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Paper 54
Entered: November 14, 2022

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

HONEYWELL INTERNATIONAL, INC., TCT MOBILE (US) INC., TCT MOBILE (US) HOLDINGS INC., TCL COMMUNICATION TECHNOLOGY HOLDINGS LIMITED, TCT MOBILE INTERNATIONAL LIMITED, TCT MOBILE, INC., DELL INC., SIERRA WIRELESS, INC., and THALES DIS AIS DEUTSCHLAND GMBH,
Petitioner,

v.

3G LICENSING S.A.,
Patent Owner.

IPR2021-00908
Patent 7,319,718 B2

Before MONICA S. ULLAGADDI, AARON W. MOORE, and RUSSELL E. CASS, *Administrative Patent Judges.*

CASS, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining No Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

A. Background

In this *inter partes* review, Honeywell International, Inc., TCT Mobile (US) Inc., TCT Mobile (US) Holdings Inc., TCL Communication Technology Holdings Limited, TCT Mobile International Limited, TCT Mobile, Inc., Sierra Wireless, Inc., and Thales DIS AIS Deutschland GMBH ("Petitioner") challenge the patentability of claims 1, 2, 4–7, 9–13, and 15–23 (the "challenged claims") of U.S. Patent No. 7,319,718 B2 (Ex. 1001, "the '718 patent"), which is assigned to 3G Licensing SA ("Patent Owner").

We have jurisdiction under 35 U.S.C. § 6. This Final Written Decision, issued pursuant to 35 U.S.C. § 318(a), addresses issues and arguments raised during the trial in this *inter partes* review. For the reasons discussed below, Petitioner has not proven by a preponderance of the evidence that claims 1, 2, 4–7, 9–13, and 15–23 are unpatentable.

B. Procedural History

In this proceeding, Petitioner relies upon the following references:

> TDoc R1-02-0046 submitted to 3GPP TSG RAN WG1#23 by Philips, titled "Coding of Channel Quality Information" (Ex. 1004, "Philips46"); and
>
> TDoc R1-02-0019 submitted to TSG RAN WG1 #23 by Nokia, titled "Channel coding and error detection for uplink QI signaling" (Ex. 1021, "Nokia").

Pet. iii–v, 29.

Petitioner submits the Declaration of Dr. Paul C. Clark (Ex. 1002). Petitioner also submits the Declaration of Craig Bishop, which discusses the public availability of 3GPP technical specifications and other documents (Ex. 1015). Patent Owner submits declarations from Dr. Michael Smith (Exs. 2001, 2006).

Petitioner challenges the patentability of claims 1, 2, 4–7, 9–13, and 15–23 of the '718 patent based on the following grounds:

Claims Challenged	35 U.S.C. §	Reference(s)/Basis
1, 2, 4, 5, 15–23	103(a)[1]	Philips46
6–7, 9–13	103(a)	Philips46, Nokia

Pet. 29.

Patent Owner filed a Preliminary Response. Paper 16 ("Prelim. Resp."). We instituted trial on all grounds of unpatentability. Paper 32 ("Inst. Dec."), 41.

During the trial, Patent Owner filed a Response (Paper 33, "PO Resp."), Petitioner filed a Reply (Paper 39, "Pet. Reply"), and Patent Owner filed a Sur-reply (Paper 40, "PO Sur-reply").

An oral hearing was held on August 18, 2022, a transcript of which appears in the record. Paper 50 ("Tr.").

C. Real Parties in Interest

Petitioner states that the real parties in interest are Cradlepoint, Inc.,[2] Dell, Inc., Dell Marketing L.P., Dell Products L.P., Dell Technologies Inc., Denali Intermediate Inc., Ericsson Inc., Honeywell International, Inc., Sierra Wireless, Inc., Sierra Wireless America, Inc., Telefonaktiebolaget LM

[1] The Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011) ("AIA"), included revisions to 35 U.S.C. § 103 that became effective after the filing of the application that led to the '718 patent. Therefore, we apply the pre-AIA version of 35 U.S.C. § 103.

[2] On November 3, 2022, the parties filed a motion to terminate Cradlepoint Inc. from the proceeding due to a settlement reached between Cradlepoint and Patent Owner. Paper 51. We granted the motion and terminated Cradlepoint from this proceeding on November 7, 2022. Paper 53.

Ericsson, TCL Communication Technology Holdings Ltd., TCT Mobile International Ltd., TCT Mobile Inc., TCT Mobile (US) Inc., TCT Mobile (US) Holdings Inc., Thales DIS AIS USA, LLC, Verifone, Inc., Wiko SAS, Wiko USA, Inc., ZTE Corporation, and ZTE (USA) Inc.[3] Pet. vii–viii; Paper 21, 1. Patent Owner states that 3G Licensing S.A. is the real party in interest. Paper 11, 1.

D. Related Proceedings

The parties identify multiple district court cases asserting the '718 patent in the U.S. District Courts for the District of Delaware and the Northern District of Texas, including cases brought against Cradlepoint, Inc., Dell Inc., Honeywell International, Inc., TCL Communication Technology Holdings Ltd., and Wiko SAS. Pet. viii–ix; Paper 11, 1.

E. The '718 Patent (Ex. 1001)

The '718 patent describes a scheme for encoding channel quality information ("CQI") in a wireless communication system, and specifically for use in an uplink High Speed Dedicated Physical Control Channel (HS-DPCCH) in a High Speed Data Packet Access (HSDPA) system. Ex. 1001, 1:6–9, 2:20–22. The CQI is a 5-bit binary value (a binary representation of an integer between 0 and 30) that a mobile device sends to a base station indicating the quality of the device's connection. Ex. 1002 ¶¶ 38–39, 42. The '718 patent explains that, in channel coding for CQI, "a number of uplink CQI coding methods have been proposed and most proposals assume

[3] On August 24, 2021, ZTE Corporation and ZTE (USA) Inc. filed a motion to terminate these two ZTE entities from the proceeding due to a settlement reached between the ZTE entities and Patent Owner. Paper 17. We granted the motion and terminated the ZTE entities from this proceeding on September 8, 2021. Paper 20.

that the CQI is to be coded into 20 channel bits." Ex. 1001, 3:38–42. The patent further states that "CQI coding methods are based on the Transmit Format Combination Indicator (TFCI) coding method of [the] 3GPP specification." *Id.* at 3:42–44.

The '718 patent discloses two exemplary 3GPP encoders, a (16, 5) TFCI encoder and a (32,10) TFCI encoder. Ex. 1001, 3:43–48. These encoders take each information bit of the codeword, multiply it by a corresponding basis sequence ($M_{i,n}$), sum the results, and convert the answer to a binary bit. *Id.* at 3:50–4:9; Ex. 1002 ¶¶ 47, 91. The (16,5) TFCI encoder uses five information bits and the (32,10) TFCI encoder uses ten information bits. *Id.* at 3:45–65. Each base sequence $M_{i,n}$ is a series of numbers, as shown in the table below for a (16,5) TFCI encoder:

TABLE 1a

i	$M_{i,0}$	$M_{i,1}$	$M_{i,2}$	$M_{i,3}$	$M_{i,4}$
0	1	0	0	0	1
1	0	1	0	0	1
2	1	1	0	0	1
3	0	0	1	0	1
4	1	0	1	0	1
5	0	1	1	0	1
6	1	1	1	0	1
7	0	0	0	1	1
8	1	0	0	1	1
9	0	1	0	1	1
10	1	1	0	1	1
11	0	0	1	1	1
12	1	0	1	1	1
13	0	1	1	1	1
14	1	1	1	1	1
15	0	0	0	0	1

Table 1a above is a table for a (16,5) TFCI encoder with five base sequences $M_{i,0}$ to $M_{i,4}$. Ex. 1001, 3:50–54, 4:40–65.

The ’718 patent discloses that conventional TFCI coding methods can be used to modify (16,5) TFCI and (32,10) TFCI encoders to “fit the required number of bits for CQI coding” for a “5 information bits and 20 coded bits, i.e. (20, 5) CQI code.” Ex. 1001, 4:15–20. To accomplish this, the ’718 patent teaches extending the (16,5) TFCI code by adding four bits to each basis sequence. *Id.* at 4:21–22. The ’718 patent also teaches a two-step process for generating a (20,5) CQI code from a (32,10) TFCI code: (1) expurgating the (32, 10) TFCI code to the (32, 5) modified TFCI code by deleting last 5 basis sequences, and (2) puncturing and repeating the (32, 5) expurgated TFCI code to meet the (20, 5) CQI code. *Id.* at 4:24–30.

The ’718 patent discloses that the performance of conventional CQI coding schemes may vary depending on the extended parts of their basis sequence table. Ex. 1001, 7:36–38. “[S]ince the HSDPA system has been designed in order to increase the system throughput,” the ’718 patent explains, “it is desirable to use the system throughput as one of the criteria in order to select [an] optimum CQI coding scheme.” *Id.* at 7:50–53. Thus, the invention of the ’718 patent seeks to “provide a method for generating basis sequences for CQI coding capable of maximizing a system throughput.” *Id.* at 7:59–61.

To address this issue, the ’718 patent teaches CQI encoding methods based on both (16,5) TFCI codes and (32,10) TFCI codes. Ex. 1001, 7:62–66, 8:53–56. For the (32,10) TFCI code, the ’718 patent teaches: (a) “creating first basis sequences for generating [a] (32,5) expurgated TFCI code from [a] (32,10) TFCI code”; (b) “puncturing each of the (32,5) expurgated TFCI codes in a predetermined bit pattern in order to maximize system throughput”; (c) “repeating a predetermined bit of each (32,5)

expurgated TFCI code for predetermined times in order to maximize system throughput"; and (d) "encoding 5 information bits into CQI codes using . . . second basis sequences generated through (b) and (c)." *Id.* at 7:64–8:5.

