Trials@uspto.gov
571-272-7822

Paper 10
Date: October 20, 2023

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD., and
SAMSUNG ELECTRONICS AMERICA, INC.,
Petitioner,

v.

APEX BEAM TECHNOLOGIES LLC,
Patent Owner.

IPR2023-00603
Patent 10,944,527 B2

Before JOHN D. HAMANN, SEAN P. O'HANLON, and
SCOTT RAEVSKY, *Administrative Patent Judges*.

HAMANN, Administrative Patent Judge.

DECISION
Granting Institution of *Inter Partes* Review
35 U.S.C. § 314

APPLE 1166
Apple v. Apex Beam
IPR2025-00897

I. INTRODUCTION

Samsung Electronics Co., Ltd. and Samsung Electronics America, Inc. (collectively "Petitioner") filed a petition for *inter partes* review of claims 1–20 of U.S. Patent No. 10,944,527 B2 (Ex. 1001, "the '527 patent"). Paper 1 ("Pet."). Apex Beam Technologies LLC ("Patent Owner") filed a Preliminary Response. Paper 8 ("Prelim. Resp.").

We have authority to determine whether to institute an *inter partes* review under 35 U.S.C. § 314 (2018) and 37 C.F.R. § 42.4(a) (2022). An *inter partes* review may be instituted if "the information presented in the petition filed under section 311 and any response filed under section 313 shows that there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition." 35 U.S.C. § 314(a).

Upon consideration of the papers, we determine that the information presented in the Petition demonstrates that there is a reasonable likelihood that Petitioner would prevail in establishing the unpatentability of at least one challenged claim of the '527 patent.

A. Real Parties-In-Interest

The parties identify themselves as the real parties-in-interest. Pet. 81; Paper 5, 2.

B. Related Matters

The parties identify *Apex Beam Technologies LLC v. Samsung Electronics Co.*, No. 2:22-cv-00188 (E.D. Tex.) ("the related district court litigation"); *Apex Beam Technologies LLC v. ZTE Corp.*, No. 2:22-cv-00031 (E.D. Tex.); *Apex Beam Technologies LLC v. OnePlus Technology (Shenzhen) Co.*, No. 2:22-cv-00032 (E.D. Tex.); and *Apex Beam*

Technologies LLC v. TCT Mobile Int'l Ltd., No. 2:21-cv-00438 (E.D. Tex.) as matters that may affect, or be affected by, a decision in this proceeding. Pet. 81–82; Paper 5, 3.

C. The '527 Patent

The '527 patent relates to multiple antenna transmission in a wireless communication system. Ex. 1001, 1:19–20. As background, the '527 patent explains that in massive Multiple-Input Multiple-Output (MIMO), "multiple antennas can improve communication quality by forming narrower beams pointing to a specific direction through beamforming." *Id.* at 1:26–28. "In a massive MIMO system, the total throughput of a cell can be greatly increased by the number of massive antennas, so the number of single-cell users can be greatly increased." *Id.* at 1:37–39. "However, an increase in the number of cell users will lead to a large amount of signaling overhead for dynamic scheduling of wireless time-frequency resources," according to the '527 patent. *Id.* at 1:40–42. "The signaling overhead of wireless resource dynamic scheduling is an urgent problem to be solved in massive MIMO system[s]," the '527 patent states. *Id.* at 1:42–44.

In response, the '527 patent discloses embodiments that address this problem. *Id.* at 1:45–46. More specifically, the '527 patent discloses reducing "[t]he overhead of wireless resource scheduling signaling . . . by using beam information." *Id.* at 12:48–51. For example, the '527 patent discloses for an embodiment that "by associating [a] first time resource pool with [a] first antenna port group, [a user equipment (UE)] can quickly determine[] the location of the first time resource pool in the time domain by [an] index of the first antenna port group." *Id.* at 2:3–8. The '527 patent explains that an antenna port can be "formed by superposing multiple

physical antennas through antenna virtualization; the mapping coefficients from the multiple physical antennas to the antenna port(s) constitute an antenna virtualization vector for the antenna virtualization." *Id.* at 2:34–38. The '527 patent discloses that a time resource can comprise a symbol or a subframe. *Id.* at 5:63–65.

In addition, the '527 patent discloses for another embodiment 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.* at 2:9–14. The '527 patent discloses that a radio signal can include one or more of Channel State Information Reference signal(s) (CSI-RSs). *Id.* at 2:29–33.

D. Illustrative Claim

Of the challenged claims, claims 1, 6, 11, and 16 are independent. Claim 1 is illustrative of the challenged claims and is reproduced below.

> 1. A method for multi-antenna transmission in a user equipment, comprising:
>
> receiving a first radio signal from a base station; and
>
> receiving a first signaling from the base station;
>
> 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; the first signaling is used to determine a first time resource pool; at least one of a first antenna virtualization vector and a second antenna virtualization vector is associated with the first antenna port group; 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 the K is a positive integer greater than 1.

Ex. 1001, 29:8–26.

E. Asserted Grounds of Unpatentability

Petitioner asserts that the challenged claims of the ’527 patent are unpatentable based on the following grounds:

Claim(s) Challenged	35 U.S.C. §[1]	Reference(s)
1, 4–6, 9–11, 14–16, 19, 20	103	Kim,[2] Zhang[3]
1, 4–6, 9–11, 14–16, 19, 20	103	Kim, Zhang, Kang[4]
2, 3, 7, 8, 12, 13, 17, 18	103	Kim, Zhang, Park[5]
2, 3, 7, 8, 12, 13, 17, 18	103	Kim, Zhang, Kang, Park

Pet. 10–79. Petitioner submits in support of its arguments the Declaration of Apostolos K. Kakaes, Ph.D. (Ex. 1002).

II. DISCRETIONARY DENIAL UNDER 35 U.S.C. § 314

Patent Owner argues that we should exercise discretion under § 314(a) to deny institution in light of the related district court litigation. Prelim. Resp. 27–33.

