

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.

Case No. IPR2023-00747
U.S. Patent No. 10,951,271

PETITION FOR *INTER PARTES* REVIEW

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Ex. 1003	Declaration of Apostolos K. Kakaes, Ph.D. (“Kakaes”)
Ex. 1004	CV of Apostolos K. Kakaes, Ph.D.
Ex. 1005	International Publication WO2016/015307 A1 to Liu et al.
Ex. 1006	Certified English translation of International Publication WO2016/015307 A1 to Liu et al. (“ <i>Liu</i> ”) ¹
Ex. 1007	Certification of English translation of International Publication WO2016/015307 A1 to Liu et al.
Ex. 1008	International Publication WO2016/126099 A1 to Park et al.
Ex. 1009	Certified English translation of International Publication WO2016/126099 A1 to Park et al. (“ <i>Park</i> ”) ²
Ex. 1010	Certification of English translation of International Publication WO2016/126099 A1 to Park et al.
Ex. 1011	U.S. Patent Application Publication No. 2013/0308608 A1 to Hu et al. (“ <i>Hu</i> ”)
Ex. 1012	U.S. Patent Application Publication No. 2011/0038330 A1 to Luo et al. (“ <i>Luo</i> ”)
Ex. 1013	U.S. Patent Application Publication No. 2011/0176519 A1 to Vitthaladevuni et al. (“ <i>Vitthaladevuni</i> ”)

¹ Citations to *Liu* are made to the English translation.

² Citations to *Park* are made to the English translation.

Exhibit	Description
Ex. 1014	Excerpts from Stefania Sesia et al., <i>LTE – The UMTS Long Term Evolution from Theory to Practice</i> (John Wiley & Sons, Ltd. 2d ed. 2011) (“ <i>Sesia LTE</i> ”)
Ex. 1015	3GPP TS 36.133 v13.2.0 (“Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for support of radio resource management (Release 13)”) (Jan. 2016)
Ex. 1016	3GPP TS 36.211 v13.0.0 (“Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Physical channels and modulation (Release 13)”) (Dec. 2015)
Ex. 1017	3GPP TS 36.212 v13.0.0 (“Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Multiplexing and channel coding (Release 13)”) (Dec. 2015)
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Ex. 1020	3GPP TS 36.331 v13.0.0 (“Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification (Release 13)”) (Dec. 2015)
Ex. 1021	Farhana Afroz et al., <i>SINR, RSRP, RSSI and RSRQ Measurements in Long Term Evolution Networks</i> , International Journal of Wireless & Mobile Networks (IJWMN), Vol. 7, No. 4, pp. 113-123 (Aug. 2015) (“ <i>Afroz</i> ”)

Exhibit	Description
Ex. 1022	<i>Apex Beam Technologies LLC v. Samsung Electronics Co. Ltd. et al.</i> , No. 2:22-cv-00188-JRG, Dkt. No. 1, Complaint for Patent Infringement (E.D. Tex. June 1, 2022)
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Ex. 1027	U.S. Patent Application Publication No. 2015/0036612 A1 to Kim et al. (" <i>Kim</i> ")
Ex. 1028	International Publication WO2015/131494 A2 to Chen et al.
Ex. 1029	Certified English translation of International Publication WO2015/131494 A2 to Chen et al. (" <i>Chen</i> ")
Ex. 1030	Certification of English translation of International Publication WO2015/131494 A2 to Chen et al.
Ex. 1031	<i>Apex Beam Technologies LLC v. Samsung Electronics Co. Ltd. et al.</i> , No. 2:22-cv-00188-JRG, Plaintiff's Infringement Contentions, Appendix E - Claim Chart for US Patent No. 10,951,271 Against Samsung Accused Products (E.D. Tex. Jan. 5, 2023)

I. PRELIMINARY STATEMENT

Petitioner Samsung Electronics Co., Ltd., and Samsung Electronics America, Inc. (collectively “Petitioner”), requests *inter partes* review of U.S. Patent 10,951,271 (Ex. 1001), assigned to Patent Owner Apex Beam Technologies LLC, and cancellation of claims 1-20.

The challenged claims are directed to wireless communications and describe a procedure for a user equipment to select and report channel information about transmitting antenna port groups. During prosecution, the applicant attempted to distinguish the claimed invention from the prior art by stating that the invention uses the measured reference signal received powers (“RSRP”) and calculates an RSRP ratio to select the transmitting antenna ports. But U.S. Patent Application Publication No. 2015/0036612 to Kim et al. (“*Kim*”) and International Publication WO2015/131494 to Chen et al. (“*Chen*”)³ both teach that calculating RSRP-to-max(RSRP) ratios was a well-known method to select the transmitting antenna ports. The examiner, however, did not consider *Kim* or *Chen*.

As explained below, claims 1-20 would have been obvious based on *Kim* and *Chen*. The Board should thus institute review and cancel all challenged claims.

³ Citations to *Chen* are made to the English translation.

II. THE '271 PATENT

A. Alleged Invention

The '271 patent discloses “a scheme for multi-antenna transmission in a wireless communication system” and describes “a method for multi-antenna transmission in a user equipment (UE), including: receiving a first signaling; receiving a first wireless signal; and transmitting first information.” Ex. 1001, 1:18-19, 1:59-63. In the method, “K antenna port groups are used to transmit the first wireless signal,” and “the first signaling is used to determine the K antenna port groups.” *Id.*, 1:64-67. “[T]he K antenna port groups respectively correspond to K channel quality values,” which are “Reference Signal Received Power[s] (RSRP[s]).” *Id.*, 1:67-2:2, 3:63-65. “K1 antenna port groups” correspond to “K1 channel quality values of the K channel quality values,” where K1 is “less than or equal to the K.” *Id.*, 2:2-5. In the method, “a first proportional sequence corresponds to a ratio(ratios) among the K1 channel quality values,” and “the first information is used to determine []the K1 antenna port groups[and] the first proportional sequence[.]” *Id.*, 2:5-9. The “K1 channel quality values” include “a first channel quality [that] is a best channel quality value” and “a second channel quality [that] is a worse channel quality value,” and “a ratio between the second channel quality and the first channel quality [being] greater than or equal to [a] target threshold” determined from the first signaling. *Id.*, 2:9-16. The '271 patent

explains that an “antenna port group” may be “composed of one antenna port.” *Id.*, 2:45-46, 13:64-65. These disclosures parallel the claims of the ’271 patent.

The ’271 patent describes “the advantage of the foregoing method” “is that the base station may obtain a proportional relationship among reception qualities corresponding to multiple beams.” *Id.*, 2:17-22. The claims recite only transmitting “first information,” which “is *used to determine*... the first proportional sequence,” not sending the proportional sequence itself. *Id.*, 27:20-21, 27:37-39 (emphasis added); Ex. 1003, Kakaes Declaration (“Kakaes”) ¶72. But the prior art taught this, as explained below.

B. Claim Construction

Claims must be construed only to the extent necessary to resolve a controversy. *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017). Here, no terms need construction to resolve the controversy in this forum.⁴

⁴ Petitioner reserves the right to argue in an appropriate forum that certain limitations in the challenged claims are indefinite.

III. STATEMENT OF PRECISE RELIEF REQUESTED

A. Prior Art

Ex. 1027	U.S. Patent Application Publication No. 2015/0036612 to Kim <i>(“Kim”)</i>
Ex. 1028	International Publication WO2015/131494 to Chen
Ex. 1029	Certified English translation of International Publication WO2015/131494 to Chen (<i>“Chen”</i>) ⁵

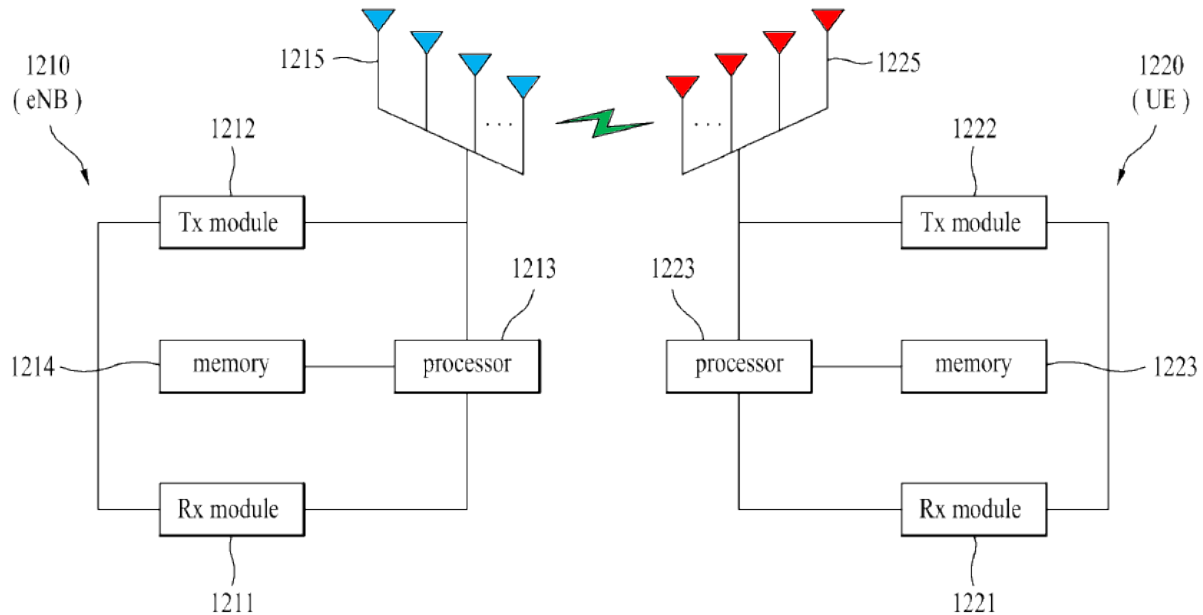
1. *Kim*

Kim published February 5, 2015, as U.S. Patent Application Publication No. 2015/0036612, making *Kim* prior art under 35 U.S.C. § 102(a)(1)-(2).

Kim discloses “a method for a terminal carrying out a measurement report in a wireless communication system.” *Kim*, Abstract, [0001]. *Kim*’s method includes a “terminal,” e.g., “user equipment (UE).” *Kim*, [0036], FIG. 12. *Kim*’s FIG. 12 shows a “UE device 1220” that “include[s] an Rx module 1221, a Tx module 1222, ... and a plurality of antennas 1225” (**red**), and a “BS [base station] device 1210” that “include[s] a reception (Rx) module 1211, a transmission (Tx) module 1212,

⁵ *Chen* citations are to the English translation.

... and a plurality of antennas 1215” (blue). *Kim*, [0174], [0177]. The “plurality of antennas” of the base station and UE indicate the devices “supporting MIMO transmission and reception” (green). *Id.*; Kakaes ¶84.



Kim, FIG. 12 (annotated).

Kim’s base station transmits signaling to the UE. *Kim*, [0079]-[0081], Table 3. The signaling includes “CSI-RS [Channel State Information-Reference Signal] config information element[s],” such as “antennaPortsCount-r10” that “indicates the number of antennas” used for transmitting CSI-RS pilot signals to the UE. *Kim*, [0079]-[0080]. *Kim*’s base station “inform[s] the UE of specific information through RRC [Radio Resource Control] signaling,” including “CSI-RS configuration” information that identifies an “antenna port pair” transmitting a

particular CSI-RS signal. *Kim*, [0142]. These reference signals “may be transmitted through 1, 2, 4 or 8 antenna ports” of the base station, and each CSI-RS “may be mapped to REs [Resource Elements of a Resource Block (“RB”)] on a per-antenna port basis.” *Kim*, [0071], [0074], [0076]. When receiving the CSI-RSs from the base station, “the UE performs RSRP measurement reporting” of the received signals and transmits a measurement report back to the base station. *Kim*, [0111]. *Kim*’s “UE may report... indexes of a maximum of M CSI-RSs” having a “ratio ($\text{RSRP}_n / \max(\text{RSRP}_i)$)... which is higher than a predetermined threshold value” and “the RSRP estimation result of the corresponding CSI-RS.” *Kim*, [0135]-[0136] (“measurement report value for the n-th CSI-RS” can be “the ratio of the n-th CSI-RS average Rx power level to the best CSI-RS average Rx power level”), [0148]-[0149].

Kim is analogous art to the ’271 patent because *Kim* is in the same field of endeavor, particularly wireless communications related to multi-antenna technology, such as MIMO, like the ’271 patent’s “communication scheme of MIMO using multiple antennas.” *Compare Kim*, [0102], [0174] (MIMO base station), [0177] (MIMO UE), with Ex. 1001, 1:18-19; Kakaes ¶86. *Kim* “relates to a wireless communication system” and “a method and apparatus for performing measurement report[s]” in MIMO systems. *Kim*, [0001], [0053], [0102]. *Kim* addresses “various matters such as a triggering condition associated with a

measurement report based on various reference signals (RSs),” e.g., CSI-RS, like the ’271 patent’s antenna port groups selection through feedback measurement reports. *Compare Kim*, [0003], [0005], with Ex. 1001, 1:40-50, 4:13-14, 13:25-52; Kakaes ¶86.

2. *Chen*

Chen published September 11, 2015, as WIPO publication WO2015/131494, making *Chen* prior art under 35 U.S.C. § 102(a)(1)-(2).

Chen relates to “a channel information feedback method and pilot and beam transmission methods.” *Chen*, 1. In *Chen*, a “base station configures the N pilot ports in the M pilot ports for [a] terminal according to terminal information reported by the terminal.” *Chen*, 11, FIG. 1. The terminal (UE) “receives and detects pilot signals from the N pilot ports” and detects the N pilot signals “according to the port information... to obtain received powers corresponding to the N types of pilot signals.” *Chen*, 13, FIG. 1. “[T]he terminal selects K pilot ports from the N pilot ports according to received signal quality, and feeds back channel information of channels formed by the K pilot ports,” where the K pilot ports are selected “according to a power threshold configured by the base station.” *Chen*, 14, FIG. 1. The pilot ports and threshold are configured “through signaling” by the base station to the UE. *Chen*, Abstract, 11, 18, 21, 23.

Chen is analogous art to the '271 patent because *Chen*, like the '271 patent, relates to “a wireless communication system, a transmitter and a receiver achiev[ing] a higher data transmission rate by means of a plurality of antennas in a spatial multiplexing manner,” and in particular MIMO transmission systems.

Compare Chen, 1, 3, with Ex. 1001, 1:18-19; Kakaes ¶89. *Chen*, like the '271 patent, describes a “channel information feedback method” where a UE “receives and detects pilot signals from the N pilot ports” of a base station, “selects K pilot ports from the N pilot ports according to received signal quality, and feeds back channel information of channels formed by the K pilot ports” to the base station. *Chen*, 3; Kakaes ¶89.

B. Challenges

Ground	Claims	Basis	Prior Art
1	1-20	35 U.S.C. § 103	<i>Kim and Chen</i>

IV. LEVEL OF ORDINARY SKILL

A person of ordinary skill in the art (“POSITA”) would have had at least a master’s degree in electrical engineering or a similar field and at least two years of experience working with telecommunications systems, including multiple-input multiple-output (“MIMO”) technology. Additional relevant work experience can compensate for less education, and vice versa. Kakaes ¶81.

V. THE CHALLENGED CLAIMS ARE UNPATENTABLE

A. Ground 1: Claims 1-20 Are Rendered Obvious by *Kim* and *Chen*

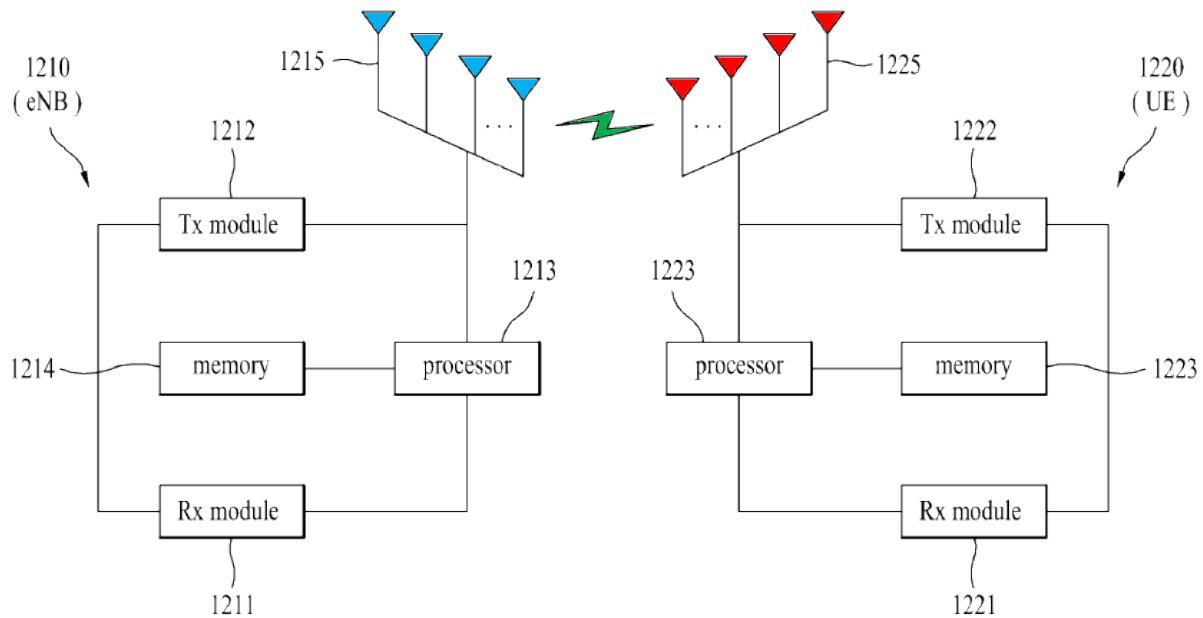
1. Claim 1:

Kim and *Chen* render obvious claim 1. Kakaes ¶¶94-147.

a. [1Preamble] “A method for multi-antenna transmission in a user equipment (UE), comprising:”

To the extent the preamble is limiting, *Kim* discloses [1Preamble]. Kakaes ¶¶96-98.

