

Petitioner's Demonstratives

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

Petitioner

v.

Apex Beam Technologies LLC,

Patent Owner

IPR2023-00603 - Patent No. 10,944,527

Samsung Exhibit 1038

Samsung v. Apex - IPR2023-00603

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Topics

- Instituted grounds
- High-level explanation of technology
- Established *prima facie* case of obviousness
- Disputed issues

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Instituted Grounds

- All claims of the '527 patent are challenged:
 - Claims 1-5: user equipment method
 - Claims 6-10: base station method
 - Claims 11-15: user equipment apparatus
 - Claims 16-20: base station apparatus

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

Topics

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- Established *prima facie* case of obviousness
- Disputed issues

Exemplary '527 Claim: Transmission Using Multiple Antenna Port Groups

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.

('527 patent, Claim 1.)

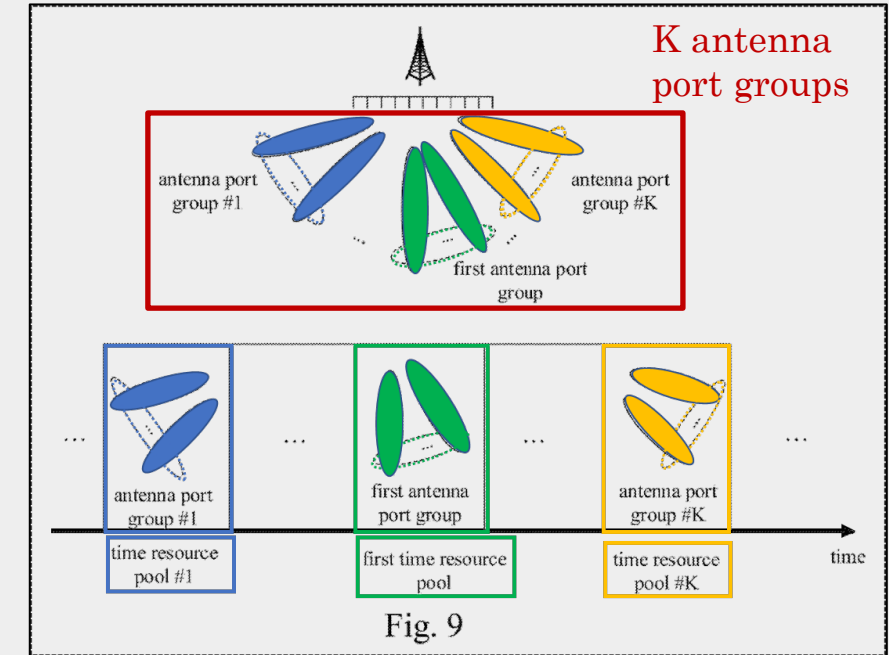


Fig. 9

In one embodiment, the foregoing method is advantageous in that, by associating the first time resource pool with the first antenna port group, the UE can quickly determine the location of the first time resource pool in the time domain by the index of the first antenna port group in the K antenna port groups.

('527 patent, 2:3-8, Fig. 9.)

Topics

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- High-level explanation of technology
- Established *prima facie* case of obviousness
- Disputed issues

Kim Discloses Transmitting a Radio Signal Using Multiple Antenna Port Groups

[0055] In order to satisfy the conditions as described above, an exemplary embodiment of the present invention proposes a method of transmitting a CSI-RS for a massive MIMO system by using CSI-RS resources of the related art introduced in the LTE-A. The CSI-RS resources of the related art introduced in the LTE-A support a maximum of 8 transmission antennas. Therefore, in order to use the CSI-RS resources of the related art, a method capable of transmitting a signal through scores or more transmission antennas is needed. In order to transmit a CSI-RS through scores or more transmission antennas by using limited resources as described above, an eNB divides the transmission antennas into a plurality of groups.

(Kim, [0055].)

[0060] Referring to FIG. 5, the CSI-RSs for massive MIMO are transmitted at different time intervals according to the respective antenna groups in FIG. 4. In FIG. 5, one time interval corresponds to one subframe in an LTE/LTE-A system. The subframe is a time unit used for resource allocation 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

(Kim, [0060].)

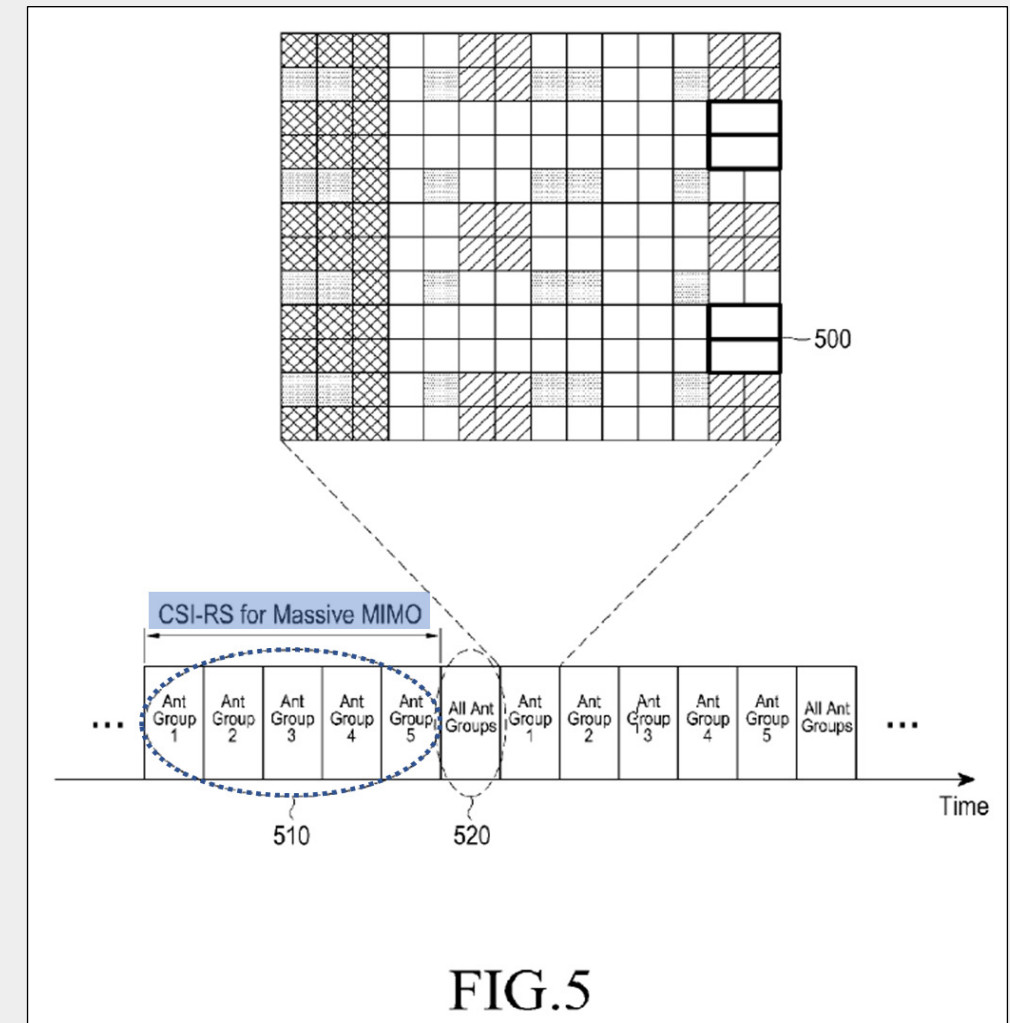


FIG.5

(Kim, Fig. 5.)

Kim Discloses Transmitting a Radio Signal Using Multiple Antenna Port Groups

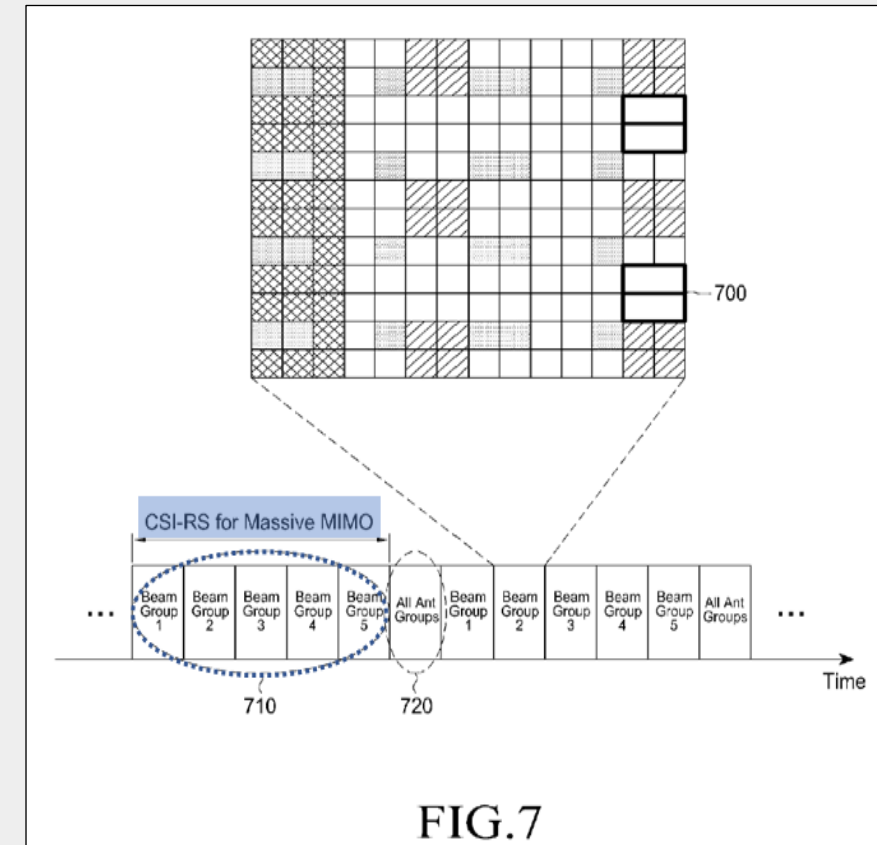
[0081] When CSI-RSs for massive MIMO are transmitted using a plurality of beams transmitted after being differently precoded, the plurality of beams may be grouped into a plurality of beam groups for transmission, as in the above case of grouping the multiple transmission antennas into multiple antenna groups for transmission.

