

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. 10,944,527
Filing Date: June 3, 2019
Issue Date: March 9, 2021

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

PATENT OWNER'S RESPONSE

Case No. IPR2023-00603

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the second time resource pool includes a positive integer number of time resource block(s); the first signaling is a dynamic signaling; the first signaling occupies one time resource block in the third time resource pool at most; the third time resource pool includes a positive integer number of time resource block(s); a minimum time interval between time resource blocks in the third time resource pool is greater than a minimum time interval between time resource blocks in the second time resource pool,” as Required by Claim 3	28
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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 January 12, 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> , IPR2023-00603, on December 19, 2023 ("Kakaes Depo.")

I. INTRODUCTION

The Board should issue a Final Written Decision finding Claims 1-20 (the “Challenged Claims”) of the U.S. Patent No. 10,944,527 (Ex. 1001, the “’527 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 any combination of (i) U.S. Patent Application Publication No. 2013/0182594 to Kim et al., published July 18, 2013 (“Kim”); (ii) International Publication No. WO 2015/199414 to Zhang et al., published December 30, 2015 (“Zhang”); (iii) U.S. Patent Application Publication No. 2015/0195025 to Kang et al., published July 9, 2015 (“Kang”); and (iv) U.S. Patent Application Publication No. 2019/0387501 to Park et al., published December 19, 2019 (“Park”).

Petitioner does not assert any grounds of anticipation but asserts four related grounds of obviousness. However, any combination of Kim, Zhang, Kang, and Park does not teach key claim elements of the ’527 Patent’s Challenged Claims, such as “wherein the first radio signal is transmitted by K antenna port groups of the base station,” “the first signaling is used to determine a first time resource pool,” “the first antenna virtualization vector is an antenna virtualization vector available to the base station in the first time resource pool,” “the second antenna virtualization vector is an antenna virtualization vector available to the user equipment in the first time

resource pool,” and “operating a second radio signal in a first time resource sub-pool,” “the second signaling is used to determine the first time resource sub-pool from the first time resource pool,” “wherein the operating is receiving from the base station, or the operating is transmitting to the base station,” and “[t]he method of claim, comprising: monitoring the second signaling in a second time resource pool, wherein the second signaling occupies one time resource block in the second time resource pool at most; and the second time resource pool includes a positive integer number of time resource block(s); or monitoring the second signaling in a second time resource pool and monitoring the first signaling in a third time resource pool, wherein the second signaling occupies one time resource block in the second time resource pool at most; the second time resource pool includes a positive integer number of time resource block(s); the first signaling is a dynamic signaling; the first signaling occupies one time resource block in the third time resource pool at most; the third time resource pool includes a positive integer number of time resource block(s); a minimum time interval between time resource blocks in the third time resource pool is greater than a minimum time interval between time resource blocks in the second time resource pool.”

Petitioner also (i) incorrectly construes “the first radio signal is transmitted by K antenna port groups of the base station” to mean transmitting multiple signals respectively over multiple antenna port groups; and (ii) incorrectly construes “time

resource pool” to read out the word “pool.” 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 ’527 Patent not unpatentable.

II. THE ’527 PATENT

The ’527 Patent discloses and claims “a multiple antenna transmission method in a wireless communication system.” ’527 Patent, at 1:19-20.

The ’527 Patent describes why such a method is necessary in view of “the urgent problem” of “signaling overhead of wireless resource dynamic scheduling,” as in the prior art:

[A]n increase in the number of cell users will lead to a large amount of signaling overhead for dynamic scheduling of wireless time-frequency resources. The signaling overhead of wireless resource dynamic scheduling is an urgent problem to be solved in massive MIMO system.

Id. at 1:40-44.

The exemplary embodiments of the '527 Patent to address the aforementioned problem have several technical advantages, including that the UE can quickly determine the location of the first time resource pool and quickly determine the antenna virtualization vectors for receiving a radio signal by associating the first time resource pool with the first antenna port group:

In one embodiment, the foregoing method is advantageous in that, by associating the first time resource pool with the first antenna port group, the UE can quickly determine the location of the first time resource pool in the time domain by the index of the first antenna port group in the K antenna port groups.

In one embodiment, the foregoing method is advantageous in that, by associating the first time resource pool with the first antenna port group, the UE can quickly determine the antenna virtualization vectors which used for receiving radio signal transmitted on the first time resource pool by the location of the first time resource pool in the time domain.

Id., 2:3-14.

III. THE ALLEGED PRIOR ART

A. Kim

Kim “relates to a wireless mobile communication system. More particularly, the present invention relates to a method for effectively transmitting and receiving a Channel State Information-Reference Signal (CSI-RS) and measuring interference.” Ex. 1004, [0003].

