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**~~

DECLARATION OF APOSTOLOS K. KAKAES, PH.D.

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~~1. *Claim 1* ..... 9~~

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

~~I.~~IX. ~~comprising:" ..... 9~~THE PRIOR ART 54

A. ~~[1a] "receiving, by the UE, a first signaling~~*Kim* (U.S. Patent Application Publication ~~originating from a base station;" ..... 10~~No. 2015/0036612 A1) 54

~~b. *[1b] "receiving, by the UE, a first wireless signal originating from the base station; and" ..... 12*~~

~~c. *[1c] "transmitting, by the UE, first information to* the base station;" ..... 15~~

~~d. *[1d] [1d1] "wherein, K antenna port groups of the base station are used to transmit the first wireless* signal;" ..... 16~~

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B. *Chen* (WO 2015/131494) 58

X. GROUND OF UNPATENTABILITY 59

XI. THE CHALLENGED CLAIMS ARE UNPATENTABLE OVER THE PRIOR ART 60

A. Ground 1: Claims 1-20 Are Rendered Obvious by *Kim* and *Chen* 60

1. Claim 1 60

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

~~e. [1d2] "the first signaling is used by the UE to~~comprising:" 61~~ determine the K antenna port groups transmitting the first wireless signal received by the UE; the K~~ is a positive integer greater than 1;" 22

~~f. [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);" ..... 25~~

~~g. [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;" ..... 26~~

~~h. [1d5] "a first proportional sequence corresponds to a ratio(ratios) among the K1 channel quality~~

~~values;" ..... 28~~

~~i. [1d6] "the first information is used to determine the K1 antenna port groups and the first~~

~~proportional sequence;" ..... 29~~

~~j. [1d7] "the first signaling is used to determine a target threshold; the target threshold is a~~

~~non-negative real number;" ..... 30~~

~~i. Motivation to combine ..... 32~~

~~ii. Expectation of success ..... 34~~

k. *[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;" 35

l. *[1d9] "a ratio between the second channel quality and the first channel quality is greater than or*

equal to the target threshold." 36

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; …"* *37*

i. Motivation to Combine 39

ii. Expectation of Success 40

3. *Claim 3* *41*

a. *[3Preamble] "The method according to claim 1,"* *41*

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;" 41

c. *[3b] "a second proportional sequence corresponds to a ratio(ratios) among the K2 channel quality*

values;" 44

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;" 44

e. *[3d] "the first information is further used to determine the K2 antenna port groups and the*

second proportional sequence." 48

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…."* *48*

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."* *50*

6. *Claim 6* *56*

a. *[6Preamble] "A method for multi-antenna*

transmission in a base station, comprising:" 56

b. *[6a] "transmitting, by the base station, a first*

signaling to a user equipment (UE);" 56

c. *[6b] "transmitting, by the base station, a first*

wireless signal to the UE; and" 56

d. *[6c] "receiving, by the base station, first*
information from the UE;" 56

e. *[6d] [6d1]-[6d9]* *57*

7. *Claims 7-10* *57*

8. *Claim 11* *57*

b. [1a] "receiving, by the UE, a first signaling originating from a base station;" 62

c. [1b] "receiving, by the UE, a first wireless signal originating from the base station; and" 65

d. [1c] "transmitting, by the UE, first information to the base station;" 69

e. [1d] [1d1] "wherein, K antenna port groups of the base station are used to transmit the first wireless signal;" 70

i. Motivation to combine 75

ii. Expectation of success 77

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;" 78

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);" 81

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;" 83

i. [1d5] "a first proportional sequence corresponds to a ratio(ratios) among the K1 channel quality values;" 84

j. [1d6] "the first information is used to determine the K1 antenna port groups and the first proportional sequence;" 87

k. [1d7] "the first signaling is used to determine a target threshold; the target threshold is a non-negative real number;" 87

i. Motivation to combine 90

ii. Expectation of success 93

l. [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;" 94

m. [1d9] "a ratio between the second channel quality and the first channel quality is greater than or equal to the target threshold." 96

2. Claim 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)." 97

i. Motivation to Combine 99

ii. Expectation of Success 100

3. Claim 3 101

a. [3Preamble] "The method according to claim 1," 101

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;" 102

c. [3b] "a second proportional sequence corresponds to a ratio(ratios) among the K2 channel quality values;" 106

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;" 106

e. [3d] "the first information is further used to determine the K2 antenna port groups and the second proportional sequence."..... 110

Claim 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 ~~[11Preamble] "A user equipment (UE) for multi-~~quasi-co-located (QCL); or any two antenna ports in the K1 antenna ~~transmission comprising:"~~
~~.....58~~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

~~a. *[11a] "a first receiver at the UE, receiving a first signaling originating from a base station;"..... 58*~~

~~b. *[11b] "a second receiver at the UE, receiving a first wireless signal originating from the base*~~
~~station; and".....60~~

~~i. Motivation to Combine.....61~~

ii. Expectation of Success 62

c. *[11c] "a third transmitter at the UE, transmitting*

first information to the base station;" 62

d. *[11d] [11d1] [11d9]* *63*

9. *Claims 12-14* *64*

10. *Claim 15* *64*

11. *Claim 16* *64*

a. *[16Preamble] "A base station for multi-antenna transmission comprising:"* *65*

b. *[16a] "a first transmitter at the base station, transmitting a first signaling to a user equipment*

(UE);" 65

c. *[16b] "a second transmitter at the base station, transmitting a first radio signal to the UE; and"* *67*

i. Motivation to Combine 68

ii. Expectation of Success 69

d. *[16c] "a third receiver at the base station, receiving*
first information from the UE;" 70

e. *[16d] [16d1] [16d9]* *71*

12. *Claims 17-19* *71*

13. *Claim 20* *71*

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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." 111

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." 113

6. Claim 6 119

a. [6Preamble] "A method for multi-antenna transmission in a base station, comprising:" 119

b. [6a] "transmitting, by the base station, a first signaling to a user equipment (UE);" 119

c. [6b] "transmitting, by the base station, a first wireless signal to the UE; and" 120

d. [6c] "receiving, by the base station, first information from the UE;" 120

e. [6d] [6d1] "wherein, K antenna port groups of the base station are used to transmit the first wireless signal;" 120

f. [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;.....120

g. [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);".....120

h. [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;".....120

i. [6d5] "a first proportional sequence corresponds to a ratio(ratios) among the K1 channel quality values;" 121

j. [6d6] "the first information is used to determine the K1 antenna port groups and the first proportional sequence;" 121

k. [6d7] "the first signaling is used to determine a target threshold; the target threshold is a non-negative real number;".....121

l. [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;" 121

m. [6d9] "a ratio between the second channel quality and the first channel quality is greater than or equal to the target threshold." 121

7. Claim 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 comprses 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)." 122

8. Claim 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." 123

9. Claim 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." 124

10. Claim 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." 125

11. Claim 11 125

a. [11Preamble] "A user equipment (UE) for multi-antenna transmission comprising:" 126

b. [11a] "a first receiver at the UE, receiving a first signaling originating from a base station;" 126

c. [11b] "a second receiver at the UE, receiving a first wireless signal originating from the base station; and" 129

a. Motivation to Combine 131

a. Expectation of Success 131

d. [11c] "a third transmitter at the UE, transmitting first information to the base station;" 132

e. [11d] [11d1] "wherein, K antenna port groups of the base station are used to transmit the first wireless signal;" 133

f. [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;" 133

g. [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);" 134

h. [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;".....134

i. [11d5] "a first proportional sequence corresponds to a ratio(ratios) among the K1 channel quality values;" 134

j. [11d6] "the first information is used to determine the K1 antenna port groups and the first proportional sequence;" 134

k. [11d7] "the first signaling is used to determine a target threshold; the target threshold is a non-negative real number;" 134

l. [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;".....134

m. [11d9] "a ratio between the second channel quality and the first channel quality is greater than or equal to the target threshold." 135

12. Claim 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)." 135

13. Claim 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."....136

14. Claim 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." 137

15. Claim 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." 138

16. Claim 16 138

a. [16Preamble] "A base station for multi-antenna transmission comprising:" 139

b. [16a] "a first transmitter at the base station, transmitting a first signaling to a user equipment (UE);" 139

c. [16b] "a second transmitter at the base station, transmitting a first radio signal to the UE; and" 141

a. Motivation to Combine 144

a. Expectation of Success 145

d. [16c] "a third receiver at the base station, receiving first information from the UE;" 145

e. [16d] [16d1] "wherein, K antenna port groups of the base station are used to transmit the first wireless signal;" 146

f. [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;" 146

g. [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);" 147

h. [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;".....147

i. [16d5] "a first proportional sequence corresponds to a ratio(ratios) among the K1 channel quality values;" 147

j. [16d6] "the first information is used to determine the K1 antenna port groups and the first proportional sequence;" 147

k. [16d7] "the first signaling is used to determine a target threshold; the target threshold is a non-negative real number;" 148

l. [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;" 148

m. [16d9] "a ratio between the second channel quality and the first channel quality is greater than or equal to the target threshold." 148

17. Claim 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)." 149

18. Claim 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." 150

19. Claim 19: "The base station to claim 18, wherein any two antenna ports in the Kl 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." 151

20. Claim 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 Kl 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." 152

~~II.~~XII. CONCLUSION 152

I. INTRODUCTION

1. I have been retained by Samsung Electronics Co., Ltd. and Samsung Electronics America, Inc., (collectively "Petitioner") as an independent expert consultant in this proceeding before the United States Patent and Trademark Office.

2. I am over 21 years of age and, if I am called upon to do so, I would be competent to testify as to the matters set forth herein.

3. My compensation is in no way contingent on the nature of my findings, the presentation of my findings in testimony, or the outcome of any proceeding.

4. I understand that this proceeding involves U.S. Patent No. 10,951,271 ("the '271 patent," Ex. 1001). The application for the '271 was filed June 27, 2019, as U.S. Patent Application No. 16/454,075 ("the '075 application"). The '271 patent claims priority as "a continuation of application No. PCT/CN2017/094209, filed on Jul. 25, 2017." Ex. 1001, cover. The '271 patent also claims priority to Chinese patent application CN 20161236923.2, filed December 28, 2016. Ex. 1001, cover.

5. I have been asked by Petitioner to provide my opinion whether the claims of the '271 patent would have been obvious to a person of ordinary skill in the art at the time of the earliest claimed priority date of the '271 patent. In

performing my analysis, I have been asked to assume that the priority date is December 28, 2016. My opinions are set forth below.

6. Throughout this declaration, I refer to specific pages, figures, and/or line numbers of various exhibits. These citations are illustrative and are not intended to suggest that they are the only support for the propositions for which they are cited.

II. SUMMARY OF OPINIONS

7. This declaration considers claims 1-20 of the '271 patent. Below, I set forth the opinions I have formed, the conclusions I have reached, and the bases for these opinions and conclusions. I believe the statements contained in this declaration to be true and correct to the best of my knowledge.

8. Based on my experience, knowledge of the art at the time of the applicable priority date (I was told to assume a priority date of December 28, 2016), it is my opinion that claims 1-20 of the '271 patent would have been obvious based on the asserted grounds discussed below.

9. I am being compensated for my time at my normal hourly rate. My compensation is in no way contingent upon the nature of my findings, the presentation of my findings in testimony, or the outcome of this proceeding.

III. QUALIFICATIONS AND BACKGROUND

10. I believe that I am well qualified to serve as a technical expert in this matter based upon my qualifications, discussed in detail below. A copy of my curriculum vitae is included as Exhibit 1004.

11. I am competent to write this Declaration.

12. I have personal knowledge and expertise concerning the relevant technologies based upon my education, training, or experience. My relevant experience includes a deep understanding of the systems that we broadly refer to as "1G," "2G," ''3G," "4G," "LTE," and "5G" communications systems, as well as other wireless communication technologies, including those based on the IEEE 802.11 set of standards (often referred to as WiFi) as well as those related to IEEE 802.16 set of standards (often referred to as WiMAX).

13. I am an expert in the field of communication engineering and specifically, among others, the field of wireless communications. I have over 40 years of experience in electrical engineering and computer science and in fixed and mobile communications networks. I attended the University of Colorado from 1974 to 1980, during which I earned a Bachelor of Science (B.S.) and a Master of Science (M.S.) in applied mathematics with a minor in electrical engineering. I attended the Polytechnic Institute of New York between 1982 and 1988, during which I earned a Doctor of Philosophy (Ph.D.) in electrical engineering, with a

minor in applied mathematics. My Ph.D. thesis was titled "Topological Properties and Design of Multihop Packet Radio Networks." While pursuing my Ph.D. degree, I held a joint appointment as Special Research Fellow and Adjunct Instructor at the Polytechnic Institute of New York between 1985 and 1986 teaching graduate-level courses in Electrical Engineering.

14. Between 1982 and 1987, I worked at AT&T Bell Laboratories in Holmdel, New Jersey. While at AT&T Bell Laboratories, I worked on modeling, analysis, design, and performance evaluation of voice and data networks. I developed algorithms for DNHR (Dynamic, Non-Hierarchical Routing) used in the telephone network. I also analyzed advanced data services and formulation of long-term plans for development of enhanced data services and network design tools to support such services.

15. I was an Assistant Professor of Electrical Engineering and Computer Science at The George Washington University (GWU) in Washington, D.C., between 1987 and 1994. During my association with GWU, I taught graduate courses in the area of communication engineering, including communication theory, coding theory, voice and data networking, and mobile communications. In the early 1990s I developed and taught the first course on Mobile Communications at GWU to Electrical Engineering graduate students. I also received several research awards/grants, including the prestigious NSF Research Initiation Award.

16. In 1988, I founded Cosmos Communications Consulting Corporation ("Cosmos"), which is a private communications engineering consulting firm specializing in mobile communications, and I have been the President of the company since its founding. Since 1994, I have worked full-time at Cosmos. At Cosmos, among various activities, I have consulted on high level technology-related issues and trends to corporate entities, governmental agencies, and international organizations, such as the United Nations.

17. I have provided technical consultancy to engineering firms, operators, and equipment vendors on issues related to existing or evolving technologies for mobile communications, and to the investment community on issues related to both fixed and wireless communications technologies. I developed and taught hundreds of courses to thousands of engineers around the world in the area of communication engineering, mostly in the area of mobile, wireless communications.

18. Over the course of my career, I have authored and co-authored some thirty (30) publications on various aspects of fixed and mobile communications, as noted in my curriculum vitae. I am a life member of the Institute of Electrical and Electronics Engineers (IEEE) and have been actively involved in the Communications Society and the Information Theory Society of the IEEE. Between 1991 and 1992, I served as the Secretary of IEEE Communications

Society National Capital Area Chapter. Between 1992 and 1993, I was the Vice-Chair of IEEE Communications Society National Capital Area Chapter. I was the Vice-Chair of the Communication Theory Technical Committee of the Communications Society of the IEEE for the 1993–1996 term, and Treasurer of the Communication Theory Technical Committee of the Communications Society of the IEEE for the 1996–1999 term.

19. I have served as a reviewer for the IEEE, book editors, other technical publications, and various National Science Foundation (NSF) Panels. I have organized technical sessions in technical conferences, including the IEEE International Conference on Communications (ICC) and IEEE Global Communications Conference (Globecom). I served as the Technical Program Chair for the Communication Theory Mini-Conference in 1992.

20. During the past 35+ years, I have been lucky enough to be part of the community of engineers that have contributed to the astounding growth of the mobile communications industry. It started from a niche industry that was thought of as being something for the "rich and the famous" to becoming one of the most widespread household concepts, providing useful tools to all segments of the global society.

21. My involvement in this industry included providing consulting services to company executives who needed to make deployment plans, taking into

consideration the strengths and weaknesses of the technology, economics, user value, etc. As such, I have developed a deep understanding of all aspects of a given technology, its features, added value, and the like. In addition, my consulting services included developing courses for the companies that were at the forefront of this developing technology. By definition, this previously non-existent technology was not taught in university courses, as it was too new. Having developed hundreds of courses over the years and taught thousands of engineers (and non-engineers alike), I have a solid understanding and knowledge of the technical developments and how their importance fits in the larger puzzle of a fast-developing technology.

22. My consulting included providing training to engineers in the field that were deploying the various networks. For example, I developed courses and provided training and consulting to the engineers deploying some of the earliest GSM networks in Germany and France, to be followed by many countries in Europe and around the world, including the United States when it was decided that GSM would be used in the U.S. Successful deployments of the initial GSM systems were followed by deployments of GPRS and EDGE, which was then followed by deployments of 3G UMTS systems worldwide. Of course, the 3G systems were followed by the currently most widespread deployments of 4G systems, also referred to as LTE, worldwide and most recently deployments of 5G networks. Thus, as I explain above, my experience includes a deep understanding

of the entirety of each system that we broadly refer to as "1G," "2G," ''3G," "4G," "LTE," and "5G."

23. Similarly, I developed courses and provided training and consulting to engineers deploying and/or enhancing wireless local area networks using one or more of the IEEE 802.11 set of standards (often referred to as WiFi) as well as networks using the IEEE 802.16 set of standards (often referred to as WiMax).

24. As an expert consultant, I have served on both civil and criminal legal cases, including several patent infringement cases both at the ITC and in district courts, as well as in support of IPR petitions, such as the one in this case. I have also participated as a technical expert consultant in the analysis of large patent portfolios for the purposes of due diligence, sales, and merger and acquisition activities for some of the largest companies in the mobile communications space. These projects span a multidimensional spectrum of technologies in both fixed and mobile communications as they have evolved over the past more than 30 years.

IV. MATERIALS CONSIDERED

25. In forming my opinions, I have reviewed the following documents, and any other document cited in this declaration.

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35 U.S.C. § 102(a)(1) 4, 7

35 U.S.C. § 102(a)(2) 4, 7

35 U.S.C. § 103 8

35 U.S.C. § 325(d) ... 73

Other Authorities

USPTO, Interim Procedure for Discretionary Denials in AIA Post-Grant Proceedings with Parallel District Court Litigation (June 21, 2022) 72, 73

~~LIST OF EXHIBITS~~

Exhibit	Description
Ex. 1001	U.S. Patent No. 10,951,271 (“the ’271 patent”)

Exhibit	Description
Ex. 1002	File History of U.S. Patent No. 10,951,271
~~**Ex. 1003**~~	~~Declaration of Apostolos K. Kakaes, Ph.D. ("Kakaes")~~
~~**Ex. 1004**~~	~~CV of Apostolos K. Kakaes, Ph.D.~~
Ex. 1005	International Publication ~~WO2016~~WO 2016/015307 A1 to Liu et al.
Ex. 1006	Certified English translation of International Publication ~~WO2016~~WO 2016/015307 A1 to Liu et al. ("*Liu*")~~1~~1
Ex. 1007	Certification of English translation of International Publication ~~WO2016~~WO 2016/015307 A1 to Liu et al.
Ex. 1008	International Publication ~~WO2016~~WO 2016/126099 A1 to Park et al.
Ex. 1009	Certified English translation of International Publication ~~WO2016~~WO 2016/126099 A1 to Park et al. ("*Park*")~~2~~2
Ex. 1010	Certification of English translation of International Publication ~~WO2016~~WO 2016/126099 A1 to *Park* et al.
Ex. 1011	U.S. Patent Application Publication No. 2013/0308608 A1 to Hu et al. ("*Hu*")
Ex. 1012	U.S. Patent Application Publication No. 2011/0038330 A1 to Luo et al. ("*Luo*")
Ex. 1013	U.S. Patent Application Publication No. 2011/0176519 A1 to Vitthaladevuni et al. ("*Vitthaladevuni*")

Ex. 1014	Excerpts from Stefania Sesia et al., *LTE – The UMTS Long Term Evolution From Theory to Practice* (John Wiley & Sons Ltd. 2nd ed. 2011) ("*Sesia LTE*")
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)") (January 2016)

[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., *LTE – The UMTS Long Term Evolution from Theory to Practice* (John Wiley & Sons, Ltd. 2d ed. 2011) ("*Sesia LTE*")~~
~~**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.~~December 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.~~December 2015)
Ex. 1018	3GPP TS 36.213 v13.0.0 ("Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures (Release 13)") (~~Dec.~~December 2015)
Ex. 1019	3GPP TS 36.214 v13.0.0 ("Technical Specification Group Radio Access Network; Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer; Measurements (Release 13)") (~~Dec.~~December 2015)
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.~~December 2015)
Ex. 1021	Farhana Afroz et al., *SINR, RSRP, RSSI and RSRQ Measurements in Long Term Evolution Networks*, International Journal of Wireless & Mobile Networks (IJWMN), Vol. 7, No. 4, pp. 113-123 (~~Aug.~~August 2015) ("*Afroz*")

~~Exhibit~~	~~Description~~
~~Ex. 1022~~	~~*Apex Beam Technologies LLC v. Samsung Electronics Co. Ltd. et al.*, No. 2:22-cv-00188-JRG, Dkt. No. 1, Complaint for Patent Infringement (E.D. Tex. June 1, 2022)~~
~~Ex. 1023~~	~~Reserved~~
~~Ex. 1024~~	~~*Apex Beam Technologies LLC v. Samsung Electronics Co., Ltd. et al.*, No. 2:22-cv-00188-JRG, Dkt. No. 37, Docket Control Order (E.D. Tex. Feb. 6, 2023)~~
~~Ex. 1025~~	~~3GPP Declaration of Friedhelm Rodermund~~
~~Ex. 1026~~	~~*Apex Beam Technologies LLC v. Samsung Electronics Co. Ltd. et al.*, No. 2:22-cv-00188-JRG, Plaintiff's Infringement Contentions Cover Pleading (E.D. Tex. Jan. 5, 2023)~~
Ex. 1027	U.S. Patent Application Publication No. 2015/0036612 A1 to Kim et al. ("*Kim*")
Ex. 1028	International Publication WO2015/131494 A2 to Chen et al.

Exhibit	Description
Ex. 1029	Certified English translation of International Publication WO2015/131494 A2 to Chen et al. ("*Chen*~~")~~")[3]
Ex. 1030	Certification of English translation of International Publication WO2015/131494 A2 to Chen et al.
~~**Ex. 1031**~~	~~*Apex Beam Technologies LLC v. Samsung Electronics Co. Ltd. et al.*, 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 (

26. I have also relied on my education, experience, research, training, and knowledge in the relevant art, and my understanding of any applicable legal principles described in this declaration.

27. All of the opinions contained in this declaration are based on the documents I reviewed and my knowledge and professional judgment. My opinions have also been guided by my understanding of how a person of ordinary skill in the art would have understood the claims of the '271 patent at the time of the earliest claimed priority date.

28. I reserve the right to supplement and amend any of my opinions in this declaration based on documents, testimony, and other information that becomes available to me after the date of this declaration.

V. LEGAL STANDARDS

29. I am not a lawyer. My understanding of the legal standards to apply in reaching the conclusions in this declaration is based on discussions with counsel

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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.

for Petitioner, my experience applying similar standards in other patent-related matters, and my reading of the documents submitted in this proceeding. In preparing this declaration, I have tried to faithfully apply these legal standards to the challenged claims.

30. I have been informed that there are two ways in which prior art may render a patent claim unpatentable. First, I have been informed that the prior art can "anticipate" a claim. Second, I have been informed that the prior art can render a claim "obvious" to a person of ordinary skill in the art. I understand that a claim is patentable if it was not anticipated and would not have been obvious by the prior art at the effective filing date of the patent.

31. I have been informed that a dependent claim is a patent claim that refers back to another patent claim. I have been informed that a dependent claim includes all of the limitations of the claim to which it refers.

32. I have been asked to provide my opinions as to whether the cited prior art teaches or renders obvious claims 1-20 of the '271 patent from the perspective of a person of ordinary skill in the art at the '271 patent's earliest claimed priority date in 2016, as described in more detail below.

33. I have been informed that in *inter partes* review proceedings, such as this one, the party challenging the patent bears the burden of proving

unpatentability by a preponderance of the evidence. I understand that a preponderance of the evidence means "more likely than not."

34. For purposes of this declaration, I have been asked to provide my opinions on issues regarding unpatentability. I have been informed of the following legal standards, which I have applied in forming my opinions.

A. Level of Ordinary Skill

35. I have been informed a person of ordinary skill in the art is determined by considering several factors, including the (i) type of problems encountered in the art; (ii) prior art solutions to those problems; (iii) rapidity with which innovations are made; (iv) sophistication of the technology; and (v) educational level of active workers in the field.

36. I have been instructed to assume a person of ordinary skill in the art is not a specific real individual, but rather a hypothetical individual having the qualities reflected by the factors discussed above.

B. Prior Art

37. I have been advised and understand the information used to evaluate whether an invention was new and not obvious when made is generally referred to as "prior art." I understand that prior art includes patents and printed publications that existed before the earliest claimed priority date or the earliest filing date of the patent (which I have been informed is also called the "effective filing date"). I have

been informed and understand that a patent or published patent application is prior art if it was filed before the earliest filing date of the claimed invention and that a printed publication is prior art if it was publicly available before the earliest filing date.

C. Anticipation

38. I have been informed that under 35 U.S.C. § 102, a patent claim is unpatentable for anticipation if the claimed subject matter was patented or described in a printed publication before the effective filing date of the claimed invention. I have been informed that this is referred to as unpatentability by anticipation. I have been informed that a patent claim is anticipated under § 102 if a single prior art reference discloses all limitations of the claimed invention.

D. Obviousness

39. I have been informed that obviousness under 35 U.S.C. § 103, a patent claim is unpatentable if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious to a person having ordinary skill in the art to which said subject matter pertains at the time the invention was made. I have been informed that this is referred to as unpatentability by obviousness.

40. I have been informed that a proper obviousness analysis includes the following:

a. Determining the scope and content of the prior art;

b. Ascertaining the differences between the prior art and the claims at issue;

c. Resolving the level of ordinary skill in the pertinent art; and

d. Considering evidence of secondary indicia of non-obviousness (if available).

41. I have been informed that the relevant time for considering whether a claim would have been obvious to a person of ordinary skill in the art is the time of invention. For my obviousness analysis, counsel for Petitioner instructed me to assume that the date of invention for the Challenged Claims is December 28, 2016. My opinions would not change if I assumed a later date of invention.

42. I have been informed that a reference may be modified or combined with other references or with a person of ordinary skill in the art's own knowledge if the person would have found the modification or combination obvious. I have also been informed that a person of ordinary skill in the art is presumed to know all the relevant prior art, and the obviousness analysis may take into account the inferences and creative steps that a person of ordinary skill in the art would employ.

43. I have been informed that whether a prior art reference renders a patent claim obvious is determined from the perspective of a person of ordinary

skill in the art. I have also been informed that, while there is no requirement that the prior art contain an express suggestion to combine known elements to achieve the claimed invention, and while a suggestion to combine known elements to achieve the claimed invention may come from the prior art as a whole or individually and may consider the inferences and creative steps a person of ordinary skill in the art would employ, as filtered through the knowledge of one skilled in the art, obviousness grounds cannot be sustained by mere conclusory statements and must include some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.

44. In determining whether a prior art reference could have been combined with another prior art reference or other information known to a person having ordinary skill in the art, I have been informed that the following principles may be considered:

a. A combination of familiar elements according to known methods is likely to be obvious if it yields predictable results;

b. The substitution of one known element for another is likely to be obvious if it yields predictable results;

c. The use of a known technique to improve similar items or methods in the same way is likely to be obvious if it yields predictable results;

d. The application of a known technique to a prior art reference that is ready for improvement to yield predictable results;

e. Any need or problem known in the field and addressed by the reference can provide a reason for combining the elements in the manner claimed;

f. A person of ordinary skill often will be able to fit the teachings of multiple references together like a puzzle; and

g. The proper analysis of obviousness requires a determination of whether a person of ordinary skill in the art would have a "reasonable expectation of success"—but not "absolute predictability" of success—in achieving the claimed invention by combining prior art references.

45. I have been informed that, when a work is available in one field, design alternatives and other market forces can prompt variations of it, either in the same field or in another. I have been informed that if a person of ordinary skill in the art could have implemented a predictable variation and would have seen the benefit of doing so, that variation is likely to have been obvious. I have been informed that, in many fields, there may be little discussion of obvious combinations, and in these fields market demand—not scientific literature—may drive design trends. I have been informed that, when there was a design need or

market pressure and there are a finite number of predictable solutions, a person of ordinary skill in the art would have had a good reason to pursue those known options.

46. I have been informed that the law permits the application of "common sense" in examining whether a claimed invention would have been obvious to a person skilled in the art. For example, I have been informed that combining familiar elements according to known methods and in a predictable way may suggest obviousness when such a combination would yield nothing more than predictable results. I understand, however, that a claim is not obvious merely because every claim element is disclosed in the prior art and that a party asserting obviousness must still provide a specific motivation to combine or modify the references as recited in the claims and explain why one skilled in the art would have reasonably expected to succeed in doing so.

