

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD. AND
SAMSUNG ELECTRONICS AMERICA, INC.,

Petitioners,

v.

APEX BEAM TECHNOLOGIES LLC,

Patent Owner.

Patent No. 10,951,271
Filing Date: June 27, 2019
Issue Date: March 16, 2021

Inventor: Xiaobo Zhang
Title: METHOD AND DEVICE FOR
MULTI-ANTENNA TRANSMISSION IN UE AND BASE STATION

PATENT OWNER'S RESPONSE

Case No. IPR2023-00571

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EXHIBIT LIST

Exhibit No.	Description of Document
2001	Defendants' Patent L.R. 3-3 Invalidity Contentions and Subject Matter Ineligibility Contentions, <i>Apex Beam Technologies LLC v. Samsung Electronics Co., Ltd. et al.</i> , Case No. 2:22-cv-00188-JRG, served March 2, 2023
2002	Order Denying Motion to Stay Pending <i>Inter Partes</i> Review, Dkt. 55, <i>Apex Beam Technologies LLC v. Samsung Electronics Co., Ltd., et al.</i> , Case No. 2:22-cv-00188-JRG (E.D. Tex. June 14, 2023)
2003	Redline Comparison of the Declaration of Apostolos Kakaes, Ph.D. (Ex. 1003) to the Petition
2004	Declaration of Miguel Gomez ("Gomez Decl."), dated February 6, 2024 and Exhibit A, Curriculum Vitae of Miguel Gomez
2005	Deposition of Apostolos Kakaes, taken in <i>Samsung Elecs. Co., Ltd. and Samsung Elecs. America, Inc. v. Apex Beam Techs. LLC</i> , IPR2023-00571 and IPR2023-00747, on January 18, 2024 ("Kakaes Depo.")
2006	Excerpts from Steven M. Kaplan, Wiley Electrical and Electronics Engineering Dictionary (2004)

I. INTRODUCTION

The Board should issue a Final Written Decision finding Claims 1-20 (the “Challenged Claims”) of U.S. Patent No. 10,951,271 (Ex. 1001, the “’271 Patent”) not unpatentable because Samsung Electronics Co., Ltd. and Samsung Electronics America, Inc. (collectively, “Petitioner” or “Samsung”) fails to show that the Challenged Claims are obvious over the combination of International Publication WO 2016/015307 to Liu et al. (“Liu”) (Ex. 1006) and International Publication WO 2016/126099 to Park et al. (“Park”) (Ex. 1009).

Petitioner does not assert any grounds of anticipation but asserts one ground of obviousness. However, the combination of Liu and Park does not teach key claim elements of the ’271 Patent’s Challenged Claims, such as “wherein, K antenna port groups of the base station are used to transmit the first wireless signal; the K is a positive integer greater than 1,” “the first signaling is used by the UE to determine the K antenna port groups transmitting the first wireless signal received by the UE,” “the K antenna port groups respectively correspond to K channel quality values; the K channel quality values are K non-negative real numbers; the K channel quality values are Reference Signal Received Powers (RSRPs) or a Signal to Interference plus Noise Ratios (SINRs),” “K1 antenna port groups of the K antenna port groups correspond to K1 channel quality values of the K channel quality values,” “a first proportional sequence corresponds to a ratio (ratios) among the K1 channel quality

values,” and “transmitting, by the UE, first information to the base station; the first information is used to determine the K1 antenna port groups and the first proportional sequence.”

Petitioner also (i) incorrectly construes “K antenna port groups of the base station are used to transmit the first wireless signal” to read out the fact that at least 2 groups of antennas of the base station are collectively responsible for transmitting the claimed first radio signal; and (ii) incorrectly construes “proportional sequence corresponds to a ratio (ratios) among the K1 channel quality values” to eliminate the creation of a sequence of K1 proportions between channel quality values. A proper construction of these terms would not allow a person of ordinary skill in the art to render obvious the Challenged Claims.

Patent Owner respectfully submits that Petitioner’s deficient arguments, Patent Owner’s arguments presented herein, and the additional evidence submitted herewith, such as the Declaration of Miguel Gomez, and the deposition testimony of Dr. Apostolos Kakaes, demonstrate that the Challenged Claims are patentable. Accordingly, the Board should issue a Final Written Decision finding all of the Challenged Claims of the ’271 Patent not unpatentable.

II. THE ’271 PATENT

The ’271 Patent discloses and claims “a scheme for multi-antenna transmission in a wireless communication system.” ’271 Patent, at 1:18-19.

The '271 Patent describes why such a scheme is necessary in view of the “urgent problem” of “how to use the information reported by the UE to form the best beam to serve the UE service” where there are a limited number of beams for beam scanning and number of beams reported, as in the prior art:

[T]he base station can perform beam scanning over a period of time resources. The UE selects and reports the beam. However, due to the limitation of air interface resources, the number of beams used for beam scanning and the number of beams reported by the UE are limited. In addition, due to the uncertainty of the UE location, the beam used for beam scanning does not necessarily include the beam that best serves the UE. How to use the information reported by the UE to form the best beam to serve the UE service is an urgent problem to be solved.

Id. at 1:40-50.

