

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

LENOVO (UNITED STATES) INC. AND

MOTOROLA MOBILITY LLC,

Petitioners,

v.

COLLISION COMMUNICATIONS, INC.

Patent Owner.

Case No. IPR2025-00927

U.S. Patent No. 7,593,492

**DECLARATION OF GIUSEPPE CAIRE REGARDING PATENT
OWNER'S PRELIMINARY RESPONSE FOR *INTER PARTES* REVIEW OF
U.S. PATENT NO. 7,593,492**

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I, Dr. Giuseppe Caire, hereby declare as follows:

I. Introduction

1. My name is Giuseppe Caire. I have been retained in the above-referenced *inter partes* review proceeding by Collision Communications, Inc., to evaluate United States Patent No. 7,593,492 (the “’492 patent”) against certain references that are presented by the Petitioner. As detailed in this report, it is my opinion that the Petition does not establish that any of the challenged claims are anticipated or rendered obvious by the references presented by the Petitioner. If requested by the Patent Trial and Appeal Board, I am prepared to testify at trial about my opinions expressed herein.

II. Qualifications

2. I have over thirty years of experience in the field of electrical engineering. For the past nine years I have held a Full Professorship and faculty position as the Chair of Communications and Information Theory at Technische Universität Berlin. In my work and research, I have researched and written about Information Theory, Communication Theory and Coding Theory, Wireless Communication Systems, Signal Processing and Statistics.

3. Prior to my appointment at the Technische Universität Berlin, I was a tenured Full Professor at the University of Southern California, Los Angeles from 2005-2016. Although I am currently at the Technische Universität Berlin, I have

retained the title of Adjunct Research Professor at the University of Southern California, Los Angeles since 2016. Prior to my tenure at the University of Southern California, Los Angeles, I spent seven years as a Professor at Eurecom Institute, and held various Assistant Professorships from 1995-1998.

4. I studied Electrical Engineering and received my Ph.D. in 1994 from the Politecnico di Torino, my Master's Degree in 1992 from Princeton University, and my Bachelor of Science Degree in 1990 from the Politecnico di Torino. In addition to my studies at undergraduate and graduate levels and academic qualifications, I have held industrial research positions such as my current role as the Director of the Huawei-TU Berlin Joint Innovation Center, which has a focus on fundamental research in wireless technology.

5. I have authored or co-authored over four hundred publications in the areas of computer networks, and telecommunications. My publication and patents are listed on my curriculum vitae, which is attached hereto as EX2002.

6. In 2021, I was awarded the Leibniz Price, which is awarded to "exceptional scientists and academics for their outstanding achievements in the field of research" and known as the most important research award in Germany. In 2022, I was elected a Member of the Berlin Brandenburg Akademie der Wissenschaften (BBAW). Further, I served as President of the Institute of Electrical and Electronics Engineers (IEEE) Information Theory Society in 2011.

7. As a result of my background in information and communication theory, I have extensive knowledge regarding the state of the technical art in this area at the time of filing of the '492 Patent.

8. I am co-author of an article titled "Bit-Interleaved Coded Modulation" which was published in IEEE Transactions on Information Theory, Vol. 44, No. 3, May 1998 at pp. 927-946. This paper has been cited in other publications over thirty-three hundred (3300) times (Google Scholar).

9. In addition, I am co-author of an article titled "Iterative Multi-User Joint Decoding: Unified Framework and Asymptotic Analysis," which was published in IEEE Transactions on Information Theory 48, No. 7 (2002): 1772-1793. This paper has been cited 409 times, which makes it one of the most referenced papers on turbo multiuser joint decoding. In this paper, we presented the idea of feeding back to the MUD the soft-estimations of the symbols produced by the soft-output decoders and do partial interference cancellation in order to clean up the signal from interfering along the iterations.

III. Materials Considered

10. In preparing this declaration, I have reviewed the specification and claims of the '492 Patent (EX1001) and the file history of the '492 Patent (EX1002). I understand the '492 Patent was issued on September 22, 2009, from U.S. Patent Application No. 11/532,125.

11. I have also reviewed the Petition, declaration of Dr. Paul S. Min (EX1003) and all publications and exhibits cited in the Petition and declaration of Dr. Paul S. Min including:

- U.S. Patent Publication No. 2004/0213360 to McElwain (“McElwain”) (EX1004);
- International Patent Publication No. WO2006/092090 to Wang et al. (“Wang”) (EX1006);
- U.S. Publication No. 2007/0060061 to Sampath (“Sampath”) (EX1006);
- U.S. Publication No. 2003/0193966 to Mills (“Mills”) (EX1007);
- U.S. Publication No. 2006/0188031 to Liu (“Liu”) (EX1008);
- Adaptive Modulation and Adaptive Antenna Array Assisted Network Performance of Multi-User Detection Aided UTRA-like FDD/CDMA Systems (2002), available at <https://eprints.soton.ac.uk/257148/1/jsb-lhvtcfall-2002.pdf> (EX1009);
- Single- and Multi-Carrier CDMA: Multi-User Detection, Space-Time Spreading, Synchronization and Standards (2003), available at https://eprints.soton.ac.uk/258485/3/samplechaps1%252C2%252C9%252C17_singlepdf.pdf (EX1010);
- U.S. Publication No. 2002/0037061 (“Learned”) (EX1011);

- Adaptive Symbol and Parameter Estimation in Asynchronous Multiuser CDMA Detectors (1997), available at https://www.researchgate.net/profile/Teng-Lim-3/publication/3159141_Adaptive_symbol_and_parameter_estimation_in_asynchronous_multiuser_CDMA_detectors/links/09e4150b595e286cbf000000/Adaptive-symbol-and-parameter-estimation-in-asynchronous-multiuserCDMA-detectors.pdf (EX1012);
- Hybrid Iterative Multiuser Detection for Channel Coded Space Division Multiple Access OFDM Systems (2006), available at <https://eprints.soton.ac.uk/262110/1/46-tvt06-jiang-ng-hanzo.pdf> (EX1013).
- Multi-User Detection for DS-CDMA Communications (1996), available at http://cswww.cs.yale.edu/homes/yry/readings/wireless/wireless_readings/article16.pdf (EX1014);
- Hopfield Neural Network Implementation of the Optimal CDMA Multiuser Detector (1995), available at <https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=aff318a439822a7ab47683b1e604a03bce633d26> (EX1015);
- Application of Density Evolution in Turbo-MUD Design for Overloaded Coded CDMA Systems (2004), available at <https://flore.unifi.it/bitstream/2158/238224/1/Application%20of%20Density>

%20Evolution%20in%20TurboMUD%20Design%20for%20Overloaded%20Coded%20CDMA%20System s.pdf (EX1016);

