. v. G+ Communications LLC*, respectively IPR2022-01598 (“’1598 IPR”) and IPR2023-00441 (“’441 IPR”). See ’1598 IPR, Paper 38 (final written judgment determining no challenged claims unpatentable); ’441 IPR, Paper 10 (decision granting institution of *inter partes* review).

C. The ’130 Patent

The application for the ’130 patent was filed as national stage application No. 16/089,060 on March 24, 2017, from PCT/CN2017/078212 filed on September 27, 2018. Ex. 1001, codes (21), (22), (86). The PCT application claims priority to Chinese application 2016 1 0206116 (“’116 application”), filed March 31, 2016. *Id.* at code (30).

1. Background Technology

In conventional LTE (Long Term Evolution) and LTE-A (Long Term Evolution-Advanced), “Transmission Time Interval (TTI) is a basic unit for scheduling downlink and uplink transmission in a time domain.” Ex. 1001, 1:14–19. In an “LTE/LTE-A Frequency Division Duplex (FDD) system, a time dimension is divided into radio frames having the length of 10 ms,” each frame divided into ten subframes of 1 ms. *Id.* at 1:18–22. Each subframe is in turn divided into two time slots. *Id.* at 1:23–25. Thus, each subframe time slot is 0.5 ms in length. *Id.* at 1:23–24.

Contrasted with LTE and LTE-A, 5G (5th Generation Partnership Project) “will support a higher rate (Gbps), a massive link (1M/Km²), an ultra-low time delay (1 ms), higher reliability, hundredfold energy efficiency improvement and the like so as to support a new change in demand.” Ex.

1001, 1:32–37. The ultra-low time delay has “direct impact” on certain “time delay constrained services such as an Internet of vehicles” and other applications. *Id.* at 1:38–42.

Air interference adds 10 ms to the time delay index in LTE and LTE-A systems. Ex. 1001, 1:43–45. Reducing the length of the TTI is a solution. *Id.* at 1:45–46. However, this solution increases overhead of Reference Symbols (RS) of an existing Physical Uplink Control Channel (PUCCH) used to send receipt of transmission Acknowledgements (ACK) or Negative Acknowledgements (NACK). *Id.* at 1:50–57.

2. Uplink Control of the '130 Patent

In one embodiment shown in Figure 1, the '130 patent describes a “method for uplink control signal transmission.” Ex. 1001, 3:47–49. Figure 1 is reproduced below.

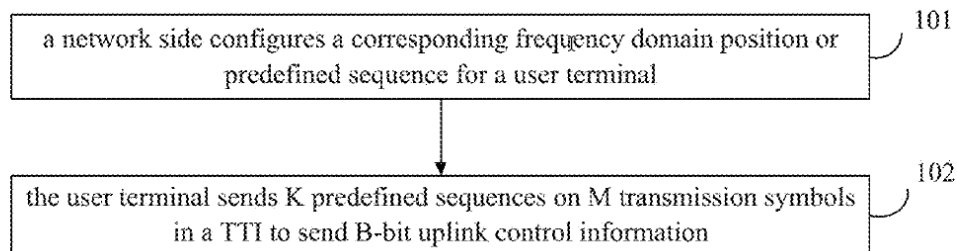


FIG. 1

Figure 1 is a flowchart of a method for uplink control signal transmission of one embodiment.

Id. at 2:58–60. The operations shown in Figure 1 include a network side 101 configuring a “frequency domain position or predefined sequence for a user terminal.” *Id.* at 3:52–54. A user terminal at 102 of Figure 1 sends “K

predefined sequences on M transmission symbols in a TTI to send B -bit uplink control information.” *Id.* at 3:59–61. The number of transmission symbols “ M is a positive integer, K is an integer, $1 \leq K \leq 2^B$, B is an integer greater than or equal to 1.” *Id.* at 3:62–63.

As illustrated in Figure 2, a symbol for an ACK and one for a NACK may be transmitted. Figure 2 is reproduced below.

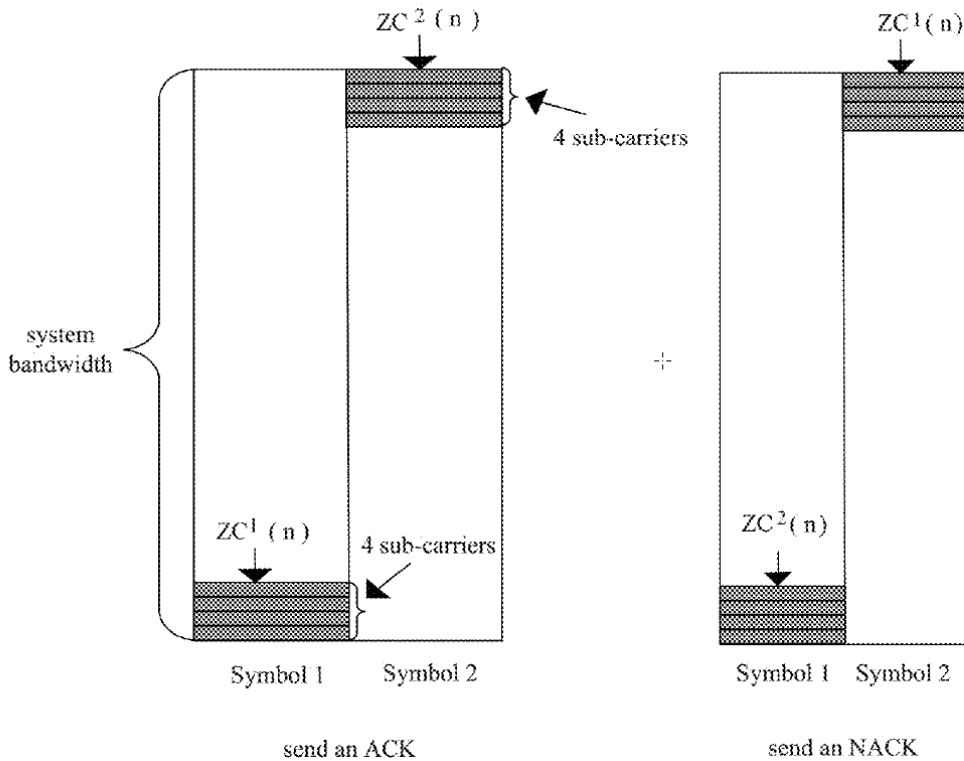


FIG. 2

Figure 2 is a schematic diagram showing a user terminal sending a 1-bit ACK/NACK using two predefined sequences having a length of 4 on two symbols.

Ex. 1001, 2:61–64. The two predefined sequences, $ZC_1(n)$ and $ZC_2(n)$, are distributed by a network to the user and are generated by the following formula:

$$ZC_q(n) = \exp\left(\frac{-jq\pi n^2}{N}\right)$$

Id. at 11:35–46. In the above formula, “q is a basic sequence index, and the $ZC_1(n)$ and the $ZC_2(n)$ may be obtained by respectively performing different time domain cyclic shifts on the basic sequence.” *Id.* at 11:46–49.

As further shown in Figure 2, “when the ACK message is sent, the user terminal sends the sequence $ZC_1(n)$ at the symbol 1 place, and sends the sequence $ZC_2(n)$ at the symbol 2 place.” Ex. 1001, 11:50–52. When the NACK message is sent, “the user terminal sends the sequence $ZC_2(n)$ at the symbol 1 place, and sends the sequence $ZC_1(n)$ at the symbol 2 place.” *Id.* at 11:53–55. The “frequency domain positions on the two symbols, to which the predefined sequences are mapped, are different, and are located at two sides of a system bandwidth.” *Id.* at 11:55–58. The ’130 patent discloses that,

by carrying the uplink control information to a scene having the TTI length being 2–4 symbols, a frequency diversity gain can be obtained; and thus, the demodulation complexity of noncoherent detection at a receiving end is low, the synchronization with the user terminal is convenient, and the transmission of the ACK/NACK and the SR [“Scheduling Request”] may be fed back during desynchronization. According to the technical solutions provided by the embodiments of the disclosure, the transmission efficiency of the uplink control information is improved, the data time delay is reduced, and thus the communication efficiency is improved.

Id. at 2:43–54, 1:53 (“SR”).

D. Illustrative Claim

Claims 1–5, 7–9, 14, and 20 of the ’130 patent are challenged. Pet. 2. Claims 1 and 20 are independent and claim a method and a device

respectively. Claims 2–5, 7–9, and 14 depend directly or indirectly from claim 1.

1[pre]¹ A method for uplink control signal transmission, comprising:

[1.a] sending, by a user terminal, K predefined sequences on M transmission symbols in a Transmission Time Interval (TTI) to send B-bit uplink control information,

[1.b] wherein M is a positive integer, K is an integer, $1 \leq K \leq 2^B$, B is an integer greater than or equal to 1,

[1.c] on each of the M transmission symbols, one of the K predefined sequences is sent and

[1.d] each of the K predefined sequences has a length of N and is mapped to N subcarriers of the transmission symbols corresponding to the each of the K predefined sequences,

[1.e] wherein $N=2n$ with n being a positive integer.

