

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS AMERICA, INC.,
SAMSUNG ELECTRONICS CO., LTD.,
Petitioners,

v.

COLLISION COMMUNICATIONS, INC.,
Patent Owner.

Case No. IPR2024-01247
U.S. Patent No. 7,593,492

DECLARATION OF PAUL S. MIN, PH.D.
IN SUPPORT OF PETITION FOR *INTER PARTES* REVIEW OF
U.S. PATENT NO. 7,593,492

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I. Introduction

1. I, Paul S. Min, Ph.D., submit this declaration to state my opinions on the matter described below.

2. I have been retained by Petitioners Samsung Electronics Co., Ltd. and Samsung Electronics America, Inc. (“Petitioners”), as an independent expert in this proceeding before the United States Patent and Trademark Office. Although I am being compensated at my usual and customary rate of \$500 per hour, no part of my compensation depends on the outcome of this proceeding, and I have no other interest in this proceeding.

3. I understand that this proceeding involves U.S. Patent No. 7,593,492 (the “’492 patent”), and I have been asked to consider the validity of certain claims of the ’492 patent based on certain prior art references. I have also been asked to consider the state of the art and prior art available as of September 15, 2006. Based on the prior art discussed in this declaration, it is my opinion that claims 1-18 of the ’492 patent are unpatentable for the reasons provided below.

II. Qualifications and Background

4. I believe that I am well qualified to serve as a technical expert in this matter based upon my educational and work experience, and specifically, in the field of vehicle electronics and computing devices. My curriculum vitae (“CV”) is submitted as Exhibit 1003.

5. Of note, as shown in my CV, I have extensive experience design and implementation of receiver devices to be used in the cellular equipment and the WLAN equipment.

6. I received a B.S. degree in Electrical Engineering in 1982, an M.S. degree in Electrical Engineering in 1984, and a Ph.D. degree in Electrical Engineering in 1987 from the University of Michigan in Ann Arbor. I received several academic honors, including my B.S. degree with honors, a best graduate student award and a best teaching assistant award during my M.S. study, and a best paper award from a major international conference for reporting results from my Ph.D. thesis.

7. After receiving my Ph.D., I worked at Bellcore in New Jersey from August 1987 until August 1990. At Bellcore, I was responsible for evolving the public switched telephone network (POTS) into a multi-services voice and data network that incorporated packet switches, optical technologies, and wireless technologies.

8. In September 1990, I joined the faculty at Washington University in St. Louis. In July 1996, I was promoted to an Associate Professor of Electrical Engineering with tenure. I am currently a Senior Professor at Washington University of the Electrical and Systems Engineering. I have also served as the Chair of the

Graduate Curriculum (2000-2002) and the Chair of the Undergraduate Curriculum (2011-2014) for the Electrical and Systems Engineering department.

9. At Washington University, I have conducted research in communication, computing, and related electronic hardware and software. My research group has pioneered a new paradigm for designing electronic circuits that can alleviate the speed and performance mismatch against optical technology. I have received several grants from the U.S. Federal Agencies, including the National Science Foundation and the Defense Advanced Research Project Agency, and numerous contracts from companies and organizations around the world. Specifically related to the technology matters in this Investigation, I have researched a variety of wireless communication technologies, including CDMA, WCDMA, OFDM, FDD, SC-FDMA, and TDD. I have an extensive background and experience in each of these technologies.

10. As a faculty member at Washington University, I have taught a number of courses in electronics, communication, and computing at both the undergraduate and graduate levels. For example, I have taught communication theory (Washington University ESE 471), transmission and multiplexing (Washington University ESE 571), and signaling and control of communication networks (Washington University ESE 572).

11. I have supervised numerous graduate students, many of whom received a doctoral degree under my guidance. A number of doctoral theses that I have supervised relate specifically to LTE and other cellular technologies. In particular, my students and I have published a number of peer-reviewed articles on resource allocation, scheduling, modulation, mobility management, and multiplexing. Several of these articles received accolades in the field. For example, in 2011, we received a best paper award in 3G WCDMA-related mobility and resource management at the prestigious Mobility 2011 international conference.

12. In addition to my responsibilities as a university faculty member, I have founded two companies. In May 1997, I founded MinMax Technologies, Inc., a fabless semiconductor company that developed switch fabric integrated circuit chips for the Internet. In March 1999, I founded Erlang Technology, Inc., a fabless semiconductor company that focused on the design and development of integrated circuit chips and software for the Internet. One of Erlang's products received a best product of the year award in 2004 from a major trade journal for the electronics industry.

13. Outside my own start-up companies, I have also served in various technology and business advisor roles for other companies and organizations around the world. I was the main technical author for one of two winning proposals to the

Korean government for CDMA wireless service licenses (1996). I was responsible for designing a commercial scale IS-95 CDMA cellular network, which I understand to be one of the earliest such networks deployed in the world. I worked with numerous engineers and scientists around the world to implement this commercial-scale cellular network before IS-95 CDMA was widely accepted. This provided me with extensive insight into various components of CDMA technology, which by and large are used in WCDMA network. I have also been involved in a semiconductor company that specializes in semiconductor memories such as flash EEPROMs as a board member and as a technical advisor (2007-2011).

14. I am a named inventor on eleven U.S. patents, many of which are directly related to resource allocation, packet processing, and network designing. I have extensively published technical papers in international conferences and journals, technical memoranda and reports, and given a number of seminars and invited talks. Many of these papers are specifically within the context of the 3GPP standard. I have organized several international conferences and served as an international journal editor.

15. I am a member of and have been actively involved in a number of professional organizations. For example, I have served as the Chair of the Saint Louis Section of the IEEE with more than 3,000 members (2014), and a member of

the Eta Kappa Nu Honor Society for electrical engineers. I have also been an Ambassador of the McDonnell International Scholars Academy (2007-2013).

16. In my nearly 30 years of experience with telecommunications technology, I have acquired significant knowledge about telecommunications systems industry standards, standard setting organizations such as 3GPP, and the rules and document policies that those organizations have in place to develop industry standards.

III. Legal Standards

17. In forming my opinions and considering the subject matter of the '268 patent and its claims in light of the prior art, I am relying on certain legal principles that counsel in this case explained to me. My understanding of these concepts is summarized below.

18. I understand that the claims define the invention. I also understand that an unpatentability analysis is a two-step process. First, the claims of the patent are construed to determine their meaning and scope. Second, after the claims are construed, the content of the prior art is compared to the construed claims.

19. I understand that a claimed invention is only patentable when it is new, useful, and non-obvious in light of the "prior art." That is, the invention, as defined by the claims of the patent, must not be anticipated or rendered obvious by

the prior art.

A. Claim Construction

20. I understand that the United States Patent and Trademark Office interprets claim terms in an *inter-partes* review proceeding under the same claim construction standard that is used in a United States federal court. I understand that under this standard, the meaning of claim terms is considered from the viewpoint of one of ordinary skill in the art at the time of the alleged invention.

21. I understand that claim terms are generally given their ordinary and customary meaning as understood by one of ordinary skill in the art in light of the specification and the prosecution history pertaining to the patent. I understand, however, that claim terms are generally not limited by the embodiments described in the specification.

22. I understand that in addition to the claims, specification, and prosecution history, other evidence may be considered to ascertain the meaning of claim terms, including textbooks, encyclopedias, articles, and dictionaries. I have been informed that this other evidence is often less significant and less reliable than the claims, specification, and prosecution history.

B. Anticipation Under 35 U.S.C. § 102

23. I understand that under 35 U.S.C. § 102, a patent claim is invalid if its subject matter was patented or described in a printed publication before the

effective filing date of the claimed invention. I have been told that this is referred to as invalidity by anticipation. I have been told that a patent claim is anticipated under § 102 if a single prior art reference discloses all limitations of the claimed invention.

C. Obviousness Under 35 U.S.C. § 103

24. I understand that a patent claim is invalid as obvious if the claimed invention would have been obvious to a person of ordinary skill in the art (“POSITA”) at the time the claimed invention was made. This means that even if all of the elements of the claim cannot be found in a single prior art reference that would anticipate the claim, a person of ordinary skill in the field who knew about all the prior art would have come up with the claimed invention. I understand that in an obviousness determination, the person of ordinary skill in the art is presumed to have knowledge of all material prior art. I understand that whether a claim is obvious is based upon the determination of several factual issues.

25. I understand that obviousness is a determination of law based on underlying determinations of fact. I understand that these factual determinations include the scope and content of the prior art, the level of ordinary skill in the art, the differences between the claimed invention and the prior art, and secondary considerations of non-obviousness.

26. In considering obviousness, I understand that one must determine the

scope and content of the prior art. I understand that, in order to be considered as prior art to a patent being considered, a prior art reference must be reasonably related to the claimed invention of that patent. A reference is reasonably related if it is in the same field as the claimed invention or is from another field to which a person of ordinary skill in the art would look to solve a known problem.

27. I understand that one must determine what differences, if any, existed between the claimed invention and the prior art.