- An Iterative Multiuser Receiver Using Partial Parallel Interference Cancellation for Turbo-Coded DS-CDMA Systems (2004), available at <https://ieeexplore.ieee.org/document/965116> (EX1017);
- A Low-Complexity Iterative Multiuser Receiver for Turbo-Coded DSCDMA Systems (2001), available at <https://core.ac.uk/download/pdf/61613862.pdf> (EX1018);
- Computational Complexity and Performance of RAKE Receivers with Channel Estimation for DS-UWB (2005), available at https://www.researchgate.net/profile/TomoakiOhtsuki/publication/220242734_Computational_Complexity_and_Performance_of_RAKE_Receivers_with_Channel_Estimation_for_DSUWB/links/551d5c0a0cf2fcae4456d460/Computational-Complexity-andPerformance-of-RAKE-Receivers-with-Channel-Estimation-for-DSUWB.pdf (EX1019);
- Iterative Multiuser Interference Reduction: Turbo CDMA (1999), available at https://www.researchgate.net/publication/3159939_Iterative_Multiuser_Interference_Reduction_Turbo_CDMA (EX1020);

- Complexity in Geometric SINR (2007), available at https://www.researchgate.net/profile/Yvonne-Anne-Pignolet/publication/221628472_Complexity_in_geometric_SINR/links/544129930cf2a6a049a56308/Complexity-in-geometric-SINR.pdf (EX1021);
- The Eigen-decomposition: Eigenvalues and Eigenvectors (2007), available at <https://malabdali.com/wp-content/uploads/2023/10/Abdi-EVD2007-pretty.pdf> (EX1022);
- Harville, Matrix Algebra From a Statistician's Perspective (1997) (EX1023);
- Direction of Arrival Estimation Using the Parameterized Spatial Correlation Matrix (2007), available at https://www.wirelesslab.ca/File/pdf_files/journals/J015.pdf (EX1024).
- Correlation Matrix Distance, a Meaningful Measure for Evaluation of NonStationary MIMO Channels (2005), available at <https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=d09aefac68ac3ef15829ef55e18b7fb166c559c5> (EX1025);
- Claim Construction Order in Collision Communications, Inc. v. Nokia Networks and Solutions Oy et al., 2-21-cv-00308 (EDTX) (Aug. 31, 2022) (EX1100); and
- Samsung Electronics America, Inc. v. Collision Communications, Inc., Case No IPR2024-01247, Paper No. 14 (PTAB Feb. 7, 2025) (EX1101).

12. I have also reviewed relevant parts of the publications and exhibits cited in this declaration, including the following publications:

- U. Madhow, *Fundamentals of Digital Communication*, Cambridge University Press 2008 (“Madhow” (EX2003)); and
- R.G. Gallager, *Principles of Digital Communication*, Cambridge University Press 2008 (“Gallagher” (EX2004)).

IV. Wireless Communication Background

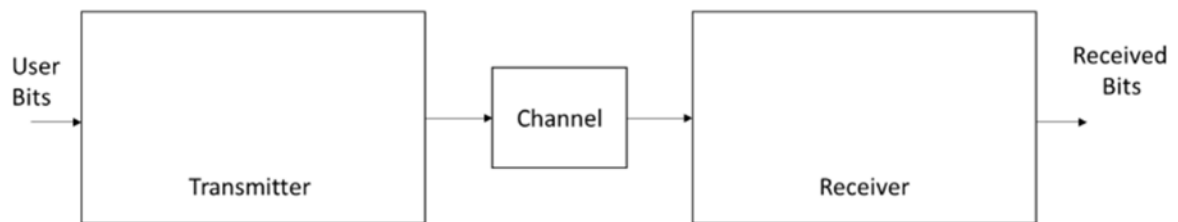
13. The challenged claims generally concern the processing of wireless signals. More specifically, the claims are directed to improved systems and methods for selecting in real time which of a plurality of available multi-user detection algorithms should be used to process a particular received signal, so that each signal is processed using the appropriate available multi-user detection algorithm.

14. To provide context for the claimed subject matter and Lenovo’s Petition, the following brief background addresses the following topics:

- wireless channels;
- detectors;
- multi-user detection algorithms; and
- prior art approaches to selecting multi-user detection algorithms.

A. Wireless Channels

15. A wireless communications system typically includes a transmitter that sends information to a receiver over a wireless channel. (EX2003 at 2-4; EX2004 at 1-5, 95, 181-183, 208-209).



16. As illustrated in the above overview, information in the form of bits (sequences of 0s and 1s) is input to the transmitter, which first converts those bits into a high-frequency wave signal and then transmits that signal over the wireless channel to the receiver. (EX2003 at 2-4; EX2004 at 1-5, 95, 181-183, 208-209).

17. This wireless channel is the medium through which the signal is transmitted. For example, in a wireless cell phone communication, the channel could be affected by the relay towers used to transmit the waves and the physical spaces between those towers, including all buildings and other surfaces that may reflect, refract, or absorb parts of the travelling waves.

18. By the channel's very nature, as the electromagnetic wave signal passes through the channel, noise is introduced and information can be lost or corrupted. (EX2003 at 2-4; EX2004 at 1-5, 95, 181-183, 208-209).

19. Thus, when a receiver receives the electromagnetic signal and attempts to convert it back into bits, the noise must be accounted for and can affect the accuracy of the conversion and reproduction of the original signal. (EX2003 at 2-4; EX2004 at 1-5, 95, 181-183, 208-209).

B. Detectors

20. Each receiver includes a “detector” that tries to recover the desired transmitted signal. A detector can fall into two categories: (1) single-user detectors or (2) multi-user detectors.

21. Regardless of the number of users or interferers, the goal of a single-user detector is to recover the signal from only a single user. Accordingly, instead of attempting to recover all signals from all users, a single-user detector uses algorithm that focuses on the signal from just one user and treats all other user signals as noise. (EX1001 at 2:43-47 and 3:1-6).

22. In contrast, the goal of a multi-user detector is to recover signals from two or more users. Thus, instead of treating and discarding the other user’s signals as noise, a multi-user detector uses an algorithm designed to detect each such signal. (EX1001 at 4:4-23).

C. Multi-User Detection Algorithms

23. The algorithm that a multi-user detector uses to recover multiple user signals is called a “multi-user detection” (MUD) algorithm. There are numerous

kinds of MUD algorithms, each resulting in a different kind of multi-user detector. Exemplary algorithms include the Maximum Likelihood Sequence Estimation algorithm, Minimum Mean Square Error algorithm, Decorrelator algorithm, reduced state Viterbi, matched filter, Fano algorithm, zero-forcing block linear, and sphere decoder.

24. But MUDs are not all created equal – an algorithm that might successfully recover signals in one circumstance may fail in another. Moreover, a MUD may be able to successfully recover signals in a particular circumstance but would also unnecessarily expend excessive computational resources. Thus, even where two algorithms could both succeed in various circumstances, how efficiently each can do so might differ from circumstance—one might be more efficient in one environment, while another is more efficient in a different environment.