We consider the following factors when determining whether to deny institution under § 314(a) based on a parallel district court proceeding:

1. whether the court granted a stay or evidence exists that one may be granted if a proceeding is instituted;

[1] The Leahy-Smith America Invents Act (“AIA”) included revisions to 35 U.S.C. § 103 that became effective on March 16, 2013. Because the earliest possible effective filing date of the ’527 patent is after March 16, 2013, we apply the AIA version of this basis for unpatentability.
[2] US 2013/0182594 A1, published July 18, 2013 (Ex. 1004, “Kim”).
[3] WO 2015/199414 A1, published Dec. 30, 2015 (Ex. 1005, “Zhang”).
[4] US 2015/0195025 A1, published July 9, 2015 (Ex. 1006, “Kang”).
[5] US 2019/0387501 A1, published Dec. 19, 2019 (Ex. 1007, “Park”).

> 2. proximity of the court's trial date to the Board's projected statutory deadline for a final written decision;
>
> 3. investment in the parallel proceeding by the court and the parties;
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> 4. overlap between issues raised in the petition and in the parallel proceeding;
>
> 5. whether the petitioner and the defendant in the parallel proceeding are the same party; and
>
> 6. other circumstances that impact the Board's exercise of discretion, including the merits.

Apple Inc. v. Fintiv, Inc., IPR2020-00019, Paper 11 at 5–6 (PTAB Mar. 20, 2020) (precedential) ("*Fintiv*"). We also consider "several clarifications" made by the Director of the United States Patent and Trademark Office ("USPTO"). *See* USPTO Memorandum, Interim Procedure for Discretionary Denials in AIA Post-Grant Proceedings with Parallel District Court Litigation, 2 (June 21, 2022) ("Director's Memo").[6]

The Director's Memo provides that "[c]onsistent with *Sotera Wireless, Inc.*,[7] the PTAB will not discretionarily deny institution in view of parallel district court litigation where a petitioner presents a stipulation not to pursue in a parallel proceeding the same grounds or any grounds that could have reasonably been raised before the PTAB." Director's Memo 3. With our authorization, Petitioner has filed a stipulation, which stipulates

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[6] *Available at* https://www.uspto.gov/sites/default/files/documents/interim_proc_discretionary_denials_aia_parallel_district_court_litigation_memo_20220621_.pdf.

[7] *Sotera Wireless, Inc. v. Masimo Corp.*, IPR2020-01019, Paper 12 at 18–19 (PTAB Dec. 1, 2020) (precedential).

"that if the PTAB institutes *inter partes* review, Petitioner 'will not pursue in [*Apex Beam Technologies LLC v. Samsung Electronics Co., Ltd. et al.*, Case No. 2:22-cv-00188-JRG (E.D. Tex.) (consolidated with *Apex Beam Technologies LLC v. ZTE Corporation*, Case No. 2:22-cv-00031-JRG-RSP (E.D. Tex.))] the specific grounds [asserted in IPR2023-00603], or . . . any other ground . . . that was raised or could have been reasonably raised in an IPR (i.e., any ground that could be raised under §§ 102 or 103 on the basis of prior art patent or printed publications).'" Ex. 1031, 1 (quoting *Sotera Wireless, Inc.*, Paper 12 at 13–14) (alterations in original).

We determine that the language of this stipulation sufficiently comports with the language of the stipulation discussed in the Director's Memo. *See* Director's Memo 3. We accordingly decline to discretionarily deny institution in view of the related district court litigation.

III. PETITIONER'S EXPERT DECLARATION

Relying on the Board's precedential *Xerox* decision, Patent Owner argues that we should not consider Dr. Kakaes's declaration because it "is almost entirely a recitation of the Petition." Prelim. Resp. 34 (citing *Xerox Corp. v. Bytemar, Inc.*, IPR2022-00624, Paper 9 (PTAB Aug. 24, 2022) (precedential); 37 C.F.R. § 42.65(a)). Patent Owner argues that "[b]ecause Dr. Kakaes provides nearly no independent analysis aside from copying the attorney arguments in the Petition and does not disclose the underlying facts or data upon which his opinions are based, his opinion should be entitled to no weight." *Id.*

We do not read *Xerox* to require us to give little weight to an expert declaration solely because some or all of it is also repeated within the Petition. Rather, *Xerox* found a declaration was entitled to little weight

where the declaration merely repeated "the *conclusory* assertion for which it is offered to support." *Xerox*, Paper 9 at 15 (emphasis added). If declaration testimony is supported sufficiently and, in turn, supports contentions in the Petition, we do not give it little to no weight simply because it is repeated in the Petition. Patent Owner does not point to any specific statements in Dr. Kakaes's declaration and explain specifically why Patent Owner believes they are conclusory, and thus, Patent Owner has not sufficiently explained the applicability of *Xerox* here. *See, e.g.*, Prelim. Resp. 15 n.1, 18 n.2, 23 n.3, 25 n.4, 25 n.5, 34.

Moreover, we can assess the weight to be given to Dr. Kakaes's declaration testimony, including based on its corresponding factual support, if any, and afford such testimony an appropriate weight. Accordingly, at this stage, we decline Patent Owner's invitation to assign no weight to all of Dr. Kakaes's declaration testimony.

IV. LEVEL OF ORDINARY SKILL IN THE ART

To determine whether an invention would have been obvious at the time it was made, we consider the level of ordinary skill in the pertinent art at the time of the invention. *Graham v. John Deere Co.*, 383 U.S. 1, 17 (1966). In assessing the level of ordinary skill in the art, various factors may be considered, including the "type of problems encountered in the art; prior art solutions to those problems; rapidity with which innovations are made; sophistication of the technology; and educational level of active workers in the field." *In re GPAC, Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995) (citing *Custom Accessories, Inc. v. Jeffrey-Allan Indus., Inc.*, 807 F.2d 955, 962–63 (Fed. Cir. 1986)). "[O]ne or more factors may predominate." *Id.*

Petitioner argues that one of ordinary skill in the art at the time of the invention of the ’527 patent “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.” Pet. 9–10 (citing Ex. 1002 ¶ 65). Petitioner adds that “[m]ore work experience can compensate for less education, and *vice versa*.” *Id.* at 10.