Kim discloses “a method for a terminal carrying out a measurement report in a wireless communication system.” *Kim*, Abstract, [0001]. *Kim*’s method includes transmitting “a measurement report based on various reference signals (RSs).” *Kim*, [0003]; Kakaes ¶97. The base station and UE each engage in multi-antenna transmission in a MIMO system where multiple base station (“BS”) antennas transmit to the UE and multiple “terminal” (UE) antennas transmit to the base station. *Kim*, [0174], [0177], [0036]; Kakaes ¶97. *Kim*’s UE and base station are “device[s] for supporting MIMO transmission and reception” (**green**), where “UE device 1220” includes an “Rx module 1221,” “Tx module 1222,” and “plurality of antennas 1225” (**red**), and the “BS device 1210” includes a “reception (Rx) module 1211,” “transmission (Tx) module 1212,” and “plurality of antennas 1215” (**blue**). *Kim*, [0174], [0177]; Kakaes ¶97.



Kim, FIG. 12 (annotated).

Kim explains that, “[i]f data is transmitted and received using multiple antennas, a channel state between each transmission antenna and each reception antenna should be known in order to accurately receive a signal,” which, together with the discussions cited below, describes multi-antenna transmission in a UE and a base station. *Kim*, [0053]; Kakaes ¶¶98.

b. [1a] “receiving, by the UE, a first signaling originating from a base station;”

Kim discloses element [1a]. Kakaes ¶¶99-103.

Kim discloses the UE receiving first signaling, for example, “RRC [Radio Resource Control] signaling” that includes “CSI-RS [Channel State Information-Reference Signal] config information element[s],” originating from the base

station. *Kim*, [0079]-[0081], Table 3, [0142], [0146], [0148]; Kakaes ¶100. This signaling includes “antennaPortsCount-r10,” which “indicates the number of antennas needed for CSI-RS transmission (for example, one, two, four, or eight antennas may be selected),” and “resourceConfig-r10,” which “indicate[s] a CSI-RS transmission position” such as the “RE [Resource Element] of a single RB [Resource Block]” for the CSI-RS. *Kim*, [0080]-[0081]. The RRC signaling’s “CSI-RS configuration” information may also identify an “antenna port pair” transmitting to the UE. *Kim*, [0142].

The RRC signaling indicates a set of antenna port groups for measuring channel quality values by the UE. *Kim*, [0146]; Kakaes ¶101. The UE measures the RSRP of the indicated CSI-RSs and selects and reports the “M CSI-RS values each having the best quality,” “where M... may be previously designated by the BS through RRC signaling.” *Kim*, [0146].

A POSITA, as Dr. Kakaes explains, would have recognized that *Kim*’s RRC signaling, such as configuration information, (“first signaling”) is used by the UE to determine the set of N antenna port groups to measure, with information of M determined antenna port groups of the N antenna port groups being fed back to the base station in a measurement report, including as known in the 3GPP standards. Kakaes ¶102; *Kim*, [0038], [0078]-[0081], [0106], [0110]-[0111], [0119], [0135]-[0136], [0148]-[0149] (base station signals to UE which antenna ports

should be measured to determine RSRP); *accord* Ex. 1001, 3:16-17 (CSI-RS wireless signal), 3:46-47 (RRC signaling), 4:13-14 (CSI reporting).

c. [1b] “receiving, by the UE, a first wireless signal originating from the base station; and”

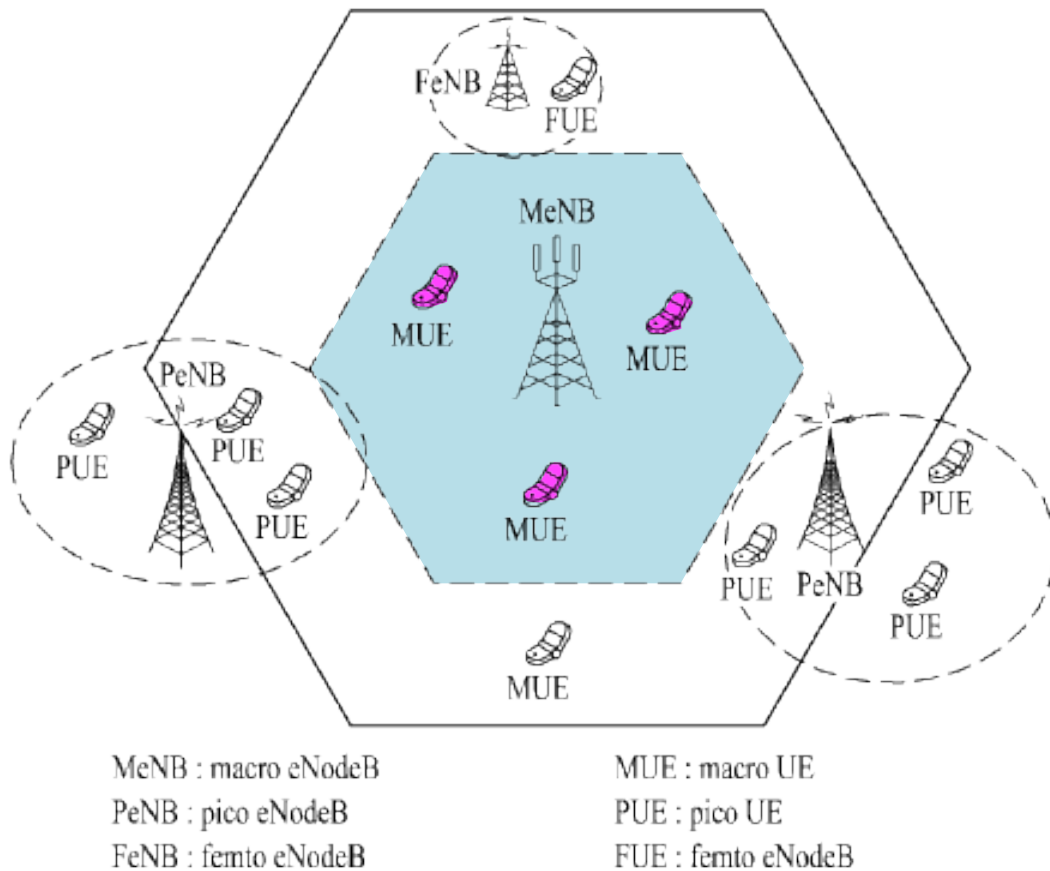
Kim discloses element [1b]. Kakaes ¶¶104-108.

Kim’s UE receives a first wireless signal, for example, a pilot signal or reference signal (e.g., cell-specific reference signal (“CRS”) or channel state information-reference signal (“CSI-RS”)), originating from the base station. *Kim*, [0052], [0057]-[0064]. The received reference signals are used “for acquiring channel information,” “to perform channel measurement[s],” and “for data demodulation,” and may be “transmitted in a region in which data is transmitted.” *Kim*, [0064]. The CSI-RSs are wireless signals originating from the base station because “CSI-RSs may be transmitted through 1, 2, 4 or 8 antenna ports” of the base station to the UE. *Kim*, [0071]; Kakaes ¶105. Each CSI-RS “may be mapped to REs on a per-antenna port basis” at the base station for transmission. *Kim*, [0074], [0076], FIG. 6; Kakaes ¶105.

Kim explains that a “[b]ase station (BS)” includes “a fixed station, a Node B, an eNode B (eNB), an access point (AP) and the like,” and a “‘cell’ may be understood as a base station (BS or eNB)” or “Remote Radio Head (RRH)..., etc.” *Kim*, [0036]. “[C]ells” may be “configured in the form of a distributed antenna or

RRH *of a single BS*,” meaning a single base station transmits multiple CSI-RSs to the UE. *Kim*, [0103] (emphasis added); Kakaes ¶106. In other words, where *Kim* refers to a CSI-RS being transmitted by an eNB, BS, cell, or RRH, a POSITA would have understood that it refers to transmission by one base station or multiple base stations. Kakaes ¶106. In one example, *Kim* describes multiple antenna ports transmitting CSI-RS wireless signals “according to the number of transmit antennas of the base station,” such that “antenna ports 0 to 3” are transmitting from the base station or, in another example, “antenna ports 15 to 18 for four antenna ports, and antenna ports 15 to 22 for eight antenna ports” are transmitting. *Kim*, [0065], [0066], [0071].

Kim’s FIG. 7 shows UEs within range of only a single base station (MeNB) servicing three UEs (**pink**) within the cell (**teal**).



Kim, FIG. 7 (annotated); *see also Kim*, [0103] (transmitting antenna ports can be “a distributed antenna or RRH of a single BS” (emphasis added)).

Dr. Kakaes explains that, because *Kim*’s measured wireless signals are used to support radio resource management (“RRM”), for example, to perform antenna port selection, a POSITA would have recognized that *Kim*’s wireless signals are conventional reference signals that were well-known wireless signals in prior art systems, including as known in 3GPP standards. Kakaes ¶108; *Kim*, [0038], [0051]-[0053], [0063], [0070] (describing reference signals transmitted by base

station antenna ports to perform channel measurements, e.g., RSRP); *accord* Ex. 1001, 3:16-17 (CSI-RS wireless signal). Indeed, *Kim* confirms that “[t]he UE receives the reference signal to perform channel measurement and data [demodulation].” *Kim*, [0064].

d. [1c] “transmitting, by the UE, first information to the base station;”

Kim discloses element [1c]. Kakaes ¶¶109-111.

Kim’s UE transmits a “measurement report” containing first information, such as antenna port indices, RSRP values, RSRP-to-max(RSRP) ratios, and other information of the CRS and/or CSI-RS wireless signals to the base station. *Kim*, [0105]-[0106], [0110]-[111], [0136], [0149]. The measurement report “covers Radio Resource Management (RRM) measurement of measuring the signal strengths... of a serving cell..., including Reference Signal Received Power (RSRP).” *Kim*, [0106]. The UE may perform RSRP measurements on the CRS and CSI-RS signals transmitted by the base station and report the RSRP values and RSRP-to-max(RSRP) ratios back to the base station as first information in the measurement report. *Kim*, [0113], [0136], [0148]-[0149]; Kakaes ¶110.

A POSITA, as Dr. Kakaes explains, would have recognized that *Kim*’s UE feeding back measurement report information to the base station was well known in prior art systems, including as known in 3GPP standards. Kakaes ¶111; *Kim*,

[0005], [0006], [0038]; *see Park*, [368]-[378] (UE reports RSRP of antenna ports); *accord* Ex. 1001, 4:13-14 (CSI reporting).

- e. [1d] [1d1] “wherein, K antenna port groups of the base station are used to transmit the first wireless signal;”

Kim discloses, or alternatively *Kim* and *Chen* render obvious, element [1d1].

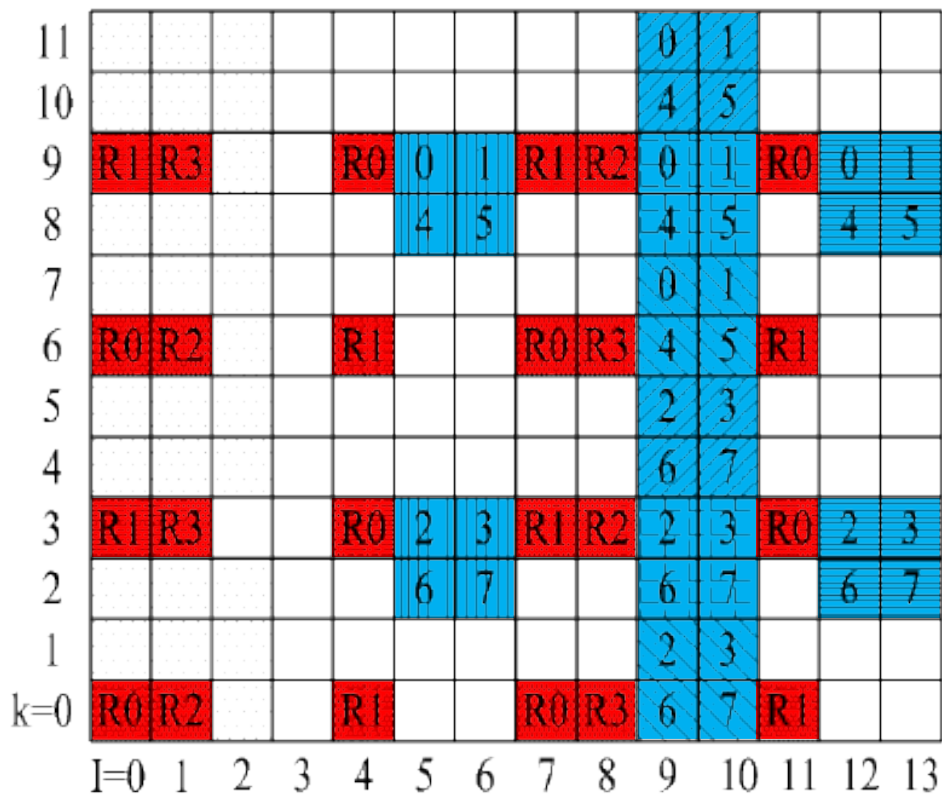
Kakaes ¶¶112-121.

As explained above, *Kim*’s base station transmits the first wireless signal, such as CSI-RS, using antenna port groups identified by corresponding Resource Elements (“REs”) of the transmitting base station. *Kim*, [0057]-[0063], [0076], [0053]; *supra* § V.A.1.c ([1b]). The CSI-RSs wireless signals “may be transmitted” to the UE “through 1, 2, 4 or 8 antenna ports” of the base station. *Kim*, [0071]; Kakaes ¶113. Each CSI-RS is “mapped to REs on a per-antenna port basis”⁶ at the base station for transmission. *Kim*, [0074], [0076]; Kakaes ¶113.

FIG. 6 shows an example of how the base station identifies K CSI-RS antenna port groups using configuration information. Kakaes ¶114. In FIG. 6, “CSI-RSs are mapped to REs on a per-antenna port basis according to a specific

⁶ The ’271 patent states that an “antenna port group” may be “composed of one antenna port.” Ex. 1001, 2:45-46, 13:64-65. This Petition refers to “antenna ports,” each of which is an “antenna port group” under the ’271 patent’s disclosure. *Id.*

CSI-RS configuration,” where “each number represents that CSI-RS is mapped to each antenna port,” where “RE denoted by 0 or 1 may be mapped to CSI-RS corresponding to antenna port 0 or 1,” as shown below, and so on for each CSI-RS antenna ports 0 through 7 (e.g., 8 antenna port groups) (**blue**). *Kim*, [0076], FIG. 6; Kakaes ¶114. Similarly, “R0 to R3 [**red**)] denote that CRSs are mapped to [four] respective antenna ports” according to “the number of transmit antennas of the base station.” *Kim*, [0065], [0076], FIG. 6; Kakaes ¶114.



Kim, FIG. 6 (annotated).

When a pair (group) of two CSI-RS antenna ports are “mapped to the same RE,” then each CSI-RS in the pair “may be identified by different orthogonal codes.” *Kim*, [0076]. Thus, *Kim* teaches that a CSI-RS may be an “antenna port group” having either (1) one port per group or (2) an antenna port pair having two antenna ports per group. *Kim*, [0076], [0141].

Kim describes transmitting the first wireless signal from antenna ports at a one or more base stations. *Supra* §§ V.A.1.b-V.A.1.c ([1a]-[1b]); *Kim*, [0103], FIGS. 8-9; Kakaes ¶116. Although “a” means “one or more,” *SanDisk Corp. v. Kingston Tech. Co.*, 695 F.3d 1348, 1360 (Fed. Cir. 2012), to the extent Patent Owner argues that a single base station is required and that *Kim* does not disclose K antenna port groups of a single base station being used to transmit the first wireless signal, a POSITA would have found this obvious. Kakaes ¶117.

Chen discloses that “a base station side is configured with a massive antenna array, for example, 100 antennas and even more.” *Chen*, 2. *Chen* describes the same transmission and reporting process as *Kim*, where “a base station transmits M types of pilot signals” using “M pilot ports,” where “N pilot ports” of the M ports

are configured for and identified to the UE “through signaling.”⁷ *Chen*, Abstract, 3-5, 11, 18. The UE “receives and detects pilot signals from the N pilot ports” using the signaling and selects a subset of pilot ports to report to the base station. *Chen*, Abstract, 3, 5, 13, 19. *Chen*’s “N pilot ports are formed by virtualization of a same group of antennas,” *Chen*, 3, 5, 7, 11, 18, which a POSITA would have understood describes a group of antennas at a single base station. Kakaes ¶117. *Chen* also explains that the transmitting antenna ports form “a linear array” or “two-dimensional... array” of antennas, which a POSITA would have also understood describes the antenna ports being located at a single base station. *Chen*, 12; Kakaes ¶117.

A POSITA would have found it obvious to configure *Kim*’s system such that a single base station includes the K antenna port groups used to transmit the first

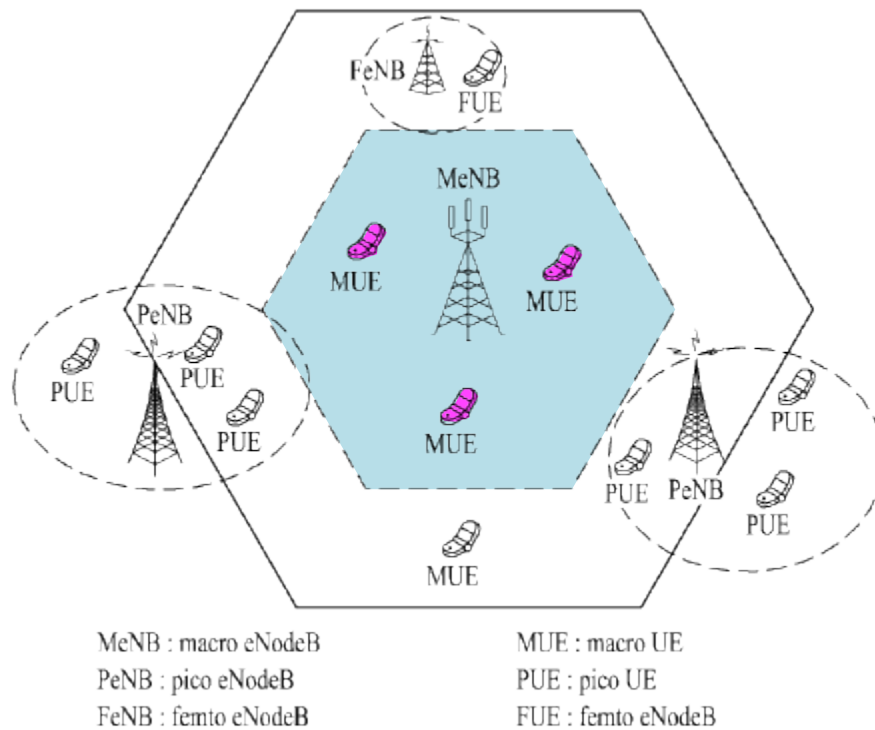
⁷ The prior art and ’271 patent use overlapping variables to represent the number(s) of port groups. The following table shows the relationship between the variables in the ’271 patent, *Kim*, and *Chen*.