[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.

(Kim, [0081]-[0082].)

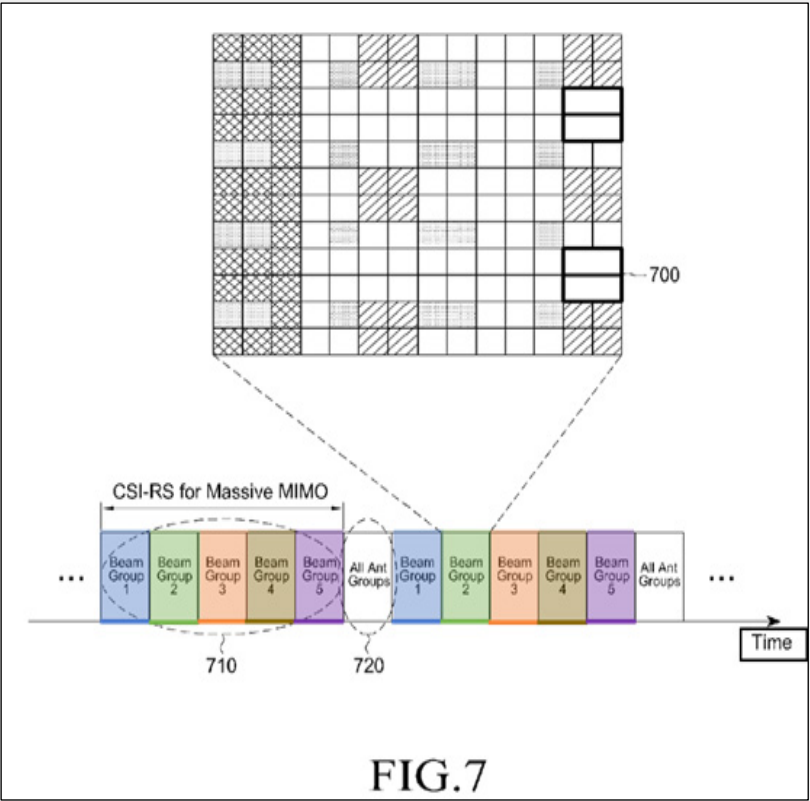
In Embodiment 9, the first antenna port group is one of the K antenna port groups. The K antenna port groups respectively correspond to K different beam groups. The K antenna

('527 patent, 17:1-3.)



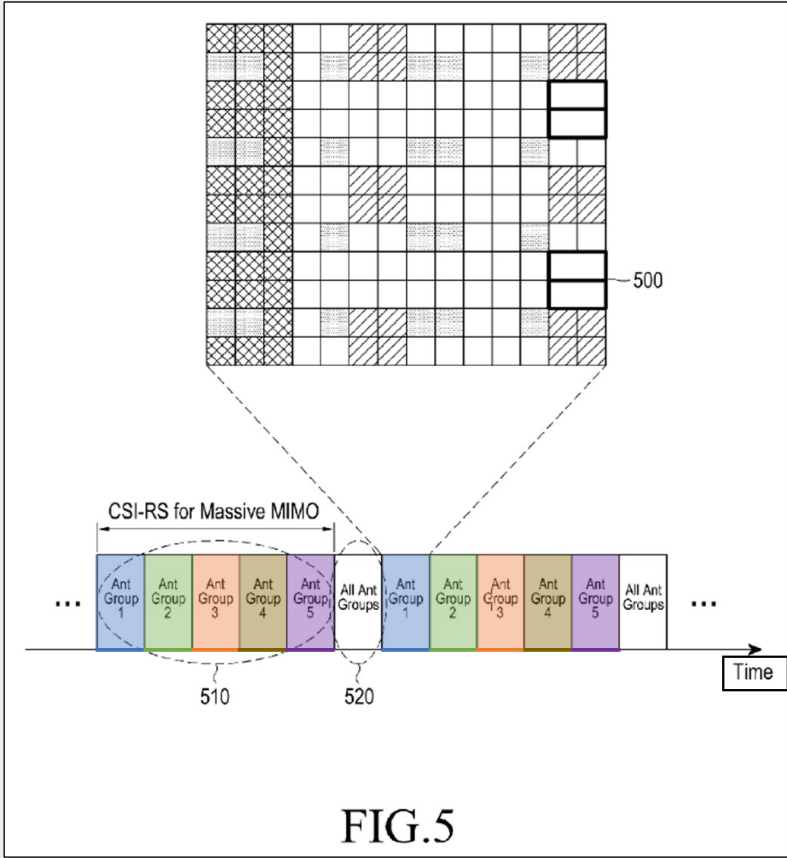
(Kim, Fig. 7.)

Kim Discloses Associating a Time Resource Pool with a Respective Antenna Port Group



[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.

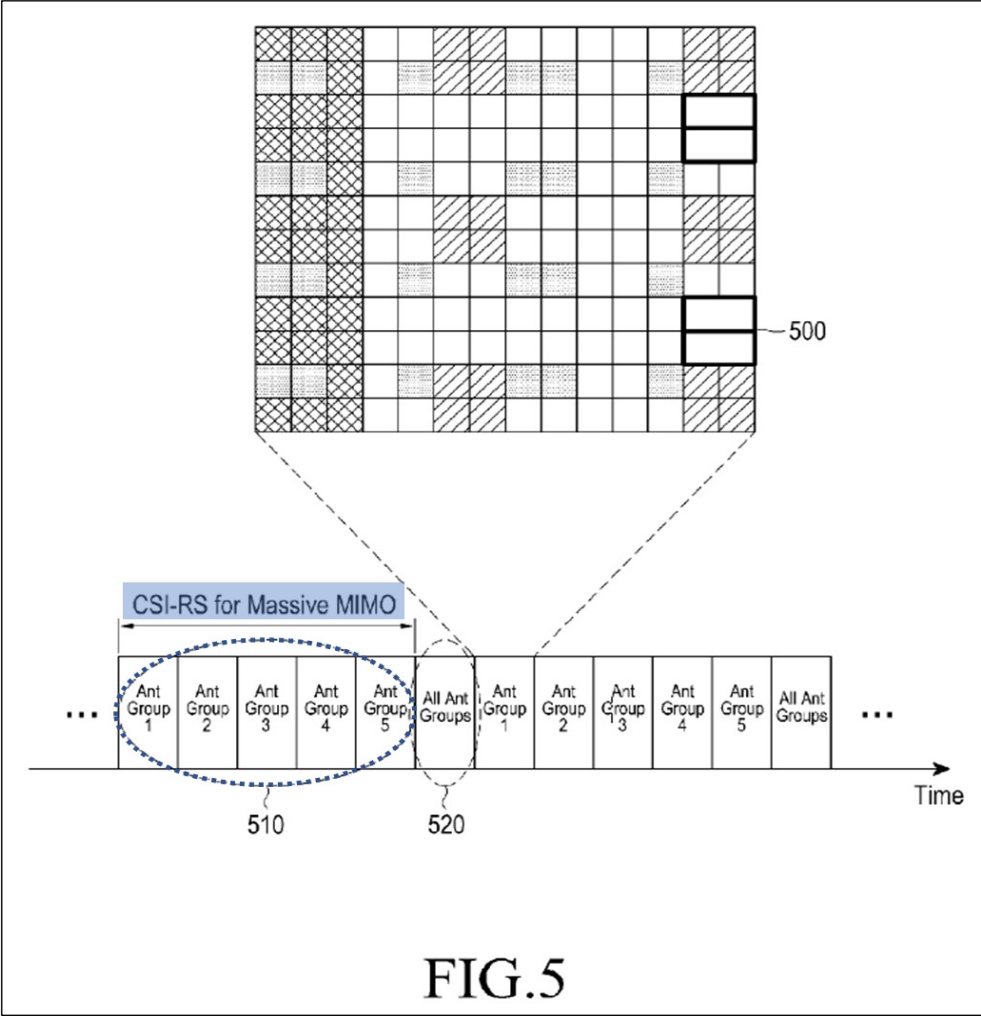
(Kim, [0082], Fig. 7.)



[0060] Referring to FIG. 5, the CSI-RSs for massive MIMO are transmitted at different time intervals according to the respective antenna groups in FIG. 4. In FIG. 5, one time interval corresponds to one subframe in an LTE/LTE-A system. The subframe is a time unit used for resource allocation in an LTE/LTE-A system and corresponds to 1 msec. For

(Kim, [0060], Fig. 5.)