Patent Owner at this stage of the proceeding does not provide an alternative definition for a level of skill in the art that one would have had at the time of the invention of the ’527 patent or identify any shortcoming in Petitioner’s formulation. *See* Prelim. Resp. 12.

For purposes of this Decision on Institution, we adopt Petitioner’s definition of the level of skill for one of ordinary skill in the art, except we decline to adopt the recitals of “at least” as that language is vague and open-ended. Pet. 10. As adopted, we view the definition for the level of ordinary skill is consistent with the ’527 patent and the asserted prior art, and we apply it in our analysis below.

V. CLAIM CONSTRUCTION

Because the Petition was filed after November 13, 2018, we apply the same claim construction standard that would be used in a civil action under 35 U.S.C. § 282(b), following the standard articulated in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc). 37 C.F.R. § 42.100(b); 83 Fed. Reg. 51,340, 51,340–41, 51,343 (Oct. 11, 2018). In applying such standard, claim terms are generally given their ordinary and customary meaning, as would be understood by a person of ordinary skill in the art, at the time of the invention and in the context of the entire patent disclosure.

Phillips, 415 F.3d at 1312–13. "In determining the meaning of the disputed claim limitation, we look principally to the intrinsic evidence of record, examining the claim language itself, the written description, and the prosecution history, if in evidence." *DePuy Spine, Inc. v. Medtronic Sofamor Danek, Inc.*, 469 F.3d 1005, 1014 (Fed. Cir. 2006) (citing *Phillips*, 415 F.3d at 1312–17).

Petitioner argues that "no terms need construction to resolve the controversy in this forum." Pet. 8. Patent Owner argues that at this stage of the proceeding, "claim construction is not required to resolve any issues." Prelim. Resp. 12.

We determine that no express constructions are needed for us to render our Decision on Institution. *See, e.g.*, *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc*., 200 F.3d 795, 803 (Fed. Cir. 1999)) ("[W]e need only construe terms 'that are in controversy, and only to the extent necessary to resolve the controversy.'"). Rather, at this stage of the proceeding, we apply the plain and ordinary meaning of the claim terms.

VI. PRINCIPLES OF LAW

A claim is unpatentable under 35 U.S.C. § 103 if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, would have been obvious at the time of the invention to a person having ordinary skill in the art. *KSR Int'l Co. v. Teleflex, Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the

prior art; (3) the level of ordinary skill in the art; and (4) objective evidence of non-obviousness, if present.[8] *See Graham*, 383 U.S. at 17–18. When evaluating a claim for obviousness, we also must "determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue." *KSR*, 550 U.S. at 418 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)).

VII. ALLEGED OBVIOUSNESS OVER KIM, ZHANG, AND KANG

Petitioner argues that the combination of Kim, Zhang, and Kang renders obvious claims 1, 4–6, 9–11, 14–16, 19, and 20. Pet. 10–56. We have reviewed the parties' arguments and the evidence of record. For the reasons that follow, we determine that Petitioner demonstrates a reasonable likelihood that it would prevail in showing that the combination of Kim, Zhang, and Kang renders at least one of these challenged claims obvious.

A. Summary of Kim

Kim "relates to a wireless mobile communication system . . . for effectively transmitting and receiving a [CSI-RS] and measuring interference." Ex. 1004 ¶ 3. In particular, Kim relates to "transmitting a reference signal for effective data transmission and reception, measuring interference, and generating channel state information in a [MIMO] transmission and reception." *Id.* ¶ 16. Kim's teachings are also directed to "effective transmission and reception of a reference signal in a massive [MIMO] wireless communication system which transmits data by using scores or more transmission antennas." *Id.* ¶ 47.

[8] Patent Owner does not present arguments or evidence of such objective evidence of non-obviousness. *See generally* Prelim. Resp.

To that end, Kim teaches "a method of transmitting a reference signal for generation of channel state information by [a base station] in a wireless communication system," which "includes grouping a plurality of transmission antennas into a plurality of antenna groups, transmitting the reference signal to UEs in different time intervals or frequency intervals according to the antenna groups." *Id.* ¶ 22. Similarly, Kim teaches "a method of transmitting a reference signal for generation of channel state information by [a base station] in a wireless communication system," which "includes grouping a plurality of beams transmitted through a plurality of transmission antennas into a plurality of beam groups, transmitting the reference signal to UEs in different time intervals or frequency intervals according to the beam groups." *Id.* ¶ 23.

B. Summary of Zhang

Zhang relates to "mobile communication systems, and more particularly to a method and apparatus for reference signal transmitting and receiving in active antenna systems." Ex. 1005 ¶ 1. In relevant part, Zhang teaches that "[p]ort virtualization to transmit antennas may be implemented for multiple . . . antenna ports and applying different vertical beamforming vectors to implement port virtualization for the different . . . antenna ports." *Id.* ¶ 63. Zhang explains that "[t]he port virtualization to transmit antennas refers to precoding the reference signal for the . . . port with a precoding vector." *Id.* ¶ 100.

C. Summary of Kang

Kang relates to wireless communication systems and, more specifically, to virtualizing an antenna. Ex. 1006 ¶ 1. In relevant part, Kang teaches implementing antenna virtualization at a UE's receiver. Ex. 1006

¶¶ 125–126, Fig. 10 (showing a receiver employing multiple virtual antennas). Kang also teaches that the UE can apply an antenna virtualization pattern to map its physical antennas to virtual antennas. *Id.* ¶¶ 138, 146.