’271 patent	<i>Kim</i>	<i>Chen</i>
K	N or management set	N ports or P beams
K1	M or reported set	K ports or Q beams
K2	M or reported set	K ports or Q beams

wireless signal, for example, because a single base station may have more than 100 antennas arranged in arrays to provide multiple antenna port groups to various UEs within range of the base station. *Chen*, 2, 3, 5, 7, 11, 18; Kakaes ¶118. A POSITA would have found it obvious to configure *Kim*'s system such that the K antenna port groups transmit from a single base station so that the base station can provide improved transmission to the UEs within its broadcast area, as described in *Kim* and *Chen*, and confirmed by *Liu*, *Park*, and the 3GPP standards as conventional activities. Kakaes ¶118; *see Kim*, [0103]; *Chen*, 2, 3, 5, 7, 11, 18; *Liu*, 1, 16, 18; *Park*, [206], [208], [205]-[222]; *Sesia LTE*, 155, 167, 169, 654.

i. Motivation to combine

A POSITA would have been motivated to configure *Kim*'s system such that K antenna port groups of the base station are used to transmit the first wireless signal, as taught by *Chen*. *Chen*, 2, 3, 5, 7, 11, 18; Kakaes ¶119. A POSITA would have been motivated to configure *Kim*'s system in this way to optimize transmissions to each UE within range of the base station, in particular by allowing the UE to select the optimum CSI-RSs transmitted from the corresponding antenna ports when the UE is within range of, or is detecting CSI-RSs from, only one base station, such as shown in *Kim*'s FIG. 7 (pink UEs within teal cell). Kakaes ¶119.



Kim, FIG. 7 (annotated). A POSITA would have been motivated to configure *Kim*'s system this way because it would allow each UE to measure the received signal strengths and select a subset consisting of the strongly received wireless signals, which a POSITA would have recognized improves data transmission because the data transfer rate can be increased when the number of transmitting and receiving antennas is higher or using transmit diversity, and because data throughput has been shown to be generally proportional to the signal strength, RSRP, and SNR. Kakaes ¶120; *Chen*, 1; Ex. 1021, *Afroz*, 115, 118, 120, 122, FIG. 7.

ii. Expectation of success

A POSITA would have had a reasonable expectation of success in configuring *Kim*'s system as recited in element [1d1]. Kakaes ¶121. Transmitting a wireless signal from multiple antenna port groups of a single base station was a basic, well-known, and conventional operation in LTE, 4G, and predecessor systems, and was even accounted for in various 3GPP standards for LTE. Kakaes ¶121; *Sesia LTE*, 155, 167, 169, 654; *Kim*, [0103]; *Chen*, 2, 3, 5, 7, 11, 18; *Liu*, 1, 16, 18; *Park*, [206], [208], [205]-[222]. Transmitting the first wireless signal using K antenna port groups of a base station was a straightforward operation of MIMO systems, described in *Kim* and *Chen*, that applies only known, conventional functions to yield predictable results (transmitting pilot signals from respective antenna port groups at a base station). *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 416 (2007); *Slot Speaker Techs., Inc. v. Apple Inc.*, 680 F. App'x 932, 943-44 (Fed. Cir. 2017).

- f. [1d2] “the first signaling is used by the UE to determine the K antenna port groups transmitting the first wireless signal received by the UE; the K is a positive integer greater than 1;”**

Kim discloses element [1d2]. Kakaes ¶¶122-125.

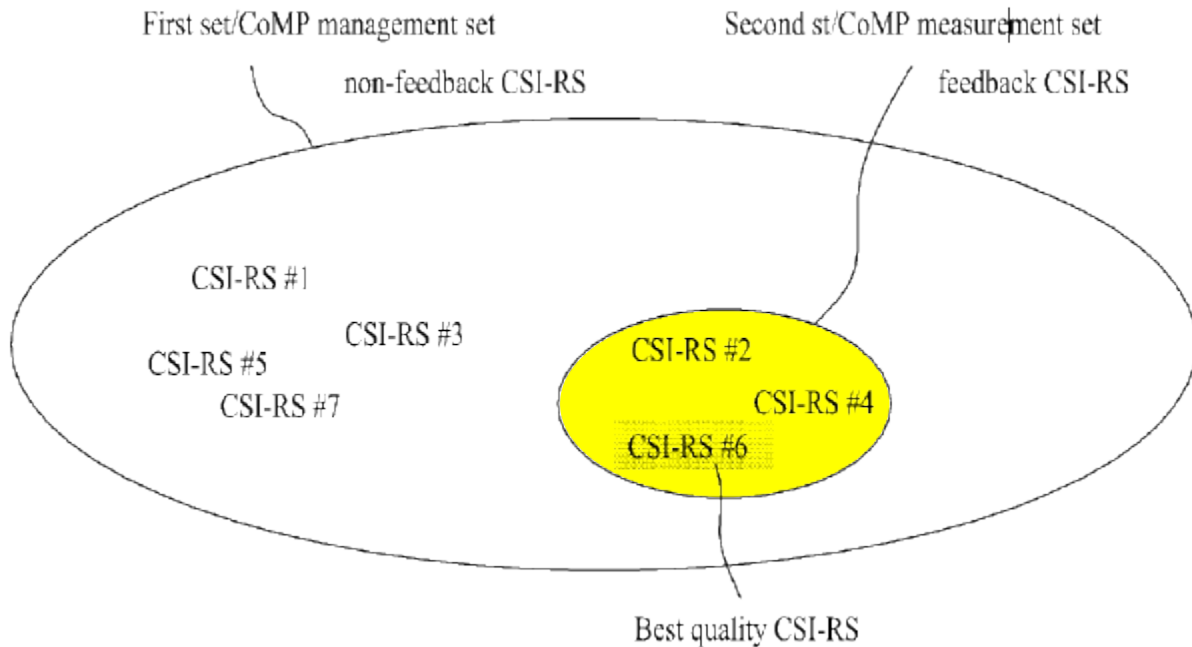
As explained in elements [1a] and [1d1], the first signaling is used by the UE to determine the K antenna port groups used to transmit the CSI-RS first wireless

signal received by the UE and identified in the Resource Block by the corresponding Resource Elements (“REs”). *Supra* §§ V.A.1.b, V.A.1.e; Kakaes ¶123. K is a positive integer greater than 1, for example, 2, 4, or 8 antenna ports for CSI-RS transmission. *Supra* §§ V.A.1.b, V.A.1.e ([1a], [1d1]); Kakaes ¶123.

Kim’s “CSI-RS may be signaled to the UE as a CSI-RS config information element.” *Kim*, [0079]. Alternatively, the base station “may inform the UE of specific information through RRC signaling,” including “CSI-RS configuration” information that identifies a CSI-RS “antenna port pair” transmitting from a single RE. *Kim*, [0142]. For example, the UE receives, from the base station, first signaling, such as “CSI-RS config information element[s],” which includes “antennaPortsCount-r10” that “indicates the number of antennas needed for CSI-RS transmission (for example, one, two, four, or eight antennas may be selected),” and “resourceConfig-r10” that “indicates which RE [Resource Element]” is transmitting the CSI-RS. *Kim*, [0079]-[0081], Table 3; Kakaes ¶124. The base station uses this signaling information to “designate[] a plurality of configurations of CSI-RSs” to be measured and “inform[] the UE” of the CSI-RSs to be measured. *Kim*, [0119], [0111], [0137] (“BS [base station] independently designates the number of antenna ports to be used for RSRP measurement according to each CSI-RS configuration”), [0142] (base station “inform[s] the UE of specific information through RRC signaling” to indicate CSI-RS configuration

and antenna ports), [0143], [0146]-[0148] (CSI-RS “previously designated by the BS through RRC signaling” and “N, M, T1, and T2 may be signaled to the UE through RRC signaling”).

The antenna port groups specified for CSI-RS measurements may include a “management set” of transmitted signals where the subset or “measurement set” meeting a particular criterion (such as RSRP ratio threshold, *infra* § V.A.1.i ([1d5])) is reported back to the base station. Kakaes ¶125; *Kim*, [0130]. One example is shown in *Kim*’s FIG. 9 below, the management set of CSI-RS #1-#7 (white oval) identified by the base station for reporting RSRP values in the configuration information for feeding back to the base station, and the measurement set of CSI-RS #2, CSI-RS #4, and CSI-RS #6 (yellow) is reported back based on the measured values. *Kim*, [0111] (“BS sets configurations of [CSI-RSs] each of which will perform RSPR [sic: RSRP]... measurement..., and informs the UE of the resultant configurations,” and UE “perform[s] RSRP... measurement of CSI-RSs transmitted from cells contained in the CoMP management set” and reports those where “the measurement result satisfies a specific condition”), [0119] (“BS designates a plurality of configurations of CSI-RSs to be RSRP/RSRQ-measured as a CoMP management set”), [0136], [0148]-[0149]; Kakaes ¶125.



Kim, FIG. 9 (annotated).

- g. [1d3] “the K antenna port groups respectively correspond to K channel quality values; the K channel quality values are K non-negative real numbers; the K channel quality values are Reference Signal Received Powers (RSRPs) or a Signal to Interference plus Noise Ratios (SINRs);”

Kim discloses element [1d3]. Kakaes ¶¶126-128.

Kim discloses that each antenna port transmitting the CSI-RSs has a corresponding channel quality value, e.g., RSRP. *Kim*, [0111], [0132], [0135], [0148]-[0149]. RSRP is measured in milliwatts (mW), which are non-negative real numbers. *Kim*, [0135]; Kakaes ¶127. After receiving the configuration information used to determine the K antenna port groups, *supra* § V.A.1.f ([1d2]), *Kim*’s UE “perform[s] RSRP... measurement of CSI-RSs transmitted from cells contained in

the CoMP management set” and reports those ports where “the measurement result satisfies a specific condition.” *Kim*, [0111], [0136], [0148]-[0149]. The UE measures the RSRP of the transmitted CSI-RSs in the “management set,” such as all CSI-RSs #1-#7 in FIG. 9, and reports the measurements set, such as CSI-RSs #2, #4, #6. *Kim*, [0111], [0119], [0136], [0148]-[0149]; Kakaes ¶128.

Kim’s UE may report “indexes of a maximum of M CSI-RSs” from “among N CSI-RSs,” where “the RSRP ratio ($\text{RSRP}_n/\max(\text{RSRP}_i)$)” is “higher than a predetermined threshold value” and “the RSRP estimation result of the corresponding CSI-RS.” *Kim*, [0149]. To determine the “M CSI-RSs” (reported measurement set) from among the “N CSI-RSs” (management set), the UE determines the RSRP (channel quality value) of each of the N CSI-RSs in the management set. *Kim*, [0111], [0148]-[0149]; Kakaes ¶128. As a result, *Kim*’s N antenna port groups in the management set (K antenna port groups) each have channel quality RSRP values that are non-negative real numbers measured in mW. Kakaes ¶128; *Kim*, [0135].

- h. [1d4] “K1 antenna port groups of the K antenna port groups correspond to K1 channel quality values of the K channel quality values; the K1 is a positive integer less than or equal to the K;”**

Kim discloses element [1d4]. Kakaes ¶¶129-130.

As explained in element [1d3], *Kim* discloses measuring K antenna port groups (e.g., management set of N antenna ports) that have real, non-negative RSRP channel quality values. *Supra* § V.A.1.g. The measurement set of M antenna port groups is included within the N channel quality values, because “a maximum of M CSI-RSs... from among [the] N CSI-RSs contained in the CoMP management set” is reported by the UE to the base station. *Kim*, [0149]. The M reported RSRP values (measurement set) correspond to the K1 antenna port groups that satisfy a threshold measurement. *Kim*, [0111], [0136], [0149].

Kim explains that the UE “perform[s] RSRP or RSRQ measurement of [N] CSI-RSs transmitted from cells contained in the CoMP management set” and reports up to M antenna ports for which “the measurement result satisfies a specific condition,” for example, the M antenna ports with an RSRP-to-max(RSRP) ratio greater than a threshold. *Kim*, [0111], [0136], [0148]-[0149]’ Kakaes ¶130. For example, the UE may report the “indexes of a maximum of M CSI-RSs... from among N CSI-RSs contained in the CoMP management set,” and “the RSRP estimation result of the corresponding CSI-RS.” *Kim*, [0149]. Because “a maximum of M” CSI-RS ports are reported, then the reported ports will have a number less than or equal to M, which is less than or equal to N, because M is “a maximum” number selected “from among N” antenna ports. *Id.*; Kakaes ¶130. *Kim* therefore discloses K1 antenna port groups of the K antenna port groups having K1

channel quality values (e.g., M RSRP of measured N CSI-RSs), where the K1 (M) is a positive integer less than or equal to the K (N). Kakaes ¶130.

i. [1d5] “a first proportional sequence corresponds to a ratio(ratios) among the K1 channel quality values;”

Kim discloses element [1d5]. Kakaes ¶¶131-133.

Kim discloses reporting the K1 antenna ports that satisfy “the RSRP ratio” of a received port that “is higher than a predetermined threshold value” when compared to the maximum received RSRP. *Kim*, [0149], [0136]; Kakaes ¶132. Specifically, the indexes and RSRP values “of a maximum of M [CSI-RSs] configured to satisfy Equation 4 may be reported”:

$$\text{RSRP}_n / \max(\text{RSRP}_i) > \text{Threshold}$$

Kim, [0149]; *see also Kim*, [0136]. A POSITA would have understood that, because each of the RSRP values of the reported antenna ports (K1 antenna ports) satisfies Equation 4’s threshold ratio, the corresponding ratios comprise a first proportional sequence among the reported (K1) channel quality RSRP values because they would be compared against the measured values to determine which are above the threshold requirement to determine “a maximum of M” to be reported, thus creating a sequence. Kakaes ¶132. The measurement report value may include “the ratio of the n-th CSI-RS average Rx power level to the best CSI-RS average Rx power level.” *Kim*, [0136], [0148]-[149]. A POSITA, as Dr.

Kakaes explains, would have understood “average Rx power level” is the RSRP value because “RSRP is defined as the linear average... power contributions of REs that carry downlink” CSI-RS signals, and “linear average... power contributions of REs” would have been known to mean the received power for a particular transmitting antenna port. *Kim*, [0107], [0136]; Kakaes ¶132.

During prosecution of the '271 patent, the applicant argued that “the target threshold in the present application and claims is a restriction of channel quality report, i.e., to restrict the difference between the largest and smallest channel qualities in a UE report.” Ex. 1002, 472. To the extent Patent Owner argues that the “proportional sequence” includes—and the UE must report—only K1 RSRP ratio values above a certain threshold, *Kim* discloses this interpretation, as explained above, because all M reported ports all have RSRP ratio values that satisfy the RSRP ratio threshold of Equation 4. Kakaes ¶133. In such cases K1 has the same value as *Kim*’s M. *Id.*; *Kim*, [0148]-[0149], [0136], [0146].

j. [1d6] “the first information is used to determine the K1 antenna port groups and the first proportional sequence;”

Kim discloses element [1d6]. Kakaes ¶¶134-135.

As explained for [1d5], the first information, such as antenna port indices, RSRP values, and RSRP-to-max(RSRP) ratios, is used to determine the M reported antenna port groups satisfying the threshold of Equation 4 (K1 antenna port

groups) and the first proportional sequence of RSRP-to-max(RSRP) values, such as determined using Equation 4. *Supra* § V.A.1.i; Kakaes ¶135.

- k. [1d7] “the first signaling is used to determine a target threshold; the target threshold is a non-negative real number;”

Kim discloses or suggests, or alternatively *Kim* and *Chen* render obvious, element [1d7]. Kakaes ¶¶136-143.

Kim discloses that the RSRP-to-max(RSRP) ratio of each CSI-RS RSRP value is compared to a threshold value. *Kim*, [0149]; Kakaes ¶137; *cf. Kim*, [0136], [0150]-[0151] (comparing RSRP ratios to target threshold values). *Kim* explains that the UE reports “indexes of a maximum of M CSI-RSs (the RSRP ratio ($\text{RSRP}_n/\text{max}(\text{RSRP}_i)$) of which is higher than a predetermined threshold value) from among N CSI-RSs contained in the CoMP management set,” for example, that satisfy Equation 4”: $\text{RSRP}_n/\text{max}(\text{RSRP}_i) > \text{Threshold}$. *Kim*, [0149]; Kakaes ¶137.

Kim’s threshold is a non-negative real number because it corresponds to the “linear value” in milliwatts (mW), which is itself a positive non-negative real number and the ratio of two non-negative real numbers is also a non-negative real number. Kakaes ¶137; *Kim*, [0135]-[0136].

Although *Kim* teaches that “different threshold values may be signaled to the UE” by the base station, *Kim*, [0163], *Kim* does not explain how the RSRP ratio threshold is determined by the UE. Kakaes ¶137.

