

*In the United States Patent Trial and
Appeal Board*

**Apex Beam Tech. LLC
Patent Owner's Presentation**

**IPR2023-00603
U.S. Patent No. 10,944,527**

FABRICANT LLP
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**Before: John D. Hamann
Sean P. O'Hanlon
Scott Raevsky**
Administrative Patent Judges

Exemplary Challenged Claim

Claim 1: A method for multi-antenna transmission in a user equipment, comprising:

- receiving a first radio signal from a base station; and
- receiving a first signaling from the base station;

wherein the first radio signal is transmitted by K antenna port groups of the base station;

the antenna port group includes a positive integer number of antenna port(s);

a first antenna port group is one of the K antenna port groups;

the first signaling is used to determine a first time resource pool;

at least one of a first antenna virtualization vector and a second antenna virtualization vector is associated with the first antenna port group;

the first antenna virtualization vector is an antenna virtualization vector available to the base station in the first time resource pool;

the second antenna virtualization vector is an antenna virtualization vector available to the user equipment in the first time resource pool; and

the K is a positive integer greater than 1.

Grounds

Ground 1	Ground 2	Ground 3	Ground 4
Claims 1, 4-6, 9-11, 14-16, and 19-20 are not Obvious under 35 U.S.C. 103 over Kim and Zhang	Claims 1, 4-6, 9-11, 14-16, and 19-20 are not Obvious under 35 U.S.C. 103 over Kim, Zhang, and Kang	Claims 2-3, 7-8, 12-13, and 17-18 are not Obvious under 35 U.S.C. 103 over Kim, Zhang, and Park	Claims 2-3, 7-8, 12-13, and 17-18 are not Obvious under 35 U.S.C. 103 over Kim, Zhang, Kang, and Park

Claim Construction

“the first radio signal is transmitted by K antenna port groups of the base station”

“the first radio signal is transmitted by K antenna port groups of the base station” : “the first radio signal is collectively transmitted by K groups of antenna ports of the base station”

A person of ordinary skill in the art, including Petitioner’s expert, would understand from the explicit language of Claim 1 that “an antenna port group is a group of antenna ports” while antenna port groups are “more than one antenna port group”:

11 Q. What is your understanding of
12 that term, "antenna port group" or
13 "antenna port groups"?
14 A. Well, antenna -- well, antenna
15 port groups means it's more than one
16 antenna port group. So an antenna port
17 group is a group of antenna ports.

Ex. 2005, 22:11-17

18 Q. Do you see the claim limitation
19 that says -- and it's at the end of Claim
20 1 -- "the K is a positive integer greater
21 than 1"?
22 A. Yes, I do.

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

2 A. Two.

Ex. 2005, 22:18-23:2

“the first radio signal is transmitted by K antenna port groups of the base station”

A person of ordinary skill in the art, such as Mr. Gomez, would understand that the claimed first signal is not transmitted by each group separately, but rather transmitted by the K groups collectively (i.e., collectively as a unit):

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

Ex. 1001, 3:44-49

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.

Ex. 1036, 32:11-18.

“the first radio signal is transmitted by K antenna port groups of the base station”

Claim 1 requires that “the K is a positive integer greater than 1.” As Petitioner’s expert confirms, that means K is an integer that is at least 2.

K refers to the number of antenna port groups. While an embodiment indicates a singular group may contain one antenna port, at a minimum of 2 antenna port groups each comprising one antenna port, Claim 1 requires at least 2 antenna ports and at least 2 antenna port groups

Petitioner’s Reply indicates it only focuses on the use case of a single antenna port group with one antenna port:

18 Q. Do you see the claim limitation
19 that says -- and it's at the end of Claim
20 1 -- "the K is a positive integer greater
21 than 1"?

22 A. Yes, I do.

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

2 A. Two.

Ex. 2005, 22:18-23:2

Apex’s construction makes both “groups” and “ports” plural nouns, whereas the original language “antenna port groups” is a single plural noun, and there are K of them. The Board should reject Apex’s construction because it contradicts the plain language of the claim and the specification.