Kim discloses the problem it tries to solve as follows:

The resources of time, frequency, and transmission power are limited in a mobile communication system. Therefore, an increase in the quantity of resources allocated to a reference signal may decrease the quantity of resources that can be allocated to transmission of traffic channels and thus may reduce the absolute quantity of transmitted data. In this case, although the performances of channel measurement and estimation may be improved, the reduced absolute quantity of transmitted data may rather decrease the performance of the entire system throughput. Therefore, in order to obtain an optimum performance in view of the entire system throughput, a proper distribution between resources for the reference signal and resources for transmission of traffic channels is necessary.

Id. at [0008].

An exemplary embodiment of Kim is:

[A] method of transmitting a reference signal for generation of channel state information by an evolved Node B(eNB) in a wireless communication system is provided. The method includes transmitting a first reference signal to a plurality of User Equipments (UES), receiving channel state information generated based on the first reference signal from the plurality of UEs, selecting candidate UEs to which wireless resources are to be allocated and transmitting second reference signals to the selected candidate UEs, receiving channel state information generated based on the second reference signals from the candidate UEs, and selecting final UEs, to which wireless resources are to be allocated, from the candidate UEs based on the channel state information generated based on the second reference signals, and transmitting control information for data reception to the selected final UEs.

Id. at [0018].

B. Zhang

Zhang “relates to a field of mobile communication systems, and more particularly to a method and apparatus for reference signal transmitting and receiving in active antenna systems.” Ex. 1005 at [1].

Zhang seeks to solve “the coverage problem of CRS signal and physical broadcast channel (PBCH)/physical downlink control channel (PDCCH)/physical downlink shared channel (PDSCH) demodulated based on CRS and the problem of measurement for radio resource management (RRM) in the active antenna systems.”

Id. at [24].

Zhang’s exemplary embodiments “provide reference signal transmitting and receiving devices in the active antenna system. With these devices, the coverage problem of CRS signal and physical broadcast channel (PBCH)/physical downlink control channel (PDCCH)/physical downlink shared channel (PDSCH) demodulated based on CRS and the problem of measurement for radio resource management (RRM) in the active antenna systems may be avoided.” *Id.* at [25]. For example, “[a] reference signal transmitting method in an active antenna system includes: setting number of Cell-specific Reference Signal (CRS) ports and transmitting a notification of number of the CRS ports, wherein the number of the CRS ports is larger than 1; precoding a reference signal with a different precoding vector for each of the CRS

ports, wherein number of elements in the precoding vector is equal to number of transmit antennas, which correspond to the CRS ports; and transmitting the precoded reference signal for the each of the CRS ports over a corresponding frequency-time resource.” *Id.* at [26]-[30].

C. Kang

Kang “relates to a wireless communication system and, more specifically, to a method and apparatus for virtualizing an antenna.” Ex. 1006 at [0001].

Kang seeks to solve the technical problem of performance deterioration due to channel aging as beamforming resolution increases:

In enhanced wireless communication systems, support for more accurate beam forming is considered. As beamforming resolution increases, performance deterioration due to channel aging may be aggravated. Furthermore, as a moving speed of a UE increases, a channel that the UE suffers remarkably changes and thus performance deterioration due to channel aging may become serious.

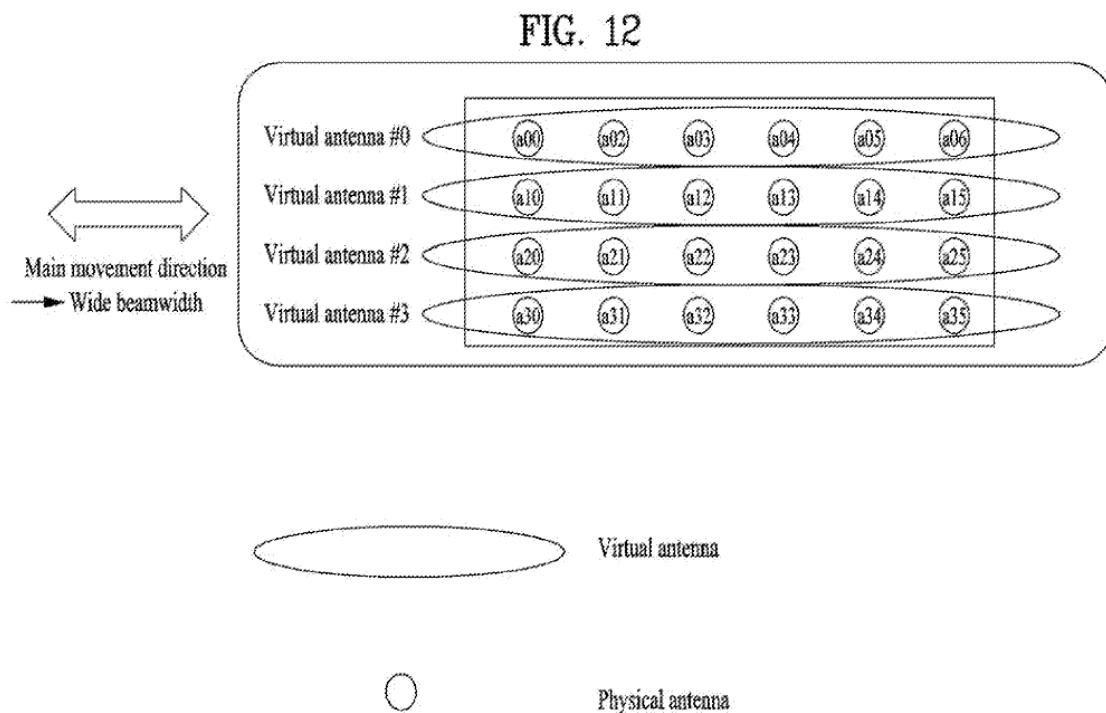
An object of the present invention devised to solve the problem lies in a method and apparatus for virtualizing an antenna to minimize performance deterioration due to channel aging even when channel aging occurs.