Chen, like *Kim*, discloses a “channel information feedback method, and pilot and beam transmission methods.” *Chen*, Abstract. In *Chen*, “a base station transmits M types of pilot signals... corresponding to M pilot ports respectively” and “configures, through signaling, N pilot ports in the M pilot ports for a terminal [UE].” *Id.* *Chen*’s “terminal [UE] receives and detects pilot signals from the N pilot ports, selects K pilot ports from the N pilot ports according to received signal quality, and feeds back channel information of channels formed by the K pilot ports.” *Id.* Like *Kim*, *Chen*’s pilot signals are CSI-RSs. *Chen*, 2. The channel information includes “information of the K pilot ports,” such as “received power information,” which a POSITA would have understood discloses sending the port indices and RSRP information, like *Kim*. *Chen*, 3; Kakaes ¶138.

Chen’s UE selects the K antenna ports “according to a power threshold,” such as “a relative threshold” (e.g., RSRP ratio), “configured by the base station.” *Chen*, 4, 5, 7, 9, 14-15 (reporting antenna port “when the ratio of a received power [RSRP] to the maximum received power [max(RSRP)] is greater than or equal to a preset threshold value”), 19, 22, 24. *Chen*’s base station configures the pilot signals “through signaling.” *Chen*, Abstract, 11, 18, 21, 23. A POSITA would have

understood that a power threshold “configured by the base station” “through signaling” and used by the UE to select antenna ports describes the UE determining the threshold using the signaling to identify the configured threshold from the base station. Kakaes ¶138.

A POSITA reading *Kim* and *Chen* would have found it obvious to use the first signaling to determine a target threshold, for example, to have the base station configure the relative power threshold used in both *Kim* and *Chen* at the base station, as taught by *Chen* and suggested by *Kim*’s transmitting other threshold values for antenna port selection. Kakaes ¶139; *Kim*, [0163]; *Chen*, Abstract, 11, 18, 21, 23. A POSITA would have found such configuration obvious because it was well known to configure threshold values at the base station and send the thresholds to the UE using signaling. *Chen*, Abstract, 11, 18, 21, 23; *Liu*, 16-17, 22-23.

i. Motivation to combine

A POSITA would have been motivated to configure *Kim*’s system such that the first signaling is used to determine the target threshold, for example, the ratio threshold “configured by the base station” and broadcast to the UE through signaling. *Chen*, Abstract, 7, 9, 11, 18, 19, 21-24; Kakaes ¶140. Configuring the threshold at the base station and broadcasting the threshold to the UE was well known in the art, as explained by *Chen*, at Abstract, 11, 18, 21, 23, and confirmed

by *Liu*, which also teaches that transmitting “threshold[s]” and “criteri[a]” for selecting antenna port signals (such *Kim*’s and *Chen*’s CSI-RS) can be “provided through base station broadcasting.” *Liu*, 16-17, 22-23 (selection “threshold” or “criterion” “provided through base station broadcasting” “by broadcasting information, high-layer signaling, or dynamic signaling”); Kakaes ¶140.

A POSITA would have been motivated to configure *Kim*’s system such that the first signaling is used to determine a target threshold because it would have allowed the base station to better control the distribution of wireless signals selected by UEs. Kakaes ¶141. For example, the base station can signal the UEs to select only those signals that are proportionally strong to help the base station achieve optimal performance and consistency across the transmissions to various UEs because the base station knows that the reported results will be sufficient for its system balancing and scheduling. *Id.*

A POSITA would have recognized that such system would select only signals having comparable strength, determined from the base station’s signaling, which improves transmission and data transfer because the data transfer over a transmission beam is proportional to the received signal strength. Kakaes ¶142; *see Afroz*, 115, 118, 120, 122, FIG. 7. Knowing that each antenna port group signal selected by the UE is within a certain relative signal strength threshold would have allowed for better transmission scheduling by the base station to support consistent

transmission over multiple beams. Kakaes ¶142; *see Afroz*, 115, 118, 120, 122, FIG. 7; *Chen*, 1; *Park*, [93]-[94] (MIMO systems “collect[] a plurality of data pieces received through a plurality of antennas”), [405]. Thus, using the first signaling to determine the target threshold, e.g., relative power threshold, for antenna port selection at a particular base station (taught by *Chen*, and confirmed by *Liu*), would have been recognized by a POSITA as improving overall system performance and data transmission in *Kim*’s MIMO system. Kakaes ¶142. A POSITA would have recognized that dividing data across multiple transmissions with strengths determined by base station configurations would have greater overall integrity and reliability of the system because it allows for more consistent signal strength across the antenna ports to “achieve a higher data transmission rate” and data throughput. Kakaes ¶142; *Chen*, 1; *Afroz*, 115, 118, 120, 122, FIG. 7; *Park*, [93]-[94], [405].

ii. Expectation of success

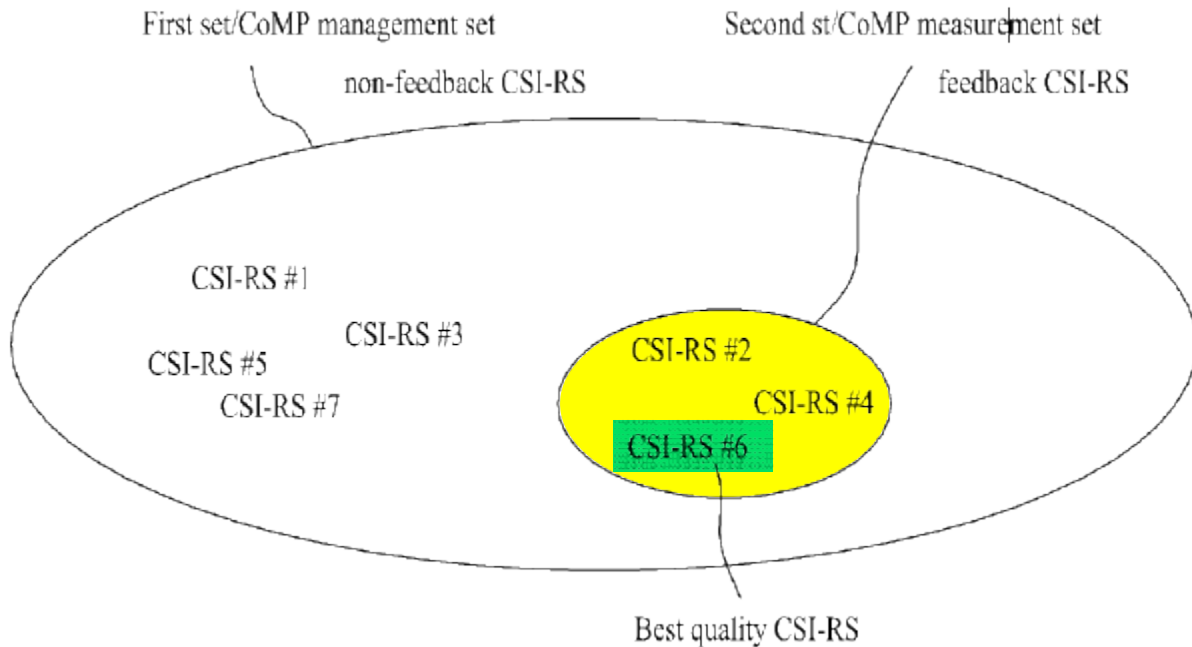
A POSITA would have had a reasonable expectation of success in implementing the first signaling being used to determine the target threshold, as taught by *Chen*, and confirmed by *Liu*. Kakaes ¶143. Transmitting threshold and criteria information through signaling was well known to POSITAs. *Id.*; *Chen*, Abstract, 11, 18, 21, 23; *Liu*, 16-17, 22-2 (selection thresholds “provided through base station broadcasting”)3. It was also well known to use RSRP-to-max(RSRP)

thresholds as antenna port selection thresholds (e.g., target thresholds). *Kim*, [0136], [0148]-[0149]; *Chen*, 14-15; *Liu*, 16-17, 22-23; *Park*, [371]-[373]. Using the first signaling to determine the target threshold at the UE would therefore have been a straightforward operation that applies only known, conventional operations (sending known target thresholds in signaling to a UE) used according to their known functions to yield predictable results (transmitting thresholds with signaling to the UE). *KSR*, 550 U.S. at 416; *Slot Speaker*, 680 F. App'x at 943-44.

- I. **[1d8] “a first channel quality is a best channel quality value among the K1 channel quality values; a second channel quality is a worse channel quality value among the K1 channel quality values;”**

Kim discloses element [1d8]. Kakaes ¶¶144-146.

Kim discloses a first or “best” channel quality, e.g., “max(RSRP_i)” or “best CSI-RS average Rx power level” among the selected M antenna ports. *Kim*, [0136], [0149]. A POSITA would have recognized that the maximum RSRP (e.g., maximum or best CSI-RS average Rx power level) would be included in *Kim*'s M (K1) antenna port groups because the maximum ratio of *Kim*'s Equation 4 would be when RSRP_n is the same as max(RSRP_i). Kakaes ¶145. *Kim* identifies the “[b]est quality CSI-RS” (green) in FIG. 9 of the measurement set (yellow), shown below.



Kim, FIG. 9 (annotated); Kakaes ¶145.

Kim discloses a second or “worse” channel quality among the selected M (K1) antenna ports, such as when $RSRP_n$ is less than $\max(RSRP_i)$ and the ratio of $RSRP_n/\max(RSRP_i)$ is greater than the threshold value, for example, CSI-RS #2 or #4 in FIG. 9. *Kim*, [0148]-[0149], [0136]; Kakaes ¶146. This is confirmed because *Kim* discloses selecting “a maximum of M CSI-RSs,” (plural), which would have been understood is a number greater than 1. *Kim*, [0149], [0146], [0148]; Kakaes ¶146.

- m. [1d9] “a ratio between the second channel quality and the first channel quality is greater than or equal to the target threshold.”

Kim discloses element [1d9]. Kakaes ¶¶147-148.

As explained for elements [1d5]-[1d8], *Kim* discloses that a ratio between the second (“worse”) channel quality (RSRP_n) and first (“best”) channel quality (max(RSRP_i)) is greater than Equation 4’s target threshold. *Supra* §§ V.A.1.i-V.A.1.1 ([1d5]-[1d8]); *Kim*, [0136], [0148]-[0149]. A POSITA would have understood that RSRP_n (e.g., CSI-RS #2 or #4) is a second (“worse”) channel quality, but the ratio RSRP_n/max(RSRP_i) is greater than the threshold of Equation 4 and thus is one of the M antenna ports being reported in the measurement set, but RSRP_n is not equal to max(RSRP_i) (e.g., CSI-RS #6). *Kim*, [0136], [0148]-[0149]; Kakaes ¶148.

2. **Claim 2: “The method according to claim 1, wherein... the first proportional sequence comprises K1 positive real numbers less than or equal to 1, and the first proportional sequence comprises at least one 1; or the first proportional sequence comprises quantized values corresponding to K1 positive real numbers;”**

For the reasons discussed above, *Kim* and *Chen* render obvious claim 1.

Claim 2 recites five alternative options separated by “or.” Satisfying any one of these options satisfies the requirements of claim 2. *Brown v. 3M*, 265 F.3d 1349, 1351 (Fed. Cir. 2001).

Kim discloses that the first proportional sequence comprises K1 positive real numbers less than or equal to 1, and the first proportional sequence comprises at least one 1. Kakaes ¶¶151-152.

As explained for elements [1d5]-[1d9], *Kim* discloses a proportional sequence of M ($K1$) RSRP-to-max(RSRP) ratios using $RSRP_n/\max(RSRP_i)$ that results in positive real numbers less than or equal to 1. *Supra* §§ V.A.1.i-V.A.1.m. When $RSRP_n$ is less than $\max(RSRP_i)$, but still satisfies Equation 4 (e.g., CSI-RS #2 or #4 of FIG. 9), the ratio will be a positive real number less than 1. Kakaes ¶152; *Kim*, [0135]-[0136], [0148]-[0149]; *see Chen*, 14-15. Similarly, when $\max(RSRP_i)$ is compared to itself (e.g., CSI-RS #6 in FIG. 9), the ratio value will be 1. Kakaes ¶152; *Kim*, [0135]-[0136], [0148]-[0149]; *see Chen*, 14-15.

Additionally, *Chen* also renders obvious that the first proportional sequence comprises quantized values corresponding to $K1$ positive real numbers. Kakaes ¶153. *Chen* teaches that “quantized feedback” of “codebook-based channel information” was well known. *Chen*, 1. *Chen* also explains that when reporting an “amplitude/power ratio” (e.g., *Kim*’s $RSRP_n/\max(RSRP_i)$), the UE’s feedback to the base station includes “a pilot port with the highest power” (e.g., *Kim*’s CSI-RS #6) and an indicator of each reported antenna port relative to the antenna port with the highest power (e.g., *Kim*’s CSI-RS #2 and #2 relative to #6). *Chen*, 17. For example, “a magnitude order of the amplitude or power is indicated first, and then a coefficient at the magnitude order is indicated,” where “[t]he coefficient may be uniformly quantized.” *Id.* A POSITA would have recognized that this magnitude quantization describes quantization of the reported proportional

sequence that simplifies reporting of the M (K1) antenna port groups. Kakaes

¶153. *Chen* and *Kim* both teach that the ratio may also be reported in the measurement report with the selected antenna port indices and RSRP values. *Chen*, 3, 5, 19, 21, 24; *Kim*, [0136], [0148]-[0149]; Kakaes ¶153. *Chen*'s quantized values correspond to positive real numbers, as shown below, which also would have been understood from *Kim*'s disclosure that the power ratio is a positive real number. *Chen*, 14-15, 17-18, Table 4; *Kim*, [0135]-[0136], [0148]-[0149]; Kakaes ¶153.

<i>Chen</i> 's bit sequence	<i>Chen</i> 's quantization	Value of quantization
00	$10^{-0.5}$	0.3162
01	10^{-1}	0.1000
10	$10^{-1.5}$	0.0316
11	10^{-2}	0.0100

Chen, 14-15, 17-18, Table 4 (header row added; right-most column added).

i. Motivation to Combine

A POSITA would have been motivated to send the quantized ratios of *Kim*'s M (K1) antenna port groups to simplify reporting because the quantization limits the number of bits used in reporting (e.g., *Chen*'s 2-bit-based reporting). *Chen*, 17-18, Table 4; Kakaes ¶154. Quantizing the reported ratio would have made the data transferred in the measurement report more efficient, allowing either reduced

bandwidth to handle the reporting or allowing more information to be reported within a particular measurement report. Kakaes ¶154. A POSITA would have been motivated to use *Chen*'s quantized ratio reporting in *Kim*'s measurement report to better manage data transmission and antenna port allocation by the base station because the base station is provided with additional information from the UEs to better control and coordinate antenna port allocation across the system. *Id.*

ii. Expectation of Success

A POSITA would have had a reasonable expectation of success in implementing quantized values of positive real numbers, as recited in claim 2. Kakaes ¶155. Transmitting quantized values was well known to POSITAs to limit the amount of reported data based on the number of bits allocated to the quantization. *Id.*; *Chen*, 14-15, 1, 12; see *Sesia LTE*, 390-391 (quantization of codebook configurations), 663 (reporting “quantized” values “to reduce the overhead to a reasonable level”). Reporting quantized RSRP values was already implemented in the 3GPP standards. Kakaes ¶155; Ex. 1015, 3GPP TS 36.133 v13.2.0, § 9.1.4, Table 9.1.4-1 (RSRP quantized into 1dBm intervals). Having the first proportional sequence comprise quantized values corresponding to K1 positive real numbers would therefore have been a straightforward operation that applies only known, conventional operations (quantized reporting of the ratio) used

according to their known functions to yield predictable results (transmitting a quantized value). *KSR*, 550 U.S. at 416; *Slot Speaker*, 680 F. App'x at 943-44.

3. Claim 3:

a. [3Preamble] “The method according to claim 1,”

For the reasons discussed above, *Kim* and *Chen* render obvious claim 1.

b. [3a] “wherein K2 antenna port groups in the K antenna port groups correspond to K2 channel quality values in the K channel quality values; the K2 is a positive integer less than or equal to the K;”

Kim discloses wherein K2 antenna port groups in the K antenna port groups correspond to K2 channel quality values in the K channel quality values; the K2 is a positive integer less than or equal to the K. Kakaes ¶¶157-163.

Kim teaches that the maximum number of reported antenna ports, M, “may be signaled to the UE through RRC signaling” by the base station. *Kim*, [0148], [0146] (M “designated by the BS through RRC signaling”). *Kim* also explains that, “[i]f M CSI-RSs are changed, the report triggering may be performed,” which a POSITA would have understood describes a new measurement report being sent to the base station because M is redesignated (e.g., through RRC signaling) or because the RSRP values within M satisfy another triggering condition. *Kim*, [0148]. If the base station signals a change in M, such as from 2 to 3 (*see Chen*, 15-16), the UE may determine a new set of antenna port groups (K2) based on the new signaling. Kakaes ¶158; *Kim*, [0146], [0148]-[0149]. Because the reported CSI-RS

will be “a maximum of M,” M (K2) will be less than or equal to N (K) because M is selected from “among N” antenna port groups. *Kim*, [0149]; Kakaes ¶158.

To the extent Patent Owner argues that this claim element covers a second measurement report, such as resulting from a change in triggering conditions or based on a time expiration, *Kim* discloses identifying a second set (K2) of antenna port groups from the CSI-RS being measured after a “predetermined time (T2).” *Kim*, [0148]; Kakaes ¶159. A POSITA would have found it obvious to select the K2 antenna port groups during a second measurement report using the first information, such as a predetermined interval or occurrence of a triggering condition. Kakaes ¶¶159-160; *Kim*, [0148]; *Sesia LTE*, 75.

As explained above, the new measurement set (K2 antenna ports) has channel quality values in the configured set of N antenna ports (K antenna port groups) having channel quality values. *Supra* § V.A.1.h ([1d4]). A POSITA would have found it obvious to select the K2 antenna port groups to allow the UE to optimize the data transmission, for example, by selecting the M antenna ports (if M has changed) or to account for differences in RSRP values at a subsequent time T2, as explained above. Kakaes ¶160. A POSITA would have been motivated to do this to improve data transmission, such as by selecting higher signal strength(s), as explained above. Kakaes ¶160; *Chen*, 1; *Afroz*, 115, 118, 120, 122, FIG. 7; *see Park*, [93]-[94], [405].

