

Petitioner's Demonstratives

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

v.

Apex Beam Technologies LLC

IPR2023-00571

IPR2023-00747

August 22, 2024

U.S. Patent No. 10,951,271

U.S. Patent No. 10,951,271
“Method and Device for Multi-Antenna Transmission in UE and Base Station”



(12) **United States Patent**
Zhang

(10) **Patent No.:** US 10,951,271 B2
(45) **Date of Patent:** Mar. 16, 2021

(54) **METHOD AND DEVICE FOR MULTI-ANTENNA TRANSMISSION IN UE AND BASE STATION**

(58) **Field of Classification Search**
CPC H04B 1/0064; H04B 7/024; H04B 7/04; H04B 7/0404; H04B 7/0408; (Continued)

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(*) **Notice:** Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

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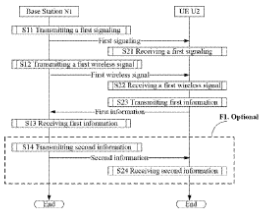
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(Continued)

(52) **U.S. Cl.**
CPC H04B 7/0408 (2013.01); H04B 7/0413 (2013.01); H04B 7/0617 (2013.01); H04B 7/2085 (2013.01)

20 Claims, 10 Drawing Sheets



Ex. 1001, cover

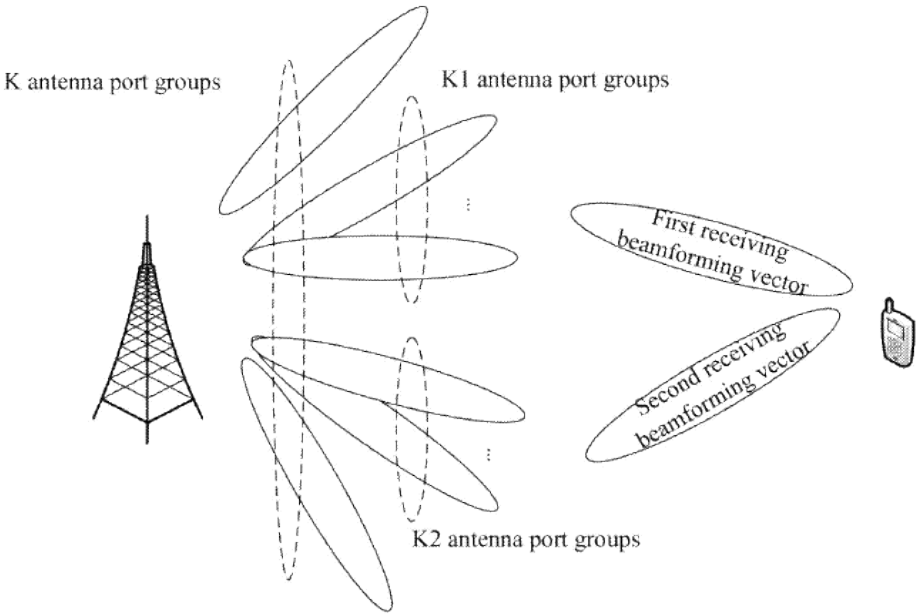


FIG. 8

As a sub-embodiment, the K antenna port groups respectively correspond to K reference signal groups.

* * *

As a sub-embodiment, the reference signal group includes only one reference signal.

Ex. 1001, 13:62-63, 13:66-67

In one embodiment, the K antenna port groups respectively correspond to K reference signal groups. The K reference signal groups are respectively transmitted through the K antenna port groups. The first wireless signal is composed of the K reference signal groups.

Ex. 1001, 3:22-26

E.g., Ex. 1001, 3:22-26, 13:62-63, 13:66-67, FIG. 8

Independent claim 1 is representative

1. A method for multi-antenna transmission in a user equipment (UE), comprising:
receiving, by the UE, a first signaling originating from a base station;
receiving, by the UE, a first wireless signal originating from the base station; and
transmitting, by the UE, first information to the base station;
wherein, K antenna port groups of the base station are used to transmit the first wireless signal; 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; the K antenna port groups respectively correspond to K channel quality values; the K channel quality values are K non-negative real numbers; the K channel quality values are Reference Signal Received Powers (RSRPs) or a Signal to Interference plus Noise Ratios (SINRs); K1 antenna port groups of the K antenna port groups correspond to K1 channel quality values of the K channel quality values; the K1 is a positive integer less than or equal to the K; a first proportional sequence corresponds to a ratio(ratios) among the K1 channel quality values; the first information is used to determine the K1 antenna port groups and the first proportional sequence; the first signaling is used to determine a target threshold; the target threshold is a non-negative real number; 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; a ratio between the second channel quality and the first channel quality is greater than or equal to the target threshold.

} Element [1d1]

} Element [1d5]

E.g., Ex. 1001, 27:14-47

Grounds of unpatentability

Ground	Claims	Obviousness Basis
IPR2023-00571	1-20	<i>Liu and Park</i>
IPR2023-00747	1-20	<i>Kim and Chen</i>

- Patent Owner’s patentability arguments limited to independent claim 1
- No separate arguments for other independent claims
- No separate arguments for dependent claims

E.g., '571 Pet. 9; '747 Pet. 8; '571 Reply 23; '747 Reply 22

Prior art: *Liu*

During antenna configuration, a second network device transmits configuration information of M antenna ports to a first network device and transmits signals of the M antenna ports to the first network device, which receives the signals of the M antenna ports transmitted by the second network device based on the configuration information, where M is a positive integer; in the present embodiment, the first network device may be user equipment (UE), and the second network device may be a base station; alternatively, the first network device may be user equipment, and the second network device may be user equipment; alternatively, the first network device may be a base station, and the second network device may be a base station.

Liu (Ex. 1006), 15

for example, the M antenna ports are divided into X groups, and the base station individually configures one codebook set for each antenna port group. The user equipment

Liu (Ex. 1006), 21

UE measures the 5 groups of antenna ports corresponding to these 5 cells and discovers that the received signal power is strongest for ports 0, 1 corresponding to cell 1; for example, $RSRP_1 > RSRP_2 > RSRP_3 > RSRP_4 > RSRP_5$, with $RSRP_1$ representing the received signal power corresponding to cell 1, $RSRP_2$ representing the received signal power corresponding to cell 2, and $RSRP_n$ representing the received signal power corresponding to cell n. However, if

Liu (Ex. 1006), 26

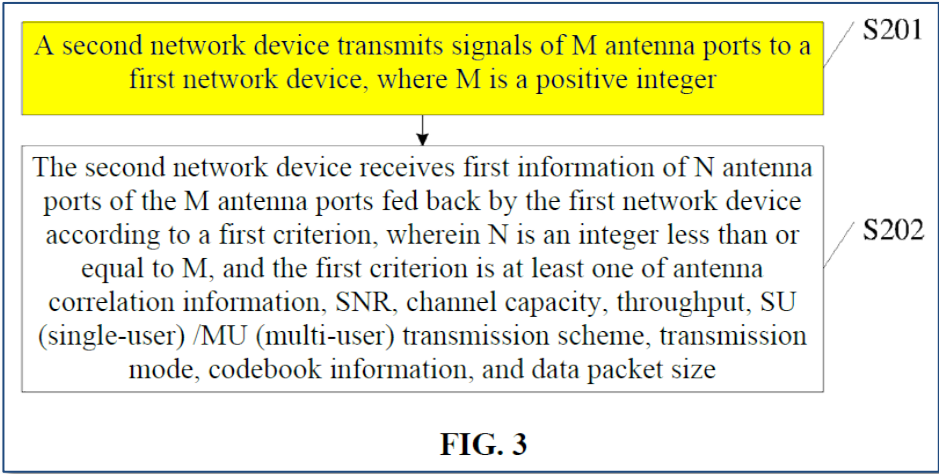


FIG. 3

Liu (Ex. 1006), FIG. 3 (S201)