Apex’s construction appears to require that each group have a plurality of antenna ports. POR, 11-12. But the plain claim language is not so limited, and neither is the specification. To the contrary, the specification expressly states that “[i]n one embodiment, the antenna port group includes only one antenna port.”

Ex. 1001, 3:18-19.

Paper No. 15 (Petitioner’s Reply), at 5

IPR2023-00603, Paper 13 at 12-13
IPR2023-00603, Paper 17, at 2.

“time resource pool”

“time resource pool” : “collection of time resources for a shared use”

“time resource,” “time resource pool,” and “time resource sub-pool” each have different meanings:

Embodiment 4 illustrates a schematic diagram of a first time resource pool and a first time resource sub-pool, as shown in FIG. 4.

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

In a sub-embodiment 1 of Embodiment 4, the time resource is a subframe.

In a sub-embodiment 2 of Embodiment 4, the time resource is an OFDM symbol.

Ex. 1001, 15:26-40

Embodiment 5 illustrates a schematic diagram of a time-frequency resources occupied by second radio signal, as shown in FIG. 5. In FIG. 5, the slash-filled block is the time-frequency resource occupied by the second radio signal.

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

In a sub-embodiment 1 of Embodiment 5, the time resource is a subframe.

In a sub-embodiment 2 of embodiment 5, the time resource is an OFDM symbol.

In a sub-embodiment 3 of the embodiment 5, the time-frequency resource is a wireless resource block(s).

Ex. 1001, 15:44-61

“time resource pool”

“pool” requires a “shared” or “common” component, according to its plain and ordinary meaning:

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

8 A. It's a pool of time resources.

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

12 A. Time resource pool is the pool
13 of time resources. So yes, it's
14 different. Time resource is a time
15 resource. A time resource pool is a pool
16 of time resources.

17 Q. Could you describe what is a
18 pool?

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

Ex. 2005, 23:6-20

Pool, verb(2):
*to combine (things, such
as resources) in a common
pool or effort*

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

Pool, noun (COLLECTION):
A number of people or a
quantity of a particular thing,
such as money, *collected
together for shared use* by
several people or organizations

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

Ex. 2004, ¶ 36 (citing
[https://dictionary.cambridge.org/
us/dictionary/english/pool](https://dictionary.cambridge.org/us/dictionary/english/pool))

***Kim, Zhang, and Kang Do Not
Render Claim 1 Obvious***

“wherein the first radio signal is transmitted by K antenna port groups of the base station ”

Kim teaches that one of multiple CSI-RSs (Petitioner’s alleged “first radio signal”) each correspond to an antenna port group (instead of “K antenna port groups”)

[0058] CSI-RSs for massive MIMO are transmitted to each UE for each group of multiple antennas as illustrated in FIG. 4, so that CSI-RSs for more transmission antennas than the 8 transmission antennas supported by the LTE-A are transmitted.

Ex. 1004, [0058]

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

Ex. 1004, [0060]

[0082] FIG. 7 illustrates a grouping of a plurality of beams into five beam groups, wherein each beam group is transmitted in an individual time interval, according to an exemplary embodiment of the present invention.

[0083] Referring to FIG. 7, five beam groups 710 are illustrated, each antenna group includes 8 transmission antennas, and each antenna group transmits CSI-RSs by using one CSI-RS resource 700 for 8 ports in each transmission interval. Although CSI-RSs for massive MIMO are transmitted using a particular CSI-RS resource within a subframe as indicated by reference numeral 720, CSI-RSs for a large number of beams may be transmitted by performing transmission for different beam groups according to subframes.

Ex. 1004, [0082]-[0083]

Whether each of Kim’s antenna groups contain multiple ports is inapposite to the claimed multiple groups transmitting a single first radio signal (e.g., CSI-RS).

“the first signaling is used to determine a first time resource pool”

Petitioner improperly interprets the claimed “time resource pool” as the same as “time resource” because Petitioner ignores the term “pool” entirely.