Claim 1: “wherein the first radio signal is transmitted by K antenna port groups of the base station”

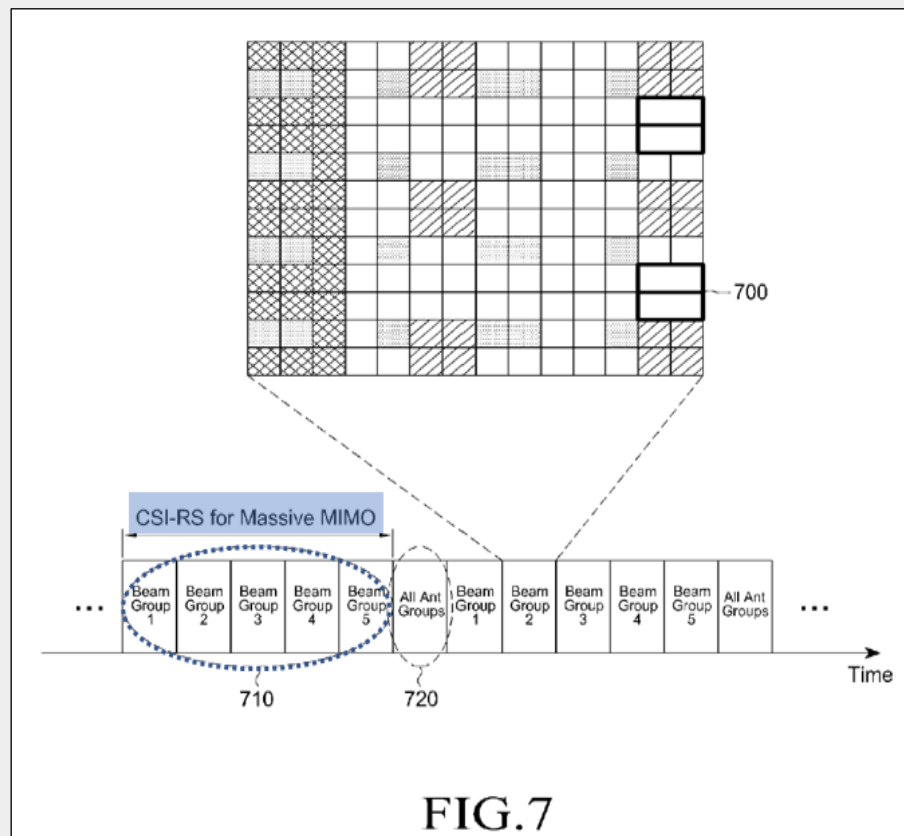


[0060] Referring to FIG. 5, the CSI-RSs for massive MIMO are transmitted at different time intervals according to the respective antenna groups in FIG. 4. In FIG. 5, one time interval corresponds to one subframe in an LTE/LTE-A system. The subframe is a time unit used for resource allocation in an LTE/LTE-A 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

(Kim, [0060].)

(Kim, Fig. 5.)

Claim 1: “wherein the first radio signal is transmitted by K antenna port groups of the base station”

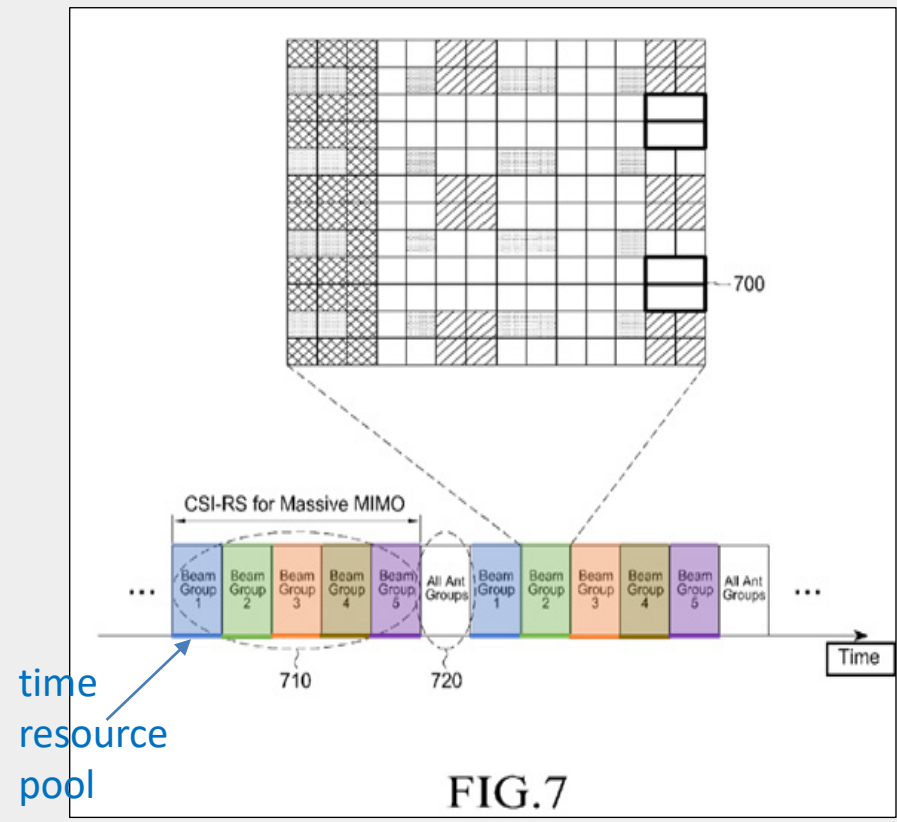


(Kim, Fig. 7.)

[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.

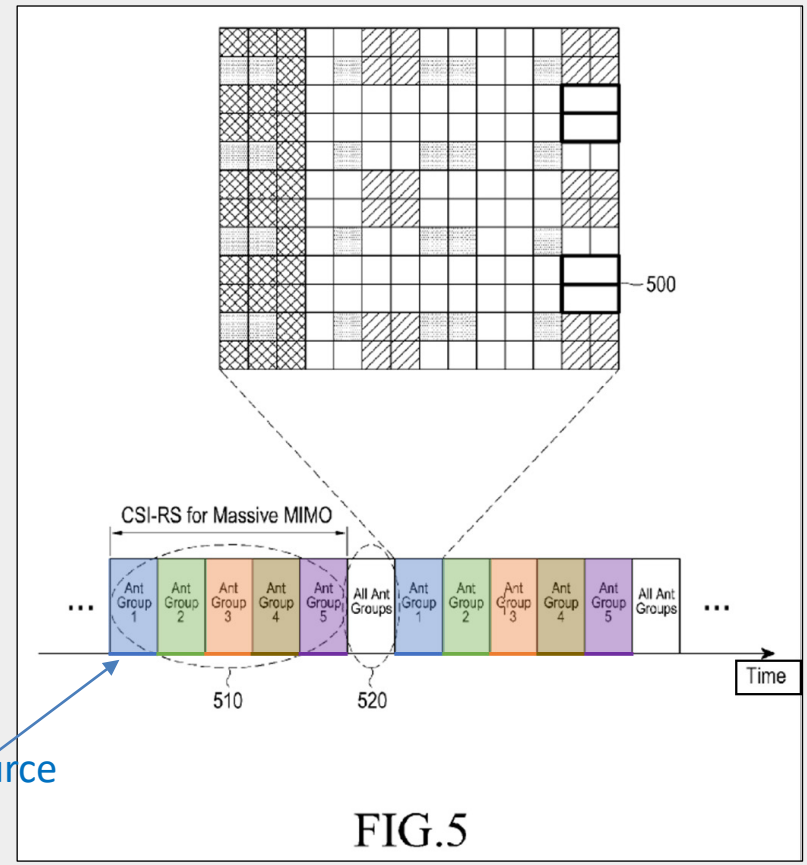
(Kim, [0083].)

Claim 1: “the first signaling is used to determine a first time resource pool”



[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.

(Kim, [0082], Fig. 7.)



[0060] Referring to FIG. 5, the CSI-RSs for massive MIMO are transmitted at different time intervals according to the respective antenna groups in FIG. 4. In FIG. 5, one time interval corresponds to one subframe in an LTE/LTE-A system. The subframe is a time unit used for resource allocation in an LTE/LTE-A system and corresponds to 1 msec. For

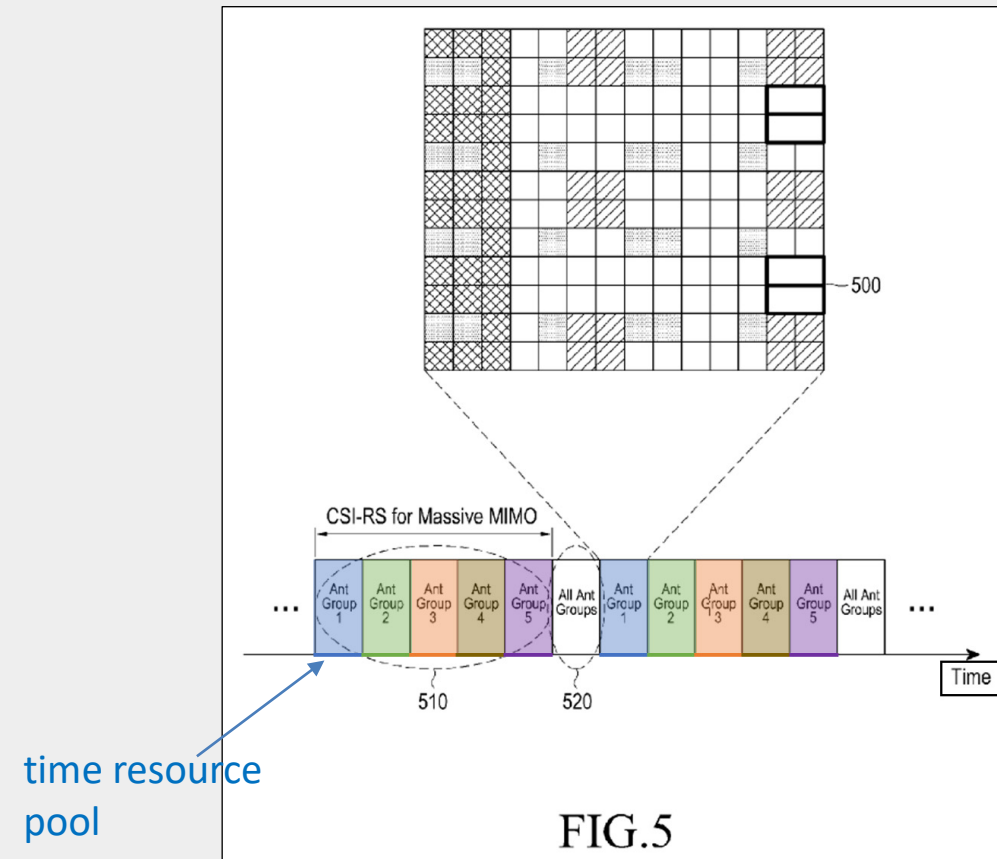
(Kim, [0060], Fig. 5.)