E.g., '571 Pet. 5-7, 16-17, 22; '571 Reply 15-16

Prior art: *Park*

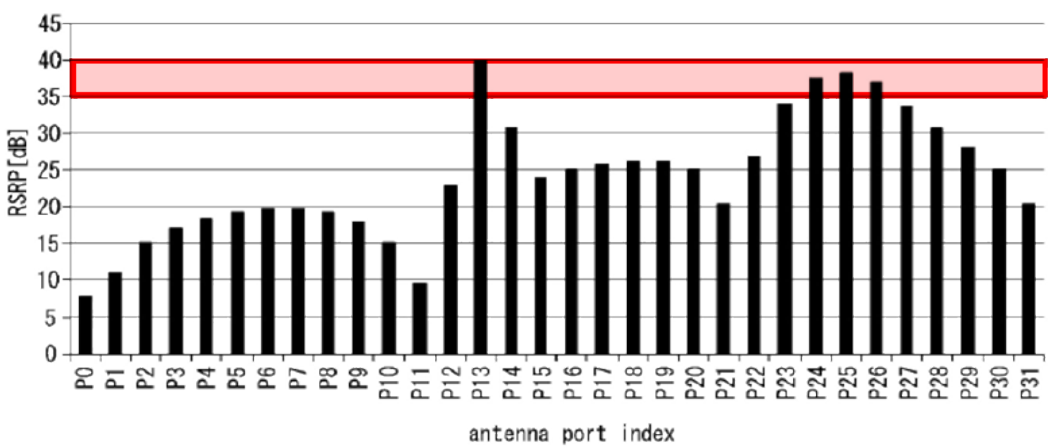
- [371] A UE in which a plurality of RRM-RSs has been configured measures the RSRP of each antenna port of each of RRM-RS. If R RRM-RSs have been configured in a UE and the number of antenna ports of the r^{th} RRM-RS is M_r , then the RSRP of the m^{th} antenna port of the r^{th} RRM-RS is defined as $\text{RSRP}(r, m)$. The UE aligns the $\text{RSRP}(r, m)$, and reports the RSRP of L antenna ports chosen from among these that are strongly received.
- [372] By slightly modifying the above scheme, the UE aligns the $\text{RSRP}(r, m)$ and selects the RSRPs of antenna ports that belong to the aligned $\text{RSRP}(r, m)$ and that are received strongly, and limits reporting to RSRPs of ports that are within a certain difference compared to the RSRP of the selected antenna ports, in other words, $\max(\text{RSRP}(r, m))$. Thus, the RSRP of a maximum of L antenna ports, which have an RSRP difference greater than a certain threshold value expressed as an RSRP ratio or dB scale, is reported as follows.

[373] [Equation 13]

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

Park (Ex. 1009), [371]-[373]

[FIG. 12]



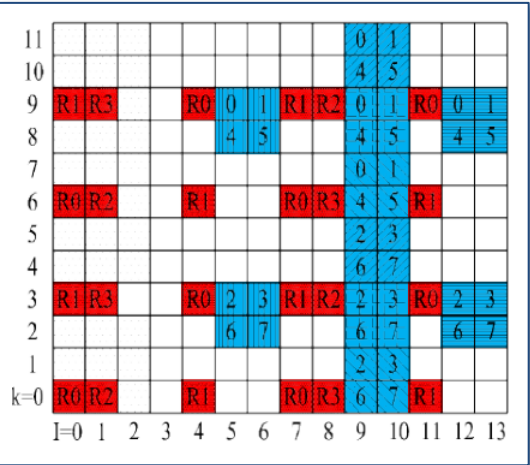
'571 Kakaes (Ex. 1003), ¶131 (annotating *Park*, FIG. 12)

E.g., '571 Pet. 7-9, 24-26; '571 Reply 18-20

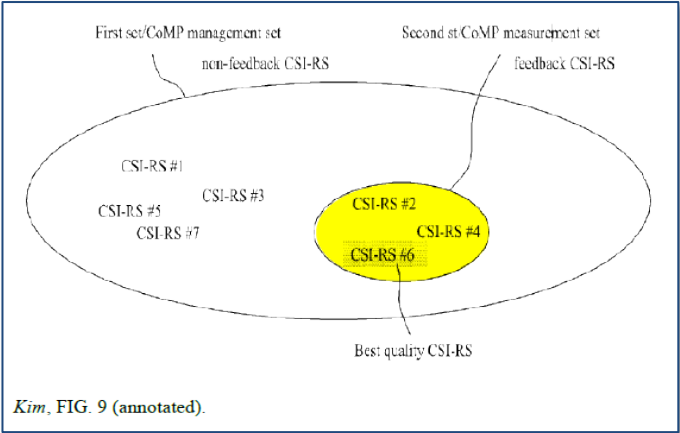
Prior art: Kim

[0076] In FIG. 6, CSI-RSs are mapped to REs on a per-antenna port basis according to a specific CSI-RS configuration by Equation 1 and Equation 2. In FIG. 3, R0 to R3 denote Kim (Ex. 1027), [0076] (excerpted)

[0053] If 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. Accordingly, a reference signal is present per transmission antenna and, more particularly, per antenna port. Kim (Ex. 1027), [0053]



'747 Pet. 17 (annotating Kim, FIG. 6)



'747 Pet. 25 (annotating Kim, FIG. 9)

[0149] The above-mentioned scheme is slightly modified, 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. That is, indexes of a maximum of M CSI-RSs configured to satisfy Equation 4 may be reported.

$RSRP_n/\max(RSRP_i) > \text{Threshold}$ [Equation 4]

Kim (Ex. 1027), [0149]

[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. Alternatively, the measurement report value may also be defined as the ratio of the average Rx power level of the best CSI-RS to the n-th CSI-RS average Rx power level. Since the ratio of power level on a linear scale is defined as a difference in power level on a decibel scale, the above ration of power level (linear value) has the same meaning as a difference in power level (dB value).

Kim (Ex. 1027), [0136]

Prior art: *Chen*

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, K being a positive integer less than N.

* * *

the N pilot ports are formed by virtualization of a same group of antennas, wherein each pilot port in the N pilot ports corresponds to a set of virtualized precoding weights.

Chen (Ex. 1029), 5; see also *id.* at 5, 7, 11, 18

the terminal selects the K pilot ports from the N pilot ports according to a power threshold configured by the base station, wherein the power threshold is a relative threshold or an absolute threshold.

Chen (Ex. 1029), 14

Two issues in dispute

Issue	Proper Resolution
“wherein, K antenna port groups of the base station are used to transmit the first wireless signal” [1d1]	Claim construction: No construction necessary.
	Comparison to prior art: Prior art same as '271 disclosure for [1d1], transmitting K reference signals respectively from K antenna port groups.
“a first proportional sequence corresponds to a ratio(ratios) among the K1 channel quality values” [1d5]	Claim construction: No construction necessary.
	Comparison to prior art: Both petitions show RSRP-to-max(RSRP) ratio sequence under Patent Owner’s construction.

E.g., '571 Pet. 4; '747 Pet. 3; '571 POR 11-18; '747 POR 11-17; '571 Reply 5, 8, 15-16, 21-22; '747 Reply 5, 8, 14-15, 21-22

**Construction of
“wherein, K antenna port groups of the base station
are used to transmit the first wireless signal” [1d1]
(IPR2023-00571, -00747)**

Patent Owner’s construction of [1d1] introduces two flaws

Term	Petitioner’s Position	Patent Owner’s Construction
“wherein, K antenna port groups of the base station are used to transmit the first wireless signal” [1d1]	No construction necessary	“ <u>K groups of antenna ports</u> of the base station are used to <u>collectively</u> transmit the first wireless signal”

- Patent Owner did not offer construction in district court
- “K antenna port groups” ≠ “K groups of antenna ports”
- “Collectively” makes term ambiguous
- Patent Owner’s construction contradicted by the ’271 patent’s specification
- The Board need not construe element [1d1] because *Liu* and *Kim* teach examples in ’271 patent

E.g., ’571 Pet. 4; ’747 Pet. 3; ’571 Reply 2-5, 15-16; ’747 Reply 2-5, 14-15; ’571 POR 11-14; ’747 POR 11-14

“K groups of antenna ports” ≠ “K antenna port groups”

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

group:

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

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

'571 POR 12; '747 POR 12

In one embodiment, the antenna port group is composed of one antenna port.

Ex. 1001, 2:45-46

As a sub-embodiment, the antenna port group includes only one antenna port.

Ex. 1001, 13:64-65

² Apex asserts that “[c]laim 1 requires at least 2 antenna port groups,” POR 12-13, but that is undisputed because “K is ... greater than 1.” Ex. 1001, 27:26-27.