28. I understand that a patent claim composed of several elements is not proved obvious merely by demonstrating that each of its elements was independently known in the prior art. In evaluating whether such a claim would have been obvious, one may consider whether a reason has been identified that would have prompted a person of ordinary skill in the art to combine the elements or concepts from the prior art in the same way as in the claimed invention. There is no single way to define the line between true inventiveness on the one hand (which is patentable) and the application of common sense and ordinary skill to solve a problem on the other hand (which is not patentable). For example, market forces or other design incentives may be what precipitated a change, rather than true inventiveness.

29. I understand that whether a prior art reference renders a patent claim

unpatentable as obvious is determined from the perspective of a person of ordinary skill in the art at the time of the alleged invention. I have been told that there is no requirement that the prior art contain an express suggestion to combine known elements to achieve the claimed invention, but a suggestion to combine known elements to achieve the claimed invention may come from the prior art, as filtered through the knowledge of one skilled in the art. In addition, I have been told that the inferences and creative steps a person of ordinary skill in the art would employ are also relevant to the determination of obviousness.

30. I understand that there is no rigid rule that a reference or combination of references must contain a “teaching, suggestion, or motivation” to combine references. But I also understand that the “teaching, suggestion, or motivation” test can be a useful guide in establishing a rationale for combining elements of the prior art. I have been told that this test poses the question as to whether there is an express or implied teaching, suggestion, or motivation to combine prior art elements in a way that realizes the claimed invention, and that it seeks to counter impermissible hindsight analysis.

31. I understand that one may consider, e.g., whether (1) the change was merely the predictable result of using prior art elements according to their known functions, or whether it was the result of true inventiveness; (2) there is some

teaching or suggestion in the prior art to make the modification or combination of elements claimed in the patent; (3) the claimed innovation applies a known technique that had been used to improve a similar device or method in a similar way; (4) the claimed invention would have been obvious to try, meaning that the claimed innovation was one of a relatively small number of possible approaches to the problem with a reasonable expectation of success by those skilled in the art; (5) the invention merely substituted one known element for another known element in order to obtain predictable results; (6) the invention merely applies a known technique to a known device, method, or product to yield predictable results; or (7) known work in the field may have prompted variations of use of the same inventions in the same or different fields due to market forces or design incentives that would have been predictable to a person of ordinary skill in the art.

32. I understand that any assertion of secondary considerations of non-obviousness must be accompanied by a nexus between the merits of the invention and the evidence offered.

IV. The '492 patent

A. Background of Technology

33. I first begin with a summary of the technology involved with the '492 patent. In the below summary, I refer to two well-known texts regarding wireless

communications: “Modern Digital and Analog Communication Systems” by Lathi (“Lathi”) (Ex. 1009) and “Multiuser Detection” by Verdu (“Verdu”) (Ex. 1007).

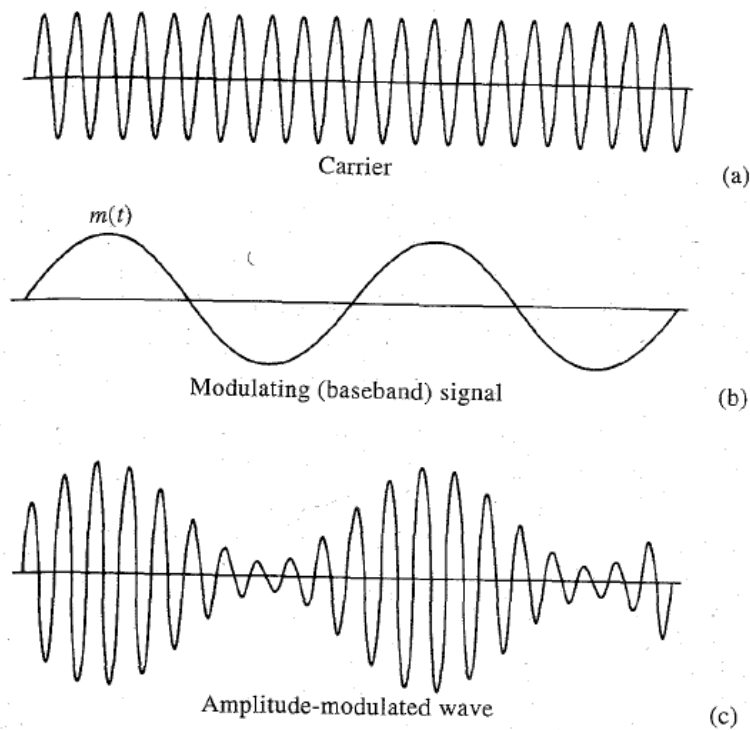
34. The ’492 patent is directed to wireless communications. When transmitting information over a wireless telecommunication system, information is first converted into a baseband signal. Lathi, 10. Baseband signals operate at low frequencies. For example, for telephony, the audio baseband is 0 to 3.5 KHz. *Id.*, 85. For digital data, baseband depends on the “ R_b pulses for second,” and is 0 to R_b Hz. *Id.* Because “baseband signals have sizable power at low frequencies,” they are “suitable for communications over a pair of wires, coaxial cables, or optical fibers.” *Id.*

35. However, wirelessly transmitting a baseband signal is usually not practical because the low frequencies mean the signal has a very long wavelength. For example, AM radio, which operates at 500 kHz to 1600 kHz, has wavelengths of 187.5 to 600 meters. By contrast, FM radio, which operates at 100 MHz, has a wavelength of about 3 meters.

36. One problem with long wavelengths is that they require very large antennas to transmit. Signals with long wavelengths may also have trouble entering smaller areas—for example, AM radio does not work in tunnels because the wavelengths are too long. Finally, baseband frequencies are much more susceptible

to noise, interference, and distortion from the environment—such as audible noise and electricity.

37. As a result, baseband signals are usually converted to much higher frequencies (*e.g.*, radio frequencies) using a process called ***modulation***. Ex. 1009, 15. Modulation is the process of taking a carrier wave (also called a carrier frequency) at the desired frequency and modulating one of its parameters (*e.g.*, amplitude, frequency, or phase) so that it carries the information being transmitted. *Id.* For example, in amplitude modulation, the carrier frequency is a high-frequency wave (for example, 600 kHz), and its amplitude is modified according to the baseband signal (which may have a center of 10 kHz), resulting in an amplitude-modulated wave (figure (c)). *Id.*, 15-16.



38. Another issue with baseband signals is that they cannot be transmitted simultaneously because they “would interfere with each other.” *Id.*, 16. However, this can be solved by dividing the signal into components. For example, in FDMA, different carrier frequencies are modulated with different signals, and as long as “the various carrier frequencies are chosen sufficiently far apart in frequency,” they will not interfere with each other. *Id.* This allows for “transmitting several signals simultaneously,” and thus allows for multiple users to share the same frequency band. *Id.*

39. CDMA also allows users to share bandwidth. However, instead of allocating a particular frequency range to a user, CDMA uses codes for each user to

modulate the signal. Each code is orthogonal to another user's code and thus minimizes interference.

40. I note that FDMA, TDMA, CDMA are **multiaccess** techniques that make use of **multiplexing**, which allows for multiple data streams to be transmitted simultaneously. However, "multiplexing" should not be confused with "multiaccess," although those terms are sometimes "used interchangeably." Verdu, 18. The primary difference is that "multiaccess usually refers to situations where the message sources are not collocated and/or operate autonomously." *Id.* In a multiaccess channel, the sources "are referred to as *users*," and therefore the signal is a multiuser signal. *Id.* By contrast, multiplexing is a more general technique that does not necessarily involve multiaccess—for example, sometimes a MIMO signal is transmitted by a single source and generally does not involve multiple users and would therefore not be multiaccess even if the signal is multiplexed.

41. Regardless, even when multiplexing and/or multiaccess techniques are used, interference and noise are nevertheless almost always present with any transmission channel. This can create challenges in detecting the various user signals within a single channel, because interference makes it difficult to differentiate one user's transmission signal from another user's transmission signal. As one of the prior art references Onggosanusi explains, CDMA systems have

“frequency-selective channels which cause MUI (multi-user interference) as a result of the loss of orthogonality between spreading codes.” Onggosanusi, ¶19.

42. Before the '492 patent, there were a number of algorithms for performing multi-user detection, and Onggosanusi provides an explanation for some of these algorithms. *Id.*, ¶¶22-29. Onggosanusi notes that these algorithms have different levels of complexity, with more complex algorithms like “joint ML detector” having better performance but higher power requirements, whereas a low complexity algorithm like “maximum ratio combining (MRC)” cannot accommodate interference at all. *Id.*, ¶¶30-34. However, Onggosanusi notes that in a low interference channel, both MRC and joint ML have the same performance—but as signals become more correlated (*i.e.* have higher interference), “the performance difference between the ML detector and a linear detector becomes large.” *Id.*, ¶35.

B. Overview of the '492 patent (Ex. 1001)

43. The '492 patent notes that it was well-known to allow for increased demand in data for wireless signals, “multiple users [can now] access the same communications medium to transmit or receive information.” Ex. 1001, 1:32-33. To accommodate such signals, “Advanced receiver processing techniques cover several areas, namely interference suppression (also called Multi-User Detection or

MUD), multipath combining and space-time processing, equalization, and channel estimation.” *Id.*, 1:36-40.