For a (16,5) TFCI code, the '718 patent teaches: "(a) "obtaining first basis sequences from [a] (16, 5) TFCI code"; (b) "extending basis sequences to [a] (20, 5) CQI code in a predetermined pattern in order to maximize system throughput"; and (c) "encoding 5 information bits into CQI codes using . . . second basis sequences generated through (a) and (b)." Ex. 1001, 8:53–61.

In both cases, the '718 patent discloses, "[t]he second basis sequences are as in [the] following table:"

i	$M_{i,0}$	$M_{i,1}$	$M_{i,2}$	$M_{i,3}$	$M_{i,4}$
0	1	0	0	0	1
1	0	1	0	0	1
2	1	1	0	0	1
3	0	0	1	0	1
4	1	0	1	0	1
5	0	1	1	0	1
6	1	1	1	0	1
7	0	0	0	1	1
8	1	0	0	1	1
9	0	1	0	1	1
10	1	1	0	1	1
11	0	0	1	1	1
12	1	0	1	1	1
13	0	1	1	1	1
14	1	1	1	1	1
15	0	0	0	0	1
16	0	0	0	0	1
17	0	0	0	0	1
18	0	0	0	0	1
19	0	0	0	0	1

Ex. 1001, 8:12–34, 8:59–61. The above table includes five base sequences $M_{i,0}$ to $M_{i,4}$, each with 20 bits. *Id.*

F. Illustrative Claims

Of challenged claims 1, 2, 4–7, 9–13, and 15–23, claims 1, 6, 15, and 19 are independent. For purposes of the issues addressed in this decision, claims 1 and 6 are illustrative and are reproduced below.

1. [1.1] A method of coding channel quality information (CQI), comprising the steps of,

[1.2] providing information bits a_0, a_1, a_2, a_3, and a_4;

[1.3] providing five basis sequences $M_{i,n}$ for a (20,5) CQI code;

[1.4] encoding the information bits by combining the information bits with the basis sequences;

[1.5] generating a 20-bit codeword;

[1.6] wherein the basis sequences $M_{i,n}$ are defined as:

I	$M_{i,0}$	$M_{i,1}$	$M_{i,2}$	$M_{i,3}$	$M_{i,4}$
0	1	0	0	0	1
1	0	1	0	0	1
2	1	1	0	0	1
3	0	0	1	0	1
4	1	0	1	0	1
5	0	1	1	0	1
6	1	1	1	0	1
7	0	0	0	1	1
8	1	0	0	1	1
9	0	1	0	1	1
10	1	1	0	1	1
11	0	0	1	1	1
12	1	0	1	1	1
13	0	1	1	1	1
14	1	1	1	1	1
15	0	0	0	0	1
16	0	0	0	0	1
17	0	0	0	0	1
18	0	0	0	0	1
19	0	0	0	0	1.

6. [6.1] A method of coding channel quality information (CQI), comprising the steps of,

[6.2] providing information bits a_0, a_1, a_2, a_3, and a_4;

[6.3] providing five basis sequences $M_{i,n}$ for a TFCI code;

[6.4] encoding the information bits by combining the information bits with the basis sequences;

[6.5] generating an intermediate codeword;

[6.6] adding a further bit repeated four times to generate a 20-bit codeword.

Ex. 1001, 12:29–58, 13:11–19 (bracketed paragraph identifiers added).

II. DISCUSSION

A. Claim Construction

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)." 37 C.F.R. § 42.100(b) (2020). Neither party proposes a construction of any claim terms. Pet. 29; PO Resp. 15. We determine that it is not necessary to provide an express interpretation of any claim terms for purposes of this Decision. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017); *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) ("[O]nly those terms need be construed that are in controversy, and only to the extent necessary to resolve the controversy.").

B. Principles of Law

A claim is unpatentable under 35 U.S.C. § 103 if "the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) where in evidence, objective evidence of non-obviousness. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). When evaluating a combination of teachings, we must also "determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue." *KSR*, 550 U.S. at 418 (citing *In re*

Kahn, 441 F.3d 977, 988 (Fed. Cir. 2006)). Whether a combination of prior art elements would have produced a predictable result weighs in the ultimate determination of obviousness. *Id.* at 416–417.

In an *inter partes* review, the petitioner must show with particularity why each challenged claim is unpatentable. *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016); 37 C.F.R. § 42.104(b) (2020). The burden of persuasion never shifts to Patent Owner. *Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015).

We analyze the challenges presented in the Petition in accordance with the above-stated principles.

C. Level of Ordinary Skill in the Art

In our Institution Decision, we adopted Petitioner's assessment of the level of skill in the art as including a Bachelor's degree in electrical engineering, computer engineering, or a similar discipline with approximately two years of signal processing experience, which is supported by the declaration of Dr. Clark and the prior art of record. Inst. Dec. 12 (citing Ex. 1002 ¶¶ 70–72). We also agreed with Patent Owner that a combination of more experience in the field and less education or more education and less experience in the field may also suffice. *Id.* In its Patent Owner Response, Patent Owner states that it does not object to the level of ordinary skill we adopted in the Institution Decision. PO Resp. 9. For purposes of this Final Written Decision, we adhere to the level of ordinary skill adopted in our Institution Decision, which is consistent with the disclosures of the '718 patent and the asserted prior art.

D. Ground 1: Obviousness of Claims 1, 2, 4–5, and 15–23 Based on Philips46

Petitioner contends that claims 1, 2, 4–5, and 15–23 are obvious over Philips46. Pet. 29, 35–55. Patent Owner disagrees. PO Resp. 9–24.

1. Overview of Philips46 (Ex. 1004)

Relying on the testimony of Mr. Bishop, Petitioner asserts that Phillips46 "is a Temporary Document ('TDoc') titled 'Coding of Channel Quality Information' that was submitted to 3GPP TSG RAN WG1#23 in Espoo, Finland, on January 8th–11th 2002." Pet. 33 (citing Ex. 1015 ¶ 48; Ex. 1004, 1; Ex. 1002 ¶¶ 74–75). According to Petitioner and Mr. Bishop, "Philips46 was distributed via the TSG RAN WG1 email list and, on January 12, 2002, it was uploaded to the 3GPP public file repository." *Id.* (citing Ex. 1015 ¶¶ 52–53). Thus, Petitioner contends, Philips46 "was publicly available as of January 7 and/or 12, 2002," and "is prior art under 35 U.S.C. § 102(b)." *Id.* Patent Owner does not contest the prior art status of Philips46. PO Resp. 9–23. Based on the full trial record, we find that Petitioner has shown by a preponderance of the evidence that Philips46 qualifies as prior art.

Phillips46 explains that "in the coding of CQI in HSDPA," the "current working assumption is that 5 information bits will be transmitted in a 20 bit data field." Ex. 1004, 1. To carry this out, Phillips46 explains, "[t]he most promising proposals are" (1) "[t]o take the (16,5) bi-orthogonal TFCI code and append 4 of the 5 data bits to make a 20 bit code word" or "suitably extend[] the basis vectors to 20 bits," and (2) "[t]o take 5 basis vectors from a (32, 10) Reed-Muller code and puncture to 20 bits." *Id.* According to Phillips46, "it is also desirable that if possible the most significant bits of the data are better protected than the least significant bits,"

which "would reduce the probability that transmission errors would result in large errors in the received channel quality value." *Id.* Therefore, Phillips46 "propose[s] to extend the basis vectors of the (16,5) TFCI code as shown in Table 1," which "gives significant extra protection to the MSB, and a little more robustness to the next most significant bit." *Id.* Table 1 is reproduced below:

Table 1: Basis sequences for (20,5) code as an extended (16,5) TFCI code

i	$M_{i,0}$	$M_{i,1}$	$M_{i,2}$	$M_{i,3}$	$M_{i,4}$
0	1	0	0	0	1
1	0	1	0	0	1
2	1	1	0	0	1
3	0	0	1	0	1
4	1	0	1	0	1
5	0	1	1	0	1
6	1	1	1	0	1
7	0	0	0	1	1
8	1	0	0	1	1
9	0	1	0	1	1
10	1	1	0	1	1
11	0	0	1	1	1
12	1	0	1	1	1
13	0	1	1	1	1
14	1	1	1	1	1
15	0	0	0	0	1
16	0	0	0	0	1
17	0	0	0	0	1
18	0	0	0	0	1
19	0	0	0	1	0

Ex. 1004, 2. Philips46's Table 1 lists the 5 basis sequences $M_{i,0}$ to $M_{i,4}$ for a (20,5) TFCI code extended from a (16,5) TFCI code. *Id.*

2. Analysis of Independent Claim 1

a) [1.1]: "[a] method of coding channel quality information (CQI), comprising the steps of:"

Petitioner asserts that, to the extent the preamble of claim 1 is limiting, Philips46 discloses this limitation. Pet. 42. Petitioner points to Philips46's disclosure that the "channel quality information is coded using a (16,5) bi-orthogonal code," and argues that one of ordinary skill in the art

"would understand that this is a method of coding CQI." *Id.* (citing Ex. 1004, 4; Ex. 1002 ¶ 101; Ex. 1001, 4:15–39).

Patent Owner does not present arguments regarding the preamble. *See* PO Resp. 9–24; PO Sur-reply 2–11.