'571 Reply 3 n.2; '747 Reply 3 n.2

E.g., '571 Reply 2-3, 3 n.2; '747 Reply 2-3, 3 n.2; '571 POR 12; '747 POR 12

“Collectively” adds ambiguity; Patent Owner and its expert could not explain meaning of “collectively”

5 Q. What do you mean by "collectively"?

6 A. Together.

7 Q. Does collectively require the signal
8 be transmitted by K groups of antenna ports
9 simultaneously?

10 A. Well, you know, they're sent
11 together, for sure, and...

12 Q. Do you mean something other than "at
13 the same time" when you say "together"?

14 ATTORNEY PYMENTO: Objection.
15 Form.

16 THE WITNESS: I just use that in
17 the ordinary sense of the word "together,"
18 "collectively."

Gomez Tr. (Ex. 1037), 30:5-18

the added word “collectively” to clarify this requirement. The parties’ dispute is clear, and there is no legitimate misunderstanding over the possible scope of the word “collectively” in the context of this construction. The issue is simply whether

’571 Sur-reply at 4; ’747 Sur-reply at 4

11 Q. So by "collectively," you do mean

12 that the first radio signal should be

13 transmitted by K groups of antenna ports at the
14 same time?

15 ATTORNEY PYMENTO: Objection.

16 THE WITNESS: Again, they're

17 treated -- they're sent collectively as a
18 unit.

Gomez Tr. (Ex. 1037), 32:11-18

11 Q. Does the first radio signal being

12 transmitted by K antenna port groups of the

13 base station require that the first radio

14 signal be transmitted by K groups of internet

15 ports of the base station at the same time?

16 A. I think I've written that in my

17 declaration, that the first radio signal is

18 transmitted by K antenna groups collectively,

19 which would be, you know, similar to at the

20 same time.

Gomez Tr. (Ex. 1037), 8:11-20

E.g., ’571 Reply 3-5; ’747 Reply 3-5; ’571 POR 13-14; ’747 POR 13-14; ’571 Sur-reply 4; ’747 Sur-reply 4

***Liu* discloses element [1d1]
(IPR2023-00571)
and
Kim discloses element [1d1]
(IPR2023-00747)**

The prior art discloses [1d1]

- IPR2023-00571:
 - *Liu* teaches M antenna port groups respectively transmitting M wireless reference signals for beam selection
 - Alternatively, *Liu* teaches X antenna port groups of two ports per group respectively transmitting X wireless reference signals for beam selection
- IPR2023-00747:
 - *Kim* teaches N antenna port groups (with one or two ports per group) respectively transmitting N CSI-RS (management set) for beam selection
- Parties' actual dispute is "first wireless signal"

E.g., '571 Pet. 13-14, 16-17; '747 Pet. 12-15, 16-19; '571 Reply 8, 9, 15-16; '747 Reply , 8, 9, 14-15

Liu transmits M references signals (first wireless signal) using M antenna ports (K antenna port groups) (IPR2023-00571)

During antenna configuration, a second network device transmits configuration information of M antenna ports to a first network device and transmits signals of the M antenna ports to the first network device, which receives the signals of the M antenna ports transmitted by the second network device based on the configuration information, where M is a positive integer; in the present embodiment, the first network device may be user equipment (UE), and the second network device may be a base station; alternatively, the first network device may be user equipment, and the second network device may be user equipment; alternatively, the first network device may be a base station, and the second network device may be a base station.

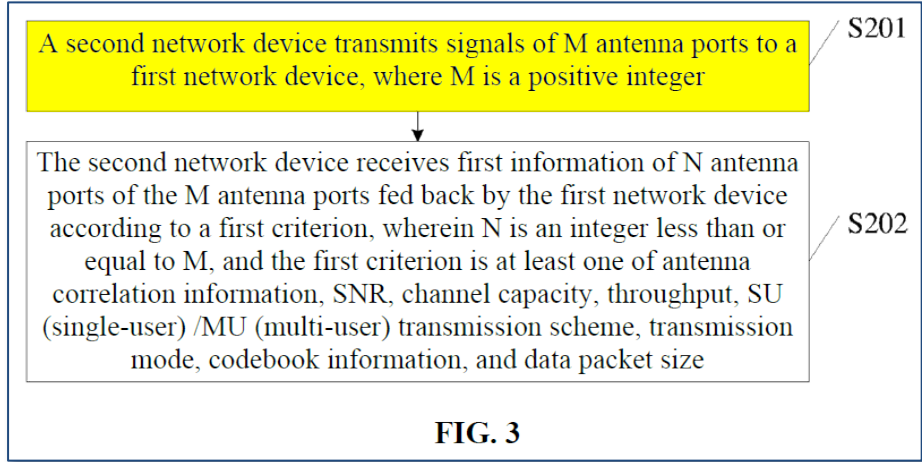
Liu (Ex. 1006), 15; see also Liu, 23, 24, 32

for example, the M antenna ports are divided into X groups, and the base station individually configures one codebook set for each antenna port group. The user equipment

Liu (Ex. 1006), 21

UE measures the 5 groups of antenna ports corresponding to these 5 cells and discovers that the received signal power is strongest for ports0,1 corresponding to cell 1; for example, $RSRP1 > RSRP2 > RSRP3 > RSRP4 > RSRP5$, with RSRP1 representing the received signal power corresponding to cell 1, RSRP2 representing the received signal power corresponding to cell 2, and RSRPn representing the received signal power corresponding to cell n. However, if

Liu (Ex. 1006), 26



Liu (Ex. 1006), FIG. 3 (S201)

E.g., '571 Pet. 13-14, 16-17; '571 POR 20-22; '571 Reply 9-14

The '571 Petition shows that *Liu* discloses element [1d1] (IPR2023-00571)

The “second network device [BS]... transmits signals of the M antenna ports to the first network device [UE], which receives the signals of the M antenna ports transmitted by the second network device based on the configuration information....” *Liu*, 15, FIG. 1 (S101). *Liu* describes “wireless systems,” *Liu*, 1, making the M or X antenna port group “signals” received by the UE “wireless signals.” Kakaes ¶102. A POSITA would have understood that an “antenna” or antenna port transmits and receives radiated wireless signals, confirming *Liu*’s disclosure that a “first wireless signal” is sent between the base station and UE using the base station’s antenna port groups because the signal is broadcast in different directions from different antenna ports. *Id.* Dr. Kakaes explains that, because *Liu* teaches that the measured signals are used during antenna port selection—or “RRM,” radio resource management—a POSITA would have recognized that *Liu*’s wireless signals are the conventional reference signals that were well-known wireless signals in prior art systems. Kakaes ¶¶103, 58, 61-64, 66-67, 69; see *Kim*, [0051]-[0053], [0063], [0070] (describing reference signals

’571 Pet. 13-14

Liu’s base station transmits the first wireless signal using M individual antenna ports, which correspond to K antenna port groups having one port per group. Kakaes ¶110; Ex. 1001, 13:64-65 (stating that antenna port group may include only one port), 2:45-46. Alternatively, the base station transmits the first

* * *

Liu’s base station “transmits signals of the M antenna ports” to the UE, “which receives the signals of the M antenna ports.” *Liu*, 15; see also *Liu*, 23, 24, 32, FIG. 1 (S101), FIG. 3 (S201), FIG. 3 (S301). A POSITA would have understood that the base station “transmit[ting] signals of the M antenna ports” describes transmitting the first wireless signal using the M (K) antenna port groups where each group corresponds to one port. Kakaes ¶111.

’571 Pet. 16

codebook set C1 for antenna configuration 1.” *Liu*, 21. *Liu*’s UE “measures the 5 groups of antenna ports corresponding to these 5 cells” and records the received signal power (RSRP) for each cell’s wireless signal, which confirms a POSITA’s understanding that each group of antenna ports (e.g., cell) is used to transmit a corresponding wireless signal. *Liu*, 26; Kakaes ¶112. And these are the same wireless signals discussed in [1b]. Kakaes ¶112.

’571 Pet. 17

E.g., ’571 Pet. 13-14, 16-17; ’571 Reply 10, 14-16

Kim transmits N CSI-RS (first wireless signal, management set) using N antenna ports (K antenna port groups)

[0076] In FIG. 6, CSI-RSs are mapped to REs on a per-antenna port basis according to a specific CSI-RS configuration by Equation 1 and Equation 2. In FIG. 3, R0 to R3 denote that CRSs are mapped to respective antenna ports, and each number represents that CSI-RS is mapped to each antenna port. For example, RE denoted by 0 or 1 may be mapped to CSI-RS corresponding to antenna port 0 or 1. In this case, CSI-RS corresponding to two antenna ports may be mapped to the same RE, and each CSI-RS may be identified by different orthogonal codes.