47. I have been informed that there is no rigid rule that a reference or combination of references must contain a "teaching, suggestion, or motivation" to combine references. But I also understand that the "teaching, suggestion, or motivation" test can be a useful guide in establishing a rationale for combining elements of the prior art. I have been informed that this test poses the question as to whether there is an express or implied teaching, suggestion, or motivation to

combine prior art elements in a way that realizes the claimed invention, and that it seeks to counter impermissible hindsight analysis.

48. I am not aware of any evidence of secondary considerations that would support a determination of non-obviousness of the claimed subject matter in the ’271 patent.

49. I have been informed that, in an obviousness analysis, prior art must be analogous prior art to the patent being considered. I have been informed that a prior art reference is considered to be analogous, or in the same field of art, if the reference is either (1) in the same field of endeavor as the challenged patent, regardless of the problems the challenged patent and the prior art address, or (2) reasonably pertinent to the particular problem being solved by the challenged patent.

VI. TECHNOLOGY BACKGROUND AND STATE OF THE PRIOR ART

50. The development of wireless communications has been rapid, fueled in no small part by the world-wide adoption and usage of services made possible by wireless communications. One of the sub-areas within the broad area of wireless communications is the development of techniques to enable (and capitalize on the resulting benefits of) transmissions using multi-antennas, which the ’271 patent relates to. Ex. 1001, cover page.

51. Well before the earliest claimed priority date of the '271 patent (which I have been asked to assume is December 28, 2016), a large body of knowledge and associated techniques had been developed. This section will provide an overview of the state of the related art that would have been well known to a POSITA at the earliest claimed priority date.

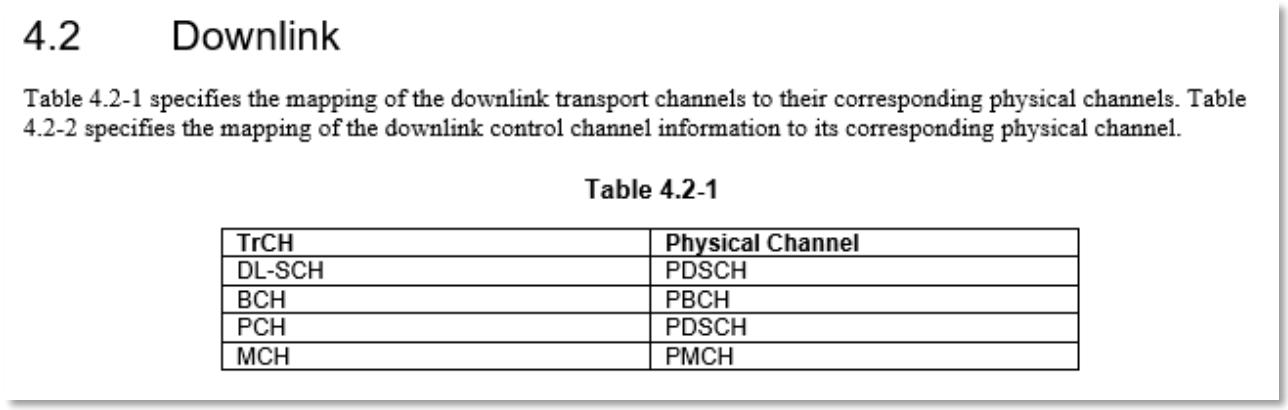
52. To facilitate these explanations and to provide support for my opinions contained herein, I will use prior technical specifications developed by 3GPP, consistent with the named inventors' reference to 3GPP in the section titled "Related Art." Ex. 1001, 1:32-36. In my explanations, I will use 3GPP references from the 2015 time frame, although many of these concepts were developed in earlier years and can be found in earlier versions of the technical specifications.

53. In order to enable a user equipment ("UE") to communicate with a base station, several steps have to take place, ideally in a manner "invisible" to the end-user so as to "hide" the complexities involved. This makes the steps appear as simple as possible to the end-user or the user may even be unaware of the steps taking place. I will focus the discussion herein to the subset of such steps that are related to the '271 patent, which were well known in the time frame before the earliest priority date of the '271 patent.

54. One of these steps is the base station transmitting, and the UE receiving, control information, which informs the UE how the base station

operates. This is necessary for the UE to be in a position to communicate with the base station. This includes what is called "System information" which "is divided into the *MasterInformationBlock* (MIB) and a number of *SystemInformationBlocks* (SIBs). The MIB includes a limited number of most essential and most frequently transmitted parameters that are needed to acquire other information from the cell, and is transmitted on BCH" (Broadcast Channel). *See* 3GPP TS 36.331 v13.0.0, § 5.2.1.1 (emphasis in the original).

55. A Broadcast Channel ("BCH") is one of the Transport Channels in the set of Transport Channels ("TrCh") broadcast by the base station. Transport Channels are mapped to Physical Channels, which transmit the corresponding information after appropriate processing. As shown below, the BCH is mapped to the Physical Broadcast Channel ("PBCH"). *See* 3GPP TS 36.212 v13.0.0, § 4.2:



4.2 Downlink

Table 4.2-1 specifies the mapping of the downlink transport channels to their corresponding physical channels. Table 4.2-2 specifies the mapping of the downlink control channel information to its corresponding physical channel.

Table 4.2-1

TrCH	Physical Channel
DL-SCH	PDSCH
BCH	PBCH
PCH	PDSCH
MCH	PMCH

3GPP TS 36.212 v13.0.0, Table 4.2-1.

56. In the interest of conciseness, I will not describe the specifics the information transmitted in the MIB. But, there is at least one piece of information

that is conveyed by the PBCH that is relevant to the '271 patent which I will discuss below.

57. As shown below, a base station may use 1, 2, or 4 antenna ports for its transmissions. A simple discussion of the relationship between an "antenna" and an "antenna port" may be useful: At the most basic level, an "antenna" (also referred to as an "antenna element" or a "physical antenna") is a radiating device for transmitting or receiving wireless signals. It is often desirable to build an "antenna" that has certain desired properties by placing several "antenna elements" in a specific, well-designed configuration that achieves the desired overall behavior by the collective action of all the antenna elements involved. The result is that the so-configured "antenna elements" are no longer "an antenna" as it actually consists of several "antennas," namely the individual antenna elements. However, the antenna elements, working together, appear to act as a single antenna, which is referred to as an "antenna port." Thus, signals transmitted using an "antenna port" present the same characteristics from the perspective of the user equipment, even though the "antenna port" may actually consist of one physical antenna or more than one physical antenna acting together. The radiating pattern that results from the combination of these physical antennas is the radiation pattern of the corresponding "antenna port." This is explained, for example, by *Sesia LTE* as shown below:

Each RS pattern is transmitted from an *antenna port* at the eNodeB. An antenna port may in practice be implemented either as a single physical transmit antenna, or as a combination of multiple physical antenna elements. In either case, the signal transmitted from each antenna port is not designed to be further deconstructed by the UE receiver: the transmitted RS corresponding to a given antenna port defines the antenna port from the point of view of the UE, and enables the UE to derive a channel estimate for all data transmitted on that antenna port – regardless of whether it represents a single radio channel from one physical antenna or a composite channel from a multiplicity of physical antenna elements together comprising the antenna port. The designations of the antenna ports available in LTE are summarized below:

Sesia LTE at 167.

58. Returning to the transmission of the PBCH, the base station may use 1, or 2, or 4 antenna ports for the transmission of the PBCH. *See* 3GPP TS 36.211 v13.0.0, § 6.6.3. Depending on how many antenna ports are to be used, the base station also transmits "reference signals" corresponding to each of the antenna ports on specific time and frequency occasions (Resource Elements), as shown below. *See* 3GPP TS 36.211 v13.0.0, § 6.10.1.2. The figure below illustrates the transmission of reference signals at a high level, which I discuss further below.

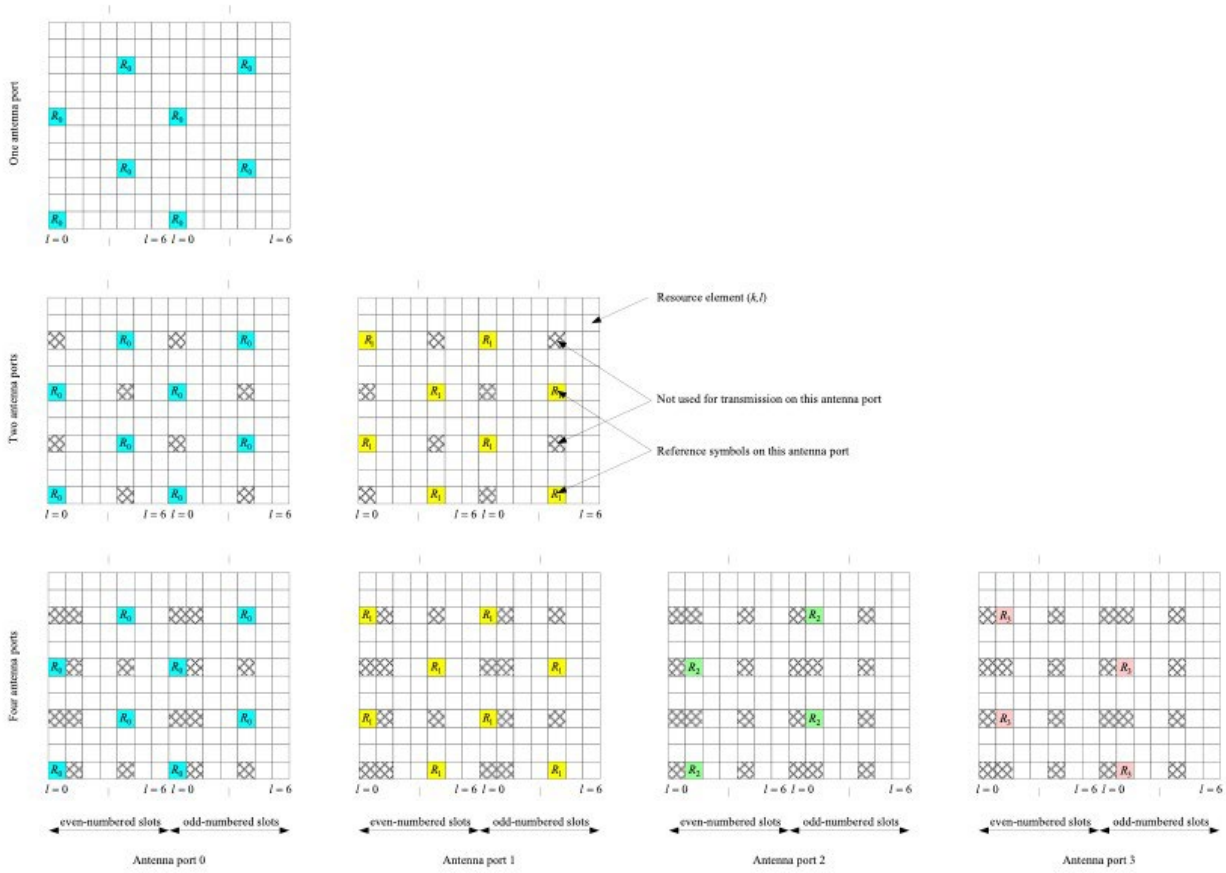


Figure 6.10.1.2-1. Mapping of downlink reference signals (normal cyclic prefix).

See 3GPP TS 36.211 v13.0.0, Figure 6.10.1.2-1.

59. Referring to the figure above, each "large square" represents what the LTE standard calls a "Resource Block" ("RB"). Each RB consists of a number of Resource Elements ("RE"), wherein each RE corresponds to a specific subcarrier (in the frequency domain) and a specific symbol (in the time domain). which is used for the transmission of one modulation symbol. In the example above, each Resource Block ("RB") consists of 12 subcarriers and 14 symbols corresponding to 12*14=168 Resource Elements ("RE"). In the figure above, the first row

(consisting of a single RB) represents the case of transmitting on only one antenna port (port0), while the second and third row (consisting of 2 and 4 RBs, respectively) represent the case of transmitting on 2 and 4 antenna ports, respectively. Furthermore, each column of the Resource Blocks ("RB") represents how the RB is used for transmission on a particular antenna port. The first, leftmost RB column (wherein some of the RE are colored blue) represents the transmission on antenna port0; similarly, the second RB column (wherein some RE are colored yellow) represents antenna port1; similarly, the third RB column (wherein some RE are colored green) represents antenna port2; and the fourth, rightmost RB column (wherein some RE are colored red) represents antenna port3. The RB rows, from top to bottom represent whether one antenna port is being used (topmost RB row, port0 (blue) only), two antenna ports are being used (middle RB row of ports0,1 (blue, yellow)), and all four antenna ports are being used (bottom RB row of ports0,1,2,3 (blue, yellow, green, red). The respective colored RE in each grid are Resource Elements used for transmitting reference signals on a particular antenna port. The cross-hatched cells are not used for **any** transmission, because they correspond to resource elements of another antenna port, which is why there are more cross-hatched cells in the bottom row for port 0 in the bottom row, and no cross-hatched cells in the top row for port 0. The blank cells in each grid are available for transmission of other information, e.g., user data. Thus, for

example, if two antenna ports are used (antenna port 0 and antenna port 1) the "blue" resource elements are used for transmission of reference signals on antenna port 0 and the yellow ones for transmission of reference signals on antenna port 1. In contrast, *nothing* is transmitted by an antenna port on the resource elements on which another antenna port is transmitting reference signals (cross-hatched cells). I will return to this information below.

60. The UE needs to know how many antenna ports are being used (1, 2, or 4). The way the UE knows how many ports are being used by the base station is provided by 3GPP TS 36.212, v13.0.0, using a Cyclic Redundancy Code ("CRC") mask. 3GPP TS 36.212 v13.0.0, § 5.3.1.1. The specifics of the CRC mask are not necessary to understand the '271 patent's disclosure. The UE uses the transmitted reference signals to determine the effect of the channel on the transmitted signal from each antenna port. In other words, the reference signals are known ahead of time, but the UE receives a distorted version of the original reference signal and knowing the reference signal allows the UE to calculate the difference between the received signal and the transmitted reference signal. To use a simple analogy, if the UE knows that on antenna port 0 the base station transmits the value "5" and the UE receives the value "7," the UE knows that the difference between "5" and "7", i.e., the distortion, was caused by the channel, because no other antenna port is transmitting using that RE. The UE can make similar evaluations of the channel

conditions for each of the antenna ports that is being used by the base station. In addition, the UE can determine the received power, referred to as the Reference Signal Received Power, or RSRP, for each of the antenna ports that is being used.

61. A UE will generally report different types of information to a base station. These are generally called Channel State Information, or CSI. *Sesia LTE* at 280-281. A transmitter, such as a base station "can configure the UE to report measurement information to support the control of UE mobility." *Sesia LTE* at 75. These requirements can be transmitted by the base station using, for example, the "RRCConnectionReconfiguration message." *Sesia LTE* at 75. One such configuration is a "Reporting configuration" that "cause[s] the UE to send a measurement report," which may include information such as Reference Signal Received Power (RSRP)" for a given antenna port. *Sesia LTE* at 75. The Reference Signals are used to determine the downlink quality of the signal. "Each RS pattern is transmitted from an *antenna port* at the eNodeB." *Sesia LTE* at 167. In particular, it was well known that "RSRP is measured by the UE over the cell-specific Reference Signals (RS) within the measurement bandwidth over a measurement period. RSRP is a type of signal strength measurement and is indicative of the cell coverage. It is defined as the linear average over the power contributions (in Watts) of the REs that carry sell-specific RSs within the

considered measurement frequency bandwidth …. RSRP is therefore considered to be the most important measurement quantity for E-UTRAN." *Sesia LTE* at 513.

62. A POSITA would have known that "[a]n antenna port may in practice be implemented either as a single physical transmit antenna, or as a combination of multiple physical antenna elements." *Sesia LTE* at 167. The antenna port, whether a single antenna or combination of antennas transmits a wireless signal, such as the Reference Signal, and "the transmitted RS corresponding to a given antenna port defines the antenna port from the point of view of the UE, and enables the UE to derive a channel estimate for all data transmitted on that antenna port – regardless of whether it represents a single radio channel from one physical antenna or a composite channel from a multiplicity of physical antenna elements together comprising the antenna port." *Sesia LTE* at 167. Thus, the UE measures the RSRP of a particular antenna port, which represents the state of, or information about, the channel being measured, and transmits the RSRP back to the base station. *See Sesia LTE* at 167. When the UE reports back to the base station, it provides a measurement report for each antenna port measured. Various reporting criteria can cause the UE to send a measurement report, such a periodic or event-triggered criteria. *Sesia LTE* at 75. One of the details that the UE may report to the base station is Reference Signal Received Power (RSRP). *Sesia LTE* at 75.

63. As one example, 3GPP TS 36.133 v13.2.0, Section 9.1.4, specifies a mapping table of the RSRP range measured by the UE for a given transmission cell. For example, "[t]he reporting range of RSRP is defined from -140 dBm to -44 dBm with 1 dB resolution. The mapping of measured quantity is defined in Table 9.1.4-1. The range in the signaling may be larger than the guaranteed accuracy range." 3GPP TS 36.133 v13.2.0, § 9.1.4. In particular, "[t]he measurement report mapping for RSRP measurements is as defined in Section 9.1.4." 3GPP TS 36.133 v13.2.0, § 9.1.18.2.1. Table 9.1.4-1: RSRP measurement report mapping, for reporting RSRP values from the UE is shown below:

Table 9.1.4-1: RSRP measurement report mapping

Reported value	Measured quantity value	Unit
RSRP_00	RSRP < -140	dBm
RSRP_01	-140 ≤ RSRP < -139	dBm
RSRP_02	-139 ≤ RSRP < -138	dBm
...	...	...
RSRP_95	-46 ≤ RSRP < -45	dBm
RSRP_96	-45 ≤ RSRP < -44	dBm
RSRP_97	-44 ≤ RSRP	dBm

3GPP TS 36.133 v13.2.0, § 9.1.4. Table 9.1.4-1. Similarly, the measurement report may also report the CSI-RSRP, as shown in 3GPP TS 36.133 v13.2.0, § 9.1.14.3.3. Table 9.1.143.3-1: CSI-RSRP measurement report mapping, shown below:

Table 9.1.14.3.3-1: CSI-RSRP measurement report mapping

Reported value	Measured quantity value	Unit
CSI_RSRP_00	CSI_RSRP < -140	dBm
CSI_RSRP _01	-140 ≤ CSI_RSRP < -139	dBm
CSI_RSRP _02	-139 ≤ CSI_RSRP < -138	dBm
…	…	…
CSI_RSRP _95	-46 ≤ CSI_RSRP < -45	dBm
CSI_RSRP _96	-45 ≤ CSI_RSRP < -44	dBm
CSI_RSRP _97	-44 ≤ CSI_RSRP	dBm

3GPP TS 36.133 v13.2.0, § 9.1.14.3.3.

64. Other 3GPP standards also state that RSRP may be reported as *rsrpResult*, which is the measured RSRP of a particular antenna port, or cell, measured by the UE. *See* 3GPP TS 36.331 v13.0.0, at 365 ("*MeasResults* field descriptions", "*rsrpResult*"). This is done, for example, using the *reportCRS-Meas* parameter, which "indicates that the UE shall report rsrp, rsrp together with csi-rsrp in the measurement report, if possible." *See* 3GPP TS 36.331 v13.0.0, at 370 ("*ReportConfigEUTRA field descriptions*").

65. The base station also uses precoding matrices, which are applied to the signals to be transmitted by the particular antenna ports, as discussed and illustrated below. *See* 3GPP TS 36.211 v13.0.0, § 6.3.

6.3 General structure for downlink physical channels

This section describes a general structure, applicable to more than one physical channel.

The baseband signal representing a downlink physical channel is defined in terms of the following steps:

- scrambling of coded bits in each of the codewords to be transmitted on a physical channel
- modulation of scrambled bits to generate complex-valued modulation symbols
- mapping of the complex-valued modulation symbols onto one or several transmission layers
- precoding of the complex-valued modulation symbols on each layer for transmission on the antenna ports
- mapping of complex-valued modulation symbols for each antenna port to resource elements
- generation of complex-valued time-domain OFDM signal for each antenna port

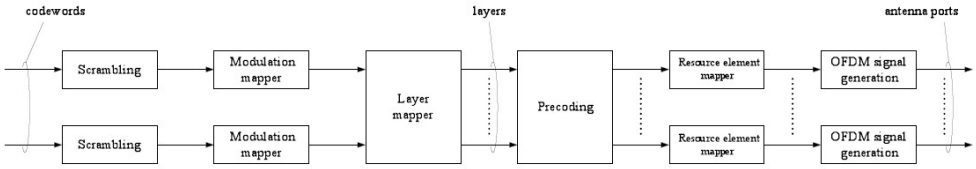


Figure 6.3-1: Overview of physical channel processing.

66. When the UE receives the Reference Signals, it determines which precoding matrix will result in the best correction of the distortion that the channel will cause during transmission. The precoding matrix that the UE determines is the best one to be used is identified by an index, referred to as the Precoding Matrix Indicator (PMI). *See, e.g.*, 3GPP TS 36.213 v13.0.0, § 7.2; *Sesia LTE* at 272-273, section 11.2.2.4). The PMI is then sent back to the base station as part of the CSI. The base station, in turn, can apply the precoding matrix identified by the UE to preemptively compensate for the distortion caused by the channel to the transmissions to the UE. The base station can also use a different precoding matrix than the one suggested by the UE. In either case, the precoding matrix used by the base station is reported to the UE so that the UE can properly account for the

impact of the channel to the received Reference Signal. *See* 3GPP TS 36.212 v13.0.0, § 5.3.3.1.3A, "Format 1B"; *see also Sesia LTE* at 273-274 ("this enables the UE to derive the correct phase reference relative to the cell-specific RSs in order to demodulate the PDSCH data"), *Sesia LTE* at 266-267.

67. In some cases, the base station may supply predetermined set of precoding matrices to the UE, and the UE selects the best precoding matrix to indicate to the base station from that set. To simplify the measurements and reporting by the UE, the "eNodeB [base station] may also restrict the set of precoders which the UE may evaluate and report." *Sesia LTE* at 273. "This is known as *codebook subset restriction*" and "enables the eNodeB to prevent the UE from reporting precoders which are not useful …." *Sesia LTE* at 273.

68. Other examples of CSI reported by the UE to the base station include Channel Quality Indicator (CQI), a Precoding Matrix Indicator (PMI) as discussed above, and Rank Indicator (RI), as shown below:

7.2 UE procedure for reporting Channel State Information (CSI)

If the UE is configured with a PUCCH-SCell, the UE shall apply the procedures described in this clause for both primary PUCCH group and secondary PUCCH group unless stated otherwise

- When the procedures are applied for the primary PUCCH group, the terms 'secondary cell', 'secondary cells', 'serving cell', and 'serving cells' in this clause refer to secondary cell, secondary cells, serving cell or serving cells belonging to the primary PUCCH group respectively unless stated otherwise.
- When the procedures are applied for secondary PUCCH group, the terms 'secondary cell', 'secondary cells', 'serving cell' and 'serving cells' in this clause refer to secondary cell, secondary cells (not including the PUCCH-SCell), serving cell, serving cells belonging to the secondary PUCCH group respectively unless stated otherwise. The term 'primary cell' in this clause refers to the PUCCH-SCell of the secondary PUCCH group.

The time and frequency resources that can be used by the UE to report CSI which consists of Channel Quality Indicator (CQI), precoding matrix indicator (PMI), precoding type indicator (PTI), CSI-RS resource indicator (CRI), and/or rank indication (RI) are controlled by the eNB. For spatial multiplexing, as given in [3], the UE shall determine a RI corresponding to the number of useful transmission layers. For transmit diversity as given in [3], RI is equal to one.

3GPP TS 36.213 v13.0.0, § 7.2.

The CQI identifies the modulation scheme and the coding scheme for the base station to transmit subsequent information to the UE. *See* 3GPP TS 36.213 v13.0.0, Table 7.2.3-1. Ever since Release 10 of the LTE standards, the base station was capable of transmitting data to the UE using up to eight antenna ports indicated in the measurement report from the UE.

6.3.4.4 Precoding for spatial multiplexing using antenna ports with UE-specific reference signals

Precoding for spatial multiplexing using antenna ports with UE-specific reference signals is only used in combination with layer mapping for spatial multiplexing as described in clause 6.3.3.2. Spatial multiplexing using antenna ports with UE-specific reference signals supports up to eight antenna ports and the set of antenna ports used is $p = 7,8,\ldots,\upsilon+6$.

3GPP TS 36.211 v13.0.0, § 6.3.4.4; *see also* Ex. 1027, *Kim*, [0071], [0164] ("CSI-RSs may be transmitted through 1, 2, 4 or 8 antenna ports" and "although CSI-RSs contained in 'set_1' may be selected from number of antenna ports (1, 2, 4, 8), the

number of antenna ports of CSI-RSs contained in the remaining set_n(n> 1) may be set to a predetermined number, for example, 1 or 2.").

Table 7.2.3-1: 4-bit CQI Table

CQI index	modulation	code rate x 1024	efficiency
0	out of range		
1	QPSK	78	0.1523
2	QPSK	120	0.2344
3	QPSK	193	0.3770
4	QPSK	308	0.6016
5	QPSK	449	0.8770
6	QPSK	602	1.1758
7	16QAM	378	1.4766
8	16QAM	490	1.9141
9	16QAM	616	2.4063
10	64QAM	466	2.7305
11	64QAM	567	3.3223
12	64QAM	666	3.9023
13	64QAM	772	4.5234
14	64QAM	873	5.1152
15	64QAM	948	5.5547

See 3GPP TS 36.213 v13.0.0, Table 7.2.3-1.

69. Thus, a POSITA in 2016 would have recognized that it was well known in the art to provide (a) for a base station to transmit signaling information, which is received by the UE, (b) the UE uses the signaling information to determine the number of antenna ports used by the base station and thus identifies the RS used by each antenna port, (c) for the base station to transmit reference signals (wireless signals) using the antenna ports, which are received by the UE,

(d) the UE uses the reference signals to determine, among other things, the RSRP and channel quality, (e) for the UE to transmit information to the base station, such as in a measurement report, which enables the base station to make decisions about what resources to use for the given transmission to the UE and how to transmit to the given UE on the given resources available.

I.VII. THE '271 PATENT

A. Alleged Invention of the '271 Patent

70. The '271 patent discloses relates to "a scheme for multi-antenna transmission in a wireless communication system" and." Ex. 1001, 1:18-19.

7.71. The patent 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," where "K is a positive integer greater than 1." Ex. 1001, 1:64-67. "[T]he K antenna port groups respectively correspond to K channel quality values," which "are K non-negative real numbers." Ex. 1001, 1:67-2:2. The patent explains that, "[i]n one embodiment, the channel quality value is … Reference Signal Received Power (RSRP)."

Ex. 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~~1001, 3:63-65. Similarly, “K1 antenna port groups of the K 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.*,Ex. 1001, 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.*," Ex. 1001, 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 the method includes "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.*,Ex. 1001, 2:9-16. TheWhen discussing antenna port groups, the '271 patent explains that an ""[i]n one embodiment, the antenna port group" may be " is composed of one antenna port." Ex. *Id.*,1001, 2:45-46, 13:64-65. These disclosures parallel the claims of the '271 patent.

8.72. 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.*," Ex. 1001, 2:17-22. The, but the claims do not recite only sending any ratios to the base station. Instead, the claims recite transmitting only "first information," which "is used to determine… the K1 antenna port groups and the first proportional sequence," not sending the proportional sequence itself. *Id.*," *E.g.*, Ex. 1001, 27:20-21, 27:37-39 (emphasis added); Ex. 1003, Kakaes Declaration ("Kakaes") ¶72. But the prior art taught this, as explained below.

27:37-39. As explained below, the prior art taught this.

73. The '271 patent thus taught conventional antenna selection methods, such as measuring RSRP of reference signals and selecting the channels corresponding to one or more reference signals that meets a particular criteria or threshold, as explained above in Section VI.

B. Prosecution History

74. The '271 patent was filed June 27, 2019, as U.S. Patent Application No. 16/454,075 and claims priority to Chinese patent application no. 201611236923.2, filed December 28, 2016. Ex. 1002, 15, 73. During prosecution, the examiner rejected claims 1-20 under 35 U.S.C. §§ 112 and 103 as indefinite and rendered obvious. Ex. 1002, 402-414. In response, the applicant amended the independent claims to clarify which device performed various claimed steps and to add that "the K channel quality values is a Reference Signal Received Power (RSRP) or a Signal to Interference plus Noise Ratio (SINR)." Ex. 1002, 462-467. The applicant distinguished the cited prior art by arguing that it did not use RSRP or SINR for antenna selection and instead used "a threshold of **delay spread or Doppler**," while "the target threshold in the present application and the claims is a threshold ratio between two channel qualities such as **RSRP and SINR**." Ex. 1002, 471-472 (emphasis in original).

