In the United States Patent Trial and Appeal Board

Apex Beam Tech. LLC Patent Owner's Presentation

IPR2023-00571
IPR2023-00747
U.S. Patent No. 10,951,271

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

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DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Exemplary Challenged Claim

Claim 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.

Grounds

Ground (IPR2023-00571)	Ground 2 (IPR2023-00747)
Claims 1-20 are not Obvious under 35 U.S.C. 103 over **Liu** in view of **Park**	Claims 1-20 are not Obvious under 35 U.S.C. 103 over **Kim** in view of **Chen**

Claim Construction

“K antenna port groups of the base station are used to transmit the first wireless signal”

“**K antenna port groups of the base station are used to transmit the first wireless signal**”: “K groups of antenna ports of the base station are used to ***collectively*** transmit the first wireless signal ”

Claim 1 requires that “the K is a positive integer greater than 1,” which means that K must be at least 2. Petitioner’s expert, Dr. Kakaes, agrees.

Q And on claim 1, which is on column 27, specifically Line 26, there is a claim limitation that says, "K is a positive integer greater than 1."
Do you see that?
A Yes, I do.
Q What is the lowest integer that K could be in this claim?
A A positive integer is greater than 1, the smallest that could be is a number 2.

Ex. 2005, 17:7-17

IPR2023-00571, Paper 14 at 11-14
IPR2023-00747, Paper 14, at 11-14

"K antenna port groups of the base station are used to transmit the first wireless signal"

Since the claimed "first wireless signal" is transmitted by at least 2 groups of antennas, it is not sufficient for only 1 group to transmit the first wireless signal separately.

"K antenna port groups are used to transmit the first wireless ***signal***"

Ex. 1001, 13:31-32, 20:22-23, 20:41-42, 20:58-59, 20:44-45, 23:60-61, 24:15-16, 24:58-59, 25:59-60 (indicating multiple port groups per singular signal)

So if K equals 3, does the claim require that 3 antenna port groups off the base station are used to transmit the first wireless signal?

A Well, if K is 3, then this portion of the claim requires 3 antenna port groups off the base station are used to transmit the first wireless signal, that's what the claim says.

Ex. 2005, 18:20-19:4 (if K=3, then all 3 groups are used to transmit the first wireless signal)

IPR2023-00571, Paper 14 at 11-14
IPR2023-00747, Paper 14, at 11-14

"proportional sequence corresponds to a ratio (ratios) among the K1 channel quality values"

"**proportional sequence corresponds to a ratio (ratios) among the K1 channel quality values**": "a sequence of K1 proportions, where each of the K1 proportions is a ratio between one channel quality value to itself or to another of the K1 channel quality values"

A POSITA would understand that the "proportional sequence" is a sequence (i.e., arrangement) of proportions (i.e., relationships between two or more quantities). the proportions that make up the sequence are ratios (i.e., relationship(s) between two quantities consisting of one being divided by the other).

Proportional:
1. Having, establishing, or maintaining a relationship with one or more entities or values. For instance, the force between two charged particles is directly proportional to the product of their magnitudes, and inversely proportional to the square of their distance.
2. A relationship between two or more quantities, in which the variation in one causes a change in the other…

Ex. 2006, 608

Sequence:
1. An arrangement of two or more things, entities, or events, in a given order.
2. An arrangement of two or more things, entities, or events, in a successive order.
3. That which is ordered by a sequence (1) or sequence (2).
4. To arrange in a sequence (1) or sequence (2).

Ex. 2006, 695

Ratio:
A relationship between two quantities consisting of one being divided by the other.