D. Challenged Claim 1

1. Method for Multi-antenna Transmission (Preamble)

Claim 1's preamble recites "[a] method for multi-antenna transmission in a user equipment." Ex. 1001, 29:8–9. At this stage of the proceeding, we agree with Petitioner and find that Kim teaches claim 1's preamble. Pet. 15–16.

More specifically, we find that Kim teaches transmitting, by multiple antennas of a base station, a reference signal to a UE. Ex. 1004 ¶¶ 50–53, code (57), Fig. 3. Kim further teaches that "one UE can receive one or more spatial channels," and that "the number of spatial channels which one UE can receive is determined depending on the number of reception antennas owned by the UE and the channel condition." *Id.* ¶ 51.

After reviewing Petitioner's arguments and evidence, which are not addressed by Patent Owner at this stage of the proceeding, we are persuaded that Petitioner demonstrates, for purposes of this institution decision, that Kim teaches "[a] method for multi-antenna transmission in a user equipment." In light of our finding, we need not, and thus do not, reach whether claim 1's preamble is limiting.

2. Receiving a First Radio Signal

Claim 1 further recites "receiving a first radio signal from a base station." Ex. 1001, 29:10. At this stage of the proceeding, we agree with Petitioner and find that Kim teaches this limitation. Pet. 16.

In particular, at this stage, we find that Kim teaches a UE receiving a CSI-RS (i.e., first radio signal) from a base station. Ex. 1004 ¶¶ 55–58, 91. More specifically, the CSI-RS is a radio signal transmitted by transmission antennas of the base station to the UE. *Id.* ¶¶ 50, 58, Fig. 3; Ex. 1002 ¶ 94.

After reviewing Petitioner's arguments and evidence, which are not addressed by Patent Owner at this stage of the proceeding, we are persuaded that Petitioner demonstrates, for purposes of this institution decision, that Kim teaches "receiving a first radio signal from a base station."

3. Receiving a First Signaling

Claim 1 further recites "receiving a first signaling from the base station." Ex. 1001, 29:11. At this stage of the proceeding, we agree with Petitioner and find that Kim teaches this limitation. Pet. 17.

In particular, at this stage, we find that Kim teaches that the UE receives control information from the base station, where the control information indicates positions of time resources at which a CSI-RS for each antenna group is transmitted. Ex. 1004 ¶¶ 65, 69.

In addition, Kim teaches that the control information is "transferred to the UE, separately from the CSI-RSs." *Id.* ¶ 79. Kim also teaches that control information may be transmitted through a Physical Downlink Control Channel (PDCCH). *Id.* ¶ 107.

After reviewing Petitioner's arguments and evidence, which are not addressed by Patent Owner at this stage of the proceeding, we are persuaded that Petitioner demonstrates, for purposes of this institution decision, that Kim teaches "receiving a first signaling from the base station."

4. First Radio Signal Is Transmitted by K Antenna Port Groups

Claim 1 further recites "wherein the first radio signal is transmitted by K antenna port groups of the base station," "and the K is a positive integer greater than 1." Ex. 1001, 29:12–13, 29:25–26. At this stage of the proceeding, we agree with Petitioner and find that Kim teaches this limitation. Pet. 17–20, 36.

In particular, at this stage, we find that Kim teaches that the base station divides transmission antennas into a plurality of antenna groups and transmits a CSI-RS over the antenna groups. Ex. 1004 ¶¶ 55–58. More specifically, Kim teaches that "[i]n order to transmit a CSI-RS through scores or more transmission antennas," the base station "divides the transmission antennas into a plurality of groups." *Id.* ¶ 55. Kim teaches, for example, that "[o]ne antenna group includes 8 transmission antennas." *Id.* ¶ 57. Furthermore, Kim teaches that grouping may be "made based on actual transmission antennas," or "based on virtual transmission antennas other than the actual transmission antennas." *Id.*

In addition, Kim teaches that the CSI-RS is transmitted by a number of antenna port groups that is a positive integer greater than 1. For example, as we discuss above, Kim teaches that to transmit the CSI-RS, the base station "divides the transmission antennas into a plurality of groups." *Id.* ¶ 55; *see also id.* at Figs. 4–5 (showing five antenna groups for CSI-RS 510).

After reviewing Petitioner's arguments[9] and evidence, which are not addressed by Patent Owner at this stage of the proceeding, we are persuaded that Petitioner demonstrates, for purposes of this institution decision, that Kim teaches "wherein the first radio signal is transmitted by K antenna port groups of the base station."

5. Antenna Port Group Includes Antenna Port(s)

Claim 1 further recites that "the antenna port group includes a positive integer number of antenna port(s)." Ex. 1001, 29:13–14. At this stage of the proceeding, we agree with Petitioner and find that Kim teaches this limitation. Pet. 20.

In particular, at this stage, we find that Kim teaches that each antenna port group may include a plurality of antenna ports. *See* Ex. 1004 ¶¶ 55–57, Fig. 4 (showing eight antenna ports for each of five antenna groups). In particular, Kim teaches that, for example, "[o]ne antenna group includes 8 transmission antennas" (e.g., antenna ports). *Id.* ¶ 57 (citing Ex. 1004, Fig. 4). Kim also teaches that "the grouping may be made based on virtual transmission antennas," where "a virtual transmission antenna refers to an individual antenna signal which can be identified by a UE, and is implemented by a signal transmitted from an actual transmission antenna." *Id.* And at this stage, we find persuasive Dr. Kakaes's testimony that "each virtual transmission antenna constitutes an antenna port because signals

[9] Petitioner also argues that this limitation is taught by Kim's teachings of beam groups, where "each beam group corresponds to an antenna port (i.e., virtual antenna)." Pet. 19–20 (citing Ex. 1004 ¶¶ 80–81, 83, Fig. 7; Ex. 1001, 17:2–3). We do not reach these alternative arguments, because, at this stage, we find Petitioner's arguments concerning antenna groups sufficient for purposes of institution.

transmitted over each virtual transmission antenna experience the same channel characteristics, and the UE receives the signals from each virtual transmission antenna as if they are transmitted from a single antenna." Ex. 1002 ¶ 98. In addition, we agree with Petitioner that "8" is a positive integer number of antenna ports. Pet. 20 (citing Ex. 1002 ¶ 101).