Unlike the ’527 Patent, Petitioner makes no distinction between time resources and a pool of time resources, and at most, only discloses time resources.

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

Ex. 1001, 15:29-31

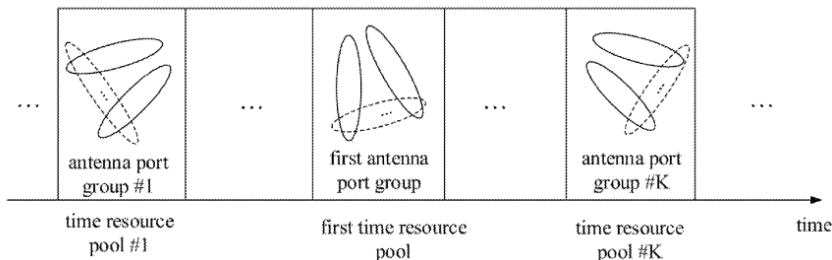
g. [1f]: “the first signaling is used to determine a first time resource pool;”

Kim discloses that the first signaling (signaling including the control information) is used to determine a first time resource pool. Kakaes, ¶105. For example, *Kim* discloses that the control information includes “positions of time and frequency resources at which a CSI-RS for each antenna group is transmitted.” *Kim*, ¶[0069]. Figures 5 and 7 of *Kim* show that CSI-RSs for each antenna port group are transmitted over separate time resources (subframes). *Kim*, ¶¶[0060], [0082]-[0083].

Paper No. 1 (Petition), at 20-21

“the first signaling is used to determine a first time resource pool”

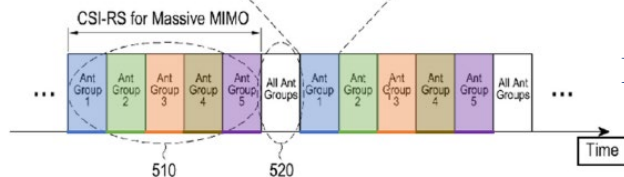
Fig. 9 of the '527 Patent clearly shows an entire time resource pool dedicated to each antenna port group. On the other hand, Petitioner admits that “CSI-RSs for each antenna port group” (i.e., one CSI-RS per antenna port group) is transmitted over **one** time resource (a subframe). The '527 Patent describes that a time resource pool is comprised of several time resources.



Ex. 1001, Fig. 9 (showing multiple time resources / group)

In Embodiment 4, the first time resource pool includes N_1 time resources; the first signaling indicates the distribution of the first time resource pool in the time domain. The
Ex. 1001, 15:29-31

Kim, ¶[0069]. Figures 5 and 7 of Kim show that CSI-RSs for each antenna port group are transmitted over separate time resources (subframes). Kim, ¶[0060], [0082]-[0083]. Paper No. 1 (Petition), at 20-21, 58.



Ex. 2004, Fig. 5

[0083] Referring to FIG. 7, five beam groups 710 are illustrated, each antenna group includes 8 transmission antennas, and each antenna group transmits CSI-RSs by using **one CSI-RS resource 700 for 8 ports in each transmission interval.**

Ex. 1004, [0083] (one time resource per CSI-RS per antenna group of 8 ports)

***Kim, Zhang, Kang, and Park Do
Not Render Claim 2 Obvious***

“operating a second radio signal in a first time resource sub-pool”

Petitioner only relies on Kim to disclose the claim limitation of “operating a second radio signal in a first time resource sub-pool.” Pet. at 58-59. As described earlier, Petitioner alleges that a subframe is the claimed first time resource pool.

A person of ordinary skill in the art, including Petitioner’s expert, would have understood the “first time resource sub-pool” to be a “subset” of the “first time resource pool”:

20	Q.	Sure. Does Figure 6 show a time
21		resource subpool?
22	A.	Yes, it does. It shows an
23		example of a subpool.
24	Q.	In this figure, can you describe
25		what the first time resource subpool is?
2	A.	As the word "subpool" suggests,
3		it's a subset of the pool. It's something
4		smaller than the pool. And in this
5		example, the first time resource subpool
6		that's indicated in Figure 6 consists of
7		Subframes No. 3 and No. 7.