Ex. 2006, 636

IPR2023-00571, Paper 14 at 14-18; IPR2023-00747, Paper 14, at 14-17

"proportional sequence corresponds to a ratio (ratios) among the K1 channel quality values"

The '571 Patent provides an example where K=2 and K1=2

In this example, the sequence of proportions is "composed of 1, ratio of the second channel quality and the first channel quality" or {1, CQ2/CQ1}

Claim 1 is clear that "the K channel quality values are Reference Signal Received Powers (RSRPs) or a Signal to Interference plus Noise Ratios (SINRs)"

In Embodiment 9, the UE receives the first wireless signal transmitted through the K antenna port groups. The K antenna port groups correspond to the K channel quality values. The UE receives the first signaling to determine that K1 is equal to 2. The first antenna port group and the second antenna port group are two antenna port groups of the K antenna port groups. The first antenna port group corresponds to the first channel quality. The second antenna port group is corresponding to the second channel quality. The first channel quality is a best channel quality value of the K channel quality values. The second channel quality is a second best channel quality value of the K channel quality values. The UE reports {the first antenna port group, the second antenna port group, and the first proportional sequence} to the base station. The first proportional sequence is composed of 1, ratio of the second channel quality and the first channel quality. The first analog beam-

Ex. 1001, 24:15-31

IPR2023-00571, Paper 14 at 14-18;
IPR2023-00747, Paper 14, at 14-17

Liu/Park and Kim/Chen Do Not Render Claim 1 Obvious

Liu: "K antenna port groups of the base station are used to transmit the first wireless signal"

Liu (M antenna ports / M signals):
Liu does not disclose multiple groups of antenna ports to ***collectively*** transmit a signal.

Rather Liu discloses only a singular antenna port for ***individually*** transmitting each singular signal (*i.e.*, a one-to-one mapping of ports to signals).

For example, Liu describes transmitting ***signals (plural)*** 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, which receives the signals of the M antenna ports transmitted

Ex. 1006, 23, 25, 32. Even in an embodiment where all antenna port groups each comprised one antenna port, there must be at least 2 antenna port groups that transmit the claimed first wireless signal, which Liu does not disclose.

Liu: "K antenna port groups of the base station are used to transmit the first wireless signal"

Liu (M antenna ports / M signals):

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

(step S201), FIG. 3 (step S301). 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)." and *Liu*, 15, *see also Liu*, 23. A POSITA would have understood that the base station "transmit[ting] signals

Ex. 1003 (Kakaes Declaration), ¶ 111 (citing Ex. 1006, [0015], [0023])).

Q Are those M antenna -- sorry, are 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 and those reference signals viewed in their totality consistent with what Liu teaches and consistent with the '271 Patent teaches, form the first wireless signal of the claim, of claim 1 of the '271 Patent.

Ex. 2005, 24:5-12

Liu: "K antenna port groups of the base station are used to transmit the first wireless signal"

Liu (NEW CSI Bursts):

Petitioner's new theory that Liu's "CSI bursts" (M wireless signals collectively) disclose the claimed first wireless signal is not present in the Petition and should be rejected by the Board as a new argument.

The Petition's argument regarding this term is less than two pages long and plainly does not mention a "CSI-RS burst." Nor does it advance anything resembling the argument that a reference signal could be divided across different M antenna ports.

See Paper No. 1 ("Pet.") at 16-17.

Petitioner further looks to support this new argument using an apparent combination with the specification **of the '271 Patent** (despite no articulated motivation to combine). Reply at 9-10. The '271 Patent specification is not prior art so this is a conclusory argument that a POSITA would already know the entire specification of the challenged patent.

Petitioner "may not submit new evidence or argument in reply that it could have presented earlier [in the petition], *e.g.*, to make out a prima facie case of unpatentability.")

US Patent Trial and Appeal Board, Consolidated Trial Practice Guide 73 (Nov. 2019)

Liu: "K antenna port groups of the base station are used to transmit the first wireless signal"

Liu (Codebook Sets):

Petitioner admits that a wireless signal is transmitted per port group (i.e. one-to-one) since codebook information is mapped on a per group basis:

"[A] POSITA would have understood describes the base station ***transmitting the wireless signal for each of the X (K) antenna port groups*** because the ***codebook information for each group*** corresponds to the matrix that describes the beam pattern transmitted by the base station and received by the UE ***for that port group***."

Pet. at 17 (citing Ex. 1006, [0021]; Ex. 1003, ¶ 112);

"As I explain there, the ***code book information for each group*** corresponds to the matrix that describes the beam pattern created for a transmission by the base station".

Ex. 2005, 45:19-46:3 (emphasis added).