We agree with Petitioner that the cited disclosures of Philips46 teach a method of coding channel quality information (CQI), as recited in the preamble.[4]

b) [1.2]: "providing information bits a_0, a_1, a_2, a_3, and a_4;"

Petitioner argues that "Philips46 provides information bits a_0, a_1, a_2, a_3, and a_4 (where a_0 is least significant bit ('LSB') and a_4 is MSB.)." Pet. 43. Relying on the testimony of Dr. Clark, Petitioner asserts that providing these information bits "as explicitly set forth in Philips46, would be obvious to" one of ordinary skill in the art. *Id.* (citing Ex. 1002 ¶ 102).

Patent Owner does not present arguments regarding this limitation. *See* PO Resp. 9–24; PO Sur-reply 2–11.

We agree with Petitioner that Philips46 teaches this limitation. Specifically, we agree that Philips46 discloses providing information bits a_0, a_1, a_2, a_3, and a_4, where a_0 is the least significant bit and a_4 is the most significant bit.

c) [1.3]: "providing five basis sequences $M_{i,n}$ for a (20,5) CQI code;"

Petitioner argues that Philips46 "describes five basis sequences, $M_{i,0}$ through $M_{i,4}$ for a (20,5) code," pointing to Table 1 of Philips46. Pet. 43

[4] Because we are persuaded that Petitioner has shown that Philips46 teaches the subject matter recited in the preamble, we need not decide whether the preamble is limiting.

(citing Ex. 1004, Table 1, 4–5). Petitioner asserts that one of ordinary skill "would understand that, as part of the coding of channel quality information, five basis sequences for a (20,5) CQI code would be provided," and "would thus find this element explicitly disclosed by Philips46." *Id.* at 43–44 (citing Ex. 1002 ¶ 103; Ex. 1001, 4:9, 4:21–22, Table 1a).

Patent Owner does not present arguments regarding this limitation. *See* PO Resp. 9–24; PO Sur-reply 2–11.

We agree with Petitioner that Philips46 teaches this limitation. Specifically, we agree that Philips46 discloses five basis sequences, $M_{i,0}$ through $M_{i,4}$ for a (20,5) CQI code in Table 1. Pet. 43; Ex. 1004, Table 1, 4–5.

d) [1.4]: "encoding the information bits by combining the information bits with the basis sequences;"

Petitioner argues that Philips46 "describes encoding by linearly combining the information bits with the basis sequences of the code according to a specific equation." Pet. 44 (citing Ex. 1004, 5). According to Petitioner, "[t]his linear combination encodes the information bits by combining them with the basis sequences to generate a codeword," as described further for element 1.5 below. *Id.* Thus, Petitioner asserts, one of ordinary skill in the art would understand Philips46 to explicitly disclose this element. *Id.* (citing Ex. 1002 ¶¶ 104–105; Ex. 1001, 7:15–20, 3:51–62, Figs. 5–6).

Patent Owner does not present arguments regarding this limitation. *See* PO Resp. 9–24; PO Sur-reply 2–11.

We agree with Petitioner that Philips46 teaches this limitation. Specifically, we agree that Philips46 discloses encoding the information bits by linearly combining them with the basis sequences of the code to generate

a codeword, as described further below with respect to element 1.5. Pet. 44; Ex. 1004, 5.

e) [1.5]: "generating a 20-bit codeword;"

Petitioner argues that "Philips46 'describes mak[ing] a 20-bit codeword' as part of its proposal," and "further specifies that the codeword bits (b_i) are generated" by a specific equation. Pet. 44 (citing Ex. 1004, 1, 5). In this equation, according to Petitioner, b_i is the output bit, a_n is a given information bit, and $M_{i,n}$ is the basis sequence of the code. *Id.* Petitioner contends that one of ordinary skill "would understand this this outputs a codeword of length *i*, such that, for Philips46, the output is a 20-bit codeword." *Id.* at 45 (citing Ex. 1002 ¶ 106; Ex. 1001, 3:50–4:8; Ex. 1004, 5).

Patent Owner does not present arguments regarding this limitation. *See* PO Resp. 9–24; PO Sur-reply 2–11.

We agree with Petitioner that Philips46 discloses generating a 20-bit codeword, as required by this limitation. Pet. 44–45; Ex. 1004, 1, 5; Ex. 1002 ¶ 106).

f) [1.6]: "wherein the basis sequences $M_{i,n}$ are defined as . . . ."

The parties' dispute as to claim 1 focuses on this limitation. We will discuss the parties' contentions below, followed by our analysis and findings.

(1) The Parties' Arguments

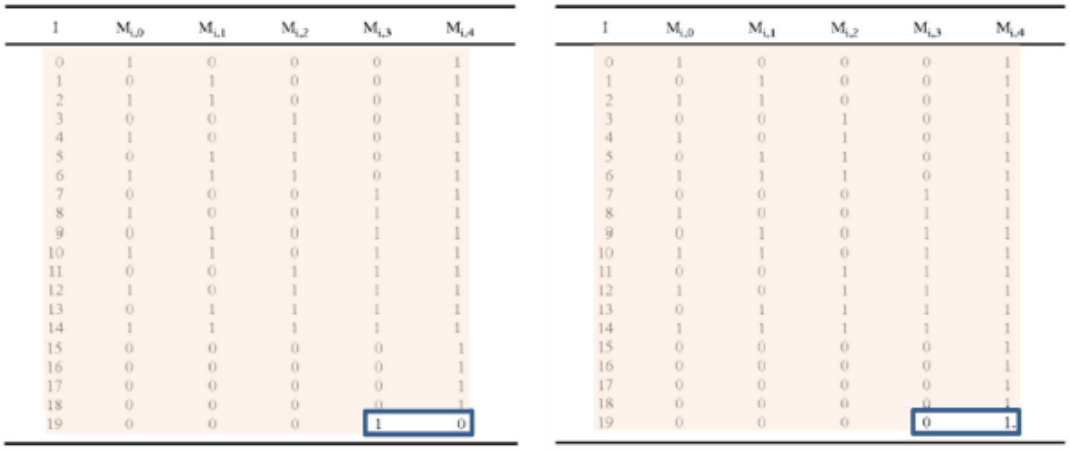
Petitioner argues that Philips46 provides a table (Table 1) for its (20,5) basis sequence, which is reproduced below with annotations by Petitioner:

Table 1: Basis sequences for (20,5) code as an extended (16,5) TFCI code

i	$M_{i,0}$	$M_{i,1}$	$M_{i,2}$	$M_{i,3}$	$M_{i,4}$
0	1	0	0	0	1
1	0	1	0	0	1
2	1	1	0	0	1
3	0	0	1	0	1
4	1	0	1	0	1
5	0	1	1	0	1
6	1	1	1	0	1
7	0	0	0	1	1
8	1	0	0	1	1
9	0	1	0	1	1
10	1	1	0	1	1
11	0	0	1	1	1
12	1	0	1	1	1
13	0	1	1	1	1
14	1	1	1	1	1
15	0	0	0	0	1
16	0	0	0	0	1
17	0	0	0	0	1
18	0	0	0	0	1
19	0	0	0	1	0

Pet. 45 (citing Ex. 1004, 2 (annotated)). As discussed above, this table shows the 5 basis sequences $M_{i,0}$ to $M_{i,4}$ for a (20,5) TFCI code extended from a (16,5) TFCI code. Ex. 1004, 2. Petitioner asserts that "Rows 0–18 of this table are identical to what is claimed in the '718 patent." Pet. 45. Petitioner identifies row 19, surrounded by a yellow rectangle, as the only row of Table 1 that is different from the table in claim element 1.6. *Id.*

Petitioner argues that the only difference between the table of base sequences in the Philips46 prior art and the one in the '718 patent is that the last two bits of the last row are flip-flopped. Pet. 2–3. Petitioner illustrates this difference in the figure reproduced below:



Prior Art ’718 patent

Pet. 2–3. This figure from the Petition reproduces Table 1 from Philips46 on the left, with the last two bits of the last row being “1,0,” and the table from claim 1 of the ’718 patent on the right, with the last two bits of the last row being “0,1.” *Id.*

According to Petitioner, “Phillips 46 notes that the most significant bit is the final bit of the five information bits (a_0, a_1, a_2, a_3, $\mathbf{a_4}$) and attempts to provide ‘significant extra protection to the MSB [most significant bit].’” Pet. 36 (citing Ex. 1002 ¶¶ 78–79; Ex. 1004, 1). Relying on the testimony of Dr. Clark, Petitioner contends that swapping the two bits on the last row of Philips46’s Figure 1 “would achieve the stated goal of [Phillips46] of providing extra protection to the most significant bit, at the tradeoff of providing slightly less protection to the second-most significant bit.” *Id.* at 36–37 (citing Ex. 1002 ¶ 99). “In effect,” according to Petitioner, one of ordinary skill “attempting to maximize the protection for the most significant bit would extend the last bit from the $M_{i,4}$ basis sequence of the (16,5) code of Philips46 through the remainder of the extended base sequence to the 20th bit, as opposed to stopping at the 19th bit.” *Id.* at 37

(citing Ex. 1002 ¶¶ 108–109). This is because "[i]t was known that by adjusting the position of the '1' in the 16–20th rows of the basis sequence of the code, the bit afforded the protection changes." *Id.* at 37–38 (citing Ex. 1002 ¶ 112). Thus, one of ordinary skill "would have known that the selection of where to place this '1' directly impacts which bit receives protection." *Id.* at 38 (citing Ex. 1002 ¶¶ 111–112). And, Petitioner and Dr. Clark assert, "if protection is desired for the a_4 bit, then a 1 will be in the final basis sequence $M_{i,4}$," but "if protection is desired for the a_3 bit, then a 1 will be in the second to final basis sequence $M_{i,3}$." Pet. 38; Ex. 1002 ¶ 115.