44. The ’492 patent notes there are different methods for MUD of varying complexity. For high complexity, there are “maximum likelihood MUD, maximum likelihood sequence estimator for multiple interfering users, successive interference cancellation, TurboMUD or iterative MUD, and various linear algebra based multi-user detectors.” *Id.*, 5:14-18. For “suboptimal multiuser detectors that are less computationally complex” that were known, there are “linear detectors, includes decorrelators, minimum mean square error or MMSE detectors, and zero-forcing block linear equalizers.” *Id.*, 5:25-29.

45. The ’492 patent notes that with wireless devices, “the amount of processing within the device is limited, directly limiting the amount of computational complexity that is allowed.” *Id.*, 6:56-58. Thus, while the ’492 patent admits MUDs of varying complexity were known, the ’492 patent purports to introduce a system for selecting among a plurality of MUDs of varying complexity. However, as explained below, the selection of a plurality of MUDs was known in the prior art.

C. Prosecution History of the ’492 patent

46. I have reviewed the prosecution history of the application that led to the ’492 patent. Ex. 1002. I note that the examiner did not issue any rejections.

D. Person of Ordinary Skill in the Art

47. I am informed that patentability must be analyzed from the perspective of “one of ordinary skill in the art” in the same field as the ’492 patent at the time of the invention. As previously discussed, the relevant time of invention is the patent’s priority date, which is no earlier than September 15, 2006. Moreover, I understand that whether or not a patent application provides “written description” support for patent claims must also be assessed from the perspective of a person of ordinary skill in the art.

48. I am also informed that several factors are considered in assessing the level of ordinary skill in the art, including (1) the types of problems encountered in the art; (2) the prior art solutions to those problems; (3) the rapidity with which innovations are made; (4) the sophistication of the technology; and (5) the education level of active workers in the field.

49. A person of ordinary skill in the art pertinent to the ’492 patent would have had at least a bachelor’s in EE/CE/CS, physics, or equivalent, and two years of experience with cellular telecommunications, radio-access network architectures, protocols and signal propagation in wireless networks. Additional education could substitute for professional experience and vice versa. A person of ordinary skill in the art would also be able to understand and apply the prior art discussed herein.

50. Although I surpass this definition of one of ordinary skill in the art now and at the priority date of the '492 patent, my analysis regarding the '492 patent has been based on the perspective of one ordinary skill in the art as of the priority date of the '492 patent.

51. I am also familiar with the knowledge of the person of ordinary skill in the art as of the priority date of the '492 patent. I am able to opine on how the person of ordinary skill in the art would have understood the disclosure and claims of the '492 patent, the disclosures of the prior art, the motivation to combine the prior art, and what combinations would have been obvious to one of ordinary skill in the art.

V. Claim Construction of Terms of the '492 patent

52. As I discussed above, I have been informed that for purposes of *inter-partes* reviews, the standard for claim construction of terms within the claims of the patent is the same as that applied in federal district court litigation. I have been asked to assume that the claim terms otherwise have their plain and ordinary meaning to a person skilled in the art in light of the specification and the prosecution history.

53. As of this time, I am not aware of any term that requires specific construction for my opinions. To the extent Patent Owner suggests a narrow construction for a term, I reserve the right to respond to those opinions.

VI. Overview of Prior Art

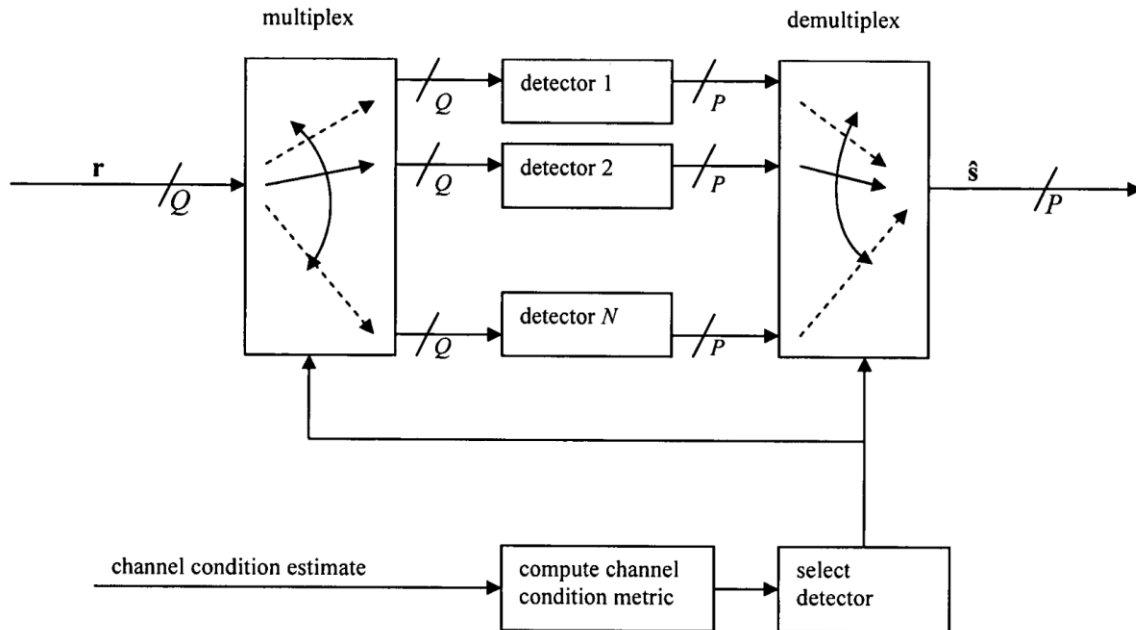
54. Below, I discuss the two references I rely on.

A. Onggosanusi (Ex. 1005)

55. U.S. Pat. Pub. No. 2006/0018410A1 (“Onggosanusi”) (Ex. 1005) was filed on July 26, 2004 and published on January 26, 2006. I understand it is prior art.

56. Onggosanusi describes its invention as follows: “In a wireless MIMO system, a multimode detector selects detection mode by channel estimation: ill-conditioned channels trigger use of high performance detection, whereas well-behaved channels lead to low complexity detection. Detection modes typically include maximum likelihood, minimum mean squared error, zero forcing, and so forth.” Onggosanusi, Abstract.

57. Figure 2 provides a block diagram of Onggosanusi’s system, where a selector chooses among a plurality of detectors based on a channel condition estimate.



58. Specifically, Onggosanusi discloses a “channel estimation, H ” which can be inputted into a function “ $f(H)$ ” to indicate whether “the channel is ‘well-behaved’” or “ill-conditioned.” *Id.*, ¶36. H in particular is “the $Q \times P$ channel matrix of attenuations and phase shifts” of the “baseband received signal” and “may be estimated using known (pilot) symbols.” *Id.*, ¶14. Onggosanusi further describes that $H=[h_1 \ h_2 \ \dots \ h_p]$ where h_p is the channel (maybe including multipath combining and equalization) from the p th data source to the receiver,” thus disclosing that the estimate is based on received signals providing received data information. *Id.*

59. Onggosanusi also teaches that “the preferred embodiment detector computes a channel metric $f(H)$, and based on $f(H)$ selects one of the N detectors by

setting the multiplexer and demultiplexer.” *Id.*, ¶36. Onggosanusi discloses several detectors of varying complexity, such as:

- “1. joint ML detector: best performance, highest complexity
2. iterative detectors (IZF/IMMSE)
3. linear detectors (LZF/LMMSE)
4. maximum ratio combining (MRC) detector: worst performance (not interference resistant in general), lowest complexity.” *Id.*, ¶¶31-34.

B. Egnor (Ex. 1006)

60. U.S. Pat. Pub. No. 2005/0053173A1 (“Egnor”) (Ex. 1006) was filed on September 10, 2003 and published on March 10, 2005. I understand it is prior art.

61. Egnor discloses a prior art MUD system in which “[t]he bit streams from [a] MUD [multi-user decoder] are passed to a bank of error correction decoder units 185.” Egnor, ¶59. Egnor also describes iterative decoding, where “[s]oft outputs for each bit of each user from the bank of decoders 185 is **fed back to the multiuser detector** 180 for each iteration, one stream of outputs for each interfering user present in the received signal.” Egnor, ¶60.

62. Finally, the purported invention of Egnor was to use a windowing technique to pipeline the transmission through a series of MUD processors and decoders. *See, e.g., id.*, ¶¶77-84. This is depicted in Figure 5 below.