The '271 Patent claims address the aforementioned problem and provide the following advantage:

[T]he advantage of the foregoing method is that the base station may obtain a proportional relationship among reception qualities corresponding to multiple beams, and may generate a more accurate serving beam for the UE according to the proportional relationship, thereby improving transmission quality.

Id. at 2:17-23.

As one example of the advantageous claims, the '271 Patent describes that a first signaling originating from a base station can, in one embodiment of the subject patent specification, comprise quasi-co-located (QCL) information. The UE uses

this information to determine K antenna port groups that transmit a wireless signal:

In one embodiment, the first signaling is used to determine the co-located or QCL information.

In one embodiment, the first signaling explicitly indicates the co-located or QCL information.

In one embodiment, the first signaling implicitly indicates the co-located or QCL information.

Id., 6:44-49.

Another aspect of the claimed invention is “a first proportional sequence [that] corresponds to a ratio(ratios) among the K1 channel quality values” and one example of a channel quality value is a Reference Signal Received Power (RSRP). *Id.*, Claim 1. The '271 Patent utilizes channel quality values of RSRP that would create a proportion of one RSRP to all the other RSRPs in the K1 subset of antenna port groups to create a proportional sequence:

In one embodiment, the first proportional sequence includes K1-1 positive real number(s). The K1-1 positive real numbers is(are) a ratio(s) between the channel quality values other than the best channel quality value of the K1 channel quality values and the best channel quality value.

In one embodiment, the first proportional sequence is composed of quantized values corresponding to the K1-1 positive real number(s).

Id., 4:29-36.

In another embodiment, the '271 Patent describes that the claimed sequence consists of the proportions of one RSRP to all the other RSRPs in the K1 subset of antenna port groups. For example, where K1 is equal to 2, the proportional sequence would consist of two values: {1 (the ratio of the first channel quality with itself), the ratio of the second channel quality and the first channel quality}:

The UE receives the first signaling to determine that K1 is equal to 2. The first antenna port group and the second antenna port group are two antenna port groups of the K antenna port groups. The first antenna port group corresponds to the first channel quality. The second antenna port group is corresponding to the second channel quality. The first channel quality is a best channel quality value of the K channel quality values. The second channel quality is a second best channel quality value of the K channel quality values. The UE reports {the first antenna port group, the second antenna port group, and the first proportional sequence} to the base station. ***The first proportional sequence is composed of 1, ratio of the second channel quality and the first channel quality.***

Id. at 24:18-31¹.

In another embodiment, the '271 Patent also describes a first signaling is used to determine a target threshold, so as to compare a ratio between the second channel quality and first channel quality to the target threshold. *Id.*, Claim 1.

¹ Emphasis added unless otherwise added.

III. THE ALLEGED PRIOR ART

A. Liu

Liu “relates to the field of telecommunications technology and in particular to a signal transmission method and an associated device.” Ex. 1006, 1.

Despite disclosing antenna port groups generally in other contexts (*id.*, 16), Liu discloses that only singular antenna ports transmit wireless signals. Liu states as follows:

Refer to FIG. 6, which is a structural diagram of a second network device provided by an embodiment of the present invention; the second network device 2000 comprises:

a transmitting unit 21, which is for *transmitting signals of M antenna ports* to a first network device, where M is a positive integer.

During antenna configuration, the transmitting unit 21 transmits configuration information of M antenna ports to a first network device and *transmits signals of M antenna ports* to a first network device, which *receives the signals of the M antenna ports* transmitted by the transmitting unit 21 based on the configuration information, where M is a positive integer[.]

Id., 32. Accordingly, Liu discloses a one-to-one mapping of ports to signals.

Liu also explains that any first signaling in Liu is limited to the antenna configuration information which is used by the UE to determine *M antenna ports*, and not antenna port groups:

During antenna configuration, the second network device

transmits configuration information *of M antenna ports* to the first network device and *transmits signals of the M antenna ports* to the first network device.

Id., 23, 25. See also *id.* at 32.

Additionally, Liu describes that “[i]n yet another implementation, the first criterion is codebook information; for example, the M antenna ports are divided into X groups, and the base station individually configures *one codebook set for each antenna port group.*” *Id.*, 21. Liu further describes that [c]odebook information refers to information containing multiple precoding matrices that are individually configured at the base station for each antenna configuration, but *configuration* is not a base station *transmission* of a first wireless signal:

[T]he base station individually configures one codebook set for each antenna port group. The user equipment calculates the SNR based on the configured codebook set and feeds it back to the base station equipment. For example, the first group of antenna ports corresponds to antenna configuration 1, comprising antenna ports port0 and port1; the base station configures codebook set C1 for antenna configuration 1, and the precoding matrices included in C1 are W_{11} , W_{12} , W_{1n} , . . . , W_{1N} ;

Id.

Liu also describes that “the user equipment . . . uses all the codebooks [] to conduct random beamforming” for those antenna configurations.

[F]or example, the user equipment at the pilot frequency of antenna configuration 1 uses all the codebooks in C1 to conduct random beamforming and obtain RSRP1; for the

pilot frequency of antenna configuration 2, all the codebooks in C2 are used to conduct random beamforming and obtain RSRP2, . . . ; and UE feeds back the index corresponding to the antenna configuration having the largest RSRP to the base station.