Patent Owner argues that the "'718 patent is concerned with maximizing the entire system throughput, not minimizing the Root-Mean-Square ('RMS') error of the code, minimizing bit error rate ('BER') of the code, nor maximizing the protection of the MSBs, as disclosed by Philips." PO Resp. 11 (emphasis omitted) (citing Ex. 1001, code (57), 7:40–49; Ex. 2006 ¶¶ 11, 14). "Indeed," according to Patent Owner, "the '718 patent teaches that efforts to minimize RMS error and to minimize BER produce conflicting, incompatible results." I*d.* (emphasis omitted) (citing Ex. 1001, 11:38–12:19; Ex. 2006 ¶ 13). Thus, Patent Owner asserts, "Philip's pursuit of protecting the MSBs would not influence a [person of ordinary skill in the art] to act in a manner that would maximize system throughput." *Id.* at 12.

Patent Owner also asserts that, although "Petitioners have focused on the protection of the MSB," the "amount of protection assigned to each bit using unequal error protection ('UEP') is a coincidental result of optimizing the code for system throughput" as taught by the '718 patent, "not a metric that necessarily optimizes system throughput." PO Resp. 12 (emphasis omitted). "The '718 patent explains," according to Patent Owner, "that only

by simulating system throughput can the correct balance between minimizing RMS error and BER be obtained and the best code that allocates the correct UEP be determined." *Id.* (citing Ex. 1001, 12:8–19; Ex. 2006, 14). Thus, Patent Owner contends, a "desire to optimize BER, RMS error, UEP, or protection of just the MSB of the code" is opposed to the '718 patent's goal of "optimiz[ing] system throughput." *Id.*

Patent Owner also takes issue with Petitioner's argument that one of ordinary skill "could knowingly and reliably create or find an optimum CQI code simply" by "switching two digits in the last row of the Philips table" to "afford[] greater protection to just the MSB of one of the proposed codes." PO Resp. 12 (citing Ex. 2006, 15). To the contrary, Patent Owner contends, "[a] full understanding of the proposed CQI codes and their properties was not available at the time of the '718 patent," and "[a]n understanding of the mathematical relationship between basis sequences in this field, such as those being considered by 3GPP, and the resulting codewords[,] was not demonstrated until a research paper was published in 2016—over a decade after the filing date of the '718 patent." *Id.* at 12–13 (citing Ex. 2006 ¶¶ 15–28).

Additionally, Patent Owner argues that "the 3GPP Temporary Documents ('TDocs') and meeting reports (or minutes) confirm that even experts in mobile communications disagreed on optimal basis sequences even on the eve of the '718 patent's February 16, 2002 priority date." PO Resp. 13. In January 2002, according to Patent Owner, "[t]he members of 3GPP, the world experts in mobile communications, struggled to agree on what constituted the 'best' CQI code." *Id.* at 14.

More specifically, Patent Owner argues, "[i]n their January 2002 meeting in Espoo, 3GPP received five different proposals, including papers from Ericsson, Nokia, Samsung, and Philips." PO Resp. 14 (citing Ex. 2006 ¶ 31). The Ericsson, Nokia, and Samsung papers, Patent Owner asserts, "proposed the introduction of varying levels of protection for different bits, such as the 'four least reliable information bits,' of five data input bits," which "is the practice of Unequal Error Protection discussed above." *Id.* (citing Ex. 2006 ¶ 32). According to Patent Owner, "UEP differed from the prior methods of encoding information such as a channel quality indicator ('CQI')" because "it provided additional protection to bits more likely to be damaged in transmission" rather than "affording equal protection to each bit." *Id.* (citing Ex. 2006 ¶ 33). However, "despite th[is] unequal protection," Patent Owner asserts, "these initial proposals each proposed BER—the ratio of data bits compromised during radio transmission where protection of bits is weighted equally—as the appropriate metric for a CQI code." *Id.* at 14–15 (citing Ex. 2006 ¶ 34).

In contrast, Patent Owner argues, Philips's paper (the Philips46 reference) "recommended a departure from BER as the sole code metric" and proposed an "RMS error formula to better measure code performance in a UEP scheme." PO Resp. 15 (citing Ex. 2006 ¶ 35). According to Patent Owner, Philips "advocated for providing additional protection of the most significant bits ('MSBs') of the input, and proposed a different set of basis sequences (i.e., a different encoding matrix) to achieve protection of the MSBs." *Id.* (citing Ex. 2006 ¶ 36). "Despite pushback from Samsung who did not believe that Philips' proposal provided improvement over the prior

art," Patent Owner contends, "3GPP adopted Philips as part of the relevant 3GPP standard." *Id.* (citing Ex. 2006 ¶ 37).

However, Patent Owner argues, "[d]uring the February 2002 3GPP meeting in Orlando, LGE, the '718 patentee, presented findings that contradicted the Philips proposal." PO Resp. 15 (citing Ex. 2006 ¶ 34). More specifically, Patent Owner asserts, "LGE presented a paper indicating that neither BER nor RMS error, the theories underlying all prior proposals to 3GPP, were the appropriate underlying basis for what constituted an 'optimal' CQI code." *Id.* (citing Ex. 2006 ¶ 39). "Rather," according to Patent Owner, "by unveiling the results of new simulations, LGE argued that the 3GPP should shift its paradigm to that taught by the '718 patent—using system throughput as the appropriate metric to select an optimum CQI coding scheme." *Id.* (emphasis omitted) (citing Ex. 2006 ¶ 40). Patent Owner contends that this was "an entirely new paradigm—an alternative set of basis sequences that were optimized for system throughput that explicitly combined the BER and RMS error metrics." *Id.* at 15–16 (citing Ex. 2006 ¶ 41). LGE also included "the same chart of basis sequences as the '718 patent" in its proposal." *Id.* at 16 (citing Ex. 2006 ¶ 45).

Patent Owner argues that "LGE's simulation" in the February 2002 paper "demonstrated that by including the effects of both BER and RMS error, basis sequences not previously considered by 3GPP yielded unexpected, previously unobtained, results: namely the optimum CQI code for system throughput." PO Resp. 16 (citing Ex. 2006 ¶ 42). According to Patent Owner, these results were "particularly noteworthy" because "prior efforts to optimize both BER and RMS error yielded mutually exclusive results," showing that "maximizing one would be at the cost of the other."

Id. (citing Ex. 2006 ¶¶ 42–43). Thus, Patent Owner contends, LGE's simulation results demonstrated that "focus on system throughput, rather than protection of MSBs (as advocated by Philips) yielded the optimum result." *Id.* (citing Ex. 2006 ¶ 44).

"LGE's proposal," Patent Owner argues, "left 3GPP's members divided." PO Resp. 16. According to Patent Owner, Samsung responded by "expressing doubts over the simulation results presented in LGE's paper," while "Philips ultimately supported LGE's conclusions in light of this brand new evidence provided by the LGE experiments, results, and explanation." *Id.* (citing Ex. 2006 ¶ 46). "Subsequent meetings in April and May of 2002," Patent Owner contends, "ultimately led to 3GPP changing the standard from the Philips proposal" in order "to align with LGE's proposal (and the '718 patent)." *Id.* (citing Ex. 2006 ¶ 47).

Based on this 3GPP history, Patent Owner argues, Petitioner's contention that it would have been obvious to simply swap the last two digits in the Philips46 chart "substantially oversimplifies the issues faced by the 3GPP members considering the issues at the time of the invention—let alone the difficulties faced" by a person of ordinary skill. PO Resp. 17. According to Patent Owner, "[t]he very first proposals in January 2002 were significant departures into unknown territory in the field," with "several new types of codes" having been proposed having an "unknown" mathematical relationship. *Id.* (citing Ex. 2006 ¶ 48). Patent Owner argues that "[t]hese new codes were being optimized in new and various different ways," as "UEP, a technique not covered in textbooks at the time, had been introduced as foundational," in contrast to "all prior methods [which] assumed equal

error protection and relied on BER to provide an accurate measure of CQI code performance." *Id.* (citing Ex. 2006 ¶ 49).

Thus, according to Patent Owner, "[t]o even understand the Philips reference," a person of ordinary skill "would have needed to understand the combination of at least five 3GPPP technical papers that led to Philips'[s] conclusion and proposals," which would have "require[d] a level of skill well beyond that of" a person of ordinary skill in the art. PO Resp. 17–18 (citing Ex. 2006 ¶¶ 50–51). "Even with the disclosures of" Philips46, Patent Owner contends, a person of ordinary skill "would be confronted with the same problem of resolving the mutually exclusive optimizations of BER and RSM faced by the world-experts of 3GPP." *Id.* at 60 (citing Ex. 2006 ¶ 52). Consequently, Patent Owner argues, "[t]he history and adoption of relevant 3GPP standards demonstrates that" the 3GPP members "(1) originally adopted a solution ***other*** than that taught by the '718 patent, (2) when confronted with the '718 patent's solution, that solution met with disagreement and protest, and (3) only adopted the '718 patent's methods after much debate, uncertainty, [and] requests for more test results from LGE." *Id.* (citing Ex. 2006 ¶ 53).

Petitioner responds that the "near co-extensiveness" between claim 1 of the '718 patent and Philips46 renders claim 1 obvious. Pet. Reply 2–4. Petitioner also argues that, "as of the priority date of the '718 patent[,] there was extensive industry analysis underway evaluating ways to accurately convey CQI representations by providing the requisite level of protection for the various bits representing that CQI," an example of which is found in Philips46. *Id.* at 4 (citing Ex. 1001, 7:33–34; Ex. 1004, 1; Ex. 1002 ¶¶ 96, 99, 114, 182). One of ordinary skill, Petitioner contends, would have

understood that Philips46 provides "significant extra protection" to the MSB by repeating it an additional three times in the resulting codeword, and "a little more robustness to the second most significant bit" by representing it one additional time in the codeword. *Id.* (citing Ex. 1004, 1; Ex. 1002 ¶ 79). According to Petitioner, one of ordinary skill would have been motivated to modify Philips to provide "the most protection to the MSB," because it "would decrease the aggregate magnitude of transmission errors," and thus would have been motivated to switch the last two digits in the last row of the Philips46 table. *Id.* (citing Ex. 1002 ¶¶ 55–56, 91–93, 108; Inst. Dec. 19–20). "The benefits of providing additional protection to the MSB," Petitioner argues, were known to persons of ordinary skill. *Id.* (citing Ex. 1002 ¶¶ 91–92; Ex. 1023, 1:50–53; Ex. 1024, 10–11).