Id. at [0004]-[0005].

One aspect of the way in which Kang seeks to solve the technical problem above is through “communicating with a base station using the one or more virtual

antennas, wherein one or more physical antennas mapped to one virtual antenna are determined on the basis of a direction of movement of the terminal.” *Id.* at [0007].

Such virtual antennas do not overlap and each virtual antenna corresponds to only one antenna port group for the UE’s antenna configuration, as shown in Fig. 12 and related disclosure of Kang.



Id., at FIG. 12.

FIG. 12 illustrates an antenna virtualization method with respect to a two-dimensional antenna configuration according to the present invention.

In the example of FIG. 12, it is assumed that a UE has a two-dimensional antenna configuration in which 24 physical antennas are arranged in four columns and 6 rows. The UE may be a vehicle and the physical antennas may be arranged outside the vehicle.

Id. at [0139]-[0140].

D. Park

Park “relates to a wireless communication system and, more particularly, to a method for transmitting and receiving Downlink Control Information (DCI) in a wireless communication system and an apparatus for implementing the method.” Ex. 1007 at [0002].

Park seeks to solve the technical problem of “enabl[ing] a base station to adjust payload sizes to be identical when transmitting different DCI formats, thereby minimizing the number of times for a user equipment (UE) to perform blind detection.” *Id.* at [0005].

Park’s exemplary embodiment includes “a method for transmitting Downlink Control Information (DCI) by a base station in a wireless communication system, the method including: allocating a resource for data transmission; transmitting in a first DCI format, DCI including scheduling information about the allocated resource; and transmitting data according to the scheduling information, wherein the first DCI format is transmitted in a payload size, which is adjusted to be identical to a payload size of a pre-configured second DCI format, through a Common Search Space (CSS) when the DCI includes scheduling information about multicast/broadcast data, and wherein the first DCI format is transmitted in a payload size, which is not adjusted,

through a UE-specific Search Space (USS) when the DCI includes scheduling information about unicast data.” *Id.* at [0008].

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 multiple-input multiple-output (MIMO) technology in telecommunications systems” and that “[m]ore work experience can compensate for less education, and *vice versa*.” Pet. at 9-10; Ex. 2004, ¶ 20. The Board noted that “Petitioner’s last sentence regarding additional relevant work experience compensating for less education and *vice versa*, [] is vague” Inst. at 9-10; 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. “the first radio signal is transmitted by K antenna port groups of the base station”

Despite the parties not proposing any claim constructions during the Institution phase, Petitioner has apparently improperly construed “the first radio signal is transmitted by K antenna port groups of the base station” 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; Ex. 2004, ¶ 27. Therefore, Patent Owner proposes the following claim construction: “the first radio signal is transmitted by K antenna port groups of the base station” should be construed to mean “the first radio signal is collectively transmitted by K groups of antenna ports of the base station.” *Id.*

As a preliminary matter, a person of ordinary skill in the art, including Petitioner’s expert, 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”:

Q. What is your understanding of that term, “antenna port group” or “antenna port groups”?

A. Well, antenna -- well, antenna port groups means it's more than one antenna port group. So an antenna port group is a group of antenna ports.

Ex. 2004, ¶ 28 (citing Ex. 2005, 22:11-17).

Petitioner's expert's understanding 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, ¶ 29 (citing Steven M. Kaplan, Wiley Electrical and Electronics Engineering Dictionary, p. 324 (2006))¹

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

¹ Emphasis added unless otherwise noted.

at least 2 and, therefore, Claim 1 requires at least 2 antenna port groups:

Q. Do you see the claim limitation that says -- and it's at the end of Claim 1 -- "the K is a positive integer greater than 1"?