Ex. 2005, 25:20-26:7

Since Kim does not disclose the claimed “first time resource pool” from which the claimed sub-pool depends upon, any combination of Kim, Zhang, Kang, and Park therefore cannot disclose, teach, or suggest “operating a second radio signal in a first time resource sub-pool” or “the second signaling is used to determine the first time resource sub-pool from the first time resource pool.”

Kim, Zhang, Kang, and Park
Do Not Render Claim 3 Obvious

Kim, Zhang, Kang, and Park Do Not Render Claim 3 Obvious

Claim 3 depends upon Claim 2.

For at least the same reasons as Claim 2, any combination of *Kim, Zhang, Kang, and Park* fails to render obvious Claim 3.

IPR2023-00603, Paper 13 at 30-31.

***Kim, Zhang, and Kang Do Not
Render Claims 4-5 Obvious***

Kim, Zhang, and Kang Do Not Render Claims 4-5 Obvious

Claims 4 and 5 depend upon Claim 1.

For at least the same reasons as Claim 1, any combination of *Kim, Zhang,* and *Kang* fails to render obvious Claims 4 and 5.

IPR2023-00603, Paper 13 at 24-25.

***Kim, Zhang, and Kang Do Not
Render Claims 6, 9, and 10 Obvious***

***Kim, Zhang, and Kang* Do Not Render Claims 6, 9, and 10 Obvious**

Claims 6, 9, and 10 recite: “method[s] for multi-antenna transmission in a base station”

- This mirrors the limitations of Claims 1, 4, and 5, which recite: “method[s] for multi-antenna transmission in a user equipment”
- Claims 6, 9, and 10 disclose methods from the perspective of the base station that is in communication with the UE in Claims 1, 4, and 5
- For at least the same reasons as Claims 1, 4, and 5, any combination of *Kim, Zhang, and Kang* fails to obviate Claims 6, 9, and 10

IPR2023-00603, Paper 13 at 24-25.

***Kim, Zhang, Kang, and Park Do
Not Render Claims 7-8 Obvious***

Kim, Zhang, Kang, and Park Do Not Render Claims 7-8 Obvious

Claims 7-8 recite: “method[s] for multi-antenna transmission in a base station”

- This mirrors the limitations of Claims 2-3, which recite: “method[s] for multi-antenna transmission in a user equipment”
- Claims 7-8 disclose methods from the perspective of the base station that is in communication with the UE in Claims 2-3
- For at least the same reasons as Claims 2-3, any combination of *Kim, Zhang, Kang, and Park* fails to obviate Claims 7-8

IPR2023-00603, Paper 13 at 30-31.

***Kim, Zhang, and Kang Do Not
Render Claims 11, 14, and 15 Obvious***

***Kim, Zhang, and Kang* Do Not Render Claims 11, 14, and 15 Obvious**

Claims 11, 14, and 15 recite “user equipment (UE) for multi-antenna transmission,” which are the apparatus claims of Claims 1, 4, and 5.

For at least the same reasons as Claims 1, 4, and 5, any combination of *Kim, Zhang, and Kang* fails to render obvious Claims 11, 14, and 15.

IPR2023-00603, Paper 13 at 24-25.

***Kim, Zhang, Kang, and Park Do Not
Render Claims 12-13 Obvious***

***Kim, Zhang, Kang, and Park* Do Not Render Claims 12-13 Obvious**

Claims 12-13 recite “user equipment (UE) for multi-antenna transmission,” which are the apparatus claims of Claims 2-3.

For at least the same reasons as Claims 2-3, any combination of *Kim, Zhang, Kang, and Park* fails to render obvious Claims 12-13.

IPR2023-00603, Paper 13 at 30-31.