Liu: "K antenna port groups of the base station are used to transmit the first wireless signal"

Liu (Codebook Sets):

The Board agrees that "Liu's teaching that 'the base station individually configures one codebook set for each antenna port group" ***is somewhat unclear***." Paper No. 10 (Institution Decision), 16-17. Liu describes that codebook information refers to information containing multiple precoding matrices that are individually configured at the base station for each antenna configuration, but ***configuration*** is not a base station ***transmission*** of a first wireless signal:

[T]he base station **individually configures one codebook set for each antenna port group**. The user equipment calculates the SNR based on the configured codebook set and feeds it back to the base station equipment. For example, the first group of antenna ports corresponds to antenna configuration 1, comprising antenna ports port0 and port1; the base station configures codebook set C1 for antenna configuration 1, and the precoding matrices included in C1 are W11, W12, W1n, . . ., W1N."
Ex. 1006, 21.

Nothing in Liu's discussion of codebook sets discloses **multiple** antenna port **groups** used to transmit a "first wireless signal," even if that discussion were not limited to calculating an SNR based on a configured codebook set.

Liu: "K antenna port groups of the base station are used to transmit the first wireless signal"

Liu (Codebook Sets):

Liu also describes that "***the user equipment. . .*** uses all the codebooks [] to conduct random beamforming" for those antenna configurations, but does not disclose transmitting the claimed first wireless signal ***from the base station***:

"[F]or 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 to conduct random beamforming and obtain RSRP2, . . .; and UE feeds back the index corresponding to the antenna configuration having the largest RSRP to the base station."

Ex. 1006, 21-22.

Kim: "K antenna port groups of the base station are used to transmit the first wireless signal"

Kim:

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

[0074] The CSI-RSs generated by Equation 1 may be mapped to REs on a per-antenna port basis by the following equation 2.

Ex. 1027, [0074].

[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.

Ex. 1027, [0076].

Kim: "K antenna port groups of the base station are used to transmit the first wireless signal"

Kim:

Petitioner's expert confirms "the CRSs [in Kim] are mapped to on a per antenna port basis":

station and received by the UE, because "CSI-RSs may be transmitted through 1, 2, 4 or 8 antenna ports" of the base station to the UE. *Kim*, [0071]. Each CSI-RS "may be mapped to REs on a per-antenna port basis" at the base station for transmission. *Kim*, [0074], [0076]. A POSITA would also have understood that the CRSs are mapped on a per-antenna port basis based on *Kim*'s teaching that, as shown in FIG. 6, "CSI-RSs are mapped to REs on a per-antenna port basis" and "CRSs are mapped to respective antenna ports." *Kim*, [0076], [0065].

Ex. 1003, ¶ 105

Kim: "K antenna port groups of the base station are used to transmit the first wireless signal"

Kim:

Petitioner's expert confirms each CSI-RS in Kim is mapped to resource elements and transmitted on a per antenna port (*i.e.*, one-to-one) basis:

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 Right, I'm just trying to get at the meaning of per antenna port basis.

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.

Q And then the last quote of that paragraph says CRSs are mapped to respective antenna ports.

Does that mean that each CRS is mapped to an antenna port?

A So as I explain there, with respect to the portions that you are reading, I'm referring to what's shown in Kim's figure 6, and if we turn to Kim's figure 6, we see that there is a mapping to specific resource elements for both the CRSs, as well as for the CRSs -- sorry, I think I misspoke, for both the CSI RSs as well as for the CRSs on a specific to each antenna port.

Ex. 2005, 47:14-48:17. Mapping two CSI-RSs to a common resource element is irrelevant because that mapping does not involve ***transmission*** of a wireless signal by the base station.

Chen: "K antenna port groups of the base station are used to transmit the first wireless signal"

Chen's base station uses M pilot ports to transmit M pilot signals, i.e. a one-to-one mapping:

[T]ransmitting, by a base station, M types of pilot signals, wherein the ***M types of pilot signals respectively correspond to M pilot ports***

Ex. 1029, Abstract.

[A] base station transmits M types of pilot signals, ***the M types of pilot signals corresponding to M pilot ports*** respectively.

Ex. 1029, 3, 4.