Ex. 1001, 27:15–25 (line breaks added); *see also id.* at 32 (certificate of correction).

E. Evidence of Record

This proceeding relies on the following prior art reference, additional reference, and expert testimony:

Kwak, U.S. Patent No. 10,615,925 B2, issued Apr. 7, 2020 (Ex. 1005);

¹ Both parties identify each claim by claim number followed by a letter for each claim limitation. *See, e.g.*, Pet. 12–13 (claim 1); PO Resp. ix–xi (Claim Listing of U.S. Patent No. 10,736,130). We adopt that convention for purposes of this Decision.

Kwak Provisional, U.S. Prov. Appln. No. 62/308,820, filed March 15, 2016 (Ex. 1006);

Petitioner relies on the Declaration of Dr. Zhi Ding in Support of Petition for Inter Partes Review of U.S. Patent No. 10,736,130 (Ex. 1002, “Ding Declaration”) and the Rebuttal Declaration of Dr. Zhi Ding (Ex. 1015, “Ding Rebuttal Declaration”); and

Patent Owner relies on the Declaration of Robert Akl in Support of Patent Owner’s Preliminary Response (Ex. 2001, “Akl Declaration”) and the Declaration of Dr. Robert Akl in Support of Patent Owner’s Response (Ex. 2004, “Akl Rebuttal Declaration”).

F. Asserted Grounds

Claim(s) Challenged	35 U.S.C.² §	Reference(s)/Basis
1–5, 7–9, 14, 20	102	Kwak
1–5, 7–9, 14, 20	102	Kwak (based on the filing date of the Kwak Provisional) ³

² The Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112-129, 125 Stat. 284, 285–288 (2011), revised 35 U.S.C. §§ 102 and 103 effective March 16, 2013. Because the challenged patent was filed after March 16, 2013, we refer to the current version of these statutes. The findings and analysis in this Decision would be the same under the pre-AIA versions.

³ Petitioner presents this challenge as two separate grounds. For “Ground 1,” Petitioner relies on Kwak’s PCT filing date of December 9, 2016. Pet. 2, 12–40. For “Ground 2,” Petitioner relies on Kwak’s Provisional Application No. 62/308,820 filing date of March 15, 2016. Pet. 3, 40–76; *see also* Ex. 1005, code (60). Petitioner asserts that the latter is only necessary if Patent Owner alleges that the ’130 patent claims are entitled to the benefit of the March 31, 2016, filing date of the ’116 application. Pet. 3 n.2. Patent Owner does not claim the benefit of the filing date of the ’116 application. *See* PO Resp. 23–25. Accordingly, we do not analyze “Ground 2.” *See* Section III.F below.

Claim(s) Challenged	35 U.S.C. ² §	Reference(s)/Basis
8, 9	103	Kwak
8. 9	103	Kwak (based on the filing date of the Kwak Provisional) ⁴

III. PATENTABILITY ANALYSIS

A. Level of Ordinary Skill in the Art

Petitioner proposes that a person of ordinary skill in the art for the invention of the '130 patent “would have had an undergraduate degree in electrical engineering, computer engineering, computer science or a related field along with at least two years of work experience in the field of wireless communication technology.” Pet. 5 (citing Ex. 1003 ¶ 23).

Patent Owner does not expressly propose a level of ordinary skill. *See* PO Resp. However, Dr. Akl, Patent Owner’s expert, proposes a level of ordinary skill in the art similar to that proposed by Petitioner. *See* Ex. 2001 ¶¶ 25–26. In the Akl Rebuttal Declaration, Dr. Akl commented on, but did not dispute, Petitioner’s proposed level of ordinary skill in the art. Ex. 2004 ¶ 40.

The level of ordinary skill in the art proposed by Dr. Akl is slightly different from Petitioner’s proposal but Dr. Akl does not explain whether

⁴ Petitioner presents this challenge as two separate grounds. For “Ground 3,” Petitioner relies on Kwak’s PCT filing date (Pet. 3, 74–75), and for “Ground 4,” Petitioner relies on Kwak’s Provisional Application (*id.* at 3, 75–76). For “Ground 4,” Patent Owner does not claim the benefit of the filing date of the '116 application. *See* PO Resp. 51. Accordingly, we do not analyze “Ground 4.” *See* Section III.H below.

this difference is material to his analysis nor that his conclusions and opinions would be different under Petitioner’s proposed level of skill. Furthermore, the level of skill is not dispositive of any issue here. For purposes of this Decision, we adopt Petitioner’s proposed level of ordinary skill because we are satisfied that it comports with the level of skill necessary to understand and implement the teachings of the ’130 patent.

B. Claim Construction

In an *inter partes* review, a claim shall be construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. § 282(b), including construing the claim in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent. 37 C.F.R. § 42.100 (2019); *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc).

Petitioner asserts “claim terms are typically given their ordinary and customary meanings, as would have been understood by a [person of ordinary skill in the art] at the time of the invention, having taken into consideration the language of the claims, the specification, and the prosecution history of record.” Pet. 11–12 (citing *Phillips*, 415 F.3d at 1313; *see also id.* at 1312–1316); Pet. Supp. Br. 1–4. Petitioner deems that express construction is unnecessary and does not propose any term for construction. *Id.* Patent Owner disagrees and argues the terms “on each of the M transmission symbols, one of the K predefined sequences is sent” (“M transmission term”) and “ $1 \leq K \leq 2^B$ ” (“K term”)” should be construed. PO Resp. 18–20.

In our Construction Order we requested additional briefing regarding the M transmission term. Construction Order 3; *see also* Pet. Supp. Br.; PO

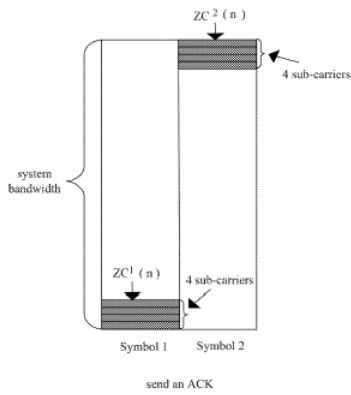
Supp. Br. Our Construction Order advised the parties that we preliminarily determined Patent Owner's proposed construction of the M transmission term was contradicted because: 1) both independent claims 1 and 20 use the open-ended language "comprising;" and 2) dependent claim 7 requires "one or more [of] the predefined sequences sent on each symbol." Construction Order 3.

1. *"on each of the M transmission symbols, one of the K predefined sequences is sent" (limitations 1.c and 20.d)*

We did not construe the M transmission term in the Institution Decision. We preliminarily determined that even applying Patent Owner's proposed construction from the Preliminary Response (Paper 6, "Prelim. Resp.") Kwak discloses limitation 1.c. Inst. Dec. 11–12 (citing Prelim. Resp. 26–27). As it argued in the Preliminary Response, Patent Owner contends the "M transmission term" should be construed to mean that "one, and only one K predefined sequence is sent on each of the M transmission symbols." PO Resp. 18 (citing Ex. 2004 ¶ 23).

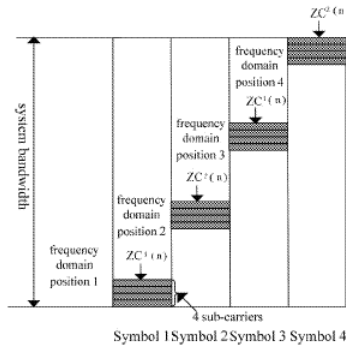
In support of its construction, Patent Owner argues the plain and ordinary meaning supports its proposed construction and that "[i]n every embodiment of the '130 patent, only one sequence is sent on every symbol." PO Resp. 19 (citing Ex. 1001, Figs. 2, 6, 7); *see also* PO Supp. Br. 1–2 (arguing plain and ordinary meaning and that all embodiments support Patent Owner's construction and citing Ex. 1001, 11:34–60, 12:54–13:12, 13:15–46, Figs. 2, 6, 7). Patent Owner cites supporting case law that "the claims should always be construed in view of the full specification." PO Supp. Br. 2 (citing *Vitronics Corp. v. Conceptronic, Inc.*, 90 F.3d 1576, 1582 (Fed. Cir. 1996)).

Figures 2, 6, and 7 of the '130 patent, as annotated by Patent Owner, are reproduced below.



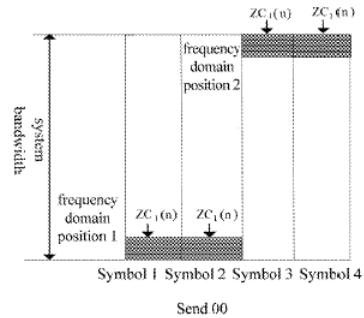
First Embodiment

'130 patent at Fig. 2
 (annotated)



Fifth Embodiment

'130 patent at Fig. 6
 (annotated)



Sixth Embodiment

'130 patent at Fig. 7
 (annotated)

'130 patent Figures 2, 6, and 7 Annotated.