After reviewing Petitioner's arguments and evidence, which are not addressed by Patent Owner at this stage of the proceeding, we are persuaded that Petitioner demonstrates, for purposes of this institution decision, that Kim teaches that "the antenna port group includes a positive integer number of antenna port(s)."

6. First Antenna Port Group

Claim 1 further recites that "a first antenna port group is one of the K antenna port groups." Ex. 1001, 29:14–16. At this stage of the proceeding, we agree with Petitioner and find that Kim teaches this limitation. Pet. 20.

In particular, at this stage, we find that Kim teaches, for example, having five antenna port groups for CSI-RS 510, and any of the antenna port groups 1–5 teach "a first antenna port group." Ex. 1004 ¶¶ 55–57, 60, Figs. 4–5; Ex. 1002 ¶¶ 103–104.

After reviewing Petitioner's arguments and evidence, which are not addressed by Patent Owner at this stage of the proceeding, we are persuaded that Petitioner demonstrates, for purposes of this institution decision, that Kim teaches "a first antenna port group is one of the K antenna port groups."

7. First Signaling Used to Determine First Time Resource Pool

Claim 1 further recites that "the first signaling is used to determine a first time resource pool." Ex. 1001, 29:16–17. At this stage of the

proceeding, we agree with Petitioner and find that Kim teaches this limitation. Pet. 20–22.

In particular, at this stage, we find that Kim teaches that "[i]n order to transmit the CSI-RSs for massive MIMO," as illustrated in Figure 5, a base station "should notify a UE of related control information before transmitting a CSI-RS." Ex. 1004 ¶ 65. "The control information is imperative for proper reception of the CSI-RSs for massive MIMO and proper determination of the channel state based on the received CSI-RSs by the UE." *Id.* Kim teaches that "[s]uch control information may include" "[i]nformation on the time and frequency resource positions at which the CSI-RSs for massive MIMO are transmitted, wherein this information includes positions of time and frequency resources at which a CSI-RS for each antenna group is transmitted." *Id.* ¶¶ 65, 69.

In addition, at this stage, we agree with Petitioner and find that Kim's Figure 5 illustrates that CSI-RSs for each antenna port group are transmitted over separate time resources (e.g., subframes). Pet. 21. Figure 5, as annotated by Petitioner, is shown below.

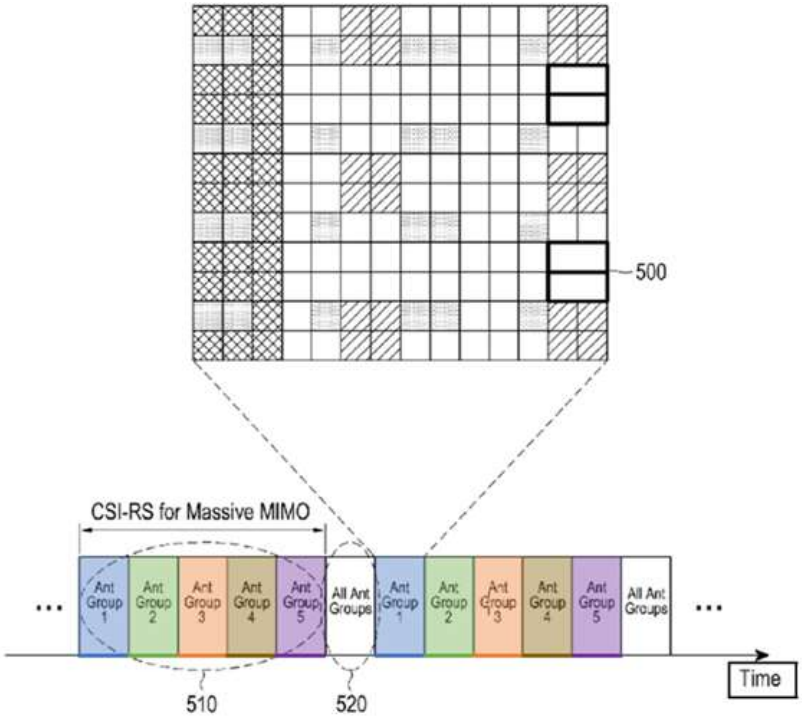

FIG.5

Figure 5 "illustrates a transmission of CSI-RSs for massive MIMO according to an exemplary embodiment of the" '527 patent. Ex. 1004 ¶ 30. Petitioner annotates the figure by coloring the blocks for (i) ANT (antenna) Group 1 blue, (ii) Ant Group 2 green, (iii) Ant Group 3 orange, (iv) Ant Group 4 brown, and (v) Ant Group 5 purple. Pet. 21 (annotating Ex. 1004, Fig. 5). Petitioner also draws a black box around the "Time" label on the axis. *Id.*

As illustrated, each of antenna groups 1–5 for CSI-RS 510 are transmitted using separate time resources—each group is situated at a different portion of the time axis. Ex. 1004, Fig. 5. Moreover, Figure 5 illustrates that each antenna group (e.g., the second (i.e., later in time) block for antenna group 1) "transmits a CSI-RS in each transmission interval by

using one CSI-RS resource [500] for 8 ports." *Id.* ¶ 60, Fig. 5 (showing that the CSI-RS transmission interval comprises a subframe). In addition, at this stage, we find persuasive Dr. Kakaes's testimony that based on Kim's teachings, one of ordinary skill in the art "would have understood that the first signaling including the control information is used by the [UE] to determine a first time resource pool over which the CSI-RS for the first antenna port group is transmitted, such that the user equipment can properly receive the CSI-RS for the first antenna port group." Ex. 1002 ¶ 107. We view this testimony as consistent with Kim's teachings, discussed above.