75. The examiner then allowed the claims and certain post-allowance amendments to correct "formal matters." Ex. 1002, 480-483, 502-510.

~~B.~~C. 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.~~

II. STATEMENT OF PRECISE RELIEF REQUESTED

B. Prior Art

Ex. 1027	U.S. Patent Application Publication No. 2015/0036612 to Kim ("*Kim*")
Ex. 1028	International Publication WO2015/131494 to Chen
Ex. 1029	Certified English translation of International Publication WO2015/131494 to Chen ("*Chen*")[5]

76. I have been instructed that the "intrinsic record" includes the patent itself, including the claims, description, and figures (Ex. 1001), and the patent's prosecution history—i.e., the record of proceedings at the U.S. Patent and Trademark Office ("Patent Office") concerning the patent (Ex. 1002). I understand that, like the claims and written description, the prosecution history provides evidence to a person of ordinary skill in the art of how the inventor intended his patent to be understood, and how the Patent Office understood the patent. I understand that the inventor is permitted to apply a special definition to the terms or to limit the scope of claim terms in his patent claims, which may differ from the term's plain and ordinary meaning. That special definition or limitation on scope may be provided in the patent's written description, the patent's prosecution history, or both.

77. I understand that claim interpretation may also be informed by

"extrinsic evidence" (that is, evidence outside of the patent record itself). I have been informed that extrinsic evidence may include dictionaries, technical treatises, and other materials evidencing the meaning of a claim term and the understanding held by a POSITA in the relevant time period.

78. I have been asked for purposes of this declaration to apply the plain and ordinary meaning of the claim terms as they would have been understood by a

person of ordinary skill in the art at the earliest claimed priority date of the '271 patent.

79. I understand that no claim term's construction is in dispute at this time. Based on my review of these materials and my personal knowledge and experience, I have considered each term of the '271 patent as it would have been understood by a person of ordinary skill in the art at the earliest claimed priority date of December 28, 2016.

VIII. LEVEL OF ORDINARY SKILL IN THE ART

80. In rendering the opinions set forth in this declaration, I have been asked to consider the '271 patent's claims and the prior art through the eyes of a person of ordinary skill in the art (which I may also refer to as "one skilled in the art," "skilled artisan," "POSITA," or similar variation). I have considered factors such as the educational level and years of experience of those working in the pertinent art, the types of problems encountered in the art, the teachings of the prior art, patents and publications of other persons or companies, and the sophistication of the technology.

81. Taking the factors described in the Legal Standards – Level of Ordinary Skill section into consideration, it is my opinion that 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*.

IX. THE PRIOR ART

82. In forming my opinions, I found the following prior art relevant when considering whether the claims of the '271 patent would have been obvious to a person of ordinary skill in the art.

Ex. 1027	U.S. Patent Application Publication No. 2015/0036612 A1 to Kim et al. ("*Kim*")
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. ("*Chen*")[4]

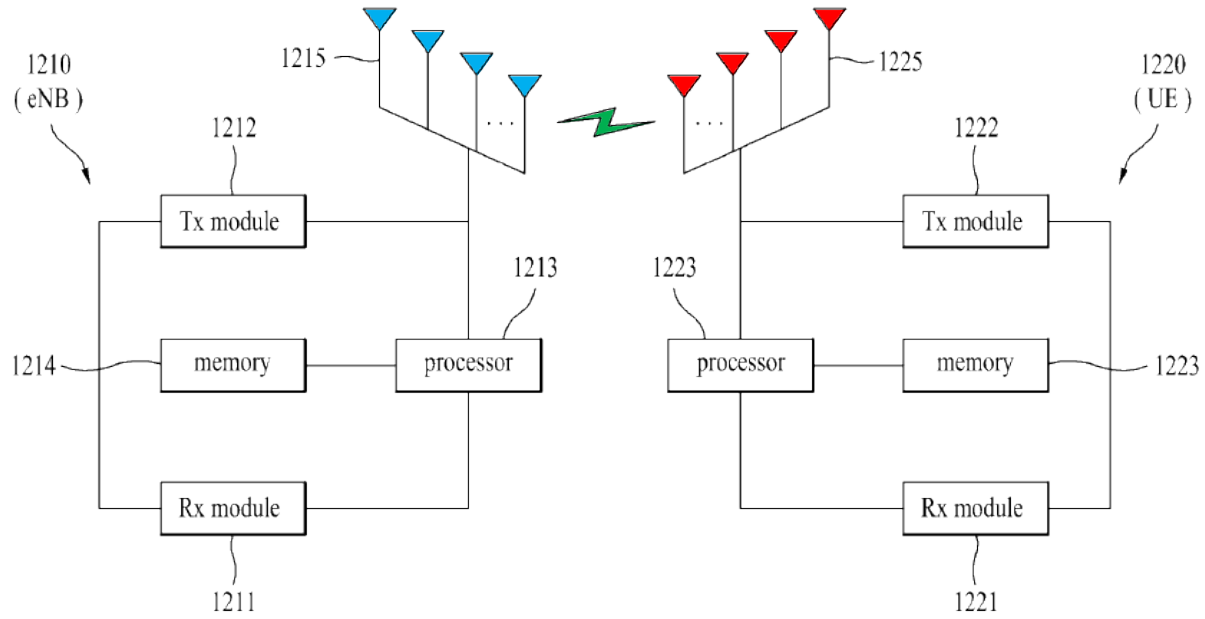
~~1.~~ *Kim*

A. ~~*Kim* published February 5, 2015, as~~ (U.S. Patent Application Publication No. 2015/0036612 A1)

83. *Kim* published as U.S. Patent Application No. 2015/0036612 A1 on February 5, 2015, and claims priority from PCT application no. PCT/KR2013/01742, filed March 5, 2013, which in turn claims priority to various U.S. ~~, making~~provisional patent applications. I understand and have been asked to assume that *Kim* is prior art ~~under 35 U.S.C. § 102(a)(1)-(2).~~.

[4] Citations to *Chen* are made to the English translation.

~~9.~~84. *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., "~~such as "a user equipment (UE~~)."~~), … or the like." *Kim*, [0036], FIG. 12. *Kim*'s FIG. ~~12~~12, annotated below, shows a "UE device 1220" that "may 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 "may include a reception (Rx) module 1211, a transmission (Tx) module 1212, … and a plurality of antennas 1215" (**blue**). *Kim*, [0177], [0174]. The "plurality of antennas 1215" of the base station and "plurality of antennas 1225" of the UE "indicate[] a UE apparatus supporting MIMO transmission and reception" (**green**). *Kim*, [0174], [0177].



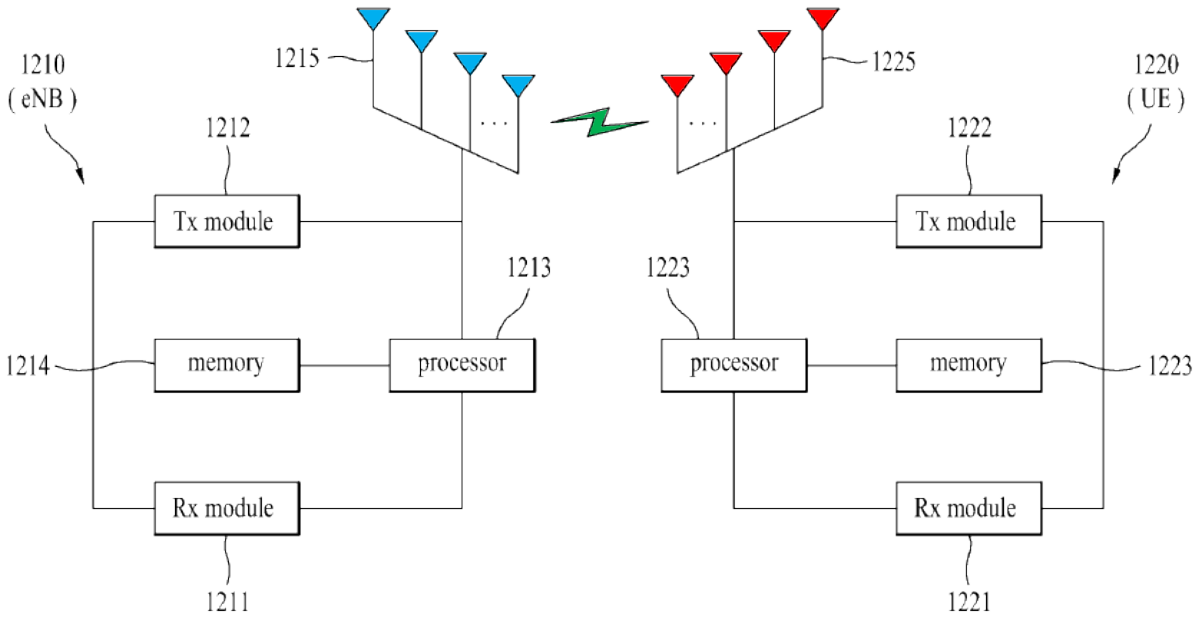
Kim, FIG. 12 (annotated).

~~… and~~

Kim describes 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~~ transmitting first signaling ~~to the UE. *Kim*, [0079]-[0081], Table~~

~~10.~~85. ~~3. The signaling includes "CSI-RS [Channel State Information-Reference Signal]~~, such as "CSI- RS config information element[s]," to user equipment (UE). *Kim*, [0079]-[0081], Table 3. The signaling includes certain parameters, such as "antennaPortsCount- r10" that "indicates the number of antennas~~"~~ needed for CSI-RS [Channel State Information-Reference Signals]" used for transmitting ~~CSI-RS~~ pilot signals to the UE. *Kim*, [0079]-[0080]. ~~*Kim*'s base station "~~For example, "the BS or eNB may 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 to the UE. *Kim*, [0142]. These reference signals "may be transmitted through 1, 2, 4 or 8 antenna ports" of the base station, and such that 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*, [0111]. *Kim* explains that "the UE may report not only indexes of a maximum of M CSI-RSs (the RSRP ratio (RSRP_n/max(RSRP_i)) of which is higher than a predetermined threshold value) from among N CSI-RSs contained in the CoMP management set, but also the RSRP estimation result of the corresponding CSI-RS." *Kim*, [0135]-[0136] ("the measurement report value for the n-th CSI-RS may

Kim's "UE may report… indexes of a maximum of M CSI-RSs" having a "

be defined as the ratio ~~(RSRP_n/max(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].

~~11.~~86. *Kim* is analogous art to the '271 patent because *Kim* is in the same field of endeavor as the '271 patent, 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 ~~"~~more particularly to a method and apparatus for performing measurement report~~[s]"~~" in MIMO systems. *Kim*, [0001], [0053], [0102~~].~~], [0174], [0177]; *see also* Ex. 1001, '271 patent, 1:18-19. *Kim*, like the '271 patent, discloses "a communication scheme of MIMO using multiple antennas." *Kim*, [0102], [0174] (base station having multiple transmission antennas and multiple receive antennas for MIMO operations), [0177] (user equipment having multiple transmission antennas and multiple receive antennas for MIMO operations);. *Kim* addresses "various matters such as a triggering condition associated with a measurement report based on various reference signals (RSs)," ~~e.g.,~~such as CRS and 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.~~ 3:16-17 (CSI-RS wireless signal), 3:46-47 (RRC signaling), 4:13-14 (CSI reporting), 13:25-52.

B. *Chen* (WO 2015/131494)

87. *Chen* published September 11, 2015, as WIPO PCT publication no. WO2015/131494~~, making~~ A2, from PCT application no. PCT/CN2014/084568, filed August 15, 2014, and claiming priority to Chinese patent application CN 201410077620.5, filed March 4, 2014. I understand and have been asked to assume that *Chen* is prior art ~~under 35 U.S.C. § 102(a)(1)-(2).~~.

~~12.~~88. *Chen*, like the '271 patent, "relates to ~~"~~a channel information feedback technology in communications, and in particular to a channel information feedback method and pilot and beam transmission methods." *Chen*, 1. ~~In~~ *Chen*~~,~~ discloses, for example, in FIG. 1, that 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, in particular, "the terminal detects ~~the N pilot signals ",~~ according to the port information~~...~~, the N types of pilot signals from the N pilot ports 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.

~~13.~~89. *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~~in multiple-antenna transmission systems, such as MIMO. *Chen*, 1, 3. *Chen*, like the ’271 patent, provides for a “ channel information feedback method” in which “a base station transmits M types of pilot signals” to a terminal (UE) and “the terminal 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 and the terminal.” *Chen*, 3; *see also* Ex. 1001, ’271 patent, 1:18-19.

~~*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**~~

X. GROUND OF UNPATENTABILITY

90. Based on my review of the materials set forth above, including my application of the knowledge of a person of ordinary skill in the art, it is my

opinion that claims 1-20 of the ’271 patent would have been obvious to one of ordinary skill in the art.

91. In particular, it is my opinion that claims 1-20 of the ’271 patent would have been obvious to a person of ordinary skill in the art based on the combination shown below:

Ground	Claims	Basis	Prior Art
1	1-2010	35 U.S.C. § 103	*Kim* andin combination with *Chen*

III. 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.

~~II.~~XI. THE CHALLENGED CLAIMS ARE UNPATENTABLE OVER THE PRIOR ART

92. In my opinion claims 1-20 would have been obvious to one skilled in the art at the earliest priority date of the '271 patent.

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

~~1. Claim 1:~~

93. In my opinion, the combination of *Kim* and *Chen* ~~render~~renders obvious claims 1-10.

1. Claim 1:

~~14.~~94. In my opinion, the combination of *Kim* and *Chen* renders obvious claim 1. ~~Kakaes ¶¶94-147.~~

95. *Kim* teaches or suggests each element of claim 1 either expressly or based on a POSITA's understanding reading *Kim*'s disclosure. To the extent Patent Owner argues that *Kim* does not disclose the first signaling is not used to determine the target threshold, *Chen* discloses and renders obvious at least the first signaling being used to determine the target threshold, if found not to be disclosed or suggested by *Kim*, as recited in claim 1. Moreover, to the extent Patent Owner argues that this claim requires only a single base station being used to transmit the wireless signal from K antenna port groups, *Kim* teaches that limitation as

discussed below. But to the extent Patent Owner alleges that *Kim* does not disclosed or suggest this interpretation, *Chen* discloses and renders it obvious.

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

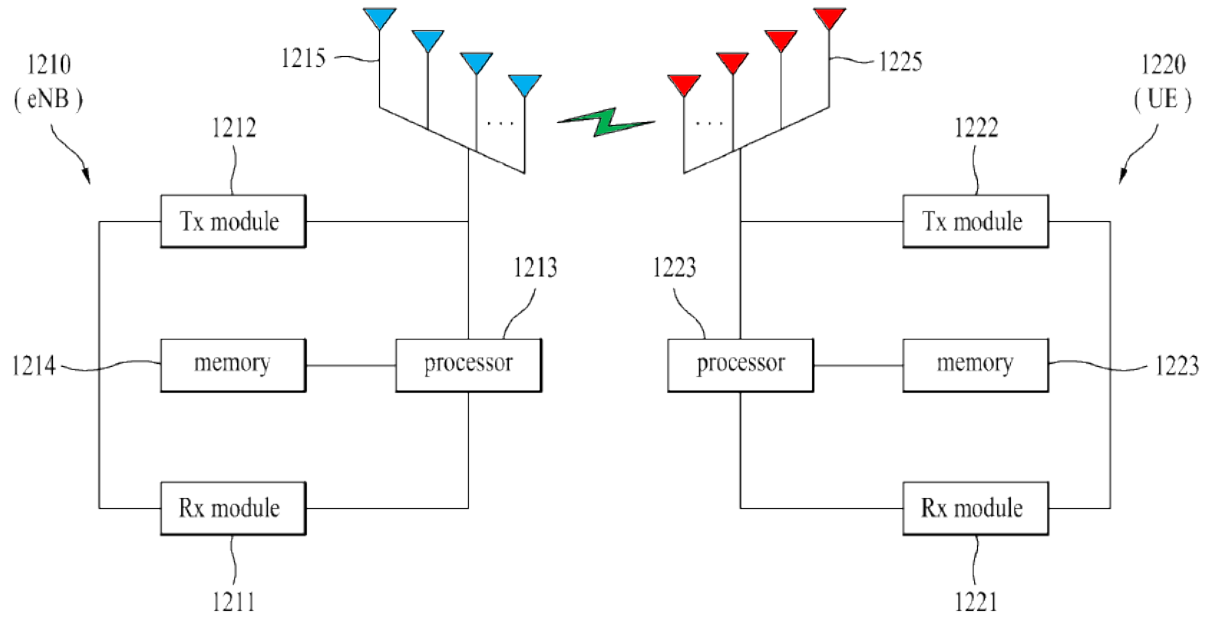
~~15.~~96. To the extent the preamble is limiting, *Kim* discloses ~~[1Preamble]. Kakaes~~a method for multi-antenna transmission in a user equipment ("UE").

~~¶¶96-98.~~

~~16.~~97. *Kim* discloses "a method for a terminal carrying out a measurement report in a wireless communication system." *Kim*, Abstract, [0001]. ~~*Kim*'s~~For example, the method includes ~~transmitting "~~"defining various matters such as a triggering condition associated with a measurement report based on various reference signals (RSs)." *Kim*, [0003~~]; Kakaes ¶97. The~~]. *Kim* explains that the base station and UE each engage in multi- antenna transmission in a MIMO system where multiple antennas of the base station ~~("BS") antennas~~ transmit to the UE and multiple ~~"terminal" (UE)~~ antennas of the UE transmit to the base station. *Kim*, [0174], [0177~~],~~]. *Kim*'s method includes a "terminal," such as "a user equipment (UE), … or the like. *Kim*, [0036~~]; Kakaes ¶97.~~], FIG. 12. *Kim*'s ~~UE and base station are "device[s] for supporting MIMO transmission and reception" (**green**), where~~FIG. 12, annotated below, shows a "UE device 1220" ~~includes~~that "may include an ~~"~~Rx module 1221~~,"~~ ", a Tx module 1222~~,"~~, … and ~~"~~a plurality of antennas 1225" (**red**), and ~~the~~a "BS [base station] device 1210" ~~includes~~that "may include a ~~"~~reception (Rx) module 1211~~,"~~ ", a

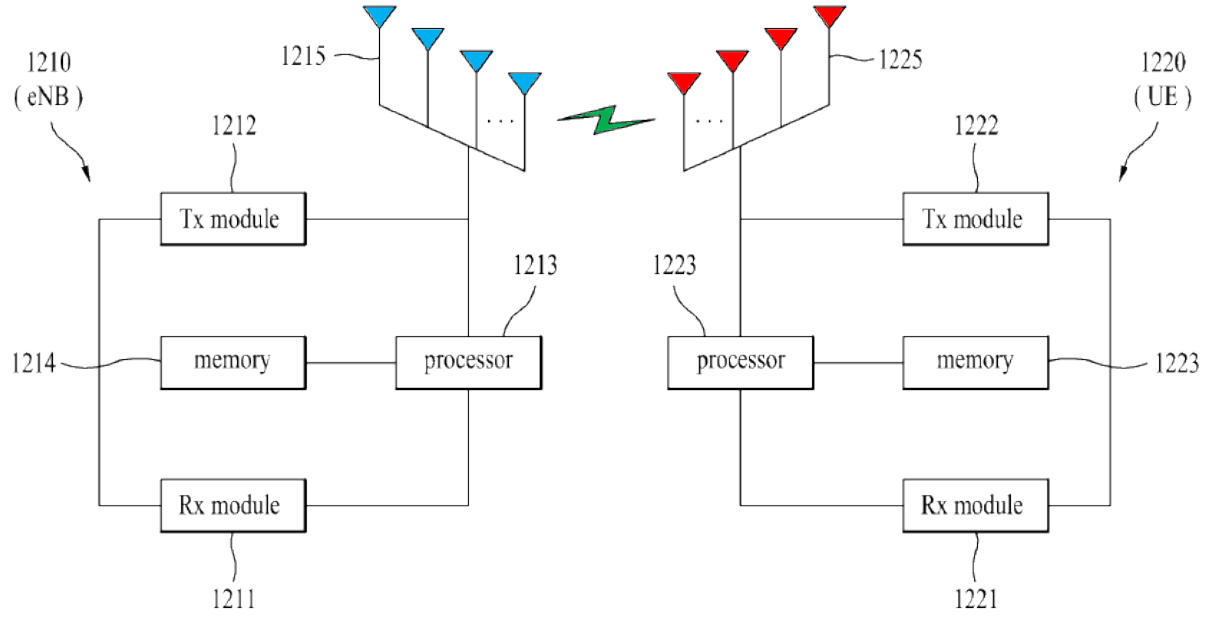
transmission (Tx) module 1212~~,"~~, … and ~~"~~a plurality of antennas 1215" (**blue**).

Kim, [0174], [0177~~]; Kakaes ¶97.~~]. The "plurality of antennas 1215 indicates a BS device for supporting MIMO transmission and reception" of the base station and the "plurality of antennas



~~*Kim*, FIG. 12 (annotated).~~

1225" of the UE "indicates a UE apparatus supporting MIMO transmission and reception" (**green**). *Kim*, [0174], [0177].



Kim, FIG. 12 (annotated).

~~17.~~98. *Kim* further 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;"

~~18.~~99. *Kim* discloses ~~element [1a]. Kakaes ¶¶99-103~~receiving, by the UE, a first signaling originating from a base station.

~~19.~~100. *Kim* discloses the UE receiving first signaling, ~~for example,~~such as "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~~]. *Kim* explains that, in this signaling ~~includes "~~, "'antennaPortsCount-~~r10," which "~~r10' 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 "~~r10' indicates which RE [Resource Element] of a single RB [Resource Block~~]" for the CSI-RS.~~] is located on time-frequency frequencies …." *Kim*, [0080~~] [0081]. The RRC signaling's "~~]. Similarly, "'resourceConfig-r10' contained in 'CSI-RS Config' may indicate a CSI-RS transmission position, and may indicate the positions of symbols and subcarriers contained in one RB according to the CSI-RS configuration~~" information may also identify an "antenna port pair" transmitting to the UE. *Kim*, [0142].~~ numbers (shown in Table 1) denoted by 0 to 31." *Kim*, [0081]. For example, "the BS or eNB may inform the UE of specific information through RRC [Radio Resource Control] signaling," including "CSI-RS configuration" information that identifies an "antenna port pair" transmitting a CSI-RS signal to the UE. *Kim*, [0142], [0132].

101. The RRC signaling ~~indicates~~ may also indicate a set of antenna port groups to be used by the UE for measuring channel quality values ~~by the UE.~~, such as

RSRP values, of N CSI-RS signals, such that a maximum of M antenna ports are reported back from the set of N CSI-RS sent from the base station. *Kim*, [0146~~]; Kakaes ¶101. The~~]. "RSRP is defined as the linear average over the power contributions of REs [Resource Elements] that

carry downlink CRSs [Cell-specific Reference Signals]." *Kim*, [0107]. As part of the CSI-RS-based measurement reporting, the UE measures "the ~~RSRP~~quality of ~~the indicated CSI-RSs and selects and reports the "~~M CSI- RS values each having the best quality," such as RSRP values, "where M~~…~~ may be predetermined or may be previously designated by the BS through RRC signaling." *Kim*, [0146]. Furthermore, "[t]he CSI-RS may be signaled to the UE as a CSI-RS config information element shown in Table 3." *Kim*, [0079].

~~20.~~102. 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~~of which information of M determined antenna port groups of the N antenna port groups being measured, is fed back to the base station in a measurement report, ~~including~~ as was well known in the 3GPP standards. *Kim*, [0038], [0078]-[0081], [0106], [0110]-[0111], [0119],

~~Kakaes ¶102; *Kim*, [0038], [0078]-[0081], [0106], [0110]-[0111], [0119],~~

[0135]-[0136], [0148]-[0149] (describing base station ~~signals~~configuring antenna ports for radio resource management measurements and signaling to UE which antenna ports should be measured to determine channel qualities and various options for the UE to report measurements, including RSRP~~); *accord*~~, on a subset of the measured antenna port groups); *supra* § VI (Technology Background).

103. The '271 patent confirms this, explaining that, for example, "the first

signaling is a Radio Resource Control (RRC) signaling," that "the first wireless signal is an CSI-RS burst," and that "the first information is transmitted in a CSI

report." Ex. 1001, 3:16-17 (CSI-RSfirst wireless signal is CSI-RS), 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.

104. *Kim*'sreceiving, by the UE receives, a first wireless signal, for example, a pilot signal or reference signal (e.g., originating from the base station.

105. *Kim* discloses the UE receiving first wireless signals, such as cell-specific reference signal ("CRS") or channel state information-reference signals ("CSI-RS"), originating from the base station. *Kim*, [0057]-[0064]. The wireless signal may also be "referred to as a pilot signal or a reference signal ("CSI-RS")), originating from the base station." *Kim*, [0052], [0057]-[0064]. The received reference signals are used "for acquiring channel information," "to" and "for data demodulation." *Kim*, [0064]. In some cases, "[t]he UE receives the reference signal to perform channel measurement[s]," and "for data demodulation," and may be "transmitteddata [demodulation][5]" and a "reference signal is transmitted in a region in which data is transmitted." *Kim*, [0064]. The

[5] Although the text of *Kim* says "modulation," a POSITA would have recognized that this is a typographical error and should refer to "demodulation." Paragraph [0064] of *Kim* previously refers to "demodulation" and paragraphs [0055], [0060],

[0062], [0065], which provide context for paragraph [0064], all refer to "demodulation." Thus, read in context, a POSITA would have understood that "modulation" is a typographical error and should read "demodulation."

CRSs and CSI-RSs are wireless signals ~~originating from~~transmitted using antenna ports by the base station and received by the UE, 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~~],~~]. A POSITA would also have understood that the CRSs are mapped on a per-antenna port basis based on *Kim*'s teaching that, as shown in FIG. 6~~; Kakaes ¶105.~~, "CSI-RSs are mapped to REs on a per-antenna port basis" and "CRSs are mapped to respective antenna ports." *Kim*, [0076], [0065].