PO Resp. 20. Figure 2 is one embodiment shown via a “schematic diagram, in which a user terminal sends a 1-bit ACK/NACK using two predefined sequences having the length of 4 on two symbols.” Ex. 1001, 2:61–64. Figures 6 and 7 illustrate two other embodiments where, respectively, a 1-bit ACK/NACK is sent using two predefined sequences on four symbols (Fig. 6) and a 2-bit ACK/NACK is sent using four predefined sequences on four symbols (Fig. 7). *Id.* at 3:7–12.

The arguments regarding “comprising” and claim 7 are analyzed below.

a. “comprising”

Patent Owner agrees that the term “comprising” used in the preambles of claims 1 and 20 raises a presumption that additional unrecited elements may be added. PO Supp. Br. 2. According to Patent Owner, the presumption should not be followed here because it rewrites the M

transmission term or strips it of the claim’s express requirements. *Id.* at 2–3 (citing *In re Varma*, 816 F.3d 1352, 1362 (Fed. Cir. 2016); *Apple Inc. v. Samsung Elects. Co.*, 695 F.3d 1370, 1377–79 (Fed. Cir. 2012)).

Petitioner argues “[t]he transition term comprising . . . is inclusive or open-ended and does not exclude additional, unrecited elements or method steps.” Pet. Supp. Br. 4 (citing *CollegeNet, Inc. v. ApplyYourself, Inc.*, 418 F.3d 1225, 1235 (Fed. Cir. 2005); *Crystal Semiconductor Corp. v. Tritech Microelectronics Int’l, Inc.*, 246 F.3d 1336, 1348 (Fed. Cir. 2001)).

According to Petitioner, the M transmission term “certainly require[s] transmission of ‘one of the K predefined sequence,’ but they do not prohibit transmission of additional predefined sequences on the same symbol.” *Id.* Petitioner then cites to claim 7 as support for its position that the claim “covers transmission of more than one sequence per symbol.” *Id.* Claim 7 is discussed below.

The claim at issue in *Varma* recited “a statistical analysis request corresponding to two or more selected investments” which was arguably anticipated by a reference that disclosed performing *two separate requests* to analyze two or more investments. *Varma*, 816 F.3d at 1362 (emphasis added). The Federal Circuit held that the claimed single statistical analysis of two or more investments was read out of the claim. *Id.* The Federal Circuit specifically held that “[c]omprising’ means that the claim can be met by a system that contains features over and above those specifically required by the claim element, but *only if the system still satisfies the specific claim-element requirements.*” *Id.* (emphasis added). Stated differently, “comprising” allows for broadening the claim with additional claim elements but not the broadening of existing claim elements.

Similar to *Varma*, *Apple* dealt with a limitation that recited a “plurality of heuristic modules.” *Apple*, 695 F.3d at 1373. The *Apple* court held that the “comprising” claim at issue was “not amenable to the addition of other modules that do not use *different heuristic algorithms* because such addition would impermissibly wipe out the express limitation that requires every module to have a *unique heuristic algorithm*.” *Id.* at 1379 (emphasis added).

Relying on the *Varma* and *Apple* cases, we determine that the M transmission term is a claim element that cannot be broadened under the presumption arising from the use of “comprising.” Each case makes clear that the language of a particular element is not subject to being rewritten. This is not a situation where the claim is being broadened, as per the presumption, by the addition of elements. Rather, all embodiments in the specification show one predefined sequence per symbol. *See, e.g.*, Ex. 1001, Figs. 2, 6, 7. Petitioner does not point to anything to the contrary. Indeed, Petitioner cannot cite to where the ’130 patent specification shows “more than one” predefined sequence per symbol. Tr. 26:8–19.

Petitioner acknowledges that the M transmission term “certainly require[s] transmission of ‘one of the K predefined sequence,’” but argues that the term is broader because of the “comprising” presumption. *See* Pet. Supp. Br. 4; *see also* Tr. 13:10–14:15 (arguing “comprising” means that claim not limited to “more than one sequence” on a symbol).⁵ Petitioner does not address the clarification of the presumption provided in the *Varma* and *Apple* cases. As already discussed, Petitioner’s argument is not

⁵ Petitioner does argue dependent claim 7 finds support in the specification for “one or more [of] the predefined sequences sent on each symbol.” *See* Section III.B.1.b below.

persuasive because it focuses on a specific claim element and not the existing claim elements as a whole.

We disagree with Petitioner that our final construction is an added limitation. *See* Pet. Supp. Br. 2. Rather, it reflects a construction of the M transmission term. The plain and ordinary meaning of the M transmission term is that “only one sequence is sent on each symbol.” *See* PO Supp. Br. 1–3; PO Resp. 18. Additional sequences on a symbol are not within the scope of the claim. For the reasons above, we determine that the M transmission term means “one” and “only one” predefined sequence is sent on each symbol. *See* PO Resp. 18.

b. Claim 7

Claim 7 depends from claim 1 and additionally recites, in pertinent part, “one or more the predefined sequences sent on each symbol is determined by different predefined channel resources.” Ex. 1001, 27:60–63. Patent Owner argues that claim 7’s relevance to construction of the M transmission term was raised in the Construction Order and was not raised by Petitioner and should not be considered as part of the record. PO Supp. Br. 4 (citing *Intelligent Bio-Systems, Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1367 (Fed. Cir. 2016)).

Alternatively, Patent Owner argues the language of claim 7 “requires that the predefined sequence sent on each symbol, where there can be one or more of them (i.e., 4 sequences sent on 4 symbols), are determined by different predefined channel resources.” PO Supp. Br. 4–5. According to Patent Owner, the language of claim 7 “does not mean that more than one defined sequences are to be sent on each symbol.” *Id.* at 5.

Patent Owner further argues that the whole of claim 7 includes the recited condition that “when different uplink control information is sent.”

PO Supp. Br. 5. According to Patent Owner, “[t]he import of this is that when different uplink control information is sent, the predefined sequence on each symbol is determined by a different predefined channel resource[s]. It doesn’t provide support that more than one predefined sequence can be sent on each symbol.” *Id.* Patent Owner concludes that, because claim 7 applies to “different predefined channel resources,” it “should not impact the phrase in the independent claims.” *Id.* (citing *Karlin Tech., Inc. v. Surgical Dynamics, Inc.*, 177 F.3d 968, 971–72 (Fed. Cir. 1999) (claim differentiation “normally means that limitations stated in dependent claims are not to be read into the independent claim from which they depend”)).

Petitioner argues “Patent Owner’s proposed construction should also be rejected as it would improperly require dependent claim 7 to be broader than independent claim 1.” Pet. Supp. Br. 5. Petitioner argues that “dependent claims can never be broader than the independent claim from which they depend.” *Id.* (citing *Intendis GmbH v. Glenmark Pharms., Inc.*, 822 F.3d 1355, 1365 (Fed. Cir. 2016); *Littelfuse, Inc. v. Mersen USA EP Corp.*, 29 F.4th 1376, 1379 (Fed. Cir. 2022)).

Petitioner argues “the ’130 Patent recites ‘wherein when different uplink control information is sent, **one or more [of] the predefined sequences sent on each symbol** is determined by different predefined channel resources.’” Pet. Supp. Br. 5 (citing Ex. 1001, 27:59–63). Petitioner also points to the specification as expressly contemplating “that **more than one** predefined sequence may be sent on each symbol.” *Id.* (citing Ex. 1001, 5:45–56, 17:1–12).

Petitioner’s cite to column 27 is claim 7, quoted above. We have already considered the language of claim 7 in our analysis. The citation to column 5 relates to “predefined channel resources” associated with each

transmission. *See, e.g.*, Ex. 1001, 5:45–47. There are multiple transmissions based on the “number of sending antenna ports.” *Id.* at 5:44–47. Column 17’s disclosure, also cited by Petitioner, is all but identical to column 5 and our analysis below is the same.

The “predefined channel resources” disclosure relied on by Petitioner differs from the claim language at issue, “predefined sequences.” Specifically, the column 5 citations all relate to an embodiment where there are “four predefined channel resources.” Ex. 1001, 5:4–13. In the embodiment described, when a 1-bit NACK is sent, “predefined sequences sent on each symbol are all determined by the second channel resource.” *Id.* at 5:1–3. The specification further explains that “predefined channel resources” are associated with each transmission. *Id.* at 5:45–47. There are multiple transmissions based on the “number of sending antenna ports.” *Id.* at 5:44–47. The description describes multiple “predefined sequences sent on [the] each transmission symbol.” *Id.* at 5:52–53. Thus, the “channel resources” control the content of the “predefined sequences.” Accordingly, we are not persuaded that the specification mitigates against Patent Owner’s proposed construction.