Id., 21-22.

Liu describes that, even if “each piece of configuration information correspond[ed] to the configuration of one of the antenna port groups,” the first network device of Liu would receive signals of M antenna ports transmitted by a second network device:

[S]tep S101: a first network device ***receives signals of M antenna ports*** transmitted by a second network device, where M is a positive integer.

During antenna configuration, a second network device transmits configuration information of M antenna ports to a first network device and transmits signals of the M antenna ports to the first network device, which receives the ***signals of the M antenna ports transmitted*** by the second network device based on the configuration information, where M is a positive integer

It is possible that the second network device transmits only one piece of configuration information to the first network device, wherein the ***configuration information is the configuration information of the M antenna ports***; alternatively, that the M antenna ports are divided into multiple groups, and transmission to the first network device takes the form of ***multiple pieces of configuration information, with each piece of configuration information corresponding to the configuration of one of the antenna port groups***.

Id., 15-16.

Liu describes that “M antenna ports are divided into multiple groups” from which “each piece of configuration information correspond[s] to the configuration of one of the antenna port groups.” *Id.*, 16. The only other division in *Liu* is from those individual M antenna ports into individual N antenna ports, where N is an integer less than or equal to M. *Id.*

B. Park

Park “relates to a wireless communication system, and more particularly to a method for feeding back CSI from a terminal based on a reference signal and an apparatus supporting the same.” Ex. 1009 at [1].

In one embodiment, Park describes that differences in RSRP can be expressed as a ratio:

Thus, the RSRP of a maximum of L antenna ports, which have an ***RSRP difference greater than a certain threshold value expressed as an RSRP ratio*** or dB scale, is reported as follows.

[Equation 13]

$$\text{RSRP}(r,m) - \max(\text{RSRP}(r,m)) > \text{Threshold}$$

...

In other words, the UE reports ***if the difference between RSRPs, expressed as an RSRP ratio*** or on a dB scale, exceeds a certain threshold value. . . .

...

If the UE has been configured to report the RSRP of an antenna port having an RSRP within 5 dB of the antenna port with the greatest RSRP, then because antenna port 13

has the greatest RSRP of 40 dB as shown in FIG. 12, the UE reports antenna ports with an RSRP over 35 dB.

Id., [372]-[378]. *Park* does not disclose creating a proportional sequence of RSRP ratios with each of the other channel quality values that are not the maximum RSRP among the total channel quality values.

Park also discusses creating RSRP ratios for “a maximum of L antenna ports,” instead of RSRP ratios for a subset of the total antenna port groups. *See id.*, [372].

IV. LEVEL OF ORDINARY SKILL IN THE ART

In its Preliminary Response, Patent Owner utilized Petitioner’s proposed level of skill in the art— a person of ordinary skill in the art (“POSITA”) would have had “at least a master’s degree in electrical engineering or a similar field and at least two years of experience working with telecommunications systems, including multiple-input multiple-output (‘MIMO’) technology” and that “[a]dditional relevant work experience can compensate for less education, and *vice versa*.” Pet. at 9. The Board noted that “Petitioner’s last sentence regarding additional relevant work experience compensating for less education and *vice versa*, [] is vague.” Decision Granting Institution, Paper No. 10, (P.T.A.B. Nov. 13., 2023) (“Inst.”) at 10; Ex. 2004, ¶ 20. In view of the Board’s guidance, Patent Owner proposes that a POSITA would have had either (i) at least a master’s degree in electrical engineering or a similar field and at least two years of experience working with telecommunications systems; or (ii) at

least a bachelor's degree in electrical engineering or a similar field and at least five years of experience working with telecommunications systems. Ex. 2004, ¶ 20.

V. CLAIM CONSTRUCTION

37 C.F.R. § 42.104 governs the required content of the petition. 37 C.F.R. § 42.104(b)(3) specifically requires the Petitioner to point out “[h]ow the challenged claim is to be construed” and also “[w]here the claim to be construed contains a means-plus-function or step-plus-function limitation as permitted under 35 U.S.C. § 112(f), the construction of the claim must identify the specific portions of the specification that describe the structure, material, or acts corresponding to each claimed function.” 37 C.F.R. § 42.104(b)(3).

A. **“K antenna port groups of the base station are used to transmit the first wireless signal”**

Patent Owner proposes the following claim construction: “K antenna port groups of the base station are used to transmit the first wireless signal” should be construed to mean “K groups of antenna ports of the base station are used to collectively transmit the first wireless signal.” Ex. 2004, ¶ 27. Despite the parties not proposing any claim constructions during the Institution phase, Petitioner has apparently improperly construed “K antenna port groups of the base station are used to transmit the first wireless signal” to read out the fact that at least 2 groups of antennas of the base station are collectively responsible for transmitting the claimed

first radio signal. *See infra* Section VII.A.1; *id.*

As a preliminary matter, a POSITA would understand from the explicit language of Claim 1 that “an antenna port group is a group of antenna ports,” while antenna port groups are “more than one antenna port group,” which comports with the plain and ordinary meaning of “group” identified by Wiley Electrical and Electronics Engineering Dictionary:

group:

1. *A collection* of things. Such a collection is usually located together, and/or *regarded as a unit*. For example, a family of chemical elements with similar properties arranged vertically within a periodic table.
2. In communications, *a number of channels treated as a unit*. For instance, a collection of associated voice channels in frequency-division multiplexing.
3. In computers, a collection of elements regarded as a unit. For example, a set of records in a database.