25. Thus, MUD algorithms and detectors are not a one-size-fits-all proposition. In a superior system, the right MUD out of many is chosen for the right circumstance. Which MUD algorithm is the right one will depend on the current conditions and the amount of complexity needed for success. Improperly selecting a MUD that will not succeed under the present conditions will result in a defective system; improperly selecting one that can succeed but is not the most efficient available for the current conditions will result in an inferior system.

V. The Challenged '492 Patent

26. The '492 Patent's claimed subject matter allows for a system that switches back and forth between the MUD algorithm most appropriate for each changing circumstance.

27. The '492 Patent discloses and claims **specific improved** systems and methods for selecting among a plurality of MUD algorithms, systems and methods that the Petition does not prove are disclosed in the asserted references.

Among these specific improvements are:

- (1) a “multi-user detector decision unit” comprising either a MUD decision unit 220 or a decision logic unit 520 running one of several specific disclosed selection algorithms for selecting among a plurality of MUDs; and
- (2) dividing a received signal into small windows of data and, for each window, selecting the MUD most appropriate to process that particular window.

A. Multi-User Detector Decision Unit

28. The '492 Patent does not generically disclose selecting from a plurality of MUDs the one best suited for the current processing conditions, but instead chooses a specific system and method for making that selection. Part of this system is the disclosed “multi-user detector decision unit,” which the patent describes as

selecting from a plurality of MUDs and “represent[ing] one of the inventive aspects of the present invention.” (EX1001 at 13:33-34).

29. The '492 Patent describes this “multi-user detector decision unit” as MUD decision unit 220 (or, alternatively, decision logic unit 520) executing one of several specific disclosed selection algorithms for selecting among a plurality of MUDs. Unlike the prior art algorithms used to select a MUD, these disclosed algorithms are based on different information or an expansive amount of granular data points instead of a few limited generalized data points.

30. As a result, where the prior art would often result in the selection of a MUD more complex than necessary for the present conditions, the '492 Patent's “multi-user detector decision unit” is able to identify that a lower complexity detector is still the most appropriate detector in those same conditions. In other words, where the simple prior art approach defaults to a high complexity detector when the considered generalized criteria (rightly or wrongly) indicates a channel having a significant amount of noise and interference, the novel decision unit disclosed in the '492 Patent uses different information or an expansive amount of granular data points to identify when, in those same exact conditions, a lower complexity MUD is still the most appropriate MUD.

31. The '492 Patent discloses several different algorithms for achieving these improved results, where each algorithm can be based on data points

concerning granular aspects of the channel. Some exemplary algorithms disclosed in the '492 Patent are highlighted below.

32. **BER/User Algorithm:** In one disclosed MUD selection algorithm, the expected Bit Error Rate (BER) of each channel user is calculated for every available MUD. Which MUD to use is then selected based on these expansive calculations and data points:

If any of the users have an expected BER that is acceptable, or above a threshold, for any of the lower complexity MUD techniques, then use the lowest complexity MUD possible that meets that criteria. As users are [thus processed and removed,] the expected BER of the remaining users changes. If none of the users ... have an expected BER below the threshold for any of the lower complexity MUD techniques then the highest complexity MUD technique should be used.

(EX1001 at 13:63-14:6, 20:43-49).

33. **SINR/Symbol Algorithm:** A wireless signal comprises a series of many “symbols,” where each symbol represents one or several bits. In another algorithm, the signal to interference plus noise ratio (SINR) is calculated for every symbol received via the channel and those ratios are used to select the appropriate MUD. “If the SINR for any symbols is above a threshold set for a specific lower complexity MUD technique, then use that technique. If none of the SINR values are above any of the lower complexity MUD thresholds then use the highest complexity MUD.” (EX1001 at 14:19-24).

34. **Filtered SINR/Symbol Algorithm:** Similarly, another selection algorithm calculates the expected SINR value for each symbol after filtering with one of the lower complexity MUDs. If any of the post filtering SINR values are above a threshold for a specific lower complexity MUD, that MUD can be used. If none of the post filtering SINR values are above any of the available lower complexity MUD thresholds, then the highest complexity MUD is used. (EX1001 at 14:26-32).

35. **Detected Amount/Symbol Algorithm:** Another symbol-based algorithm focuses on the number of detected symbols. In this algorithm, a threshold of symbols is set for each possible MUD, and the lowest complexity MUD whose threshold exceeds the detected number of symbols is selected and used. (EX1001 at 13:39-55).

36. **Correlation Matrix Ratio/User Algorithm:** In the wireless context, a user “correlation matrix” is a table depicting the amount of correlation (similarity) between each possible pair of user signals. A fifth MUD decision algorithm looks at the correlation matrix between the users, and ratios calculated therefrom, to determine which MUD or MUDs to use:

[L]ook at the correlation matrix between the users and compar[e] each diagonal term to the sum of the off diagonal correlation terms. If the ratio for a certain number of users is greater than a certain threshold then a lower complexity MUD can be used. If the ratio is below that threshold then a higher complexity MUD can be used.

(EX1001 at 13:55-62).

37. **Correlation Matrix Eigenvalues Algorithm:** To analyze the complex detailed information included in the above-described user correlation matrix, another algorithm performs an eigendecomposition on that matrix to represent its information using eigenvalues and eigenvectors. The algorithm then considers all of the eigenvalues (and their associated eigenvectors) to select the appropriate MUD:

If the first N eigenvalues are very close to one another and the eigenvectors associated with those eigenvalues all have the same N entries terms then use a lower complexity MUD. If there are any other regions of the eigenvalues that are basically equal and the eigenvalues have the same dominant terms or if there is any one eigenvector that has a dominant term and its eigenvector is above the noise floor then use a lower complexity MUD. If the eigenvalues and eigenvectors of the correlation matrix do not have these characteristics then use the highest complexity MUD.

(EX1001 at 14:7-18).

38. The specification also provides some other criteria, for example, computational complexity, number of bits, and number of users. (EX1001 at 14:34-36).

39. Each of these algorithms has a common thread—instead of looking at just a few select representative or averaged pieces of data concerning the channel, it considers characteristics of a complete set of granular data such as, for example, information concerning all of the subject users or symbols. By digging deep in this

manner, the disclosed and claimed “multi-user detector decision unit” succeeds where prior art approaches fail, selecting the appropriate MUD that achieves an optimal balance between complexity and performance. (EX1001 at 14:48-55).

B. Dividing A Received Signal Into Windows Of Data And Selecting The MUD Most Appropriate To Process That Particular Window

40. Another improvement identified and claimed in the '492 Patent is dividing a received signal into small windows containing a limited amount of transmitted symbols/bits and, for each window, selecting the MUD most appropriate to process that particular window.

41. The '492 Patent describes that in this improvement, the received signal is broken into numerous subparts, called “windows”: “The received signals are split into a plurality of window . . . , wherein the windows are subsets of the total received signals.” (EX1001 at 18:52-54). “[T]he processing window is at least as wide as any single block of data;” typically in a small channel, each window will be around three symbols in length, while each can be longer for larger channels. (EX1001 at 17:24-57).