A. Yes, I do.

Q. Based on that claim limitation, what is the lowest integer that K could be?

A. Two.

Ex. 2004, ¶ 30 (citing Ex. 2005, 22:18-23:2).

Since the claimed "first radio signal" is transmitted by at least 2 groups of antennas, a person of ordinary skill in the art would understand that the claimed first signal is not transmitted by each group separately, but rather transmitted by the K groups collectively. Ex. 2004, ¶ 31. Such an understanding is confirmed by the specification of the '527 Patent:

In one embodiment, the first radio signal is *transmitted by the K antenna port groups* in a manner that the first radio signal *carries the K reference signal groups*, and the antenna virtualization vectors *corresponding to the K reference signal groups* are respectively used to *map the K reference signal groups* to a set of physical antennas to be transmitted.

Ex. 2004, ¶ 31 (citing '527 Patent, 3:44-49).

As a result of Petitioner's improper construction of "the first radio signal is transmitted by K antenna port groups of the base station" that ignores the collective transmission of the first radio signal, as noted below (*see infra* Section VII.A.1),

Patent Owner requests that the Board construe “the first radio signal is transmitted by K antenna port groups of the base station” to mean “the first radio signal is collectively transmitted by K groups of antenna ports of the base station.” Ex. 2004, ¶ 32.

B. “time resource pool”

Petitioner’s implied construction that reads out the word “pool” from “time resource pool” runs contrary to the specification of the ’527 Patent and, in particular, reads out the word “pool,” which should be read according to its plain and ordinary meaning. Ex. 2004, ¶ 33. To assist the Board in ascertaining that plain and ordinary meaning, Patent Owner proposes that “time resource pool” be construed as “collection of time resources for a shared use” based on what a person of ordinary skill in the art would have understood it to mean. Ex. 2004, ¶ 33.

A person of ordinary skill in the art would have understood from the ’527 Patent specification that “time resource,” “time resource pool, and “time resource sub-pool,” each have different meanings:

In Embodiment 4, *the first time resource pool includes N1 time resources*; the first signaling indicates the distribution of the first time resource pool in the time domain. The second radio signal is transmitted on the first time resource sub-pool. The first time resource sub-pool includes N2 time resources #k1-#km in the N1 time resources. The second signaling indicates the number #k1-#km of the N2 time resources in the N1 time resources.

Ex. 2004, ¶ 34 (citing '527 Patent, 15:26-40).

In Embodiment 5, the second radio signal is transmitted on *the time resource #k1-#km of the first time resource sub-pool*. By the second signaling, the UE determines a *first time resource sub-pool from the first time resource pool* and determines the frequency domain resources occupied by the second radio signal, thereby determining the second time-frequency resource occupied by the second radio signal.

Ex. 2004, ¶ 34 (citing '527 Patent, 15:44-61).

Petitioner's expert has also noted that the term "time resources" possesses a different meaning than the term "time resource pool" and that a person of ordinary skill in the art would understand "time resource pool" by its plain and ordinary meaning:

Q. What is your understanding of a time resource pool?

A. It's a pool of time resources.

Q. In your opinion, does the term "time resource pool" mean anything different than the term "time resource"?

A. Time resource pool is the pool of time resources. So yes, it's different. Time resource is a time resource. A time resource pool is a pool of time resources.

Q. Could you describe what is a pool?

A. So it's a plain and ordinary meaning of the word "pool."

Ex. 2004, ¶ 35 (citing Ex. 2005, 23:6-20).

The plain and ordinary meaning of "pool" or "resource pool" can be identified by the various dictionaries below, and indicates that a pool requires a "shared" or

“common” component:

Pool, verb(2):

to combine (things, such as resources) in a common pool or effort

Ex. 2004, ¶ 36 (citing <https://www.merriam-webster.com/dictionary/pool>)

(emphasis added).

Pool, noun (COLLECTION):

A number of people or a quantity of a particular thing, such as money, *collected together for shared use* by several people or organizations

Pool, verb:

To *collect something* such as money in order for it to be *used by several different people or groups*

Id., ¶ 36 (citing <https://dictionary.cambridge.org/us/dictionary/english/pool>)

(emphasis added).

Given the plain and ordinary meaning of the term, “pool,” a person of ordinary skill in the art would have understood that a “time resource pool” should be construed differently from just a “time resource” or “time resources.” Ex. 2004, ¶ 37. Moreover, a person of ordinary skill in the art would understand “time resource pool” to be construed as a “collection of time resources for a shared use.” Ex. 2004, ¶ 37.