Ex. 2004, ¶ 28 (citing Ex. 2006, (Steven M. Kaplan, Wiley Electrical and Electronics Engineering Dictionary, p. 324 (2004)))

Notably, another claim limitation in Claim 1 recites that “the K is a positive integer greater than 1” which, as Petitioner’s expert confirms, means that K must be at least 2 and, therefore, Claim 1 requires at least 2 antenna port groups:

Q. And on claim 1, which is on column 27, specifically Line 26, there is a claim limitation that says, “K is a positive integer greater than 1.” Do you see that?

A. Yes, I do.

Q. What is the lowest integer that K could be in this claim?

A. A positive integer is greater than 1, the smallest that could be is a number 2.

Ex. 2004, ¶ 29 (citing Ex. 2005, 17:7-17).

Since the claimed “first wireless signal” is transmitted by at least 2 groups of antennas, a POSITA would understand that the claimed first wireless signal is not transmitted by each group separately, but rather transmitted by the K groups collectively. *Id.*, ¶ 30. Such an understanding is confirmed by the specification of the '271 Patent as well as Petitioner's expert:

K antenna port groups are used to transmit the first wireless signal.

Id. (citing '271 Patent, 13:31-32, 20:22-23, 20:41-42, 20:58-59, 20:44-45, 23:60-61, 24:15-16, 24:58-59, 25:59-60).

Q. So if K equals 3, does the claim require that 3 antenna port groups of the base station are used to transmit the first wireless signal?

A. Well, if K is 3, then this portion of the claim requires 3 antenna port groups of the base station are used to transmit the first wireless signal, that's what the claim says.

Id. (citing Ex. 2005, 18:20-19:4).

Because Petitioner improperly construes of “K antenna port groups of the base station are used to transmit the first wireless signal” to ignore the collective transmission of the first radio signal, as noted below (*see infra* Section VII.A.1),

Patent Owner requests that the Board construe “K antenna port groups of the base station are used to transmit the first wireless signal” to mean “K groups of antenna ports of the base station are used to collectively transmit the first wireless signal.” *Id.*, ¶ 31.

B. “proportional sequence corresponds to a ratio (ratios) among the K1 channel quality values”

Despite the parties not proposing any claim constructions during the Institution phase, Petitioner has apparently improperly construed “proportional sequence corresponds to a ratio (ratios) among the K1 channel quality values” to eliminate the creation of a sequence of K1 proportions between channel quality values. *See infra* Section VII.A.5; Ex. 2004, ¶ 32. Additionally, the Board noted “the parties have not addressed in detail the meaning of limitation [1d5], including the meaning of the terms ‘proportional’ and ‘corresponds’” and “[w]e invite the parties to construe limitation [1d5] during trial.” Inst. at 23. To that end, Patent Owner proposes the following claim construction: “proportional sequence corresponds to a ratio(ratios) among the K1 channel quality values” should be construed to mean “a sequence of K1 proportions, where each of the K1 proportions is a ratio between one channel quality value to itself or to another of the K1 channel quality values.” Ex. 2004, ¶ 32.

The '271 Patent provides no further definition of “proportional,” “sequence,” or “ratio” other than the plain and ordinary meaning of the terms. Therefore, a POSITA would understand the terms to be construed as the following, identified by Wiley Electrical and Electronics Engineering Dictionary (2004):

Proportional:

1. Having, establishing, or maintaining a relationship with one or more entities or values. For instance, the force between two charged particles is directly proportional to the product of their magnitudes, and inversely proportional to the square of their distance.
2. A relationship between two or more quantities, in which the variation in one causes a change in the other. For example, a transducer whose input is a DC, and whose output is a proportional AC.

Id., ¶ 33 (citing Ex. 2006, at 608)

Sequence:

1. An arrangement of two or more things, entities, or events, in a given order.
2. An arrangement of two or more things, entities, or events, in a successive order.
3. That which is ordered by a sequence (1) or sequence (2).
4. To arrange in a sequence (1) or sequence (2).

Id. (citing Ex. 2006, at 695)

Ratio:

A relationship between two quantities consisting of one being divided by the other.

Id. (citing Ex. 2006, at 636).