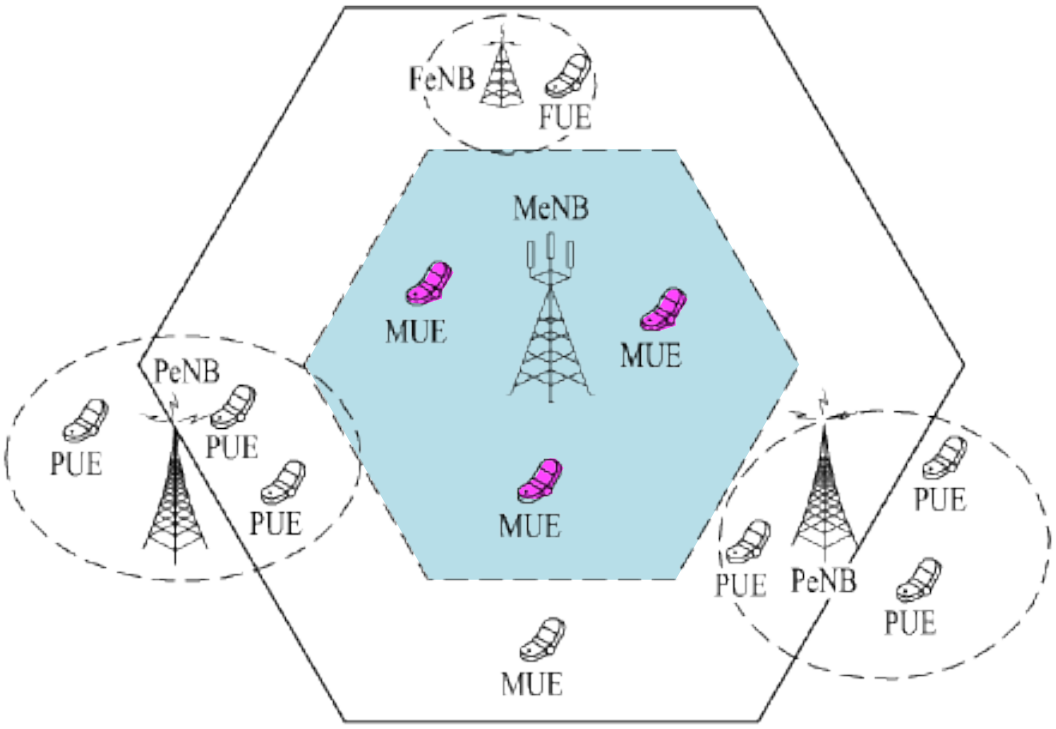
~~21.~~106. *Kim* explains that ~~a~~the term "[b]ase station (BS)" includes "a fixed station, a Node B, an eNode B (eNB), an access point (AP) and the like," and a "'cell' may be understood as a base station (BS or eNB~~)" or "Remote Radio Head (RRH)…, etc." *Kim*, [0036]. "[C]ells" may be "configured in the form of a distributed antenna or~~), a sector, a Remote Radio Head (RRH), a relay, etc." *Kim*, [0036]. In other words, where *Kim* refers to a CSI- RS or CRS being transmitted by a an eNB, a BS, a cell, or an RRH, a POSITA would have understood that it refers to transmission by a base station. For example, *Kim* explains that, even when it refers to "cells," they may be "configured in the form of a distributed antenna or RRH *of a single BS*," meaning a single base station transmits multiple CRSs or CSI-RSs. *Kim*, [0103] (emphasis added). A POSITA would have recognized based on this disclosures and others disclosures of *Kim* relating to "CoMP clusters" that *Kim* describes

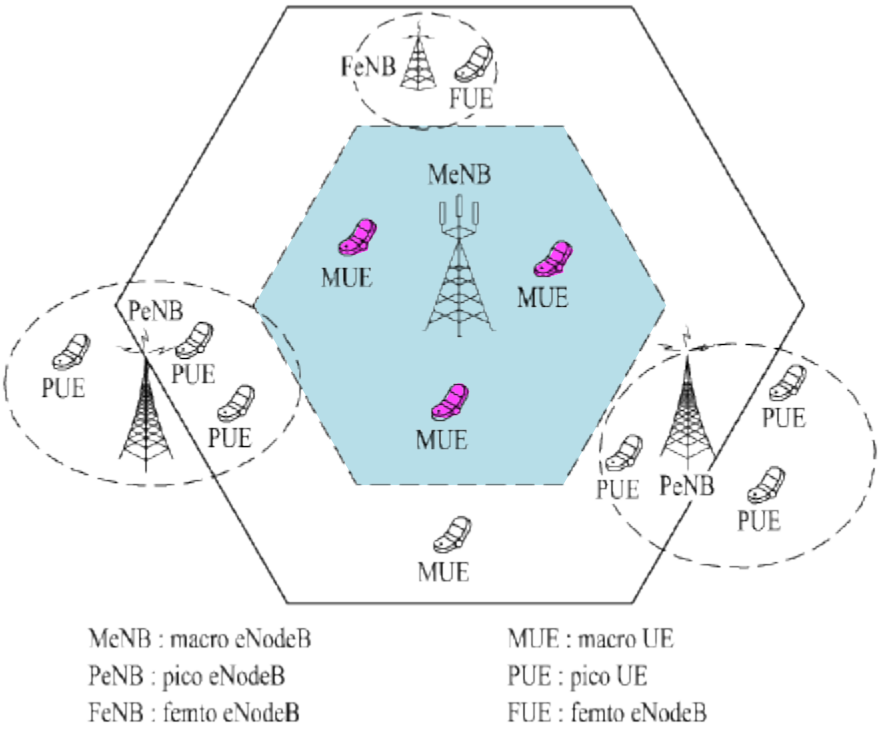
transmitting the CSI-RSs from a single base station in some embodiments and

from multiple base stations or a

RRHcluster 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 in other embodiments. In particular, *Kim* notes that, in one example, *Kim* describes multiple"four antenna ports transmitting CSI-RS wireless signals "are transmit[ing] according to the number of transmit antennas of the base station," such that " and "antenna ports 0 and 1 are transmit[ing]" or "antenna ports 0 to 3" are transmitting fromtransmit[ing]" at the base station or, in another example, ". *Kim*, [0065], [0066], [0071] ("antenna ports 15 to and 16 for two antenna ports, 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].").

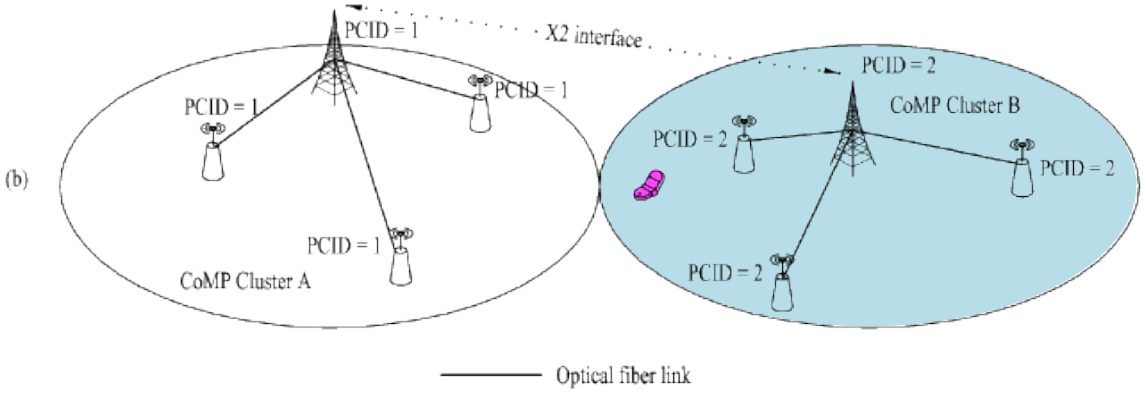
22.107. *Kim*'sFor example, FIG. 7 shows UEs within range of only a single base station (MeNB) servicing three UEs (**pink**) within the cell (**teal**).


FeNB
FUE
MeNB
MUE
MUE
PeNB
PUE
PUE
PUE
MUE
PUE
PeNB
PUE
PUE
MUE
MeNB : macro eNodeB
PeNB : pico eNodeB
FeNB : femto eNodeB
MUE : macro UE
PUE : pico UE
FUE : femto eNodeB


FeNB
FUE
MeNB
MUE
MUE
PeNB
PUE
PUE
PUE
MUE
PUE
PeNB
PUE
PUE
MUE
MeNB : macro eNodeB
PeNB : pico eNodeB
FeNB : femto eNodeB
MUE : macro UE
PUE : pico UE
FUE : femto eNodeB

Kim, FIG. 7 (annotated~~); *see also Kim*, [0103] (transmitting antenna ports can be "a~~). Similarly, FIG. 8(b) shows two CoMP clusters A and B that are each "configured in the form of a distributed antenna or RRH *of a single BS*" ~~(emphasis added)).~~," as shown below.

~~Dr. Kakaes explains~~



Kim, FIG. 7(b) (annotated).

Because *Kim* teaches that~~, because *Kim*'s~~ the 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 the conventional reference signals that were well-known wireless signals in prior art systems, ~~including~~ as was well known in the 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*~~

~~23.~~108. ~~Ex. 1001, 3:16-17 (CSI-RS wireless signal). Indeed~~*supra* § VI (Technology Background). Moreover, *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;"

~~24.~~109. *Kim* discloses ~~element [1c]. Kakaes ¶¶109-111~~transmitting, by the UE, first information to the base station.

~~25.~~110. ~~*Kim*'s~~ *Kim* discloses that the UE transmits a "measurement report" ~~containing~~to the base station, where the measurement report contains 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~~measured by the ~~base station~~UE. *Kim*, [0105]-[0106], [0110]-[~~111~~0111], [0136], [0148]-[0149]. *Kim* also reports the RSRP-to-max(RSRP) ratio back to the base station with the measurement report (first information). *Kim*, [0136] ("In another embodiment, if CSI-RS having the best average Rx power level is selected from among a plurality of CSI-RSs, the measurement report value for the n-th CSI- RS may be defined as the ratio of the n-th CSI-RS average Rx power level to the best CSI-RS average Rx power level."). "The measurement report ~~"~~conceptually covers Radio Resource Management (RRM) measurement of measuring the signal strengths~~…~~ or signal strengths to total reception power of a serving cell~~…~~, and neighbor cells, including Reference Signal Received Power (RSRP~~)."~~) …." *Kim*, [0106]. The UE may perform RSRP measurements on both 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.~~] (“In addition to CRS based RSRP/RSRQ measurement reporting for mobility management of UE

handover, the CoMP measurement set configuration and the CSI-RS based RSRP/RSRQ measurement reporting for ICIC are simultaneously performed, such that accuracy and flexibility of network RRM can be increased."), [0136], [0148]-[0149] ("The UE may report not only indexes of M CSI-RSs indicating the best RSRP result from among N CSI-RS contained in the CoMP management set, but also the RSRP estimation result of the corresponding CSI-RS").

26.111. A POSITA, as Dr. Kakaes explains, would have recognized that *Kim*'s UE feeding back measurement report information, such as RSRP, to the base station was well known in prior art systems, including as was well known in the 3GPP standards. Kakaes ¶111; *Kim*, [0005], [0006], [0038]; *see Park*, [368]-[378] (UE reports RSRP of antenna ports); *supra* § VI (Technology Background).

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;"

27.112. *Kim* discloses, or alternatively the combination of *Kim* and *Chen* renderrenders obvious, element [1d1].wherein, K antenna port groups of the base station are used to transmit the first wireless signal.

Kakaes ¶¶112-121.

113. As explained above,in element [1b], *Kim*'s base station transmits the first wireless signal, such as CSI-RS, using antenna cell-specific reference signal

(“CRS”) or channel state information-reference signals (“CSI-RS”), which are transmitted from antenna port groups identified ~~by corresponding~~ in the Resource Elements ~~(“REs”) of the~~ corresponding to each transmitting

antenna port of the base station. *Kim*, [0057]-[0063], [0076], [0053]; *supra* § V.A.1.cXI.A.1.c ([1b]). The CSI-RSs wireless signals "signal may also be transmitted" to the UE ""referred to as a pilot signal or a reference signal." *Kim*, [0052]. The CRSs and CSI-RSs are wireless signals transmitted using antenna ports by the base stations and received by the UE, because "CSI-RSs may be transmitted through 1, 2, 4 or 8 antenna ports" of the base station to the UE. *Kim*, [0071]; Kakaes ¶113.]. Each CSI-RS is ""may be mapped to REs on a per-antenna port basis"[66] at the base station for transmission. *Kim*, [0074], [0076]; Kakaes ¶113.].

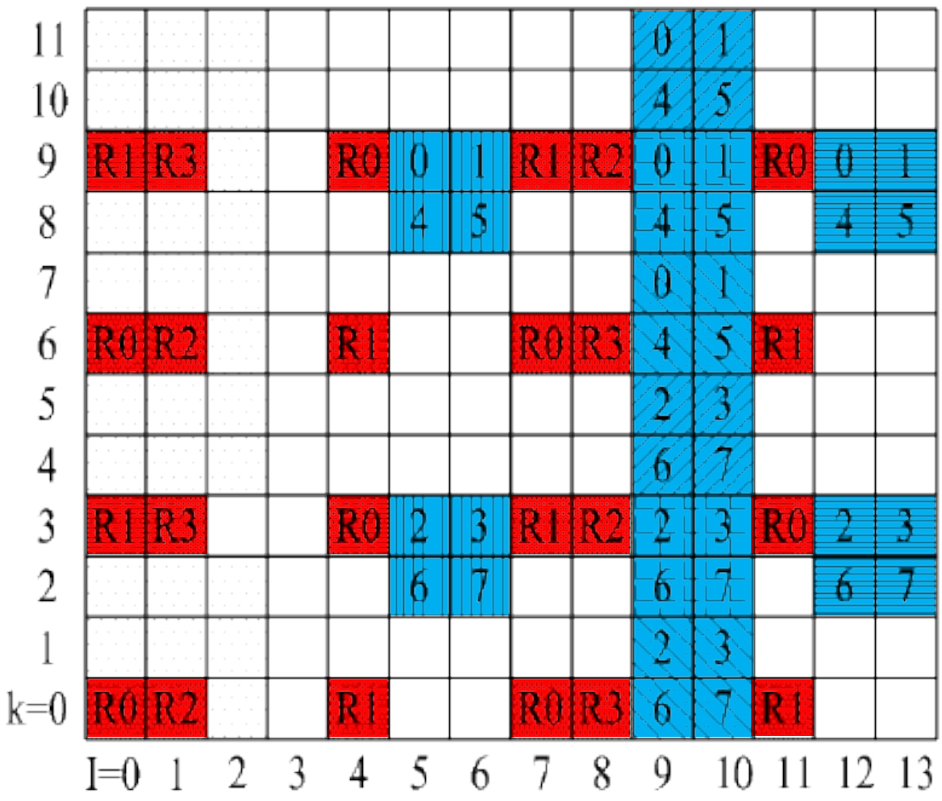
A POSITA would also have understood that the CRSs are mapped on a per-antenna port basis based on *Kim*'s teaching that, as shown in FIG. 6, "CSI-RSs are mapped to REs on a per-antenna port basis" and "CRSs are mapped to respective antenna ports." *Kim*, [0076].

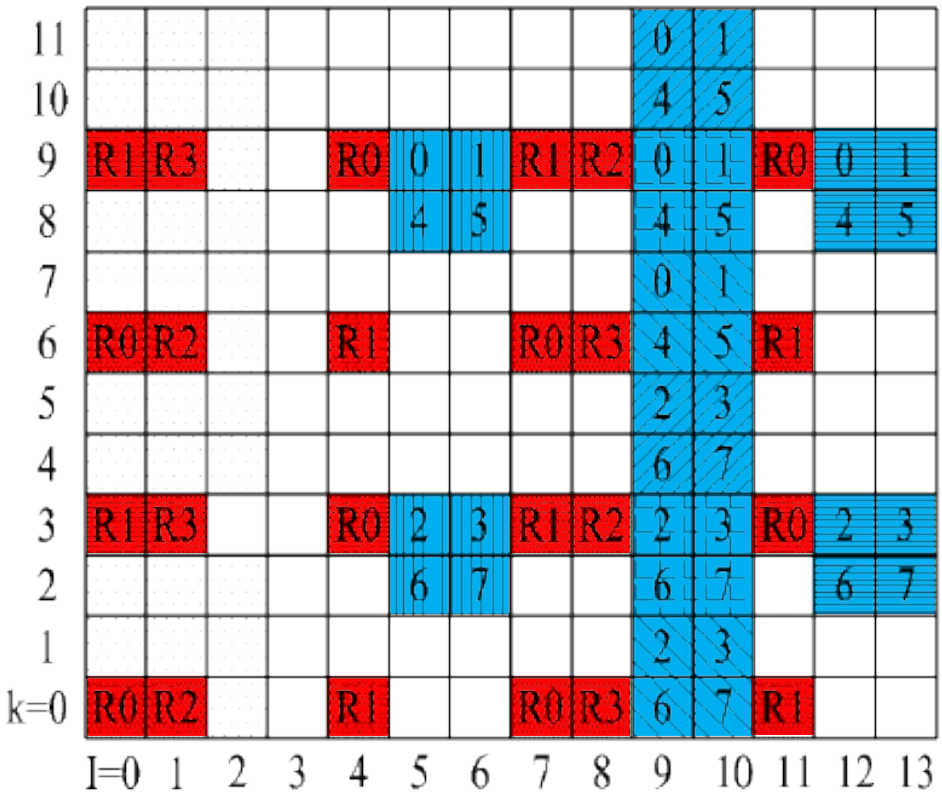
28.114. FIG. 6 shows an example of how the base station identifies K antenna ports as CSI-RS antenna port groups usingports based on the configuration information. Kakaes ¶114. In FIG. 6, "CSI-RSs are mapped to REs on a per-antenna port basis according to a specific CSI-RS configuration," where "R0 to R3 denote that CRSs are mapped to

[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~~For simplicity, I refer to "antenna ports," each of which is an "antenna port group" under the '271 patent's disclosure. ~~*Id*~~Ex. 1001, 2:45-46, 13:64-65.

~~CSI-RS configuration," where~~respective antenna ports," as shown below (**red**), for four transmitting antenna port groups. *Kim*, [0076], FIG. 6. Similarly, "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~~,~~ (**blue**), 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~~

~~29.~~115. For groups of antenna ports comprising more than one antenna port per CSI-RS, e.g., "CSI-RS corresponding to two antenna ports ~~are,~~" then the antenna port group is "mapped to the same RE~~," then~~, and each CSI-RS ~~in the pair~~ "may be identified by

different orthogonal codes." *Kim*, [0076]. Thus,], FIG. 6. Similarly, for CRS, "four antenna ports are transmitted according to the number of transmit antennas of the base station." *Kim* teaches, [0065].

Kim explains 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].

116. *Kim* describes transmitting the first wireless signal from antenna ports that are located at a one or more base stations., including a single base station or multiple base stations forming a cluster. *Supra* §§ V.A.1.bXI.A.1.b-V.A.1.cXI.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.

To the extent Patent Owner argues that this claim is limited to having only a single base station is required and also argues that *Kim* does not disclose a single base station transmitting the CRS and/or CSI-RS in the K antenna port groups, a POSITA would have found it obvious that the K antenna port groups of a singlethe base station beingare used to transmit the first wireless signal, a POSITA would have found this obvious. Kakaes ¶117.

30.117. . *Chen*, for example, 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*, whereexplains that "a base station transmits M types of pilot signals" using ", the M

types of pilot ~~ports," where "~~signals corresponding to M pilot ports respectively; and the base station configures, through signaling, N pilot ports~~" of~~ in the M pilot ports for a terminal, M being a positive integer and N being a positive

are configured for and identified to the UE "through signaling."[7] integer less than M." [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, Abstract, 5, 13, 19. *Chen*'s ""[T]he N pilot ports are formed by virtualization of a same group of antennas, each pilot port in the N pilot ports corresponds to a set of virtualized precoding weights," *Chen*, 3, -5, 7, 11, 18, which a POSITA would have understood describes a groupgroups of antennas at a single base station. Kakaes ¶117.

Chen also explains that the transmitting antennas (antenna ports) form "a linear array" or "two-dimensional… array" of antennas, *Chen*, 12, which a POSITA would have also understood describes the antenna ports being located at a single base station. *Chen*, 12; Kakaes ¶117.

31.118. A POSITA would have found it obvious to configure *Kim*'s system such that a single base station includes the K antenna port groups of the base station are used to transmit the first wireless signal. For example, a POSITA would have found it obvious to configure

[7] The prior art and '271 patent use overlapping variables to represent the number(s) of port groups. The following table below shows the relationship between the

variables in the ’271 patent, *Kim*, and *Chen*.

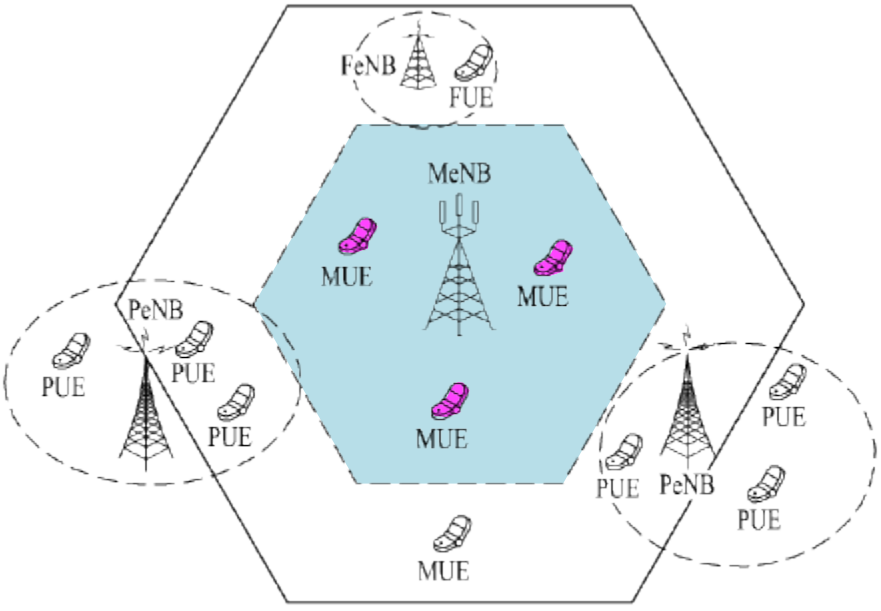
’271 patent	***Kim***	***Chen***
K	N or management set	N ports or P beams
K1	M or reported set	K ports or Q beams
K2	M or reported set	K ports or Q beams

Kim's system such that a single base station includes the K antenna port groups transmitting the first wireless signal~~, for example,~~ because, as taught by *Chen*, a single base station may have more than 100 antennas arranged in arrays to provide multiple antenna port groups to various ~~UEs~~UE 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~~each of K antenna port groups ~~transmit~~is transmitting from a single base station so that the base station can provide improved transmission to the UEs within its broadcast area by transmitting pilot signals, as described in *Kim* and *Chen*, and confirmed by *Liu*, *Park*, and the 3GPP standards as conventional activities. ~~Kakaes ¶118; see~~*See* *Kim*, [0103]; *Chen*, 2, 3, 5, 7, 11, 18; *Liu*, 1, 16, 18; *Park*, [206], [208], [205]-[222]; *Sesia LTE*, ~~*Park*, [206], [208], [205]-[222]; *Sesia LTE*,~~ 155, 167, 169, 654~~.~~; *supra* § VI (Technology Background).

i. Motivation to combine

~~32.~~119. 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 the **teal** cell~~). Kakaes ¶119.~~ annotated below).



MeNB : macro eNodeB
PeNB : pico eNodeB
FeNB : femto eNodeB

MUE : macro UE
PUE : pico UE
FUE : femto eNodeB

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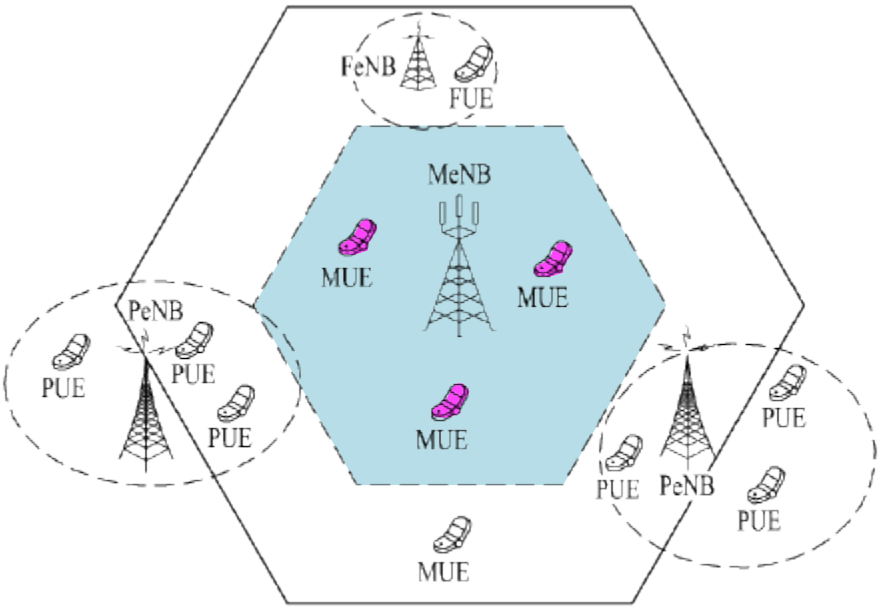


MeNB : macro eNodeB
PeNB : pico eNodeB
FeNB : femto eNodeB

MUE : macro UE
PUE : pico UE
FUE : femto eNodeB

Kim, FIG. 7 (annotated).

~~33.~~120. A POSITA would have been motivated to configure *Kim*'s system this way because it would allow each UE to measure the strength of the received ~~signal strengths~~signals 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 is higher when the received signal strength is higher. The data transfer rate can also be increased by using diversity transmission or multiple layers of transmission when the number of transmitting and receiving antennas is higher ~~or using transmit diversity, and because~~and that 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.~~

RSRP and signal-to-noise ratio (SNR) in LTE systems. *Chen*, 1 ("a higher data transmission rate by means of a plurality of antennas"); Ex. 1021, Ex. 1021, *Afroz*, *Measurements in Long Term Evolution Networks*, 115, 118, 120, 122, FIG. 7.

ii. Expectation of success

~~34.~~121. A POSITA would have had a reasonable expectation of success in configuring *Kim*'s system ~~as recited in element [1d1]. Kakaes ¶121~~such that K antenna port groups of the base station are used to transmit the first wireless signal. 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~~*Sesia LTE*, 155, 167, 169, 654; *Kim*, [0103]; *Chen*, 2, 3, 5, 7, 11, 18; *Liu*, 1, 16, 18; *Park*, [206], [208], [205]-~~¶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~~]; *supra* § VI (Technology Background). Having K antenna port groups of ~~a~~the base station ~~was~~being used to transmit the first wireless signal would have been a straightforward operation of MIMO systems, such as those described in *Kim* and *Chen*~~,~~ that applies only known, conventional functions used according to their known functions to yield predictable results (transmitting ~~pilot signals~~CSI-RSs 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.

122. *Kim* discloses 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.

As explained above in elements [1a] and [1d1], the first signaling is used by the UE to determine the K antenna port groups that are used to transmit CRSs and/or CSI-RSs, i.e., the CSI-RSK antenna port groups transmitting the first wireless signal received by the UE and identified in the Resource Block by the corresponding Resource Elements ("REsRE"). *Supra* §§ V.A.1.bXI.A.1.b, V.A.1.e; Kakaes

35.123. ¶123.XI.A.1.e ([1a], [1d1]). As explained above in element [1d1], K is a positive integer greater than 1, for example, 2 or 4 for CRS or 2, 4, or 8 antenna ports for CSI-RS transmission.. *Supra* §§ V.A.1.bXI.A.1.b, V.A.1.eXI.A.1.e ([1a], [1d1]); Kakaes ¶123.]).

36.124. *Kim*'s "CSI-RS may be signaled to the UE as a CSI-RS config information element." *Kim*, [0079]. Alternatively, the base station "*Kim* discloses that "the BS or eNB may inform the UE of specific information through RRC [Radio Resource Control]

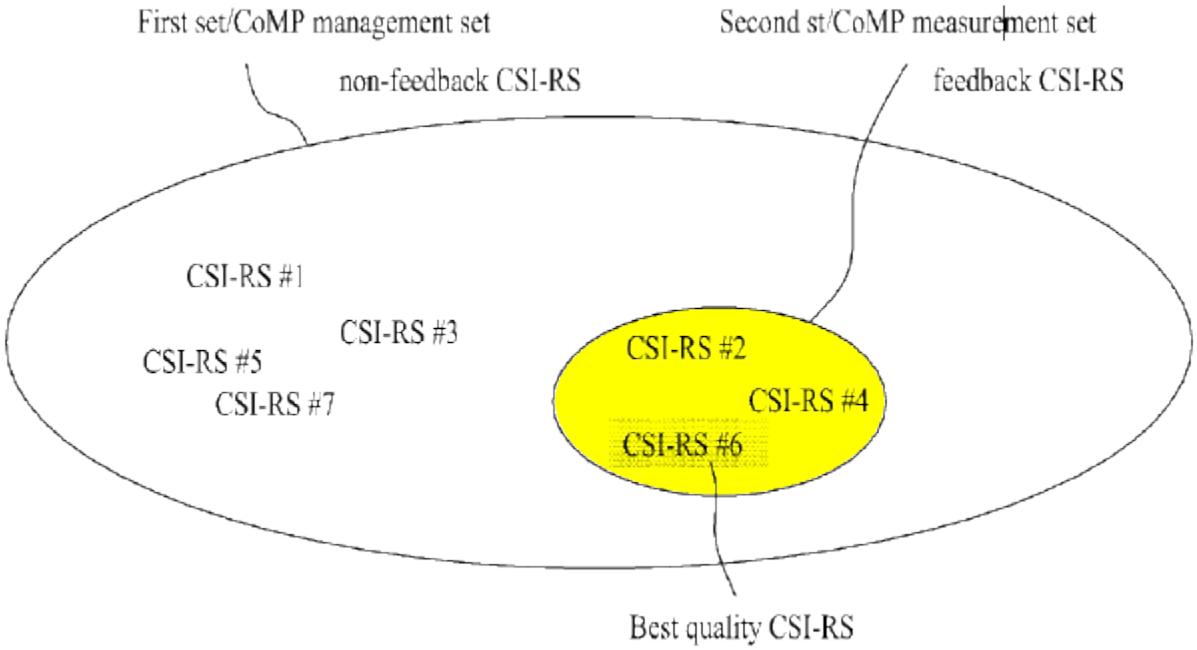
signaling," including "CSI-RS configuration" information that identifies ~~a CSI-RS~~an "antenna port pair" ~~transmitting from a single RE.~~is transmitted through a CSI-RS signal is transmitted to the UE. *Kim*, [0142]. ~~For~~As one example, ~~the~~"CSI-RS may be signaled to the UE as a CSI-RS config information element." *Kim*, [0079]. The UE receives, from the base station, first signaling, such as "CSI- RS config information element[s]," which includes "antennaPortsCount-r10" that

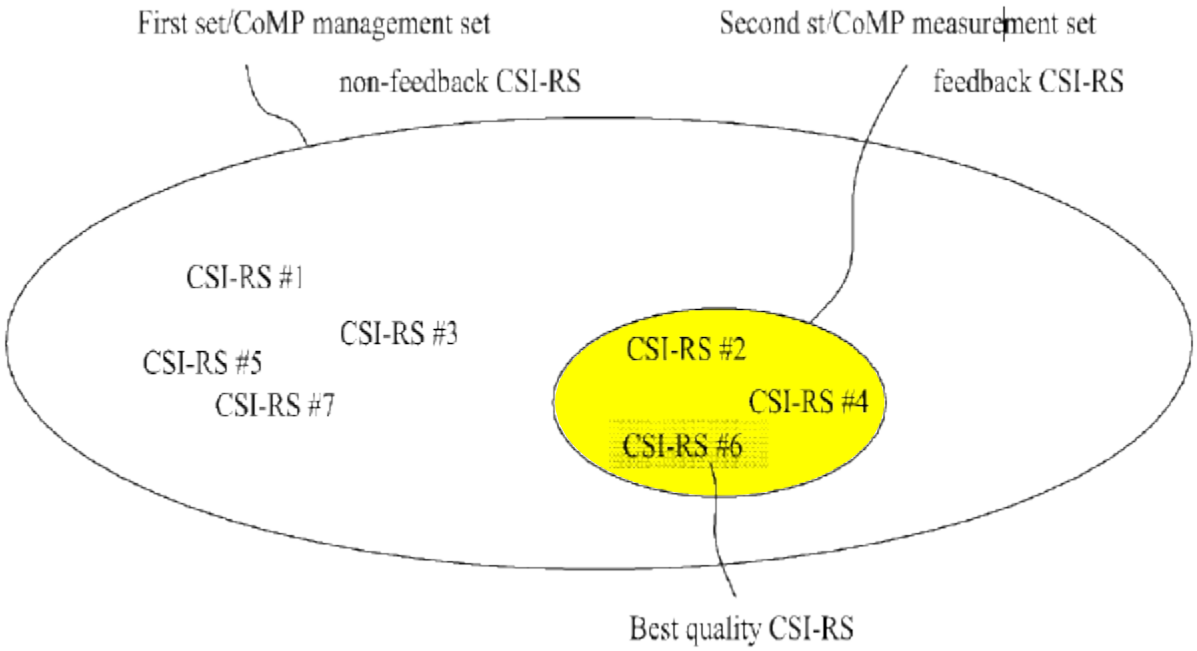
"indicates the number of antennas needed for CSI-RS transmission (for example, one, two, four, or eight antennas may be selected),")." and "resourceConfig-r10" that "indicates which RE [Resource Element]" is transmitting the CSI-RS.] of a single RB [Resource Block] is located on time-frequency frequencies …." *Kim*, [0079]-[0081], Table 3; Kakaes ¶124. The base station uses this signaling. This information is used by the base station to "designate[] a plurality of configurations of CSI-RSs" to be measured and used to "inform[] the UE" of the CSI-RSs to be measured.measurement set." *Kim*, [0119], [0111],] (the base station "sets configurations of CSI_RSs each of which will perform RSPR [sic: RSRP] or RSRQ measurement to a CoMP measurement set, and informs the UE of the resultant configurations"), [0137] ("the 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]" and "[a]ll the antenna ports or a plurality of antenna ports for a specific CSI-RS configuration are used for RSRP measurement"), [0142] ("the BS or eNB may inform the UE of specific information through RRC signaling" to indicate CSI-RS configuration. The specific information indicates whether the CDM-processed antenna port pair is transmitted through a CSI-RS configuration in which only the corresponding antenna port is established through the above RRC signaling"), [0143], [0146]-[0148] ("the quality of CSI-RS values each having the best quality can be reported, where M … may be previously designated by the BS through RRC signaling. The

UE may periodically report the

~~and antenna ports), [0143], [0146]-[0148] (~~quality of M CSI-RS ~~"previously designated by the BS through RRC signaling~~values" and "N, M, T1, and T2 may be signaled to the UE through RRC signaling~~")).~~" from the base station).