Additionally, if Patent Owner argues, or the Board finds, that *Kim* does not disclose the K2 antenna port groups, it would have been obvious to a POSITA to select two sets of antenna port groups, K1 and K2, because the carriers or frequency bands of each of the antenna port groups may be different and, thus, each carrier or frequency band requires a different selection of antenna ports to optimize the transmission from the base station. Kakaes ¶161. *Kim* discloses that Resource Blocks for the transmitting CSI-RS may include subcarrier frequencies. *Kim*, [0043]. A POSITA would have been motivated to select the K1 and K2 antenna port groups based on carriers to coordinate the signals, such as by using cross-polarized transmissions, correlation, or different transmission modes of different carriers/frequencies to prevent interference. *See Liu*, 20, 23, 29; Kakaes ¶161.

A POSITA would have reasonably expected success in selecting the K2 antenna port group signals having channel quality values because it is subset of the K channel quality values (RSRP), as explained in [1d3]-[1d4], based on a second measurement report or carrier selection. The K2 subset would have been a straightforward determination based on the measured channel quality values, and therefore applies only known, conventional calculations used according to their known functions to yield predictable results. Kakaes ¶163.

- c. **[3b] “a second proportional sequence corresponds to a ratio(ratios) among the K2 channel quality values;”**

Kim discloses that a second proportional sequence corresponds to a ratio(ratios) among the K2 channel quality values. Kakaes ¶¶164-165.

Because the K2 antenna port groups described in [3a] are part of the set of N (K) antenna port groups, *Kim*’s UE calculates a second proportional sequence that corresponds to the RSRP-to-max(RSRP) ratio among the K2 RSRP values, as explained in claim 1. *Supra* §§ V.A.1.i-V.A.1.m ([1d5]-[1d9]); Kakaes ¶165.

- d. **[3c] “a first receiving beamforming vector is used to receive signals transmitted through the K1 antenna port groups; a second receiving beamforming vector is used to receive signals transmitted through the K2 antenna port groups; the first receiving beamforming vector and the second receive beamforming vector are different;”**

Kim discloses, or *Kim* and *Chen* render obvious, that a first receiving beamforming vector is used to receive signals transmitted through the K1 antenna port groups, that a second receiving beamforming vector is used to receive signals transmitted through the K2 antenna port groups, and that the first receiving beamforming vector and the second receive beamforming vector are different. Kakaes ¶¶166-172.

Kim discloses that a “precoding matrix” is used to transmit signals, e.g., data, over the CSI-RS antenna ports of the base station. *Kim*, [0111]. For example,

“a Rank-1 precoding matrix is optimally applied to the antenna port set of the corresponding CSI-RS and data is then transmitted,” and the received power of the data channel may be reported. *Kim*, [0144]-[0145]. That is, the precoding matrix is used to transmit data through the selected antenna ports, which *Chen* confirms.

Kakaes ¶167; *Chen*, 2 (“a channel matrix correspond[s] to each transmission resource” and includes “precoding vector[s]” for the received CSI-RSs). A POSITA would have recognized that the beamforming vectors of the “transmit beamforming matrix” have “matching receive beamforming structure” for transmission between the base station and UE, and thus disclosure of the transmitted beamforming vectors having corresponding receiving beamforming vectors. *Sesia LTE*, 253; Kakaes ¶167. Thus, a POSITA would have recognized that *Kim*’s and *Chen*’s beamforming matrices describe both transmit and receive beamforming vectors for the selected antenna ports. Kakaes ¶167.

Chen further explains that “channel statistic information” sent from the UE also includes “characteristic vectors of the correlation matrix” (e.g., “DFT vectors” or “Kronecker products $f(v_k, v_l)$ ”) that are assigned to the transmitting antenna ports. *Chen*, 4. Thus, when the UE reports back the vectors to the base station, new beams are constructed from the selected antenna ports “according to a channel correlation matrix fed back by the [UE],” and the base station “transmits the P new beams to the [UE].” *Chen*, 9, 20, 21, 25.

The base station may then use “a channel correlation sub-matrix of one terminal” to shape the new beams transmitted to the UE, *Chen*, 21, which a POSITA would have understood corresponds to the receiving beamforming vectors used to transmit on the selected antenna ports. Kakaes ¶168-169; *Sesia LTE*, 253. A POSITA would have recognized that different sub-matrices would have been provided by the UE for the K1 and K2 antenna port groups with the measurement report(s) and, therefore, would have been different receiving beamforming vectors. Kakaes ¶169.

Park confirms this understanding of *Kim*’s and *Chen*’s descriptions that each of the K1 and K2 port groups would have different receiving beamforming vectors (and matrices) because “beamforming is configured differently for each antenna port.” *Park*, [359]; Kakaes ¶170; *see also Vitthaladevuni*, [0005].

A POSITA would have found it obvious to provide a first receiving beamforming vector and a second receiving beamforming vector for the K1 and K2 antenna port groups, respectively, for transmitting data through the antenna port groups, where the first and second beamforming vectors are different to optimize the transmission, as taught by *Kim* and *Chen*. Kakaes ¶171. A POSITA would have been motivated to utilize receiving beamforming vectors to improve the gain of the received signals, at least because data transmission was known to be related to the received signal strength and beamforming allows for improving the

received strength for the K1 and K2 antenna port groups. *Id.*; see *Afroz*, 115, 118, 120, 122, FIG. 7.

A POSITA would have had a reasonable expectation of success in configuring *Kim*'s system such that a first receiving beamforming vector is used to receive signals transmitted through the K1 antenna port groups, a second receiving beamforming vector is used to receive signals transmitted through the K2 antenna port groups, and the first and second receiving beamforming vectors are different. Kakaes ¶172. Transmitting wireless signals using antenna ports was a basic, well-known, and conventional operation in LTE, 4G, and predecessor systems, and was even accounted for in various 3GPP standards for LTE. *Id.*; *Sesia LTE*, 155, 167, 169, 654; *Kim*, [0103]; *Chen*, 2, 3, 5, 7, 11, 18; *Liu*, 1, 16, 18; *Park*, [206], [208], [205]-[222]. Beamforming was a conventional operation known to POSITAs through the use of precoding matrices, and receiving beamforming vectors were “simple concepts” known to POSITAs. *Sesia LTE*, 254-255; Kakaes ¶172. Having different first and second receiving beamforming vectors for the K1 and K2 antenna port groups would have been a straightforward operation of MIMO systems, such as described in *Kim* and *Chen*, that applies only known, conventional functions (using precoding matrices containing beamforming vectors to form transmission beams) used according to their known functions to yield predictable

results (directing and receiving the beams based on the vectors). *KSR*, 550 U.S. at 416; *Slot Speaker*, 680 F. App'x at 943-44.

- e. **[3d] “the first information is further used to determine the K2 antenna port groups and the second proportional sequence.”**

Kim discloses that the first information is further used to determine the K2 antenna port groups and the second proportional sequence. Kakaes ¶¶173-174.

As explained for elements [1d6] and [3b], the first information is used to determine the K2 antenna port groups and the second proportional sequence, such as when the UE reports the K2 antenna port groups. *Supra* §§ V.A.1.j ([1d6]), V.A.3.c ([3b]); Kakaes ¶174.

- 4. **Claim 4: “The method according to claim 3, wherein... any two antenna ports in the K1 antenna port groups are on a same carrier, and any two antenna ports in the K2 antenna port groups are on a same carrier....”**

For the reasons discussed above, *Kim* and *Chen* render obvious claim 3.

Claim 4 recites three alternative options, separated by “or.” Satisfying any one of these options satisfies the requirements of claim 4. *Brown*, 265 F.3d at 1351.

Kim discloses or renders obvious that any two antenna ports in the K1 antenna port groups are on a same carrier, and any two antenna ports in the K2 antenna port groups are on a same carrier. Kakaes ¶¶177-178. *Kim* teaches a

“single carrier frequency division multiple access” or “SC-FDMA.” *Kim*, [0039], [0002]. *Kim* explains that CSI-RSs can be “configured to perform coordinated cells [that] have *the same carrier frequency*,” which simplifies processing by the UE. *Kim*, [0170] (emphasis added); Kakaes ¶177. A POSITA would have understood that, because “the same carrier frequency” is used, any two antenna ports in the K1 antenna port groups are on a same carrier and any two antenna ports in the K2 antenna port groups are on a same carrier. Kakaes ¶177. *Kim* confirms this, describing “contiguous subcarriers” for transmitting from the base station to the UE and Resource Blocks including CSI-RSs having subcarrier frequencies identified in the first signaling information sent to the UE. *Kim*, [0043], [0048], [0067], [0081]; Kakaes ¶177. *Sesia LTE* confirms a POSITA’s understanding of *Kim* that a particular carrier frequency contains subcarriers within a particular carrier frequency bandwidth:

Table 14.2: LTE Uplink SC-FDMA parametrization for selected carrier bandwidths.

	Carrier bandwidth (MHz)					
	1.4	3	5	10	15	20
FFT size	128	256	512	1024	1536	2048
Sampling rate: $M/N \times 3.84$ MHz	1/2	1/1	2/1	4/1	6/1	8/1
Number of subcarriers	72	180	300	600	900	1200
Number of RBs	6	15	25	50	75	100
Bandwidth efficiency (%)	77.1	90	90	90	90	90

Sesia LTE, 324; Kakaes ¶177. Because *Kim* describes the Resource Block having a “single carrier” or “subcarriers,” a POSITA would have understood that any two

antenna ports in the K1 antenna port groups are on a same carrier and any two antenna ports in the K2 antenna port groups are on a same carrier. Kakaes ¶178.

5. **Claim 5: “The method according to claim 3, further comprising: receiving a second wireless signal; wherein a target antenna port group is used to transmit the second wireless signal; the target antenna port group is associated with the K1 antenna port groups and the first proportional sequence, or the target antenna port group is associated with the K2 antenna port groups and the second proportional sequence.”**

For the reasons discussed above, *Kim* and *Chen* render obvious claim 3.

Kim and *Chen* render obvious the receiving of claim 5. Kakaes ¶¶179-186.

The claim language does not require the “target antenna group” be different from the K1 or K2 antenna port groups, or that the “second wireless signal” be associated with both the K1 and K2 port groups or proportional sequences, but instead only “associated with” one of those groups and proportional sequences. Kakaes ¶180.

Kim discloses receiving a second wireless signal as a data transmission and that a target antenna port group is used for transmitting the data transmission. Kakaes ¶181. *Kim* describes “data transmission/reception relations between an eNode B and a user equipment.” *Kim*, [0035]. When “data is transmitted and received using multiple antennas, a channel state between each transmission antenna and each reception antenna should be known in order to accurately receive

a signal.” *Kim*, [0053]; Kakaes ¶181. *Kim* explains that a “purpose of [CSI-RS] transmission... is to perform CSI feedback... by a UE to aid scheduling of a BS (eNB) that determines a rank, precoding matrix, a modulation and coding scheme (MCS) or CQI *to be used for DL data transmission between the corresponding cell and the UE.*” *Kim*, [0111] (emphasis added). A POSITA would have understood this describes the UE identifying the selected K1 antenna port groups (e.g., through first information, *supra* § V.A.1 (claim 1)), that the base station then uses to transmit data to the UE in a second wireless signal associated with the K1 antenna ports and the corresponding proportional sequence. Kakaes ¶181.

Additionally, *Kim* also describes performing a subsequent (second) measurement report related to the N (K) antenna ports, which includes the K1 and K2 antenna ports, if “reporting is not triggered during a predetermined time (T2).” *Kim*, [0148]. The wireless signal determined at time T2 for measurement report feedback would therefore be a second wireless signal where a target antenna port group (e.g., K1) transmits the second wireless signal (CSI-RS) and is associated with the K1 antenna port group and the first proportional sequence from the first measurement report when the second measurement is performed. Kakaes ¶182; *Kim*, [0148].

To the extent Patent Owner argues that *Kim* does not disclose or suggest claim 5, *Chen* renders it obvious. Kakaes ¶¶183-186. *Chen* teaches that the base

station “determine[s] the N pilot ports according to channel statistic information fed back by the terminal [UE],” which includes “a correlation matrix” having “virtualized precoding weights corresponding to the N pilot ports.” *Chen*, 7, 9, 12; Kakaes ¶183. A POSITA would have understood this describes the UE feeding back information, such as the channel correlation matrix, to the base station for K1 antenna ports (**blue**) and the base station transmitting a second wireless signal to the UE on a channel (**pink**) associated with the selected antenna port groups, as shown in annotated FIG. 9 below, making the second wireless signal associated with the K1 antenna ports and first proportional sequence. *Chen*, FIG. 9; Kakaes ¶183.

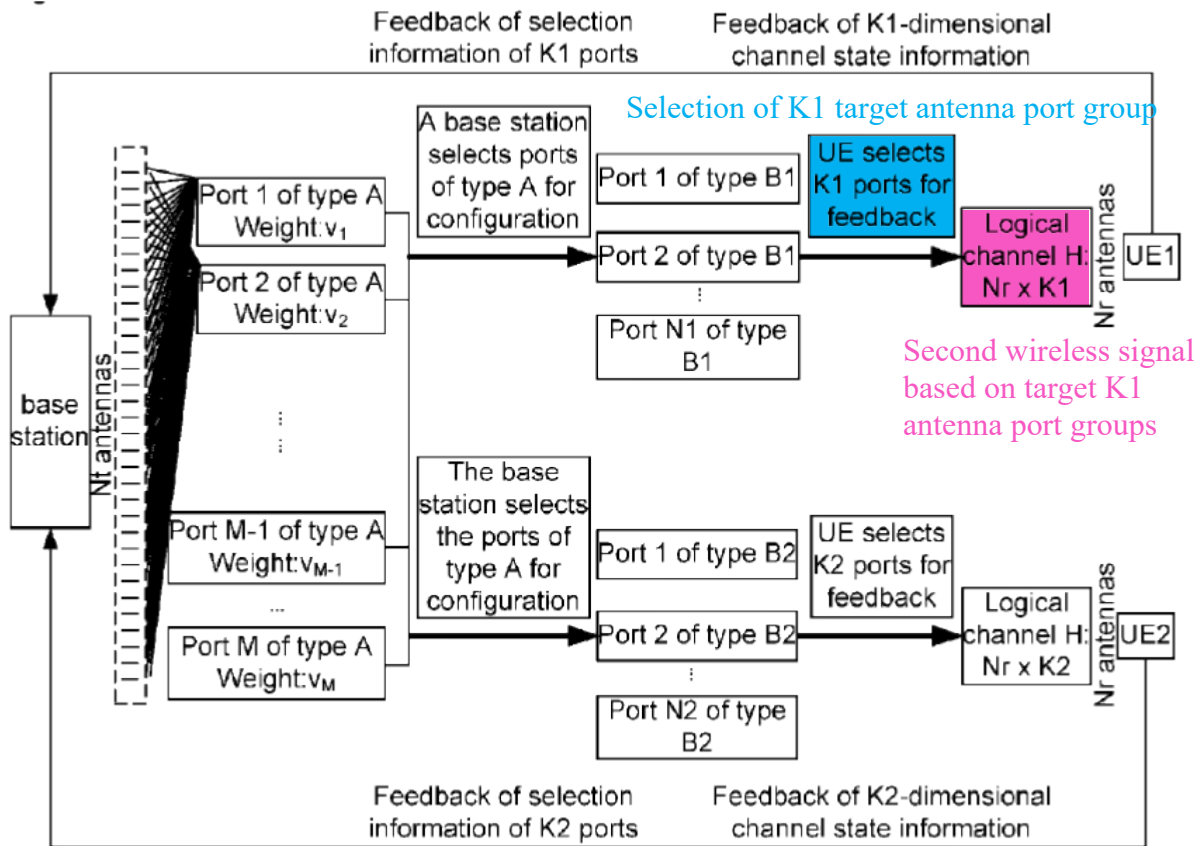


FIG. 9

Chen, FIG. 9 (annotated); Kakaes ¶183.

Chen's FIGS. 11 and 12 confirm this because a "channel correlation matrix" is fed back to the base station by the UE for the selected antenna ports and the base station "take[s] a channel correlation sub-matrix of one terminal" and develops the new transmission beam(s) for the UE through matrix processing and beamforming. *Chen*, 20-21, FIGS. 11-12; Kakaes ¶184. A POSITA would have understood that the base station uses the channel information (e.g., matrix/sub-matrix) and selected K1 antenna ports to configure the subsequent transmission to the UE. Kakaes ¶184.

A POSITA would have found it obvious to incorporate *Chen*'s second wireless signal transmitted using a target antenna port group of the K1 antenna ports selected based on the UE's proportional sequence analysis described in *Kim* and *Chen* to optimize the transmission. Kakaes ¶185. A POSITA would have been motivated to transmit the second wireless signal using the target antenna port group, where the target antenna port group is associated with the K1 selected antenna ports and the corresponding proportional sequence, to optimize the signal being transmitted to the UE by using the selected antenna ports that the UE identified as preferable. *Id.* A POSITA would have been motivated to do this because "feeding back channel information to a transmitter by a receiver and performing data transmission according to the obtained channel information by adopting a transmission precoding technology by the transmitter" was known to "greatly improv[e] transmission performance." *Chen*, 1. Because the target antenna port is selected based on, for example, the RSRP ratio being above a threshold, then the signal will be stronger, which improves data throughput to the UE. Kakaes ¶185; *Chen*, 1; *Afroz*, 115, 118, 120, 122, FIG. 7; *see Park*, [93]-[94], [405].