Claim 1: “the first signaling is used to determine a first time resource pool”

[0065] In order to transmit the CSI-RSs for massive MIMO as illustrated in FIGS. 5 and 6, an eNB should notify a UE of related control information before transmitting a CSI-RS. The control information is imperative for proper reception of the CSI-RSs for massive MIMO and proper determination of the channel state based on the received CSI-RSs by the UE. Such control information may include at least one of the following:

[0069] 4) Information on the time and frequency resource positions at which the CSI-RSs for massive MIMO are transmitted, wherein this information includes positions of time and frequency resources at which a CSI-RS for each antenna group is transmitted;

(Kim, [0065], [0069].)



(Kim, Fig. 5.)

Topics

- Instituted grounds
- High-level explanation of technology
- Established *prima facie* case of obviousness
- Disputed issues

Disputed Issues

- “the first radio signal is transmitted by K antenna port groups of the base station” (claim 1)
 - Claim construction
 - Comparison to prior art
- “time resource pool” / “the first signaling is used to determine a first time resource pool” (claim 1)
 - Claim construction of “time resource pool”
 - Comparison to prior art
- Expert qualifications

Disputed Issues

- “the first radio signal is transmitted by K antenna port groups of the base station” (claim 1)
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 - Claim construction of “time resource pool”
 - Comparison to prior art
- Expert qualifications

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

Claim Term	Samsung’s Construction	Apex’s POPR	Apex’s POR
“the first radio signal is transmitted by K antenna port groups of the base station” (claim 1)	plain and ordinary meaning	not disputed	“the first radio signal is collectively transmitted by K groups of antenna ports of the base station”

****Apex did not offer a construction for “the first radio signal is transmitted by K antenna port groups of the base station” in the related district court case.**

Apex Improperly Adds the Word “Collectively” – Not Supported

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.

(POR, 13 (quoting '527 patent, 3:44-49.))

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.

(POR, 12 (purportedly quoting Wiley Electrical and Electronics Engineering Dictionary.))

Apex Improperly Adds the Word “Collectively” – Not Clear

5 Q. What do you mean by "collectively"?
6 A. **Together.**

(Gomez Tr. (Ex.1036), 30:5-6.)

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.1036), 30:7-18.)

remainder of the limitation lacks merit. Mr. Gomez confirmed that the use of the term “collectively” refers to the responsibility for transmission, not the timing of the transmission, of the radio signal. Ex. 1036 at 32:11-33:7. Petitioner’s immaterial (Sur-Reply, 1-2.)

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.1036), 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.1036), 8:11-20.)

Apex's Construction Changes the Meaning of the Term

“K antenna port groups” $\neq$ “K groups of antenna ports”
(Claim term) (Apex's construction)

- Apex's construction requires multiple antenna ports in each group
- The '527 patent expressly permits one antenna port in an antenna port group

In one embodiment, the antenna port group includes **only one antenna port.**

('527 patent, 3:18-19.)



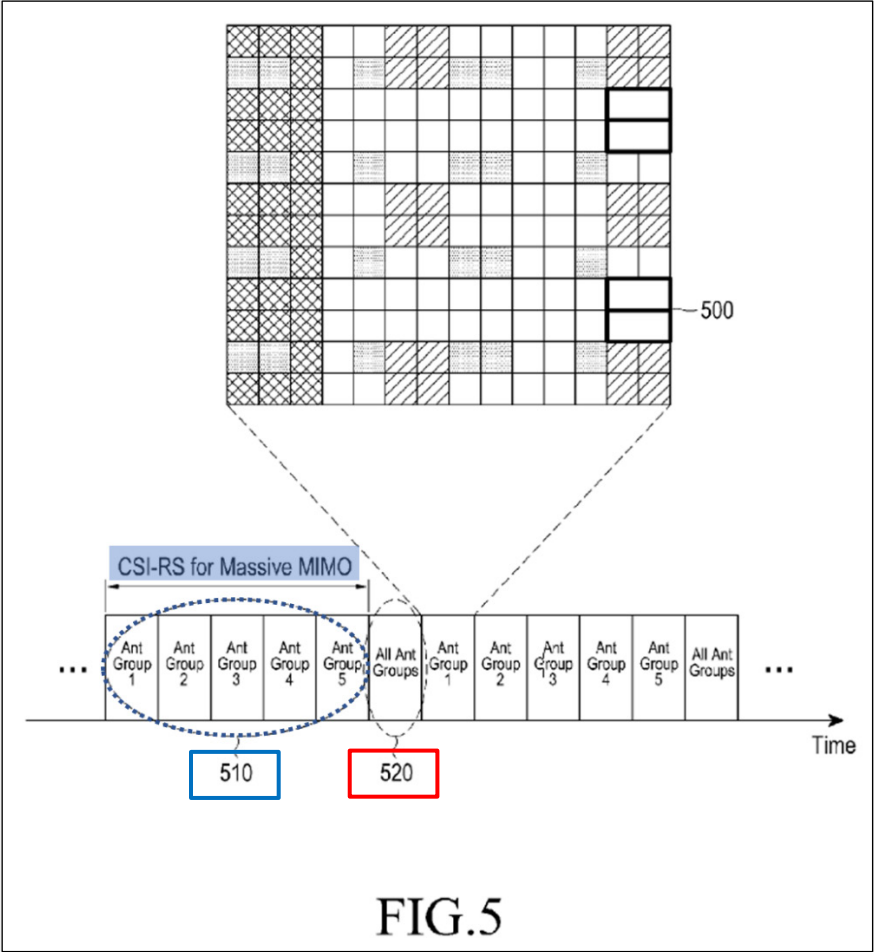
“[T]here is a strong presumption against a claim construction that excludes a disclosed embodiment.”

In re Katz Interactive Call Processing Patent Litig., 639 F.3d 1303, 1324 (Fed. Cir. 2011); see Pet. Reply 6.

Kim Discloses Apex’s Construction: “the first radio signal is collectively transmitted by K groups of antenna ports of the base station”

[0060] Referring to FIG. 5, the CSI-RSs for massive MIMO are transmitted at different time intervals according to the respective antenna groups in FIG. 4. In FIG. 5, one time interval corresponds to one subframe in an LTE/LTE-A system. The subframe is a time unit used for resource allocation 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 described above, each transmission antenna has an individual transmission resource in transmitting a CSI-RS, and the UE can measure the channel state in each transmission antenna. The channel state in each transmission antenna needs to be measured for determination of an optimum precoding scheme in massive MIMO. In contrast, UEs which do not support massive MIMO cannot receive signals transmitted from a large number of antennas as illustrated in FIG. 4 in a discriminated manner according to the antennas. For such UEs, separately from the CSI-RS 510 for massive MIMO, CSI-RSs 520 for non-massive MIMO with respect to all antenna groups are transmitted. The CSI-RSs 520 may be transmitted through a virtual antenna. Furthermore, the CSI-RSs for non-massive MIMO may also be effectively used for simultaneous signal transmission to a plurality of UEs. UEs which do not support

(Kim, [0060].)

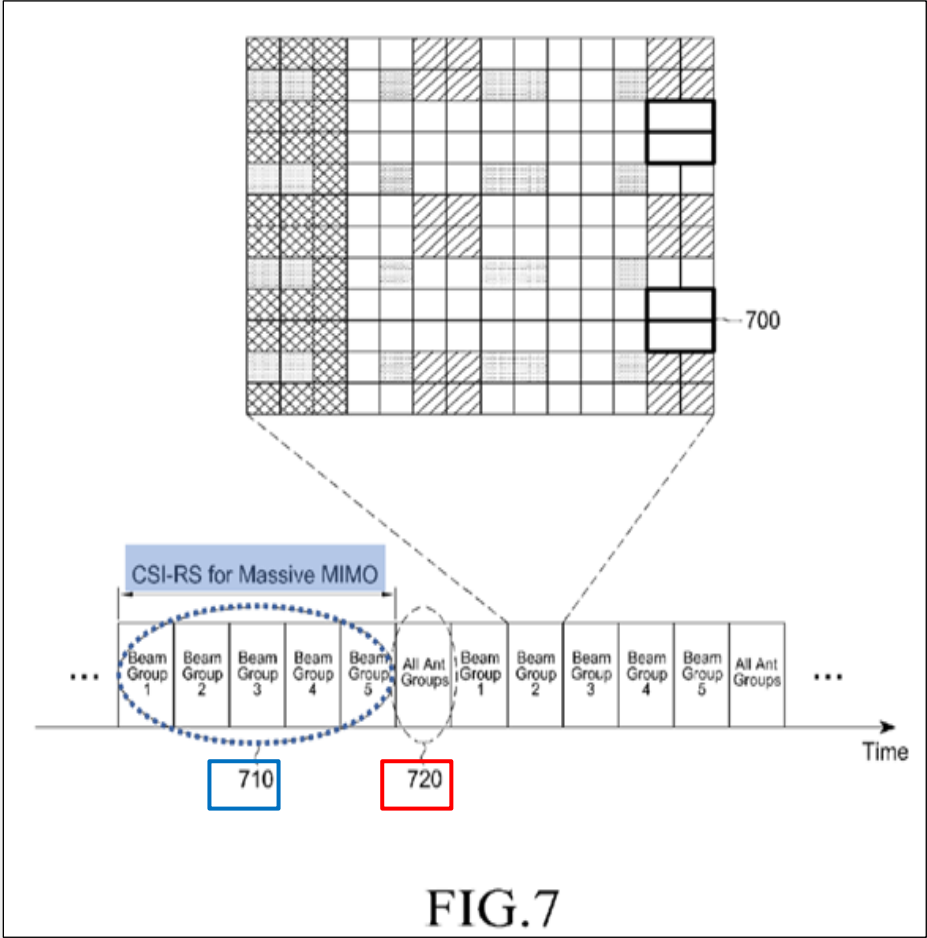


(Kim, Fig. 5.)