~~37.~~125. The antenna port groups specified for CRS or 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~~XI.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 (large 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] ("the BS sets configurations of [CSI-RSs] each of which will perform RSPR [sic: RSRP~~]...~~] or RSRQ measurement~~...~~, to a CoMP measurement set, and informs the UE of the resultant configurations~~,~~"" and the "UE ~~"~~may perform~~[s]~~ RSRP~~...~~ or RSRQ 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] ("the 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.

126. *Kim* discloses 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).

38.127. *Kim* discloses that each of the antenna portports transmitting the RS and CSI-RSsRS has a corresponding channel quality value, e.g.,such as RSRP. *Kim*, [0111], [0132], [0135], [0148] [0149].]. *Kim* explains that RSRP is measured in milliwatts (mW), which are

non-negative real numbers. *Kim*, [0135]; Kakaes ¶127.]. *Kim* explains that, "the UE performs RSRP measurement reporting of cells contained in the CoMP cluster including the UE" and that the base station "sets configurations of [CSI-RSs] each of which will perform RSPR [sic: RSRP] …, and informs the UE of the resultant configurations." *Kim*, [0111]. After receiving the configuration information used to determine the K antenna port groups, *supra* § V.A.1.fXI.A.1.f ([1d2]), *Kim*'sthe UE "perform[s] RSRP… or RSRQ measurement of CSI-RSs transmitted from cells contained in the CoMP management set" and reports thosethe antenna ports where "the measurement result satisfies a specific condition."," such as where the ratio of the RSRP if a particular port compared to the maximum received RSRP of the antenna ports being measured is greater than a threshold value. *Kim*, [0111], [0119], [0136], [0148]-[0149]. The

For example, the UE measures the RSRPall of the transmitted CSI-RSs RSRP in the "management set,"" of all transmitted CSI-RSs, 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.

128. *Kim*'s9. *Kim*, [0148]- [0149]. *Kim* explains that "the UE may report "not only indexes of a maximum of M CSI-RSs" from "among N CSI-RSs," where " (the RSRP ratio (RSRP_n/max(RSRP_i)")) of which is "higher than a predetermined threshold value" and ") from among N CSI-RSs contained in the CoMP management set, but also the RSRP estimation result of the corresponding CSI-

RS." *Kim*, [0149]. ~~To~~In order to determine the "maximum of M CSI-RSs" (~~reported~~ measurement set) from among the "N CSI-RSs" (management set), the UE ~~determines~~would

need to determine the RSRP (channel quality value), or RSRP, of each of the N CSI-RSs in the entire management set. *Kim*, [0111], [0148]-[0149]; Kakaes ¶128.]. As a result, *Kim*'sthe maximum M antenna port groups and total set of N antenna port groups in the management set ((alternatively, K antenna port groups)), each have channel quality RSRP values that are non-negative real numbers because they are measures of power, 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.

129. *Kim* discloses 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.

~~39.~~130. As explained in element [1d3], *Kim* discloses measuring K antenna port groups (e.g., ~~management set of~~ M or N antenna ~~ports~~port groups, where M<N) that have real, non- negative RSRP channel quality values. *Supra* § ~~V.A.1.g.~~XI.A.1.g ([1d3]). The ~~measurement set of M antenna port groups~~number M 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 of the M antenna ports (measurement set) correspond to the K1 antenna port groups that satisfy a threshold measurement. ~~*Kim*, [0111], [0136], [0149].~~*Kim*, [0111] ("the BS sets configurations of [CSI-RSs] each of which will perform RSPR [sic: RSRP] or RSRQ measurement to a CoMP measurement set, and informs the UE of the resultant configurations" and the "UE may perform RSRP or

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 those where "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 "not only indexes of a maximum of M CSI-RSs … from among N CSI-RSs contained in the CoMP management set," and ", but also the RSRP estimation result of the corresponding CSI-RS." *Kim*, [0149]. Because the reported CSI-RS antenna ports will be "a maximum of M" CSI-RS ports are reported," then the reported antenna ports will have a number less than or equal to M, which is itself less than or equal to N, because M is "a maximum" number selected "" from "among N" antenna ports. *Id.*; Kakaes ¶130. *Kim* thereforeport groups. *Kim*, [0149]. Therefore, *Kim* discloses K1 antenna port groups (M antenna ports being reported in measurement set) of the K antenna port groups having K1

(N antenna ports of management set) correspond to K1 channel quality values corresponding to the reported CSI- RSs of the K channel quality values (e.g., ~~M RSRP of~~ measured CSI-RSs, either of either M or N ~~CSI-RSs), where~~ antenna port groups); the K1 (M antenna port groups) is a positive integer less than or equal to the K (N~~). Kakaes ¶130.~~ antenna port groups).

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

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

131. *Kim* discloses that a first proportional sequence corresponds to a ratio(ratios) among the K1 channel quality values.

~~40.~~132. *Kim* discloses reporting the K1 antenna ports that satisfy "the RSRP ratio~~" of a received port~~ (RSRP_n/max(RSRP_i))" that "is higher than a predetermined threshold

value" when." *Kim*, [0149]; *see also* [0136]. In other words, *Kim* teaches that the RSRP of each received antenna port in the management set, RSRP_n, is determined and compared to the maximum received RSRP. *Kim*, [0149], [0136]; Kakaes ¶132.

in the management set, maximum RSRP_i, over all values of i, as a ratio, and reported back to the base station if the ratio is higher than the threshold value set by the base station. *Kim*, [0148]-[0149], [0136]. Specifically, the indexes and RSRP values "of a maximum of M [CSI-RSs] configured to satisfy Equation 4 may be reported":," where Equation 4 is:

$$RSRP_n/\max(RSRP_i)>) > \text{Threshold}$$

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 the threshold ratio of Equation 4, the corresponding ratios comprise a the first proportional sequence among the reported (K1) channel quality RSRP values because they would be compared against the measured values to determine which a "maximum of M" that are above the threshold requirement to determine "a maximum of M" to be reported, thus creating a sequence. Kakaes ¶132. The *Kim* also states that this proportional sequence may be included in the measurement report value may includesent to the base station: "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]. Awhich a POSITA, would have

understood to be the RSRP values because "RSRP is defined as ~~Dr.~~the linear average… power contributions of REs that carry downlink" signals, such as CRS or CSI-RS. *Kim*, [0107], [0136]. "[T]he linear average… power

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 a POSITA to mean averaging the received power of the signal in the Resource Elements, thus RSRP, for a particular transmitting antenna port. *Kim*, [0107], [0136]; Kakaes ¶132 (if there is more than one RE for a particular transmitting antenna port), wherein the average is computed using the linear units, e.g., mW, as discussed above.

41.133. During I understand that, during prosecution of the '271 patent, the applicant argued that "the purpose of 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 here 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. In *Kim*, all of the M reported antenna ports all have RSRP ratio values that that satisfy the RSRP ratio threshold of Equation 4. Kakaes ¶133. —that is, the proportional sequence comprising the set of M antenna ports all have RSRP ratios above the threshold value of Equation 4. In such cases K1 has the same value as *Kim*'s M. *Id.*; *Kim*, [0148]-[0149],]; *see also* [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.~~

134. *Kim* discloses that the first information is used to determine the K1 antenna port groups and the first proportional sequence.

~~42.~~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 is determined (and optionally reported) using the RSRP values based on the ratio of values compared with the maximum RSRP value by, for example, applying *Kim*'s Equation 4. *Supra*

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.§ XI.A.1.i ([1d5]).

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

43.136. *Kim* discloses or suggests, or alternatively the combination of *Kim* and *Chen* renderrenders obvious, element [1d7]. Kakaes ¶¶136-143that the first signaling is used to determine a target threshold; the target threshold is a non-negative real number.

44.137. *Kim* discloses that the RSRP-to-max(RSRP) ratio of each of the CSI- RS RSRP valuevalues is compared to a threshold value. *Kim*, [0149]; Kakaes ¶137; *cf.see also* *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 (RSRP_n/max(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": RSRP_n/max(RSRP_i)>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

(RSRP_n/max(RSRP_i)) of which is higher than a predetermined threshold value) from among N CSI-RSs contained in the CoMP management set" and "the RSRP estimation result of the corresponding CSI-RS." *Kim*, [0149]. Specifically, *Kim* reports the "indexes of a maximum of M CSI_RSs configured to satisfy Equation 4": RSRP_n/max(RSRP_i)>Threshold. *Kim*, [0149]. 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. *Kim*'s threshold is a non-negative real number because it corresponds to the "linear value" in milliwatts (mW), against which a ratio of two non-negative real numbers is compared. *Kim*, [0135]-[0136] For the comparison of being "greater than" (as shown in Equation 4) to be meaningful, the right-hand side would be a non-negative real number just as the left-hand side of Equation 4 is. Furthermore, a POSITA would have understood that the equation is only limiting if the threshold is a non-negative number. If the threshold were not non-negative, then the inequality would always be satisfied, rendering the entire exercise of computing such ratios meaningless and/or redundant. Thus, *Kim*'s "threshold' would have been understood by a POSITA to be a non-negative real number as claimed. *Kim*, [0135]-[0136].

138. *Chen*'s discloses, like *Kim*, ~~discloses a~~teaches "channel information feedback method, and pilot and beam transmission methods." *Chen*, Abstract. ~~In~~ For example,

Chen, discloses that "a base station transmits M types of pilot signals…, the M types of pilot signals corresponding to M pilot ports respectively"; and "the base station configures, through signaling, N pilot ports in the M pilot ports for a terminal [UE]." *Id. Chen*'s "], M being a positive integer and N being a positive integer less than M; and the 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. and the terminal." *Chen*, Abstract. *Chen* explains that the pilot signals are CSI-RS, like in *Kim*. *Chen*, *Chen*'s 2. The channel information sent by the UE to the base station includes "information of the K pilot ports," an "amplitude ratio information between the K pilot ports," and "received power information of the K pilot ports," which a POSITA would have understood discloses sending back the same port indices and RSRP information as described in *Kim*. *Chen*, 3. When the UE selects the K antenna ports, it does to "according to a power threshold," such as configured by the base station," which may be "a relative threshold" (e.g., RSRP ratio), "configured by the base station."." *Chen*, 4, 5, 7, 9, 14, 19, 22, 24. *Chen* also explains that configuring the pilot signals occurs "through signaling" at the base

station, like *Kim*. *Chen*, Abstract, 11, 18, 21, 23. 15 (reporting antenna port *Chen* also, like *Kim*, compares the "received power" (RSRP) to "the maximum received power" (maximum RSRP), and "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.", it is determined *Chen*, Abstract, 11, 18, 21, 23. A POSITA would have

understood that a the pilot port corresponding to the received power threshold "configured by the base station" "through signalingis a port of a first type" and used by the UE to select antenna "ports describesof the UE determining the threshold using the signaling to identify the configured thresholdfirst type are selected from the base station. Kakaes ¶138N pilot ports" by the UE. *Chen*, 15.

45.139. A POSITA reading *Kim* and *Chen* would have found it obvious to use the first signaling to determine a target threshold, for. For example, it would have been obvious 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*Kim* where the base station transmits 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,for determining antenna ports from a selection of pilot or reference signals, *Kim*, [0163]; *Chen*, Abstract, 11, 18, 21, 23; *Liu*, 16-17, 22-23 ("threshold" or selection "criterion" may be "provided through base station broadcasting" to the UE and the base station "configures" thresholds and criteria "by broadcasting information, high-layer signaling, or dynamic signaling").

22-23.

i. Motivation to combine

~~46.~~140. 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, by having the ratio threshold "configured by the base station" and broadcast to the UE through signaling~~.~~, as taught by *Chen*. *Chen*, Abstract, 4, 5, 7,9, 11, 14, 18, 19,

21~~-~~, 22, 23, 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 to be well known to a POSITA by *Liu*, which also teaches that ~~transmitting~~ "threshold[s]" and "criteri[a]" for the UE selecting antenna ~~port~~ports corresponding to pilot or reference signals (such ~~*Kim*'s and *Chen*'s~~as the CSI-RS of *Kim* and *Chen*) 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.~~").

~~47.~~141. A POSITA would have been motivated to configure *Kim*'s system such that the first signaling is used to determine a target threshold, as taught by the combination of *Kim* and *Chen*, 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 to the UEs to select only those signals that are proportionally strong to ~~help~~aid the base station ~~achieve~~in achieving optimal performance and consistency across each of the transmissions to the various UEs because the base station knows that the reported results will be sufficient for its system balancing and scheduling. ~~*Id.*~~

~~48.~~142. A POSITA would have recognized that ~~such~~the system would select only signals having a desired comparable strength~~,~~ to the strongest signal, as determined from the base station's signaling, which ~~improves~~ would have improved

transmission and

data transfer ~~because the~~and thus improved the overall integrity and reliability of the system. For example, it would have improved data transfer over a particular transmission beam ~~is~~ (e.g., antenna port group beam) because data throughput had been shown to be generally proportional to the ~~received signal strength. Kakaes ¶142; *see*~~RSRP and SNR in LTE systems, such as *Kim* and *Chen*. *See* Ex. 1021, *Afroz*, 115, 118, 120, 122, FIG. ~~7.~~7 (explaining that throughput increases as SNR increases and RSRP is on the average proportional to SNR). This improves the overall integrity and reliability of the system. Knowing that the strength of each received antenna port ~~group~~group's signal selected by the UE is within a certain relative ~~signal strength~~ threshold of the maximum RSRP strength would have allowed for better transmission scheduling by the base station to support consistent transmission amounts over multiple beams. ~~Kakaes ¶142; *see*~~*See Afroz*, 115, 118, 120, 122, FIG. ~~7; *Chen*, 1;~~7 (data transmission is generally proportional to signal strength); *Park*, [93]-[94~~] (~~], [405] (confirming that MIMO systems "collect[] a plurality of data pieces received through a plurality of antennas~~"), [405].~~"). Thus, ~~using~~allowing the first signaling to be used to determine the target threshold, ~~e.g.,~~such as the relative power threshold~~,~~ for antenna port selection at a particular base station ~~(~~, as taught by *Chen*, and confirmed to be well known to a POSITA by ~~*Liu*),~~*Liu*'s teachings, would have been recognized by a POSITA as improving overall system performance and data transmission in *Kim*'s MIMO system. ~~Kakaes ¶142.~~*See Liu*,

16-17, 22-23 (“threshold” or selection “criterion” may be “provided through base station broadcasting” to the UE and the base station

"configures" thresholds and criteria "by broadcasting information, high-layer signaling, or dynamic signaling"). A POSITA would have recognized that dividing data across multiple transmissions with strengths determined by base station configurations, such as determined from signaling, 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 by means of a plurality of antennas in a spatial multiplexing manner" and data throughput~~. Kakaes ¶142;~~ has been shown to be generally proportional to the signal strength (e.g., RSRP and SNR) in LTE systems. *Chen*, 1; *Afroz*, 115, 118, 120, 122, FIG. 7; *see also* *Park*, [93]-[94], [405].

ii. Expectation of success

~~49.~~143. 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 to be well known to a POSITA by *Liu*. ~~Kakaes ¶143.~~ Transmitting threshold and criteria information through signaling, such as *Kim*'s first signaling was well known to POSITAs. ~~*Id.*;~~ *Chen*, Abstract, 11, 18, 21, 23; *Liu*, 16-17, 22-~~2~~23 (selection thresholds "provided through base station broadcasting~~")3.~~"). It was also well known ~~to use~~that the antenna port selection thresholds (e.g., target thresholds) were RSRP-to-max(RSRP) thresholds. *Kim*, [0136], [0148]-[0149]; *Chen*, 14-15; *Liu*, 16-17,

22-23 (selection thresholds "provided through base

thresholds as antenna port selection thresholds (e.g., target thresholds). *Kim*, [0136], [0148]-[0149]; *Chen*, 14-15; *Liu*, 16-17, 22-23;station broadcasting"); *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 and configuration information from a base station to a UE so the UE can use the signaling to determine the threshold) 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.so the UE can determine the threshold using the signaling).

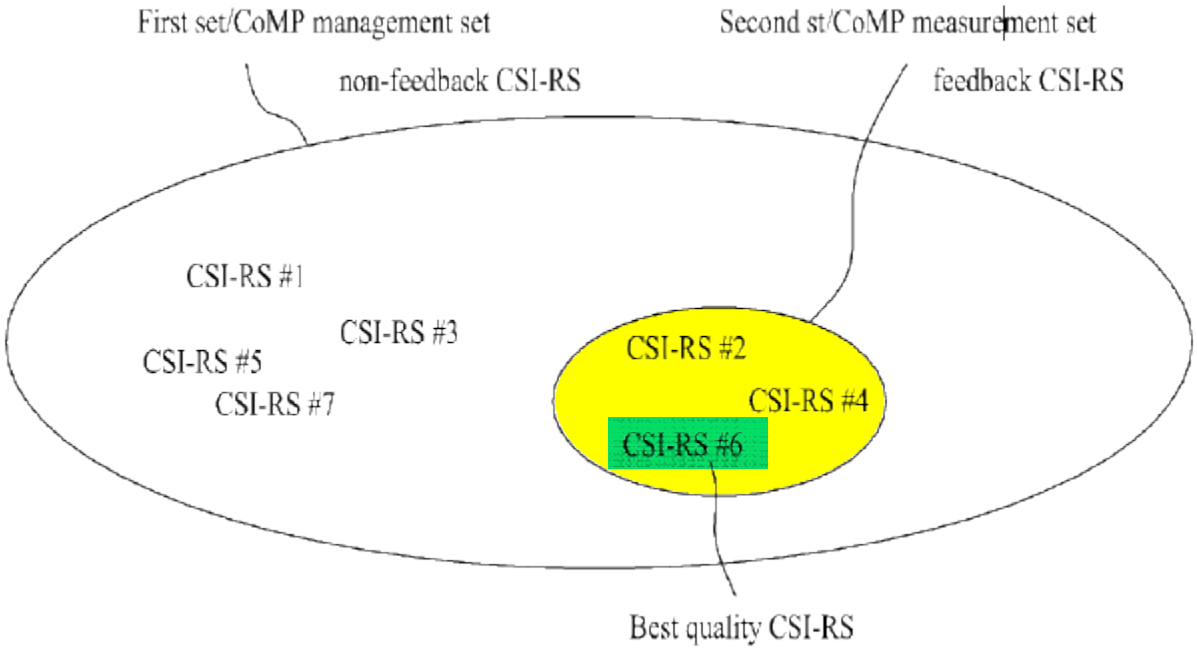
l. [1d8] "a first channel quality is a best channel quality value among the K1 channel quality values; a second channel quality is a worse channel quality value among the K1 channel quality values;"

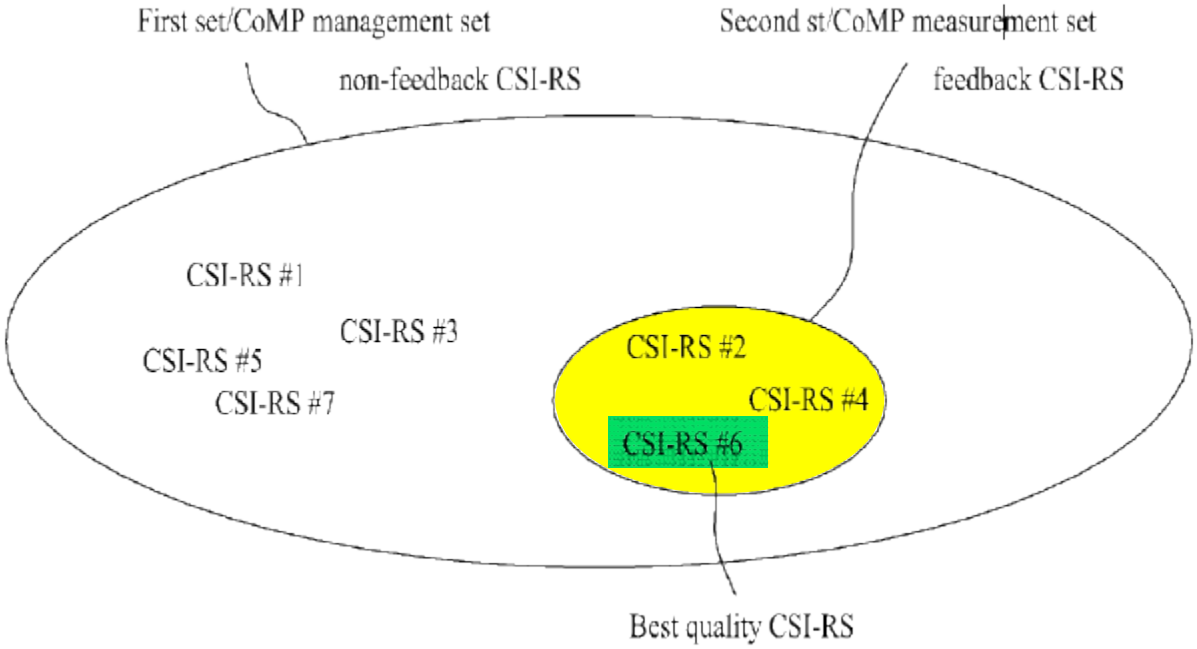
Kim discloses element [1d8]. Kakaes ¶¶144-146.

144. *Kim* discloses a first or "best" channel quality, e.g., 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.

50.145. *Kim* discloses a first channel quality that is a best channel quality, such as a "max(RSRP_i)" or "the 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~~the M (K1) antenna port groups because the maximum ratio of *Kim*'s ~~Equation~~equation 4 would be when, for some value of "n", RSRP_n is the same as max(RSRP_i). ~~Kakaes ¶145.~~For example, *Kim* identifies the ~~"[b]est~~"Best quality CSI-RS" (**green**) in FIG. 9 of the measurement set of CSI-RS (**yellow**), as shown below.





Kim, FIG. 9 (annotated~~); Kakaes ¶145.~~).

~~51.~~146. Kim discloses a second ~~or "worse"~~ channel quality that is a worse channel quality value among the selected M (K1) antenna ports, such as ~~when~~ some value of "n" for which RSRP_n value is less than max(RSRP_i~~) and~~), but such that

the ratio of RSRP_n/max(RSRP_i) is greater than the threshold value of Equation 4, 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," ~~(~~which is plural~~), which~~ and a POSITA would have ~~been~~ understood ~~is a~~that plural signifies 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.~~

147. *Kim* discloses that a ratio between the second [worse] channel quality and the first [best] channel quality is greater than or equal to the target threshold.

As explained for elements [1d5]-[1d8], *Kim* discloses that a ratio between the second ("worse~~")~~" in claim 1) channel quality (RSRP_n) and the first ("best~~")~~" in claim 1) channel quality (max(RSRP_i)) is greater than ~~Equation 4's~~the target threshold in Equation 4. *Supra* §§ ~~V.A.1.i-~~

~~52.~~148. ~~V.A.1.l~~XI.A.1.i-XI.A.1.l ([1d5]-[1d8]); *Kim*, [0136], [0148]-[0149]. A POSITA would have understood that RSRP_n is a second, or "worse," channel quality (e.g., CSI-RS #2 or ~~#4) is a second ("worse") channel quality,~~CSI-RS #4 in FIG. 9), but the ratio of 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~~because the ratio is greater than the threshold of Equation 4, but RSRP_n is not equal to max(RSRP_i) (e.g., CSI-RS #6~~). *Kim*, [0136], [0148] [0149]; Kakaes ¶148~~, which is the "best quality CSI-RS" in FIG. 9). *Kim*, [0136], [0148]-[0149]. A POSITA would have recognized that CSI-RS #2 and #4 are above Equation 4's threshold ratio, because they are included in the measurement set (e.g., K1 antenna ports being reported), but are not the "Best quality CSI-RS," or highest RSRP value, of CSI-RS #6, and thus would have a lesser ratio value that still satisfies the threshold equation. *Kim*, [0136], [0148]- [0149], FIG. 9.

~~1.~~2. Claim 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)."

149. For the reasons discussed above, the combination of *Kim* and *Chen* ~~render~~ renders obvious claim 1.

~~53.~~150. Claim 2 recites five alternative options separated by "or." ~~Satisfying~~A POSITA would have understood that satisfying any one of these options satisfies the requirements of claim 2~~. *Brown v. 3M*, 265 F.3d 1349, 1351 (Fed. Cir. 2001).~~, which I understand is consistent with legal standards.

~~54.~~151. *Kim* discloses ~~that~~ the first proportional sequence ~~comprises~~comprising K1 ratios of positive real numbers less than or equal to 1, and the first proportional sequence ~~comprises~~comprising at least one 1. ~~Kakaes ¶¶151-152.~~

~~55.~~152. As explained for elements [1d5]-[1d9], *Kim* discloses a proportional sequence of M (K1) RSRP-to-max(RSRP) ratios using Equation 4 (RSRP_n/max(RSRP_i~~)~~)) that results in values that are positive real numbers less than or equal to 1~~. *Supra* §§ V.A.1.i-V.A.1.m. When~~ for values of RSRP_n ~~is~~ less

than max(RSRP_i), ~~but still satisfies Equation 4 (e.g., CSI-RS #2 or #4 of FIG. 9),~~and results in a value of 1 when the ~~ratio will be a positive real number less than 1.~~ ~~Kakaes~~max(RSRP_i) is compared to itself. *Supra* §§ XI.A.1.i-¶152;

XI.A.1.m ([1d5]-[1d9]). When RSRP_n is less than max(RSRP_i), but still satisfies Equation 4 (for example, CSI-RS #2 or #4 of FIG. 9)_, the ratio will be a positive real number less than 1. *Kim*, [0135]-[0136], [0148]-[0149]; *see also* *Chen*, 14-15. Similarly, when max(RSRP_i) is compared to itself (e.g.,for example, CSI-RS #6 inof FIG. 9), the ratio value in the proportional sequence will be 1. Kakaes ¶152; *Kim*, [0135]-[0136], [0148]-[0149]; *see also* *Chen*, 14-15.