Kim (Ex. 1027), [0076]

[0071] More specifically, CSI-RSs may be transmitted through 1, 2, 4 or 8 antenna ports. Antenna port 15 may be used for one antenna port, antenna ports 15 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.

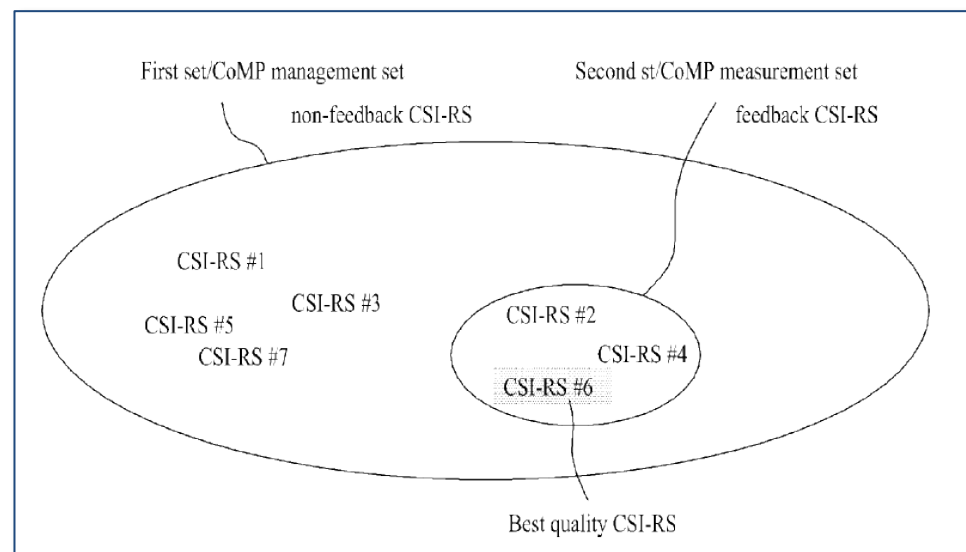
Kim (Ex. 1027), [0071]

[0053] If 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. Accordingly, a reference signal is present per transmission antenna and, more particularly, per antenna port.

Kim (Ex. 1027), [0053]

referred to as a non-feedback CSI-RS. For example, as can be seen from FIG. 9, CSI-RSs (#2, #4, #6) contained in the CoMP measurement set from among CSI-RSs (#1~#7) contained in the CoMP management set may be allocated to feedback CSI-RSs, and the remaining CSI-RSs may be allocated to non-feedback CSI-RSs.

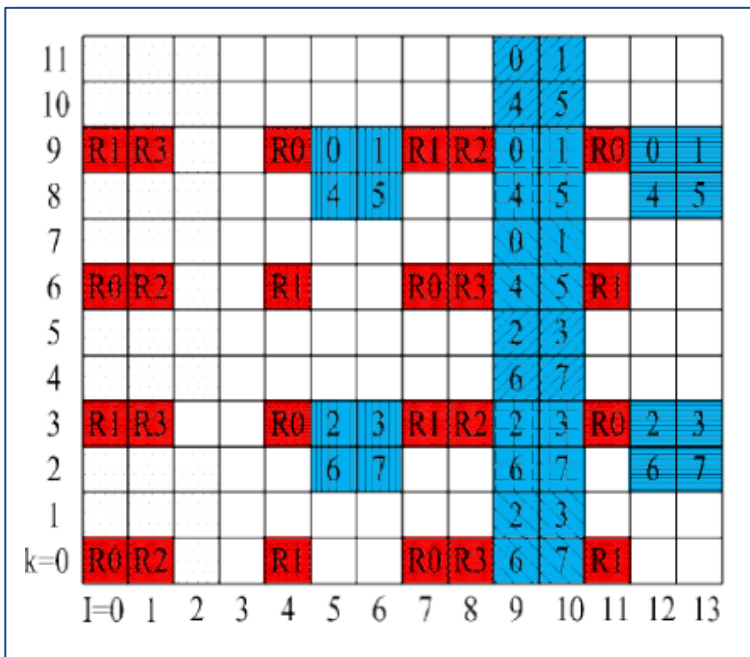
Kim (Ex. 1027), [0119] (excerpted)



Kim (Ex. 1027), FIG. 9

E.g., '747 Pet. 12-13, 16-18, 19 n.7, 22-25, 25-26; '747 Reply 9-14

The '747 Petition shows that *Kim* discloses [1d1] (IPR2023-00747)



'747 Pet. 17 (annotating *Kim*, FIG. 6)

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

'747 Pet. 19 n.7

base stations. Kakaes ¶106. In one example, *Kim* describes multiple antenna ports transmitting CSI-RS wireless signals “according to the number of transmit antennas of the base station,” such that “antenna ports 0 to 3” are transmitting from the base station or, in another example, “antenna ports 15 to 18 for four antenna ports, and antenna ports 15 to 22 for eight antenna ports” are transmitting. *Kim*, [0065], [0066], [0071].

'747 Pet. 13

FIG. 6 shows an example of how the base station identifies K CSI-RS antenna port groups using configuration information. Kakaes ¶114. In FIG. 6, “CSI-RSs are mapped to REs on a per-antenna port basis according to a specific CSI-RS configuration,” where “each number represents that CSI-RS is mapped to each antenna port,” where “RE denoted by 0 or 1 may be mapped to CSI-RS corresponding to antenna port 0 or 1,” as shown below, and so on for each CSI-RS antenna ports 0 through 7 (e.g., 8 antenna port groups) (blue). *Kim*, [0076], FIG. 6; Kakaes ¶114. Similarly, “R0 to R3 [(red)] denote that CRSs are mapped to [four]

'747 Pet. 16-17

E.g., '747 Pet. 12-13, 16-18, 19 n.7, 22-25, 25-26; '747 Reply 9-14

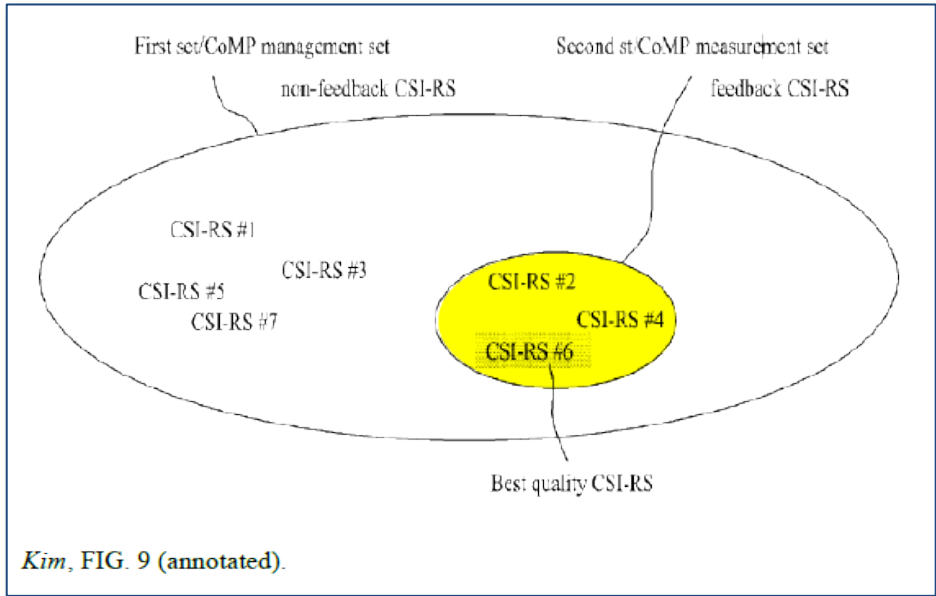
The '747 Petition shows that *Kim* discloses [1d1] (IPR2023-00747)

The antenna port groups specified for CSI-RS measurements may include a “management set” of transmitted signals where the subset or “measurement set” meeting a particular criterion (such as RSRP ratio threshold, *infra* § V.A.1.i ([1d5])) is reported back to the base station. Kakaes ¶125; *Kim*, [0130]. One example is shown in *Kim*’s FIG. 9 below, the management set of CSI-RS #1-#7 (white oval) identified by the base station for reporting RSRP values in the configuration information for feeding back to the base station, and the measurement set of CSI-RS #2, CSI-RS #4, and CSI-RS #6 (yellow) is reported back based on the measured values. *Kim*, [0111] (“BS sets configurations of [CSI-

’747 Pet. 24

[0053]; *supra* § V.A.1.c ([1b]). The CSI-RSs wireless signals “may be transmitted” to the UE “through 1, 2, 4 or 8 antenna ports” of the base station. *Kim*, [0071]; Kakaes ¶113. Each CSI-RS is “mapped to REs on a per-antenna port basis”⁶ at the base station for transmission. *Kim*, [0074], [0076]; Kakaes ¶113.