We also agree with Patent Owner that Petitioner forfeited the claim 7 argument by not raising it before the Oral Hearing and did not show why we should consider it in Petitioner’s Supplemental Brief. We are not persuaded that claim 7 recites that more than one “predefined sequence” is transmitted on one transmission symbol. Because claim 7 applies to “different predefined channel resources,” it “should not impact the phrase in the independent claims.” PO Supp. Br. 5; *see also* Ex. 1001, 27:60–63 (claim 7).

c. Conclusion on M transmission term

We determine that the plain and ordinary meaning of claim 1 supports Patent Owner’s proposed construction and that “only one sequence is sent on every symbol.” *See* PO Resp. 19 (citing Ex. 1001, Figs. 2, 6, 7). The “comprising” argument is rejected because it requires reading out of claims 1 and 20 the M transmission term.

The claim 7 argument that more than one predefined sequence is present on each symbol is not supported by either claim 7 or the specification. Neither claim 7 nor the specification support a conclusion that more than one “predefined sequence” is sent on one symbol. As discussed above, claim 7 is directed to “uplink control information” and “predefined channel resources,” not “predefined sequences.”

2. “ $1 \leq K \leq 2^B$ ” (*limitation 1.b*)

Patent Owner argues “the term ‘ $1 \leq K \leq 2^B$ ’ should be construed to mean that the number of sequences, K, that can be used depends on the number of bits, B, being sent for a Transmission Time Interval (TTI) and that the condition must be *satisfied for all K values.*” PO Resp. 20 (emphasis added). Patent Owner asserts that the expression “specifies the number of sequences that can be used to code a signal vary with the number of bits being sent.” *Id.* (citing Ex. 2004 ¶ 27). Patent Owner argues this result is correct because “‘ $1 \leq K \leq 2^B$ ’ functions as part of an encoding scheme and not an individual condition.” *Id.* at 22 (citing Ex. 2004 ¶ 32).

Patent Owner argues “[t]he intrinsic record shows that ‘ $1 \leq K \leq 2^B$ ’ means that K depends on B and must be satisfied at all times.” PO Resp. 22. Patent Owner quotes limitation 1.a from the intrinsic record, which recites “sending, by a user terminal, K predefined sequences on M control information.” *Id.* at 22–23. According to Patent Owner, every limitation

reciting the K term must be construed in conjunction with limitation 1.a, the two claim elements define the encoding scheme. *Id.* at 23 (citing Ex. 2004 ¶ 32).

In conclusion, Patent Owner argues that

Under the encoding scheme, the TTI of a specific size (i.e., having a M number of symbols) determines the number of bits that can be used. And in turn, the number of bits that can be used define the different combinations of sequences that can be used to send those bits. Thus, a reference that discloses one instance of K (e.g., $K=2$) does not disclose the encoding scheme that is the requirement of claim elements 1[a] and 1[b] interpreted together.

Id. at 23.

As we stated in the Institution Decision, the issue raised by Patent Owner is whether the expression requires that K be derived from B. *See* Inst. Dec. 12. In the Institution Decision, we preliminarily determined that “the intrinsic evidence in the form of the claim language does not require that the expression be met at all times” and that the claim does not “recite[] an equation for deriving K from B.” *Id.* Patent Owner argues the intrinsic evidence cited above is to the contrary. *See* PO Resp. 11 n.2.

Petitioner argues the K term merely specifies that “‘K’ lies in the range 1 to 2^B .” Pet. Reply 3 (citing Ex. 1015 ¶¶ 4–7). The result of this construction is that the K term “merely puts a limit on what K can be” and does not mean that “K must be derived from B.” *Id.* at 3–4 (citing Ex. 1015 ¶¶ 4–7).

Petitioner argues the intrinsic evidence supports its argument. Petitioner points to the embodiments of Figures 2 and 5 of the ’130 patent as showing “K is merely a function of the chosen implementation of the

system.” Pet. Reply 4 (citing Ex. 1015 ¶ 6). Petitioner argues specifically that the embodiments of Figures 2 and 5 both show sending a 1-bit ACK/NACK signal is sent where K can be either 1 or 2 predefined sequences. *Id.* at 4 (citing Ex. 1001, 11:33–58 (Fig. 2), 12:33–47 (Fig. 5)). Petitioner concludes that “[t]his shows that K does not depend on B and instead, depends on the implementation.” *Id.* (citing Ex. 1015 ¶ 6). Petitioner further argues that the ’130 patent does not disclose all possible K values based on the limit placed by 2^B . *Id.* at 4–5 (citing Ex. 1015 ¶ 7).

Patent Owner does not respond specifically to Petitioner’s arguments in its Sur-Reply. It maintains its arguments from its Response. PO Sur-Reply 2.

We find the intrinsic evidence in the form of the claim language does not require that the K term be met at all times. K is not the same for any given number of bits transmitted. In the embodiments of Figures 2 and 5 of the ’130 patent, the transmission of a 1-bit ACK/NACK may result in K being either 1 or 2. *See* Pet. Reply 4. As a result, we agree with Petitioner and find that K depends on the number of predefined sequences and not on B. *Id.* As noted above, Patent Owner does not respond to this argument.

We determine that it is sufficient that, sometimes, the method operates in a way such that “M is a positive integer, K is an integer, $1 \leq K \leq 2^B$, B is an integer greater than or equal to 1.” The claim recites a *condition* that K and B need only satisfy some of the time.

C. Legal Standard for Anticipation

In order for a prior art reference to serve as an anticipatory reference, it must disclose every limitation of the claimed invention, either explicitly or inherently. *In re Schreiber*, 128 F.3d 1473, 1477 (Fed. Cir. 1997). We must analyze prior art references as a skilled artisan would. *See Scripps Clinic &*

Res. Found. v. Genentech, Inc., 927 F.2d 1565, 1576 (Fed. Cir. 1991), *overruled on other grounds by Abbott Labs. v. Sandoz, Inc.*, 566 F.3d 1282 (Fed. Cir. 2009) (to anticipate, “[t]here must be no difference between the claimed invention and the reference disclosure, as viewed by a person of ordinary skill in the field of the invention”). As the Federal Circuit has held:

This modest flexibility in the rule that “anticipation” requires that every element of the claims appear in a single reference accommodates situations where the common knowledge of technologists is not recorded in the reference; that is, where technological facts are known to those in the field of the invention, albeit not known to judges. It is not, however, a substitute for determination of patentability in terms of § 103.

Cont’l Can Co. USA v. Monsanto Co., 948 F.2d 1264, 1268–69 (Fed. Cir. 1991). A claim limitation is inherent if it is necessarily present in the prior art, not merely probably or possibly present. *Akamai Techs., Inc. v. Cable & Wireless*, 344 F.3d 1186, 1192 (Fed. Cir. 2003).

D. *Legal Standard for Obviousness*

A patent claim is unpatentable as obvious “if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains.” 35 U.S.C. § 103.

The ultimate determination of obviousness is a question of law, but that determination is based on underlying factual findings. . . . The underlying factual findings include (1) “the scope and content of the prior art,” (2) “differences between the prior art and the claims at issue,” (3) “the level of ordinary skill in the pertinent art,” and (4) the presence of secondary considerations⁶ of nonobviousness such “as commercial success,

⁶ Neither party has introduced evidence of secondary considerations.

long felt but unsolved needs, failure of others,” and unexpected results.

In re Nuvasive, Inc., 842 F.3d 1376, 1381 (Fed. Cir. 2016) (citing, *inter alia*, *Graham v. John Deere Co. of Kan. City*, 383 U.S. 1, 17–18 (1966)).

“To satisfy its burden of proving obviousness, a petitioner cannot employ mere conclusory statements. The petitioner must instead articulate specific reasoning, based on evidence of record, to support the legal conclusion of obviousness.” *In re Magnum Oil Tools Int’l, Ltd.*, 829 F.3d 1364, 1380 (Fed. Cir. 2016). Furthermore, in assessing the prior art, the Board must consider whether a person of ordinary skill would have been motivated to combine the prior art to achieve the claimed invention. *Nuvasive*, 842 F.3d at 1381.

As the Federal Circuit found, in quoting from the Supreme Court’s decision in *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 418–419 (2007),

“because inventions in most, if not all, instances rely upon building blocks long since uncovered, and claimed discoveries almost of necessity will be combinations of what, in some sense, is already known,” “it can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention does.”

Personal Web Techs., LLC v. Apple, Inc., 848 F.3d 987, 991–92 (Fed. Cir. 2017).

E. Anticipation of Claims 1–5, 7–9, 14, and 20 by Kwak (Ground 1)

Petitioner alleges claims 1–5, 7–9, 14, and 20 are anticipated by Kwak based on Kwak’s December 9, 2016, PCT filing date. Pet. 2–3, 12–40.

In the Institution Decision, Patent Owner was given notice that it should address whether the relied-upon disclosure of Kwak based on the

PCT filing date established priority over the earliest filing date of the '130 patent. Inst. Dec. 17. Patent Owner's Response does not argue Kwak is not prior art based on its PCT filing date. *See* PO Resp. We make final our determination that Kwak is prior art to the '130 patent based on Kwak's PCT filing date. *See* Inst. Dec. 17 ("We preliminarily determine Kwak is prior art to the '130 patent claims based on Kwak's December 9, 2016 PCT filing date . . .").