Putting these definitions together, a POSITA would understand that the “proportional sequence” is a sequence (i.e., arrangement) of proportions (i.e., relationships between two or more quantities). *Id.*, ¶ 34. The claim language states that the “proportional sequence corresponds to ratio (ratios),” and a POSITA would understand that the proportions that make up the sequence are ratios (i.e., relationship(s) between two quantities consisting of one being divided by the other). *Id.* Further, the quantities in the relationship that is described by the ratio are channel quality values. *Id.* The channel quality values can either be Reference Signal Received Powers (RSRPs) or a Signal to Interference plus Noise Ratios (SINRs). *Id.* (citing ’271 Patent, Claim 1). The total number of channel quality values is K1, which Claim 1 notes are “K1 channel quality values of the K channel quality values” or K1 channel quality values that are a subset of the K channel quality values. *Id.*

Such an understanding is confirmed by the specification of the ’271 Patent, which provides an example of a proportional sequence of ratios where both K=2 and

K1=2:²

In Embodiment 9, the UE receives the first wireless signal transmitted through the K antenna port groups. The K antenna port groups correspond to the K channel quality values. The UE receives the first signaling to determine that K1 is equal to 2. The first antenna port group and the second antenna port group are two antenna port groups of the K antenna port groups. The first antenna port group corresponds to the first channel quality. The second antenna port group is corresponding to the second channel quality. The first channel quality is a best channel quality value of the K channel quality values. The second channel quality is a second best channel quality value of the K channel quality values. The UE reports {the first antenna port group, the second antenna port group, and the first proportional sequence} to the base station. The first proportional sequence is composed of 1, ratio of the second channel quality and the first channel quality.

Id., ¶ 35 (citing '271 Patent, 24:10-31). In other words, the proportional sequence comprises {1 (the ratio of the first channel quality with itself), the ratio of the second channel quality to the first channel quality}. There are K1 (2) ratios in the exemplary proportional sequence. *Id.*

As a result of Petitioner's improper construction of "proportional sequence corresponds to a ratio (ratios) among the K1 channel quality values" that ignores creating a sequence of proportions among a K1 subset of K channel quality values, as noted below (*see infra* Section VII.A.5), Patent Owner requests that the Board

² Claim 1 describes the possibility that K=K1, since "K1 is a positive integer less than *or equal to* the K." '271 Patent, Claim 1.

construe “proportional sequence corresponds to a ratio (ratios) among the K1 channel quality values” to mean “a sequence of K1 proportions, where each of the K1 proportions is a ratio between one channel quality value to itself or to another of the K1 channel quality values.” *Id.*, ¶ 36.

VI. REQUIREMENTS UNDER 35 U.S.C. § 103

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, so called secondary considerations. *See Graham v. John Deere Co. of Kansas City*, 383 U.S. 1, 17–18 (1966). Failure to identify the differences between the claimed subject matter and the prior art is fatal to an obviousness challenge. *See Apple, Inc. v. Contentguard Holdings, Inc.*, IPR2015-00355, Paper 9 at 9-10 (P.T.A.B. June 26, 2015).

To arrive at obviousness, the Board must sufficiently explain and support the conclusions that the prior art references disclose all the elements recited in the Challenged Claims and a relevant skilled artisan not only could have made but would have been motivated to combine all the prior art references in the way the patent claims. *See Pers. Web Techs., LLC v. Apple, Inc.*, 848 F.3d 987, 994 (Fed. Cir. 2017).

Even if all the claim elements are found across a number of references, an obviousness determination must consider whether a POSITA would have been

motivated to combine those references. *See Intelligent Bio-Sys., Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1368 (Fed. Cir. 2016); *Los Angeles Biomedical Rsch. Inst. at Harbor-UCLA Med. Ctr. v. Eli Lilly Co.*, 849 F.3d 1049, 1067 (Fed. Cir. 2017).

The Supreme Court explained in *KSR Int’l Co. v. Teleflex Inc.* that “[o]ften, it will be necessary for a court to look to interrelated teachings of multiple patents; the effects of demands known to the design community or present in the marketplace; and the background knowledge possessed by a POSITA, all in order to determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue. To facilitate review, this analysis should be made explicit.” 550 U.S. 398, 418 (2007). This combination determination, as supported by an articulated motivation to combine, requires a plausible rationale as to why those prior art references would have worked together. *See Broadcom Corp. v. Emulex Corp.*, 732 F.3d 1325, 1335 (Fed. Cir. 2013). Additionally, “knowledge of a problem and motivation to solve it are entirely different from motivation to combine particular references.” *See Innogenetics, N.V. v. Abbott Lab’ys.*, 512 F.3d 1363, 1373 (Fed. Cir. 2008).

VII. PETITIONER HAS NOT PROVED INVALIDITY OF THE CHALLENGED CLAIMS BY A PREPONDERANCE OF THE EVIDENCE

As set forth below, and in view of both the Petition (“Paper No. 1” or “Pet.”)

and the Board's Institution Decision ("Paper No. 10" or "Inst."), Petitioner has failed to demonstrate by a preponderance of the evidence that the Challenged Claims are obvious in view of the asserted prior art.

A. Claim 1 Is Not Obvious Over the Combination of Liu and Park

1. The Combination of Liu and Park Does Not Disclose "wherein, K antenna port groups of the base station are used to transmit the first wireless signal; the K is a positive integer greater than 1," as Required by Claim 1

Claim 1 of the '271 Patent recites "wherein, K antenna port groups of the base station are used to transmit the first wireless signal." Petitioner only relies on Liu to disclose this claim limitation. Pet. at 16-17; Ex. 2004, ¶ 37.