AdditionallyIn addition, *Chen* also renders obvious that the first proportional sequence comprises quantized values corresponding to K1 positive real numbers. Kakaes

56.153. ¶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" is determined (e.g., *Kim*'s RSRP_n/max(RSRP_i)), the UE's feedback to the base station includes) power ratio), "a pilot port with the highest power" (e.g., *Kim*'s CSI-RS #6) is indicated, and a ratio of an indicator of each reported antennaamplitude or power of a pilot port relative to that of the antennapilot port with the highest power (e.g., *Kim*'s CSI-RS #2 and #2 relative to #6).is fed back" to the base station by the UE. *Chen*, 17. For example, a POSITA would have understood that this describes reporting Kim's "Best quality CSI-RS," CSI-RS #6 of FIG. 9, In such reporting, "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.*~~*Chen*, 17. A POSITA would have recognized that this quantization of the magnitude ~~quantization describes~~order is a quantization of the ratio of the reported proportional sequence of the measurement set, such as RSRP or proportional sequence, that

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

~~¶153. *Chen*~~ *Chen* teaches that in addition to reporting the indices of the M antenna ports and the RSRP of the CSI-RS of the M antenna ports, as in *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 in Table 4 correspond to positive real ~~numbers~~number, as shown below, which also would have been understood from ~~*Kim*'s disclosure~~*Kim*, which discloses that the power ratio is a positive real number. *Chen*, 14-15, ~~17-18,~~ Table 4; *Kim*, [0135]~~] []- [~~0136], [0148]-[0149]~~; Kakaes~~].

~~¶153.~~

***Chen*'s bit sequence**	***Chen*'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

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

i. Motivation to Combine

154. A POSITA would have been motivated to send the quantized ratios of ~~*Kim*'s~~the M (K1) selected antenna port groups of *Kim* to simplify reporting because the quantization ~~limits~~would limit the number of reported bits ~~used in reporting (e.g.,~~

~~*Chen*'s~~ (such as the 2-bit-based reporting~~).~~ system shown in *Chen*'s Table 4). *Chen*, 17-18, Table 4~~; Kakaes ¶154. Quantizing~~. By quantizing the ~~reported~~ ratio ~~would have made the~~ reporting, such as to the 2-bit-based quantization disclosed in *Chen*, the amount of data transferred in the uplink and feedback and measurement report sent

from the UE to the base station can be made more efficient, thereby allowing either reduced bandwidth needed to handle the reporting, or allowing for more information to be reported within a particular measurement report. ~~Kakaes ¶154.~~ ~~A~~By quantizing with a fixed number of steps determined by bits (e.g., *Chen*'s 2-bit sequence for four quantized intervals), a POSITA would have recognized that the reported values would have known allocations within the measurement report, and a POSITA would have been motivated to use this quantization because it would have made it possible to know how many bits must be allocated to a value to structure the measurement report transmission. If the reported sequence were not quantized, a POSITA would have recognized that the reported number may vary, which makes transmitting more difficult for the UE because it does not have a fixed allocation of bits, and the base station, because it must receive different length reporting value. Therefore, a POSITA would have been motivated to use *Chen*'s quantized ratio reporting and to include it in *Kim*'s measurement report to the base station 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

~~57.~~155. A POSITA would have had a reasonable expectation of success in implementing *Chen*'s quantized values of positive real numbers, as recited in

claim

2. Kakaes ¶155. Transmitting values in quantized valuesform was well known to POSITAs to limit the amount of reported data based on the number of bits allocated to the quantization. *Id.*;a particular quantized reporting. *Chen*, 14-15, 1, 12; *see Sesia LTE*, 390-391 (quantization of codebook configurations), 663 (reporting "quantized" valuesUE reports "quantized representation of the physical CSI" and reporting quantized vectors "to reduce the overhead to a reasonable level"). ReportingIndeed, quantized reporting of 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 (reporting RSRP values quantized into 1dBm96 intervals, each interval being 1dBm). 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) usedreporting a quantized value, for example with a specific bit sequence to represent a quantized value) used according to their known functions to yield predictable results (transmitting a quantized version of a value, for example, to reduce overhead).

~~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.~~

~~2.~~3. Claim 3:

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

156. For the reasons discussed above, the combination of *Kim* and *Chen* ~~render~~ renders 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;"

~~58.~~157. *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.~~

~~59.~~158. *Kim* teaches that 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* 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 ~~"~~may be predetermined or may be previously designated by the BS through RRC signaling"). *Kim* also explains that "[i]f there is a change in the list of the selected M CSI-RS values, measurement report may be attempted." *Kim*, [0146]. Similarly, "[i]f M CSI-RSs are changed, the report triggering may be performed," which a POSITA would have understood ~~describes~~as describing 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~~),~~) through RRC signaling to the UE, the UE may determine a new set of antenna port groups (K2) based on the new signaling~~. Kakaes ¶158;~~ up to

the maximum value of M. *Kim*, ~~[0146], [0148] [0149]. Because the reported CSI-RS~~

[0146], [0148]-[0149]. Because *Kim*'s reported CSI-RS will be "a maximum of M," the value of M (K2 antenna ports in claim 4) will be less than or equal to N (K antenna ports in claim 3) because M is selected from "among N" antenna port groups~~.~~ transmitting the CSI-RSs. *Kim*, [0149~~]; Kakaes ¶158.~~].

~~60.~~159. 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~~selecting a second set ~~(K2)~~ of antenna ports, K2, "[i]f the reporting is not triggered during a predetermined time (T2), the report triggering may be performed" to identify a second set (K2) 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.~~].

~~61.~~160. As explained above, the new measurement set being reported (K2 antenna ports~~) has~~ in claim 3) would have channel quality values in the configured set of N antenna ~~ports~~port groups (K antenna port groups in the claims) having channel quality values~~.~~ because the measurement set is a subset of the N antenna port groups. *Supra* § ~~V.A.1.h~~XI.A.1.h ([1d4]). ~~A~~For example, a POSITA would have found it obvious to select the K2 antenna port groups ~~to allow~~because it would have allowed the UE to optimize the data transmission, for example, by

selecting the M antenna ~~ports~~port groups (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 port(s) having higher

signal strength(s), which would improve transmission quality to the UE, as explained above. ~~Kakaes ¶160;~~ *Chen*, 1; *Afroz*, 115, 118, 120, 122, FIG. 7; *see Park*, [93]-[94], [405].

Additionally

62.161. In addition, 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, for example, 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 portsport groups to optimize the transmission from the base station. Kakaes ¶161 to the UE. *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. Similarly, 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. *Kim*, [0148]; *Sesia LTE*, 75.

¶161.

162. A POSITA would have found it obvious to select the K2 antenna port groups because it would have allowed the UE to optimize the transmission of data

to the UE through antenna port selection, for example, to select among the M antenna port groups (if M has changed) or to account for differences in RSRP values at a subsequent time T2, as explained above. *Liu* explains why multiple, different groups of antenna ports may be selected: "cross-polarized antennas may be selected for SU [single-user] because such antennas have low correlation, which aids spatial multiplexing; in the case of MU [multi-user] matching, each user optimally should select co-polarized antennas because they facilitate each user's beamforming," which a POSITA would have recognized as selecting two beamformed groups, based on the RSRP values discussed above to ensure sufficient power of the transmission, and possibly other factors, such as SU or MU requirements, as described in *Liu*. *Liu*, 29, 20. A POSITA would have been motivated to do this to improve data transmission in an ever-changing RF environment, such as capitalizing on having a higher signal strength, as explained above. *Chen*, 1; *Afroz*, 115, 118, 120, 122, FIG. 7; *see also Park*, [93]-[94], [405]

~~63.~~163. A POSITA would have reasonably expected success in selecting the K2 antenna port group signals having channel quality values because ~~it is~~such subset comprises a subset of the K channel quality values (RSRP~~),~~) determined for the received signal, as explained ~~in~~for [1d3~~][~~] and [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;"

~~64.~~164. *Kim* discloses that a second proportional sequence corresponds to a ratio(ratios) among the K2 channel quality values. ~~Kakaes ¶¶164-165.~~

~~65.~~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~~XI.A.1.i-~~V.A.1.m~~XI.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;"

~~66.~~166. *Kim* discloses, or the combination of *Kim* and *Chen* ~~render~~renders 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 the a "precoding matrix" is used to transmit signals, e.g., data, over the CSI-RS antenna ports for the CSI-RS 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." *Kim*, [0144]. *Kim* also notes that "the average Rx power level of thea data channel related to the corresponding CSI-RS may be reported." to the base station. *Kim*, [0144] [0145]. That is, *Kim* explains that the precoding matrix is used to transmit data through the selected antenna ports, which *Chen* confirms.

67.167. Kakaes ¶167; *Chen*, 2 (" explains that "a channel matrix" such as *Kim*'s precoding matrix, "correspond[s] to each transmission resource" and includes "precoding vector[s]" for the receivedreceives CSI-RSs). *Chen*, 2. 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 havinghave corresponding receiving beamforming vectors. *Sesia LTE*, 253; Kakaes ¶167.. Thus, a POSITA would have recognized that *Kim*'s*Kim* and *Chen*'s beamforming matrices describe both transmit and receive beamforming vectors for the selected antenna ports. Kakaes ¶167.

68.168. *Chen* further explainsalso discloses that "channel statistic

information~~"~~ is information of a correlation matrix" is sent from the UE ~~also~~to the base station and includes "characteristic vectors of the correlation matrix~~" (e.g.,"~~ such as "DFT vectors" or "Kronecker products $f(v_k, v_l$~~")~~) of the DFT vectors," that are assigned to each of the

transmitting antenna ports. *Chen*, 4. Thus, when the UE reportsfeeds back the vectors information to the base station, new beams are constructed from the selected antenna ports "according to a channel correlation matrix fed back by the [UE],"terminal" and the base station "transmits the P new beams to the [UE]."terminal." *Chen*, 9, 20, 21, 25.

69.169. The base station may then use ""take 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 of the UE that are then used to transmit on the selected antenna ports. Kakaes ¶168-169; *Sesia LTE*, 253. A POSITA would have recognized that a different sub-matricesmatrix of vectors would have been provided by the UE to the base station for each of the K1 and K2 antenna port groups with the measurement report(s)), and, therefore, would have been different receiving beamforming vectors. Kakaes ¶169.

70.170. *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) becausethat "beamforming is configured differently for each antenna port." so that the UE can measure the RSRP for each transmission beam." *Park*, [359]; Kakaes ¶170; *see also Vitthaladevuni*, [0005]. In other words, *Park* confirms *Kim*'s and *Chen*'s descriptions that each port group (e.g., K1 and K2) would have its own different receiving beamforming vectors (and corresponding matrices) to account

for the differences in the antenna port beams.

~~71.~~171. 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 transmission through the antenna port groups, where each of the first and second beamforming vectors are different to optimize the transmission signals to the UE, as taught by *Kim* and *Chen*. ~~Kakaes ¶171.~~ A POSITA would have been motivated to ~~utilize~~provide for receiving beamforming vectors to improve the gain of the ~~received~~and reception of the 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 each of the K1 and K2 antenna port groups. *See* Ex. 1021, *Afroz*, 115, 118, 120, 122, FIG. 7.

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

72.172. 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 receiving beamforming vector and the second receivingreceive beamforming vectorsvector are different. Kakaes ¶172. Transmitting a wireless signals usingsignal from multiple antenna portsport 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. *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].11, 18; *Liu*, 1, 16, 18; *Park*, [206], [208], [205]-[222]; *Sesia LTE*, 155, 167, 169, 654; *supra* § VI (Technology Background). Beamforming was a conventional operation known to POSITAs through the use of precoding matrices, and indeed,

receiving beamforming vectors ~~were~~are "simple concepts" known to ~~POSITAs~~a POSITA. *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 those described in *Kim* and *Chen*~~,~~ that applies only known, conventional functions (using precoding matrices containing beamforming vectors ~~to form transmission~~for forming beams at the antenna port groups) used according to their known functions to yield predictable results (directing and receiving the beams based on the vectors).

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."

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

74.174. 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.jXI.A.1.j ([1d6]), XI.A.3.c ([3b]).

~~V.A.3.c ([3b]); Kakaes ¶174.~~

~~3.~~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,~~co- located or quasi-co-located (QCL), and any two antenna ports in the K2 antenna port groups are ~~on a same carrier….~~"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."

175. For the reasons discussed above, the combination of *Kim* and *Chen* ~~render~~ renders obvious claim 3.

~~75.~~176. Claim 4 recites three alternative options, separated by "or." ~~Satisfying~~As I indicated above in the context of claim 2, a POSITA would have understood that satisfying any one of these options satisfies the requirements of claim 4. ~~*Brown*, 265 F.3d at 1351~~As I also mentioned in the context of claim 2, it is my understanding that this is consistent with legal standards.

~~76.~~177. *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.~~For example, *Kim*

teaches a "single carrier frequency division multiple access" or "SC- FDMA."

Kim, [0039], [0002].

Kim also explains that the base station CSI-RSs can be "configured to perform coordinated cells [that] have *the same carrier frequency*," which simplifies processing byon the UEUE's side. *Kim*, [0170] (emphasis added); Kakaes ¶177.). A POSITA would thus have understood that , because "the same carrier frequency" is used,would be applied such 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. when "the same carrier frequency" is used. *Kim* confirms this, by describing "a plurality of contiguous subcarriers" for transmittingthe downlink transmissions from the base station to the UE and that the Resource BlocksBlock including the CSI-RSs having subcarrier (downlink signals) includes subcarriers frequencies. *Kim*, [0043], [0048], [0050], [0067], [0081]. The subcarriers are identified in the first signaling information sent from the base station to the UE. *Kim*, [0043], [0048], [0067], [0081]; Kakaes ¶177.]. *Sesia LTE* confirms athis understanding of *Kim* based on the POSITA's understanding ofknowledge reading *Kim*, explaining that a particular carrier frequency contains subcarriers within a particular carrier frequency bandwidth:, as shown below.

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 × 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

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 × 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~~ .

~~77.~~178. Thus, 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.

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.

4.5. 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."

78.179. For the reasons discussed above, the combination of *Kim* and *Chen* render obvious claim 3. renders obvious claim 3.

79.180. *Kim* and *Chen* render obvious the receiving of claim 5. Kakaes ¶¶179-186.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. The claim language does not require that the "target antenna group" be different from either 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 that it be "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.

80.181. Kakaes ¶181. *Kim* describes "explains that "embodiments of the present invention are described centering on the data transmission/reception relations between an eNode B and a user equipment." *Kim*, [0035]. When*Kim* explains that 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.]. The reference signals, e.g., CSI-RS, are used to determine the channel state of each corresponding antenna port. *Kim*, [0053]. *Kim*, for example, explains that a "purpose of [CSI-RS] transmission... in each cell is to perform CSI feedback... to be performed 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," which 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)),the RSRP ratio selection) 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.*Kim*, [0111] (emphasis added).

~~81.~~182. ~~Additionally~~Moreover, *Kim* also ~~describes performing~~ explains that a subsequent (second) measurement report ~~related to~~for the M or N (K) antenna ports designated by the base station, which

includes the K1 and K2 antenna ports, may be performed on the M or N (K) antenna ports, for example, if "reporting is not triggered during a predetermined time (T2)." *Kim*, [0148]. The second 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) transmitsis used to transmit the second wireless signal (CSI-RS) and is that is associated with the K1 antenna port group and the first proportional sequence. *Kim*, [0148]. In particular, A POSITA would understand from *Kim*'s disclosure that, after the first measurement report when theis performed, the UE is receiving a second measurement is performed. Kakaes ¶182; *Kim*, [0148].wireless signal, such as CSI-RS, corresponding to the original M port groups (K1 in the claims), and that the selection is associated with the K1 antenna port group and the first proportional sequence, thus including a target port group.

82.183. 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 "is further configured to determine[s] the N pilot ports according to channel statistic information fed back by the terminal [UE]," which includes "information of a correlation matrix" having," such as "virtualized precoding weights corresponding to the N pilot ports." *Chen*, 7, 9, 12; Kakaes ¶183. A POSITA . This description would have been understood this describesby a POSITA with

reference to FIG. 9, which shows 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~~*Chen*'s K antenna ports, described above) (**blue**), and that the base station then

~~¶183.~~

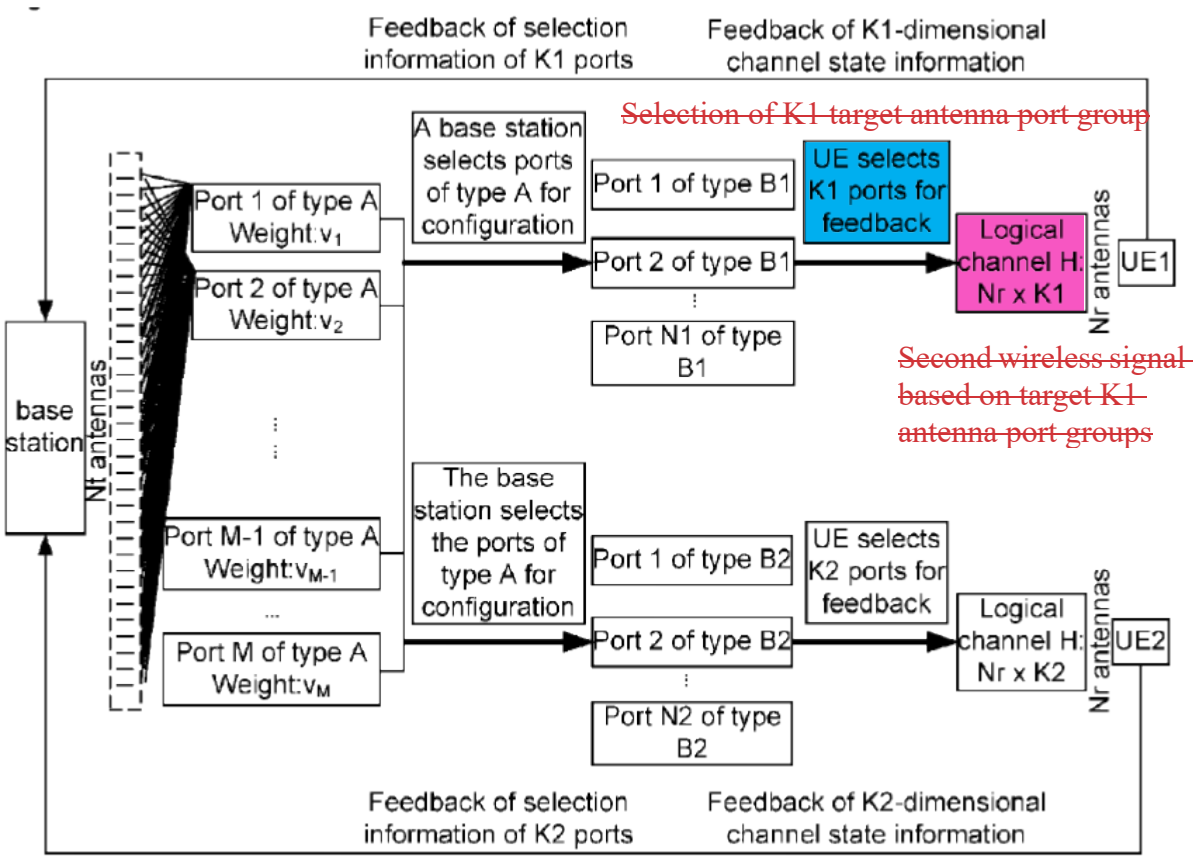


FIG. 9

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

~~*Chen*'s~~

transmits a second wireless signal to the UE using a channel (**pink**) associated with the K1 antenna port groups selected by the UE, as shown below. *Chen*, FIG. 9. Accordingly, *Chen*'s second wireless signal is associated with the UE's selected K1 antenna ports and the proportional sequence used to select the K1 antenna ports. *Chen*, FIG. 9.

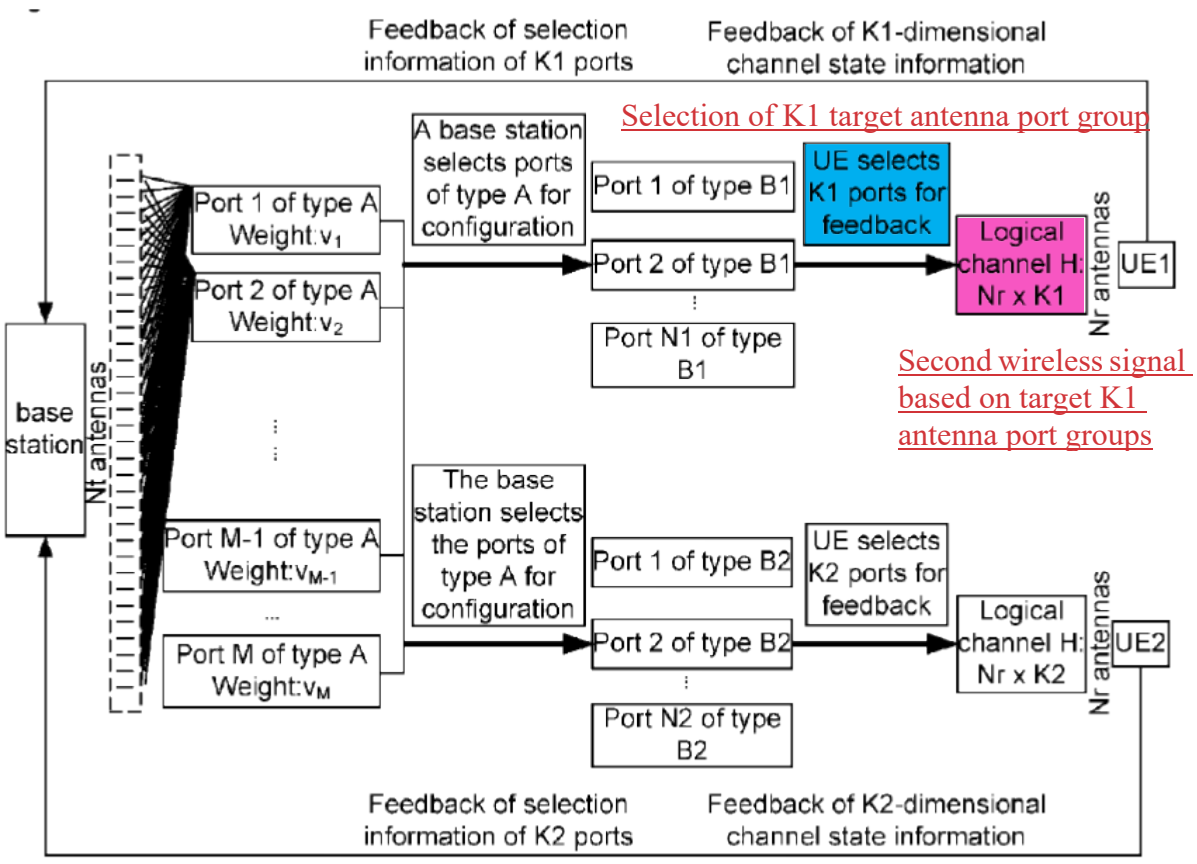


FIG. 9

Chen, FIG. 9 (annotated).

~~83.~~184. *Chen* confirms this with reference to 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 "may take~~[s]~~ a

channel correlation sub-

matrix of one terminal" and developsuse it to develop the new transmission beam(s)beams for the UE through matrix processing and beamforming. *Chen*, 20-21, FIGS. 11-12; Kakaes ¶184.. A POSITA would have understoodtherefore understand that the base station uses the channel information (e.g., matrix/ or sub-matrix) andof the K1 selected K1 antenna ports by the UE to the base station is used to configure the base station's subsequent transmission using the selected K1 antenna ports to the UE. Kakaes ¶184.

84.185. A POSITA would have found it obvious to incorporate *Chen*'s second wireless signal transmitted to the UE by the base station using a target antenna port group of the K1 antenna ports selected by the UE based on the UE's proportional sequence ratio analysis described in *Kim* and *Chen* to optimize the transmission. Kakaes ¶185. to the UE from the base station. A POSITA would have been motivated to transmit the second wireless signal using the target antenna port group of the base station to the UE, 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*Chen*, 1; *Afroz*, 115, 118, 120, 122, FIG. 7; *see also Park*, [93]-[94], [405]. ¶185; *Chen*, 1; *Afroz*, 115, 118, 120, 122, FIG. 7; *see Park*, [93]-[94], [405].

186. 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)), *supra* §§ XI.A.1.i-XI.A.1.m, XI.A.3 ([1d5]-[1d9], claim 3), 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.*; *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 "are selected by the UE and sent to the base station "so as to cause the [base station] to transmit data on these N antenna ports to the [UE]" using a second wireless signal); *Park*, [206],

[208], [205]-[222~~].~~]; *Sesia LTE*, 145, 167, 215, 254-255; *supra* § VI (Technology Background). Transmitting a second wireless signal using a target antenna port group of the base station

associated with the K1 or K2 antenna port groups and the respective proportional sequence would have been a straightforward operation of MIMO systems, such as those described in *Kim* and *Chen*, 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.

5.6. Claim 6:

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

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

85.188. To the extent the preamble is limiting, *Kim* discloses

[6Preamble] as discussed in [1Preamble]. *Supra* § ~~V.A.1.a; Kakaes ¶188.~~XI.A.1.a.

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

~~86.~~189. *Kim* discloses [6a] as discussed in [1a]. *Supra* § ~~V.A.1.b; Kakaes ¶189.~~XI.A.1.b.

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

~~87.~~190. *Kim* discloses [6b] as discussed in [1b]. *Supra* § ~~V.A.1.c; Kakaes ¶190.~~XI.A.1.c.

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

~~88.~~191. *Kim* discloses [6c] as discussed in [1c]. *Supra* § ~~V.A.1.d; Kakaes ¶191.~~XI.A.1.d.

~~**a. [6d] [6d1] - [6d9]**~~

e. ~~Limitations [6d1] - [6d9]~~] "wherein, K antenna port groups of the base station are ~~substantively identical~~used to ~~[1d1] - [1d9].~~ transmit the first wireless signal;"

192. *Kim* discloses~~,~~ or ~~alternatively~~ suggests, or the combination of *Kim* and *Chen* ~~render~~ renders obvious, [6d1~~] - [6d9~~] as discussed in [1d1~~] - [1d9~~]. *Supra* ~~§§§ V.A.1.e-V.A.1.m; Kakaes ¶¶192-200.~~XI.A.1.e.

~~**2. Claims 7-10**~~

f. [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;

193. *Kim* discloses [6d2] as discussed in [1d2]. *Supra* § XI.A.1.f.

g. [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);"

194. *Kim* discloses [6d3] as discussed in [1d3]. *Supra* § XI.A.1.g.

h. [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;"

195. *Kim* discloses [6d4] as discussed in [1d4]. *Supra* § XI.A.1.h.

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

196. *Kim* discloses [6d5] as discussed in [1d5]. *Supra* § XI.A.1.i.

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

197. *Kim* discloses [6d6] as discussed in [1d6]. *Supra* § XI.A.1.j.

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

198. *Kim* discloses or suggests, or the combination of *Kim* and *Chen* ~~render~~ renders obvious, [6d7] as discussed in [1d7]. *Supra* § XI.A.1.k.

l. [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;"

199. *Kim* discloses [6d8] as discussed in [1d8]. *Supra* § XI.A.1.l.

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

200. *Kim* discloses [6d9] as discussed in [1d9]. *Supra* § XI.A.1.m.

7. Claim 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)."

~~89.~~201. The combination of *Kim* and *Chen* renders obvious claim 6, as discussed above.

~~90.~~202. The additional limitations of ~~claims~~claim 7~~-10~~ are substantively identical to ~~claims~~claim 2~~-5~~, and are therefore disclosed by *Kim*, or rendered obvious by the combination of *Kim* and *Chen*, for the reasons discussed in claims 1~~-5 and 6.~~ ~~*Supra* §§ V.A.1-V.A.6; Kakaes ¶¶201-208.~~2 and 6. *Supra* §§ XI.A.1, XI.A.2, XI.A.6.

8. Claim 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."

203. The combination of *Kim* and *Chen* renders obvious claim 6, as discussed above.

204. The additional limitations of claim 8 are substantively identical to claim 3, and are therefore disclosed by *Kim*, or rendered obvious by the combination of *Kim* and *Chen*, for the reasons discussed in claims 1, 3, and 6. *Supra* §§ XI.A.1, XI.A.3, XI.A.6.