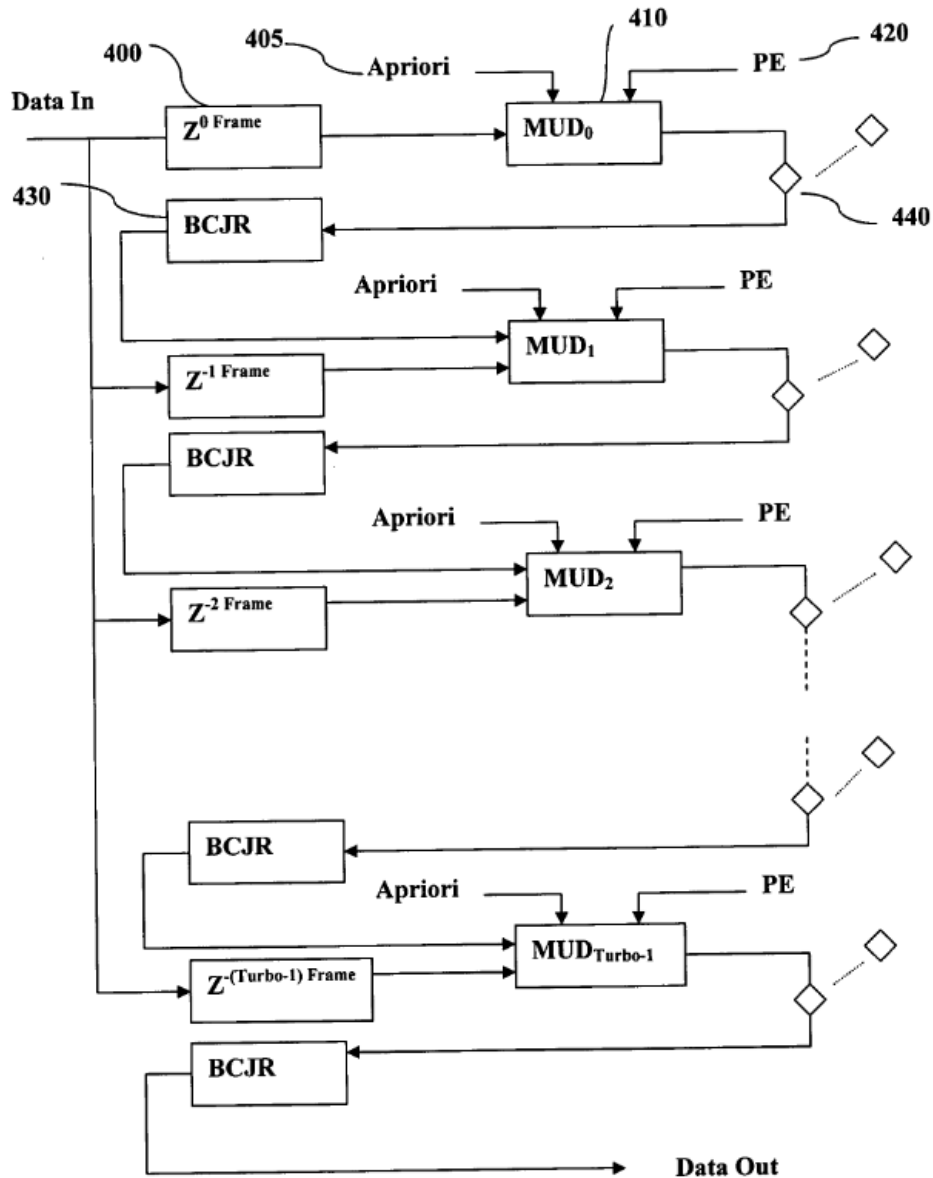


Figure 5

63. Figure 5 depicts a sequential series of MUDs (MUD₀, MUD₁, MUD₂, etc.), with each MUD processor “coupled to some form of parameter estimator 420 to obtain signal information for processing the data” and “coupled to decoders 430,

such as the BCJR decoders, used in this example for decoding the completed frames of data.” *Id.*, ¶79. An initial window of data is received by MUD₀, which “processes the partial frame of data within the processing window” and after completion, sends the processed data to “a decoding algorithm such as BCJR” which “provides the input to the next stage, MUD₁.” *Id.*, ¶80. This process continues through the sequence of MUD processors “until the last stage at which point the output from the BCJR is the output values of the system, Data Out. The Data Out is the symbol stream of improved and processed data.” *Id.*

64. Egnor further discloses that there were “various multiuser detectors known in the art” which are “detailed in the well-known text ‘Multiuser Detection’ by Sergio Verdu.” *Id.*, ¶9. In my opinion, Egnor describes with enough particular detail what material it is incorporating, specifically the Verdu text. Alternatively, it is also my opinion that a POSITA would have considered it obvious to combine Egnor with Verdu, because Egnor instructs a POSITA to refer to Verdu for details about the multiuser detection algorithms that were known at the time. A POSITA would have been motivated to incorporate Verdu’s teachings in order to give effect to Egnor’s teachings of various multiuser detectors using algorithms that Egnor expressly teaches are disclosed in Verdu. A POSITA would also be motivated to incorporate any other teachings in Verdu that involved multiuser detection. And a

POSITA would have reasonably expected the combination to succeed, since Verdu describes multiuser detection algorithms that Egnor expressly uses.

65. In my opinion, Verdu was available to ordinary artisans by 1998 and no later than 2006.

66. I am actually personally familiar with the Verdu text and know that it was publicly available in the late 1990s and early 2000s, years before the earliest filing date of the '492 patent. As Egnor accurately describes it, Verdu is a well-known text that describes many different multiuser detection techniques.

67. I am also familiar with Cambridge University Press, the publisher of the Verdu text. Cambridge University Press is a well-known, highly-respected and reputable publisher of scientific texts. In my opinion, an ordinary artisan would have considered the copyright date provided by Cambridge-published texts to be highly reliable.

68. In addition, Exhibit 1007 is a true and correct copy of the Verdu text as it was published in 1998.

VII. Summary of Opinions on Unpatentability

69. In the analysis that follows, I identify the following combinations of prior art that, in my opinion, anticipate and/or render obvious the '492 patent claims:

Grounds of Unpatentability

1	<i>Onggosanusi</i> in view of <i>Egnor</i> renders obvious claims 1-16 under Section 103
2	<i>Egnor</i> and <i>Onggosanusi</i> render obvious claims 17-18 under Section 103

70. I provide a short explanation for why Ground 2 switches the order of the references. This is because Claims 1 and 17 relate to different subject matter.

71. Claim 1 describes a fairly typical system for processing multiuser signals by using a multiuser detector and then passing off the information streams to a bank of decoders. However, Claim 1 further describes that the multiuser detector can be selected from a plurality of detectors, with the selection being based on a parameter estimate. *Onggosanusi* describes such a system where a multiuser detector is selected based on a parameter estimate. Although *Onggosanusi* describes decoders, it does not expressly describe a bank of decoders—but *Egnor* does and it would have been obvious to incorporate those teachings into *Onggosanusi*.

72. Claim 17, on the other hand, is quite different. It recites iterative multi-user detection on a sliding window of bits of the received signal. The processing of each window involves selecting a multi-user detector, although Claim 17 does not actually require that the selection be based on anything. *Egnor* discloses an iterative windowing method that is very similar to Claim 17, although does not expressly disclose selecting a detector from a plurality of detectors—and thus a POSITA

would have found it obvious to combine Egnor with Onggosanusi's teachings of selecting a detector.

A. Ground 1: Onggosanusi in view of Egnor renders obvious claims 1-19 under Section 103

73. I provide a summary of this ground as follows. Onggosanusi discloses a system for selecting among a plurality of detectors of varying complexity based on a channel estimation of received signals. Onggosanusi further discloses that these detectors output information streams to decoders. Egnor discloses that multi-user detectors can output information streams to a bank of decoders, and it would have been obvious to combine that teaching with Onggosanusi. It also would have been obvious to use Egnor's multi-user detectors, which describe the same algorithms as Onggosanusi's detectors, as well as other well-known components like iterative decoders, interleavers/deinterleavers, and a filter.

1. Motivation to Combine

74. In my opinion, a POSITA would have been motivated to combine Onggosanusi with various teachings from Egnor. A POSITA would be motivated to incorporate such teachings for various reasons. Below, I separately discuss each of the teachings in Onggosanusi that a POSITA would be motivated to combine with Egnor. To summarize, they include Egnor's teachings on: (1) multi-user detectors,

(2) bank of decoders, (3) iterative decoding, (4) interleavers and deinterleavers, and (5) a filter.

a. Egnor's multi-user detectors

75. In my opinion, although as I explained below that Onggosanusi discloses a plurality of multiuser detectors ("MUDs"), POSITA would have been motivated to include Egnor's multiuser detectors.

76. Egnor is directed to a "multiple access processing system for a ***plurality of users*** employing a ***multiuser detector*** processing partial blocks of data within a window." Egnor, Abstract.

77. In my opinion, there was motivation by an ordinary artisan to incorporate Egnor's MUDs into Onggosanusi because they would have found it desirable to use Onggosanusi's system with multi-user signals such as the multiaccess techniques FDMA, TDMA, or CDMA, thereby increasing the capabilities of Onggosanusi's system. These techniques were known as multiaccess techniques that assign different portions of a signal to different users. For example, FDMA "assigns a different carrier frequency to each users" whereas in CDMA, "[u]sers are assigned different 'signature waveforms' or 'codes.'" Verdu, 19, 23. Indeed, Onggosanusi itself recognizes that CDMA has "multi-user interference" and that its system is intended to address such problems. Onggosanusi, ¶¶3-6. As Verdu

explains, the “object of multiuser detection” is “the design and analysis of digital demodulation in the presence of multiaccess interference.” Verdu, 26. As is seen from these disclosures, the very purpose of multiuser detection is to demodulate a multiaccess signal (such as an FDMA, TDMA, or CDMA signal) in the presence of interference. Thus, a POSITA would have been motivated to give effect to Onggosanusi’s instruction for CDMA support by using Egnor’s multi-user detectors.