1. Kwak (Ex. 1005)

Kwak discloses a wireless communication system, including a terminal and base station, which receives information on a cyclic shift (CS) index configuration and "indicates the configuration of an index group for a CS related to uplink control channel transmission." Ex. 1005, code (57). Kwak identifies TTI data delay as a problem in LTE and LTE-A. *Id.* at 1:56–67; 49:26–31. Kwak recognizes that one particular area impacted by the shortened TTI is the physical uplink control channel (PUCCH). *Id.* at 1:56–59. The uplink control information (UCI) transmitted on the PUCCH includes, for example, the ACK/NACK information. *Id.* at 12:4–8. Kwak recognizes the need for a shortened TTI (i.e., TTI whose length is reduced from the conventional LTE 1 ms TTI). *Id.* at 49:26–31.

The user terminal may utilize a first cyclically shifted sequence to transmit an ACK and a second cyclically shifted sequence to transmit a NACK. Ex. 1005, 56:25–61. The user terminal may be allocated CS indices 0 and 6 "and may transmit a PUCCH using the CS index 0 in the case of ACK and may transmit a PUCCH using the CS index 6 in the case of NACK." *Id.* The sequence to which cyclic shift is applied may be a "Zadoff-Chu (ZC) sequence," which is "one of the CAZAC ['constant

amplitude zero autocorrelation’] sequences.” *Id.* at 15:36–44, 12:31–32 (CAZAC).

Kwak describes several embodiments represented, in part, by the figures below. Figure 38 is reproduced below.

【Fig. 38】

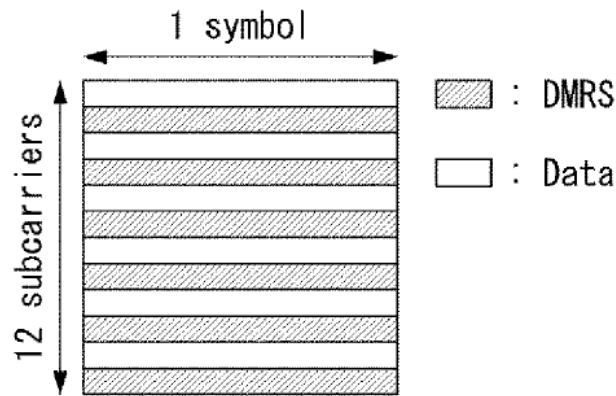
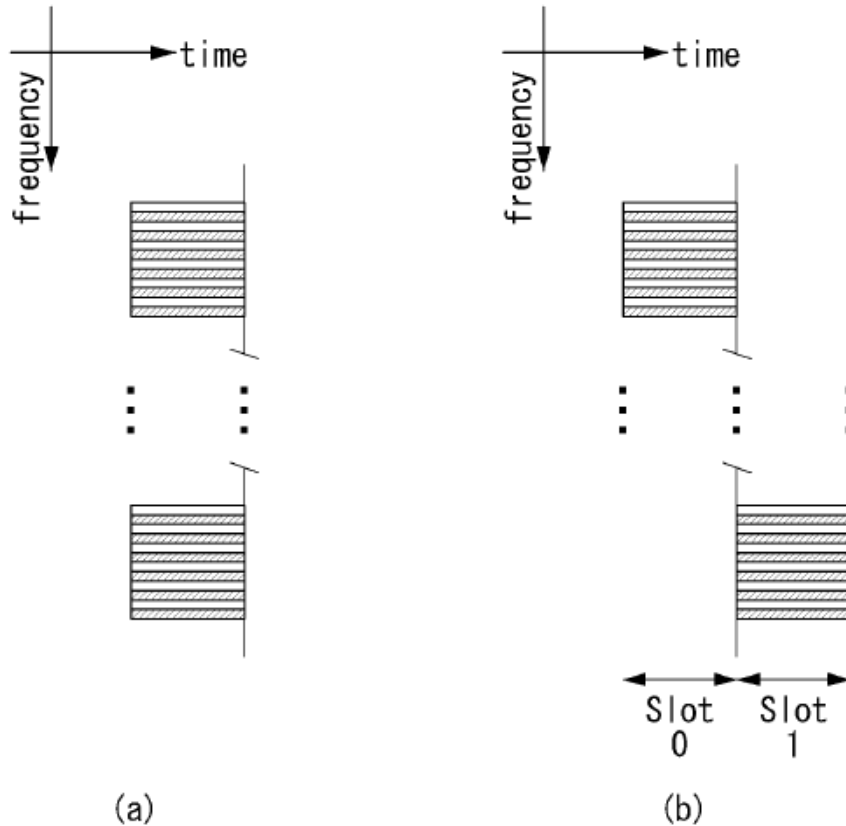


Figure 38 is an example of a PUCCH structure having a comb structure in which multiple bits may be transmitted.

Ex. 1005, 70:34–38. As depicted in Figure 38, the comb structure includes both a DMRS (demodulated reference signal) and data. *Id.* at 53:47–48. A DMRS symbol may be used for channel estimation and “a symbol in which ACK/NACK information is transmitted may be divided and defined for the PUCCH transmission.” *Id.* at 55:64–67; *see also id.* at 73:46–48 (describing Fig. 38 as a “comb structure . . . for channel estimation”).

Figures 43(a) and 43(b) are reproduced below.

【Fig. 43】



Figures 43(a) and (b) are examples of a frequency hopping structure when a PUCCH is transmitted in a 1-symbol TTI (43(a)) and a 2-symbol TTI (43(b)).

Ex. 1005, 6:1–4. Figures 43(a) and 43(b) are examples of “a frequency hopping structure when a PUCCH is transmitted in a 1-symbol and a 2-symbol TTI, to which the present invention may be applied.” *Id.* at 73:41–44. Still referring to Figure 43, “if a PUCCH is configured based on a 1-symbol TTI and a 2-symbol TTI, a terminal may use the layer signal

comb structure of FIG. 38 for channel estimation.” *Id.* at 73:46–48. Figure 43(b) illustrates two symbols where “a user may transmit a PUCCH using one symbol per slot.” *Id.* at 73:53–54.

Figure 44 of Kwak is reproduced below.

【Fig. 44】

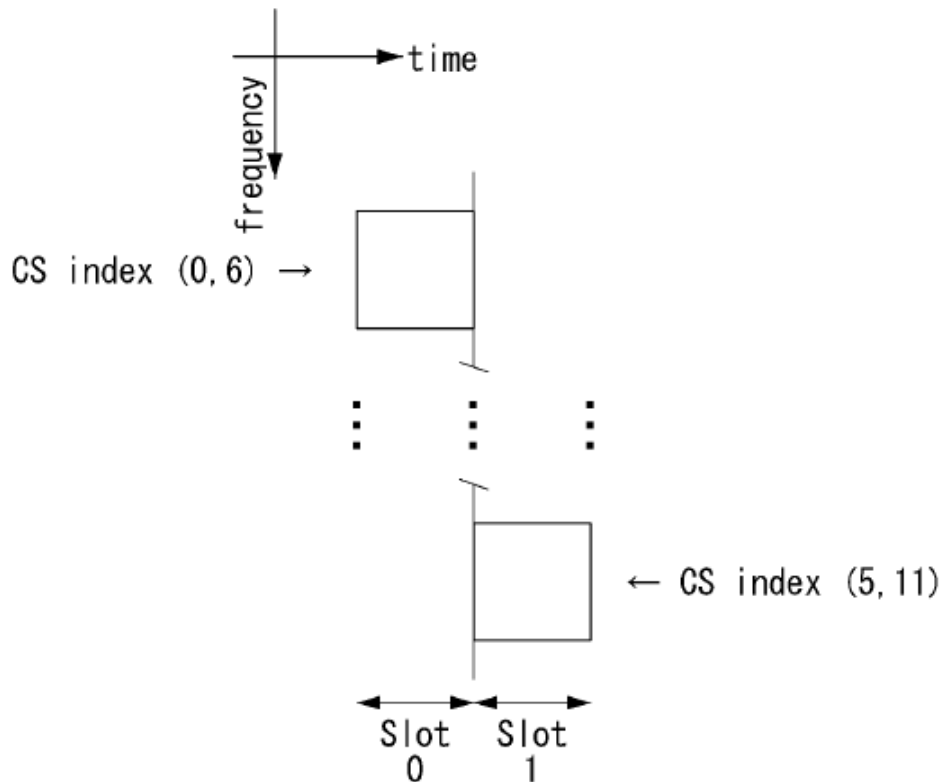


Figure 44 is an example of frequency hopping when a PUCCH is transmitted using a 2 - symbol TTI based on a base sequence.

Ex. 1005, 6:5–8, 74:9. In Figure 44, “if a TTI includes 2 symbols, a transmission method based on a base sequence may be applied to the structure of Fig. 43 and a different CS index may be applied for each slot.”

Id. at 74:9–12. The CS index may be used for ACK/NACK information. *Id.* at 74:16–18.