Kim Discloses Apex’s Construction: “the first radio signal is collectively transmitted by K groups of antenna ports of the base station”

[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.

(*Kim*, [0083].)



(*Kim*, Fig. 7.)

Kim Describes the Radio Signal Transmitted by K antenna Port Groups as the Same Signal

[0022] In accordance with another aspect of the present invention, a method of transmitting a reference signal for generation of channel state information by an eNB in a wireless communication system is provided. The method includes grouping a plurality of transmission antennas into a plurality of antenna groups, transmitting the reference signal to UEs in different time intervals or frequency intervals according to the antenna groups, and transmitting another reference signal for all of the antenna groups in an identical time interval or frequency interval.

39. A method of transmitting a reference signal for generation of channel state information by an evolved Node B (eNB) in a wireless communication system, the method comprising:
grouping a plurality of transmission antennas into a plurality of antenna groups; and
transmitting the reference signal to User Equipments (UEs) in different time intervals or frequency intervals according to the antenna groups, and transmitting another reference signal for all of the antenna groups in an identical time interval or frequency interval.

(Kim, [0022], Claim 39.)

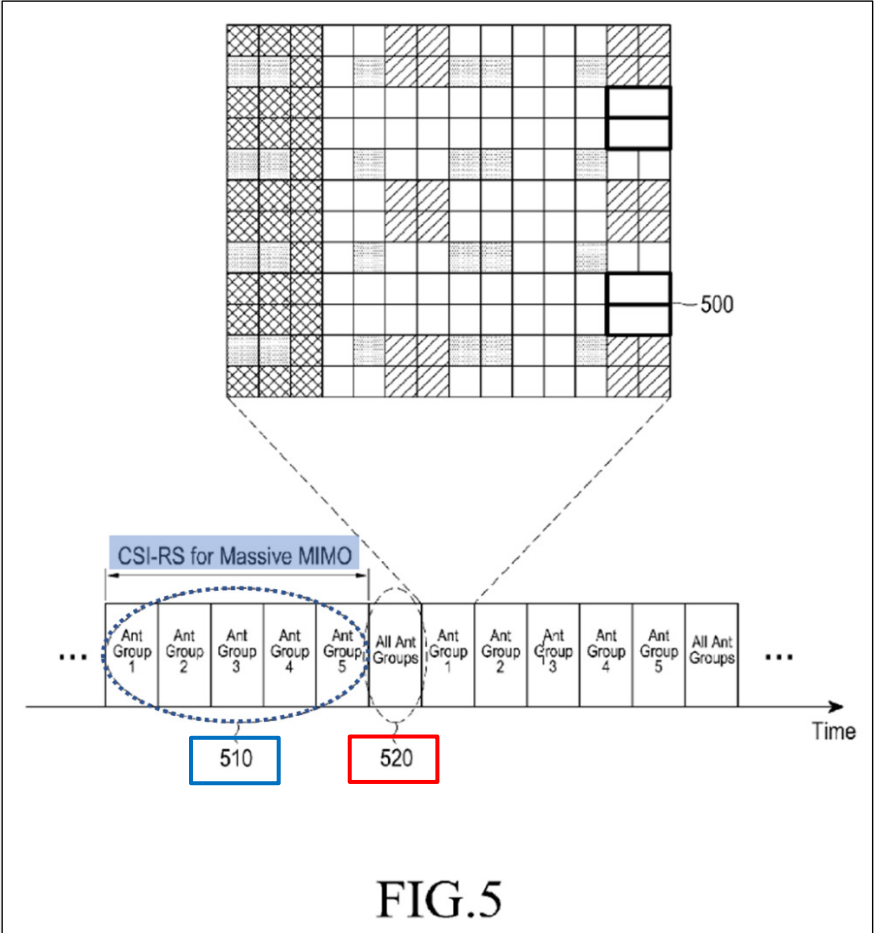


FIG.5

(Kim, Fig. 5.)

Kim Describes the Radio Signal Transmitted by K antenna Port Groups as the Same Signal

[0023] In accordance with another aspect of the present invention, a method of transmitting a reference signal for generation of channel state information by an eNB in a wireless communication system is provided. The method includes grouping a plurality of beams transmitted through a plurality of transmission antennas into a plurality of beam groups, transmitting the reference signal to UEs in different time intervals or frequency intervals according to the beam groups, and transmitting another reference signal for all of the antenna groups in an identical time interval or frequency interval.

44. A method of transmitting a reference signal for generation of channel state information by an evolved Node B (eNB) in a wireless communication system, the method comprising: grouping a plurality of beams transmitted through a plurality of transmission antennas into a plurality of beam groups; and transmitting the reference signal to User Equipments (UEs) in different time intervals or frequency intervals according to the beam groups, and transmitting another reference signal for all of the antenna groups in an identical time interval or frequency interval.

(Kim, [0023], Claim 44.)

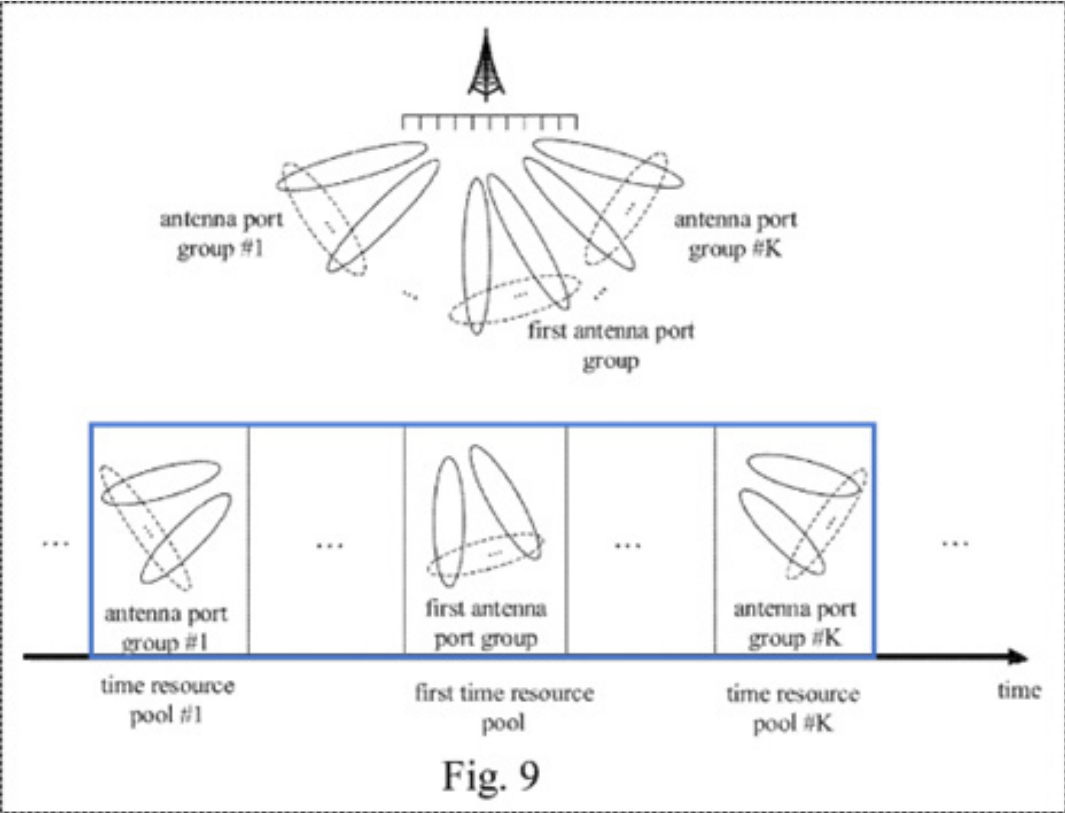


FIG.7

(Kim, Fig. 7.)