78. In addition, in my opinion, further motivation comes from Onggosanusi and Egnor both describing the same or similar algorithms for their detectors. Onggosanusi describes at least three algorithms for its detectors of varying complexity: “joint ML [maximum likelihood] detector,” “linear detectors (LZF/LMMSE),” and “maximum ratio combining (MRC) detector.” Onggosanusi, ¶¶30-34. Egnor (and Verdu, which Egnor incorporates) also discloses detectors using those same algorithms. See, e.g., Egnor, ¶8 (“maximum likelihood joint demodulator”), ¶9 (“various linear algebra based multi-user detectors such as those detailed in the well-known text ‘Multiuser Detection’ by Sergio Verdu”); Verdu, ch. 6.2 (“Minimum Mean-Square Error (MMSE) Linear Multiuser Detection”), p. 77 (“maximal-ratio combining”). Ordinary artisans understood that these were all well-known algorithms that could be used for demodulating multiplexed signals and/or multiuser signals.

79. In my opinion, a person of ordinary skill would have had a reasonable expectation of success in combining these teachings. As I discussed, Egnor and Onggosanusi disclose that their detectors use the same algorithms, and therefore would have the same complexity and power requirements. Thus, I believe it would have been a straightforward modification to use multiuser detectors as taught by Egnor in Onggosanusi's system, and an ordinary artisan would have expected Onggosanusi's selection of detectors to operate in a similar fashion, since Egnor's multi-user detectors use the same algorithms with the same complexity and power requirements.

b. Egnor's bank of decoders

80. In my opinion, a person of ordinary skill would have been motivated to incorporate Egnor's teachings of a bank of decoders with Onggosanusi.

81. Egnor teaches that it was well known that "[t]he bit streams from [a] MUD [multi-user decoder] are passed to a bank of error correction decoder units 185." Egnor, ¶59; *see also* ¶¶56, 58, Fig. 1. I believe it would have been obvious to incorporate such a teaching into Onggosanusi for the following reasons.

82. First, Onggosanusi discloses that the output of a detector is sent to a decoder as a plurality of streams. Onggosanusi, ¶22. Onggosanusi, however, does not expressly teach how its decoder handles each of the streams. Egnor, on the other

hand, teaches that a detector's plurality of streams can be decoded using a bank of decoder units, and that this was well known—I agree that it was well known. A person of ordinary skill in the art would therefore want to give effect to Onggosanusi's teaching of decoding the streams of a detector by incorporating Egnor's teachings of a bank of decoder units. In addition, in my opinion, using a bank of decoder units would have been a mere design choice.

83. Second, an ordinary artisan would have been motivated to use a bank of decoders because the ordinary artisan would know that would be an efficient method for processing the plurality of streams from Onggosanusi's detectors. A person of ordinary skill would have been aware of the benefits of processing multiple signals in parallel, which would be accomplished by using a bank of decoders, one per each stream of the plurality of streams. An ordinary artisan would have known this was more efficient and significantly faster than decoding each stream one-by-one in a series. The benefits of parallel processing had long been known by the filing date of the '492 patent in 2006.

84. In my opinion, persons of ordinary skill would also be motivated by the well-known fact that efficiency and speed were very important and desirable for processing wireless communications. As wireless communication speeds and bandwidth have increased over the past decades (including by the time of the filing

date of the '492 patent), it is necessary for the processing of such signals to become more efficient in order to process the increased amount of data in real-time. Because Onggosanusi and Egnor describe detecting and decoding wireless signals containing data, a person of ordinary skill would have found it highly desirable to perform such processing as efficiently and quickly as possible in order to maximize bandwidth.

85. It is also my opinion that an ordinary artisan would have had a reasonable expectation of success in combining these teachings. Both Onggosanusi and Egnor describe the same process of detection and then decoding the streams. Indeed, both Onggosanusi and Egnor describe similar, well-known methods of for decoding. For example, both Onggosanusi and Egnor disclose MAP decoders. Onggosanusi, ¶54; Egnor, ¶59. Both also disclose Viterbi and BCJR decoders. Onggosanusi, ¶62; Egnor, ¶28. These were well-known decoders and Egnor discloses that a bank of decoding units implementing these algorithms was already prior art and known by ordinary artisans. Thus, in my opinion, it would have been well-within the skill of an ordinary artisan to implement Onggosanusi's decoder as a bank of decoding units as taught in Egnor, since such implementation was well-known and conventional.

c. Egnor's iterative decoding

86. In my opinion, a person of ordinary skill would have been motivated to combine Egnor's iterative decoding with Onggosanusi's system for selecting a plurality of detectors.

87. Egnor discloses iterative decoding, specifically, that "[s]oft outputs for each bit of each user from the bank of decoders 185 is ***fed back to the multiuser detector*** 180 for each iteration, one stream of outputs for each interfering user present in the received signal." Egnor, ¶60. A POSITA would have been motivated to have Egnor's bank of decoders (incorporated as I described in the previous section) output their signals to Onggosanusi's detector selector to form a feed-back loop.

88. It is my opinion that a POSITA would have been motivated to allow Onggosanusi's detector selector to receive fed back decoded information because of the well-known benefits of iterative decoding—namely, increased accuracy of decoding. As Egnor explains, each iteration "produce[s] an improved stream of soft bit (or symbol) decisions that fed into the decoder for another iteration of improvement." Egnor, ¶60. A POSITA would be motivated to increase accuracy of decoding because this would allow better accommodation of noisy signals and more reliable reception of such signals.

89. Moreover, Onggosanusi also recognized the benefits of iterative decoding, stating that the “***iterative interleaved MAP decoders*** with BCJR or SOVA algorithm using LLRs for each MAP” can “achieve their maximum performance.” Onggosanusi, ¶62. Onggosanusi further discloses “decision-feedback (iterative) detectors, such as iterative ZF, and iterative MMSE.” *Id.*, ¶4. These iterative detectors use a “series of P linear detectors ... with each linear detector followed by a (hard) decision device,” *i.e.* a decoder. *Id.*, ¶26. Thus, a POSITA would understand that Onggosanusi’s iterative detection involves the decoder sending its output as feedback to the detector as the conventional iterative detectors would.

90. Egnor further teaches that by using iterative decoding, the process can “continue[] until a desired metric is reached or a fixed number [of iterations] is reached.” Egnor, ¶60. A POSITA would understand that this would provide the benefits setting a “desired metric” as a threshold for performance—allowing the user to perform a trade-off between number of iterations (*i.e.* improved decoding performance) and time, depending on their needs.

91. A POSITA would further be motivated to feed back the decoder output to Onggosanusi’s selector. This would allow Onggosanusi to use its novel approach of selecting the appropriate detector complexity based on the interference of the improved, decoded signals—allowing the system to gradually choose less complex

detectors as the signals are decoded and more decorrelated in each iteration. A POSITA would have known this would increase efficiency and power consumption.

92. In my opinion, a POSITA would have had a reasonable expectation of success in implementing Egnor's iterative decoding into Onggosanusi. The implementation would merely involve coupling the output of Egnor's bank of decoder units to the input of Onggosanusi's detectors and the selector. Egnor already teaches providing the output of the decoding units to Egnor's multi-user detector—which is instead a selector and a plurality of detectors in Onggosanusi. Such an implementation would have been well-within the capabilities of a POSITA.

d. Egnor's interleavers and deinterleavers

93. In my opinion, a POSITA would have been motivated to incorporate Egnor's teachings of interleavers and deinterleavers with Onggosanusi.

94. Egnor discloses “an interleaver coupled between the multiuser detector processors and the decoders and a deinterleaver coupled between the decoders and the multiuser detector processors.” Egnor, ¶29. Interleavers and deinterleavers were conventional components for signal processing and their benefits were well-known. Indeed, Egnor explains that “Deinterleavers and interleavers ... are used if the transmitted signals are interleaved, such as the CDMA format and are known in the art.” *Id.*, ¶58.

95. A POSITA would be motivated to incorporate such teachings because Onggosanusi discloses that its system is directed to receiving and decoding CDMA signals. Onggosanusi, ¶19. A POSITA would have understood that in order to give effect to Onggosanusi's teaching of detecting and decoding CDMA signals, interleavers and deinterleavers would be needed in order to process the interleaved CDMA signal.

96. It is also my opinion that a POSITA would have been familiar with the benefits of transmitting interleaved signals as well as the need for interleavers and deinterleavers. Interleavers change the ordering sequence of the encoded bits. By doing this, bursts of errors during transmission are more likely to be evenly distributed in the reordered sequence rather than focused on a single codeword. This increases the probability of success of proper decoding / error correction. In view of such known benefits, a POSITA would have been motivated to include interleavers and deinterleavers to support the reception of interleaved signals to increase decoding efficiency.