42. The '492 Patent further describes that when each window is processed, a new MUD selection occurs so that instead of using the same MUD for the entire signal, each subpart of the signal (window) is processed by a MUD selected as optimal for that particular window:

- “the MUD processing is performed for all of the symbols of a given window , . . before decoding the results and then moving to the next window;”
- “based upon the decision logic, the MUD is chosen . . . for the particular window of data;”
- “an independent decision is made about which MUD technique to use for every window.”

(EX1001 at 17:63-18:7).

VI. The Petition Should be Denied Because Each Asserted Ground Fails to Establish the Required Reasonable Likelihood of Success

43. I understand that Lenovo’s Petition asserts the following Grounds:

Ground	References	Basis	Challenged Claims
1A	<i>McElwain, Wang</i>	§ 103	1-3, 5-13, 15-17
1B	<i>McElwain, Sampath</i>	§ 103	1-3, 5-13, 15-17
2A	<i>Mills, Liu</i>	§ 103	1-3, 5-13, 15-17
2B	<i>Mills, Liu, Sampath</i>	§ 103	10-13, 15, 16

A. Challenged Claims 1-3, 5-13, and 15-16 All Require the Inventive “multi-user detector decision unit”

44. I understand all grounds challenge claims 1-3, 5-13, and 15-16 as obvious in light of *McElwain* or *Mills* combined with one or more of *Wang*, *Sampath*, and *Liu*. I understand independent claim 1, independent claim 10, and their respective claims each embody and recite the foregoing innovative “multi-user detection decision unit” for selecting approaches a MUD.

45. For example, this limitation is present and highlighted in the following exemplary claim 1:

1. A hybrid Multi-User Detector System for processing received signals, comprising:

a parameter estimator coupled to said received signals providing received data information;

a multi-user detector decision unit coupled to said parameter estimator and said received signals;

at least two multi-user detectors coupled to said parameter estimator and said multi-user detector decision unit, **said multi-user detector decision unit using decision criteria to determine a selected multi-user detector**, wherein said selected multi-user detector outputs a plurality of information streams, one stream corresponding to each of said received signals; and

a bank of decoders coupled to said plurality of information streams, wherein said decoders output a plurality of improved information streams.

(EX1001 at claim 1; *see also* claim 10 at 24:15-18).

1. The Agreed Construction of “Multi-User Detector Decision Unit”

46. I understand that Petitioners agree that the claimed “multi-user detector decision unit” is a means-plus-function term, where the claimed function is “using decision criteria to determine a selected multi-user detector,” and the corresponding structure is “MUD decision unit 220 (or decision logic 520) configured to perform one or more algorithms described at 8:12-18, 13:35-14:40, 15:3-21, 19:43-48, 19:56-62, and 20:41-49; and equivalents thereof.”

47. The identified algorithms are the several selection algorithms identified in the '492 Patent, some of which are discussed above, including:

- BER/User Algorithm;

- SINR/Symbol Algorithm;
- Filtered SINR/Symbol Algorithm;
- Detected Amount/Symbol Algorithm;
- Correlation Matrix Ratio/User Algorithm;
- Correlation Matrix Eigenvalues Algorithm;
- Computational Complexity Algorithm;
- Number of Bits Algorithm; and
- Number of Users Algorithm.

(EX1001 at 8:12-18, 13:35-14:40, 15:3-21, 19:43-48, 19:56-62, and 20:41-49).

48. I understand Patent Owner Collison previously asserted the '492 Patent in the District Court for the Eastern District of Texas. In that litigation, I understand the Eastern District of Texas District Court adopted this same construction. Similarly, I understand the PTAB also adopted this same construction when denying institution of an earlier Petition against the '492 Patent, identifying the corresponding structure as:

a MUD decision unit 220 (or, alternatively, decision logic unit 520) configured to perform one or more of the several decision algorithms (e.g., BER/User, SINR/Symbol, Filtered SINR/Symbol, Detected Amount/Symbol, Correlation Matrix Ratio/User Algorithm, Correlation Matrix Eigenvalues, Computational Complexity, Number

of Bits, Number of Users, and other algorithms) disclosed at 8:12-18, 13:35-14:40, 15:3-21, 19:43-48, 19:56-62, and 20:41-49 of the '492 Patent.

See Samsung v. Collision, IPR2024-01247, Paper No. 14, at 12 (PTAB 2025).

B. Ground 1A - Claims 1-3, 5-13, and 15-16: The Petition Does not Establish That Wang Discloses the Claimed “multi-user detector decision unit”

49. I understand Ground 1A challenges claims 1-3, 5-13, and 15-16 as obvious in light of *McElwain* combined with *Wang*. (Pet. at 13-36). I understand each of claims 1-3, 5-13, and 15-16 recites the inventive “multi-user detector decision unit” discussed above. I understand Ground 1A relies solely on *Wang* as allegedly disclosing this required limitation. Allegedly, “Module 13 of *Wang* performs an eigen decomposition of correlation matrix as described in the specification of the ‘492 Patent.” (Pet. at 17). I understand the Petition goes so far as to allege these algorithms are “the same.” But none of the multi-user detection algorithms in *Wang* disclose the Correlation Matrix Eigenvalues Algorithm of the ‘492 Patent.

50. The ‘492 Patent’s Correlation Matrix Eigenvalues Algorithm performs an eigen decomposition on a user correlation matrix to represent its information using eigenvalues and eigenvectors. The algorithm then considers all of the

eigenvalues (and their associated eigenvectors) above a noise floor to select the appropriate MUD:

The decision can be made by taking the eigendecomposition of the correlation matrix and **looking at all the eigenvalues that are above the noise floor. If the first N eigenvalues are very close to one another and the eigenvectors associated with those eigenvalues all have the same N entries terms** then use a lower complexity MUD. If there are any other regions of the eigenvalues that are basically equal and the eigenvalues have the same dominant terms or if there is any one eigenvector that has a dominant term and its eigenvector is above the noise floor then use a lower complexity MUD. If the eigenvalues and eigenvectors of the correlation matrix do not have these characteristics then use the highest complexity MUD.

(EX1001 at 14:7-18).

51. Based on this disclosure, the Correlation Matrix Eigenvalues Algorithm requires doing at least the following to select a MUD:

- looking at all the eigenvalues that are above the noise floor;
- evaluating whether the first N eigenvalues are very close to one another;
- evaluating the eigenvectors associated with those eigenvalues; and
- evaluating if those eigenvectors all have the same N entries terms.

52. But the Petition does not identify **any** of these required steps for the alleged *Wang* “multi-user detector decision unit,” much less **all** of them. Instead, I understand the Petition tries to rely on the fact *Wang* mentions eigenvalues and eigenvectors, ignoring that *Wang* does not describe using those eigenvalues or eigenvectors to perform any of these required steps. But *Wang* does not disclose

any and all of these missing algorithm steps of the User Correlation Matrix Eigenvalues Algorithm.