2. Claim 1

Petitioner contends with respect to limitations 1.a, 1.b, and 1.c that the recited “predefined sequences” are the CS indices of Kwak transmitted in a PUCCH. Pet. 13–19 (citing Ex. 1005, 73:53–54, 74:9–17 (“transmission method based on a base sequence . . . a different CS index may be applied for each slot”), Figs. 43(b), 44; Ex. 1002 ¶ 56). There is no dispute that the “slots” of Kwak are the recited “symbols” of the ’130 patent. Pet. 17 (“in Figure 44, a user terminal could transmit an ACK by sending, in slot 0 (symbol 0) and slot 1 (symbol 1)”); PO Resp. 36 (citing Pet. 17 (Petitioner argues “a different cyclically shifted sequence from a different region must be applied in each slot (i.e., each symbol)”).

a. “sending, by a user terminal, K predefined sequences on M transmission symbols in a Transmission Time Interval (TTI) to send B-bit uplink control information” (Limitation 1.a)

In connection with limitation 1.a, Petitioner argues Figure 43(b) “describes transmission of a PUCCH in a TTI having two slots, where there is ‘one symbol per slot.’” *Id.* at 14 (citing Ex. 1005, 73:53–54, Fig. 43(b)). Petitioner further argues that Kwak’s disclosure “means that a different cyclically shifted sequence is sent in each slot, which constitutes ‘sending, by a user terminal, **K predefined sequences** on M transmission symbols in a Transmission Time Interval (TTI).” *Id.* at 15 (citing Ex. 1005, Fig. 44; Ex. 1002 ¶ 50) (emphasis in original). Petitioner concludes that “Kwak discloses that the user terminal sends a PUCCH ‘on M transmission symbols in a TTI,’ where M=2.” *Id.*

We are persuaded that limitation 1.a is shown by Petitioner's argument and evidence.

- b. “wherein M is a positive integer, K is an integer, $1 \leq K \leq 2^B$, B is an integer greater than or equal to 1” (Limitation 1.b)

The entirety of Petitioner's argument and evidence regarding limitation 1.b follows.

Kwak discloses this limitation. (Ex. 1002, ¶ 55). As discussed above with respect to limitation [1.a], $M=2$, $K=2$, and $B=1$ (or 2). Thus, the condition $1 \leq K \leq 2^B$, B is an integer greater than or equal to 1, is satisfied.

Pet. 18.

Patent Owner contends that Petitioner “offers no substantive explanation as to why Kwak discloses claim element 1[b] separate from claim element 1[a] and discusses 1[b] with respect to 1[a].” PO Resp. 33 n.3 (citing Pet. 12–18). Patent Owner contends Petitioner's argument and evidence is “effectively” based on Figures 43 and 44 of Kwak. *Id.* at 33 n.4. Patent Owner argues its construction of the K term, i.e., that the recited “condition must be satisfied for all K values.” *Id.* at 33.

In support of its argument that its construction of the K term precludes Kwak from disclosing limitation 1.b., Patent Owner cites examples of B and K values where the condition set by the K term is not shown in Kwak. PO Resp. 34 ($B=1$ and $K=1$ or 2). Similarly, Patent Owner contends that “Petitioner does not explain how the example in Kwak would send a 2-bit signal using a single sequence, three different sequences, or four different sequences, i.e., $K=1$, $K=3$, or $K=4$.” *Id.* at 35 (citing Ex. 2004 ¶ 80). In illustrating this alleged difference between Kwak and limitation 1.b, Patent Owner points to Kwak's claims. *Id.* at 37–38. For example, Patent Owner argues “claim element 1[e] of Kwak states ‘wherein, when the number of

bits of the HARQ-ACK information is 1, the specific cyclic shift interval is configured to 6.” *Id.* at 38. Patent Owner provides additional examples from Kwak it alleges show how the predefined sequences K are dependent on the number of bits sent. *Id.* at 38–44; *see also* Ex. 2004 ¶ 54 (“Kwak uses available symbols across two slots to transmit a signal . . . the ’130 patent does not teach limiting or allocating the number of symbols M”). Representative of these arguments is Patent Owner’s assertion that the K term “specifies that the number of sequences that can be used depend on the number of bits being sent.” *Id.* at 42 (citing Ex. 2004 ¶ 75).

Petitioner argues against Patent Owner’s construction and asserts “K does not depend on B and instead, depends on the implementation.” Pet. Reply 3–4 (citing Ex. 1015 ¶ 6). As applied to limitation 1.b, Petitioner argues “there is no requirement that Kwak disclose all combinations of K and B in order to satisfy the limitation.” *Id.* at 17–18. Petitioner concludes by arguing the law “is well settled that ‘[w]hen a patent claims a range, as in this case, that range is anticipated by a prior art reference if the reference discloses a point within the range.’” *Id.* (citing *ModernaTx, Inc. v. Arbutus Biopharma Corp.*, 18 F.4th 1352, 1364 (Fed. Cir. 2021)). Patent Owner “maintains its arguments” from its Response and does not otherwise respond to Petitioner’s arguments. PO Sur-Reply 2.

We determined in Section III.B.2 above that the K term is “a *condition* that K and B need only satisfy some of the time” and not for all K values. Patent Owner’s arguments are based on its proposed construction of the K term which we rejected in Section III.B.2 above. Accordingly, we are persuaded that Petitioner has shown limitation 1.b based on our construction of the K term and Petitioner’s argument and evidence.

c. “on each of the M transmission symbols, one of the K predefined sequences is sent” (Limitation 1.c)

Specific to limitation 1.c, Petitioner argues “a cyclic shift index (0 or 6) may be used for *Slot 0, a first symbol*, and a different cyclic shift index (5 or 11) may be used for *Slot 1, the second symbol*.” Pet. 18 (citing Ex. 1005, 74:9–17; Fig. 44 (reproduced in Section III.E.1 above)). That is, Petitioner argues the slots of Kwak are the claimed “symbol.” *Id.* Petitioner explains:

This means that a first predefined sequence (a cyclically shifted base sequence corresponding to CS index 0 or 6) is sent in symbol 0 and a second predefined sequence (a cyclically shifted base sequence corresponding to CS index 5 or 11) is sent in symbol 1.

Id. at 18–19 (citing Pet. 13–18 (Pet. Section IX.A.1.ii.)). Petitioner notes that the selection of which CS index is used is an “option,” that is 0 or 6 and 5 or 11. *Id.* at 16 n.2.

Petitioner argues that Figure 43(b) of Kwak “describes transmission of a PUCCH in a TTI having two slots, where there is ‘one symbol per slot.’” Pet. 14 (citing Ex. 1005, 73:53–54), 22 (annotated Figures 43(a) and (b)). Based on the preceding, Petitioner alleges Kwak “discloses that the user terminal sends a PUCCH ‘on M transmission symbols in a TTI,’ where $M=2$.” *Id.* (citing Ex. 1005, Fig. 43(b); Ex. 1002 ¶¶ 48–49).

Petitioner points to Figure 44 of Kwak for its disclosure of a different CS index for each slot. Pet. 15 (citing Ex. 1005, 74:9–12, Fig. 44), 22 (reproducing annotated Figure 44 showing two frequency positions, one at index 0,6 and another at index 5,11). Petitioner then argues that:

[b]ecause a different cyclic index is applied in each slot (i.e., each symbol), each slot includes transmission of a different cyclically shifted sequence. [] Thus, Kwak discloses a TTI with two

symbols ($M=2$) and *further discloses sending a different cyclically shifted sequence on each symbol, i.e., $K=2$.*

Pet. 15–16 (citing Ex. 1005, 74:9–12, 56:25–67, 51:1–6, 15:36–44, Fig. 44); Ex. 1002 ¶ 50) (emphasis added). Petitioner further contends that Kwak’s Figure 44 shows that the CS indices 0 or 6 in slot 0 correspond to an ACK and 5 or 11 in slot 1 correspond to a NACK. *Id.* at 17 (citing Ex. 1005, 56:46–61; Ex. 1002 ¶¶ 51–52).

Patent Owner argues its construction for the M transmission term precludes Kwak disclosing limitation 1.c. PO Resp. 25 (citing Ex. 2004 ¶¶ 98, 99). In addition, Patent Owner argues Kwak does not disclose limitation 1.c “because it is not sending a predefined sequence but a comb structure containing DMRS signals and data subcarriers that transmit multiple bits.” *Id.* at 26–33.

We agreed with Patent Owner’s construction of the M transmission term in Section III.B.1 above. However, Kwak discloses the M transmission term under our now final construction. Petitioner argues each “symbol and such a cyclically shifted sequence is a ‘predefined sequence’ *just like in the ’130 patent.*” Pet. Reply 8–9 (citing Pet.16 n.9; Ex. 1002 ¶ 51). Kwak’s Figure 44 implementation includes two slots, the recited “symbol.” Further, each slot includes a different cyclically shifted sequence: in one case a 0 or a 6 and in the other a 5 or 11. *See* Ex. 1005, Fig. 44.⁷ A different sequence is sent in each slot/symbol, where $K=2$. *Id.*

⁷ Petitioner reasserted this position during the hearing. Tr. 17–21 (“there is only one sequence being sent in each symbol. It’s CS index 0, comma 6, for slot 0. Zero is for ACK, 6 is for NACK, . . . it’s either 0 or it’s [either] 6. It cannot be both because it would be nonsensical to send both 0 and 6 because the receiver at that point doesn’t know, is the signal an ACK or is it an NACK? It has to be only one.”).