97. In my opinion, a POSITA would have also had a reasonable expectation of success in this combination. Interleavers and deinterleavers were well-known components and well-within the skill of a POSITA to implement. It would not have been difficult to follow Egnor's instruction to incorporate interleavers and

deinterleavers between the detectors and decoders in order to support conventional, interleaved signals like CDMA.

e. Egnor's filter

98. In my opinion, a POSITA would have been motivated to incorporate Egnor's teaching of a filter with Onggosanusi.

99. Egnor teaches that "[t]he plurality of signals from each antenna 140 is processed in a RF front end unit [which] provide[s] filtering as is known in the art." Egnor, ¶53. These filtered signals are sent to the multi-user detector. *Id.*, ¶54. A POSITA would have been motivated to incorporate a filter into Onggosanusi prior to the detector and selector receiving the received signals. Indeed, given the ubiquity of filters (and other conventional components like analog-to-digital converters (ADCs) and digital-to-analog converters (DACs), upconverters, downconverters, and amplifiers) for processing received wireless signals, a POSITA would have understood Onggosanusi to include a filter in order to be operative. In any case, filters were conventional and extremely common components for signal processing that could remove unwanted components like signals of unwanted frequencies. A POSITA would have been aware of the benefits of filters and would have been motivated to incorporate Egnor's teachings of a filter to provide a filtered signal to Onggosanusi's selector and detectors. A POSITA would be motivated to provide a

filtered signal to both the selector and detectors because the selector uses the correlation between the user signals to determine which detector to perform (Onggosanusi, ¶36)—and removing undesirable components would have been known to improve the ability of the selector.

100. A POSITA would have had a reasonable expectation of success because filters were conventional and well-within the capabilities of a POSITA to implement. A POSITA would have implemented Egnor’s filter by placing a filter between the received signal and the selector and detectors.

f. Same field of endeavor

101. In my opinion, a POSITA would understand that Egnor and Onggosanusi are directed to the same field of endeavor as the ’492 patent, because all three are directed to the same field of processing wireless signals. Ex. 1001, 1:20-24 (“This present invention relates to advanced receiver techniques for processing signals, and more particularly to multi-user detection (MUD) for processing multiple users’ signals that interfere with one another.”); Onggosanusi, ¶2 (“The present invention relates to communication systems, and more particularly to multimode detectors and detection methods.”); Egnor, ¶2 (“This present invention relates to advanced receiver techniques for processing signals in a multi-user environment”).

2. 1pre: A hybrid Multi-User Detector System for processing received signals, comprising:

102. In my opinion, Onggosanusi discloses this limitation, to the extent the preamble is limiting. Alternatively, Onggosanusi in view of Egnor renders obvious this limitation.

103. With respect to the limitation “*hybrid ... System*,” Onggosanusi discloses a system for selecting among a plurality of multi-user detectors for processing received signals, *i.e. a hybrid multi-user detector system*. The ’492 patent characterizes a “hybrid MUD” as a system that “optimizes the MUD algorithms for a balance between computational complexity and performance.” Ex. 1001, 12:54-57. Onggosanusi discloses a system with “N MIMO detectors having different performance and complexity, where the performance and complexity are *inversely related*.” Onggosanusi, ¶36. Onggosanusi further describes selecting one of the detectors depending on “a channel metric $f(H)$ ” indicating that the channel is “well-behaved” or “ill-conditioned.” *Id.* As a result, the system “use[s] high complexity detectors only when the channel is sufficiently ill-conditioned to require them,” resulting in “a reduction of average computational complexity which translates to (battery-operated) receiver power savings.” *Id.*, ¶40. Thus, Onggosanusi discloses a *hybrid system*.

104. With respect to the limitation “**Multi-user Detector System**,” Onggosanusi discloses that it is directed to “multimode detectors” that “apply to multiple-input multiple-output (MIMO) systems.” *Id.*, ¶6. While MIMO detectors are not multi-user detectors, Onggosanusi does disclose that its system also can be applied to **signals with multiple users** and therefore a POSITA would understand that its disclosures of detectors include multi-user detectors. For example, Onggosanusi discloses that its teachings are applicable to “[w]ireless communication systems” that “typically ... have multi-users (such as multiple clients in a wireless LAN),” which results in “multi-user interference” that “requires ... detection methods for interference-limited systems,” such as those disclosed in Onggosanusi. *Id.*, ¶3; *see also* ¶19 (“CDMA ... system having frequency-selective channels which cause MUI (**multi-user interference**)”); *cf.* Ex. 1001, 1:37-40 (“[I]nterference suppression (also called Multi-User Detection or MUD)”). In addition, Onggosanusi discloses that its detectors are “multimode detectors” which a POSITA would understand to include multi-user detectors, not just MIMO detectors. Onggosanusi, Abstract.

105. Onggosanusi also discloses that the channel estimation matrix H constitutes data for multiple channels, each one being from a separate “data source,” which in my opinion a POSITA would understand to indicate that the received signal

came from multiple sources and therefore multiple users. *Id.*, ¶14. Indeed, the received signal has a “number of symbols that are jointly detected as they interfered with one another,” which is a multiuser signal. *Id.*, ¶21.

106. Finally, Onggosanusi discloses that its detectors use several algorithms which are known to be useful in multi-user detectors, including “joint ML [maximum likelihood],” “linear detectors (LZF/LMMSE),” “iterative detectors (IZF/MMSE,)” and “maximum ratio combining (MRC) detector.” Onggosanusi, ¶30. For example, the Verdu text (which is directed to multiuser detection) devotes an entire chapter to linear MMSE, and also mentions “maximal-ratio combining.” Verdu, ch. 6.2, p. 77. Egnor, which discloses multiuser detectors, also mentions “maximum likelihood joint demodulator” (Egnor, ¶8), and the ’492 patent recognizes “maximum likelihood joint demodulator[s],” “minimum square error” and “zero-forcing block linear equalizers” as known examples of common components of multiuser detectors. Ex. 1001, 5:26-32. These teachings indicate that Onggosanusi, Egnor and the ’492 patent were in one accord with respect to the algorithms used for multiuser detection.

107. While I do not believe that a MIMO detector is a MUD, I do note that Patent Owner has asserted that Petitioner’s MIMO detectors are “multi-user detectors,” and so at least under Patent Owner’s apparent construction,

Onggosanusi's teachings of MIMO detectors discloses the claimed "multi-user detectors." Ex. 1008 at 1 ("Multiple data streams are received at the UE from an intracell **SU-MIMO** multi-layer transmission from the same serving cell sector").

108. It is also my opinion, as I discussed above, that a POSITA would have found it obvious to combine Egnor with Onggosanusi by including the multi-user detectors as taught by Egnor to achieve the benefits provided by Egnor's MUDs, including the ability to "comput[e] outputs for each user in one mathematical step" and to take advantage of the "considerable research to address joint demodulation," especially in view of the fact that Egnor's multi-user detectors use the same algorithms as Onggosanusi's MIMO detectors, such as joint maximum likelihood, linear minimum mean-square error, and maximum ratio combining. See Onggosanusi, ¶¶30-34; Egnor, ¶¶5-6, 8-9; Verdu, ch. 6.2, p. 77.

109. With respect to the limitation "***processing received signals***," Onggosanusi discloses "preferred embodiment ***receivers*** employing preferred embodiment detection," i.e. ***processing received signals***. Onggosanusi, ¶12. The "baseband received signal" is a "Q-vector of samples of the received baseband signal (complex numbers) corresponding to a transmission time (interval/block) n," i.e. ***received signals***. *Id.*, ¶14.

$$r = \begin{bmatrix} r_1(n) \\ r_2(n) \\ \vdots \\ r_Q(n) \end{bmatrix}$$

a. 1a: a parameter estimator coupled to said received signals providing received data information;

110. In my opinion, Onggosanusi discloses this limitation.

111. Onggosanusi discloses a ***parameter estimator*** that provides a channel estimate H based on ***received signals***. Specifically, Onggosanusi discloses a “channel ***estimation***, H” which can be inputted into a function “f(H)” to indicate whether “the channel is ‘well-behaved’” or “ill-conditioned.” Onggosanusi, ¶36. H in particular is “the QxP channel matrix of attenuations and phase shifts” of the “baseband ***received signal***” and “may be ***estimated*** using known (pilot) symbols.” *Id.*, ¶14. Onggosanusi further describes that $H=[h_1 \ h_2 \ \dots \ h_p]$ where h_p is the channel (maybe including multipath combining and equalization) from the p^{th} ***data*** source to the receiver,” thus disclosing that the estimate is based on ***received signals providing received data information***. *Id.* The channel estimation H is a ***parameter estimate*** because it is based on “parameters for the received raw data” (Ex. 1001, 9:57-58), for example, “ p^{th} data source” and “known (pilot) symbols.” Onggosanusi, ¶14.

112. In other words, each row in the channel estimation matrix H corresponds with a parameter estimate of the channel for a particular data source (*e.g.*, user). This corresponds with the disclosure in U.S. Pat. No. 6,947,505 (Ex. 1010), which is incorporated by reference into the '492 patent as a disclosure of known parameter estimators (*see* Ex. 1001, 9:65-10:3) and describes that “[t]he purpose of the parameter estimation unit is to be able to derive channel parameters which uniquely distinguish the characteristics of each individual signal.” Ex. 1010, 1:19-22. To summarize, the '505 patent describes a parameter estimate as a channel estimate for the channel of each source signal—the same thing that Onggosanusi discloses with its channel estimation matrix H where each row is an estimate of the “channel ... from the p th data source to the receiver.” Onggosanusi, ¶36.