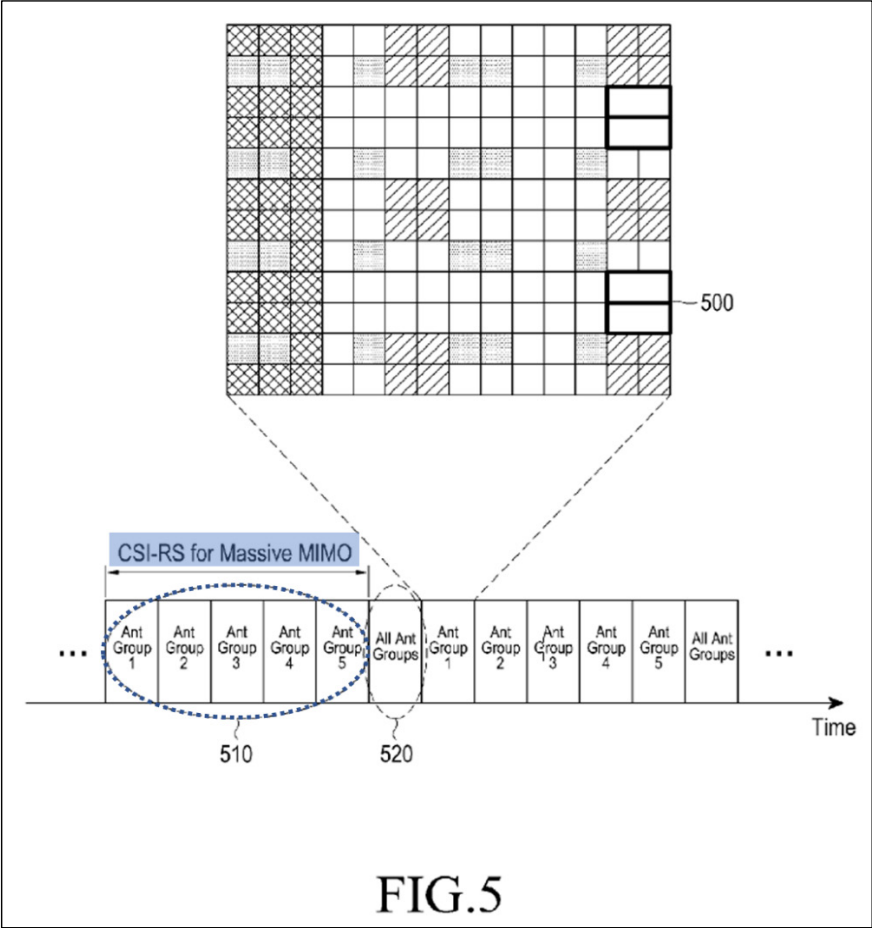
Kim Describes a Radio Signal Transmitted by K antenna Port Groups in the Same Way as '527 Patent

'527 Patent



(’527 patent, Fig. 9.)

Kim



(*Kim*, Fig. 5.)

Kim Describes a Radio Signal Transmitted by K antenna Port Groups in the Same Way as '527 Patent



“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).

Disputed Issues

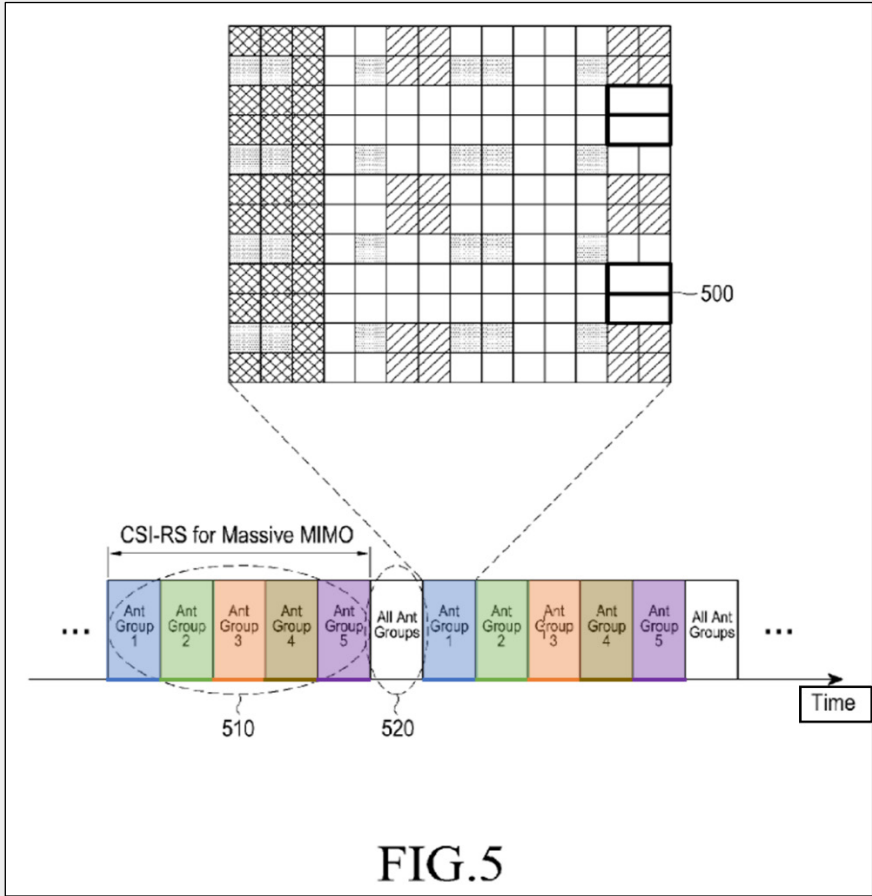
- “the first radio signal is transmitted by K antenna port groups of the base station” (claim 1)
 - Claim construction
 - Comparison to prior art
- “time resource pool” / “the first signaling is used to determine a first time resource pool” (claim 1)
 - Claim construction of “time resource pool”
 - Comparison to prior art
- Expert qualifications

Construction: “time resource pool”

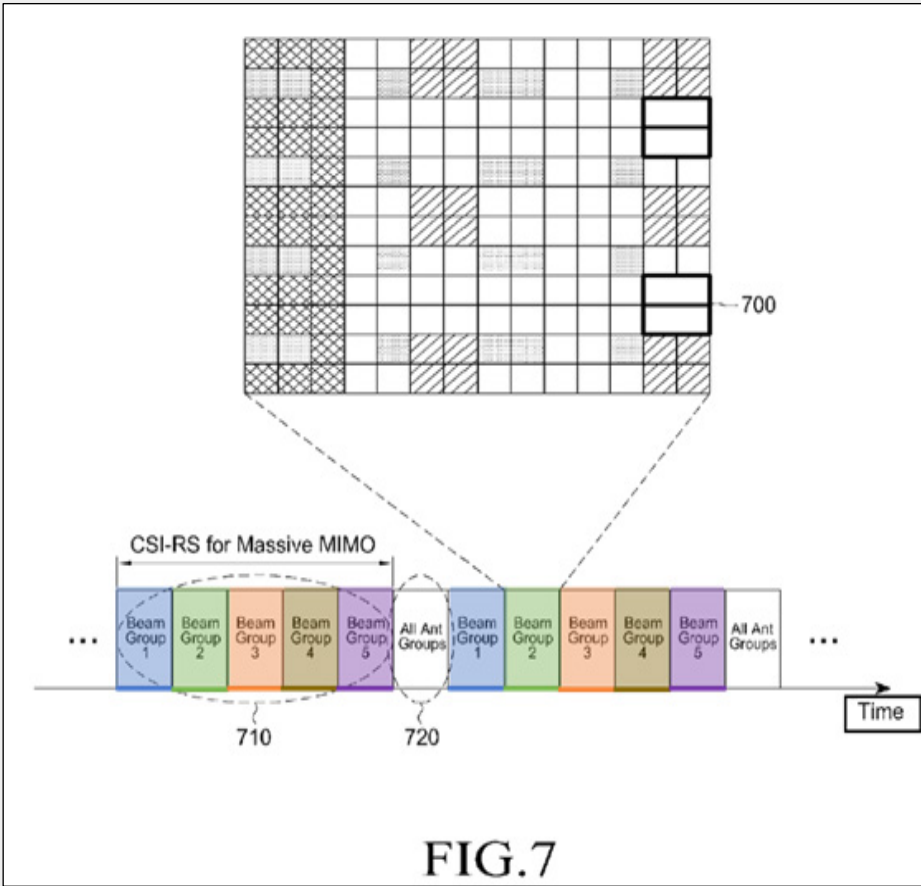
Claim Term	Samsung’s Construction	Apex’s POPR	Apex’s POR
“time resource pool” (claim 1)	plain and ordinary meaning	not disputed	“collection of time resources for a shared use”

****Apex did not offer a construction for “time resource pool” in the related district court case.**

Kim Discloses Apex’s construction: “collection of time resources for a shared use”



(Kim, Fig. 5.)

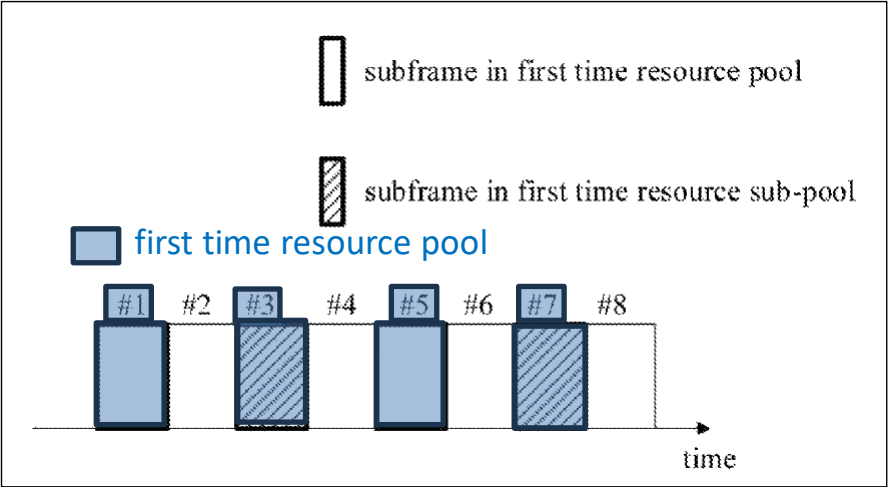


(Kim, Fig. 7.)