[T]he base station is configured to transmit M types of pilot signals, ***the M types of pilot signals corresponding to M pilot ports*** respectively, and to configure, through signaling, N pilot ports in the M pilot ports for the terminal, M being a positive integer and N being a positive integer less than M.

Ex. 1029, 6.

Chen: "K antenna port groups of the base station are used to transmit the first wireless signal"

Chen:

Petitioner's expert confirms that "Chen uses M pilot ports to transmit the same M amount of pilot signals ":

> 100 antennas and even more." *Chen*, 2. *Chen* explains that "a base station transmits M types of pilot signals, the M types of pilot signals corresponding to M pilot ports respectively; and the base station configures, through signaling, N pilot ports in the

Ex. 1003, ¶ 117

Chen: "K antenna port groups of the base station are used to transmit the first wireless signal"

Q And then the part of the sentence before the semicolon states that "Chen explains that a base station transmits M types of pilot signals.

"The M types of pilot signals corresponding to M pilot ports respectively."

Do you see that?

A I do see that.

Q Is it your understanding that each type of pilot signal in Chen corresponds to a pilot port?

A So, as I quote in the explanation of Chen, a base station transmits M types of pilot signals and that's M as in Monday, I guess.

The M types of pilot signals corresponding to the M pilot ports respectively.

So, a person of ordinary skill in the art would understand that a given pilot signal is transmitted on a pilot port, and the second one of those pilot signals would be transmitted on a second port, and a third one would be transmitted on the third pilot port and so on, until you get to all M of them.

Ex. 2005, 53:16-54:18

Liu: “proportional sequence corresponds to a ratio (ratios) among the K1 channel quality values”

Liu:

Petitioner incorrectly asserts that Liu discloses this limitation through a “ratio of RSRP over the received signal strength indicator (RSSI).” Pet. at 22.

Liu’s RSSI does not disclose “the K channel quality values are Reference Signal Received Powers (RSRPs) or a Signal to Interference plus Noise Ratios (SINRs).”

Petitioner notes that Liu only describes one ratio of RSRP/RSSI and not a sequence of proportions/ratios. Pet. at 22.

Park: "proportional sequence corresponds to a ratio (ratios) among the K1 channel quality values"

Park:

Park does not disclose the claimed "sequence."

Petitioner admits that "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)).' ***Park's UE reports the antenna ports having 'an RSRP difference greater than a certain threshold value expressed as an RSRP ratio or dB scale.'"***

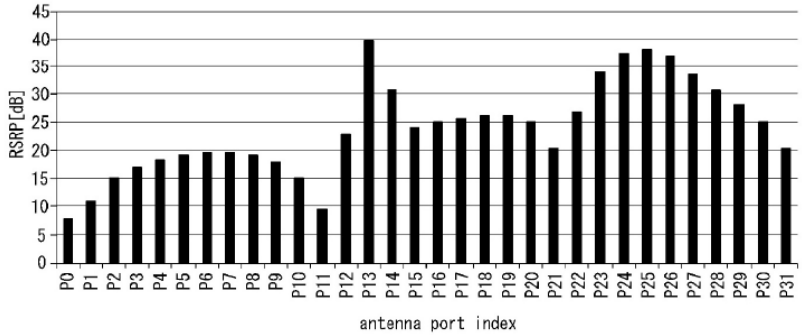
Pet. at 23 (citing Ex. 1009, [371]-[373]). A POSITA would understand that Park computes each of the differentials between the max(RSRP) and individual RSRPs and if a differential is greater than the threshold, then, and only then, will the UE report such antenna ports.

Park: "proportional sequence corresponds to a ratio (ratios) among the K1 channel quality values"

Park:

Park does not disclose the claimed "sequence."

[FIG. 12]



Petitioner confirms there is no sequence by citing to Park's Fig. 12 and then noting that "'[B]ecause antenna port 13 has the greatest RSRP of 40 dB," the UE compares each of the other antenna ports' RSRP values to antenna port 13 and "the UE reports antenna ports with an RSRP over 35 dB." Pet. at 25 (citing Ex. 1009, [378]).