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 person having ordinary skill in the art, 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. 11” 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. Claims 1, 4-6, 9-11, 14-16, and 19-20 Are Not Obvious Over Any Combination of Kim, Zhang, and Kang

1. Any Combination of Kim, Zhang, and Kang Does Not Disclose “wherein the first radio signal is transmitted by K antenna port groups of the base station,” as Required by Claim 1

Claim 1 of the '527 Patent recites “wherein the first radio signal is transmitted by K antenna port groups of the base station,” “the antenna port group includes a positive integer number of antenna port(s),” “a first antenna port group is one of the K antenna port groups,” and “the K is a positive integer greater than 1.” Petitioner relies on only Kim to render obvious this claim limitation. Pet. at 17-20; Ex. 2004, ¶ 38.

As noted above, a person of ordinary skill in the art would have understood that “the first radio signal is transmitted by K antenna port groups of the base station” should be construed to mean “the first radio signal is *collectively* transmitted by K groups of antenna ports of the base station.” See *supra* Section V.A; Ex. 2004, ¶ 39.

Petitioner argues that Kim’s CSI-RS is the claimed “first radio signal.” Pet. at 17 (Kim discloses that the CSI-RS (first radio signal) is transmitted by K antenna port groups of the base station.”). Ex. 2004, ¶ 40. Assuming that Kim’s CSI-RS may correspond to the claimed “first radio signal,” however, Kim teaches away from the required collective transmission of the CSI-RS by K groups of antenna ports. *Id.* In particular, Kim teaches that one of multiple CSI-RSs each correspond to an antenna

port group (“CSI-RSs . . . are transmitted to each UE for each group of multiple antennas”) and are each transmitted by a respective antenna group of an allocated transmission time interval for that antenna group (“each antenna group transmits a CSI-RS in each transmission interval”):

CSI-RSs for massive MIMO are transmitted to each UE for each group of multiple antennas as illustrated in FIG. 4, so that CSI-RSs for more transmission antennas than the 8 transmission antennas supported by the LTE-A are transmitted.

Id. (citing Ex. 1004, [0058]).

For example, antenna groups 1 through 5 in FIG. 4 are allocated transmission time intervals and ***transmit CSI-RSs in the allocated transmission time intervals***. In FIG. 4, since each antenna group includes 8 transmission antennas, ***each antenna group transmits a CSI-RS in each transmission interval*** by using one CSI-RS resource (as indicated by reference numeral 500 of FIG. 5) for 8 ports.

Id. (citing Ex. 1004, [0060]). Petitioner’s citation to Fig. 7 is similarly unavailing because Kim’s description of Fig. 7 also notes that “each antenna group transmits CSI-RSs”:

FIG. 7 illustrates a grouping of a plurality of beams into five beam groups, wherein each beam group is transmitted in an individual time interval.

Referring to FIG. 7, five beam groups 710 are illustrated, each antenna group includes 8 transmission antennas, and each antenna group transmits CSI-RSs by using one CSI-RS resource 700 for 8 ports in each transmission interval.

Id. (citing Ex. 1004, [0082]-[0083]). Therefore, Kim explicitly describes transmission of a different CSI-RS (not just one radio signal – “the first radio signal”) from each of its disclosed antenna groups in contravention of Claim 1’s requirement that “the first radio signal is **collectively** transmitted by K groups of antenna ports of the base station.” *Id.*

In view of Kim’s teaching to the contrary of what a person of ordinary skill in the art would understand to be required by the claim language, Kim in combination with Zhang and Kang does not render obvious this claim limitation. *Id.*, ¶ 41.

2. Any Combination of Kim, Zhang, and Kang Does Not Disclose “the first signaling is used to determine a first time resource pool,” as Required by Claim 1

Claim 1 of the ’527 Patent recites “the first signaling is used to determine a first time resource pool.” Petitioner only relies on Kim to disclose this claim limitation. Pet. at 20-22; Ex. 2004, ¶ 42.

As noted above, a person of ordinary skill in the art would have understood that “time resource pool” should be construed differently than merely “time resource.” *See supra* Section V.B; Ex. 2004, ¶ 43. Yet, Petitioner improperly interprets the claimed “time resource pool” as the same as “time resource” because Petitioner ignores the term “pool” entirely. Ex. 2004, ¶ 43. With respect to the “time resource pool” claim limitation, Petitioner only states that “*Kim* discloses that the

control information includes ‘positions of time and frequency resources at which a CSI-RS for each antenna group is transmitted.’” Pet. at 20 (citing *Kim*, ¶ [0069]); Ex. 2004, ¶ 43. Petitioner makes no distinction between time resources and a pool of time resources, and at most, only discloses time resources. Ex. 2004, ¶ 43. The ’527 Patent is clear that the two are separate concepts where “the first time resource pool includes [] time resources” but is not the time resources itself.

In Embodiment 4, *the first time resource pool includes N1 time resources*; the first signaling indicates the distribution of the first time resource pool in the time domain.

Id. (citing ’527 Patent, 15:26-40).