1. The Petition fails to show that *Wang* discloses “looking at all the eigenvalues that are above the noise floor” for selecting a MUD

53. The '492 Patent's Correlation Matrix Eigenvalues Algorithm for selecting a MUD includes the step of “looking at all the eigenvalues that are above the noise floor.” (EX1001 at 14:7-18). I understand the Petition identifies no such step in *Wang*. At best, the Petition alleges that Wang describes looking at some of the eigenvalues that are above the noise floor to select the appropriate MUD.

54. The Petition equates “noise power (σ_N^2)” with “noise floor.” (Pet. at 18-19). But the Petition does not—and could not reasonably—assert that *Wang* teaches looking at all the eigenvalues that are above the “noise power (σ_N^2)” to select the appropriate MUD. To the contrary, the Petition establishes that *Wang* does not perform this step.

55. Instead, as the Petition describes, Wang uses only some of the eigenvalues above the “noise power (σ_N^2)” to select the appropriate MUD. (Pet. at 19-20). The Petition and *Wang* call this subset of eigenvalues above the “noise power (σ_N^2)” the “effective eigenvalues.” (Pet. at 19-20; EX1005 16:7-8).

56. *Wang* explains that the “effective eigenvalues” are those eigenvalues that are above a threshold higher than “noise power (σ_N^2)”, namely the threshold of

$\sigma_N^2 + \delta_\lambda$. (EX1005 16:7-8). As a result, only eigenvalues greater than the sum of a noise power σ_N^2 plus a specific parameter δ_λ are considered for MUD selection in *Wang*. Thus, even following the Petition's logic, *Wang* does not consider eigenvalues failing to satisfy $\sigma_N^2 + \delta_\lambda$ for MUD selection, even if they are above a noise power σ_N^2 . (EX1005 16:7-8). As such, the effective eigenvalues used for selecting a MUD in *Wang* are not inclusive of **all** eigenvalues above a noise power σ_N^2 .

57. The Petition simply ignores this difference between *Wang* and the '492 Patent's Correlation Matrix Eigenvalues Algorithm.

2. The Petition fails to show that *Wang* describes evaluating “if the first N eigenvalues are very close to one another”

58. The '492 Patent's Correlation Matrix Eigenvalues Algorithm for selecting a MUD looks at all of the eigenvalues above a noise floor to, among other things, evaluate “if the first N eigenvalues [of all the eigenvalues above the noise floor] are very close to one another.” (EX1001 at 14:7-18). Because *Wang* does not look at all of the eigenvalues above the noise floor to select a MUD, it necessarily does not describe this evaluation of those eigenvalues.

59. But even aside from this threshold failing, I understand the Petition does not even attempt to identify any determination of “[i]f the first N eigenvalues are very close to one another.” Although the Petition at first acknowledges this is a

required step of the Correlation Matrix Eigenvalues Algorithm (Pet. at 17), it never again mentions the step in its *Wang* analysis and never asserts—much less proves—that *Wang* describes evaluating “[i]f the first N eigenvalues are very close to one another” to select a MUD. (*E.g.*, Pet. at 18-21).

3. The Petition fails to show that Wang evaluates “eigenvectors” to select a MUD

60. The ’492 Patent’s Correlation Matrix Eigenvalues Algorithm considers “the eigenvectors associated with those eigenvalues” to select the appropriate MUD. (EX1001 at 14:7-18). But the Petition fails to show that *Wang* considers eigenvectors at all when selecting a MUD.

61. At best, I understand the Petition explains that *Wang* identifies eigenvectors and that one or more eigenvalues are calculated with respect to each eigenvector. (Pet at 18). But the Petition completely overlooks that the eigenvectors in *Wang* are in no way considered to select a MUD.

62. To the contrary, *Wang* is clear that its MUD selection criteria is limited to the channel type, and the channel type is determined based on “the number of effective eigenvalues and the in-band power spectrum deviation.” (EX1005 at 10:21-11:2; 16:14-16). *Wang* does not describe using eigenvectors as required by the Correlation Matrix Eigenvalues Algorithm, and this is another independent reason why *Wang* fails to describe the claimed “multiuser detector decision unit.”

4. The Petition fails to show that *Wang* evaluates whether “eigenvectors associated with those eigenvalues all have the same N entries terms”

63. To select a MUD, the '492 Patent's Correlation Matrix Eigenvalues Algorithm also evaluates “if ... the eigenvectors associated with those eigenvalues all have the same N entries terms.” (EX1001 at 14:7-18). Because Wang does not use eigenvectors in any manner to select a MUD, it necessarily does not select a MUD by specifically evaluating “if ... the eigenvectors associated with those eigenvalues all have the same N entries terms.”

64. But even if the Petition could show eigenvectors are required for the MUD selection process in *Wang* (it cannot), I understand the Petition does not even attempt to identify the specific step of evaluating if “eigenvectors associated with those eigenvalues all have the same N entries terms” in *Wang*. Instead, the Petition again acknowledges this is a required step of the Correlation Matrix Eigenvalues Algorithm (Pet. at 17), but then never again mentions the step in its *Wang* analysis and never asserts—much less proves—that *Wang* describes evaluating “[i]f ... eigenvectors associated with those eigenvalues all have the same N entries terms” to select a MUD. (*E.g.*, Pet. at 18-21).

65. As such, *Wang* does not consider eigenvectors for selecting a MUD, let alone eigenvectors “associated with those eigenvalues all have the same N entries terms.”

66. Accordingly, *McElwain* and *Wang*, even if combined, as proposed are silent to:

- looking at all the eigenvalues that are above the noise floor;
 - evaluating whether the first N eigenvalues are very close to one another;
 - evaluating the eigenvectors associated with those eigenvalues; and
- evaluating if those eigenvectors all have the same N entries terms.

C. Ground 1A – Claim 17: Neither McElwain Nor Wang Describe The Iterative MUD Selection Limitations Of Claim 17

67. I understand Ground 1A challenges independent claim 17. Claim 17 is a method that repeatedly reassesses which MUD is most appropriate for a signal, dividing a received signal into small windows of data and, for each such window, making an independent determination as to which MUD is most appropriate for processing that particular subset of data from the signal:

17. A method for processing signals from multiple users with raw digitized data, comprising:

performing a parameter estimation of said raw digitized data;

grabbing a window of bits from said raw digitized data;

subtracting any known bits from said window of bits;

selecting a multi-user detector;

estimating unknown bits from said window of bits using said multi-user detector;

incrementing to a next window of bits;

repeating said steps of subtracting, **selecting**, estimating, and incrementing until there are no more windows and outputting a set of symbol estimates.

(EX1001 at claim 17).

68. But neither *McElwain* nor *Wang*, alone or in combination, describes repeatedly selecting a MUD most appropriate to process a particular window of bits.

69. *McElwain* does not and cannot teach this requirement because it does not describe selecting a MUD at all. I understand the Petition does not assert otherwise. (*E.g.*, Pet. at 37-39).