9. Claim 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."

205. The combination of *Kim* and *Chen* renders obvious claim 8, as discussed above.

206. The additional limitations of claim 9 are substantively identical to claim 4, and are therefore disclosed by *Kim*, or rendered obvious by the combination of *Kim* and *Chen*, for the reasons discussed in claims 1, 4, and 6. *Supra* §§ XI.A.1, XI.A.4, XI.A.6.

10. Claim 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."

207. The combination of *Kim* and *Chen* renders obvious claim 8, as discussed above.

208. The additional limitations of claim 10 are substantively identical to claim 5, and are therefore disclosed by *Kim*, or rendered obvious by the combination of *Kim* and *Chen*, for the reasons discussed in claims 1, 5, and 6. *Supra* §§ XI.A.1, XI.A.5, XI.A.6.

~~6.~~11. Claim 11:

~~91.~~209. Claim 11 is substantively similar to claim 1, ~~but recites the UE~~ except that it claims the user equipment itself performing ~~the~~ functions, rather than being a method~~. Kakaes ¶¶209-227~~ claim. Elements [11a]-[11c] recite a "first receiver," a "second receiver," and a "third transmitter" performing steps comparable to steps [1a]-[1c]. ~~Kakaes ¶¶211-218.~~ The above discussion for claim 1 describes why ~~the elements~~each element of claim 11 ~~are~~is taught or rendered obvious by the combination of *Kim* and *Chen*, although the specific "receiver[s]" and "transmitter" are ~~further~~ discussed in more detail below. *Supra* § XI.A.1 (claim 1). ~~*Supra* § V.A.1 (claim 1); Kakaes ¶¶209-227.~~

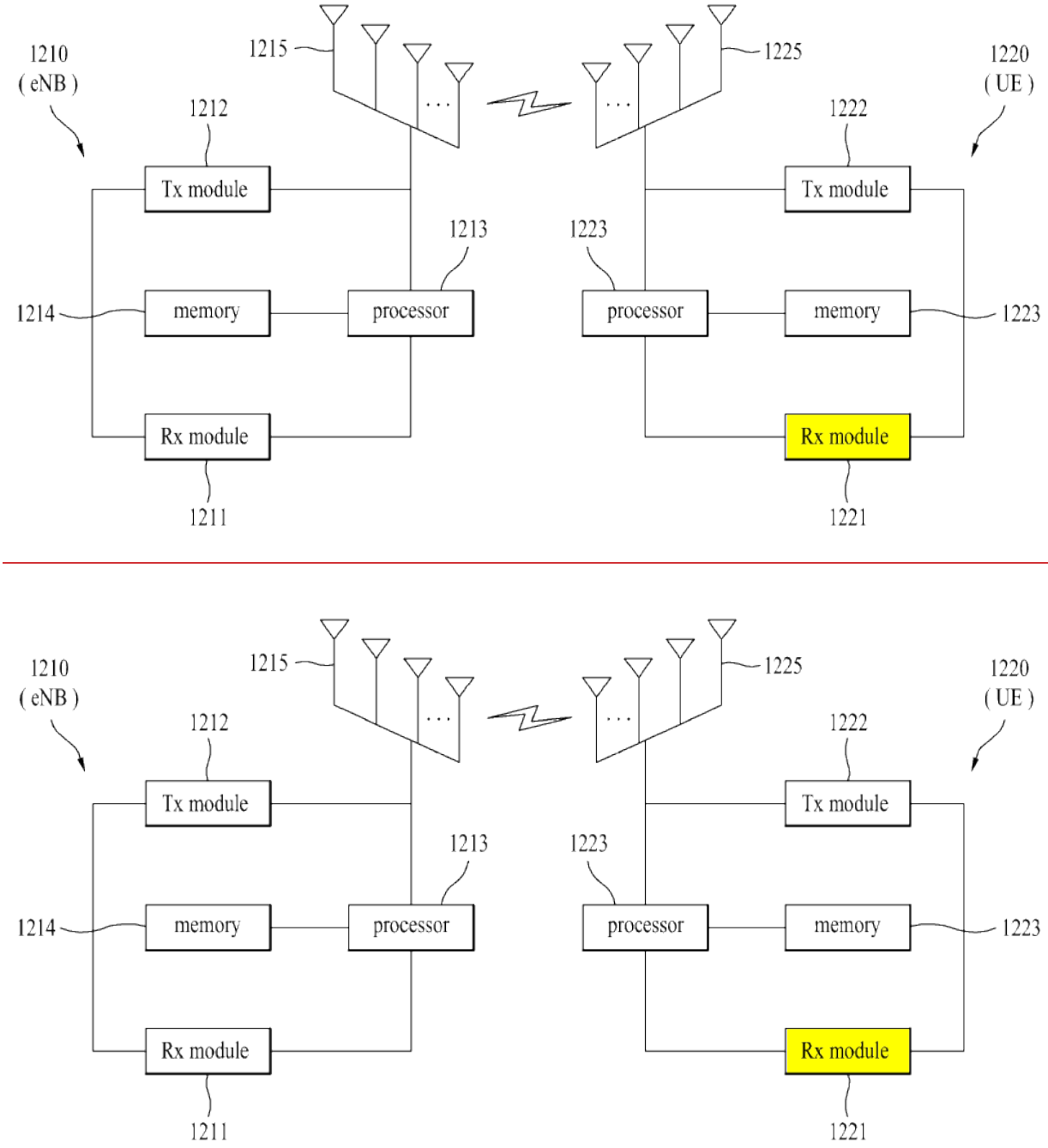
a. [11Preamble] "A user equipment (UE) for multi-antenna transmission comprising:"

~~92.~~210. To the extent the preamble is limiting, *Kim* discloses [11Preamble] as discussed in [1Preamble]. *Supra* § ~~V.A.1.a; Kakaes ¶210.~~XI.A.1.a.

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.~~

~~93.~~211. *Kim* discloses a MIMO receiver or receiving unit, as explained for [3c] and Section XI.A.1 (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~~XI.A.1.b-XI.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*.

~~94.~~212. ~~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 "~~." *Luo*, [0037]. "Each receiver 254 conditions (e.g., filters, amplifies, and~~ ~~downconverts) a respective received signal" at the UE, as shown below. *Luo*, [0037].~~

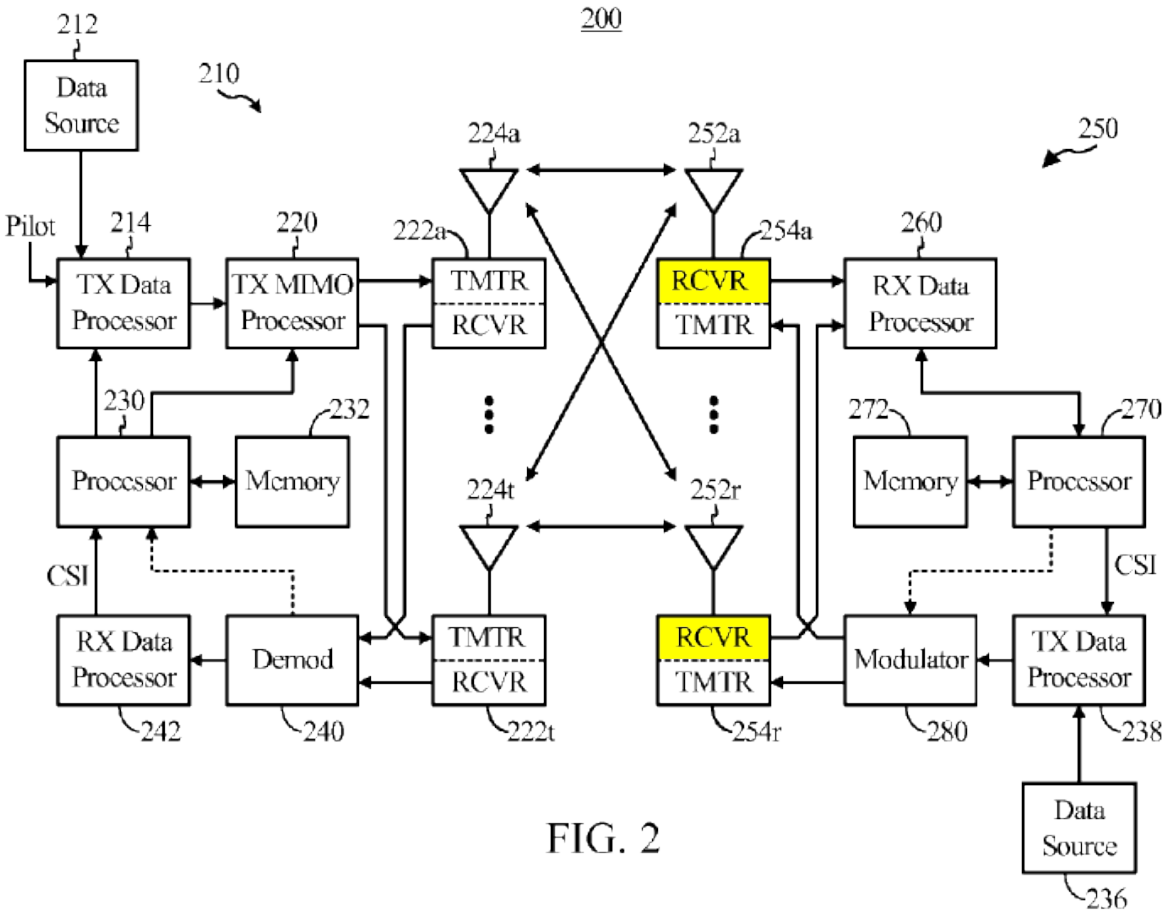


FIG. 2

downconverts) a respective received signal" at the UE, as shown in annotated FIG. 2. *Luo*, [0037].

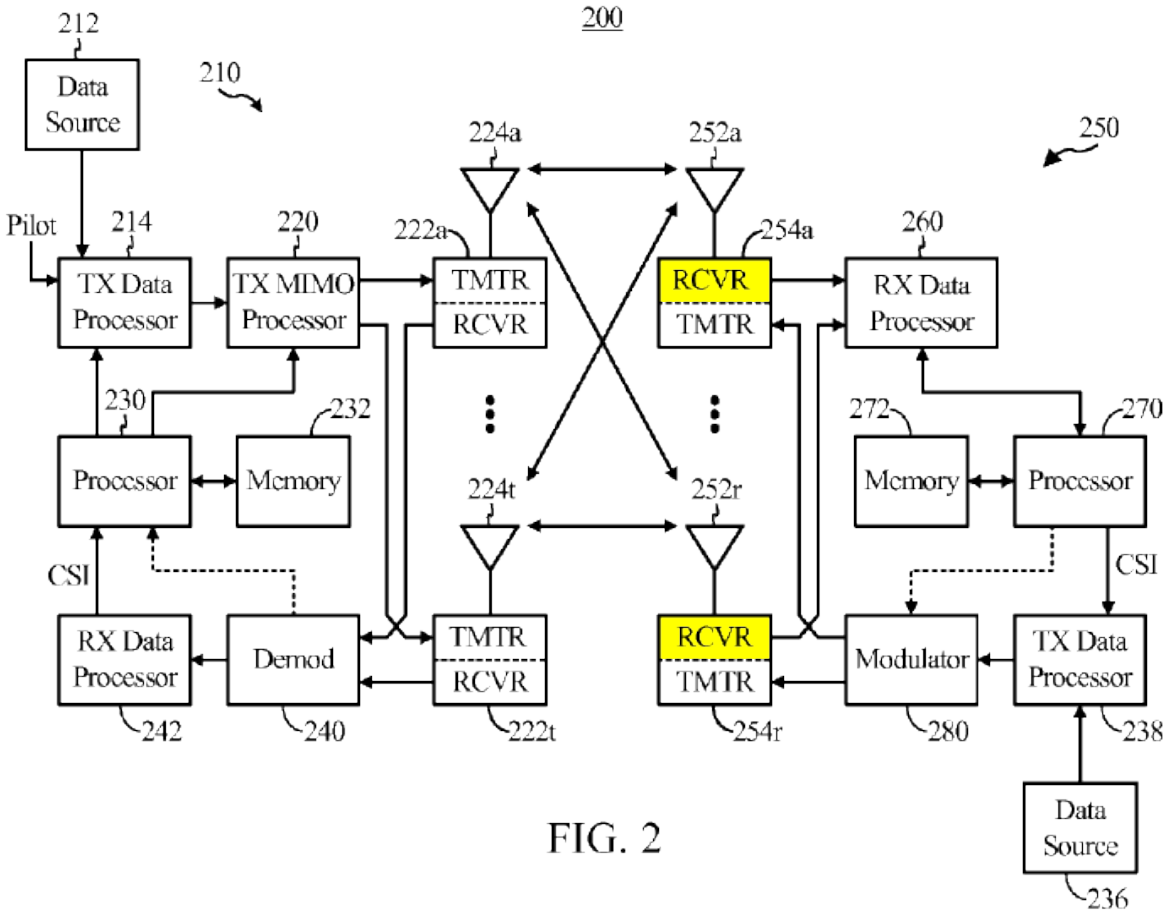


FIG. 2

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"

~~95.~~213. *Kim* discloses ~~or suggests~~ [11b] for the reasons discussed in [1b]. *Supra* § ~~V.A.1.c; Kakaes ¶¶213-217.~~XI.A.1.c. *Kim* discloses a ~~MIMO~~ receiver or receiving unit for MIMO systems, as explained for [3c] and Sections ~~V.A.3.d ([3c]),~~93 and ~~V.A.1 (claim 1), and V.A.8.b ([11a]),~~XI.A.11.b, which a POSITA would have understood includes ~~multiple receivers~~more than one receiver 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].

~~96.~~214. ~~*Id.*~~ Having a corresponding receiver for each antenna in a MIMO UE device 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].

215. For example, as explained above, *Luo* described what was well known

to a POSITA, that a first and second receivers ("RCVR") in elements 254a and 254r (yellow), each corresponding to a particular antenna 252, shown in annotated FIG. 2 below.

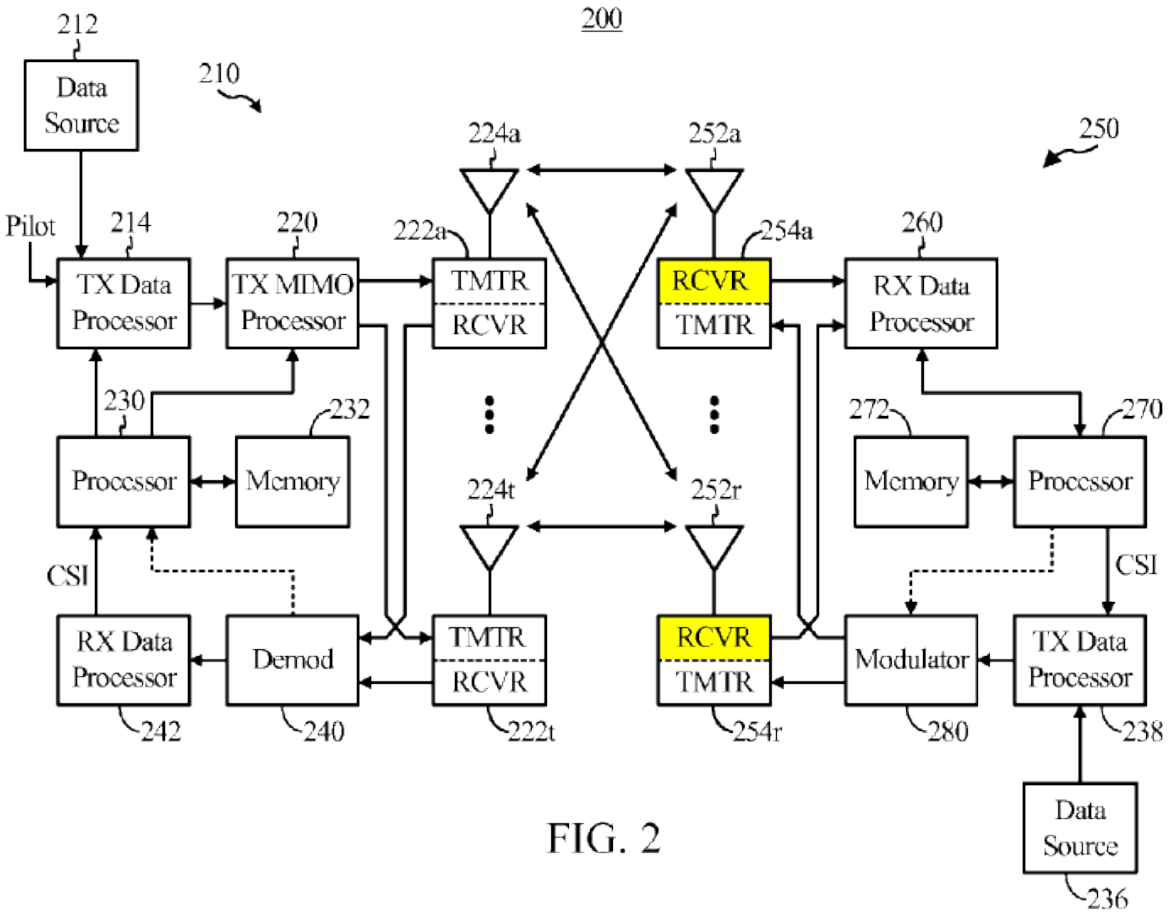


FIG. 2

Luo, FIG. 2 (annotated). *Luo* explains that "the 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." *Luo*, [0037]. *Luo* explains that "[e]ach receiver 254 conditions (e.g., filters, amplifies, and downconverts) a respective received signal, digitizes the conditioned signal to provide samples, and further processes the samples to provide a corresponding 'received' symbol stream" at the UE. *Luo*, [0037]. *Vitthaladevuni* and *Hu* confirm

this well-known knowledge of a POSITA. *Vitthaladevuni*, FIG. 10, [0116], [0120~~]~~ ~~[]~~-[0121]; *Hu*, FIG. 12, [0142]-[0143].

a. Motivation to Combine

~~97.~~216. 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~~.~~, and having a receiver for each receiving antenna would have enhanced processing at the UE because processing could be divided amongst multiple receivers thereby improving operation of the system. 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.*~~*Luo*, FIG. 2, [0037]; *Vitthaladevuni*, FIG. 10, [0116], [0120]-[0121]; *Hu*, FIG. 12, [0142]-[0143].

a. Expectation of Success

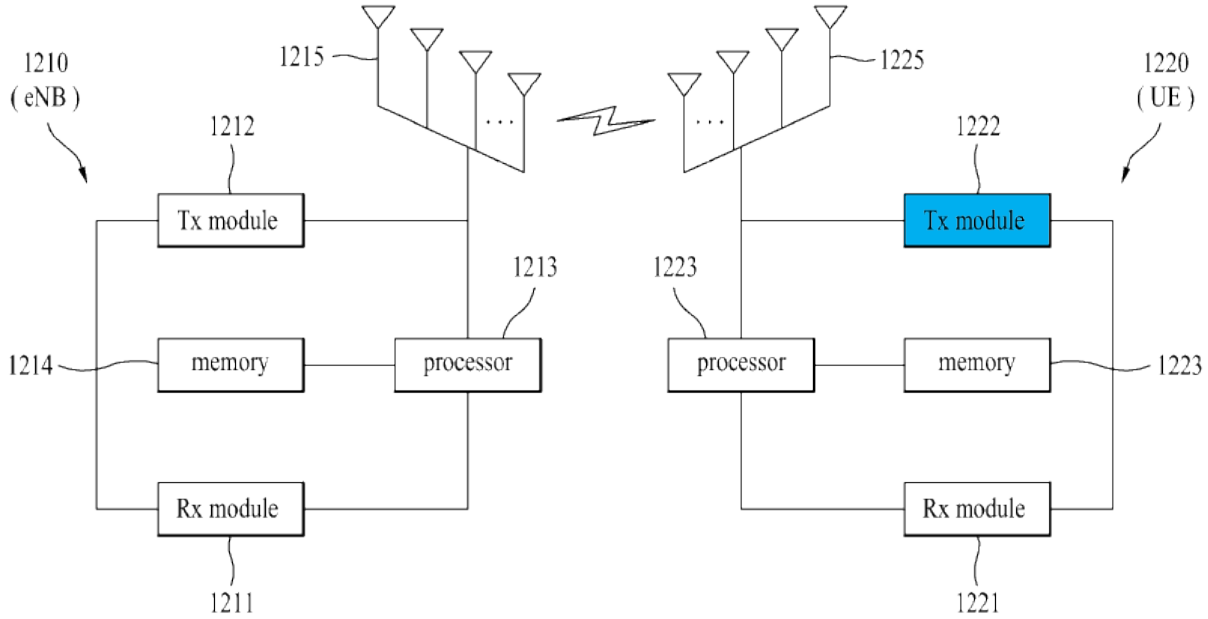
~~98.~~217. A POSITA would have reasonably expected success in providing two receivers, each receiving the first signaling and the first wireless

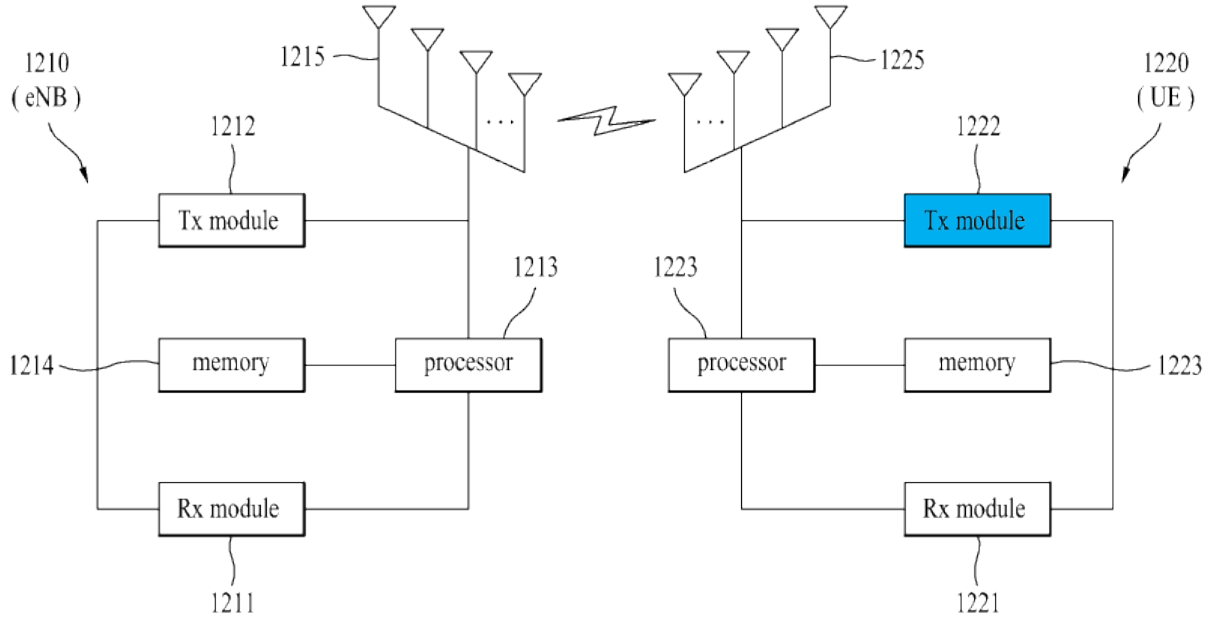
signal, in *Kim*'s

UE because multiple receivers receiving this information was conventional and routine in the MIMO ~~systems~~antennas 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;"

~~99.~~218. *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~~*Supra* § XI.A.1.d. *Kim*'s UE includes a "Tx module 1222 [(blue)] 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 for transmitting the first information, such as the information in the measurement report, to the base station, as described in Section ~~V.A.1.d~~XI.A.1.d ([1c]). *Kim*, [0177], FIG. 12~~; Kakaes ¶218~~.


1210
(eNB)
1215
1225
1220
(UE)
1212
1222
Tx module
Tx module
1213
1223
1214
memory
processor
processor
memory
1223
Rx module
Rx module
1211
1221



Kim, FIG. 12 (annotated).

~~a.~~ **[11d] [11d1~~]-[11d9]~~**

e. ~~Elements [11d1]-[11d9]~~] “wherein, K antenna port groups of the base station are ~~identical~~used to ~~[1d1]-[1d9], and are disclosed by~~transmit the first wireless signal;”

219. *Kim*~~,~~ discloses or ~~rendered obvious by~~ suggests, or the combination of *Kim* and *Chen*~~,~~

renders obvious, [11d1] as discussed in ~~Sections V.A.1.e-~~[1d1]. *Supra* § XI.A.1.e.

~~V.A.1.m. Kakaes ¶¶219-227.~~

~~3. Claims 12-14~~

f. [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;"

220. *Kim* discloses [11d2] as discussed in [1d2]. *Supra* § XI.A.1.f.

g. [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);"

221. *Kim* discloses [11d3] as discussed in [1d3]. *Supra* § XI.A.1.g.

h. [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;"

222. *Kim* discloses [11d4] as discussed in [1d4]. *Supra* § XI.A.1.h.

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

223. *Kim* discloses [11d5] as discussed in [1d5]. *Supra* § XI.A.1.i.

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

224. *Kim* discloses [11d6] as discussed in [1d6]. *Supra* § XI.A.1.j.

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

225. *Kim* discloses or suggests, or the combination of *Kim* and *Chen* ~~render~~ renders obvious, [11d7] as discussed in [1d7]. *Supra* § XI.A.1.k.

l. [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;"

226. *Kim* discloses [11d8] as discussed in [1d8]. *Supra* § XI.A.1.l.

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

227. *Kim* discloses [11d9] as discussed in [1d9]. *Supra* § XI.A.1.m.

12. Claim 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)."

~~100.~~228. The combination of *Kim* and *Chen* renders obvious claim 11, as discussed above.

229. ~~The additional limitations of claims 12~~ The additional limitations of claim 12 are substantively identical to claim 2, and are therefore disclosed by *Kim*, or rendered obvious by the combination of *Kim* and *Chen*, for the reasons discussed in claims 1, 2, and 11. *Supra* §§ XI.A.1, XI.A.2, XI.A.11.

13. Claim 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."

230. The combination of *Kim* and *Chen* renders obvious claim 11, as discussed above.

231. The additional limitations of claim 13 are substantively identical to claim 3, and are therefore disclosed by *Kim*, or rendered obvious by the combination of *Kim* and *Chen*, for the reasons discussed in claims 1, 3, and 11. *Supra* §§ XI.A.1, XI.A.3, XI.A.11.

14. Claim 14: "The user equipment to claim 13, wherein any two antenna ports in the Kl 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."

232. The combination of *Kim* and *Chen* renders obvious claim 13, as discussed above.

~~101.~~233. The additional limitations of claim 14 are substantively identical to ~~claims 2~~ claim 4, and are therefore disclosed by *Kim*, or rendered obvious by the combination of *Kim* and *Chen*, for the reasons discussed in claims 1~~-~~, 4, and 11. *Supra* §§ ~~V.A.1-V.A.4~~XI.A.1, XI.A.4, ~~V.A.8; Kakaes~~XI.A.11. ~~¶¶228-233.~~

~~**4. Claim 15**~~

15. Claim 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."

~~102.~~234. The combination of *Kim* and *Chen* ~~render~~*k* renders obvious claim 13, as discussed above.

~~103.~~235. The additional limitations of claim 15 are substantively identical to claim 5, and are therefore disclosed by *Kim*, or rendered obvious by the combination of *Kim* and *Chen* for the reasons discussed in claims 1, 5, and 11, because, as ~~explained~~I explain 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~~XI.A.5 (claim 5~~)),~~)) from the base station. ~~*Supra* §§ V.A.1, V.A.5~~*Supra* §§ XI.A.1, XI.A.5, ~~V.A.8; Kakaes ¶¶234-235.~~XI.A.11.

~~7.~~16. Claim 16:

~~104.~~236. Claim 16 is substantively similar to claim 6, ~~but recites~~except that the base station itself performing ~~the~~ functions, rather than a method. ~~Kakaes ¶¶236-256.~~ Elements [16a]-[16c] also recite a "first transmitter," "second transmitter," and "third receiver" performing steps comparable to steps [6a]-[6c]. ~~Kakaes ¶¶238-247.~~ The above discussions for claims 1 and 6 describe why ~~the elements~~each element of claim 16 ~~are~~is taught or rendered obvious by the

~~obvious by~~combination *Kim* and *Chen*, although the specific "transmitter[s]" and "receiver" are ~~further~~ discussed in more detail below. *Supra* §§ ~~V.A.1,~~XI.A.1 (claim 1), ~~V.A.6~~XI.A.6 (~~claims 1,~~claim 6~~); Kakaes ¶¶236-256.~~).