113. I also note that the '492 patent broadly describes parameter estimates to include “any ... information required by the MUD to carry out its processing.” Ex. 1001, 9:64-65. The '492 patent also states that parameter estimates include “carrier phases” (*id.*, 9:61) which corresponds with Onggosanusi’s disclosure that the channel estimate H is a “channel matrix of attenuations and ***phase shifts***,” with each row being a “channel ... from the p th data source.” Onggosanusi, ¶14.

114. Onggosanusi discloses that its “computations can be performed with digital signal processors (DSPs) or general-purpose programmable processors or

application specific circuitry (ASICs) or systems on a chip such as both a DSP, ASIC, and RISC processor on the same chip with the RISC processor controlling. Analog-to-digital converters and digital-to-analog converters provide coupling to the real world, and modulators and demodulators (plus antennas for air interfaces) provide coupling for transmission waveforms.” *Id.*, ¶13. Thus, Onggosanusi discloses that the channel estimation is performed using a processor, *i.e.* ***parameter estimator***, coupled to received signals.

b. 1b: a multi-user detector decision unit coupled to said parameter estimator and said received signals;

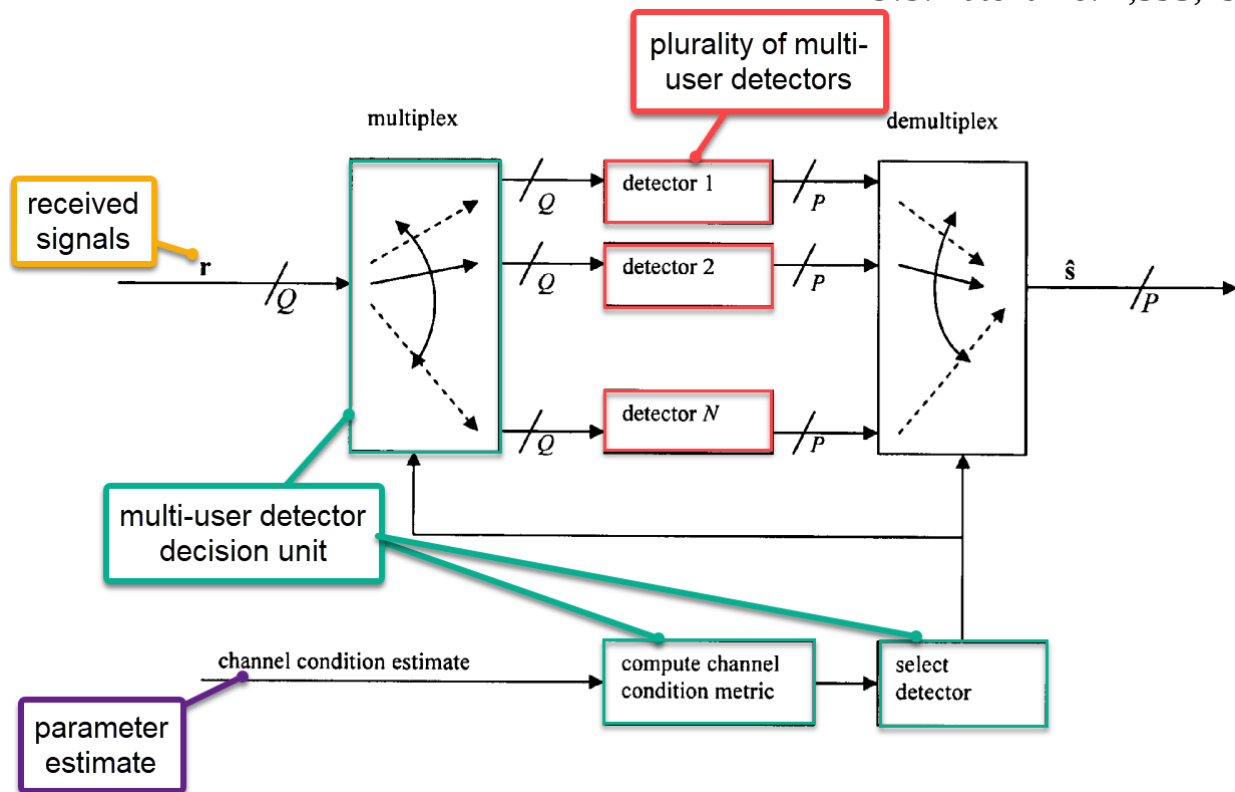
1c: at least two multi-user detectors coupled to said parameter estimator and said multi-user detector decision unit, said multi-user detector decision unit using decision criteria to determine a selected multi-user detector

115. In my opinion, Onggosanusi discloses these limitations.

116. Onggosanusi discloses using the channel estimation *H* to select from a number of MIMO detectors of varying complexity and power depending on the correlations in the channel estimate.

117. With respect the limitation “***a multi-user detector decision unit coupled to said parameter estimator and said received signals ... using decision criteria to determine a selected multi-user detector***,” Onggosanusi discloses a module that “compute[s] channel condition metric” and “select[s a] detector.”

Onggosanusi, Fig. 2 (annotated below). In particular, the “multimode detector” includes multiple “detectors having different performance and complexity” and “[f]or a given channel estimation, H , the ***preferred embodiment detector*** computes a channel metric $f(H)$, and based on $f(H)$ ***selects one of the N detectors*** by setting the multiplexer and demultiplexer.” *Id.*, ¶36. The selection of the detector is based on the channel being “well-behaved” or “ill-conditioned,” with “ $f(H)$... partitioned into N regions with each region corresponding to one of the N detectors.” *Id.* As discussed above, a POSITA would have understood or considered it obvious that Onggosanusi’s detectors also can operate on multi-user signals, not just MIMO signals. In other words, the ***multi-user detector decision unit*** uses $f(H)$, *i.e.* ***decision criteria***, to ***determine a selected detector***.



118. As can be seen in the above annotated figure, the **multi-user detector decision unit** receives the channel estimate H , and is therefore coupled to the **parameter estimator**. A POSITA would have known that a conventional “interference-resistant detector[]” utilizes the channel estimate as an input, as seen in Figure 3a of Onggosanusi. Onggosanusi, ¶4. In addition, the multiplexer, which is part of the **multi-user detector decision unit** since it used to “select[] one of the N detectors,” is coupled to “ r ”, which is the Q -dimensional vector of the “baseband received signal,” i.e. **received signals**. Onggosanusi, ¶¶14, 36. The **decision unit** is also coupled to the **received signals** via the parameter estimator, which as discussed in limitation 1a, uses the received signals to calculate the channel estimate H .

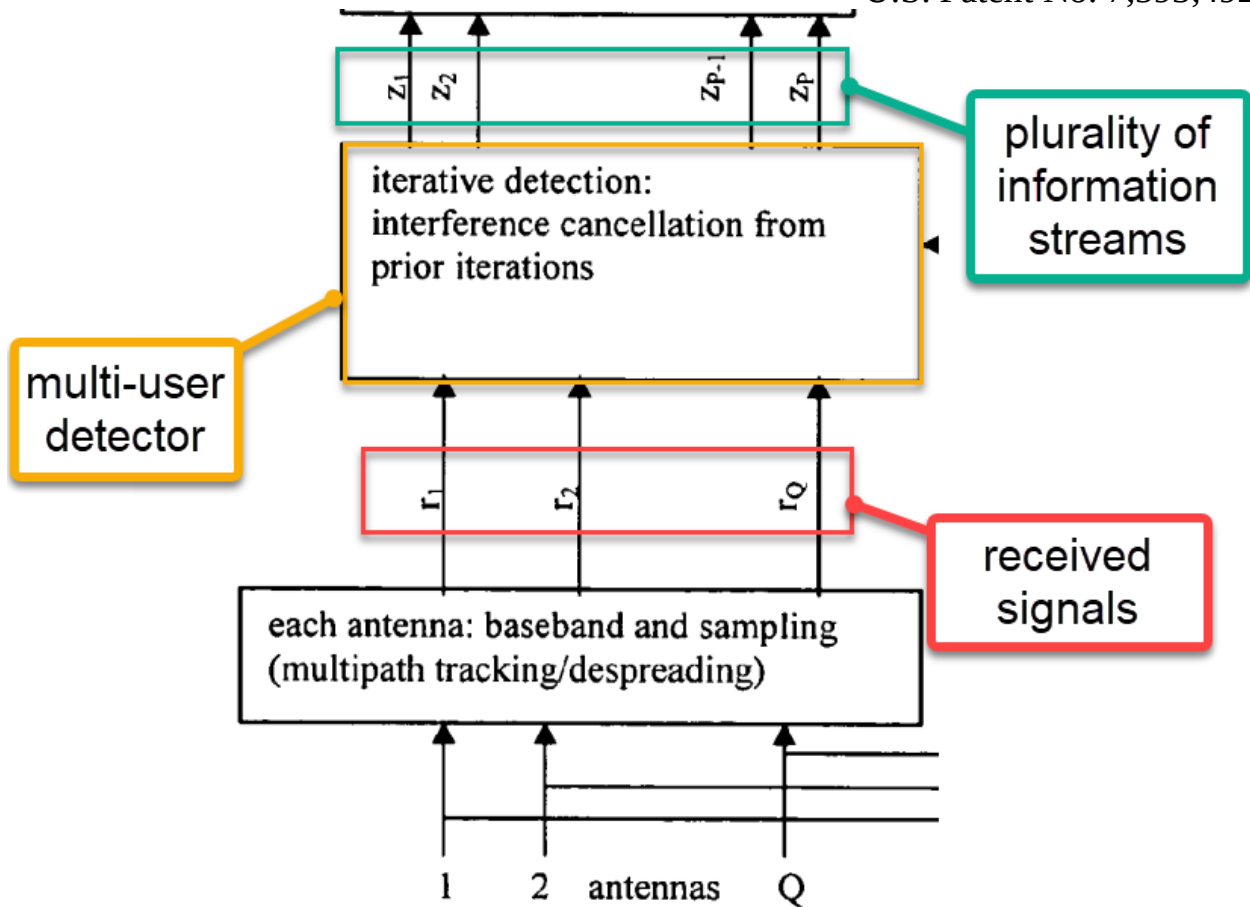
119. With respect to the limitation “***at least two multi-user detectors coupled to said parameter estimator and said multi-user detector decision unit,***” Onggosanusi discloses “N MIMO detectors.” Onggosanusi, ¶36. As discussed above, a POSITA would have understood or considered it obvious that Onggosanusi’s detectors also can operate on multi-user signals, not just MIMO signals, and are thus ***at least two multi-user detectors***. As shown in Figure 2, Onggosanusi’s detectors are ***coupled to the multi-user detector decision unit***. See also Onggosanusi, ¶36 (“[T]he preferred embodiment detector ... selects one of the N detectors”). In addition, the detectors are coupled to the ***parameter estimator*** via the decision unit, which as discussed above, uses the parameter estimate to select the detector.