As noted above in Section V.A, "K antenna port groups of the base station are used to transmit the first wireless signal" should be construed to mean "K groups of antenna ports of the base station are used to collectively transmit the first wireless signal." Ex. 2004, ¶ 38. Liu does not disclose multiple groups of antenna ports to collectively transmit a signal. *Id.* Rather Liu discloses only a singular antenna port for transmitting each singular signal (*i.e.*, a one-to-one mapping of ports to signals). *Id.* For example, Liu describes transmitting *signals* of the M antenna ports, implying one signal from each antenna port:

During antenna configuration, the second network device transmits configuration information *of M antenna ports* to

the first network device and *transmits signals of the M antenna ports* to the first network device.

Id. (citing Ex. 1006, 23, 25, 32).

Petitioner's expert confirms the understanding that Liu transmits M wireless signals from M antenna ports:

The "second network device" transmitting the M wireless signals "may be a base station," and the "first network device" receiving the M wireless signals "may be user equipment (UE)."

Id. ¶39 (citing Ex. 1003, ¶ 111 (citing Ex. 1006, [0015], [0023])).

Q. [A]re those M wireless signals transmitted by Liu's M antenna ports?

A. So, reading Liu in the context of Liu, those wireless signals are channel state information, reference signals and those -- each of the -- each of the ports transmits such reference signal.

Id. (citing Ex. 2005, 24:6-12).

The Board notes that "the antenna port group [may] include[] only one antenna port." *Id.*, ¶ 40 (citing Inst. at 14 (citing Ex. 1001, 13:64–65, 2:45–46 ("In one embodiment, the antenna port group is composed of one antenna port."))). However, the claim language itself is explicit that "K is a positive integer *greater than 1*." *Id.* (citing '271 Patent, Claim 1). Therefore, even in an embodiment where all antenna port groups each comprised one antenna port, there are still at least 2

antenna port groups or 2 antenna ports that collectively transmit the claimed first wireless signal, which Liu still does not disclose, as noted above. *Id.*

Realizing that Liu only discloses a one-to-one mapping of signals to antenna ports, Petitioner's expert, only in deposition, resorts to a novel theory of Liu showing the transmission of CSI-RS bursts (M wireless signals collectively) as the first wireless signal. *See generally* Ex. 2005, 21:21-24:17. However, Liu does not actually show CSI-RS bursts outside of Petitioner's expert's tortured explanation during deposition, and Petitioner's expert could not point to any mentions of "bursts," collection of references signals, or citations to the portion of the '271 Patent describing bursts, either in Liu, the Petition, or in his own declaration. *Id.*, 36:4-42:7. Petitioner's expert's brand new theory ought to be rejected as not being disclosed in the Petition to the extent the Board even considers it in the first instance.

Petitioner's alternate argument that codebook sets are indicative of meeting this claim limitation is also flawed in view of the proper construction of this claim limitation. Ex. 2004, ¶ 41. Specifically, "K groups of antenna ports of the base station are used to collectively transmit the first wireless signal." *Id.* However, Petitioner admits that "a POSITA would have understood describes the base station ***transmitting the wireless signal for each of the X (K) antenna port groups*** because the ***codebook information for each group*** corresponds to the matrix that describes the beam pattern transmitted by the base station and received by the UE ***for that port***

group. *Id.* (citing Pet. at 17 (citing Ex. 1006, [0021]; Ex. 1003, ¶ 112); Ex. 2005, 45:19-46:3 (“As I explain there, the code book information *for each group* corresponds to the matrix that describes the beam pattern created for a transmission by the base station”)). In other words, a POSITA would have understood that Liu teaches transmitting a wireless signal for each of its X antenna port groups instead of transmitting one wireless signal for multiple antenna port groups since Liu’s codebook information is keyed to each antenna port group. *Id.*

As the Board agrees, “Liu’s teaching that ‘the base station individually configures one codebook set for each antenna port group’ is somewhat unclear.” *Id.* ¶ 42 (citing Inst. at 16-17). Indeed, such a disclosure is irrelevant to this claim limitation. *Id.* Liu describes that [c]odebook information refers to information containing multiple precoding matrices that are individually configured at the base station for each antenna configuration, but *configuration* is not a base station *transmission* of a first wireless signal:

[T]he base station individually configures one codebook set for each antenna port group. The user equipment calculates the SNR based on the configured codebook set and feeds it back to the base station equipment. For example, the first group of antenna ports corresponds to antenna configuration 1, comprising antenna ports port0 and port1; the base station configures codebook set C1 for antenna configuration 1, and the precoding matrices included in C1 are W_{11} , W_{12} , W_{1n} , . . . , W_{1N} .

Id. (citing Ex. 1006, 21). A POSITA would have understood that Liu describes that

“the base station individually configures one codebook set for each antenna port group” for the purpose of calculating an SNR based on the configured codebook set, but that is inapposite to the proper construction of this claim limitation that “K groups of antenna ports of the base station are used to collectively transmit the first wireless signal.” *Id.*

Petitioner’s cited section of *Liu* also describes that “*the user equipment* . . . uses all the codebooks [] to conduct random beamforming” for those antenna configurations, but beamforming is also not the same as transmitting the claimed first wireless signal *from the base station*:

[F]or example, the user equipment at the pilot frequency of antenna configuration 1 uses all the codebooks in C1 to conduct random beamforming and obtain RSRP1; for the pilot frequency of antenna configuration 2, all the codebooks in C2 are used to conduct random beamforming and obtain RSRP2, . . .; and UE feeds back the index corresponding to the antenna configuration having the largest RSRP to the base station.