Kim Discloses Apex’s construction: “collection of time resources for a shared use”

- Like *Kim*, the patent and claims describe discontinuous “time resource pool”

’527 Patent

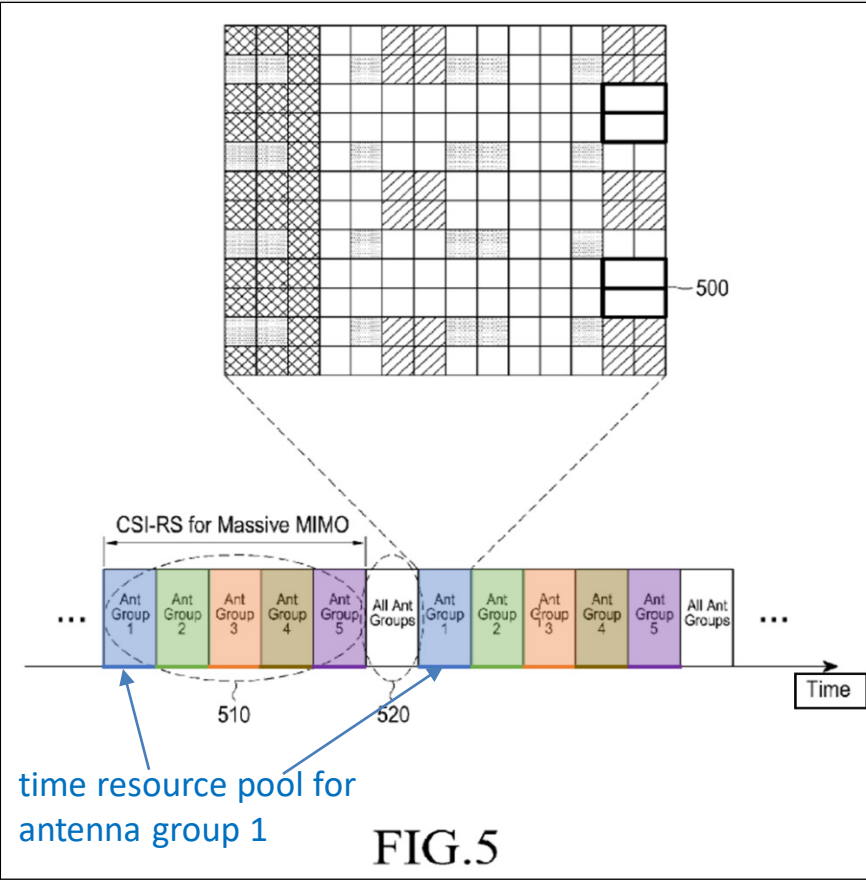


In Embodiment 6, subframes #1-#8 are candidate subframes for transmitting a second radio signal, and the first signaling, by the form of bitmap, uses 10101010 to indicate that the first time resource pool is consisted of subframes #1, #3, #5 and #7, the second signaling, by the form of bitmap,

5. The method of claim 1, wherein the first time resource pool is discontinuous in time domain; or the first signaling is a semi-static signaling.

(’527 patent, 16:4-8, Fig. 6, Claim 5.)

Kim



(Kim, Fig. 5.)



“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).

Apex's Prior Art Arguments Go Beyond Apex's Construction

Apex's Construction

meaning. Ex. 2004, ¶ 33. To assist the Board in ascertaining that plain and ordinary meaning, Patent Owner proposes that “time resource pool” be construed as “collection of time resources for a shared use” based on what a person of ordinary skill in the art would have understood it to mean. Ex. 2004, ¶ 33.

(POR 14.)

Petitioner's implied construction reads out the word “pool” from “time resource pool.” Ex. 2004, ¶ 33. Patent Owner proposes that “time resource pool” be construed as “collection of time resources for a shared use.” *Id.* Patent Owner's

(Sur-Reply 2.)

Apex's Prior Art Arguments

As noted in Section V.B., a person of ordinary skill in the art would understand “time resource pool” to be construed as “a collection of time resources *for a shared use.*” Ex. 2004, ¶ 45. The shared use of the time resource pool described in the '527 Patent refers to the shared collection of time resources for transmission by all K antenna port groups. See Section V.A.; Ex. 2004, ¶ 45. Kim contradicts that

(POR 22-23.)

The shared use of the time resource pool described in the '527 Patent refers to the shared collection of time resources for transmission by all K antenna port groups. Kim contradicts that “shared use” when it discloses that “*CSI-RSs for each antenna port group are transmitted over separate time resources (subframes).*” Ex. 2004,

(Sur-Reply 5.)

Requiring Shared Resources by “All K Antenna Port Groups” Is Unsupported

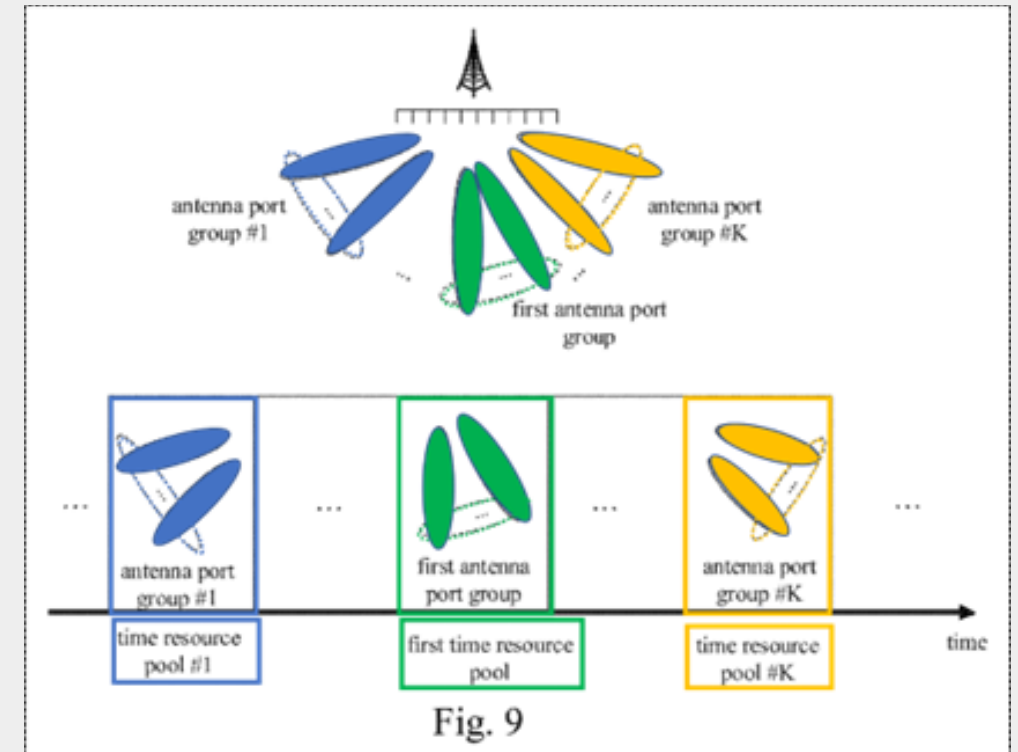
1. A method for multi-antenna transmission in a user equipment, comprising:
receiving a first radio signal from a base station; and
receiving a first signaling from a base station;
wherein the first radio signal is transmitted by K antenna port groups of the base station;
the antenna port group includes 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.
- (’527 patent, Claim 1.)

Requiring Shared Resources by “All K Antenna Port Groups” Is Unsupported

- The '527 patent describes a “first time resource pool” shared by an antenna port group, not all K antenna port groups

In Embodiment 9, the first antenna port group is one of the K antenna port groups. The K antenna port groups respectively correspond to K different beam groups. The K antenna port groups respectively correspond to K time resource pools, and the first time resource pool is a time resource pool corresponding to the first antenna port group.

(’527 patent, 17:1-6.)



(’527 patent, Fig. 9.)

Requiring Shared Resources by “All K Antenna Port Groups” Is Unsupported

- The '527 patent touts the advantages of associating the first time resource pool with the first antenna port group, not all K antenna port groups

In one embodiment, the foregoing method is advantageous in that, by associating the first time resource pool with the first antenna port group, the UE can quickly determine the location of the first time resource pool in the time domain by the index of the first antenna port group in the K antenna port groups.

In one embodiment, the foregoing method is advantageous in that, by associating the first time resource pool with the first antenna port group, the UE can quickly determine the antenna virtualization vectors which used for receiving radio signal transmitted on the first time resource pool by the location of the first time resource pool in the time domain.

('527 patent, 2:3-14.)

Requiring Shared Resources by “All K Antenna Port Groups” Is Unsupported

- Apex’s own expert took the contrary position during deposition

23 Q. Does the term 'time resource pool'
24 require a shared use of the same time resources
25 by all K antenna port groups?

1 A. It's shared among a port -- I'm
2 sorry -- a port group.

3 Q. So the time resource pool can be time
4 resources shared for use by one antenna port
5 group?

6 A. Yes.

(Gomez Tr. (Ex.1036), 23:23-24:6.)