***Kim, Zhang, and Kang Do Not
Render Claims 16, 19, and 20 Obvious***

Kim, Zhang, and Kang Do Not Render Claims 16, 19, and 20 Obvious

Claims 16, 19, and 20 recite “base station equipment for multi-antenna transmission” that mirrors the limitations of Claims 11, 14, and 15, which recite: “user equipment (UE) for multi-antenna transmission”

Claims 16, 19, and 20 disclose the base station equipment that is in communication with the UE in Claims 11, 14, and 15.

For the same reasons as Claims 11, 14, and 15, any combination of *Kim, Zhang, and Kang* fails to obviate Claims 16, 19, and 20.

IPR2023-00603, Paper 13 at 24-25.

***Kim, Zhang, Kang, and Park Do Not
Render Claims 17-18 Obvious***

Kim, Zhang, Kang, and Park Do Not Render Claims 17-18 Obvious

Claims 17-18 recite “base station equipment for multi-antenna transmission” that mirrors the limitations of Claims 12-13, which recite: “user equipment (UE) for multi-antenna transmission”

Claims 17-18 disclose the base station equipment that is in communication with the UE in Claims 12-13.

For the same reasons as Claims 12-13, any combination of *Kim, Zhang, Kang, and Park* fails to obviate Claims 17-18.

IPR2023-00603, Paper 13 at 30-31.

Patent Owner's Expert is Qualified to Offer Testimony

Patent Owner's Expert is Qualified to Offer Expert Testimony

Parties agreed on the definition of a POSITA in this proceeding:
“more than five years of relevant work and/or research experience can compensate for a lesser level of education”

Mr. Gomez has a Bachelor of Science Degree from Yale University in Electrical Engineering and over “thirty five years in the design and development of hardware and software technology used in telecommunications, data communications, wireless transmission and related protocols”

IPR2023-00603, Paper 17 at 6-9

Patent Owner's Expert is Qualified to Offer Expert Testimony

Mr. Gomez's Relevant Experience:

- Designed products that utilize the underlining technologies of Spread Spectrum (802.11a,b,g,n), LTE, OFDM, RF Transmission and Reception, which are in turn utilized by LTE and by 5G NR
- ROLM Corporation: designed transmission protocols for business telephone equipment (1983)
- Founding member of Stratacom Inc.: designed long haul voice and data routing equipment and developed compression algorithms for voice communications; designing methods to include data on the voice transmission paths that later became known as Frame Relay

IPR2023-00603, Paper 17 at 6-9

Patent Owner's Expert is Qualified to Offer Expert Testimony

Mr. Gomez's Relevant Experience:

- 1990 Consultant Work: worked on circuit design in “computing, telephony and data systems which included paging devices”
- ActSolar (Aug 2006 to Mar 2009): Vice President, tasked with implementing power conversion circuitry and radio system to convey the health status of the solar array to a web server

IPR2023-00603, Paper 17 at 6-9

Patent Owner's Expert is Qualified to Offer Expert Testimony

Petitioner's argument that Mr. Gomez is not qualified as a POSITA are based on an incorrect heightened standard

“A person may not need to be a person of ordinary skill in the art in order to testify as an expert under Rule 702, but rather must be ‘qualified in the pertinent art’” and “there is no requirement of a perfect match between the expert's experience and the relevant field.” Trial Practice Guide, 34

IPR2023-00603, Paper 17 at 6-9

Patent Owner's Expert is Qualified to Offer Expert Testimony

Mr. Gomez's Relevant Expert Experience:

- Engaged in several cases relating to OFCM
- *WiLan Inc. v. HTC Corp.*, No. 2:11-CV-68-JRG (September 2012-August 2013): supported WiLan investigating VHDL, Verilog, C, and C++ source code that implemented OFDM and SC-OFDMA
- *WiLan v. Acer*, No. 2:07-CV-473: investigated OFDM implementations used in 802.11a,b,g,n; supported WiLan investigating Verilog, C, and C++ source code that implemented OFDM

IPR2023-00603, Paper 17 at 6-9