’747 Pet. 16



Kim, FIG. 9 (annotated).

’747 Pet. 25 (annotating *Kim*, FIG. 9)

E.g., ’747 Pet. 12-13, 16-18, 19 n.7, 22-25, 25-26; ’747 Reply 9-14

Liu and Kim disclose the same first wireless signal transmission as the '271 patent: K antenna ports transmitting K CSI-RSs (IPR2023-00571, -00747)

In one embodiment, the K antenna port groups respectively correspond to K reference signal groups. The K reference signal groups are respectively transmitted through the K antenna port groups. The first wireless signal is composed of the K reference signal groups.

Ex. 1001, 3:22-26

As a sub-embodiment, the K antenna port groups respectively correspond to K reference signal groups.

* * *

As a sub-embodiment, the reference signal group includes only one reference signal.

Ex. 1001, 13:62-63, 13:66-67

In one embodiment, the first wireless signal is an CSI-RS burst.

Ex. 1001, 3:16-17

As a sub-embodiment, the first wireless signal is composed of the K reference signal groups.

As a sub-embodiment, the first wireless signal is composed of K beam-formed CSI-RSs.

Ex. 1001, 14:5-8

In one embodiment, the reference signal is a Channel State Information Reference Signal (CSI-RS).

Ex. 1001, 3:3-4

E.g., '571 Reply 9-14, 15-16; '747 Reply 9-15

Petitioner's expert confirmed that the '271 patent teaches the same transmitting the first wireless signal as *Liu* and *Kim* (IPR2023-00571, -00747)

Q Is it your opinion that the M antenna ports of Liu transmit M wireless signals?

A So, the M wireless signals that I'm discussing there are collectively from the first wireless signal required by the claim.

So, which is consistent with what the '271 Patent taught, is that a number of signals or just quote the claim, the patent, the '271 Patent to be exact -- give me one second.

So, in the '271 Patent in column 3, at line -- I will say line 16 to 17, it states, "In one embodiment the first wireless signal is a CSI RS burst."

A CSI RS burst is a channel state information reference signal burst, meaning it consists of several CSI RSs, and that's what the M wireless signals form together, a burst, which is the first wireless signal consistent with the teachings of the '271 Patent.

Kakaes Tr. (Ex. 2005), 21:21-22:19

Q In your opinion cell selection discloses a CSI RS burst?

A You're mischaracterizing what I said.

What I said is when one reads Liu, Liu's disclosure in its full context, the fact that Liu discusses the reception of the reference signals and specifically the evaluation of the reference signal received power of each antenna port group in the process of performing cell selection, means that that collection of RSRP of each antenna port group was burst, to use the language of the '271 Patent, and therefore it meets that limitation.

So, again, I'm not picking one specific word of Liu, I'm reading Liu in its proper context.

Kakaes Tr. (Ex. 2005), 35:7-24

E.g., '571 Reply 10-13; '747 Reply 11-13; Kakaes Tr. (Ex. 2005), 21:21-42:7, 48:3-17

Petitioner's expert confirmed that the '271 patent teaches the same transmitting the first wireless signal as *Liu* and *Kim* (IPR2023-00571, -00747)

Q Is it your opinion that having an SNR or RSRP of each antenna port group necessarily implies a CSI RS burst?

A The '271 Patent explained that in one embodiment the first wireless signal is a channel state information reference signal burst.

So, the channel state information reference signal burst is a set of channel state information reference signals, and Liu's disclosure of the reference signal received power is -- for each antenna port group, is an example of having such -- the situation of having a wireless signal which consists of the reference -- consists of the reference signals transmitted in that set of antenna port groups as required by the '271 Patent.

Kakaes Tr. (Ex. 2005), 32:5-22

Q Does your declaration describe a CSI RS burst in Liu?

A Yes, it does.

Q Where does your declaration describe that?

A For example, in paragraph 115, where I -- towards the bottom of the page, 72, where I say, where I explain that the user equipment uses this information to determine and measure the antenna port groups, such as calculating the SNR or RSRP of each antenna port group.

So, this is the calculating the RSRP of each antenna port group is the burst, that is what the '271 Patent calls the burst.

Kakaes Tr. (Ex. 2005), 30:22-31:13

E.g., '571 Reply 10-13; '747 Reply 11-13; Kakaes Tr. (Ex. 2005), 21:21-42:7, 48:3-17

Patent Owner asserts that *Liu* and *Kim* operate similarly when transmitting the first wireless signal (IPR2023-00571, -00747)

signal.” Ex. 2004, ¶ 38. Liu does not disclose multiple groups of antenna ports to collectively transmit a signal. *Id.* Rather Liu discloses only a singular antenna port for transmitting each singular signal (*i.e.*, a one-to-one mapping of ports to signals). *Id.* For example, Liu describes transmitting *signals* of the M antenna ports, implying one signal from each antenna port:

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

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

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

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

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

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

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

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

’571 POR 20-21

signal.” Ex. 2004, ¶ 37. Kim does not disclose at least 2 groups of antenna ports that collectively transmit a signal. *Id.* Rather Kim discloses only a singular antenna port for transmitting each singular signal (*i.e.*, a one-to-one mapping of ports to signals):

The CSI-RSs generated by Equation 1 may be *mapped to REs on a per-antenna port basis*.

Id. (citing Ex. 1027, [0074]).

In FIG. 6, CSI-RSs are *mapped to REs on a per-antenna port basis* according to a specific CSI-RS configuration by Equation 1 and Equation 2. In FIG. 3, R0 to R3 denote that *CRSs are mapped to respective antenna ports*, and each number represents that CSI-RS is *mapped to each antenna port*. For example, RE denoted by 0 or 1 may be *mapped to CSI-RS corresponding to antenna port 0 or 1*.

Id. (citing Ex. 1027, [0076]). Petitioner’s expert confirms this understanding that each CSI-RS in Kim is mapped to resource elements and transmitted on a per antenna port basis in Kim:

Q. Is it your understanding that each CSI RS in Kim is mapped to each antenna port in Kim?

A. It’s mapped to resource elements on a per antenna port basis, as I explain there.

Q. Is it your opinion that each CSI RS in Kim is mapped to each antenna port?

A. It’s mapped to resource elements for each antenna port.

’747 POR 20-21

E.g., ’571 POR 20-21; ’747 POR 20-21; ’747 Reply 9, 11

Patent Owner incorrectly alleges that Petitioner relies on the '271 patent for unpatentability; Petitioner does not rely on '271 patent for unpatentability (IPR2023-00571, -00747)

9-10. But the '271 Patent specification is not prior art, nor is it properly combinable with Liu. Petitioner's attempt to map what Dr. Kakaes refers to as CSI-RS burst functionality from certain portions of Liu to the '271 Patent is not a basis for Petitioner to import other parts of the '271 specification to fill in for missing disclosure in Liu, as it attempts to do in the Reply. See Reply at 9-10. This amounts to a conclusory argument that a POSITA would already know the entire specification of the challenged patent, based on its expert's assertion that CSI-RS burst functionality (which neither the patent nor references refers to) is present in both. This argument is improper, unsupported, and in any case should be rejected because it is plainly not in the Petition. See Pet. at 16-17.

'571 Sur-reply 10-11

Petitioner's new argument on Reply also nonsensically relies on disclosure of the '271 Patent itself, which it improperly and belatedly attempts to import into Kim. But the '271 Patent specification is not prior art, nor is it properly combinable with Kim. Petitioner attempts to map what Dr. Kakaes refers to as "CSI-RS burst functionality" from certain portions of another reference advanced in IPR2023-00571 (Liu) to the '271 Patent, and now argues (without support) that Kim includes the same functionality as Liu. Every step of this analysis is flawed. The assertion that the third prior art reference shares some functionality with the '271 Patent is not a basis for Petitioner to import other parts of the '271 specification to fill in for missing disclosure in Kim, as it attempts to do in the Reply. See Reply at 9-10. This amounts to a conclusory argument that a POSITA would already know the entire specification of the challenged patent, based on its expert's assertion that CSI-RS burst functionality (which neither the patent nor references refers to) is present in both. This argument is improper, unsupported, and in any case should be rejected because it is plainly not in the Petition. See Pet. at 16-17.