Petitioner also argues that "[t]he '718 patent does not claim or describe any throughput advantages commensurate in scope with the claimed process." Pet. Reply 5. According to Petitioner, "the '718 patent provides no evidence as to what this throughput is, the extent of the difference (if any) of throughput between the '718 patent's basis sequence and the prior art, or linking of throughput to anything in the claims." *Id.* at 5–6. Additionally, Petitioner asserts, "[t]he '718 patent does not describe how its claimed matrix of basis sequences provides any change in throughput," and "provides no evidence that any throughput differences between Philips46 and the claimed basis sequences matters." *Id.* at 7. Indeed, according to Petitioner, "Dr. Smith was unable to explain how the alleged comparisons" of throughput between base sequences "could have been calculated." *Id.* at 8 (citing Ex. 1032, 52:1–13). Thus, Petitioner contends, "little to no weight can be placed on the unclaimed, undescribed,

and undiscernible 'throughput' argument that [Patent Owner] has put forth." *Id.*

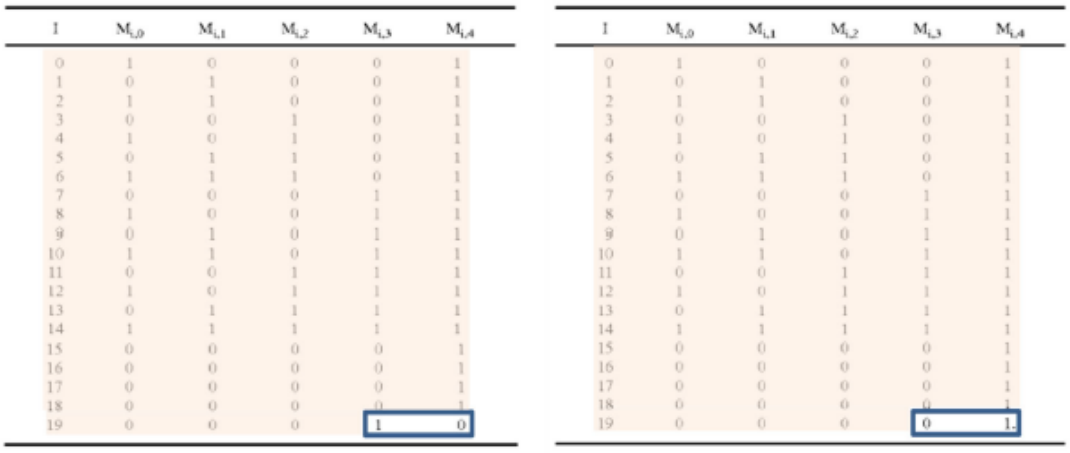
Additionally, Petitioner asserts, optimizing Philips46's base sequences "is nothing more than modifying a result effective variable to arrive at the optimal arrangement for providing the most protection for the MSB." *Id.* at 5–6 (citing Pet. 37–38). According to Petitioner, one of ordinary skill would have known that the selection of where to place the "1" in the 16^{th}-20^{th} rows of the basis sequence table "directly impacts which bit of the CQI information bits receives protection." *Id.* at 6 n.3. Thus, according to Petitioner, "the '718 patent simply is a modification to a readily optimizable parameter." *Id.* at 7.

Finally, Petitioner argues that Dr. Smith's "throughput" analysis "actually shows that the proposal in Philips46 provides better throughput using Dr. Smith's own metrics." Pet. Reply 9. Petitioner bases its argument on Figure 7 in Section 4.3 of LGE's TSGR1#24-02-0362 submission attached as Exhibit C to Dr. Smith's Supplemental Declaration. *Id.* at 9–11.

Patent Owner responds that Petitioner is mistaken that one of ordinary skill "could knowingly and reliably create or find an optimal CQI code by simply switching two digits in the tables" because "[t]he mathematical relationship between the basis sequences in the tables and their resulting codewords was not demonstrated until ***over a decade*** after the filing of the filing of the '718 patent." PO Sur-reply 4–5 (citing PO Resp. 33 (citing Ex. 2016 ¶ 15–28)). Patent Owner also takes issue with Petitioner's argument that Dr. Smith's analysis shows that Philips46 has better throughput than the LGE proposal embodied in the '718 patent. *Id.* at 5–11.

(2) Analysis

Based on the full trial record, we find that Petitioner has not proven by a preponderance of the evidence that claim 1 would have been obvious over Philips46. The parties agree that the table in limitation [1.6] is the same as the chart in Philips46 except for the last two bits of the last row, which are flip flopped as shown in Petitioner's figures below.



I	$M_{i,0}$	$M_{i,1}$	$M_{i,2}$	$M_{i,3}$	$M_{i,4}$
0	1	0	0	0	1
1	0	1	0	0	1
2	1	1	0	0	1
3	0	0	1	0	1
4	1	0	1	0	1
5	0	1	1	0	1
6	1	1	1	0	1
7	0	0	0	1	1
8	1	0	0	1	1
9	0	1	0	1	1
10	1	1	0	1	1
11	0	0	1	1	1
12	1	0	1	1	1
13	0	1	1	1	1
14	1	1	1	1	1
15	0	0	0	0	1
16	0	0	0	0	1
17	0	0	0	0	1
18	0	0	0	0	1
19	0	0	0	1	0

Prior Art

I	$M_{i,0}$	$M_{i,1}$	$M_{i,2}$	$M_{i,3}$	$M_{i,4}$
0	1	0	0	0	1
1	0	1	0	0	1
2	1	1	0	0	1
3	0	0	1	0	1
4	1	0	1	0	1
5	0	1	1	0	1
6	1	1	1	0	1
7	0	0	0	1	1
8	1	0	0	1	1
9	0	1	0	1	1
10	1	1	0	1	1
11	0	0	1	1	1
12	1	0	1	1	1
13	0	1	1	1	1
14	1	1	1	1	1
15	0	0	0	0	1
16	0	0	0	0	1
17	0	0	0	0	1
18	0	0	0	0	1
19	0	0	0	0	1

'718 patent

Pet. 2–3; PO Sur-reply 2. As Patent Owner explains, "[t]here is no—and has not been—any dispute between the parties that the two tables differ only in that the final digits of the rightmost two columns alternate digits." PO Sur-reply 2. Rather, "[t]he dispute lies in whether and how a [person of ordinary skill in the art] would have found it obvious to make this alteration." *Id.* We discuss below Petitioner's arguments as to why it would have been obvious for one of ordinary skill to make this change, and why we do not find those arguments to be persuasive.

First, we find that Petitioner has not sufficiently shown that one of ordinary skill would have been motivated to swap the last two bits in the last

row of the Philips46 table in order to provide more protection to the most significant bit (MSB). Even if we were to agree with Petitioner that one of ordinary skill would have understood that swapping the last two bits would have provided more protection to the MSB, Petitioner has not sufficiently shown that one of ordinary skill would have believed that such a change would be desirable. Patent Owner introduces evidence from Dr. Smith and the '781 patent that there was "a tradeoff between BER and RMS error" and that "efforts to minimize RMS error and to minimize BER produce conflicting and incompatible results." Ex. 1001, 11:38–44; Ex. 2006 ¶¶ 13, 43. These conflicting results are supported by the '718 patent specification's comparison of various codes (represented by C1, C2, embodiment 2, and embodiment 3), which found that the embodiment that had the best BER performance (C1) had the worst RMS error performance, and the embodiment with the best RMS error performance (embodiment 3) had the worst BER performance. Ex. 1001, 11:48–51, 11:58–61. We also find credible Dr. Smith's testimony that "[a]dding all protection to ***just*** the MSB ***removes*** protection for ***all*** other bits," which would be expected to reduce BER performance. Ex. 2006 ¶ 16.

Additionally, we rely on and find credible Dr. Smith's testimony that the early proposals to 3GPP in January 2002 for selecting the optimal CQI coding scheme "were significant departures into unknown territory in the field" with "several new types of codes ha[ving] been proposed, with the mathematical relationship between them being unknown." Ex. 2006 ¶ 48. Dr. Smith's testimony is supported by his explanation that this mathematical relationship remained unknown until 2016, when the paper "Rademacher Functions and Their Applications to 3GPP Mobile Communications

Systems" was published. *Id.* ¶¶ 26, 48, Ex. H. Additionally, Dr. Smith supports his testimony by explaining that "the only coding textbook referenced in the 3GPP T docs with respect to the CQI codes" is a 1983 textbook by Lin and Costello which only discusses Reed-Muller codes (like the basic (20, 5) code) "in passing in half a page," and does not discuss extended codes, unequal error protection, or RMS error as used by the 3GPP. *Id.* ¶ 48.

We also agree with Patent Owner that the nonobviousness of claim 1 is supported by the history of the 3GPP proceedings discussing which CQI coding scheme to use in the standard. This history shows that, prior to the critical date, there existed in the field significant uncertainty and disagreement about what CQI coding scheme would be best and what criteria should be used to evaluate the different schemes. The 3GPP history and various submissions will be discussed further below.