A POSITA would have had a reasonable expectation of success in configuring *Kim*'s system such that the UE receives a second wireless signal from the base station, wherein a target antenna port group is used to transmit the second wireless signal, and the target antenna port group is associated with the K1 antenna

port groups and the first proportional sequence or the K2 antenna port groups and the second proportional sequence. Kakaes ¶186. Transmitting a second or subsequent wireless signal from an antenna port group identified by the UE in the measurement report (e.g., K1 or K2 port groups, or a port group therein) based on the RSRP ratio selection performed by the UE (corresponding proportional sequence) was a basic, well-known, and conventional operation in LTE, 4G, and predecessor systems, and was accounted for in various 3GPP standards for LTE. *Id.*; *supra* §§ V.A.1.i-V.A.1.m, V.A.3 ([1d5]-[1d9], claim 3); *Sesia LTE*, 145, 167, 215, 254-255; *Kim*, [0103]; *Chen*, 2, 3, 5, 7, 11, 18; *Liu*, 17 (UE selects antenna ports “to cause the [base station] to transmit data on these N antenna ports to the [UE]” using second wireless signal); *Park*, [206], [208], [205]-[222]. Transmitting a second wireless signal using a target antenna port group associated with the K1 or K2 antenna port groups and the respective proportional sequence would have been a straightforward operation of MIMO systems that applies only known, conventional functions (transmitting a wireless signal to a UE using an antenna port identified by the UE in the measurement report) used according to their known functions to yield predictable results (sending a wireless signal to the UE). *KSR*, 550 U.S. at 416; *Slot Speaker*, 680 F. App’x at 943-44.

6. Claim 6

Claim 6 is substantively identical to claim 1, but recites the base station transmitting and receiving, rather than the UE receiving and transmitting, information, [6Preamble], [6a], [6b], and [6c]. Kakaes ¶¶187-191. The remaining elements [6d1]-[6d9] are substantively the same as [1d1]-[1d9]. Kakaes ¶¶192-200. The above discussion for claim 1 describes both the transmission and reception of the base station and UE and, therefore, also explains why each element of claim 6 is taught or rendered obvious by *Kim* and *Chen*. Kakaes ¶¶187-200; *supra* § V.A.1 (claim 1).

a. [6Preamble] “A method for multi-antenna transmission in a base station, comprising:”

To the extent the preamble is limiting, *Kim* discloses [6Preamble] as discussed in [1Preamble]. *Supra* § V.A.1.a; Kakaes ¶188.

b. [6a] “transmitting, by the base station, a first signaling to a user equipment (UE);”

Kim discloses [6a] as discussed in [1a]. *Supra* § V.A.1.b; Kakaes ¶189.

c. [6b] “transmitting, by the base station, a first wireless signal to the UE; and”

Kim discloses [6b] as discussed in [1b]. *Supra* § V.A.1.c; Kakaes ¶190.

d. [6c] “receiving, by the base station, first information from the UE;”

Kim discloses [6c] as discussed in [1c]. *Supra* § V.A.1.d; Kakaes ¶191.

e. [6d] [6d1]-[6d9]

Limitations [6d1]-[6d9] are substantively identical to [1d1]-[1d9]. *Kim* discloses, or alternatively *Kim* and *Chen* render obvious, [6d1]-[6d9] as discussed in [1d1]-[1d9]. *Supra* §§ V.A.1.e-V.A.1.m; Kakaes ¶¶192-200.

7. Claims 7-10

Kim and *Chen* render obvious claim 6, as discussed above.

The additional limitations of claims 7-10 are substantively identical to claims 2-5, and are disclosed by *Kim*, or rendered obvious by *Kim* and *Chen*, for the reasons discussed in claims 1-5 and 6. *Supra* §§ V.A.1-V.A.6; Kakaes ¶¶201-208.

8. Claim 11

Claim 11 is substantively similar to claim 1, but recites the UE performing the functions, rather than a method. Kakaes ¶¶209-227. Elements [11a]-[11c] recite a “first receiver,” “second receiver,” and “third transmitter” performing steps comparable to [1a]-[1c]. Kakaes ¶¶211-218. The discussion for claim 1 describes why the elements of claim 11 are taught or rendered obvious by *Kim* and *Chen*, although the specific “receiver[s]” and “transmitter” are further discussed below. *Supra* § V.A.1 (claim 1); Kakaes ¶¶209-227.

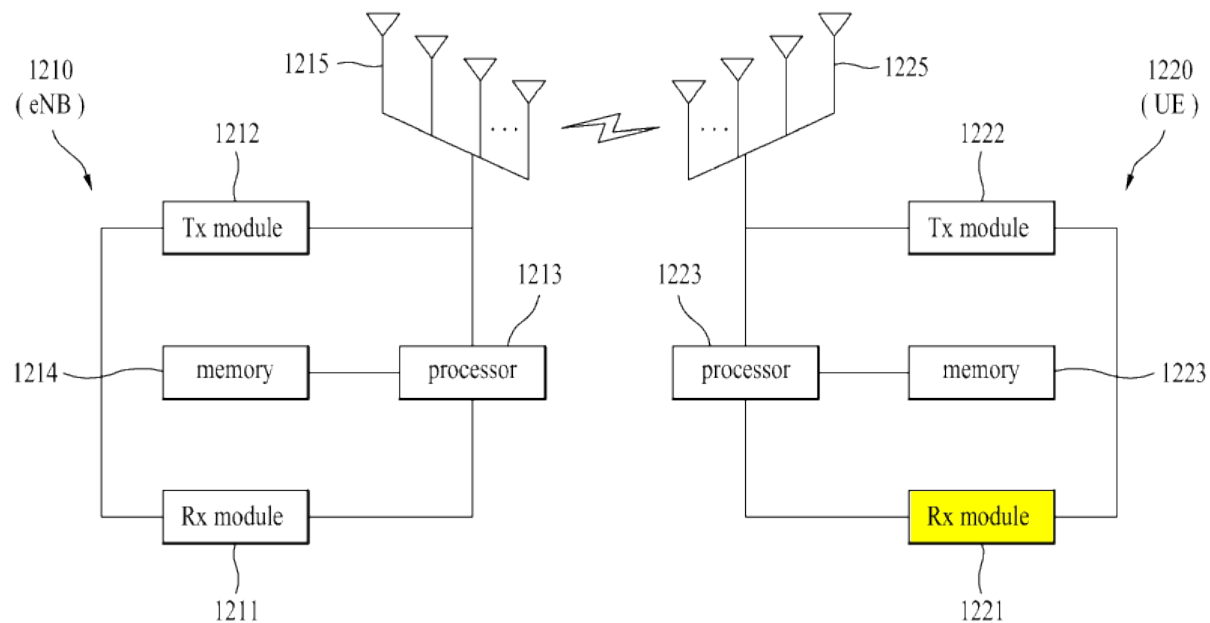
a. [11Preamble] “A user equipment (UE) for multi-antenna transmission comprising:”

To the extent the preamble is limiting, *Kim* discloses [11Preamble] as discussed in [1Preamble]. *Supra* § V.A.1.a; Kakaes ¶210.

b. [11a] “a first receiver at the UE, receiving a first signaling originating from a base station;”

Kim discloses [11a] for the reasons discussed in [1a]. *Supra* § V.A.1.b; Kakaes ¶¶211-212.

Kim discloses a MIMO receiver or receiving unit, as explained for [3c] and claim 1 (§§ V.A.3.d, V.A.1), which a POSITA would have understood includes multiple receivers because it requires “multiple output,” meaning that the UE’s antennas each have receivers to receive the first signaling and the first wireless signal. Kakaes ¶211. *Kim*’s UE receives first signaling and wireless signals transmitted from the base station at antennas 1225, as described in Sections V.A.1.b-V.A.1.c ([1a]-[1b]), and processes the signals at “Rx module 1221,” which may “receive downlink signals, data and information from the BS,” as shown in FIG. 12. *Kim*, [0177], FIG. 12; Kakaes ¶211.



Kim, FIG. 12 (annotated).

A POSITA would have understood Rx module 1221 is a type of receiver as recited in [11a], but also would have recognized that, because *Kim* discloses a MIMO system, each of *Kim*'s antennas 1225 would have a corresponding receiver to process the incoming CSI-RS signals and signaling to pass to Rx module 1221, as was conventional in the art and confirmed by *Luo*, *Vitthaladevuni*, and *Hu*. Kakaes ¶212. *Luo*, for example, explains that “transmitted modulated signals are received by N_R antennas 252a through 252r and the received signal from each antenna 252 is provided to a respective receiver (RCVR) 254a through 254r,” which “conditions (e.g., filters, amplifies, and downconverts) a respective received signal” at the UE, as shown below. *Luo*, [0037].

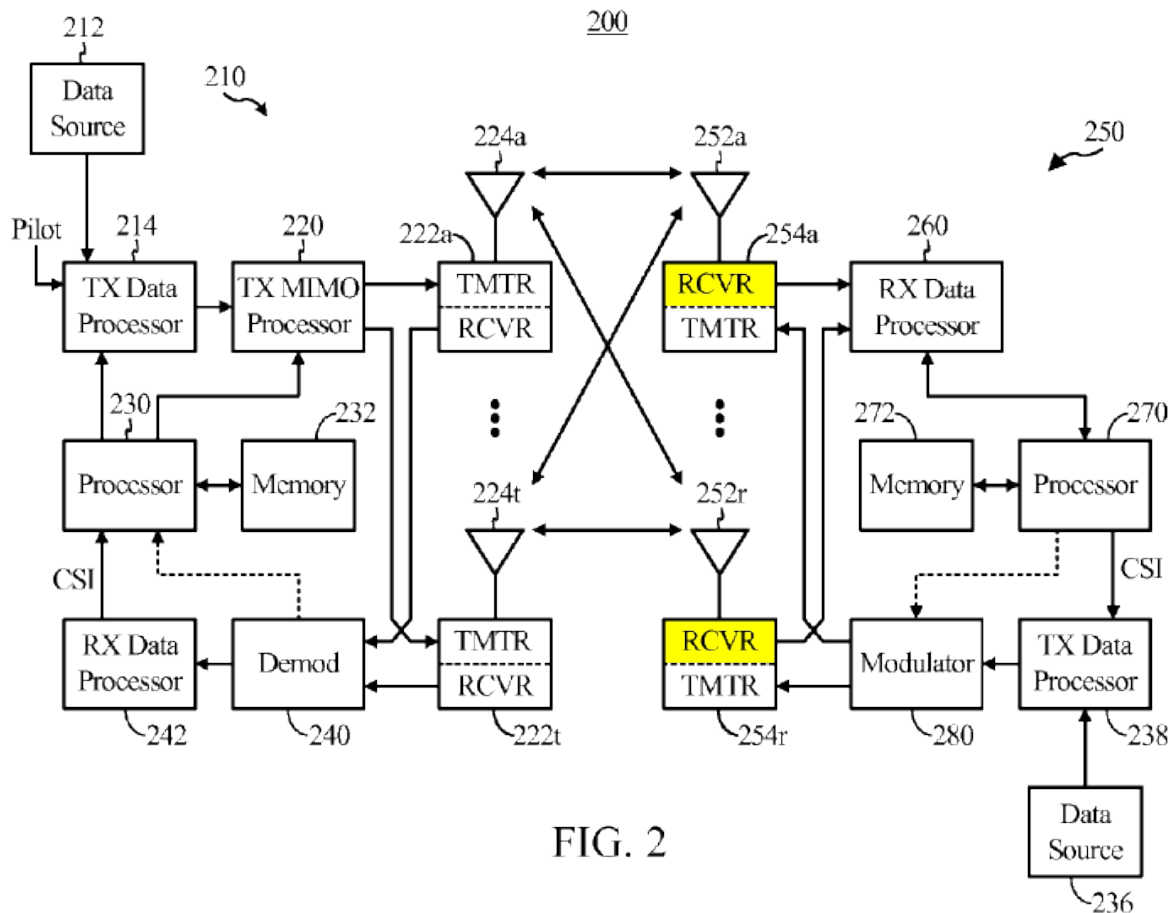


FIG. 2

Luo, FIG. 2 (annotated); *see also Vitthaladevuni*, FIG. 10, [0116], [0120]-[0121]; *Hu*, FIG. 12, [0142]-[0143]. A POSITA would have understood *Kim*'s disclosure to include receivers at each of the antennas, or at a minimum found it obvious as explained in [11b]. Kakaes ¶212.

- c. [11b] “a second receiver at the UE, receiving a first wireless signal originating from the base station; and”

Kim discloses or suggests [11b] for the reasons discussed in [1b]. *Supra*

§ V.A.1.c; Kakaes ¶¶213-217. *Kim* discloses a MIMO receiver or receiving unit, as

explained for Sections V.A.3.d ([3c]), V.A.1 (claim 1), and V.A.8.b ([11a]), which a POSITA would have understood includes multiple receivers because it requires “multiple output,” meaning that UE’s two receivers each receive the first signaling and the first wireless signal. Kakaes ¶213.

To the extent Patent Owner argues, or the Board finds, that *Kim* and *Chen* do not disclose or suggest a second receiver, a POSITA would have found it obvious to include a “second receiver” as recited in [11b]. *Id.* Having a corresponding receiver for each antenna in a MIMO UE was conventional and well known to a POSITA, and a POSITA would have found it obvious to include a second receiver at the UE to receive the first wireless signal to improve the efficiency and operation of *Kim*’s system by providing for parallel reception and processing at the UE to “achieve a higher data transmission rate by means of a plurality of antennas.” *Chen*, 1; Kakaes ¶214; *see Luo*, FIG. 2, [0037]; *Vitthaladevuni*, FIG. 10, [0116], [0120]-[0121]; *Hu*, FIG. 12, [0142]-[0143].

i. Motivation to Combine

A POSITA would have been motivated to include two receivers, as claimed, because it would have enabled the MIMO operation disclosed in *Kim* and *Chen*, and would have facilitated greater throughput and increased the channel reliability because data transfer is generally proportional to the number of receiving and transmitting antennas. This would have enhanced processing at the UE by dividing

the processing amongst multiple receivers. Kakaes ¶216. A POSITA would have known that using two receivers, each complimenting the other by receiving the signaling and wireless signals from the base station, was conventional in MIMO systems. *Id.* The multi-receiver and multi-transmitter configuration was a well-known design choice to a POSITA. *Id.*

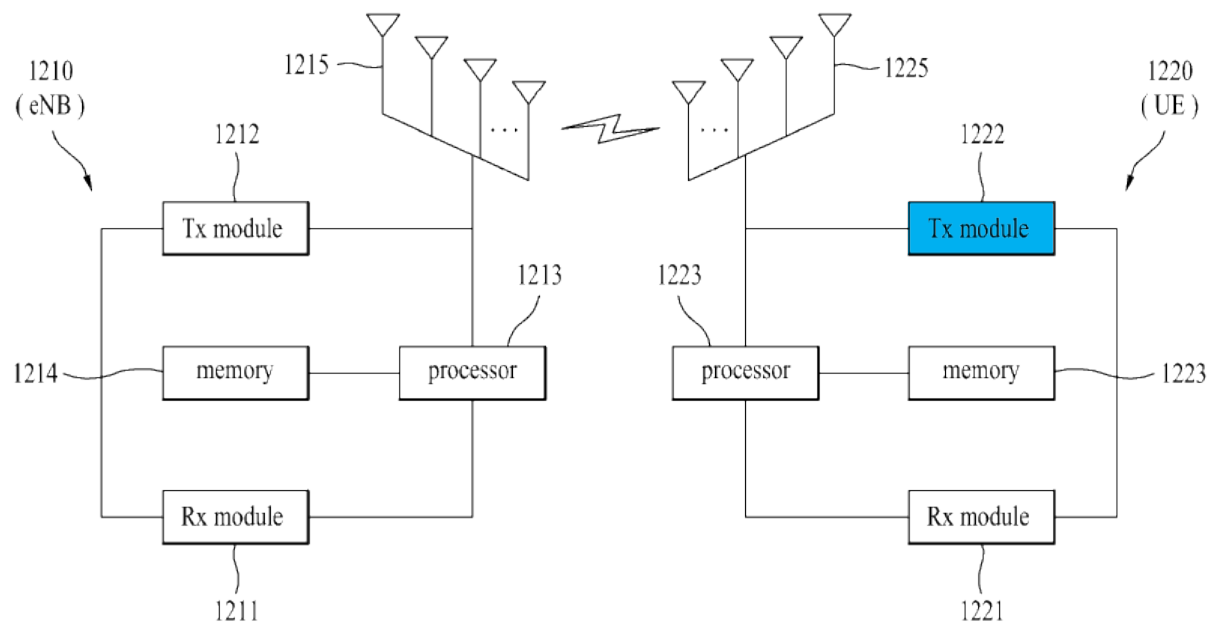
ii. Expectation of Success

A POSITA would have reasonably expected success in providing two receivers, each receiving the first signaling and the first wireless signal, in *Kim*'s UE because multiple receivers receiving this information was conventional and routine in MIMO systems described in *Kim* and *Chen*. Kakaes ¶217. MIMO technologies were well established by the earliest priority date of the '271 patent, and the use of multiple receivers, as claimed, would have required only the implementation of that well-established technology operating in its expected operation. The combination thus represents only known components operating according to their ordinary and expected functions to yield predictable results (receiving transmitted signals). *Id.*

d. [11c] “a third transmitter at the UE, transmitting first information to the base station;”

Kim discloses [11c] for the reasons discussed in [1c]. *Supra* § V.A.1.d; Kakaes ¶218. *Kim*'s UE includes a “Tx module 1222 [that] may transmit uplink

signals, data and information to the BS (eNB)” using antennas 1225, as shown in FIG. 12, which a POSITA would have understood describes a transmitter transmitting the first information, such as information in the measurement report, to the base station, as described in Section V.A.1.d ([1c]). *Kim*, [0177], FIG. 12; Kakaes ¶218.



Kim, FIG. 12 (annotated).

e. [11d] [11d1]-[11d9]

Elements [11d1]-[11d9] are identical to [1d1]-[1d9], and are disclosed by *Kim*, or rendered obvious by *Kim* and *Chen*, as discussed in Sections V.A.1.e-V.A.1.m. Kakaes ¶¶219-227.

9. Claims 12-14

Kim and *Chen* render obvious claim 11, as discussed above.

The additional limitations of claims 12-14 are substantively identical to claims 2-4, and are disclosed by *Kim*, or rendered obvious by *Kim* and *Chen*, for the reasons discussed in claims 1-4 and 11. *Supra* §§ V.A.1-V.A.4, V.A.8; Kakaes ¶¶228-233.

10. Claim 15

Kim and *Chen* render obvious claim 13, as discussed above.