Patent Owner cites to what are comb structures in Figures 43(a) and (b) of Kwak. PO Resp. 27–28. Patent Owner also points to Figure 38 as a comb structure in that DMRS and data are transmitted on every other subcarrier. *Id.* at 28 (citing Ex. 1005, 70:39–40, Fig. 38). Patent Owner argues that “[w]hen the individual data subcarriers of the comb structure are encoded with the bits to be sent, it is no longer a predefined sequence” because “the predefined sequences are sequences ‘with a length of N and is mapped to N subcarriers.’” *Id.* at 29 (citing Ex. 1005, 27:21–24); *see also* Ex. 2004 ¶ 107.

Petitioner argues Figure 44 of Kwak is not a comb structure. Pet. Reply 11–17. Petitioner first argues that the comb structure argument is attorney argument unsupported by expert testimony. *Id.* at 12–13 (citing Ex. 2004 ¶ 98). That is, Petitioner argues that Dr. Akl never testified that “Figure 44 requires a comb structure or that the sequences of Figure 44 are applied to a comb structure.” *Id.* (citing Ex. 2004). Next, Petitioner identifies Figure 44 of Kwak as “‘a transmission method based on a base sequence [that] may be applied to *the structure of FIG. 43*’ . . . which Patent Owner presumes is a ‘comb structure.’” *Id.* at 13. Petitioner correctly notes that nothing in this description or in Kwak establishes Figure 44 as a comb structure. *Id.* (citing Ex. 1015 ¶ 17). Petitioner argues the shading used to designate a DMRS subcarrier in Figure 38, which is a comb structure, is absent from Figure 44. *Id.* at 13–14 (citing Ex. 1015 ¶ 17). Lastly, Petitioner argues a DMRS signal in a comb structure is not shown to preclude the DMRS signal from being a “predefined sequence.” *Id.* at 13–16.

Applying the M transmission term construction from Section III.B.1 above, we find that Kwak discloses the M transmission term because one

symbol is associated with each predefined sequence. This finding is supported by Figure 44 of Kwak. We specifically find that Figure 44 provides for alternatives, i.e., 0 or 6 for slot 0 and 5 or 11 for the other predefined sequence at slot 1. Ex. 1005, 74:9–12 (“Referring to FIG. 44, if a TTI includes 2 symbols, a transmission method based on a base sequence may be applied to the structure of FIG. 43 and a different CS index may be applied for each slot.”), Fig. 44.

We also find that Figure 44 “may” be a comb structure but is not necessarily one. Kwak states that Figure 43 “may use the comb structure of FIG. 38.” Ex. 1005, 73:46–48. Similarly, Figure 44 “*may* be applied to the comb structure of FIG. 43.” *Id.* at 74:9–12 (emphasis added).

Accordingly, we are persuaded that Petitioner has shown limitation 1.c based on our construction of the M transmission term and Petitioner’s argument and evidence.

d. “each of the K predefined sequences has a length of N and is mapped to N subcarriers of the transmission symbols corresponding to the each of the K predefined sequences” (Limitation 1.d)

Petitioner alleges Kwak discloses limitation 1.d because it “generates its cyclically shifted sequence by applying a cyclic shift to a base sequence.” Pet. 19 (citing Ex. 1005, 74:9–12; Ex. 1002 ¶¶ 57–58). Petitioner alleges the cyclic shift is described in Kwak with reference to equations 23 and 24. *Id.* (citing Ex. 1005, 50:62–67, 52:1–6). Equation 24 is reproduced below.

$$r^{(\alpha)}(n) = e^{j\alpha n} \bar{r}(n), \quad 0 \leq n \leq 11 \quad \text{[Equation 24]}$$

Pet. 19; Ex. 1005, 52:4. According to Petitioner, equation 24 “specifies the cyclically shifted sequence as having a length of ‘12’ given that ‘n’ in equation 24 [above] extends from 0 through 11.” *Id.* (citing Ex. 1005,

50:62–67, 53:33–37 (“In the present invention, basically, assuming the transmission of a 12-subcarrier unit corresponding to 1 RB, a 12-length base sequence is described as an example.”), 4:35 (“resource block (RB)”). Petitioner concludes that “Kwak discloses that each of the K predefined sequences ‘has a length of N,’ which as discussed above is 12.” *Id.* at 20 (citing Ex. 1005, Figs. 34 and 43(b) (both illustrating “12 subcarriers”)).

Patent Owner alleges “Petitioner’s argument asserting that the comb structure of Fig. 43 is a predefined sequence fails because the comb structure combines DMRS signals with data of the cyclically shift sequences.” PO Resp. 44. According to Patent Owner, that the substructures contain DMRS signals, as it alleges is found in Kwak Figure 43, is not a “predefined sequence,” because DMRS are not a cyclical shift sequence. *Id.*

We found against Patent Owner’s argument in our analysis of limitation 1.c. We are not presented with any additional argument or evidence beyond that discussed previously.

Accordingly, we are persuaded that Petitioner has shown limitation 1.d based on our analysis of limitation 1.c and Petitioner’s argument and evidence.

e. “wherein $N=2n$ with n being a positive integer” (Limitation 1.e)

Petitioner alleges Kwak discloses this limitation where $N=12$ and n is 6. Pet. 21 (citing Ex. 1002 ¶ 59). Petitioner references its showing regarding limitation 1.d where $N=12$, making $n=6$. *Id.*

Patent Owner alleges Petitioner’s anticipation ground lacks particularity as to claim element 1.e. PO Resp. 50. Patent Owner argues “Petitioner never discusses why ‘ n ’ is equal to 6 when ‘ N ’ is equal to 12 in that section or in the section discussing limitation 1[d].” *Id.* Patent Owner

further argues there is no explanation from the Ding Declaration as to why “ $N=2n$ ” requires “ N ” to be an even number. *Id.* (citing Ex. 1002 ¶ 59).

Petitioner does not respond to Patent Owner’s argument regarding limitation 1.d. We find that Petitioner’s argument for limitation 1.d is that $N=12$. We need nothing beyond elementary algebra to find that limitation 1.e’s recitation of $N=2n$ requires n to be 6 if N is 12.

We are persuaded that Petitioner has shown limitation 1.e based on our analysis of limitation 1.d and Petitioner’s argument and evidence.

f. Conclusion on Claim 1

Petitioner has shown by a preponderance of the evidence that Kwak anticipates claim 1.

3. Claim 20

Claim 20 has similar limitations to those of method claim 1. For example, claim 20 recites in part:

sending K predefined sequences on M transmission symbols in a Transmission Time Interval (TTI) to send B -bit uplink control information, wherein M is a positive integer, K is an integer, $1 \leq K \leq 2^B$, B is an integer greater than or equal to 1.

Ex. 1001, 30:9–15, Certificate of Correction. Petitioner denominates the limitation as 20.b and 20.c in the Petition. *See* Pet. 73. The limitations are all but identical to limitations 1.a and 1.b discussed above. *See id.* at 13–18. Petitioner repeats its showing for limitations 1.a and 1.b for limitations 20.b and 20.c. *Id.* at 39–40.

Patent Owner also focuses on the arguments it made in connection with claim 1, noting that limitations 20.b, 20.c, 20.d, and 20.e are the same or substantially the same as limitations 1.a, 1.b, 1.c, and 1.d, respectively.

PO Resp. 48–49. Patent Owner asserts that the same arguments discussed in connection with the limitations of claim 1 apply to claim 20’s limitations.

Id.

For the same reasons discussed in connection with claim 1, Petitioner has shown by a preponderance of the evidence that Kwak anticipates claim 20.

4. Claims 2–4, 7, 9 and 14

We have reviewed Petitioner’s showing regarding claims 2–4, 7, 9, and 14. Pet. 21–36; Ex. 1002 ¶¶ 60–75. Patent Owner does not separately argue patentability of dependent claims 2–4, 7, 9, and 14 and relies on its arguments for claim 1. PO Resp. 48. Those arguments are addressed above.

For the reasons set forth in the Petition, Petitioner has shown by a preponderance of the evidence that Kwak anticipates claims 2–4, 7, 9, and 14.

5. Claim 5

Claim 5 recites “[t]he method for uplink control signal transmission of claim 1, further comprising: indicating, by the user terminal, the uplink control information using combinations of the K different predefined sequences sent on different time domain symbols of the M transmission symbols.”