As Dr. Smith testifies, in late 2001 and early 2002, 3GPP received five different proposals, including papers from Ericsson, Nokia, Samsung, and Philips. Ex. 2006 ¶ 31. Specifically, Ericsson submitted a proposal (R1-01-1144) at the November 19–23, 2001, 3GPP meeting in Cheju, Korea, to extend the (16, 5) bi-orthogonal code already used for TFCI coding to a (20, 5) code "with each word extended with the four least reliable information bits" for "the channel-quality-related information." Ex. 1022, 1; Ex. 2006 ¶ 32. This proposal, Ericsson explained, "is designed for optimal minimal distance." Ex. 1002 ¶ 49; Ex. 1022, 1; Ex. 1001, 5:65–6:36. "Distance, often referred to as 'Hamming distance' compares the difference between two resulting codewords," and "[t]he 'minimum distance' is the

minimum value of the Hamming distance, over all possible pairs of codewords." Ex. 1002 ¶ 50.

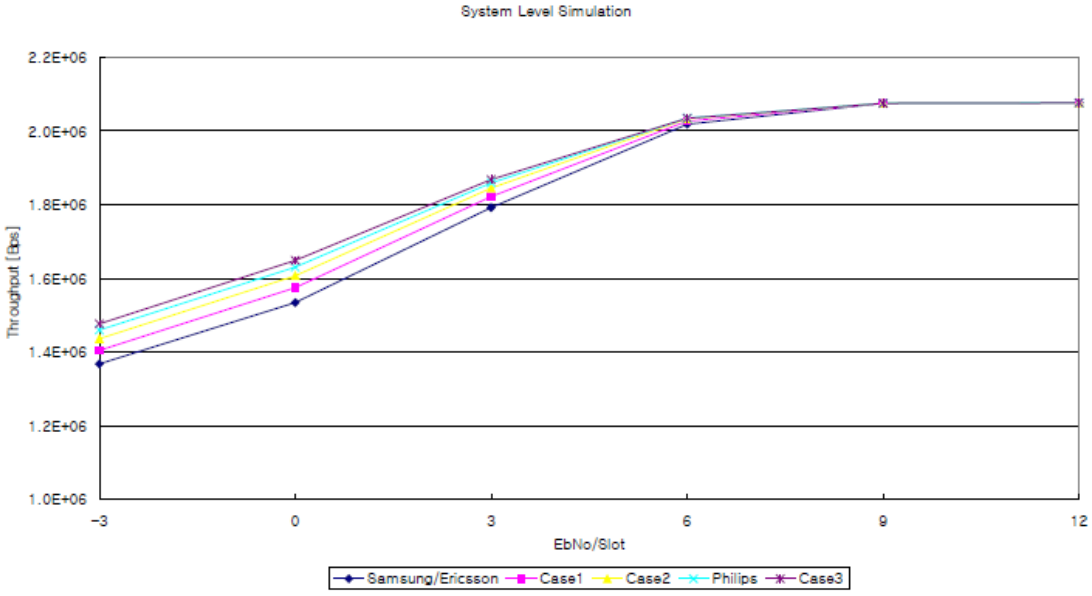
Samsung submitted a proposal (R1-01-1324) at the November meeting that involved reusing the (32,10) TFCI coding scheme in the current 3GPP specification for CQI, using only the first five bases sequence (resulting in a (32,5) code), and applying a particular puncturing pattern, to arrive at a (20,5) code. Ex. 1013, 1–2. Samsung explained that "reusing the existing code is [more] important than the performance of the coding scheme," but also noted that its proposal optimized performance because "[g]enerally, the performance of the block coding scheme is decided by the minimum distance." *Id.* at 2. Samsung also noted that its proposal had an optimum minimum distance of 9 for each bit size from one to five, unlike Ericsson's proposal, where the minimum distance increased when a code size of fewer than five bits was used. *Id.* at 2–3.

At the next 3GPP meeting from January 8–11, 2002, in Espoo, Finland, Philips made the proposal reflected in Philips46. Ex. 1004. Philips explained that "[a]s well as maximising minimum distance, it is also desirable that if possible the most significant bits of the data are better protected than the least significant bits," which "would reduce the probability that transmission errors would result in large errors in the received channel quality value." *Id.* at 1. Philips46 explains that its proposal "gives significant extra protection to the MSB, and a little more robustness to the next most significant bit." *Id.* Additionally, Philips submitted a graph showing that its proposal had a lower RMS error than the Ericsson and Samsung proposals. *Id.* at 2–3.

At the January meeting, Samsung presented a paper comparing the Philips proposal to Samsung's proposal. Ex. 2006, Ex. C, R1-02-0164; Ex. 1006, 21. The paper presented a simulation showing that "the BER performance of the [Samsung proposal] is better than that of the [Philips proposal]," and thus "the comparison shown in [the Philips paper] is not fair and hence it is expected that there will be no realistic gain from the [Philips proposal]." R1-02-0164, 1. Accordingly, Samsung recommended that its proposal be adopted. *Id.* The meeting notes state that "Philips seemed to disagree with [Samsung's] proposal." Ex. 1006, 21. Nokia also expressed the view that "[b]ased on the contributions seen so far," Samsung's proposal "looks most promising" and "is proposed to be added into" the standard. Ex. 1021, 2; Ex. 1006, 20.

At the next meeting on February 18–22, 2002, in Orlando, Florida, LGE presented a paper (TSGR1#24-02-0362) proposing the (20,5) coding scheme recited in claim 1 of the '718 patent, which was described as "Case 3." Ex. 2006 ¶¶ 38–42, Ex. C, TSGR1#24-02-0362, 3. The LGE paper compared the Ericsson, Samsung, and Philips proposals "with respect to BER performance, unequal error protection (RMS error reduction)[,] and system throughput." Ex. 2006, Ex. C, TSGR1#24-02-0362, 1. The paper noted that these "coding schemes have tradeoffs between BER and unequal error protection" and, "[i]n order for [a] fair comparison, it seems reasonable to consider the system throughput as one criteria." *Id.* The paper found that the Ericsson and Samsung proposals performed the best with respect to BER, but worst with respect to RMS (unequal error protection) and system throughput. *Id.* at 4–5. The Philips proposal did not perform best on any measure, but was second best at RMS and system throughput. *Id.* The LGE

approach that is the subject of claim 1 of the '718 patent (Case 3) performed best on system throughput and unequal error protection, but worst in BER. The paper presented the following graph in Figure 7 comparing the proposals' performance with respect to system throughput:



<Fig 7> System Level Simulation Results of CQI coding schemes

Id. at 5. The paper concluded by noting that "[f]rom [a] performance point of view, there is a trade off between BER and RMS error," but "it could desirable to use the system throughput as one of the criteria in order to select [an] optimum CQI coding scheme." *Id.*

The minutes from the February 2002 meeting report that LGE's proposal was discussed, and that "Samsung commented that they consider the Samsung proposal [to be] the best proposal" and had "some doubts on the simulation results presented in [LGE's] paper." Ex. 1007, 23. According to the minutes, "Philips supported this paper." *Id.* In the next meeting, from April 9–12 in Paris, LGE and Philips jointly submitted another paper "present[ing] additional simulation results" confirming that the LGE proposal "shows better throughput than any other cases," and

"propos[ing] that the basis sequence table for [LGE's proposal] be included for CQI coding in in TS." Ex. 2006, Ex. C, TSGR1#25-02-0653, 1, 4. According to Dr. Smith, 3GPP ultimately incorporated LGE's proposal into the standard, which Petitioner does not dispute. Ex. 2006 ¶ 55.

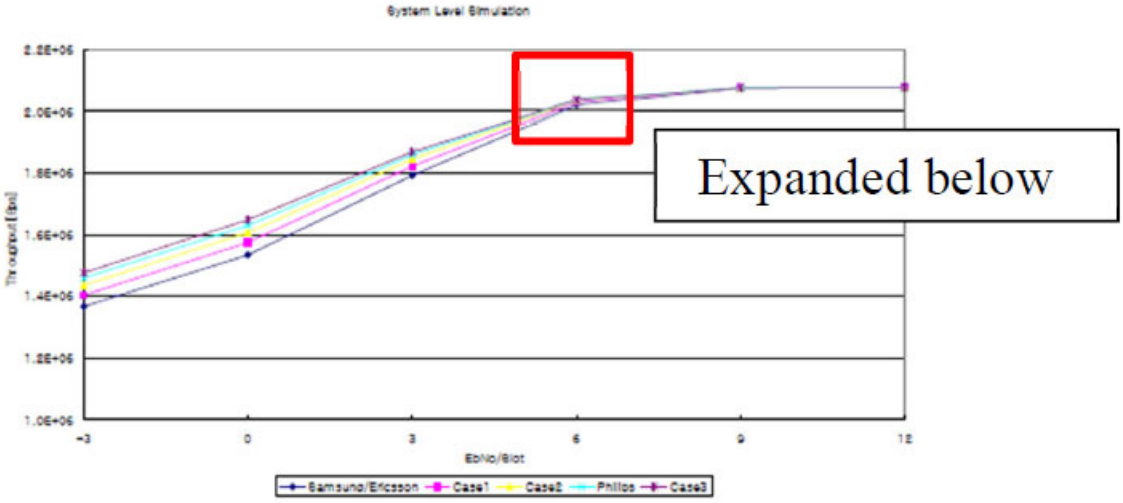
We find credible Dr. Smith's testimony that the 3GPP members who were participating in these discussions were experts in the field whose level of skill was well above the level of the person of ordinary skill in the art that we have adopted in this Decision (a person with a Bachelor's degree in electrical engineering, computer engineering, or a similar discipline with approximately two years of signal processing experience). Ex. 2006 ¶ 48. The 3GPP history shows that these experts had difficulty agreeing on what criteria to use and prioritize in coming up with a CQI coding scheme, with Samsung and Nokia focusing on reusing prior codes and BER, Philips focusing on RMS, and LGE focusing on system throughput. Indeed, even after LGE made its proposal, Samsung expressed doubts as to this proposal and considered its own proposal to be better, which further supports the conclusion that the benefits of LGE's proposal were not immediately obvious even to experts in the field. *See* Ex. 1007, 23.