The additional limitations of claim 15 are substantively identical to claim 5, and are disclosed by *Kim*, or rendered obvious by *Kim* and *Chen* for the reasons discussed in claims 1, 5, and 11, because, as explained above for claim 11, in MIMO systems, the two receivers at the UE receive the wireless signals, such as the data transmission (“second wireless signal,” *supra* § V.A.5 (claim 5)), from the base station. *Supra* §§ V.A.1, V.A.5, V.A.8; Kakaes ¶¶234-235.

11. Claim 16

Claim 16 is substantively similar to claim 6, but recites the base station performing the functions, rather than a method. Kakaes ¶¶236-256. Elements [16a]-[16c] recite a “first transmitter,” “second transmitter,” and “third receiver” performing steps comparable to [6a]-[6c]. Kakaes ¶¶238-247. The discussions for claims 1 and 6 describe why the elements of claim 16 are taught or rendered

obvious by *Kim* and *Chen*, although the specific “transmitter[s]” and “receiver” are further discussed below. *Supra* §§ V.A.1, V.A.6 (claims 1, 6); Kakaes ¶¶236-256.

a. [16Preamble] “A base station for multi-antenna transmission comprising:”

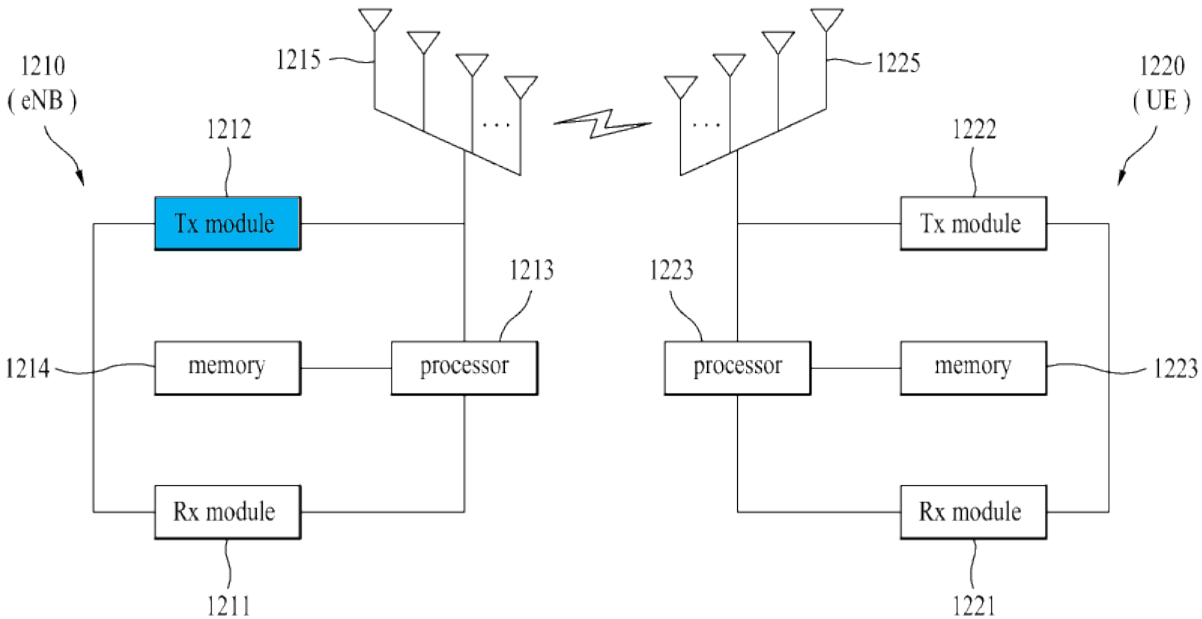
To the extent the preamble is limiting, *Kim* discloses [16Preamble] as discussed in [1Preamble] and [6Preamble]. *Supra* §§ V.A.1.a, V.A.6.a; Kakaes ¶237.

b. [16a] “a first transmitter at the base station, transmitting a first signaling to a user equipment (UE);”

Kim discloses [16a] for the reasons discussed in [1a] and [6a]. *Supra* §§ V.A.1.b, V.A.6.b; Kakaes ¶¶238-240.

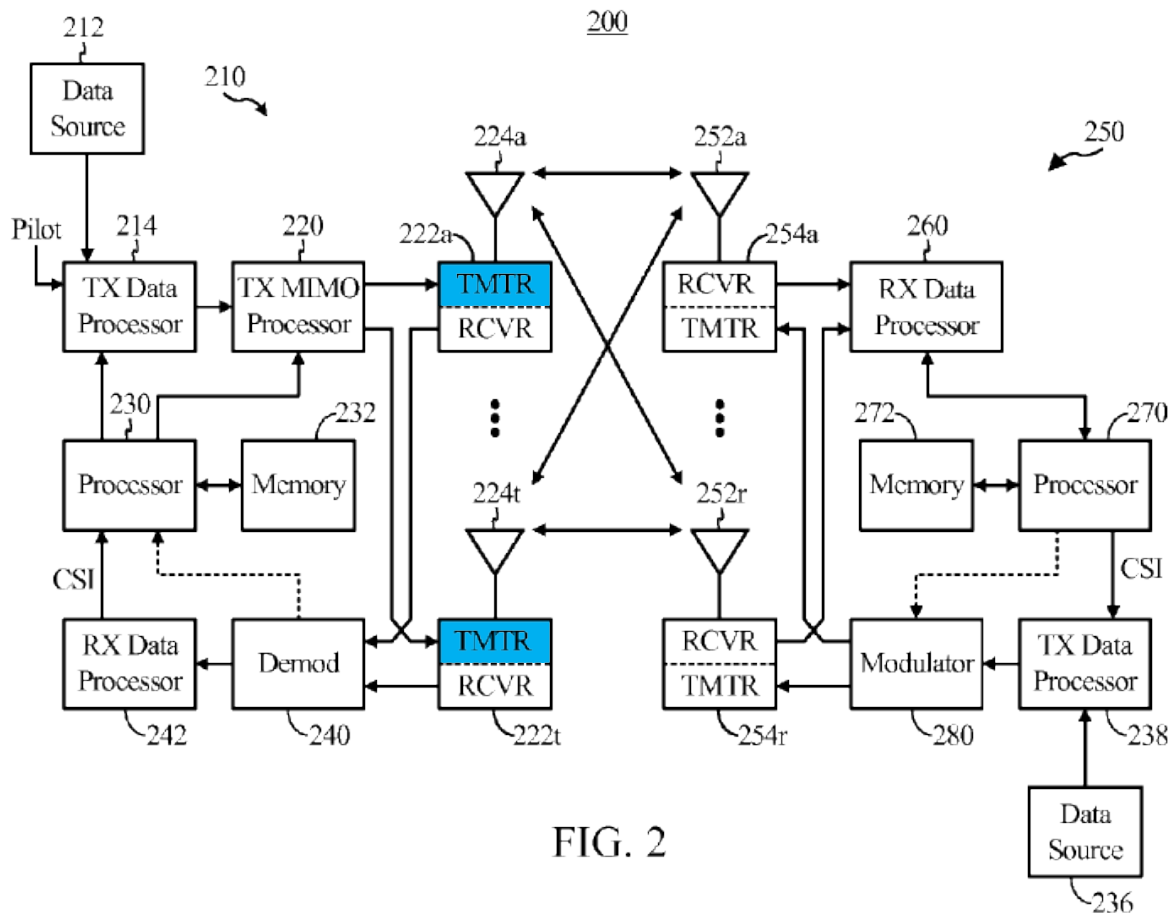
Kim discloses a MIMO transmitter at the base station, which a POSITA would have understood includes multiple transmitters because it requires “multiple input,” meaning that the base station’s antennas each have transmitters to transmit the first signaling and the first wireless signal. Kakaes ¶239. *Kim*’s base station transmits first signaling and wireless signals, as described in Sections V.A.1.b-V.A.1.c ([1a]-[1b]), using “transmission (Tx) module 1212” that “transmit[s] a variety of signals, data and information on a downlink for the UE” using antennas

1215. *Kim*, [0174], FIG. 12; Kakaes ¶239.



Kim, FIG. 12 (annotated).

A POSITA would have understood Tx module 1212 is a type of transmitter as recited in [16a], but also would have recognized that, because *Kim* discloses a MIMO system, each of *Kim*'s antennas 1215 would have a corresponding transmitter to process the outgoing CSI-RS signals and signaling received from Tx module 1212, as was conventional in the art and confirmed by *Luo*, *Vitthaladevuni*, and *Hu*. Kakaes ¶240. *Luo*, for example, explains that “[e]ach transmitter [(“TMTR”)] 222 receives and processes a respective symbol stream,” and “ N_T modulated signals from transmitters 222a through 222t are then transmitted from N_T antennas 224a through 224t, respectively.” *Luo*, [0036].



Luo, FIG. 2 (annotated); *see also Vitthaladevuni*, FIG. 10, [0116], [0118]-[0119]; *Hu*, FIG. 12, [0140]-[0141]. A POSITA would have understood *Kim*'s disclosure to include transmitters at each of the antennas, or at a minimum found it obvious as explained in [16b]. Kakaes ¶240.

- c. [16b] “a second transmitter at the base station, transmitting a first radio signal to the UE; and”

Kim discloses [16b] for the reasons discussed in [1b] and [6b]. *Supra* §§ V.A.1.c, V.A.6.c; Kakaes ¶¶241-242. *Kim*'s base station has multiple

transmitters or transmitting units in the form of transmitting antenna port groups transmitting wireless radio signals to the UE for MIMO systems, as explained for Sections V.A.3.d ([3c]), V.A.1 (claim 1), and V.A.11.b ([16a]), Kakaes ¶241.

To the extent Patent Owner argues, or the Board finds, that *Kim* and *Chen* do not disclose or suggest a second transmitter, a POSITA would have found it obvious to include a “second transmitter,” as recited in [16b]. Having a corresponding transmitter for each antenna in a MIMO base station was conventional and well known to a POSITA, and a POSITA would have found it obvious to include a second transmitter at the base station to transmit the first wireless signal to improve the efficiency and operation of *Kim*’s system by providing for parallel processing and transmission at the base station to “achieve a higher data transmission rate by means of a plurality of antennas.” *Chen*, 1; Kakaes ¶241-242; *see Luo*, FIG. 2, [0036]; *Vitthaladevuni*, FIG. 10, [0116], [0118]-[0119]; *Hu*, FIG. 12, [0140]-[0141].

i. Motivation to Combine

A POSITA would have been motivated to include two transmitters, as claimed, because it would have enabled the MIMO operation disclosed in *Kim* and *Chen*, and would have facilitated greater throughput and increased the channel reliability because data transfer is generally proportional to the number of receiving and transmitting antennas. This would have enhanced processing at the

base station by dividing the processing amongst multiple transmitters. Kakaes ¶245. A POSITA would have known that using two transmitters would have complimented each other by transmitting the signaling and wireless signals from the base station to the UE, which was conventional in MIMO systems. *Id.* The multi-transmitter and multi-receiver configuration was a well-known design choice to a POSITA. *Id.*

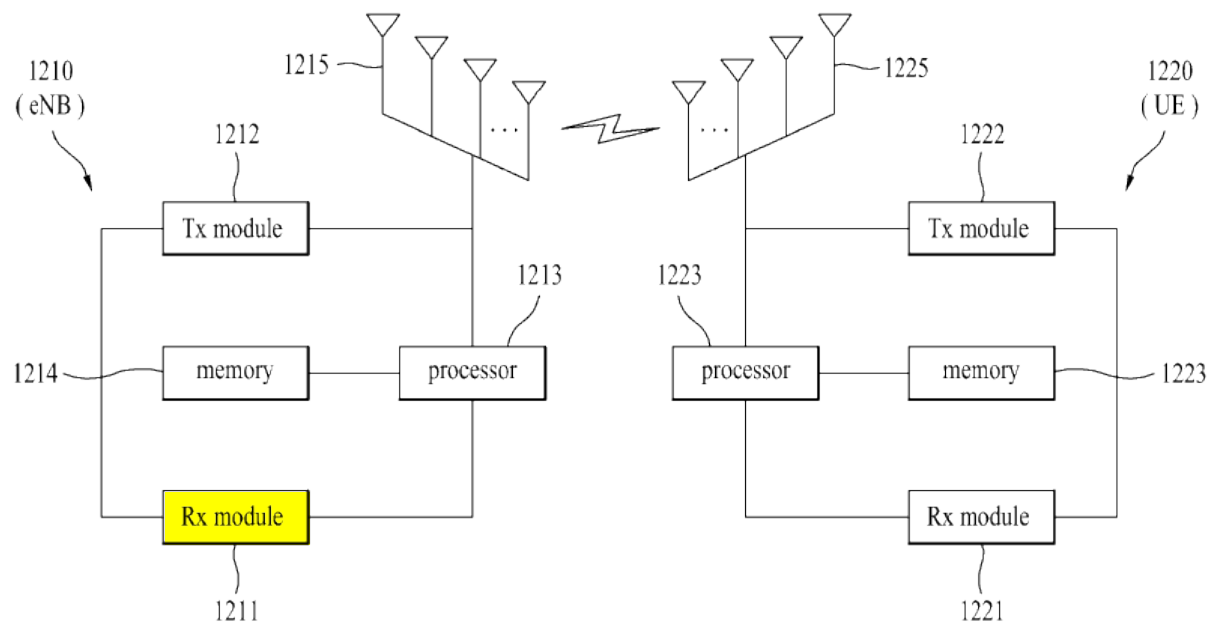
ii. Expectation of Success

A POSITA would have reasonably expected success in providing two transmitters, each transmitting the first signaling and the first wireless signal, in *Kim*'s base station because multiple transmitters transmitting this information was conventional and routine in the MIMO antennas described in *Kim* and *Chen*.

Kakaes ¶246. MIMO technologies were well established by the earliest priority date of the '271 patent, and the use of multiple base station transmitters, as claimed, would have required only the implementation of that well-established technology operating in its expected operation. The combination thus represents only known components operating according to their ordinary and expected functions to yield predictable results (transmitting signals). *Id.*

d. [16c] “a third receiver at the base station, receiving first information from the UE;”

Kim discloses [16c] for the reasons discussed in [1c] and [6c]. *Supra* §§ V.A.1.d, V.A.6.d; Kakaes ¶247. *Kim*’s base station includes “reception (Rx) module 1211” that receives “signals, data and information” from the UE using antennas 1215, as shown in FIG. 12, which a POSITA would have understood describes a receiver receiving the transmitted first information, such as the measurement report, as described in Section V.A.1.d ([1c]). *Kim*, [0174], FIG. 12; Kakaes ¶247.



Kim, FIG. 12 (annotated).

e. [16d] [16d1]-[16d9]

Elements [16d1]-[16d9] are identical to elements [1d1]-[1d9], and are disclosed by *Kim*, or rendered obvious by *Kim* and *Chen*, as discussed in [1d1]-[1d9]. *Supra* §§ V.A.1.e-V.A.1.m; Kakaes ¶¶248-256.

12. Claims 17-19

Kim and *Chen* render obvious claim 16, as discussed above.

The additional limitations of claims 17-19 are substantively identical to claims 2-4 and 7-9, and are disclosed by *Kim*, or rendered obvious by *Kim* and *Chen*, for the reasons discussed in claims 1-4, 6-9, and 16. *Supra* §§ V.A.1-V.A.4, V.A.6-V.A.7, V.A.11; Kakaes ¶¶257-262.

13. Claim 20

Kim and *Chen* render obvious claim 18, as discussed above.

The additional limitations of claim 15 are substantively identical to claims 5 and 10, and are disclosed by *Kim*, or rendered obvious by *Kim* and *Chen*, for the reasons discussed in claims 1, 5, 6, 10, and 16, because, as explained for claim 16, in MIMO systems, the two transmitters at the base station transmit the wireless signals, such as the data transmission (“second wireless signal,” *supra* § V.A.5 (claim 5)), to the UE. *Supra* §§ V.A.1, V.A.5, V.A.6-V.A.7, V.A.11; Kakaes ¶¶263-264.

VI. DISCRETIONARY DENIAL IS NOT WARRANTED

A. Denial of Institution Is Not Warranted Under *Fintiv*

Fintiv and the Office's interim guidelines dated June 21, 2022 ("Interim Procedures") require institution. Factor 6 requires institution because Petitioner presents a compelling unpatentability challenge; Factors 3 and 4 favor institution; and Factors 1, 2, and 5 are, at worst, neutral.

Factor 3 favors institution because Petitioner acted diligently and almost no parallel investment has occurred. Patent Owner served infringement contentions in January 2023. Ex. 1026. Fact discovery opened only last month and will not close until February 2024, with expert discovery closing March 2024. Ex. 1024, 3. Claim construction will not begin until August 2023 and the hearing will not take place until December 2023. *Id.*, 4-5.

Factor 4 favors institution because this Petition challenges claims 6-10 and 16-20, which are not involved in the litigation. Petitioner served invalidity contentions only last month, but is not required to select final prior art invalidity grounds until roughly June 2024, and thus any overlap at trial is speculative at this time. *Id.*, 1. Petitioner reserves the right to submit a stipulation based on developments here and/or in the litigation.

Regarding Factors 1, 2, and 5, Patent Owner filed its Complaint against Petitioner on June 1, 2022. Ex. 1022. No stay has been requested, trial is currently

scheduled for June 24, 2024, so trial is projected to occur, at the earliest, in June or July 2024. Ex. 1024, 1. A FWD is anticipated in September 2024, about two months after trial ends. In these circumstances, Factors 1, 2, and 5 are at worst neutral. *Protect Animals with Satellites v. OnPoint Sys.*, IPR2021-01483, Paper 11 at 11-13, 17 (Mar. 4, 2022). The Board has instituted with even more time between trial and FWD. *See NetNut v. Bright Data*, IPR2021-01492, Paper 12 at 9-16 (Mar. 21, 2022) (instituting IPR without stipulation and copending trial date six months before FWD); Interim Procedures, 8-9.

Denial of institution is not warranted under *Fintiv*.