Petitioner alleges Kwak discloses this limitation. Pet. 26 (citing Ex. 1002 ¶ 64). Petitioner alleges in its showing for limitation 1.a that the “user terminal sends ACK/NACK information (uplink control information) by transmitting different predefined sequences on the two (M=2) symbols.” *Id.* Kwak’s Figure 44 is cited to show that the “user terminal may transmit a sequence corresponding to CS index 0 or 6 in slot 0 (symbol 0), and a sequence corresponding to CS index 5 or 11 in slot 1 (slot 1).” *Id.* (citing

Ex. 1005, 56:46–61 (indices 0–5 indicating an ACK and 6–11 indicating a NACK)). Petitioner argues a user terminal could transmit “a combination of $K=2$ different predefined sequences, i.e., transmitting, in slot 0 (symbol 0) and slot 1 (symbol 1), a cyclically shifted sequence corresponding to CS index 0 and a cyclically shifted sequence corresponding to CS index 5, respectively.” *Id.* (citing Ex. 1002 ¶ 64). Petitioner concludes “the uplink control confirmation (i.e., ACK/NACK) is indicated by combinations of predefined sequences sent on the M transmission symbols.” *Id.*

Patent Owner argues the “transmission of the ACK or NACK is completed when the cyclically shifted sequence is transmitted on the first symbol in slot 0” and “the second sequence sent on the second symbol is merely a repeat transmission.” PO Resp. 45. Patent Owner explains that therefore “the uplink control information is not sent using combinations of the K different predefined sequences.” *Id.* Patent Owner argues that a second sequence sent on the second symbol is redundant, and claims cannot be construed to allow redundancy to fill an unneeded symbol, which would be at odds with the claim language. Sur-Reply 27–28.

We find Petitioner’s showing is sufficient because claim 5 does not preclude a repeat transmission. *See* Pet. Reply 20 (“The claim only concerns indicating uplink communication by sending different sequences on different symbols.”). We agree with Petitioner that Kwak indicates uplink communication by sending two different sequences on two different symbols (i.e., $K=2$ and $M=2$). Pet. 26; *see also* Pet. Reply 20 (citing Ex. 1015 ¶¶ 23, 26, 27). Thus, Petitioner has shown by a preponderance of the evidence that Kwak anticipates claim 5.

6. *Claim 8*

Claim 8 recites “[t]he method for uplink control signal transmission of claim 5, wherein the uplink control information comprises an Acknowledgement (ACK) and a Negative Acknowledgement (NACK); wherein the ACK corresponds to a bit ‘1’ and the NACK corresponds to a bit ‘0’, when the ACK or the NACK is sent, the ACK or the NACK is respectively indicated by different predefined sequences sent on each transmission symbol.”

Petitioner alleges Kwak discloses this limitation. Pet. 29 (citing Ex. 1002 ¶¶ 67–69). As it did for claim 5, Petitioner argues that Kwak Figure 44 relates to sending control information as an ACK/NACK. *Id.* (citing Ex. 1005, 74:16–18, 12:4–8, Fig. 44). Petitioner argues Kwak discloses “[a] positive acknowledgement response (ACK) may be encoded as ‘1’ and a negative acknowledgement response (NACK) may be encoded as ‘0’.” *Id.* at 29–30 (citing Ex. 1005, 15:27–30, Fig. 7). Petitioner relies on similar arguments to those above for claim 5 to show “when the ACK or the NACK is sent, the ACK or the NACK is respectively indicated by different predefined sequences sent on each transmission symbol.” *Id.* at 30–31 (citing Ex. 1005, 56:46–61, Fig. 44; Ex. 1002 ¶ 69).

As it did for claim 5, Patent Owner realleges that “the second sequence sent on the second symbol is merely a repeat transmission.” PO Resp. 46. For support, Patent Owner points to the different embodiments used to transmit the 1-bit ACK/NACK. *Id.* (citing Ex. 1001, Figs. 2, 4, 6 (annotated at PO Resp. 47)).

Petitioner again responds that claim 8 does not preclude a repeat transmission. Pet. Reply 20–21 (citing Ex. 1002 ¶¶ 23, 26, 27). We agree. Patent Owner’s support from different embodiments does not change the

claim or our analysis. Petitioner has shown by a preponderance of the evidence that Kwak anticipates claim 8.

7. Conclusion (Ground 1)

Petitioner has shown by a preponderance of the evidence that Kwak anticipates claims 1–5, 7–9, 14, and 20.

F. Anticipation of Claims 1–5, 7–9, 14, and 20 based on the filing date of the Kwak Provisional (Ground 2)

Petitioner also alleges claims 1–5, 7–9, 14, and 20 are anticipated by Kwak using the filing date of the Kwak Provisional because “at least one claim of the Kwak non-provisional is supported.” Pet. 40–74; *see also* Ex. 1002 ¶¶ 43 (Ding Declaration chart showing support for Kwak claim 15 in Kwak Provisional), 84–117 (mapping Kwak Provisional to challenged claims of ’130 patent). As discussed in Section II.F n.3 above, Patent Owner does not claim the benefit of the filing date of the ’116 application. *See* PO Resp. 23–25.

We do not reach Ground 2 because it is moot based on our determination regarding Ground 1. For the reasons discussed above in connection with Ground 1 in Section III.E, Petitioner has shown claims 1–5, 7–9, 14, and 20 are unpatentable.

G. Obviousness of Claims 8 and 9 over Kwak (Ground 3)

Claim 8 depends from claim 5 and is reproduced above in Section III.E.6. Petitioner alleges the limitation of claim 8 is shown because “transmission using cyclically shifted sequences in figure 44 is applicable for sending an ACK/NACK (Ex. 1005, 74:16–18, ‘the aforementioned methods for ACK/NACK information and/or SR transmission may be applied to the structure’), which is one type of uplink control information (*id.*, 12:4–8).” Pet. 29. Augmenting its showing, Petitioner argues Figure 7

of Kwak discloses “[a] positive acknowledgement response (ACK) may be encoded as ‘1’ and a negative acknowledgement response (NACK) may be encoded as ‘0’.” *Id.* at 29–30 (citing Ex. 1005, 15:27–30).

Claim 9 also depends from claim 5 and recites:

wherein the uplink control information comprises an ACK and an NACK; wherein the ACK corresponds to bit “1” and the NACK corresponds to a bit “0”, when the ACK or the NACK is sent, the ACK or the NACK is respectively indicated by the predefined sequences being mapped to different frequency domain subcarrier positions on the transmission symbols.

Petitioner references its showing for claim 8 that an ACK corresponds to a bit “1” and a NACK corresponds to a bit “0.” Pet. 31, *see also id.* at 29–30 (quoting Ex. 1005, 15:27–30).

Petitioner argues:

Thus, implementing ACK as a ‘1’ and NACK as a ‘0’ is merely one of two choices available to a POSITA, who would have been able to make and implement such a choice with reasonable success. (*Id.*) As such, implementing ACK as ‘1’ and NACK as a ‘0’ would have been obvious. *Uber Techs., Inc. v. X One, Inc.*, 957 F.3d 1334, 1340 (Fed. Cir. 2020) (“a person of ordinary skill would therefore have two predictable choices for when to perform plotting, providing them with a simple design choice as to whether to plot server-side or terminal-side.”).

Pet. 75.

Patent Owner argues that claims 8 and 9 would not have been obvious based on its showing regarding claim 1. PO Resp. 51. Patent Owner does not separately argue claims 8 and 9 are patentable. *Id.*

For the same reasons discussed in connection with claim 1, Petitioner has shown by a preponderance of the evidence that claims 8 and 9 would have been obvious over Kwak.

H. Obviousness of Claims 8 and 9 over Kwak based on the filing date of the Kwak Provisional (Ground 4)

Petitioner also alleges claims 8 and 9 would have been obvious over Kwak using the filing date of the Kwak Provisional. Pet. 3, 75–76. As discussed in Section II.F n.4 above, Patent Owner does not claim the benefit of the filing date of the '116 application. See PO Resp. 51.

We do not reach Ground 4 because it is moot based on our determination regarding Ground 3. For the reasons discussed above in connection with Ground 3 in Section III.G, Petitioner has shown claims 8 and 9 are unpatentable.

IV. CONCLUSION⁸

For the reasons discussed above, Petitioner has shown by a preponderance of the evidence that claims 1–5, 7–9, 14, and 20 of the '130 patent are unpatentable as summarized in the table below.

V. ORDER

In consideration of the foregoing, it is hereby:

⁸ Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner's attention to the April 2019 Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding. See 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. See 37 C.F.R. § 42.8(a)(3), (b)(2).

ORDERED that Petitioner has shown that challenged claims 1–5, 7–9, 14, and 20 of the '130 patent are unpatentable; and

FURTHER ORDERED that, because this is a Final Written Decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

In summary:

Claims	35 U.S.C. §	Reference(s)/Basis	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1–5, 7–9, 14, 20	102	Kwak	1–5, 7–9, 14, 20	
1–5, 7–9, 14, 20	102	Kwak based on the filing date of the Kwak Provisional ⁹		
8, 9	103	Kwak	8, 9	
8, 9	103	Kwak based on the filing date of the Kwak Provisional ¹⁰		
Overall Outcome			1–5, 7–9, 14, 20	

⁹ The challenge based on the Kwak provisional filing date is moot as discussed in Section III.F.

¹⁰ The challenge based on the Kwak provisional filing date is moot as discussed in Section III.H above.

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