70. *Wang* likewise does not teach the requirement, and again, I understand the Petition does not and cannot assert otherwise. (*E.g.*, Pet. at 37-39). Even presuming that *Wang* teaches selecting a MUD as the Petition asserts (Pet. at 39), there is no suggestion in *Wang* to repeatedly select a MUD most appropriate to process a particular window, and I understand the Petition does not assert or try to identify any such teaching in *Wang*. (Pet. at 39). It cannot because *Wang* describes selecting a MUD algorithm based on channel type **once** and using the selected MUD

algorithm to process **all data** for a signal. (EX1005 7:26-8:3, 9:3-6, 9:25-30, 10:18-21, 14:12-15:16).

71. And combining the references as the Petition baselessly proposes cannot save this Ground because the limitations missing from **both** references will still be missing when they are combined. Modifying *McElwain*, which I understand the Petition admits does not select any MUD, with *Wang*'s MUD selection, which only selects a MUD once for a signal based on the channel type and processes the signal with the selected MUD algorithm, does not teach or result in a system that repeatedly selects a MUD most appropriate to process a particular window, as required by claim 17.

72. I understand the Petition asserts that "because *McElwain* discloses an iterative process for identifying hard outputs is performed for a current data block," the combination of *McElwain* and *Wang* would repeat the steps of subtracting, selecting, estimating, and incrementing. Pet. at 39. But *McElwain* allegedly teaching an iterative process for select **other** functions does not teach using an iterative process for selecting a MUD, and certainly does not teach the **specific** iterative process for selecting MUDs required by claim 17. The mere presence of an iteration in *McElwain* would not suggest to a POSITA to select a MUD at each iteration, particularly where *Wang* teaches selecting a MUD based on channel type, which would be determined **once** for a given received signal and therefor not change

between iterations. In other words, *Wang* teaches selection of a MUD once and there is no reason to make that decision a second time for a given signal because the outcome of that decision would not change.

D. Ground 1B - Claims 1-3, 5-13, and 15-16: The Petition Does not Establish That *Sampath* Discloses the Claimed “multi-user detector decision unit”

73. I understand Ground 1B challenges claims 1-3, 5-13, and 15-16 as obvious in light of *McElwain* combined with *Sampath*. I understand each of claims 1-3, 5-13, and 15-16 recites the inventive “multi-user detector decision unit” discussed above. I understand Ground 1B relies solely on *Sampath* as allegedly disclosing this required limitation. Allegedly, “the demodulator selector 316 performs one of the MUD selection algorithms described by the ‘492 Patent by using an expected signal-to-interference-plus-noise ratio to select one of the three demodulators 304, 308, 312.” (Pet. at 45). But none of the multi-user detection algorithms in *Sampath* disclose the SINR/Symbol Algorithm of the ‘492 Patent.

74. In the ‘492 Patent’s SINR/Symbol Algorithm, the signal to interference plus noise ratio (SINR) is calculated for every symbol received via the channel and those ratios are used to select the appropriate MUD:

The decision can be made by calculating the signal to interference plus noise ratio (SINR) for **each symbol**. If the SINR for **any symbols** is above a threshold set for a specific lower complexity MUD technique then use that technique. If none of the SINR values are above any of the lower complexity MUD thresholds then use the highest complexity MUD.

(EX1001 at 14:19-24).

75. Based on this disclosure, the SINR/Symbol Algorithm requires doing at least the following to select a MUD:

- calculating the SINR for each symbol received via the channel;
- evaluating if the SINR for any of those symbols is above a threshold set for a specific lower complexity MUD technique; and
- evaluating if none of SINR for any of those symbols is above any of the lower complexity MUD thresholds.

76. But I understand the Petition shows only that *Sampath* uses the term “SINR” as if that were enough to disclose these specific features, let alone the specific SINR/symbol algorithm.

1. The Petition fails to show that *Sampath* discloses “calculating the signal to interference plus noise ratio (SINR) for each symbol” to select a MUD

77. The '492 Patent's SINR/Symbol Algorithm selects a MUD by, among other steps, “calculating the signal to interference plus noise ratio (SINR) **for each symbol**” received via the channel. (EX1001 at 14:19-24). But *Sampath* does not describe calculating a SINR for **any** symbol, much less **each** symbol.

78. Indeed, the *Sampath* patent application publication's written description does not mention an SINR at all; *Sampath* only mentions a “signal to interference-plus-noise ratio (SINR)” in its claims 9, 14, and 24. (EX1006 at claims

9, 14, 24). And nowhere does *Sampath* describe calculating the SINR for a symbol. (EX1006 at claims 9, 14, 24).

79. Accordingly, although the Petition acknowledges that “calculating the signal to interference plus noise ratio (SINR) **for each symbol**” is a required step of the SINR/Symbol Algorithm (Pet. at 45), it does not—and cannot reasonably—assert that *Sampath* calculates the SINR for **any** symbol, much less **each** symbol. (E.g., Pet. at 45-47). Instead, I understand the Petition merely alleges that in *Sampath* “the demodulator selector 316 uses a SINR threshold for a first demodulator and a SINR threshold for a second demodulator to choose between selecting the first demodulator or the second demodulator for processing received signals.” (Pet. at 46). Thus, although the Petition interprets the *Sampath* SINR claims as disclosing SINR thresholds, the Petition never even asserts, much less proves, that *Sampath* describes calculating the SINR of each (or any) symbol.

2. The Petition fails to show the MUD selection criteria in *Sampath* considers “the SINR for any symbols is above a threshold set for a specific lower complexity MUD technique” or “whether none of the SINR values are above any of the lower complexity MUD thresholds”

80. In the '492 Patent's SINR/Symbol Algorithm, once the SINRs of each symbol are calculated, the algorithm (1) evaluates if the SINR for any of those symbols is above a threshold set for a specific lower complexity MUD technique;

and (2) if none of SINR for any of those symbols is above any of the lower complexity MUD thresholds:

The decision can be made by calculating the signal to interference plus noise ratio (SINR) for each symbol. If the SINR for any symbols is above a threshold set for a specific lower complexity MUD technique then use that technique. If none of the SINR values are above any of the lower complexity MUD thresholds then use the highest complexity MUD.

(EX1001 at 14:19-24).

81. Because *Sampath* does not disclose calculating the SINR for each received symbol, *Sampath* necessarily does not describe comparing those (missing) symbol SINRs to these thresholds.

82. And I understand the Petition does not assert otherwise. Instead, the Petition merely conclusorily asserts (without any basis) that *Sampath* uses two “SINR thresholds” to choose between two demodulators. (Pet. at 46). *Sampath* in fact mentions no such SINR thresholds, but even this unsupported assertion is not what is required by the ’492 Patent’s SINR/Symbol Algorithm. For example, unlike in the ’492 Patent’s SINR/Symbol Algorithm, the Petition does not and cannot assert that *Sampath* describes that:

- the SINRs for each symbol are compared to the thresholds;
- a specific lower complexity MUD technique is selected if just any SINR (much less required “SINR for any symbol”) “is above a

threshold set for [that] specific lower complexity MUD technique;”
and

- the highest complexity MUD technique is used if “**none** of the [symbol’s] SINR values **are above** any of the lower threshold complexity thresholds.