'747 Sur-reply 10

E.g., '571 Sur-reply 10-11; '747 Sur-reply 10; '571 Reply 10, 15-16; '747 Reply 10-11, 14-15

Petitioner's reply arguments are proper



“We hold that where a patent owner in an IPR first proposes a claim construction in a patent owner response, a petitioner must be given the opportunity in its reply to argue and present evidence of anticipation or obviousness under the new construction, at least where it relies on the same embodiments for each invalidity ground as were relied on in the petition.”

Axonics, Inc. v. Medtronic, Inc., 75 F.4th 1374, 1384 (Fed. Cir. 2023)

**Construction of
“a first proportional sequence corresponds to
a ratio(ratios) among the K1 channel quality values” [1d5]
(IPR2023-00571, -00747)**

Patent Owner’s construction of element [1d5] is incorrect;
no construction is necessary

Term	Petitioner’s Position	Patent Owner’s Construction (POR)	Patent Owner’s Construction (Sur-Reply)
“a first proportional sequence corresponds to a ratio(ratios) among the K1 channel quality values” [1d5]	No construction necessary	“a sequence of <u>K1</u> proportions, where each of the <u>K1</u> proportions <u>is a ratio between one channel quality value to itself or to another of the K1 channel quality values</u> ”	“a sequence of K1 proportions, where each of the K1 proportions <u>is a ratio between one channel quality value to itself or to another of the K1 channel quality values</u> ”

- Patent Owner did not offer construction in district court
- The Board need not construe element [1d5] because *Liu+Park* and *Kim* teach Patent Owner’s constructions

E.g., ‘571 Pet. 4; ‘747 Pet. 3; ‘571 Reply 8, 21-22; ‘747 Reply 8, 21-22; ‘571 POR 14-18; ‘747 POR 14-17; ‘571 Sur-reply 7; ‘747 Sur-reply 6-7

The '271 patent does not require K1 proportions

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).

Ex. 1001, claim 2; *see also id.* at claims 7, 12, 17

In one embodiment, the first proportional sequence includes K1-1 positive real number(s). The K1-1 positive

Ex. 1001, 4:29-30

In one embodiment, 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 includes K1-1 positive real number(s), and the K1-1 positive real numbers is(are) a ratio(ratios) between the channel quality values 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 a quantized value(s) corresponding to K1-1 positive real number(s).

Ex. 1001, 5:34-45; *see also id.* at 8:60-9:4

E.g., '571 Reply 5-7; '747 Reply 5-7

The proportional sequence does not need to be the specific ratio required by Patent Owner's construction

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

* * *

quality values are K non-negative real numbers; the K channel quality values are Reference Signal Received Powers (RSRPs) or a Signal to Interference plus Noise Ratios (SINRs); $K1$ antenna port groups of the K antenna port groups correspond to $K1$ channel quality values of the K channel quality values; the $K1$ is a positive integer less than or equal to the K ; a first proportional sequence corresponds to a ratio(ratios) among the $K1$ channel quality values; the first information is used to determine the $K1$ antenna port groups and the first proportional sequence; the first signaling is used to determine a target threshold; the target threshold is a non-negative real number; 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; a ratio between the second channel quality and the first channel quality is greater than or equal to the target threshold.

Ex. 1001, claim 1, *see also id.* at claims 6, 11, 16

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).

Ex. 1001, claim 2; *see also id.* at claims 7, 12, 17

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

Ex. 1001, 4:34-36

E.g., '571 Reply 7-8; '747 Reply 7-8

***Liu* discloses or *Liu* and *Park*
render obvious [1d5]
(IPR2023-00571)
and
Kim discloses [1d5]
(IPR2023-00747)**

The prior art discloses or renders obvious [1d5]

- IPR2023-00571:
 - *Liu* and *Park* render obvious a sequence of N (K1) RSRP-to-max(RSRP) ratios
 - Alternatively, *Liu* discloses a sequence of N (K1) RSRQ ratios
- IPR2023-00747:
 - *Kim* discloses a sequence of M (measurement set) RSRP-to-max(RSRP) ratios

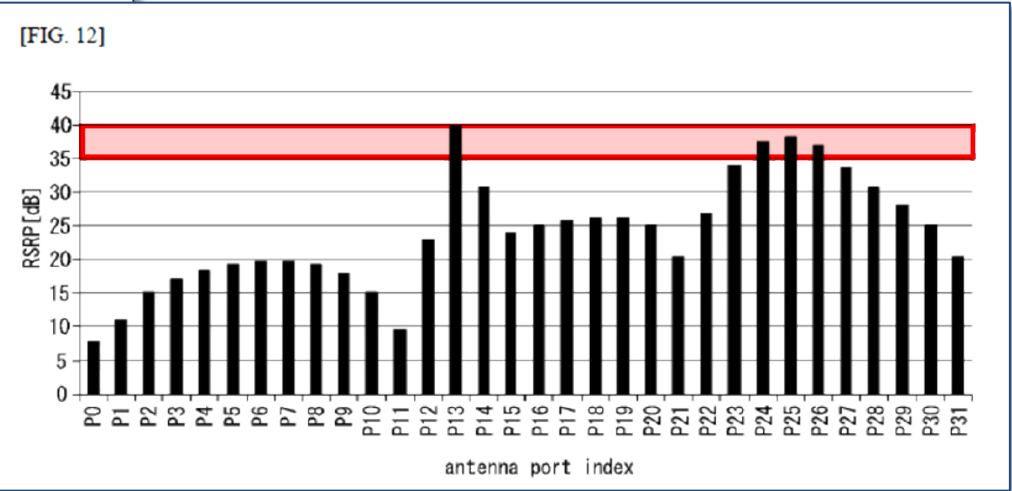
E.g., '571 Reply 8, 21-22; '747 Reply 8, 21-22

Liu and Park renders obvious [1d5] by disclosing the RSRP-to-max(RSRP) sequence of reported (K1) values (IPR2023-00571)

- [371] A UE in which a plurality of RRM-RSs has been configured measures the RSRP of each antenna port of each of RRM-RS. If R RRM-RSs have been configured in a UE and the number of antenna ports of the r^{th} RRM-RS is M_r , then the RSRP of the m^{th} antenna port of the r^{th} RRM-RS is defined as $\text{RSRP}(r, m)$. The UE aligns the $\text{RSRP}(r, m)$, and reports the RSRP of L antenna ports chosen from among these that are strongly received.
- [372] By slightly modifying the above scheme, the UE aligns the $\text{RSRP}(r, m)$ and selects the RSRPs of antenna ports that belong to the aligned $\text{RSRP}(r, m)$ and that are received strongly, and limits reporting to RSRPs of ports that are within a certain difference compared to the RSRP of the selected antenna ports, in other words, $\max(\text{RSRP}(r, m))$. Thus, the RSRP of a maximum of L antenna ports, which have an RSRP difference greater than a certain threshold value expressed as an RSRP ratio or dB scale, is reported as follows.
- [373] [Equation 13]

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

Park (Ex. 1009), [371]-[373]



'571 Kakaes (Ex. 1003), ¶131 (annotating *Park*, FIG. 12)

E.g., '571 Pet. 22-27; see also '571 Pet. 27-29; '571 Reply 17-21

Petitioner's expert explained how *Liu* and *Park* render obvious the proportional sequence of [1d5] (IPR2023-00571)

128. *Park* teaches that the user equipment “aligns the RSRP(r,m), and reports the RSRP of L antenna ports chosen from among these that are strongly received,” where RSRP(r,m) is “the RSRP of the mth antenna port of the rth RRM-RS [radio resource management reference signal].”⁸ *Park*, [371], *see also Park*, [292], [324] (describing RRM), [359] (describing RRM-RS). To determine the “strongly received” antenna port signals, *Park* aligns each measured RSRP “and limits reporting to RSRPs of ports that are within a certain difference compared to the RSRP of the selected antenna ports, in other words, max(RSRP(r,m))” and reports the antenna ports having “an RSRP difference greater than a certain threshold value expressed as an RSRP ratio or dB scale.” *Park*, [371]-[373] (emphasis added). As I discussed above, a POSITA reading *Park* would have recognized that an “RSRP ratio” describes the power ratio $\text{RSRP}(r,m)/\text{max}(\text{RSRP}(r,m))$ because it is contrasted with the alternative “dB scale” option. *Park*, [371]-[373].