Petitioner also seems to argue that Kim’s “separate time resource (subframes),” over which different CSI-RSs are transmitted by different antenna port groups, correspond to the claimed “time resource pool.” Ex. 2004, ¶ 44; Pet. at 21 (“*Kim* show[s] that CSI-RSs for each antenna port group are transmitted over *separate time resources (subframes)*.”); *see also* Ex. 1004, ¶¶ [0060], [0082]-[0083]. A person of ordinary skill in the art would not have understood that those “separate time resources” are the claimed “time resource pool.” Ex. 2004, ¶ 44.

As noted in Section V.B., a person of ordinary skill in the art would understand “time resource pool” to be construed as “a collection of time resources *for a shared use*.” Ex. 2004, ¶ 45. The shared use of the time resource pool described

in the '527 Patent refers to the shared collection of time resources for transmission by all K antenna port groups. *See* Section V.A.; Ex. 2004, ¶ 45. Kim contradicts that “shared use” because, as Petitioner admits, “*Kim show[s] that CSI-RSs for each antenna port group are transmitted over separate time resources (subframes).*” Ex. 2004, ¶ 45; Pet. at 21; *see also supra* Section VII.A.1.

Therefore, Kim in combination with Zhang and Kang does not render obvious this claim limitation. Ex. 2004, ¶ 46.

3. Any Combination of Kim, Zhang, and Kang Does Not Disclose “the first antenna virtualization vector is an antenna virtualization vector available to the base station in the first time resource pool,” as Required by Claim 1

Claim 1 of the '527 Patent recites “the first antenna virtualization vector is an antenna virtualization vector available to the base station in the first time resource pool.”

As noted above in Section VI.A.2, any combination of Kim, Zhang, and Kang does not disclose the claimed “first time resource pool,” and therefore cannot disclose, teach, or suggest “the first antenna virtualization vector is an antenna virtualization vector available to the base station *in the first time resource pool.*” Ex. 2004, ¶ 47.

Therefore, any combination of Kim, Zhang, and Kang does not render obvious this claim limitation. Ex. 2004, ¶ 48.

4. Any Combination of Kim, Zhang, and Kang Does Not Disclose “the second antenna virtualization vector is an antenna virtualization vector available to the user equipment in the first time resource pool,” as Required by Claim 1

Claim 1 of the '527 Patent recites “the second antenna virtualization vector is an antenna virtualization vector available to the user equipment in the first time resource pool.”

As noted above in Section VI.A.2, any combination of Kim, Zhang, and Kang does not disclose the claimed “first time resource pool,” and therefore cannot disclose, teach, or suggest “the second antenna virtualization vector is an antenna virtualization vector available to the user equipment *in the first time resource pool.*” Ex. 2004, ¶ 49.

Therefore, any combination of Kim, Zhang, and Kang does not render obvious this claim limitation. Ex. 2004, ¶ 50.

5. Any Combination of Kim, Zhang, and Kang Does Not Render Obvious Independent Claims 4-5, 6, 9-11, 14-16, and 19-20

Claims 4 and 5 depend upon Claim 1. Ex. 2004, ¶ 51. For at least the same reasons as Claim 1, any combination of Kim, Zhang, and Kang fails to render obvious Claims 4 and 5. *Id.*.

Claims 6, 9, and 10 recite “method[s] for multi-antenna transmitting in a base station” that mirrors the claim limitations of Claims 1, 4, and 5, which recite

“method[s] for multi-antenna transmission in a user equipment.” *Id.*, ¶ 52. In other words, Claims 6, 9, and 10 disclose methods from the perspective of the base station that is in communication with the UE in Claim 1. *Id.* For at least the same reasons as Claims 1, 4, and 5, any combination of Kim, Zhang, and Kang fails to render obvious Claims 6, 9, and 10. *Id.*

Claims 11, 14, and 15 recite “user equipment (UE) for multi-antenna transmission,” which are the apparatus claims of Claims 1, 4, and 5. *Id.*, ¶ 53. For at least the same reasons as Claim 1, any combination of Kim, Zhang, and Kang fails to render obvious Claims 11, 14, and 15. *Id.*

Claims 16, 19, and 20 recite “base station equipment for multi-antenna transmission” that mirrors the claim limitations of Claims 11, 14, and 15, which recites “user equipment (UE) for multi-antenna transmission.” *Id.*, ¶ 54. In other words, Claims 16, 19, and 20 disclose the base station equipment that is in communication with the UE in Claims 11, 14, and 15. *Id.* For at least the same reasons as Claims 11, 14, and 15, any combination of Kim, Zhang, and Kang fails to render obvious Claims 16, 19, and 20. *Id.*

B. Claims 2-3, 7-8, 12-13, and 17-18 Are Not Obvious Over Any Combination of Kim, Zhang, Kang, and Park

- 1. Any Combination of Kim, Zhang, and Kang Does Not Disclose “operating a second radio signal in a first time resource sub-pool,” or “the second signaling is used to determine the first**

**time resource sub-pool from the first time
resource pool,” as Required by Claim 2**

Claim 2 of the '527 Patent recites “operating a second radio signal in a first time resource sub-pool” and “the second signaling is used to determine the first time resource sub-pool from the first time resource pool.” Petitioner only relies on Kim to disclose the claim limitation of “operating a second radio signal in a first time resource sub-pool.” Pet. at 58-59; Ex. 2004, ¶ 55.