(EX1001 at 14:19-24; Pet. at 46-47).

83. The Petition cannot identify in *Sampath* any of these detailed steps (either for the required symbol SINRs or even for SINRs in general) because *Sampath* includes no such details. Instead, at best, the short *Sampath* claims that mention SINR disclose that SINR is used as a metric for choosing between a first or second demodulator. (EX1006 at claims 9, 14, 24; Pet. at 46-47). For example, *Sampath* published claims 8 and 9 read as follows:

8. The multiple-input receiver as recited in claim 1, wherein the decision logic is configured to choose based upon a metric.

9. The multiple-input receiver as recited in claim 8, wherein the metric is a signal to interference-plus-noise ratio (SINR) for the first or second demodulator.

(EX1006 at claims 8, 9).

84. But this mere mention of SINR says nothing about **how** SINR is used as metric and certainly do not describe any of the foregoing **specific ways** to use **symbol** SINRs to select a particular MUD technique.

E. Ground 1B – Claim 17: Neither McElwain nor Sampath Describe The Iterative MUD Selection Limitations Of Claim 17

85. I understand Ground 1B challenges independent claim 17. Claim 17 is a method that repeatedly reassesses which MUD is most appropriate for a signal, dividing a received signal into small windows of data and, for each such window, making an independent determination as to which MUD is most appropriate for processing that particular subset of data from the signal:

17. A method for processing signals from multiple users with raw digitized data, comprising:

performing a parameter estimation of said raw digitized data;

grabbing a window of bits from said raw digitized data;

subtracting any known bits from said window of bits;

selecting a multi-user detector;

estimating unknown bits from said window of bits using said multi-user detector;

incrementing to a next window of bits;

repeating said steps of subtracting, **selecting**, estimating, and incrementing until there are no more windows and outputting a set of symbol estimates.

(EX1001 at claim 17).

86. But neither *McElwain* nor *Sampath*, alone or in combination, describes repeatedly selecting a MUD most appropriate to process a particular window of bits.

87. The Petition does not even attempt to map this element to these references or a combination thereof—Ground 1B includes no analysis at all, and instead solely comprises references to prior assertions concerning a different ground (the *McElwain-Wang* combination of Ground 1A).

88. The Petition does not even attempt to map the *McElwain-Sampath* combination to claim 17 because it cannot. *Sampath* describes decision logic configured to choose a first demodulator or a second demodulator and that the decision logic can choose based on a metric that includes SINR. (EX1006 claims 1, 8, 9). Nowhere does *Sampath* suggest repeatedly selecting a demodulator for a signal. Instead, *Sampath* teaches selecting a demodulator to pass the entire signal to for processing and, once a decision is made, does not revisit that decision for a given signal. (EX1006 ¶ 39, 41).

89. The mere presence of iteration in *McElwain* would not suggest to a POSITA to select a MUD at each iteration, particularly where *Sampath* teaches selecting a demodulator once for a given set of signals. In other words, *Sampath* teaches selection of a demodulator once and there is no reason to make that decision a second time for a given signal because the outcome of that decision would not change.

F. Grounds 2A and 2B - Claims 1-3, 5-13, and 15-16: The Petition Does not Establish That *Liu* Discloses the Claimed “multi-user detector decision unit”

90. I understand Ground 2A challenges claims 1-3, 5-13, and 15-16 as obvious in light of *Mills* combined with *Liu*, while Ground 2B challenges claims 10-13, 15, and 16 as obvious in light of *Mills* combined with *Liu* and *Sampath*. (Pet. at 53-78, 82-85). I understand each of Grounds 2A and 2B relies solely on *Liu* as allegedly disclosing the claimed “multi-user detector decision unit” required by these challenged claims. (*E.g.*, Pet. at 59-65, 83). Allegedly, Logic 403 “selects one of the decoders 404, 406, 407 using an expected bit error rate algorithm equivalent to the expected bit error rate algorithm of the ‘492 Patent.” Pet. at 45. But nothing in *Liu* suggests or discloses the BER/User Algorithm of the ‘492 Patent.

91. In the ‘492 Patent’s BER/User Algorithm, the expected Bit Error Rate (BER) of each channel user is calculated for every available lower complexity MUD. Which MUD to use is then selected based on these expansive calculations and data points:

The decision can be made by calculating the expected bit error rate (BER) of each user based on all the lower complexity MUD techniques. If any of the users have an expected BER that is acceptable, or above a threshold, for any of the lower complexity MUD techniques, then use the lowest complexity MUD possible that meets that criteria. As users are [thus processed and removed,] the

expected BER of the remaining users changes. **If none of the users ... have an expected BER below the threshold for any of the lower complexity MUD techniques** then the highest complexity MUD technique should be used.

(EX1001 at 13:63-14:6, 20:43-49).

92. Based on this disclosure, the BER/User Algorithm requires doing at least the following to select a MUD:

- calculating the expected bit error rate (BER) of each user;
- calculating each user's expected BER based on all the lower complexity MUD techniques; and
- comparing the calculated expected BER of each user to the (BER) thresholds for the lower complexity MUD techniques.

93. But the Petition does not identify **any** of these required steps for the alleged *Liu* “multi-user detector decision unit,” much less **all** of them. Instead, I understand the Petition tries to rely on the fact *Liu* includes a single mention of an “acceptable error rate,” ignoring that *Liu* does not describe calculating an expected BER for every user, calculating the user expected BERs based on all the lower complexity MUD techniques, or comparing those expected BERS to thresholds for the lower MUD techniques, as required in these steps.

1. The Petition fails to show how *Liu* discloses “calculating the expected bit error rate (BER) of each user”

94. The '492 Patent's BER/User Algorithm selects a MUD by, among other steps, “calculating the expected bit error rate (BER) of each user.” (*E.g.*, EX1001 at 13:63-14:6). *Liu* does not describe this step, and the Petition does not identify any such description. Instead, the Petition repeatedly points to and relies on a single reference in *Liu* to an “acceptable error rate”:

However, if linear multi-user decoder 406 cannot satisfactorily decode the intended signal, such as failing to provide a threshold SNR strength and/or other threshold factors, resulting in **an unacceptable error rate or other performance**, non-linear multi-user decoder 407 is preferably used for decoding.

(EX1008 at ¶ 29; Pet. at 62-64).

95. This passage does not describe calculating an **expected** bit error rate, and it certainly does not describe or suggest “calculating the **expected** bit error rate (BER) **of each user**.”

96. Indeed, *Liu*'s system actually precludes performing this required step. *Liu* describes ignoring or filtering out signals that have a strength below a given strength threshold. (EX1008 ¶ 29). By filtering out or otherwise ignoring signals based on the strength of the signal's preamble, *Liu* cannot calculate the expected BER of **each user**.