Disputed Issues

- “the first radio signal is transmitted by K antenna port groups of the base station” (claim 1)
 - Claim construction
 - Comparison to prior art
- “time resource pool” / “the first signaling is used to determine a first time resource pool” (claim 1)
 - Claim construction of “time resource pool”
 - Comparison to prior art
- Expert qualifications

Definitions of Level of Ordinary Skill

Samsung

V. LEVEL OF ORDINARY SKILL IN THE ART

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 multiple-input multiple-output (MIMO) technology in telecommunications systems. More work experience can compensate for less education, and vice versa. Kakaes, ¶65.

(Petition 9-10.)

Board

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

(Institution Decision 9.)

Apex

10; Ex. 2004, ¶ 20. 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.

(POR 10.)

Experience with MIMO Technology Is Required for Level of Ordinary Skill

- The claimed invention is related to a multiple-input multiple-output (MIMO) system
 - MIMO refers to the multiple-antenna technology used to improve communication quality

Technical Field

The present disclosure relates to a multiple antenna transmission method in a wireless communication system.

Related Art

Massive Multiple-Input Multiple-Output (MIMO) has become a research hotspot for next-generation mobile communications. In massive MIMO, multiple antennas can improve communication quality by forming narrower beams pointing to a specific direction through beamforming.

('527 patent, 1:19-28.)

SUMMARY

In a massive MIMO system, the total throughput of a cell can be greatly increased by the number of massive antennas, so the number of single-cell users can be greatly increased. However, an increase in the number of cell users will lead to a large amount of signaling overhead for dynamic scheduling of wireless time-frequency resources. The signaling overhead of wireless resource dynamic scheduling is an urgent problem to be solved in massive MIMO system.

In view of the above problem, the present disclosure provides a solution. It should be noted that, in the case of no

('527 patent, 1:35-46.)

Experience with MIMO Technology Is Required for Level of Ordinary Skill

- The claimed “antenna port groups,” “first antenna virtualization vector,” and “second antenna virtualization vector” are all multi-antenna techniques in MIMO systems

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.

(’527 patent, Claim 1.)

In one embodiment, the antenna port is formed by superposing multiple physical antennas through antenna virtualization; the mapping coefficients from the multiple physical antennas to the antenna port(s) constitute an antenna virtualization vector for the antenna virtualization.

(’527 patent, 2:34-38.)

Experience with MIMO Technology Is Required for Level of Ordinary Skill

- The asserted prior art concerns MIMO technology

[0016] Aspects of the present invention are to address at least the above-mentioned problems and/or disadvantages and to provide at least the advantages described below. Accordingly, an aspect of the present invention is to provide a method and an apparatus for transmitting a reference signal for effective data transmission and reception, measuring interference, and generating channel state information in a Multiple Input Multiple Output (MIMO) transmission and reception.

[0017] Another aspect of the present invention is to provide an effective transmission and reception method in a MIMO system having scores or more transmission antennas.

(Kim, [0016]-[0017].)

(57) Abstract: Embodiments of the present disclosure provide reference signal transmitting and receiving methods and devices in an active antenna system. Port virtualization to a transmit antennas may be implemented for multiple cell-specific reference signal (CRS) antenna ports and applying different vertical beamforming vectors to implement port virtualization for the different CRS antenna ports. The User Equipment (UE) reports the maximum RSRP/RSRQ value measured based on multiple CRS ports, or the UE

(Zhang, Abstract.)

TECHNICAL FIELD

[0001] The following description relates to a wireless communication system and, more specifically, to a method and apparatus for virtualizing an antenna.

BACKGROUND ART

[0002] MIMO (multiple-input multiple-output) refers to a method for improving data transmission/reception efficiency by adopting multiple transmit (Tx) antennas and multiple receive (Rx) antennas instead of a single Tx antenna and a single Rx antenna. When a single antenna is used, a receiver

(Kang, [0001]-[0002].)

Experience with MIMO Technology Is Required for Level of Ordinary Skill

- The named inventor of the '527 patent was well-versed in MIMO technology

Xiaobo Zhang
CTO at LangBo Com



Shanghai Jiao Tong University
Master's degree, Electrical, Electronics and Communications Engineering
1998 - 2004

(Xiaobo Zhang Linked-in Profile
(Ex. 1032), 1-2.)

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A CDD Based MIMO-HARQ Transmission Scheme

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(Ex. 1033, 1.)

2013 8th International Conference on Communications and Networking in China (CHINACOM)

Energy-efficient Dynamic Cooperative Virtual MIMO Based Routing Protocol in Wireless Sensor Networks

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(Ex. 1034, 1.)

Law Regarding Experts



“To offer expert testimony from the perspective of a skilled artisan in a patent case—like for claim construction, validity, or infringement—a witness must at least have ordinary skill in the art.”

Kyocera Senco Indus. Tools Inc. v. Int’l Trade Comm’n, 22 F.4th 1369, 1376-77 (Fed. Cir. 2022).

Mr. Gomez (Apex) Fails to Meet Samsung's Definition of a POSITA

Mr. Gomez (Apex) ❌

- No master's degree
- No MIMO experience

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

(Ex. 2004 (Gomez), ¶2.)

Curriculum Vitae of Miguel Gomez

2178 Sirah Ct., Livermore CA 94550
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ph. 415.793.4103

Education

Year	College or University	Degree
1983	Yale University	BSEE

(Ex. 2004 (Gomez), Ex. A, 2.)

10 Q. Are you familiar with multiple-input/
11 multiple-output technologies? 10:14
12 A. MIMO, yes.
13 Q. What's your understanding of MIMO?
14 A. MIMO is a way to provide various
15 different services, including diversity, as well 10:14
16 as beamforming so that, you know, you can get
17 either -- you can get a more reliable signal to
18 the receiver that you're intending to target.
19 Q. Which of the engineering experiences
20 listed on your CV involved MIMO? 10:15
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 10:15

1 phased array antenna. But I haven't actually
2 specifically built a product related to those
3 technologies.

(Ex. 1035 (Gomez Tr.), 51:10-52:3.)

Mr. Gomez (Apex) Lacks Relevant Experience

Mr. Gomez (Apex) ❌

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.**

(Gomez Tr. (Ex. 1035), 47:17-48:11.)

2 **Q. Did any of the engineering**
3 **experiences listed on your CV involve 4G**
4 **cellular network communications?**
5 **A. From the engineering experiences,**
6 **most of the work was done either on the -- on**
7 **the 2G or the local area network protocols like**
8 **802.11a and some of the other protocols that had**
9 **to do with technology similar to 4G.**
10 **Q. But none of them directly involved**
11 **4G?**
12 **A. (Witness indicating.)**
13 **MR. PYMENTO: Objection.**
14 **THE STENOGRAPHER: I didn't get an**
15 **answer. I'm sorry.**
16 **THE WITNESS: Like I said, the**
17 **technologies included some of the same**
18 **elements of the 4G, like, you know, the**
19 **OFDM -- OF -- the orthogonal**
20 **frequency-division multiplexing.**
21 **(Stenographer clarification.)**
22 **THE WITNESS: Orthogonal**
23 **frequency-division multiplexing.**
24 **Some of the same technologies.**

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.**

(Gomez Tr. (Ex. 1035), 50:2-51:9.)

Dr. Kakaes (Samsung) Satisfies Either Party's Definition of a POSITA

Dr. Kakaes (Samsung) ✓

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

(Ex. 1002 (Kakaes), ¶13.)

AREAS OF EXPERTISE

All aspects of fixed and mobile communications. Over the years, my emphasis has been both in breadth and in depth, originally in fixed communications networks and then in mobile communications. Specific areas of in-depth expertise include:

- NR/5G, LTE/LTE-Advanced and evolution issues of 3G to 4G and 5G
- UMTS, including FDD, TDD, HSDPA/HSUPA, HSPA+, both air interface (UTRA) and Radio Access Network (RAN) as well as Core Network (CN) technologies
- GSM, GPRS, EDGE (EGPRS) and related evolutionary problems and solutions
- cdma2000 family from IS-95, through its evolution to 1x, 3x, 1xEV-DO (HDR), 1xEV-DV (all aspects of the evolution to “3G” and beyond)
- Wired and Wireless Local Area Networks (LAN) including all variants of IEEE 802.11 (WiFi)
- Metropolitan Area Networks (MAN), and Personal Area Networks (PAN) technologies, Paging networks, Ad hoc networks, including IEEE 802.16 (WiMAX), HIPERLAN, Bluetooth, Near Field Communications, IrDA (Infrared Data Association) operating with any of the available access technologies
- North American TDMA and IS-54/IS-136
- IMS, SIP, and VoIP (Voice over IP), including VoIP over LTE
- TETRA
- iDEN™
- Core Network technologies, IS-41, SS7, ATM, MAP, SAE, etc.
- Design and implementation of voice and data networking (circuit switching as well as all the evolving all IP-based technologies)
- Traffic engineering and network design; both air interface aspects (including resource allocation, QoS, MAC protocol, etc.) and design of core network, both user plane and control plane

(Ex. 1002 (Kakaes), App. A.)

Dr. Kakaes (Samsung) Satisfies Either Party's Definition of a POSITA

Dr. Kakaes (Samsung) ✓

16	Q.	Going through your employment
17		history, could you briefly describe which
18		of these jobs related to MIMO Technology?
19	A.	So when I was teaching in the
20		George Washington University in the
21		department of electrical engineering and
22		computer science, I taught mostly graduate
23		courses in communication engineering, and
24		some of those courses included
25		MIMO-related transmission and reception.
11		MIMO is one of the techniques that has
12		been used, and therefore, I have consulted
13		on how MIMO can be exploited to the
14		benefit of the network's operation.

(Kakaes Tr. (Ex. 2005), 18:16-19:14.)