Kim: "proportional sequence corresponds to a ratio (ratios) among the K1 channel quality values"

Kim:

Kim does not disclose the claimed "sequence." Petitioner admits that:

[T]he corresponding ratios comprise a first proportional sequence among the reported (K1) channel quality RSRP values because they would be compared against the measured values to determine which are above the threshold requirement ***to determine 'a maximum of M' to be reported***, thus creating a sequence. ***The measurement report value may include "the ratio*** of the n-th CSI-RS average Rx power level to the best CSI-RS average Rx power level."

Pet. at 28 (citing Ex. 1027, [0136], [0148]-[149]) (citations omitted). In other words, a POSITA would understand that Kim's measurement report value corresponds to either (i) a ratio ("the ratio of the n-th CSI-RS average Rx power level to the best CSI-RS average Rx power level"), which is a ratio of averages instead of a ratio between two specific channel quality values (which each corresponds to an antenna port group); or (ii) a "maximum of M" ratios that meet the threshold instead of the full sequence of ratios, regardless of any threshold.

Liu/Park and Kim/Chen Does Not Render Claims 2-5 Obvious

Liu/Park and Kim/Chen Does Not Render Claims 2-5 Obvious

Claims 2-5 depend on Claim 1—for at least the same reasons as Claim 1, any combination of *Liu/Park* or *Kim/Chen* fails to obviate Claims 2-5

IPR2023-00571, Paper 14 at 30-31
IPR2023-00747, Paper 14, at 29-30

Liu/Park and Kim/Chen Does Not Render Claims 6-10 Obvious

Liu/Park and Kim/Chen Does Not Render Claims 6-10 Obvious

Claims 6-10 recite: "method[s] for multi-antenna transmitting in a base station"

- This mirrors the limitations of Claims 1-5 which recite: "method[s] for multi-antenna transmission in a user equipment"
- Claims 6-10 disclose a method from the perspective of the base station equipment that is in communication with the UE in Claims 1-5
- For at least the same reasons as Claims 1-5, any combination of *Liu/Park* or *Kim/Chen* fails to obviate Claims 6-10

IPR2023-00571, Paper 14 at 30-31
IPR2023-00747, Paper 14, at 29-30

Liu/Park and Kim/Chen Does Not Render Claims 11-15 Obvious

Liu/Park and Kim/Chen Does Not Render Claims 6-10 Obvious

Claims 11-15 recite "user equipment (UE) for multi-antenna transmission" which are the apparatus claims for Claims 1-5

For at least the same reasons as Claims 1-5, *Liu/Park* or *Kim/Chen* fails to obviate Claims 11-15

IPR2023-00571, Paper 14 at 30-31
IPR2023-00747, Paper 14, at 29-30

Liu/Park and Kim/Chen Does Not Render Claims 16-20 Obvious

Liu/Park and Kim/Chen Does Not Render Claims 6-10 Obvious

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

Claims 16-20 disclose the base station equipment that is in communication with the UE in Claims 11-15

For the same reasons as Claim 11, any combination of *Liu/Park* or *Kim/Chen* fails to obviate Claims 16-20

IPR2023-00571, Paper 14 at 30-31
IPR2023-00747, Paper 14, at 29-30

Patent Owner's Expert is Qualified to Offer Testimony

Patent Owner's Expert is Qualified to Offer Expert Testimony

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"

IPR2023-00571, Paper 20 at 15-19
IPR2023-00747, Paper 20 at 13-16

Patent Owner's Expert is Qualified to Offer Expert Testimony

Petitioner improperly relies on the board's adoption of its proposed level of ordinary skill ***solely for purposes of institution*** as a decision on the merits eliminating the work experience component normally accompanying the level of ordinary skill in the art

Even the Petition acknowledges "[a]dditional relevant work experience can compensate for less education." Pet. at 9.

IPR2023-00571, Paper 20 at 15-19
IPR2023-00747, Paper 20 at 13-16

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

IPR2023-00571, Paper 20 at 15-19
IPR2023-00747, Paper 20 at 13-16

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

IPR2023-00571, Paper 20 at 15-19
IPR2023-00747, Paper 20 at 13-16

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

IPR2023-00571, Paper 20 at 15-19
IPR2023-00747, Paper 20 at 13-16

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

IPR2023-00571, Paper 20 at 15-19
IPR2023-00747, Paper 20 at 13-16