97. For these reasons alone, the Petition’s conclusory assertion that Liu somehow describes “an algorithm that is the same as” the ’492 Patent’s BER/User Algorithm is wholly baseless.

2. The Petition fails to show that Liu discloses calculating each user’s expected BER “based on all the lower complexity MUD techniques”

98. The ’492 Patent’s BER/User Algorithm requires not only calculating each user’s expected BER, but doing so based on all the lower complexity MUD techniques: “calculating the expected bit error rate (BER) of each user based on all the lower complexity MUD techniques.” (*E.g.*, EX1001 at 13:63-14:6). *Liu* does not describe this step.

99. First, because *Liu* does not disclose “calculating the expected bit error rate (BER) of each user,” it necessarily does not disclose “calculating the expected bit error rate (BER) of each user **based on all the lower complexity MUD techniques.**”

100. Second, even focusing on Liu’s single general reference to “an unacceptable error rate,” Liu does not describe calculating that that unacceptable error rate—which again, is not an expected BER for each user—based on all the lower complexity MUD techniques. (*See, e.g.*, EX1008 at ¶ 29).

101. And I understand the Petition does not assert otherwise. Although the Petition at first acknowledges this is a required step of the BER/User Algorithm

(Pet. at 60), it never again mentions the step in its *Liu* analysis and never asserts—much less proves—that *Liu* describes calculating the expected bit error rate (BER) of each user “**based on all the lower complexity MUD techniques.**” (*E.g.*, Pet. at 61-64).

3. The Petition fails to show that Liu discloses comparing the calculated expected BER of each user to the (BER) thresholds for the lower complexity MUD techniques to see if they are above those thresholds”

102. After calculating the expected bit error rate (BER) of each user based on all the lower complexity MUD techniques, the '492 Patent's BER/User Algorithm requires comparing the calculated expected BER of each user to the (BER) thresholds for the lower complexity MUD techniques to see if they are above those thresholds (i.e., acceptable):

The decision can be made by calculating the expected bit error rate (BER) of each user based on all the lower complexity MUD techniques. **If any of the users have an expected BER that is acceptable, or above a threshold, for any of the lower complexity MUD techniques,** then use the lowest complexity MUD possible that meets that criteria. As users are [thus processed and removed,] the expected BER of the remaining users changes. **If none of the users ... have an expected BER below the threshold for any of the lower complexity MUD techniques** then the highest complexity MUD technique should be used.

(EX1001 at 13:63-14:6, 20:43-49).

103. *Liu* is completely silent on these required steps. First, because *Liu* does not describe calculating the expected bit error rate (BER) of each user based on all the lower complexity MUD techniques, it necessarily cannot and does not describe comparing those (missing) calculations to the required thresholds.

104. Second, even focusing on *Liu*'s single general reference to "an unacceptable error rate," *Liu* does not describe comparing that that unacceptable error rate—which again, is not an expected BER for each user based on all the lower complexity MUD techniques—to thresholds for the lower complexity MUD techniques. (*See, e.g.*, EX1008 at ¶ 29). Not only does *Liu* describe no such comparisons, but the only thresholds identified in the Petition are not thresholds for the lower complexity MUD techniques:

However, if linear multi-user decoder 406 cannot satisfactorily decode the intended signal, such as failing to provide **a threshold SNR strength and/or other threshold factors**, resulting in an unacceptable error rate or other performance, non-linear multi-user decoder 407 is preferably used for decoding.

(EX1008 at ¶ 29; Pet. at 62-64).

105. The only mentioned threshold is a SNR threshold and "other" unidentified thresholds.

106. Accordingly, *Mills* and *Liu*, even if combined, as proposed are silent to:

- calculating the expected bit error rate (BER) of each user;

- calculating each user's expected BER based on all the lower complexity MUD techniques; and
- comparing the calculated expected BER of each user to the (BER) thresholds for the lower complexity MUD techniques.

G. Ground 2A – Claim 17: Neither Mills nor Liu Describe The Iterative MUD Selection Limitations Of Claim 17

107. I understand Ground 2A challenges independent claim 17. Claim 17 is a method that repeatedly reassesses which MUD is most appropriate for a signal, dividing a received signal into small windows of data and, for each such window, making an independent determination as to which MUD is most appropriate for processing that particular subset of data from the signal:

17. A method for processing signals from multiple users with raw digitized data, comprising:

performing a parameter estimation of said raw digitized data;

grabbing a window of bits from said raw digitized data;

subtracting any known bits from said window of bits;

selecting a multi-user detector;

estimating unknown bits from said window of bits using said multi-user detector;

incrementing to a next window of bits;

repeating said steps of subtracting, **selecting**, estimating, and incrementing until there are no more windows and outputting a set of symbol estimates.

(EX1001 at claim 17).

108. But neither *Mills* nor *Liu*, alone or in combination, describes repeatedly selecting a MUD most appropriate to process a particular window of bits.

109. *Mills* does not and cannot teach this requirement because it does not describe selecting a MUD at all. I understand the Petition does not assert otherwise. (*E.g.*, Pet. at 59, 80).

110. *Liu* likewise does not teach the requirement, and again, I understand the Petition does not and cannot assert otherwise. (*E.g.*, Pet. at 78-81). Even presuming that *Liu* teaches selecting a decoder as the Petition asserts (Pet. at 39), there is no suggestion in *Liu* to repeatedly select a MUD most appropriate to process a particular window, and the Petition does not assert or identify any such teaching in *Liu* does. (*E.g.*, Pet. at 78-81). It cannot because *Liu* describes selecting a decoder **once** based on the strength of a signal's preamble, which does not vary. (EX1008 ¶ 29).

111. And combining the references as the Petition baselessly proposes cannot save this Ground because the limitations missing from **both** references will still be missing when they are combined. Modifying *Mills*, which I understand the

Petition admits does not select any MUD, with *Liu*'s decoder election, which only selects a decoder once for a signal based on preamble strength, does not teach or result in a system that repeatedly selects a MUD most appropriate to process a particular window, as required by claim 17.

112. The Petition asserts that “because *Mills* explains that the iterative process proceeds to the next block of received data bits, repeating the process” the combination of *Mills* and *Liu* would repeat the steps of subtracting, selecting, estimating, and incrementing. (Pet. at 81). But *Mills* allegedly teaching an iterative process for selecting other functions does not teach using an iterative process for selecting a MUD, and certainly does not teach the specific iterative process for selecting MUDs required by claim 17.

113. The mere presence of an iteration in *Mills* would not suggest to a POSITA to select a MUD at each iteration, particularly where *Liu* teaches selecting a detector based on preamble strength, which would be determined once for a given signal and consequently not change between iterations. In other words, *Liu* teaches selection of a detector once and there is no reason to make that decision a second time for a given signal because the outcome of that decision would not change.

I declare that all statements made herein of my knowledge are true, and that all statements made on information and belief are believed to be true, and that these

statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code.

Dated: August 25, 2025

A handwritten signature in blue ink, appearing to read "Ginger Cairn", is written in a cursive style.