At this stage, we find unavailing Patent Owner's argument that Petitioner mischaracterizes Kim's teachings when Petitioner argues that "*Kim* [shows] that CSI-RSs for each antenna port group are transmitted over separate time resources (subframes)." *See* Prelim. Resp. 15 (citing Pet. 21). Patent Owner argues that Kim "actually indicate[s] that an 'antenna group transmits a CSI-RS in ***each*** transmission interval by using ***one*** CSI-RS resource.'" *Id.* (quoting Ex. 1004 ¶ 60) (alterations in original). Patent Owner restates this argument as Kim teaching "a CSI-RS is transmitted over only one subframe." *Id.*

Patent Owner's argument is unclear. To the extent that Patent Owner is arguing that Kim teaches that all antenna groups transmit during the same subframe, we disagree. Rather, Kim teaches that each antenna group transmits a CSI-RS during different subframes, as we discuss above. *See* Ex. 1004 ¶¶ 60, 69, Fig. 5. To the extent that Patent Owner is arguing that Kim teaches that each antenna group only transmits a single CSI-RS that is one subframe, we also disagree. Rather, Kim teaches that each antenna group transmits a CSI-RS in multiple subframes. *See id.* at Fig. 5 (showing

the repetition of subframes for each antenna group along the time axis). In addition, Patent Owner does not explain how its argument relates to the language of this limitation. *See* Prelim. Resp. 15–16.

At this stage, we also find unavailing Patent Owner's argument that Petitioner ignores the term "pool" because "Petitioner's expert notes that 'the first time resource pool' is 'the time resource corresponding to the first antenna port group.'" *See id.* (quoting Ex. 1002 ¶ 130). First, we note that this portion of Dr. Kakaes's testimony relates to another limitation, and thus how Petitioner allegedly ignored "pool" in its showing for this limitation because of this testimony is unclear. Second, at this stage, we view how Patent Owner parsed the quoted testimony as changing its meaning. In particular, Dr. Kakaes actually testifies that "*Kim* discloses that the base station applies a precoding scheme in the first time resource pool (the time resource corresponding to the first antenna port group) for transmitting the CSI-RS corresponding to the first antenna port group." Ex. 1002 ¶ 130. At this stage, rather than equating "the first time resource pool" with "the time resource corresponding to the first antenna port group," we view this testimony, when read in the context of the entire sentence, as conveying that "the time resource corresponding to the first antenna port group" is the time portion of "the first time resource pool" that is precoded for the CSI-RS "corresponding to the first antenna port group." *Id.*

In addition, at this stage, we find unavailing Patent Owner's argument that "Kim cannot disclose the claimed 'time resource ***pool***' because it only discloses one subframe in which to transmit a CSI-RS." Prelim. Resp. 16–17. As we discuss above, at this stage, we disagree with this reading of Kim.

In addition, we find unavailing Patent Owner's argument that "[p]recluding the time resource pool from having multiple subframes, as in Kim, would completely eliminate . . . embodiments in the '527 [p]atent which describe sub-pools (i.e., a subset of subframes from the first resource pool) that receive the second radio signal." *Id.* at 17–18. The proper scope of "time resource pool" is not guided by what Kim teaches, but rather what the term would have meant to one of ordinary skill in the art in light of the intrinsic evidence for the '527 patent. And at this stage, we view the claim construction question that would arise under Patent Owner's reading of Kim to be whether "pool" covers a single time resource, as well as multiple time resources—not whether multiple time resources are precluded. Again, however, we disagree with Patent Owner's reading of Kim, at this stage.

In sum, at this stage, we find that Kim teaches that "the first signaling is used to determine a first time resource pool."

8. First and Second Antenna Virtualization Vectors

Claim 1 further recites that "at least one of a first antenna virtualization vector and a second antenna virtualization vector is associated with the first antenna port group." Ex. 1001, 29:17–20.

As an initial matter, at this stage of the proceeding, we conclude that the plain and ordinary meaning of this claim limitation requires both a first antenna virtualization vector and a second antenna virtualization vector, contrary to Petitioner's argument. *See* Ex. 1001, 29:17–20; Pet. 23. Petitioner's sole basis to argue that this limitation "require[s] ***either*** a first antenna virtualization ***or*** a second antenna virtualization vector, but not both" is Petitioner's reading of Patent Owner's infringement contentions. Pet. 23 (citing Ex. 1022, 15–26). Such a basis is insufficient to overcome

the plain and ordinary meaning of the claim language. However, we conclude, at this stage, that the plain and ordinary meaning of the claim language only requires that at least one of these vectors is associated with the first antenna port group. *See* Ex. 1001, 29:17–20.

At this stage of the proceeding, we agree with Petitioner and find that the combination of Kim, Zhang, and Kang teaches this limitation, which includes teaching both the first and second antenna virtualization vectors. Pet. 23–34.

a. First Antenna Virtualization Vector

At this stage, we agree with Petitioner and find that the combination of Kim and Zhang teaches the claimed first antenna virtualization vector. Pet. 23–25. In particular, we find that Kim teaches for a base station that each antenna port group includes multiple antenna ports, as we discuss above. *See supra* Section VII.D.5; Ex. 1004 ¶¶ 55–57, Fig. 4. As we also discuss above, Kim teaches that the antenna port grouping may be made based on virtual transmission antennas, and that each virtual transmission antenna constitutes an antenna port. *See supra* Section VII.D.5; Ex. 1004 ¶ 57; Ex. 1002 ¶ 98. In addition, at this stage, we find persuasive Dr. Kakaes's testimony that Kim teaches that a base station can apply "a precoding scheme to multiple physical antennas to form an antenna port (beam or virtual antenna) for transmitting the CSI-RS." Ex. 1002 ¶ 110 (citing Ex. 1004 ¶¶ 80–81).