Id., ¶43 (citing Ex. 1006, 21-22).

Therefore, *Liu* in combination with *Park* does not render obvious this claim limitation. *Id.*, ¶ 44.

2. The Combination of Liu and Park Does Not Disclose “the first signaling is used by the UE to determine the K antenna port groups transmitting the first wireless signal received by the UE,” as Required by Claim 1

Claim 1 of the '271 Patent recites “the first signaling is used by the UE to determine the K antenna port groups transmitting the first wireless signal received by the UE; the K is a positive integer greater than 1.” Petitioner only relies on *Liu* to disclose this claim limitation. Pet. at 17-19; *Id.*, ¶ 45.

As noted above in Section VII.A.1, *Liu* does not disclose the claimed “K antenna port groups of the base station are used to transmit the first wireless signal” or “the K is a positive integer greater than 1” and therefore cannot disclose, teach, or suggest “determin[ing] the K antenna port groups transmitting the first wireless signal received by the UE.” *Id.*, ¶ 46.

Therefore, *Liu* in combination with *Park* does not render obvious this claim limitation. *Id.*, ¶ 47.

3. The Combination of Liu and Park Does Not Disclose “the K antenna port groups respectively correspond to K channel quality values; the K channel quality values are K non-negative real numbers; the K channel quality values are Reference Signal Received Powers (RSRPs) or a Signal to Interference plus Noise Ratios (SINRs),” as Required by Claim 1

Claim 1 of the '271 Patent recites “the K antenna port groups respectively

correspond to K channel quality values; the K channel quality values are K non-negative real numbers; the K channel quality values are Reference Signal Received Powers (RSRPs) or a Signal to Interference plus Noise Ratios (SINRs).” Petitioner only relies on Liu to disclose this claim limitation. Pet. at 19-20; *Id.*, ¶ 48.

As noted above in Section VII.A.1, *Liu* does not disclose the claimed “K antenna port groups of the base station are used to transmit the first wireless signal” and therefore cannot disclose, teach, or suggest “*the K antenna port groups* respectively correspond to K channel quality values; the K channel quality values are K non-negative real numbers; the K channel quality values are Reference Signal Received Powers (RSRPs) or a Signal to Interference plus Noise Ratios (SINRs).” *Id.*, ¶ 49.

Therefore, Liu in combination with Park does not render obvious these claim limitations. *Id.*, ¶ 50.

**4. The Combination of Liu and Park Does Not Disclose
“K1 antenna port groups of the K antenna port
groups correspond to K1 channel quality values of the
K channel quality values,” as Required by Claim 1**

Claim 1 of the ’271 Patent recites “a first proportional sequence corresponds to a ratio (ratios) among the K1 channel quality values.” Petitioner only relies on *Liu* to disclose this claim limitation. Pet. at 21-22; *Id.*, ¶ 51.

As noted above in Section VII.A.1, Liu does not disclose the claimed “K

antenna port groups of the base station are used to transmit the first wireless signal” and therefore cannot disclose, teach, or suggest “K1 antenna port groups of *the K antenna port groups* correspond to K1 channel quality values of the K channel quality values.” *Id.*, ¶ 52.

Therefore, Liu in combination with Park does not render obvious this claim limitation. *Id.*, ¶ 53.

5. The Combination of Liu and Park Does Not Disclose “a first proportional sequence corresponds to a ratio (ratios) among the K1 channel quality values,” as Required by Claim 1

Claim 1 of the ’271 Patent recites “a first proportional sequence corresponds to a ratio (ratios) among the K1 channel quality values.”

Petitioner incorrectly asserts that Liu discloses this limitation through a “ratio of RSRP over the received signal strength indicator (RSSI).” Pet. at 22 (citing Ex. 1006, 21, 30-31, 16, 26); *Id.*, ¶ 54. But Liu’s RSSI falls squarely outside of the claim language that describes “the K channel quality values are Reference Signal Received Powers (RSRPs) or a Signal to Interference plus Noise Ratios (SINRs).” Ex. 2004, ¶ 54. Since RSSI is not an RSRP or SINR, Liu cannot disclose a ratio among the K1 *channel quality values* since channel quality values are defined by the claim as RSRPs or SINRs. *Id.* Liu also does not meet the proper construction for this claim limitation which is “a sequence of K1 proportions, where each of the K1 proportions

is a ratio between one channel quality value to itself or to another of the K1 channel quality values.” *Id.* Instead, Petitioner notes that Liu only describes one ratio of RSRP/RSSI and not a sequence of proportions/ratios. *Id.* (citing Pet. at 22).