'571 Kakaes (Ex. 1003), ¶128

129. The description of FIG. 12 confirms that *Park* compares each measured RSRP to the max(RSRP), which together form a proportional sequence of ratios, as described above. *Park*, [376]-[378], FIG. 12. *Park* performs the same RSRP ratio comparison for individual antenna ports and for “an antenna port group,” where the “base station may designate the [antenna port] group.” *Park*,

'571 Kakaes (Ex. 1003), ¶129 (excerpted) *E.g.*, '571 Pet. 22-27; *see also* '571 Pet. 27-29; '571 Reply 17-21; '571 Kakaes (Ex. 1003), ¶¶127-138, 140

is on the average proportional to SNR). Knowing the proportional strength of each received antenna port group's signal would have allowed for a determination of which of the received signals (e.g., N or K1 antenna port group signals within the M or X antenna port groups) has sufficient strength to support transmit diversity over multiple beams. *See Liu*, 7 (“selecting N antenna ports from among M antenna ports ... that causes SNR to be less than or equal to or greater than or equal to a second threshold value after beamforming or transmit diversity”), 27, 34.

'571 Kakaes (Ex. 1003), ¶136 (excerpted)

140. As explained in element [1d5], the combination of *Liu* and *Park* renders obvious using the channel state information (CSI), such as RSRP, (“first information”) to determine the first proportional sequence and to select the N (e.g., K1 in the '271 patent) antenna port groups of the M or X (K in the '271 patent) antenna port groups. *Supra* § XI.A.1.i ([1d5]).

'571 Kakaes (Ex. 1003), ¶140

Liu and *Park* render obvious [1d5] under both parties' constructions (IPR2023-00571)

[371] A UE in which a plurality of RRM-RSs has been configured measures the RSRP of each antenna port of each of RRM-RS. If R RRM-RSs have been configured in a UE and the number of antenna ports of the r^{th} RRM-RS is M_r , then the RSRP of the m^{th} antenna port of the r^{th} RRM-RS is defined as $\text{RSRP}(r, m)$. The UE aligns the $\text{RSRP}(r, m)$, and reports the RSRP of L antenna ports chosen from among these that are strongly received.

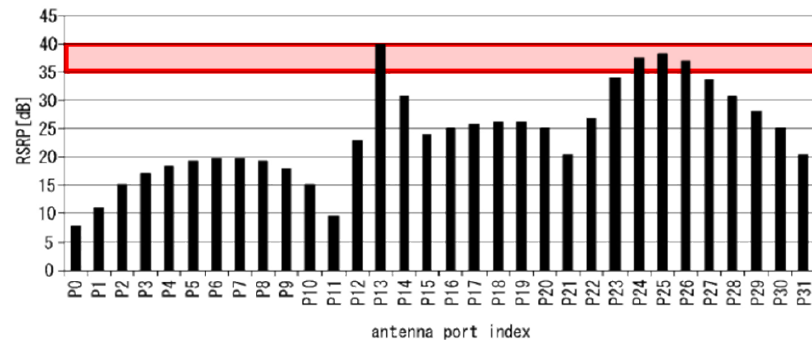
[372] By slightly modifying the above scheme, the UE aligns the $\text{RSRP}(r, m)$ and selects the RSRPs of antenna ports that belong to the aligned $\text{RSRP}(r, m)$ and that are received strongly, and limits reporting to RSRPs of ports that are within a certain difference compared to the RSRP of the selected antenna ports, in other words, $\max(\text{RSRP}(r, m))$. Thus, the RSRP of a maximum of L antenna ports, which have an RSRP difference greater than a certain threshold value expressed as an RSRP ratio or dB scale, is reported as follows.

[373] [Equation 13]

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

Park (Ex. 1009), [371]-[373]

[FIG. 12]



'571 Kakaes (Ex. 1003), ¶131 (annotating *Park*, FIG. 12)

128. *Park* teaches that the user equipment “aligns the $\text{RSRP}(r, m)$, and reports the RSRP of L antenna ports chosen from among these that are strongly received,” where $\text{RSRP}(r, m)$ is “the RSRP of the m^{th} antenna port of the r^{th} RRM-RS [radio resource management reference signal].”⁸ *Park*, [371], see also *Park*, [292], [324] (describing RRM), [359] (describing RRM-RS). To determine the “strongly received” antenna port signals, *Park* aligns each measured RSRP “and limits reporting to RSRPs of ports that are within a certain difference compared to the RSRP of the selected antenna ports, in other words, $\max(\text{RSRP}(r, m))$ ” and reports the antenna ports having “an RSRP difference greater than a certain threshold value expressed as an RSRP ratio or dB scale.” *Park*, [371]-[373] (emphasis added). As I discussed above, a POSITA reading *Park* would have recognized that an “RSRP ratio” describes the power ratio $\text{RSRP}(r, m)/\max(\text{RSRP}(r, m))$ because it is contrasted with the alternative “dB scale” option. *Park*, [371]-[373].

'571 Kakaes (Ex. 1003), ¶128

E.g., '571 Pet. 22-27; see also '571 Pet. 27-29; '571 Reply 21-22

Liu's RSRQ disclosure discloses [1d5] (IPR2023-00571)

set C4 is configured for antenna configuration 4. During RRM measurement, the user equipment employs a random beamforming approach in the codebook set Ci corresponding to the pilot frequency of each antenna configuration to calculate and report the mean reference signal receiving power (RSRP) or reference signal receiving quality (RSRQ); for example, the user equipment at the pilot frequency of antenna configuration 1 uses all the codebooks in C1 to conduct random beamforming and obtain RSRP1; for the pilot frequency of antenna configuration 2, all the codebooks in C2 are used

Liu (Ex. 1006), 21

30, 16, 26 (discussing RSRP, RSSI, RSRQ), *supra* § XI.A.1.h ([1d4]). A POSITA would have recognized that RSRQ is “the ratio of RSRP to RSSI” for a particular Reference Signal. *Sesia LTE* at 514; *Park*, [295]. *Liu* also discloses a signal-to-noise ratio (SNR), which corresponds to a proportional sequence of the received signal power over the noise. *See, e.g., Liu*, 16, 23, 24, 25.

'571 Kakaes (Ex. 1003), ¶126 (excerpted)

22.3.1.2 Reference Signal Received Quality (RSRQ)

RSRQ is the ratio of RSRP to RSSI for an E-UTRA carrier. The RSSI part of RSRQ is

Sesia LTE (Ex. 1014), 514

E.g., '571 Pet. 22; '571 Reply 16-17

Kim's RSRP-to-max(RSRP) ratio sequence discloses [1d5] (IPR2023-00747)

[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. Alternatively, the measurement report value may also be defined as the ratio of the average Rx power level of the best CSI-RS to the n-th CSI-RS average Rx power level. Since the ratio of power level on a linear scale is defined as a difference in power level on a decibel scale, the above ration of power level (linear value) has the same meaning as a difference in power level (dB value).

Kim (Ex. 1027), [0136]

[0149] The above-mentioned scheme is slightly modified, the UE may report not only indexes of a maximum of M CSI-RSs (the RSRP ratio ($\text{RSRP}_n/\text{max}(\text{RSRP}_i)$) of which is higher than a predetermined threshold value) from among N CSI-RSs contained in the CoMP management set, but also the RSRP estimation result of the corresponding CSI-RS. That is, indexes of a maximum of M CSI-RSs configured to satisfy Equation 4 may be reported.

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

[Equation 4]

Kim (Ex. 1027), [0149]

sequence. Kim also states that this proportional sequence may be included in the measurement report sent 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], which a POSITA would have understood to be the RSRP values because “RSRP is defined as 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 contributions of REs that carry downlink” signals 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 (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.

'747 Kakaes (Ex. 1003), ¶132 (excerpted)

[0107] RSRP is defined as the linear average over the power contributions of REs that carry downlink CRSs.

Kim (Ex. 1027), [0107]

E.g., '747 Pet. 28-29; '747 Reply 15-20

Kim discloses [1d5] under both parties' constructions (IPR2023-00747)

[0149] The above-mentioned scheme is slightly modified, the UE may report not only indexes of a maximum of M CSI-RSs (the RSRP ratio ($\text{RSRP}_n / \max(\text{RSRP}_i)$) 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. That is, indexes of a maximum of M CSI-RSs configured to satisfy Equation 4 may be reported.