B. Denial of Institution Is Not Warranted Under § 325(d)

No other proceedings involving the '271 patent are pending or have been brought before the Patent Office. Neither *Kim* nor *Chen* was before the Examiner during prosecution. Thus, the same or substantially the same prior art or arguments have not been presented to the Office and denial of institution is not warranted under § 325(d).

VII. MANDATORY NOTICES

A. Real Party-in-Interest

The real parties-in-interest are Samsung Electronics Co., Ltd., and Samsung Electronics America, Inc.

B. Related Matters

Apex asserted the '271 patent in the following litigations: *Apex Beam Technologies LLC v. Samsung Electronics Co., Ltd. et al.*, Case No. 2:22-cv-00188-JRG (E.D. Tex.); *Apex Beam Technologies LLC v. ZTE Corporation*, Case No. 2:22-cv-00031-JRG (E.D. Tex.); *Apex Beam Technologies LLC v. OnePlus Technology (Shenzhen) Co., Ltd.*, Case No. 2:22-cv-00032-JRG (E.D. Tex.); and *Apex Beam Technologies LLC v. TCT Mobile International Limited et al.*, Case No. 2:21-cv-00438-JRG (E.D. Tex.).

Petitioner has filed a second petition challenging claims 1-20 of the '271 patent in *Samsung Electronics Co., Ltd. et al. v. Apex Beam Technologies LLC*, IPR2023-00571.

The '271 patent is related to U.S. Patent Application Publication No. 17/138,945, which is pending, and CN108259071A/B and CN109617575A/B.

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Please address all correspondence to counsel at the addresses above.

Petitioner consents to electronic service by email at the above email addresses.

VIII. GROUNDS FOR STANDING

Petitioner certifies that the '271 patent is available for IPR and that Petitioner is not barred or estopped from requesting IPR challenging the patent claims on the grounds identified herein.

IX. CONCLUSION

For the reasons above, Petitioner has established a reasonable likelihood that the challenged claims are unpatentable. Petitioner requests institution of *inter partes* review and cancellation of each challenged claim. The Office may charge any required fees to Deposit Account No. 06-0916.

Date: March 29, 2023

Respectfully submitted,

/Joshua L. Goldberg/

Joshua L. Goldberg

Lead Counsel

Reg. No. 59,369

CERTIFICATION OF WORD COUNT

Pursuant to 37 C.F.R. § 42.24, Petitioner certifies that the word count of Petitioner's Petition for *Inter Partes* Review (exclusive of any table of contents, table of authorities, mandatory notices under § 42.8, certificates of service and word count, and list of exhibits or claim listing) as measured by Microsoft Word is 13,915.

Dated: March 29, 2023

By: /Joshua L. Goldberg/
Joshua L. Goldberg, Lead Counsel
Reg. No. 59,369

CLAIMS APPENDIX

1. **[1Preamble]** A method for multi-antenna transmission in a user equipment (UE), comprising:

[1a] receiving, by the UE, a first signaling originating from a base station;

[1b] receiving, by the UE, a first wireless signal originating from the base station; and

[1c] transmitting, by the UE, first information to the base station;

[1d] **[1d1]**⁸ wherein, K antenna port groups of the base station are used to transmit the first wireless signal;

[1d2] the first signaling is used by the UE to determine the K antenna port groups transmitting the first wireless signal received by the UE; the K is a positive integer greater than 1;

[1d3] the K antenna port groups respectively correspond to K channel quality values; the K channel quality values are K non-negative real numbers; the K channel quality values are Reference Signal Received Powers (RSRPs) or a Signal to Interference plus Noise Ratios (SINRs);

⁸ Paragraphing added for elements [1d1]-[1d9], [6d1]-[6d9], [11d1]-[11d9], and [16d1]-[16d9] for ease of reference.

[1d4] K1 antenna port groups of the K antenna port groups correspond to K1 channel quality values of the K channel quality values; the K1 is a positive integer less than or equal to the K;

[1d5] a first proportional sequence corresponds to a ratio(ratios) among the K1 channel quality values;

[1d6] the first information is used to determine the K1 antenna port groups and the first proportional sequence;

[1d7] the first signaling is used to determine a target threshold; the target threshold is a non-negative real number;

[1d8] a first channel quality is a best channel quality value among the K1 channel quality values; a second channel quality is a worse channel quality value among the K1 channel quality values;

[1d9] a ratio between the second channel quality and the first channel quality is greater than or equal to the target threshold.

2. The method according to claim 1, wherein the K channel quality values are broadband channel quality values; or the first proportional sequence comprises K1 positive real numbers less than or equal to 1, and the first proportional sequence comprises at least one 1; or the first proportional sequence comprises quantized values corresponding to K1 positive real

numbers; or the first proportional sequence comprises $K1-1$ positive real number(s), and the $K1-1$ positive real number(s) is(are) a ratio(ratios) between a channel quality value(s) other than the best channel quality value among the $K1$ channel quality values and the best channel quality value; or the first proportional sequence comprises quantized values corresponding to $K1-1$ positive real number(s).

3. **[3Preamble]** The method according to claim 1,
- [3a]** wherein $K2$ antenna port groups in the K antenna port groups correspond to $K2$ channel quality values in the K channel quality values; the $K2$ is a positive integer less than or equal to the K ;
- [3b]** a second proportional sequence corresponds to a ratio(ratios) among the $K2$ channel quality values;
- [3c]** a first receiving beamforming vector is used to receive signals transmitted through the $K1$ antenna port groups; a second receiving beamforming vector is used to receive signals transmitted through the $K2$ antenna port groups; the first receiving beamforming vector and the second receive beamforming vector are different;
- [3d]** the first information is further used to determine the $K2$ antenna port groups and the second proportional sequence.

4. The method according to claim 3, wherein any two antenna ports in the K1 antenna port groups are co-located or quasi-co-located (QCL), and any two antenna ports in the K2 antenna port groups are co-located or quasi-co-located (QCL); or any two antenna ports in the K1 antenna port groups are on a same carrier, and any two antenna ports in the K2 antenna port groups are on a same carrier; or the first signaling is further used to determine at least the last one of the K1, the K2 and the target threshold, a third channel quality is a best channel quality value among the K2 channel quality values, a fourth channel quality is a worse channel quality value among the K2 channel quality values, a ratio between the fourth channel quality and the third channel quality is greater than or equal to the target threshold, and the first information is further used to determine at least one of the first channel quality and the third channel quality.
5. The method according to claim 3, further comprising: receiving a second wireless signal; wherein a target antenna port group is used to transmit the second wireless signal; the target antenna port group is associated with the K1 antenna port groups and the first proportional sequence, or the target

antenna port group is associated with the K2 antenna port groups and the second proportional sequence.

6. **[6Preamble]** A method for multi-antenna transmission in a base station, comprising:

[6a] transmitting, by the base station, a first signaling to a user equipment (UE);

[6b] transmitting, by the base station, a first wireless signal to the UE; and

[6c] receiving, by the base station, first information from the UE;

[6d] [6d1] wherein, K antenna port groups of the base station are used to transmit the first wireless signal;

[6d2] the first signaling is used by the UE to determine the K antenna port groups transmitting the first wireless signal received by the UE; the K is a positive integer greater than 1;

[6d3] the K antenna port groups respectively correspond to K channel quality values; the K channel quality values are K non-negative real numbers; the K channel quality values are Reference Signal Received Powers (RSRPs) or Signal to Interference plus Noise Ratios (SINRs);

[6d4] K1 antenna port groups of the K antenna port groups correspond to K1 channel quality values of the K channel quality values; the K1 is a positive integer less than or equal to the K;

[6d5] a first proportional sequence corresponds to a ratio(ratios) among the K1 channel quality values;

[6d6] the first information is used to determine the K1 antenna port groups and the first proportional sequence;

[6d7] the first signaling is used to determine a target threshold; the target threshold is a non-negative real number;

[6d8] a first channel quality is a best channel quality value among the K1 channel quality values; a second channel quality is a worse channel quality value among the K1 channel quality values;

[6d9] a ratio between the second channel quality and the first channel quality is greater than or equal to the target threshold.

7. The method according to claim 6, wherein the K channel quality values are broadband channel quality values; or the first proportional sequence comprises K1 positive real numbers less than or equal to 1, and the first proportional sequence comprises at least one 1; or the first proportional sequence comprises quantized values corresponding to K1 positive real

numbers; or the first proportional sequence comprises $K1-1$ positive real number(s), and the $K1-1$ positive real number(s) is(are) a ratio(ratios) between a channel quality value(s) other than the best channel quality value among the $K1$ channel quality values and the best channel quality value; or the first proportional sequence comprises quantized values corresponding to $K1-1$ positive real number(s).

8. **[8Preamble]** The method according to claim 6,
- [8a]** wherein $K2$ antenna port groups in the K antenna port groups correspond to $K2$ channel quality values in the K channel quality values; the $K2$ is a positive integer less than or equal to the K ;
- [8b]** a second proportional sequence corresponds to a ratio(ratios) among the $K2$ channel quality values;
- [8c]** a first receiving beamforming vector is used to receive signals transmitted through the $K1$ antenna port groups; a second receiving beamforming vector is used to receive signals transmitted through the $K2$ antenna port groups; the first receiving beamforming vector and the second receiving beamforming vector are different;
- [8d]** the first information is further used to determine the $K2$ antenna port groups and the second proportional sequence.

9. The method according to claim 8, wherein any two antenna ports in the K1 antenna port groups are co-located or quasi-co-located (QCL), and any two antenna ports in the K2 antenna port groups are co-located or quasi-co-located (QCL); or any two antenna ports in the K1 antenna port groups are on a same carrier, and any two antenna ports in the K2 antenna port groups are on a same carrier; or the first signaling is further used to determine at least the last one of the K1, the K2 and the target threshold, a third channel quality is a best channel quality value among the K2 channel quality values, a fourth channel quality is a worse channel quality value among the K2 channel quality values, a ratio between the fourth channel quality and the third channel quality is greater than or equal to the target threshold, and the first information is further used to determine at least one of the first channel quality and the third channel quality.
10. The method according to claim 8, further comprising: transmitting a second wireless signal; wherein a target antenna port group is used to transmit the second wireless signal; the target antenna port group is associated with the K1 antenna port groups and the first proportional sequence, or the target

antenna port group is associated with the K2 antenna port groups and the second proportional sequence.

11. **[11Preamble]** A user equipment (UE) for multi-antenna transmission comprising:
 - [11a]** a first receiver at the UE, receiving a first signaling originating from a base station;
 - [11b]** a second receiver at the UE, receiving a first wireless signal originating from the base station; and
 - [11c]** a third transmitter at the UE, transmitting first information to the base station;
 - [11d] [11d1]** wherein, K antenna port groups of the base station are used to transmit the first wireless signal;
 - [11d2]** the first signaling is used by the UE to determine the K antenna port groups transmitting the first wireless signal received by the UE; the K is a positive integer greater than 1;
 - [11d3]** the K antenna port groups respectively correspond to K channel quality values; the K channel quality values are K non-negative real numbers; the K channel quality values are Reference

Signal Received Powers (RSRPs) or Signal to Interference plus Noise Ratios (SINRs);

[11d4] K1 antenna port groups of the K antenna port groups correspond to K1 channel quality values of the K channel quality values; the K1 is a positive integer less than or equal to the K;

[11d5] a first proportional sequence corresponds to a ratio(ratios) among the K1 channel quality values;

[11d6] the first information is used to determine the K1 antenna port groups and the first proportional sequence;

[11d7] the first signaling is used to determine a target threshold; the target threshold is a non-negative real number;

[11d8] a first channel quality is a best channel quality value among the K1 channel quality values; a second channel quality is a worse channel quality value among the K1 channel quality values;

[11d9] a ratio between the second channel quality and the first channel quality is greater than or equal to the target threshold.

12. The user equipment to claim 11, wherein the K channel quality values are broadband channel quality values; or the first proportional sequence comprises K1 positive real numbers less than or equal to 1, and the first

proportional sequence comprises at least one 1; or the first proportional sequence comprises quantized values corresponding to $K1$ positive real numbers; or the first proportional sequence comprises $K1-1$ positive real number(s), and the $K1-1$ positive real number(s) is(are) a ratio(ratios) between a channel quality value(s) other than the best channel quality value among the $K1$ channel quality values and the best channel quality value; or the first proportional sequence comprises quantized values corresponding to $K1-1$ positive real number(s).

13. **[13Preamble]** The user equipment to claim 11,
- [13a]** wherein $K2$ antenna port groups in the K antenna port groups correspond to $K2$ channel quality values in the K channel quality values; the $K2$ is a positive integer less than or equal to the K ;
- [13b]** a second proportional sequence corresponds to a ratio(ratios) among the $K2$ channel quality values;
- [13c]** a first receiving beamforming vector is used to receive signals transmitted through the $K1$ antenna port groups; a second receiving beamforming vector is used to receive signals transmitted through the $K2$ antenna port groups; the first receiving beamforming vector and the second receiving beamforming vector are different;

[13d] the first information is further used to determine the K2 antenna port groups and the second proportional sequence.

14. The user equipment to claim 13, wherein any two antenna ports in the K1 antenna port groups are co-located or quasi-co-located (QCL), and any two antenna ports in the K2 antenna port groups are co-located or quasi-co-located (QCL); or any two antenna ports in the K1 antenna port groups are on a same carrier, and any two antenna ports in the K2 antenna port groups are on a same carrier; or the first signaling is further used to determine at least the last one of the K1, the K2 and the target threshold, a third channel quality is a best channel quality value among the K2 channel quality values, a fourth channel quality is a worse channel quality value among the K2 channel quality values, a ratio between the fourth channel quality and the third channel quality is greater than or equal to the target threshold, and the first information is further used to determine at least one of the first channel quality and the third channel quality.
15. The user equipment to claim 13, wherein the second receiver further receives a second wireless signal; wherein a target antenna port group is used to transmit the second wireless signal; the target antenna port group is

associated with the K1 antenna port groups and the first proportional sequence, or the target antenna port group is associated with the K2 antenna port groups and the second proportional sequence.

16. **[16Preamble]** A base station for multi-antenna transmission comprising:
- [16a]** a first transmitter at the base station, transmitting a first signaling to a user equipment (UE);
- [16b]** a second transmitter at the base station, transmitting a first radio signal to the UE; and
- [16c]** a third receiver at the base station, receiving first information from the UE;
- [16d]** **[16d1]** wherein, K antenna port groups of the base station are used to transmit the first wireless signal;
- [16d2]** the first signaling is used by the UE to determine the K antenna port groups transmitting the first wireless signal received by the UE; the K is a positive integer greater than 1;
- [16d3]** the K antenna port groups respectively correspond to K channel quality values; the K channel quality values are K non-negative real numbers; the K channel quality values are Reference

Signal Received Powers (RSRPs) or Signal to Interference plus Noise Ratios (SINRs);

[16d4] K1 antenna port groups of the K antenna port groups correspond to K1 channel quality values of the K channel quality values; the K1 is a positive integer less than or equal to the K;

[16d5] a first proportional sequence corresponds to a ratio(ratios) among the K1 channel quality values;

[16d6] the first information is used to determine the K1 antenna port groups and the first proportional sequence;

[16d7] the first signaling is used to determine a target threshold; the target threshold is a non-negative real number;

[16d8] a first channel quality is a best channel quality value among the K1 channel quality values; a second channel quality is a worse channel quality value among the K1 channel quality values;

[16d9] a ratio between the second channel quality and the first channel quality is greater than or equal to the target threshold.

17. The base station to claim 16, wherein the K channel quality values are broadband channel quality values; or the first proportional sequence comprises K1 positive real numbers less than or equal to 1, and the first

proportional sequence comprises at least one 1; or the first proportional sequence comprises quantized values corresponding to K1 positive real numbers; or the first proportional sequence comprises K1-1 positive real number(s), and the K1-1 positive real number(s) is(are) a ratio(ratios) between a channel quality value(s) other than the best channel quality value among the K1 channel quality values and the best channel quality value; or the first proportional sequence comprises quantized values corresponding to K1-1 positive real number(s).

18. **[18Preamble]** The base station to claim 16,
[18a] wherein K2 antenna port groups in the K antenna port groups correspond to K2 channel quality values in the K channel quality values; the K2 is a positive integer less than or equal to the K;
[18b] a second proportional sequence corresponds to a ratio(ratios) among the K2 channel quality values;
[18c] a first receiving beamforming vector is used to receive signals transmitted through the K1 antenna port groups; a second receiving beamforming vector is used to receive signals transmitted through the K2 antenna port groups; the first receiving beamforming vector and the second receiving beamforming vector are different;

[18d] the first information is further used to determine the K2 antenna port groups and the second proportional sequence.

19. The base station to claim 18, wherein any two antenna ports in the K1 antenna port groups are co-located or quasi-co-located (QCL), and any two antenna ports in the K2 antenna port groups are co-located or quasi-co-located (QCL); or any two antenna ports in the K1 antenna port groups are on a same carrier, and any two antenna ports in the K2 antenna port groups are on a same carrier; or the first signaling is further used to determine at least the last one of the K1, the K2 and the target threshold, a third channel quality is a best channel quality value among the K2 channel quality values, a fourth channel quality is a worse channel quality value among the K2 channel quality values, a ratio between the fourth channel quality and the third channel quality is greater than or equal to the target threshold, and the first information is further used to determine at least one of the first channel quality and the third channel quality.
20. The base station to claim 18, wherein the second transmitter further transmits a second wireless signal; wherein a target antenna port group is used to transmit the second wireless signal; the target antenna port group is

associated with the K1 antenna port groups and the first proportional sequence, or the target antenna port group is associated with the K2 antenna port groups and the second proportional sequence.

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. §§ 42.6(e) and 42.105(a), the undersigned certifies that on March 29, 2023, a copy of the foregoing Petition for *Inter Partes* Review, the associated powers of attorney, and Exhibits 1001-1022 and 1024-1031 were served by FedEx Priority Overnight on the correspondence address of record indicated in the Patent Office's Patent Center website for U.S. Patent No. 10,951,271:

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A courtesy copy of the foregoing was also served by FedEx Priority Overnight on the address listed on the same law firm's website (<https://zhong-law.com/>):

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Date: March 29, 2023

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