As noted above in Section VI.A.2., any combination of Kim, Zhang, and Kang does not disclose the claimed “first time resource pool.” Ex. 2004, ¶ 56. A person of ordinary skill in the art, including Petitioner’s expert, would understand the first time resource sub-pool to be a “subset” of the first time resource pool:

Q. Sure. Does Figure 6 show a time resource subpool?

A. Yes, it does. It shows an example of a subpool.

Q. In this figure, can you describe what the first time resource subpool is?

A. As the word “subpool” suggests, it’s a subset of the pool. It’s something smaller than the pool. And in this example, the first time resource subpool that’s indicated in Figure 6 consists of subframes No. 3 and No. 7.

Id. (citing Ex. 2005, 25:20-26:7). Again, Petitioner provides no discussion of a “first time resource pool” outside of incorrectly stating that “*Kim* discloses [] a first time resource pool (subframe).” *Id.*, ¶ 56; Pet. at 58-59. Since Kim does not disclose the claimed “first time resource pool” from which the claimed sub-pool depends upon,

any combination of Kim, Zhang, Kang, and Park therefore cannot disclose, teach, or suggest “operating a second radio signal in a first time resource sub-pool” or “the second signaling is used to determine the first time resource sub-pool from the first time resource pool.” Ex. 2004, ¶ 56.

Therefore, any combination of Kim, Zhang, Kang, and Park does not render obvious this claim limitation. *Id.*, ¶ 57.

2. Any Combination of Kim, Zhang, Kang, and Park Does Not Disclose “wherein the operating is receiving from the base station, or the operating is transmitting to the base station,” as Required by Claim 2

Claim 2 of the ’527 Patent recites “wherein the operating is receiving from the base station, or the operating is transmitting to the base station.”

As noted above in Section VI.B.1., any combination of Kim, Zhang, Kang, and Park does not disclose the claimed “operating a second radio signal in a first time resource sub-pool,” and therefore cannot disclose, teach, or suggest “wherein *the operating* is receiving from the base station, or *the operating* is transmitting to the base station.” Ex. 2004, ¶ 58.

Therefore, any combination of Kim, Zhang, Kang, and Park does not render obvious this claim limitation. *Id.*, ¶ 59.

3. **Any Combination of Kim, Zhang, and Kang Does Not Disclose “[t]he method of claim, comprising: monitoring the second signaling in a second time resource pool, wherein the second signaling occupies one time resource block in the second time resource pool at most; and the second time resource pool includes a positive integer number of time resource block(s); or monitoring the second signaling in a second time resource pool and monitoring the first signaling in a third time resource pool, wherein the second signaling occupies one time resource block in the second time resource pool at most; the second time resource pool includes a positive integer number of time resource block(s); the first signaling is a dynamic signaling; the first signaling occupies one time resource block in the third time resource pool at most; the third time resource pool includes a positive integer number of time resource block(s); a minimum time interval between time resource blocks in the third time resource pool is greater than a minimum time interval between time resource blocks in the second time resource pool,” as Required by Claim 3**

Claim 3 of the '527 Patent recites “[t]he method of claim, comprising: monitoring the second signaling in a second time resource pool, wherein the second signaling occupies one time resource block in the second time resource pool at most; and the second time resource pool includes a positive integer number of time resource block(s); or monitoring the second signaling in a second time resource pool and monitoring the first signaling in a third time resource pool, wherein the second signaling occupies one time resource block in the second time resource pool at most;

the second time resource pool includes a positive integer number of time resource block(s); the first signaling is a dynamic signaling; the first signaling occupies one time resource block in the third time resource pool at most; the third time resource pool includes a positive integer number of time resource block(s); a minimum time interval between time resource blocks in the third time resource pool is greater than a minimum time interval between time resource blocks in the second time resource pool.”