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

[Equation 4]

Kim (Ex. 1027), [0149]

value.” 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 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:

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

Kim, [0149]; see also [0136]. A POSITA would have understood that, because each of the RSRP values of the reported antenna ports (K1 antenna ports) satisfies the threshold ratio of Equation 4, the corresponding ratios comprise the first proportional sequence among the reported (K1) channel quality RSRP values because they would be compared against the measured values to determine a “maximum of M” that are above the threshold requirement, thus creating a sequence. Kim also states that this proportional sequence may be included in the measurement report sent 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], which a POSITA would have understood to be the RSRP values because “RSRP is defined as 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

‘747 Kakaes (Ex. 1003), ¶132 (excerpted)

E.g., ‘747 Pet. 28-29; ‘747 Reply 21-22

**Mr. Gomez is not a qualified expert
for the '271 patent**

The parties' competing definitions of POSITA

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.

'571 Pet. 9; *see also* '747 Pet. 8

In view of the Board's guidance, Patent Owner proposes that a POSITA would have had either (i) at least a master's degree in electrical engineering or a similar field and at least two years of experience working with telecommunications systems; or (ii) at least a bachelor's degree in electrical engineering or a similar field and at least five years of experience working with telecommunications systems. Ex. 2004, ¶ 20.

'571 POR 10-11; *see also* '747 POR 10

stage. Prelim. Resp. 9. We are persuaded, on the present record, that Petitioner's proposal is consistent with the problems and solutions in the '271 patent and prior art of record. We adopt Petitioner's definition of the level of skill for the purposes of this Decision, except that we do not include in our definition Petitioner's last sentence regarding additional relevant work experience compensating for less education and *vice versa*, as this sentence is vague.

'571 D.I. 10; *see also* '747 D.I. 11

E.g., '571 Pet. 9; '747 Pet. 8; '571 D.I. 10; '747 D.I. 11; '571 POR 10-11; '747 POR 10

Mr. Gomez lacks a Master's degree and MIMO experience

2. I received my Bachelor's degree in Electrical Engineering from Yale University in 1983.

'571 Gomez (Ex. 2004), ¶¶2;
see also '747 Gomez (Ex. 2004), ¶¶2

Education		
<u>Year</u>	<u>College or University</u>	<u>Degree</u>
1983	Yale University	BSEE

'571 Gomez (Ex. 2004), 29;
see also '747 Gomez (Ex. 2004), 29

From:	August 2006
To:	March 30, 2009
Organization:	ActSolar Inc.
* * *	
From:	February 1997
To:	December 1999
Organization:	Philips Semiconductor

'571 Gomez (Ex. 2004), 30, 32;
see also '747 Gomez (Ex. 2004), 30, 32

17 Which of those engineering
18 experiences involved wireless networking?

19 A. There was quite a few that involved
20 wireless networking. The Philips environment
21 required wireless local area networking, as well
22 as working with Microsoft, to understand their
23 early smartphone implementations that they were
24 coming out with on CE.

25 Also the ActSolar required
1 transmission of data from the rooftops down to
2 the -- down to the receivers. And so we were
3 using a protocol called Zigbee. I think it was
4 802.11.15 was the underlying technology to that
5 -- to that -- to Zigbee. And so, you know, I
6 built a number of radio systems over the years
7 related to transmitting various types of data.

8 Q. Are there any others besides those
9 that you just called out?

10 A. Those are the two primary ones that I
11 -- that I recall.

Ex. 1036, 47:17-48:11
E.g., '571 Reply 24-25; '747 Reply 24-25

Mr. Gomez lacks a Master's degree and MIMO experience

1 BY MR. HIGH:

2 Q. But none of them directly involved
3 4G?

4 MR. PYMENTO: Objection.

5 THE WITNESS: No.

6 BY MR. HIGH:

7 Q. Did any of the engineering
8 experiences involve 5G?

9 A. No.

Ex. 1036, 51:2-9

19 Q. Which of the engineering experiences
20 listed on your CV involved MIMO?

21 A. Well, I have a fair amount of
22 experience developing antenna systems in general
23 and, you know, I'm very familiar with all of the
24 technologies involved in MIMO, mostly on the
25 receiver side when I was looking at building a
1 phased array antenna. But I haven't actually
2 specifically built a product related to those
3 technologies.

Ex. 1036, 51:19-52:3

E.g., '571 Reply 24-25; '747 Reply 24-25

Appendix

'271 patent: Independent claim 1

1. A method for multi-antenna transmission in a user equipment (UE), comprising:
receiving, by the UE, a first signaling originating from a base station;
receiving, by the UE, a first wireless signal originating from the base station; and
transmitting, by the UE, first information to the base station;
wherein, K antenna port groups of the base station are used to transmit the first wireless signal; 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; the K antenna port groups respectively correspond to K channel quality values; the K channel quality values are K non-negative real numbers; the K channel quality values are Reference Signal Received Powers (RSRPs) or a Signal to Interference plus Noise Ratios (SINRs); K1 antenna port groups of the K antenna port groups correspond to K1 channel quality values of the K channel quality values; the K1 is a positive integer less than or equal to the K; a first proportional sequence corresponds to a ratio(ratios) among the K1 channel quality values; the first information is used to determine the K1 antenna port groups and the first proportional sequence; the first signaling is used to determine a target threshold; the target threshold is a non-negative real number; 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; a ratio between the second channel quality and the first channel quality is greater than or equal to the target threshold.

E.g., Ex. 1001, 27:14-47

'271 patent: Independent claim 6

6. A method for multi-antenna transmission in a base station, comprising:
transmitting, by the base station, a first signaling to a user equipment (UE);
transmitting, by the base station, a first wireless signal to the UE; and
receiving, by the base station, first information from the UE;
wherein, K antenna port groups of the base station are used to transmit the first wireless signal; 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; 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); 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; a first proportional sequence corresponds to a ratio(ratios) among the K1 channel quality values; the first information is used to determine the K1 antenna port groups and the first proportional sequence; the first signaling is used to determine a target threshold; the target threshold is a non-negative real number; 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; a ratio between the second channel quality and the first channel quality is greater than or equal to the target threshold.

E.g., Ex. 1001, 28:32-65

'271 patent: Independent claim 11

11. A user equipment (UE) for multi-antenna transmission comprising:

- a first receiver at the UE, receiving a first signaling originating from a base station;
- a second receiver at the UE, receiving a first wireless signal originating from the base station; and
- a third transmitter at the UE, transmitting first information to the base station;

wherein, K antenna port groups of the base station are used to transmit the first wireless signal; 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; 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); 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; a first proportional sequence corresponds to a ratio(ratios) among the K1 channel quality values; the first information is used to determine the K1 antenna port groups and the first proportional sequence; the first signaling is used to determine a target threshold; the target threshold is a non-negative real number; 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; a ratio between the second channel quality and the first channel quality is greater than or equal to the target threshold.

E.g., Ex. 1001, 29:50-30:16

'271 patent: Independent claim 16

16. A base station for multi-antenna transmission comprising:

- a first transmitter at the base station, transmitting a first signaling to a user equipment (UE);
- a second transmitter at the base station, transmitting a first radio signal to the UE; and
- a third receiver at the base station, receiving first information from the UE;

wherein, K antenna port groups of the base station are used to transmit the first wireless signal; 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; 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); 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; a first proportional sequence corresponds to a ratio(ratios) among the K1 channel quality values; the first information is used to determine the K1 antenna port groups and the first proportional sequence; the first signaling is used to determine a target threshold; the target threshold is a non-negative real number; 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; a ratio between the second channel quality and the first channel quality is greater than or equal to the target threshold.

E.g., Ex. 1001, 31:1-34

'271 patent: Dependent claims 2-5

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. The method according to claim 1, 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; a second proportional sequence corresponds to a ratio(ratios) among the K2 channel quality values; 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; 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.

'271 patent: Dependent claims 7-10

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. The method according to claim 6, 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; a second proportional sequence corresponds to a ratio(ratios) among the K2 channel quality values; 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; 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.

'271 patent: Dependent claims 12-15

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. The user equipment to claim **11**, 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; a second proportional sequence corresponds to a ratio(ratios) among the K2 channel quality values; 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; 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.

'271 patent: Dependent claims 17-20

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. The base station to claim 16, 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; a second proportional sequence corresponds to a ratio(ratios) among the K2 channel quality values; 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; 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.