Park does not remedy the deficiencies of Liu because, even if Park described creating ratios comparing one RSRP with the maximum RSRP, Park still does not disclose the claimed “sequence.” *Id.*, ¶ 55. Petitioner admits that “Park aligns each measured RSRP ‘and *limits reporting to RSRPs of ports that are within a certain difference* compared to the RSRP of the selected antenna ports, in other words, $\max(\text{RSRP}(r,m))$.’ *Park’s UE reports the antenna ports having ‘an RSRP difference greater than a certain threshold value expressed as an RSRP ratio or dB scale.’*” Pet. at 23 (citing Park, [371]-[373]); *Id.* In other words, a POSITA would understand that Park computes each of the differentials between the $\max(\text{RSRP})$ and individual RSRPs and if a differential is greater than the threshold, then, and only then, will the UE report such antenna ports. Ex. 2004, ¶ 55. Petitioner confirms that understanding by citing to Park’s Fig. 12 and then noting that “[B]ecause antenna port 13 has the greatest RSRP of 40 dB,” the UE compares each of the other antenna ports’ RSRP values to antenna port 13 and “the UE reports antenna ports with an RSRP over 35 dB.” Pet. at 25 (citing Park, [378]); *Id.*

This is directly contrary to Claim 1 and therefore cannot disclose this claim limitation, which requires “a sequence of K1 proportions, where each of the K1

proportions is a ratio between one channel quality value to itself or to another of the K1 channel quality values.” Ex. 2004, ¶ 56. Moreover, a subsequent limitation recites that the UE transmits first information used to determine the first proportional sequence (i.e., the full sequence of K1 ratios regardless of any threshold). *See infra* Section VII.A.6; *see also* Claim 1 (“transmitting, by the UE, first information to the base station; the first information is used to determine the K1 antenna port groups and the first proportional sequence.”); *id.*

Therefore, Liu in combination with Park does not render obvious this claim limitation. *Id.*, ¶ 57.

6. The Combination of Liu and Park Does Not Disclose “transmitting, by the UE, first information to the base station; the first information is used to determine the K1 antenna port groups and the first proportional sequence,” as Required by Claim 1

Claim 1 of the ’271 Patent recites “transmitting, by the UE, first information to the base station” and “the first information is used to determine the K1 antenna port groups and the first proportional sequence.”

As noted above in Section VII.A.5, Liu alone, or in combination with Park, does not disclose the claimed “first proportional sequence,” and therefore cannot disclose, teach, or suggest “transmitting, by the UE, first information to the base station; the first information is used to determine the . . . first proportional sequence.”

Id., ¶ 58. Specifically, as noted above, Petitioner confirms that the UE of Park only “reports antenna ports” and not a sequence of all K1 channel quality ratios: “[B]ecause antenna port 13 has the greatest RSRP of 40 dB,” the UE compares each of the other antenna ports’ RSRP values to antenna port 13 and “the UE reports antenna ports with an RSRP over 35 dB.” Pet. at 25 (citing Park, [378]); *id.*

Therefore, Liu in combination with Park does not render obvious this claim limitation. *Id.*, ¶ 59.

B. Claims 2-20 Are Not Obvious Over the Combination of Liu and Park

1. The Combination of Liu and Park Does Not Render Obvious Claims 2-20

Claims 2-5 depend upon Claim 1. *Id.*, ¶ 60. For at least the same reasons as Claim 1, the combination of Liu and Park fails to render obvious Claims 2-5. *Id.* Specifically, as shown above in Sections VII.A.5 and VII.A.6, Liu in combination with Park, does not disclose the claimed “first proportional sequence” or any “proportional sequence,” and therefore cannot disclose the recited “first proportional sequence” of Claim 2 or the recited “first proportional sequence,” “second proportional sequence,” or “first information is further used to determine. . .the second proportional sequence” of Claims 3 and 5. *Id.*

Claims 6-10 recite “method[s] for multi-antenna transmitting in a base station” that mirrors the claim limitations of Claims 1-5, which recite “method[s] for

multi-antenna transmission in a user equipment.” *Id.*, ¶ 61. In other words, Claims 6-10 disclose methods from the perspective of the base station that is in communication with the UE in Claims 1-5. *Id.* For at least the same reasons as Claims 1-5, the combination of Liu and Park fails to render obvious Claims 6-10. *Id.*

Claims 11-15 recite “user equipment (UE) for multi-antenna transmission,” which are the apparatus claims of Claims 1-5. *Id.*, ¶ 62. For at least the same reasons as Claims 1-5, the combination of Liu and Park fails to render obvious Claims 11-15. *Id.*

Claims 16-20 recite “base station equipment for multi-antenna transmission” that mirrors the claim limitations of Claims 11-15, which recite “user equipment (UE) for multi-antenna transmission.” *Id.*, ¶ 63. In other words, Claims 16-20 disclose the base station equipment that is in communication with the UE in Claims 11-15. *Id.* For at least the same reasons as Claims 11-15, the combination of Liu and Park fails to render obvious Claims 16-20. *Id.*

VIII. CONCLUSION

Petitioner’s combinations fail to render obvious any Challenged Claim. The Board should issue a Final Written Decision finding the Challenged Claims not unpatentable.

Respectfully submitted,

Dated: February 6, 2024

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CERTIFICATE OF WORD COUNT

The undersigned hereby certifies that the portions of the above-captioned PATENT OWNER'S RESPONSE specified in 37 C.F.R. § 42.24 has 7,197 words in compliance with the 14,000 word limit set forth in 37 C.F.R. § 42.24. This word count was prepared using Microsoft Word for Office 365.

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