Claim 3 depends upon Claim 2. Ex. 2004, ¶ 60. For at least the same reasons as Claim 2, any combination of Kim, Zhang, Kang, and Park fails to render obvious Claim 3. *Id.* Specifically, as noted above in Section VI.A.2., any combination of Kim, Zhang, and Kang does not disclose the claimed “first time resource pool” or any “time resource pool, and therefore, even in combination with Park, cannot disclose, teach, or suggest “monitoring the second signaling in *a second time resource pool*, wherein the second signaling occupies one time resource block in *the second time resource pool* at most; and the *second time resource pool* includes a positive integer number of time resource block(s).” *Id.*

Petitioner does not address “monitoring the second signaling in a second time resource pool and monitoring the first signaling in a third time resource pool, wherein the second signaling occupies one time resource block in the second time resource pool at most; the second time resource pool includes a positive integer

number of time resource block(s); the first signaling is a dynamic signaling; the first signaling occupies one time resource block in the third time resource pool at most; the third time resource pool includes a positive integer number of time resource block(s); a minimum time interval between time resource blocks in the third time resource pool is greater than a minimum time interval between time resource blocks in the second time resource pool” and therefore cannot obviate this claim limitation. *Id.*, ¶ 61.

Therefore, Kim in combination with Zhang, Kang, and Park does not render obvious Claim 3. *Id.*, ¶ 62.

4. Any Combination of Kim, Zhang, Kang, and Park Does Not Render Obvious Claims 7-8, 12-13, and 17-18

Claims 7-8 recite “method[s] for multi-antenna transmitting in a base station” that mirror the claim limitations of Claims 2-3, which recite “method[s] for multi-antenna transmission in a user equipment.” *Id.*, ¶ 63. In other words, Claims 7-8 discloses a method from the perspective of the base station that is in communication with the UE in Claims 2-3. *Id.* For at least the same reasons as Claims 2-3, any combination of Kim, Zhang, Kang, or Park fails to render obvious Claims 7-8. *Id.*

Claims 12-13 recite “[a] user equipment (UE) for multi-antenna transmission,” which are the apparatus claims of Claims 2-3. *Id.*, ¶ 64. For at least the same reasons as Claims 2-3, any combination of Kim, Zhang, Kang, or Park fails

to render obvious Claims 12-13. *Id.*

Claims 17-18 recite “base station equipment for multi-antenna transmission” that mirrors the claim limitations of Claims 12-13, which recite “[a] user equipment (UE) for multi-antenna transmission.” *Id.*, ¶ 65. In other words, Claims 17-18 disclose the base station equipment that is in communication with the UE in Claims 12-13. *Id.* For at least the same reasons as Claims 12-13, any combination of Kim, Zhang, Kang, or Park fails to render obvious Claims 17-18. *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,

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By: /Vincent J. Rubino, III /
Vincent J. Rubino, III (Reg. No. 68,594)
Lead Counsel for Patent Owner
FABRICANT LLP
411 Theodore Fremd Avenue
Suite 206 South
Rye, New York 10580
Tel. 212-257-5797
Fax. 212-257-5796
Email: vrubino@fabricantllp.com

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 6,917 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.

Respectfully submitted,

January 12, 2024

By: /Vincent J. Rubino, III /
Vincent J. Rubino, III (Reg. No. 68,594)
Lead Counsel for Patent Owner
FABRICANT LLP
411 Theodore Fremd Avenue
Suite 206 South
Rye, New York 10580
Tel. 212-257-5797
Fax. 212-257-5796
Email: vrubino@fabricantllp.com

CERTIFICATE OF SERVICE

A copy of the foregoing Patent Owner's Response and Exhibit 2004 to 2005
have been served on Petitioner's counsel of record as follows:

Joshua L. Goldberg
Email: joshua.goldberg@finnegan.com
Nicholas A. Cerulli
Email: nicholas.cerulli@finnegan.com
Mingji Jin
Email: mingji.jin@finnegan.com
Chen Zang
Email: chen.zang@finnegan.com
**FINNEGAN, HENDERSON, FARABOW,
GARRETT & DUNNER, LLP**
901 New York Avenue, NW
Washington, DC 20001-4413

Kevin D. Rodkey
Email: kevin.rodkey@finnegan.com
**FINNEGAN, HENDERSON, FARABOW,
GARRETT & DUNNER, LLP**
271 17th Street NW, Suite 1400
Atlanta, GA 30363-6209

Yi Yu
Email: yi.yu@finnegan.com
**FINNEGAN, HENDERSON, FARABOW,
GARRETT & DUNNER, LLP**
1875 Explorer Street
Reston, VA 20190-6023

*Attorneys for Samsung Electronics Co., Ltd. and
Samsung Electronics America, Inc.*

January 12, 2024

By: /Vincent J. Rubino, III /
Vincent J. Rubino, III (Reg. No. 68,594)
Lead Counsel for Patent Owner
FABRICANT LLP
411 Theodore Fremd Avenue,
Suite 206 South
Rye, New York 10580
Tel. 212-257-5797
Fax. 212-257-5796
Email: vrubino@fabricantllp.com