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

~~105.~~237. To the extent the preamble is limiting, *Kim* discloses [16Preamble] as discussed in [6Preamble] and [1Preamble~~] and [6Preamble~~]. *Supra* §§ ~~V.A.1.a~~XI.A.1.a, ~~V.A.6.a; Kakaes~~XI.A.6.a. ~~¶237.~~

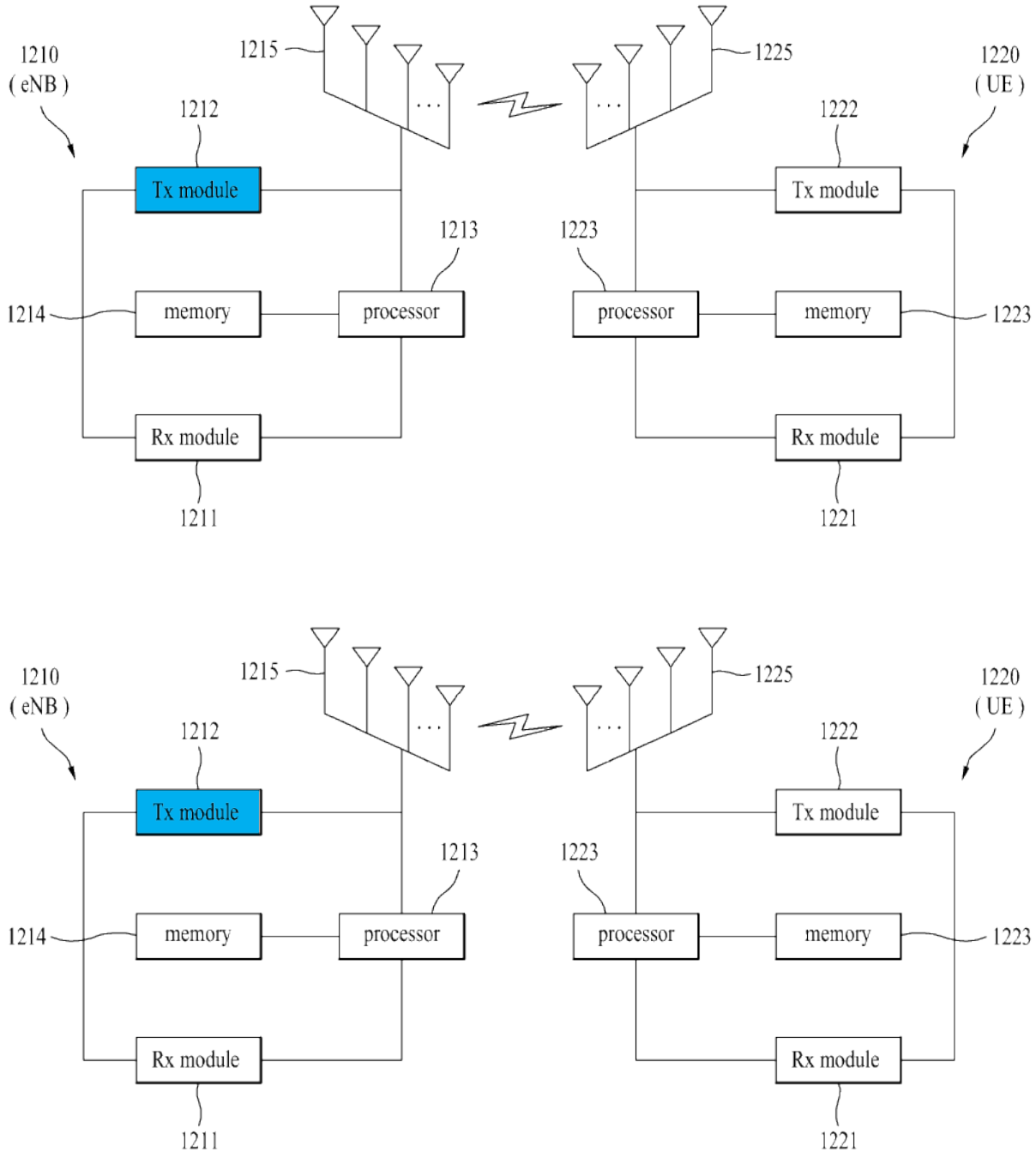
b. [16a] "a first transmitter at the base station, transmitting a first signaling to a user equipment (UE);"

~~106.~~238. *Kim* discloses [16a] for the reasons discussed in [1a] and [6a]. *Supra* ~~§§ V.A.1.b, V.A.6.b; Kakaes ¶¶238-240.~~ §§ XI.A.1.b, XI.A.6.b.

~~107.~~239. *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~~XI.A.1.b-~~V.A.1.c~~XI.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.

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



Kim, FIG. 12 (annotated).

~~108.~~240. 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 [a] symbol stream~~,~~" and "N_T modulated signals from transmitters 222a through 222t are then transmitted from ~~N_T~~N antennas 224a through 224t, respectively." *Luo*, [0036].

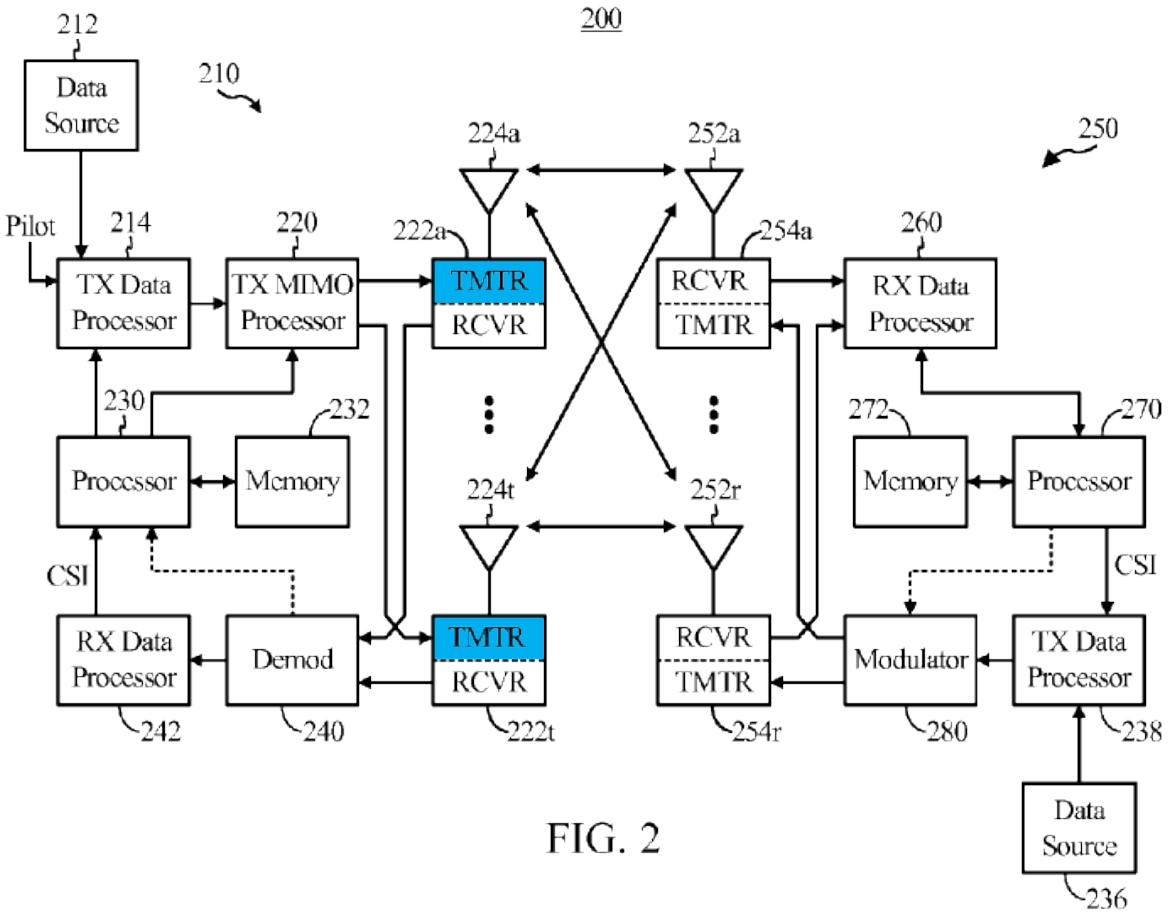

200
212
Data Source
210
224a
252a
250
Pilot
214
220
222a
254a
260
TX Data Processor
TX MIMO Processor
TMTR
RCVR
RCVR
TMTR
RX Data Processor
230
232
272
270
Processor
Memory
224t
252r
Memory
Processor
CSI
CSI
RX Data Processor
Demod
TMTR
RCVR
RCVR
TMTR
Modulator
TX Data Processor
242
240
222t
254r
280
238
Data Source
236

FIG. 2

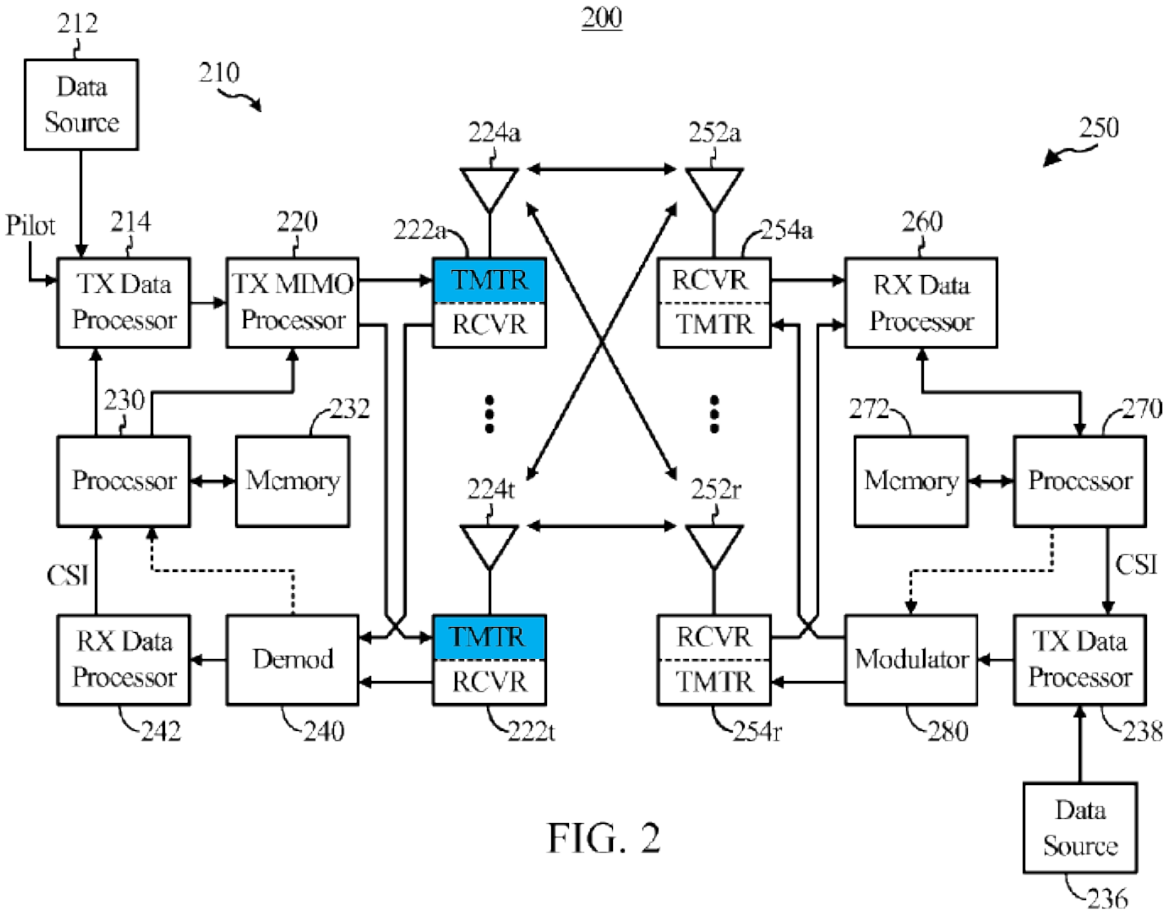


FIG. 2

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.~~*Infra* § XI.A.16.c.

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

~~109.~~241. *Kim* discloses [16b] for the reasons discussed in [1b] and [6b]. *Supra* §§ ~~V.A.1.c~~XI.A.1.c, ~~V.A.6.c; Kakaes ¶¶241-242.~~XI.A.6.c. *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.~~

signals to the UE for MIMO systems, as explained for [3c] and Section XI.A.1and XI.A.16.b. 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].

~~110.~~242. 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~~*Chen*, 1; *see Vitthaladevuni*, FIG. 10, [0116], [0118]-[0119]; *Hu*, FIG. 12, [0140]-[0141].

243. ~~¶241-242; *see*~~For example, as explained above, *Luo*~~,~~ discloses what was well known to ta POSITA, that a first and second receivers ("TMTR") in elements 222a and 222r (blue), each corresponding to a particular antenna 224, shown in annotated FIG. 2 below.

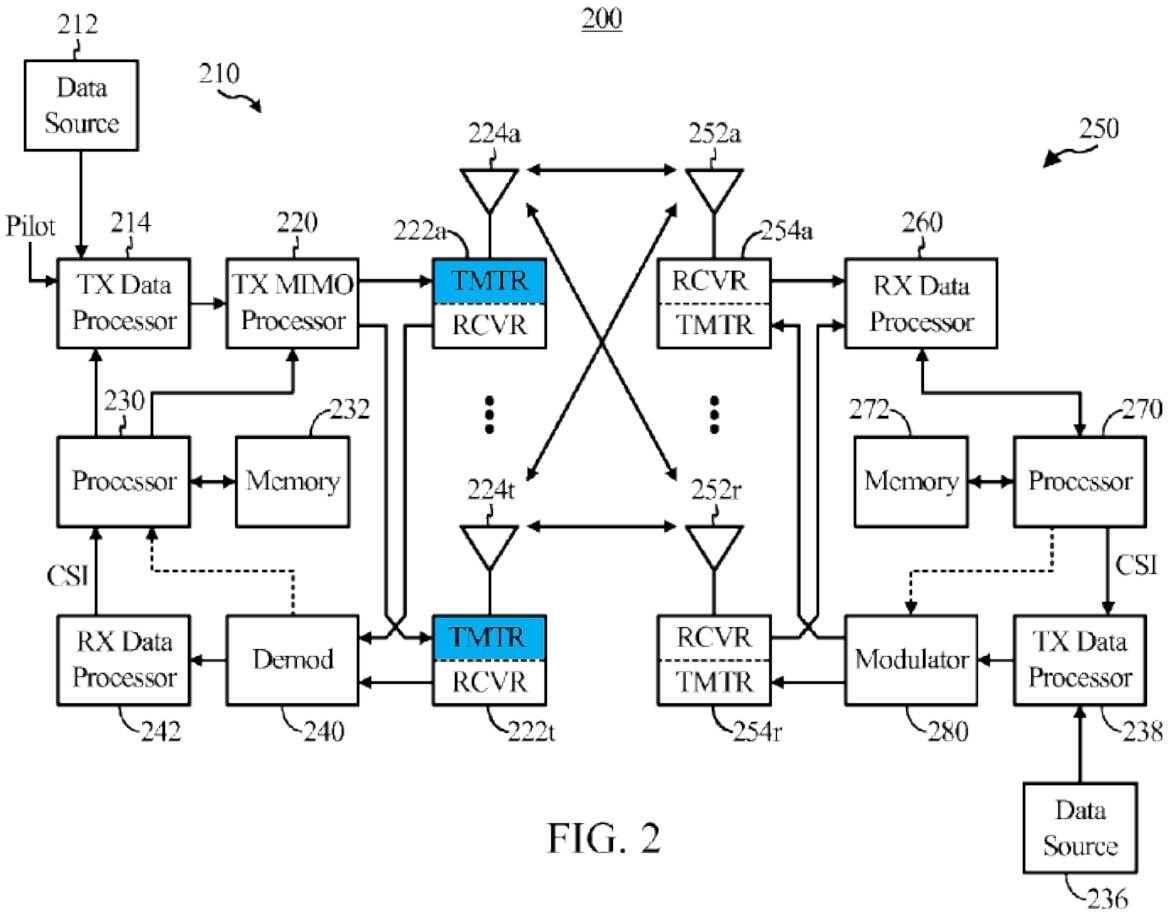


FIG. 2

Luo, FIG. 2 (annotated).

244. *Luo* explains that a "TX [transmission] MIMO processor 220 then provides N modulation symbol streams to N transmitters (TMTR) 222a through 222t." *Luo*, [0035]. *Luo* explains that "[e]ach transmitter 222 receives and processes a respective symbol stream to provide one or more analog signals" and "N_T modulated signals from transmitters 222a through 222t are then transmitted from N antennas 224a through 224t, respectively." *Luo*, [0036]. *Vitthaladevuni* and

Hu confirm this well-known knowledge of a POSITA. *Vitthaladevuni*, FIG. 10, [0116], [0118]-[0119]; *Hu*, FIG. 12, [0140]-[0141].

a. 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~~.~~, and having a transmitter for each transmitting antenna would have enhanced processing at the base station because processing could be divided amongst multiple transmitters thereby improving operation of the system. This would have enhanced processing at the base station by dividing the processing amongst multiple transmitters. ~~Kakaes~~

~~111.~~245. ~~¶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.*~~*See Luo*, FIG. 2, [0036]; *Vitthaladevuni*, FIG. 10, [0116], [0118]-[0119]; *Hu*, FIG. 12, [0140]-[0141].

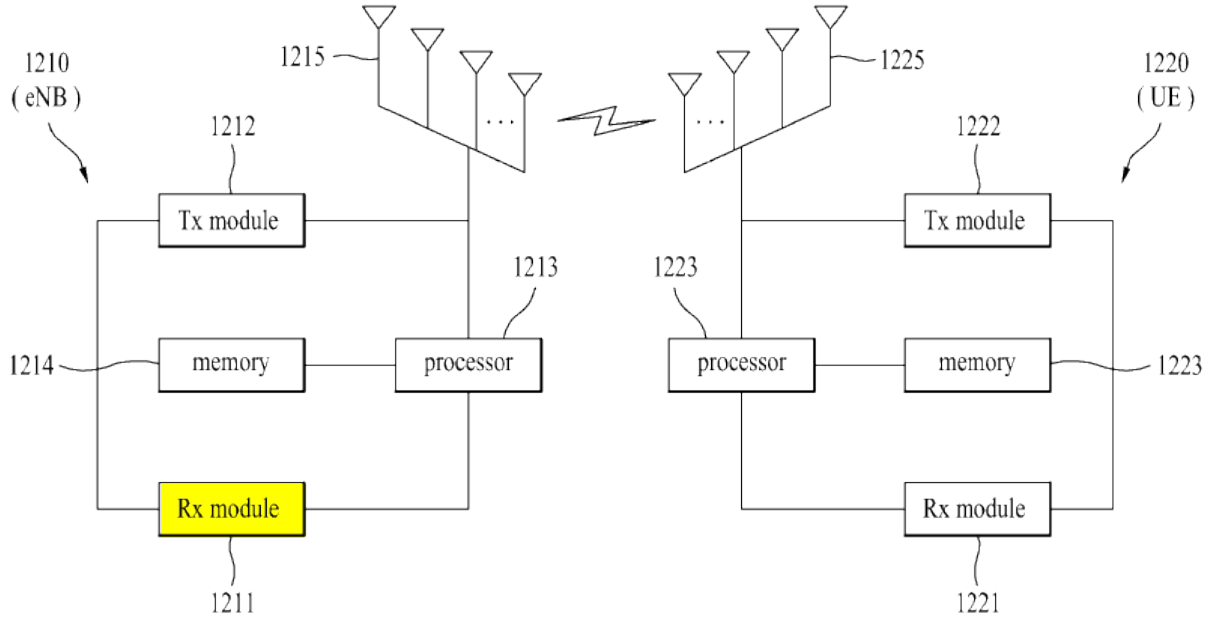
a. Expectation of Success

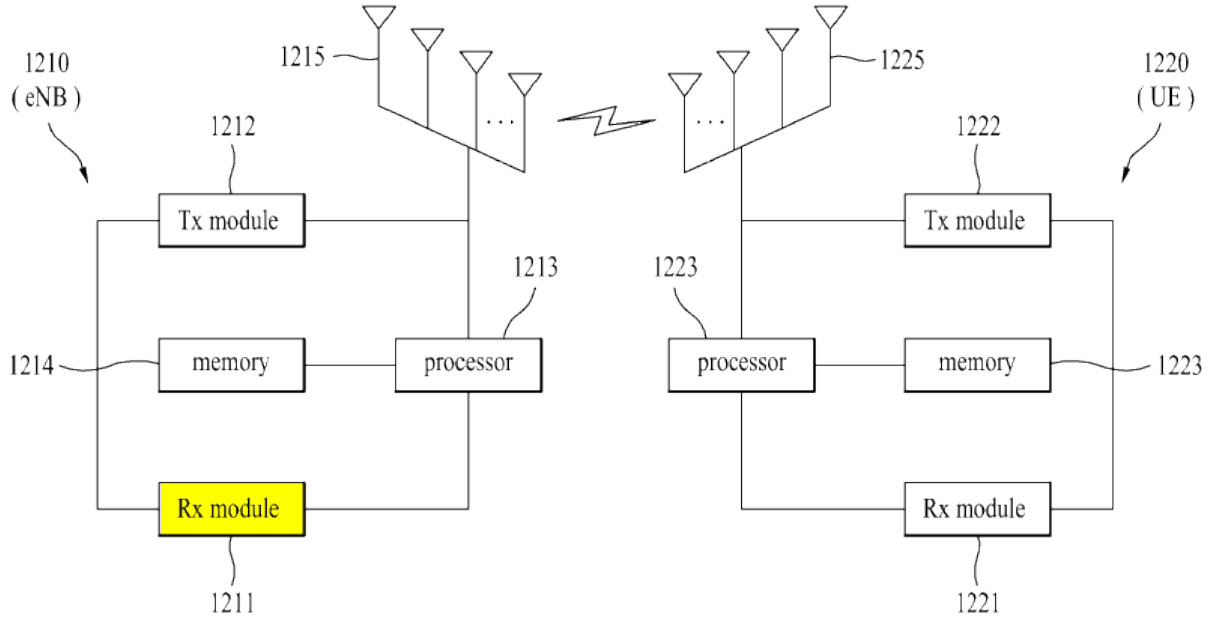
A POSITA would have reasonably expected success in providing two transmitters, each transmitting the first signaling and the first wireless signal, in *Kim*'s base station because multiple transmitters transmitting this information was conventional and routine in the MIMO antennas described in *Kim*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

~~112.~~246. ~~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;"

~~113.~~247. *Kim* discloses [16c] for the reasons discussed in [1c] and [6c]. *Supra* §§ ~~V.A.1.d~~XI.A.1.d, ~~V.A.6.d; Kakaes ¶247.~~XI.A.6.d. *Kim*'s base station includes a "reception (Rx) module 1211~~" that receives "~~ [(yellow)] may receive a variety of signals, data and information~~" on an uplink starting~~ from the UE~~" using antennas 1215, as shown in FIG. 12, which a POSITA would have understood describes a receiver for receiving the transmitted first information, such as the measurement report from the UE, as described in Section ~~V.A.1.d~~ XI.A.1.d ([1c]). *Kim*, [0174], FIG. 12~~; Kakaes ¶247~~.


1210
(eNB)
1215
1225
1220
(UE)
1212
1222
Tx module
Tx module
1213
1223
1214
memory
processor
processor
memory
1223
Rx module
Rx module
1211
1221



Kim, FIG. 12 (annotated).

~~a.~~ **[16d] [16d1~~]-[16d9]~~**

e. ~~Elements [16d1]-[16d9]~~] "wherein, K antenna port groups of the base station are ~~identical~~used to ~~elements [1d1]-[1d9], and are disclosed by~~ transmit the first wireless signal;"

~~114.~~248. *Kim*~~,~~ discloses or ~~rendered obvious by~~ suggests, or the combination of *Kim* and *Chen*~~,~~ renders obvious, [11d1] as discussed in [1d1~~]-[1d9]~~. ~~*Supra* §§ V.A.1.e V.A.1.m; Kakaes ¶¶248-256.~~] and [6d1]. *Supra* §§ XI.A.1.e, XI.A.6.e.

~~5. Claims 17-19~~

f. ~~*Kim* and *Chen* render~~[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;"

249. *Kim* discloses [16d2] as discussed in [1d2] and [6d2]. *Supra*

§§ XI.A.1.f, XI.A.6.f.

g. [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);"

250. *Kim* discloses [16d3] as discussed in [1d3] and [6d3]. *Supra* §§ XI.A.1.g, XI.A.6.g.

h. [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;"

251. *Kim* discloses [16d4] as discussed in [1d4] and [6d4]. *Supra* §§ XI.A.1.h, XI.A.6.h.

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

252. *Kim* discloses [16d5] as discussed in [1d5] and [6d5]. *Supra* §§ XI.A.1.i, XI.A.6.i.

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

253. *Kim* discloses [16d6] as discussed in [1d6] and [6d6]. *Supra* §§ XI.A.1.j, XI.A.6.j.

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

254. *Kim* discloses or suggests, or the combination of *Kim* and *Chen* renders obvious, [16d7] as discussed in [1d7] and [6d7]. *Supra* §§ XI.A.1.k, XI.A.6.k.

l. [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;"

255. *Kim* discloses [16d8] as discussed in [1d8] and [6d8]. *Supra* §§ XI.A.1.l, XI.A.6.l.

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

256. *Kim* discloses [16d9] as discussed in [1d9] and [6d9]. *Supra* §§ XI.A.1.m, XI.A.6.m.

17. Claim 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)."

~~115.~~257. The combination of *Kim* and *Chen* renders obvious claim 16, as discussed above.

258. The additional limitations of claim 17 are substantively identical to claims ~~17~~ 2 and 7, and are therefore disclosed by *Kim*, or rendered obvious by the combination of *Kim* and *Chen*, for the reasons discussed in claims 1, 2, 6, 7, and

16. *Supra* §§ XI.A.1, XI.A.2, XI.A.6, XI.A.7, XI.A.16.

18. Claim 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."

259. The combination of *Kim* and *Chen* renders obvious claim 16, as discussed above.

260. The additional limitations of claim 18 are substantively identical to claims 3 and 8, and are therefore disclosed by *Kim*, or rendered obvious by the combination of *Kim* and *Chen*, for the reasons discussed in claims 1, 3, 6, 8, and 16. *Supra* §§ XI.A.1, XI.A.3, XI.A.6, XI.A.8, XI.A.16.

19. Claim 19: "The base station to claim 18, wherein any two antenna ports in the Kl 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."

261. The combination of *Kim* and *Chen* renders obvious claim 18, as discussed above.

~~116.~~262. The additional limitations of claim 19 are substantively identical to claims ~~2~~ 4 and ~~7~~ 9, and are therefore disclosed by *Kim*, or rendered obvious by the combination of *Kim* and *Chen*, for the reasons discussed in claims 1~~-~~, 4, 6~~-~~, 9, and

16. *Supra* §§ ~~V.A.1-V.A.4~~XI.A.1, XI.A.4, ~~V.A.6-V.A.7, V.A.11; Kakaes ¶¶257-262.~~XI.A.6, XI.A.9, XI.A.16.

~~**6. Claim 20**~~

20. Claim 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 Kl 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."

~~117.~~263. The combination of *Kim* and *Chen* ~~render~~renders obvious claim 18, as discussed above.

~~118.~~264. The additional limitations of claim 15 are substantively identical to claims 5 and 10, and are therefore disclosed by *Kim*, or rendered obvious by the combination of *Kim* and *Chen*, for the reasons discussed in claims 1, 5, 6, 10, and 16, because, as ~~explained~~I explain above 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~~XI.A.5 (claim 5)), to the UE. ~~*Supra* §§ V.A.1, V.A.5~~*Supra* §§ XI.A.1, XI.A.5, ~~V.A.6 V.A.7, V.A.11; Kakaes~~XI.A.6, XI.A.10, XI.A.16.

~~¶¶263-264.~~

IV. 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).

V. 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.

C. Lead and Backup Counsel, and Service Information

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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.

VI. 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.

III.XII. CONCLUSION

265. For the reasons above, Petitioner has established a reasonable likelihoodset forth in Section XI, it is my opinion that the challengedone skilled in the art would have found claims are unpatentable. Petitioner requests institution1-20 of *inter partes* reviewthe '271 patent obvious.

~~119.~~266. In signing this declaration, I understand that the declaration will be filed as evidence in a contested case before the Patent Trial and ~~cancellation~~Appeal Board of ~~each challenged claim. The~~the United States Patent and Trademark Office. I acknowledge that I may ~~charge any~~ be subject to cross-examination in this case and that cross-examination will take place within the United States. If cross-examination is required ~~fees to Deposit Account No. 06-0916~~of me, I will appear for cross-examination within the United States during the time allotted for cross- examination.

267. I declare that all statements made herein of my knowledge are true, and that all statements made on information and belief are believed to be true, and that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Date: March ~~29~~28, 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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