Furthermore, the 3GPP history shows that the Philips46 proposal, upon which Petitioner focuses, was itself the subject of disagreement, with Samsung stating that Philips's simulation "is not fair" and there "will be no realistic gain" from it, and preferring their own proposal. Ex. 2006, Ex. C, R1-02-0164; Ex. 1006, 21. Nokia agreed with Samsung's approach, and there is no indication that Ericsson or LGE agreed with Philips's proposal. Ex. 1021, 2; Ex. 1006, 20–21. Moreover, even if one were to start with the Philips proposal, we find insufficient evidence that one of ordinary skill

would have been motivated to modify it to swap the last two bits of the last row of the table as Petitioner proposes, particularly in light of the 3GPP history. Despite Philips's recognition that it is beneficial to "give significant extra protection to the MSB," Philips did not propose doing so by swapping the last two bits of the last row, and there is no evidence that any of the other 3GPP members did so before LGE's proposal. And, as discussed above, credible evidence shows that the relationship between the CQI coding scheme and system performance was not well understood at the time. Ex. 2006 ¶¶ 28, 48–49. Thus, we find insufficient evidence that one of ordinary skill would have understood, prior to LGE's proposal, that swapping the last two digits of Philips46 "would decrease the aggregate magnitude of transmission errors" as Petitioner contends. Pet. Reply 4. We also find insufficient evidence that one of ordinary skill would have understood, at the relevant time, that the bits in the table were "result effective variables" that could be modified with readily predictable results on overall system performance. Pet. 37–38; Pet. Reply 5–6. And, even if Dr. Clark were correct that "there were a limited number of ways to extend the (16,5) TFCI basis sequences in a way that protects the MSBs better than the LSBs (*see* Ex. 1002 ¶¶ 114–115), the 3GPP history indicates that there was no consensus at the relevant time that this was the preferred approach that should be the focus of the 3GPP's efforts.

We also do not agree with Petitioner's argument that Philips46 actually provides better throughput than the '718 patent using Dr. Smith's metrics. Pet. Reply 9. Petitioner relies on Figure 7 in Section 4.3 of LGE's TSGR1#24-02-0362 submission, but Petitioner's argument points only to

the result at the value of 6 on the x-axis of the figure, as shown by the red box in Petitioner's annotated version of Figure 7 reproduced below.



<Fig 7> System Level Simulation Results of CQI coding schemes

At best, Petitioner's argument shows that the results at the value of 6 on the x-axis are nearly identical between the various approaches. However, Petitioner does not dispute that the LGE approach (Case3) shows an improvement as compared to the other approaches over the values of -3 to 3 on the graph. Pet. Reply 9–11. This is in line with TSGR1#24-02-0362 and TSGR1#25-02-0653 (running additional simulations), which both report that Case3 (the LGE proposal) produces the best throughput results. TSGR1#24-02-0362, 5; TSGR1#25-02-0653, 2–3. The fact that the difference between the approaches diminishes as one approaches a value of 6 on the x-axis does not detract from the evidence showing that, overall, the LGE approach had the best throughput results.

Finally, we are not persuaded by Petitioner's argument that "[t]he '718 patent does not claim or describe any throughput advantages commensurate in scope with the claimed process." Pet. Reply 5. The fact that claim 1 does not expressly mention throughput does not help

Petitioner's case. Philips46 does not disclose the table recited in claim 1 of the '718 patent and, as discussed above, Petitioner has failed to sufficiently show that one of ordinary skill would have been motivated to modify Philips46 to achieve the table in claim 1. Whether claim 1 expressly recites a throughput advantage is not material to this conclusion. As for the disclosures of throughput in the specification, we find that, as discussed above, the '718 specification, Dr. Smith's testimony, and the 3GPP submissions by LGE and LGE and Philips support a conclusion that the table in claim 1 achieves better throughput performance than the table in Philips46.

g) Summary for Claim 1

Based on the full trial record, Petitioner has not proven by a preponderance of the evidence that claim 1 would have been obvious over Philips46.

3. Independent Claims 15 and 19

Petitioner contends that independent claims 15 and 19 would have been obvious for the same reasons as independent claim 1. Pet. 50–51, 52–54. For the reasons discussed in Section II.D.2 above, we find that Petitioner has failed to prove by a preponderance of the evidence that claims 15 and 19 would have been obvious over Philips 46.

4. Dependent Claims 2, 4–5, and 16–18, and 20–23

Petitioner contends that dependent claims 2, 4–5, 16–18, and 20–23 would have been obvious over Philips46. Pet. 48–50, 51–52, 54–55. Because Petitioner has failed to prove obvious of independent claims 1, 15, and 19, Petitioner has necessarily failed to prove obviousness of dependent

claims 2, 4–5, 16–18, and 20–23, which depend from those independent claims.

E. Ground 2: Obviousness of Claims 6, 7, and 9–13 Based on Philips46 and Nokia

Petitioner contends that claims 6, 7, and 9–13 would have been obvious over the combination of Philips46 and Nokia. Pet. 29, 55–62. Patent Owner disagrees. PO Resp. 21–22.

1. Overview of Nokia (Ex. 1021)

Relying on the testimony of Mr. Bishop, Petitioner asserts that Nokia "is a TDoc titled 'Channel coding and error detection for uplink QI signaling' that was submitted to TSG-RAN WG1#23 for a meeting that took place in Espoo, Finland, on January 8th–11th, 2002." Pet. 34 (citing Ex. 1015 ¶¶ 87–90; Ex. 1002 ¶¶ 83–84). According to Petitioner and Mr. Bishop, "[o]n January 4, 2002, Nokia was distributed via the TSG RAN WG1 email list, and on January 6, 2002, it was also uploaded to the 3GPP public file repository." *Id.* (citing Ex. 1015 ¶¶ 87–90). Thus, Petitioner contends, Nokia was "publicly available as of January 4 and/or 6, 2002," and "provides evidence that the claimed subject matter was known by others in this country before any invention by the applicant." *Id.* at 34–35 (citing Ex. 1015 ¶ 90; Ex. 1002 ¶ 84). Patent Owner does not contest the prior art status of Nokia. *See* PO Resp. Based on the evidence of record, Petitioner has sufficiently established that Nokia qualifies as prior art.

Nokia describes a number of proposals for "channel coding and error detection for uplink quality indication (QI) signalling." Ex. 1021, 1. In one such proposal, Nokia describes the "[e]xtension of (16,5) TFCI code" "with each code word extended with the four least reliable information bits." *Id.*

2. The Philips46-Nokia Combination

Petitioner argues that Nokia was presented at the same meeting as Philips46 and specifically referenced in Philips 46. Pet. 55 (citing Ex. 1002 ¶¶ 74, 83, 185; Ex. 1004, 3). Petitioner contends that one of ordinary skill "would have been interested in the 'Previous contributions' referenced in the first sentence of Philips46 and would have been motivated to look at Nokia as background information, as specifically directed to by Philips46." *Id.* at 56 (citing Ex. 1004, 1; Ex. 1002 ¶ 185).

"In the proposed combination," Petitioner asserts, "the known (16,5) [code] is used to create a 16-bit codeword." Pet. 57 (citing Ex. 1002 ¶ 91). According to Petitioner, "Nokia confirms that, when appending additional bits, they are added to the end of the 16 coded bits from the bi-orthogonal (16,5) TFCI coding scheme." *Id.* (citing Ex. 1021, 1). Petitioner notes that, in Nokia, the appended bits are the four least reliable bits, but Philips46 states that it is "desirable . . . if possible [that] the most significant bits of the data are better protected than the least significant bits." *Id.* (citing Ex. 1021, 1; Ex. 1004, 1). Petitioner argues that, to accomplish this goal, one of ordinary skill "would have appended the MSB of data (a_4) of the information bits four times to provide the most protection possible to the MSB, instead of appending the four bits of Nokia." *Id.*

3. Analysis of Independent Claim 6

a) [6.1]: "[a] method of coding channel quality information (CQI), comprising the steps of:"

Petitioner asserts that, to the extent the preamble of claim 1 is limiting, Nokia discloses this limitation. Pet. 57. Petitioner asserts that "Nokia describes the use of a (16,5) TFCI code, which is used to code uplink quality indication information," and one of ordinary skill "would know this

quality information is channel quality information, or CQI." *Id.* (citing Ex. 1021, 1; Ex. 1002 ¶ 187). Petitioner further argues that "Philips46 confirms that the 3GPP was developing a method of coding channel quality information." *Id.* at 57–58.

Patent Owner does not present arguments regarding the preamble. *See* PO Resp. 22–23; PO Sur-reply 12–14.

We agree with Petitioner that the cited disclosures of Nokia teach a method of coding channel quality information (CQI), as recited in the preamble.

b) [6.2]: "providing information bits a_0, a_1, a_2, a_3, and a_4;"

Petitioner argues that "Nokia states that four or five information bits are assumed," and that one of ordinary skill "would know that, when a (16,5) code is used, there would be five bits provided." Pet. 58 (citing Ex. 1021, 1; Ex. 1002 ¶ 188). For example, Petitioner argues, "in the '5 bits TFCI case, the default TFCI coding scheme use the only 5 bases, say, $M_{0,i}$, $M_{1,i}$, $M_{2,i}$, $M_{3,i}$, $M_{4,i}$.'" *Id.* (citing Ex. 1021, 1). "Further," Petitioner asserts, "Philips46 confirms five information bits, a_0, a_1, a_2, a_3, and a_4, were contemplated by 3GPP." *Id.*

Patent Owner does not present arguments regarding this limitation. *See* PO Resp. 22–23; PO Sur-reply 12–14.