As to Zhang, we find that Zhang teaches implementing port virtualization for transmit antennas for multiple antenna ports by applying different vertical beamforming vectors for the different ports. Ex. 1005 ¶ 63; *see also id.* ¶ 100 (teaching that "[t]he port virtualization to transmit

antennas refers to precoding the reference signal for the . . . port with a precoding vector"). At this stage, we find persuasive Dr. Kakaes's testimony that Zhang teaches "applying a first antenna virtualization vector at a base station to implement an antenna port virtualization," as we find this testimony consistent with Zhang. Ex. 1002 ¶ 111.

In addition, at this stage, we find persuasive Dr. Kakaes's testimony that "in the context of the antenna port for transmitting the CSI-RS, [one of ordinary skill in the art] would [have] underst[oo]d that a first antenna virtualization vector is associated with the first antenna port group because the antenna port formed by the virtualization vector for transmitting the CSI-RS is part of the first antenna port group." *Id.* ¶ 110.

At this stage, we find unavailing Patent Owner's arguments that "the '527 [p]atent describes that the first antenna virtualization vector is a 'vector of the base station in the first time resource pool,'" and "a first time resource pool, . . . is directly tied to the claimed 'first antenna port group.'" Prelim. Resp. 21–22 (citing Ex. 1001, 17:1–7, 17:27–34). Claim 1 recites in a subsequent limitation that "the first antenna virtualization vector is an antenna virtualization vector available to the base station in the first time resource pool." Ex. 1001, 29:20–22. This subsequent language sets forth the claimed relationship between the first antenna virtualization vector and the first time resource pool, for which we analyze Petitioner's arguments below. *See infra* Section VII.D.9; *See In re Hiniker Co.*, 150 F.3d 1362, 1369 (Fed. Cir. 1998) (stating "the name of the game is the claim"). Likewise, claim 1 sets forth how "a first time resource pool" relates to "a first antenna port group." *See* Ex. 1001, 29:8–26. Patent Owner's argument is unavailing to the extent that it seeks to add an additional requirement to

the claim language. *See In re Self*, 671 F.2d 1344, 1348 (CCPA 1982) (stating limitations not appearing in the claims cannot be relied upon for patentability).

In sum, at this stage, we find that the combination of Kim and Zhang teaches that "at least . . . a first antenna virtualization vector . . . is associated with the first antenna port group." We also find, for purposes of institution, that Petitioner has provided sufficiently articulated reasoning with rational underpinning to support combining Kim and Zhang with a reasonable expectation of success, which is not addressed by Patent Owner at this stage of the proceeding. *See* Pet. 25–28; *In re Kahn*, 441 F.3d at 988.

b. Second Antenna Virtualization Vector

At this stage of the proceeding, we agree with Petitioner and find that the combination of Kim and Kang teaches the claimed second antenna virtualization vector. Pet. 28–31. In particular, we agree with Petitioner and find that Kim teaches that a UE can be equipped with multiple reception antennas to receive multiple spatial channels. Ex. 1004 ¶ 51. In particular, Kim teaches that "one UE can receive one or more spatial channels," where "the number of spatial channels which one UE can receive is determined depending on the number of reception antennas owned by the UE and the channel condition." *Id.*

As to Kang, we agree with Petitioner and find that Kang teaches implementing antenna virtualization at the receiver. *See, e.g.*, Ex. 1006 ¶¶ 125–126, Fig. 10 (showing a receiver employing multiple virtual antennas). Kang also teaches that the UE can apply an antenna virtualization pattern to map its physical antennas to virtual antennas. *Id.* ¶¶ 138, 146. At this stage, we find persuasive Dr. Kakaes's testimony that one of ordinary

skill in the art "would have understood that the antenna virtualization pattern in *Kang* corresponds to an antenna virtualization vector (beamforming vector) to form a receiving beam," as shown by "references describing using an antenna virtualization vector (beamforming vector) to form a receiving beam." Ex. 1002 ¶ 122 (citing Ex. 1005 ¶ 63; Ex. 1011, 3; Ex. 1013, 2–3, Figs. 5–6; Ex. 1028 ¶¶ 89–90, Fig. 5C; Ex. 1014, 2–3; Ex. 1015, 1–3).

In addition, at this stage, we find persuasive Dr. Kakaes's testimony that one of ordinary skill in the art would have found it obvious "to apply *Kang*'s antenna virtualization vector at the user equipment to receive *Kim*'s CSI-RS signal that is transmitted over the first antenna port group at the base station." Ex. 1002 ¶ 124; *KSR*, 550 U.S. at 417 ("[I]f a technique has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way, using the technique is obvious unless its actual application is beyond his or her skill."). At this stage, we also find persuasive Dr. Kakaes's testimony that "*Kang*'s antenna virtualization vector would be associated with the first antenna port group because *Kang*'s antenna virtualization vector would be used to receive signals transmitted over the first antenna port group." Ex. 1002 ¶ 124. At this stage, we disagree with Patent Owner's argument that this testimony is conclusory. Prelim. Resp. 20. Rather, at this stage, we find that this testimony is consistent with Kim and Kang's combined teachings. *See* Ex. 1004 ¶ 51; Ex. 1006 ¶¶ 125–126, 138, 146, Fig. 10.

In sum, at this stage, we find that the combination of Kim and Kang teaches that "at least . . . a second antenna virtualization vector . . . is associated with the first antenna port group." We also find, for purposes of institution, that Petitioner has provided sufficiently articulated reasoning

with rational underpinning to support combining Kim and Kang with a reasonable expectation of success, which is not addressed by Patent Owner at this stage of the proceeding. *See* Pet. 31–34; *In re Kahn*, 441 F.3d at 988.

9. First Antenna Virtualization Vector Available to Base Station

Claim 1 further recites that "the first antenna virtualization vector is an antenna virtualization vector available to the base station in the first time resource pool." Ex. 1001, 29:20–22. At this stage of the proceeding, we agree with Petitioner and find that the combination of Kim and Zhang teaches this limitation. Pet. 34.