We agree with Petitioner that Nokia and Philips46 teach this limitation. Specifically, we agree that these references disclose providing information bits a_0, a_1, a_2, a_3, and a_4, where a_0 is the least significant bit and a_4 is the most significant bit.

c) *[6.3]: "providing five basis sequences $M_{i,n}$ for a (20,5) TFCI code;"*

Petitioner argues that both Philips and Nokia disclose the use of five basis sequences, and that one of ordinary skill would have found it obvious to provide five basis sequences when encoding five information bits. Pet. 58 (citing Ex. 1004, 1; 1021, 1; Ex. 1002 ¶ 189).

Patent Owner does not present arguments regarding this limitation. *See* PO Resp. 22–23; PO Sur-reply 12–14.

We agree with Petitioner that Nokia and Philips46 teach this limitation. Specifically, we agree that these references disclose providing five basis sequences $M_{i,n}$ for a (20,5) TFCI code.

d) *[6.4]: "encoding the information bits by combining the information bits with the basis sequences;"*

Petitioner argues that "Nokia depicts the encoding of n information bits using the (16,5) code" in Nokia's Figure 1, and that this figure "is similar to what is depicted in Figure 4 of the '718 patent." Pet. 59 (citing Ex. 1021, 1, Fig. 1; Ex. 1001, Fig. 4). Petitioner asserts that "Philips46 also confirms that 3GPP was working on encoding CQI information bits using codes comprising basis sequences." *Id.* According to Petitioner, one of ordinary skill "would understand that this combination occurs through a multiplication of the (1,5) vector of information bits by the (16,5) matrix of the code, resulting in 16 coded bits." *Id.* (citing Ex. 1002 ¶¶ 42–47, 90, 190–191).

Patent Owner does not present arguments regarding this limitation. *See* PO Resp. 22–23; PO Sur-reply 12–14.

We agree with Petitioner that Nokia and Philips46 teach this limitation. Specifically, we agree that these references disclose encoding information bits by combining them with the basis sequences.

e) [6.5]: "generating an intermediate codeword;"

Petitioner argues that "Nokia generates a 16-bit codeword (i.e., an intermediate codeword that is subsequently acted upon to form the 20-bit codeword of the next element) from the encoding described above." Pet. 59 (citing Ex. 1021, 1, Fig. 1; Ex. 1002 ¶¶ 192–193).

Patent Owner does not present arguments regarding this limitation. *See* PO Resp. 22–23; PO Sur-reply 12–14.

We agree with Petitioner that Nokia teaches this limitation. Specifically, we agree that Nokia discloses generating an intermediate 16-bit codeword that is subsequently acted on to form a 20-bit codeword.

f) [6.6]: "adding a further bit repeated four times to generate a 20-bit codeword."

Petitioner argues that "Nokia states that the created 16-bit intermediate codeword is 'extended with the four least reliable information bits.'" Pet. 60 (citing Ex. 1021, 1). Because "Nokia explicitly states [that] four bits are added to the intermediate codeword," Petitioner asserts, one of ordinary skill in the art "would know that, in at least some instances, these four bits would be the same bit, such that in those instances, a single bit repeated four times would be added." *Id.* (citing Ex. 1002 ¶¶ 63, 194). According to Petitioner, "[t]his element does not specify what bit is added, only that an additional bit is added," which is supported by the fact that "claim 9 requires 'the further bit repeated four times is one of the information bits,' meaning that for this claim, only a bit need be appended,

not tied to any specific information bit or other origin." *Id.* "Nevertheless," Petitioner contends, "as noted in Nokia, the information bits that are explicitly added are the first four bits from the five information bits." *Id.* (citing Ex. 1021, 1). Dr. Clark further testifies that one of ordinary skill would "understand that extending the intermediate codeword, generated from the (16,5) TFCI code, could be accomplished by repeating row 15 to generate a 20-bit codeword," and that it would have been obvious to do so. Ex. 1002 ¶ 194.

Based on these disclosures, and relying on Dr. Clark, Petitioner argues, one of ordinary skill in the art "would find this element disclosed by Nokia, or at a minimum rendered obvious by Nokia," and thus that this claim would have been obvious based on the combination of Philips46 and Nokia. Pet. 60 (citing Ex. 1002 ¶ 194).

Patent Owner argues that Nokia does not "disclose adding ***the same bit***, (i.e., 'a further bit ***repeated***,') four times to a codeword, as is disclosed by the '718 patent," but instead discloses that "a codeword is 'extended with the four least reliable ***information bits***'" a_0, a_1, a_2, a_3, and a_4. PO Resp. 21–22 (citing Pet. 60; Ex. 2006 ¶ 57; Ex. 1021, 1). "However," according to Patent Owner, claim 6 discloses "repeating only one of the information bits four times." *Id.* at 22. Thus, Patent Owner asserts, "Nokia does not disclose the claimed bit being 'repeated four times to generate a 20-bit codeword,' but merely extending a codeword by adding 'the four least reliable information bits.'" *Id.* at 22 (citing Ex. 1001, claim 6; Ex. 1021, 1). According to Patent Owner, "Petitioner's assertion that there may be a circumstance where Nokia identifies the four least reliable information bits and those bits happen to be identical misses the mark" because "the methods

of Nokia and the '718 patent fundamentally differ," and Petitioner has provided no basis for why one of ordinary skill "would find it obvious to make the leap from Nokia's method of repeating the four least reliable bits to the '718 patent's method of repeating a single information bit four times." *Id.*

Petitioner responds that "the combination, as proposed, is based on the information on the face of Philips46 itself." Pet. Reply 13. Petitioner acknowledges that "[i]n Nokia, the appended bits are the 'four least reliable information bits," but argues that Philips46 discloses that "it is also desirable that if possible the most significant bits of the data are better protected than the least significant bits." *Id.* (citing Ex. 1021, 1; 1004, 1). "To accomplish this stated goal of providing protection to the most significant bits," according to Petitioner, one of ordinary skill "would have appended the MSB of data (a_4) of the information bits four times to the resulting codeword of Nokia to provide the most protection possible to the MSB, instead of appending the four bits suggested by Nokia." *Id.* at 13–14. Petitioner asserts that this "results in the same 20 bit codeword that would result from the modification to Philips46" discussed in connection with Ground 1. *Id.* at 14.

Patent Owner responds that Petitioner's arguments for Ground 2 suffer from the same issues as those for Ground 1, namely that one of ordinary skill "at the time of the invention engaging in MSB protection would encounter the very same dilemma encountered by 3GPP: attempts to optimize BER comes at the cost of RMS error metrics and vice versa." PO Sur-reply 12–13 (citing Ex. 2006 ¶ 41).

At the hearing, Petitioner's counsel acknowledged that, for claim 6, it is raising "the same argument, the same issue as is raised on claim 1." Tr. 23:11–12. As Petitioner's counsel explained, "[c]laim 1 provides you with a specific recitation of what the basis sequences are but the verbal recitation" in claim 6 "adding a further bit repeated four times to generate a 20-bit codeword boils down to that same fact." *Id.* at 23:12–15. "[T]hus," according to Petitioner, "we don't believe that claim 6 is patentable for the same reasons that we believe that claim 1 is unpatentable." *Id.* at 23:23–25.

As Petitioner acknowledged at the hearing, Petitioner's argument for this element of claim 6 hinges on the same arguments Petitioner made for why one of ordinary skill would have been motivated to swap the last two bits of the last row of Philips46. For the reasons discussed in Section II.D.2(f) above, we find that Petitioner has failed to prove by a preponderance of the evidence that one of ordinary skill would have been motivated to modify Philips46 as proposed. We also agree with Patent Owner that Nokia does not disclose repeating one of the information bits four times, as claim 6 requires, but rather discloses that each codeword is "extended with the four least reliable information bits." Ex. 1021, 1. Finally, we agree with Patent Owner that and that Petitioner has not sufficiently shown that one of ordinary skill would have found it obvious to alter Nokia's method of repeating the four least reliable bits in order to achieve the '718 patent's method of repeating a single information bit four times. PO Resp. 22.

g) Summary for Claim 6

Based on the full trial record, Petitioner has not proven by a preponderance of the evidence that claim 6 would have been obvious over Philips6 and Nokia.

4. Claims 7 and 9–13

Petitioner contends that dependent claims 7 and 9–13 would have been obvious over Philips46 and Nokia. Pet. 61–62. Because Petitioner has failed to prove obvious of independent claim 6, Petitioner has necessarily failed to prove obviousness of dependent claims 7 and 9–13, which depend from independent claim 6.

III. CONCLUSION

For the reasons discussed above, Petitioner has not proven, by a preponderance of the evidence, that any of the challenged claims are unpatentable, as summarized in the following table:

Claim(s)	**35 U.S.C. §**	**Reference(s)/Basis**	**Claims Shown Unpatentable**	**Claims Not Shown Unpatentable**
1, 2, 4, 5, 15–23	103(a)	Philips46		1, 2, 4, 5, 15–23
6, 7, 9–13	103(a)	Philips46, Nokia		6, 7, 9–13
Overall Outcome				1, 2, 4–7, 9–13, 15–23

IV. ORDER

Accordingly, it is

ORDERED that claims 1, 2, 4–7, 9–13, 15–23 of the ’718 patent have not been shown to be 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.

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