As we discuss above, the combination of Kim and Zhang teaches a first antenna virtualization vector (i.e., a port) that is available to the base station and associated with the first antenna port group. *See supra* Section VII.D.8.a. As we also discuss above, Kim teaches the first time resource pool via its teachings regarding the positions of time resources at which a CSI-RS for each antenna port group (including the first antenna port group) is transmitted. *See supra* Section VII.D.7; Ex. 1004 ¶¶ 65, 69; Ex. 1002 ¶ 130. Hence, at this stage, we find that the combination of Kim and Zhang teaches that "the first antenna virtualization vector is an antenna virtualization vector available to the base station in the first time resource pool."

10. Second Antenna Virtualization Vector Available to UE

Claim 1 further recites that "the second antenna virtualization vector is an antenna virtualization vector available to the user equipment in the first time resource pool." Ex. 1001, 29:22–25. At this stage of the proceeding, we agree with Petitioner and find that the combination of Kim and Kang teaches this limitation. Pet. 35–36.

As we discuss above, the combination of Kim and Kang teaches a second antenna virtualization vector (i.e., a port) that is available to the UE and associated with the first antenna port group. *See supra* Section VII.D.8.b. As we also discuss above, Kim teaches the first time resource pool via its teachings regarding the positions of time resources at which a CSI-RS for each antenna port group (including the first antenna port group) is transmitted, and thus, received. *See supra* Section VII.D.7; Ex. 1004 ¶¶ 65, 69; Ex. 1002 ¶ 132. Hence, at this stage, we find that the combination of Kim and Kang teaches that "the second antenna virtualization vector is an antenna virtualization vector available to the user equipment in the first time resource pool."

11. Summary

In summary, based on the current record, and for purposes of this institution decision, we determine that Petitioner shows a reasonable likelihood that the combination of Kim, Zhang, and Kang renders claim 1 obvious.

E. Challenged Claims 4–6, 9–11, 14–16, 19, and 20

At this stage in the proceeding, Patent Owner does not address separately Petitioner's arguments and evidence as to how the combination of Kim, Zhang, and Kang teaches the limitations of claims 4–6, 9–11, 14–16, 19, and 20. *See* Prelim. Resp. 26–27. We have reviewed Petitioner's arguments and evidence regarding these claims, and, on the current record, we find them persuasive for purposes of institution.

VIII. ALLEGED OBVIOUSNESS OVER KIM, ZHANG, KANG, AND PARK

Petitioner argues that the combination of Kim, Zhang, Kang, and Park renders obvious claims 2, 3, 7, 8, 12, 13, 17, and 18. Pet. 56–79. At this stage in the proceeding, Patent Owner does not address separately Petitioner's arguments and evidence as to how the combination of Kim, Zhang, Kang, and Park teaches the limitations of claims 2, 3, 7, 8, 12, 13, 17, and 18. *See* Prelim. Resp. 26–27. We have reviewed Petitioner's arguments and evidence regarding these claims, and, on the current record, we find them persuasive for purposes of institution.

IX. REMAINING GROUNDS

Petitioner argues that the combination of (i) Kim and Zhang renders obvious claims 1, 4–6, 9–11, 14–16, 19, and 20; and (ii) Kim, Zhang, and Park renders obvious claims 2, 3, 7, 8, 12, 13, 17, and 18. Pet. 10–79. Petitioner already has demonstrated a reasonable likelihood of success in proving that at least one claim of the '527 patent would have been obvious in view of other asserted grounds. In order to provide guidance to the parties, however, we note that we question whether Petitioner's showing is sufficient with respect to limitations involving the "second antenna virtualization vector" for these remaining grounds, which do not include Kang. *See* Consolidated Trial Practice Guide (November 2019)[10] 6 ("If a trial is instituted, the Board generally will provide analysis of the strengths and weaknesses of all challenges in the petition in order to provide guidance to the parties for the upcoming trial."). The parties should consider developing this issue during trial, in accordance with our Rules.

[10] *Available at* https://www.uspto.gov/TrialPracticeGuideConsolidated.

X. CONCLUSION

For the foregoing reasons, we determine that Petitioner shows a reasonable likelihood that it would prevail in proving the unpatentability of at least one of the challenged claims of the ’527 patent. We thus institute an *inter partes* review of all of the challenged claims of the ’527 patent on all grounds asserted in the Petition. *See* 37 C.F.R. § 42.108(a).

Any findings or conclusions in this Decision are made only for the purposes of institution and are not dispositive of any issue. We have not made a final determination with respect to the patentability of any challenged claim. Our final determination will be based on the record as fully developed during trial, including any evidence or argument timely presented by the parties under our Rules.

XI. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that, pursuant to 35 U.S.C. § 314(a), an *inter partes* review of the ’527 patent is instituted on all of the challenged claims and all grounds asserted in the Petition; and

FURTHER ORDERED that pursuant to 35 U.S.C. § 314(c) and 37 C.F.R. § 42.4, notice is hereby given of the institution of a trial; the trial commences on the entry date of this Decision.

FOR PETITIONER:

Joshua L. Goldberg
Kevin D. Rodkey
Nicholas A. Cerulli
Mingji Jin
Chen Zang
Yi Yu
FINNEGAN, HENDERSON, FARABOW, GARRETT & DUNNER, LLP
joshua.goldberg@finnegan.com
kevin.rodkey@finnegan.com
nicholas.cerulli@finnegan.com
mingji.jin@finnegan.com
chen.zang@finnegan.com
yi.yu@finnegan.com

FOR PATENT OWNER:

Vincent J. Rubino
Peter Lambrianakos
Enrique W. Iturralde
FABRICANT LLP
vrubino@fabricantllp.com
plambrianakos@fabricantllp.com
eiturralde@fabricantllp.com