c. **1d: wherein said selected multi-user detector outputs a plurality of information streams, one stream corresponding to each of said received signals; and**

120. In my opinion, Onggosanusi discloses this limitation. Alternatively, Onggosanusi in view of Egnor renders obvious this limitation.

121. Onggosanusi discloses that each of the detectors “outputs soft estimates z of the transmitted symbols to a demodulator and decoder,” with “ z ” being a vector having a P number of values, *i.e. a plurality of information streams*. Onggosanusi, ¶22. In addition, Onggosanusi discloses that the ***received signals*** “ r ” has a Q number

of values, with P being “the number of symbols that are jointly detected as they interfered with one another, and Q is simply the number of collected (spatial and/or temporal) samples at the receiver,” with Q being “as large as P .” *Id.*, ¶21. In other words, Onggosanusi discloses that the number of received signals Q can be equal to the number of outputted information streams P . In addition, Onggosanusi discloses that each decoder uses a $P \times Q$ filter matrix, which converts each received signal to a corresponding information stream. *See id.*, ¶¶23-28. Thus, Onggosanusi discloses that each stream of the plurality of information streams ***corresponds to each of said received signals***. A POSITA would have known that even if the outputs from the N detectors are combined into a serial signal, this serial signal, *i.e.*, the output from demultiplex in Figure 2 of Onggosanusi, contains a plurality of information streams, which are the outputs from the N detectors. In addition, Onggosanusi explains from a prior art MIMO receiver in Figure 3C, where the detector receives signals r_1 through r_Q and outputs bit streams z_1 through z_P , which are parallel-to-serial converted.



122. This limitation would have also been obvious in view of Egnor. Egnor discloses multi-user detectors that output a plurality of streams corresponding to received signals. Specifically, Egnor describes that “[v]arious schemes for Turbo MUD [multi-user detector] processing are well known in the art.” Egnor, ¶51. Such detectors receive as input received signals, including “interfering signals” and “outputs a *bit (or symbol) stream associated with each interfering signals* present on the channel for one data block.” *Id.*, ¶¶56, 58. Egnor also depicts in Figure 1 a transmitter transmitting on K antennas and a “MUD” (multi-user detector) that

receives “transmitted signals $r(t)$ as well as the various interfering signals, such as $n(t)$ ” and outputs K number of signals to various decoders. *Id.*, ¶¶49-50. As discussed above, a POSITA would have found it obvious to combine Onggosanusi with Egnor’s teaching of MUDs, which output a separate information stream for each received signal. In addition, a POSITA would have known that when there are multiple K separate decodes available, as in the case of Figure 1 in Egnor, there is no need for the K outputs from MUD 50 to be combined into a serial stream, as the K outputs need to be individually decoded.

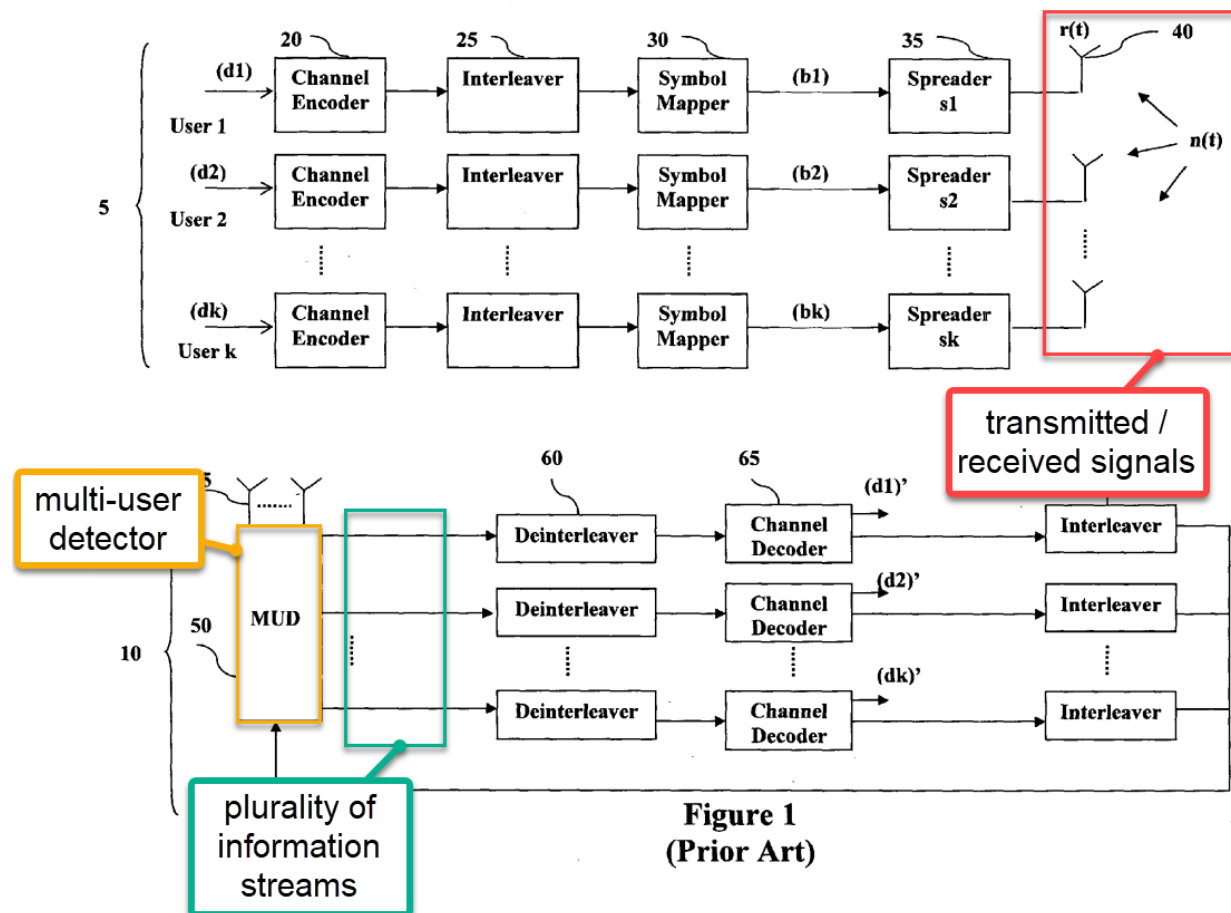


Figure 1
(Prior Art)

- d. **1e: a bank of decoders coupled to said plurality of information streams, wherein said decoders output a plurality of improved information streams.**

123. In my opinion, Onggosanusi discloses this limitation. Alternatively, Onggosanusi in view of Egnor renders obvious this limitation.

124. Onggosanusi discloses that a demodulator and decoder, *i.e. bank of decoders*, decode the information streams to output a plurality of “branch metric values for trellis path searching,” *i.e. improved information streams*. In particular, Onggosanusi discloses that “the demodulator ... converts the output P soft symbol estimates [from the detector] $z_1, z_2, \dots, z_p$ [*i.e. improved information streams*], into (bit-level) conditional probabilities of the transmitted symbols, $s_1, s_2, \dots, s_p$; and a decoder may translate (using a channel model) the conditional probabilities into branch metric values for trellis path searching,” *i.e. improved information streams*. Onggosanusi,

¶54. A POSITA would understand that “branch metric values for trellis path searching” refers to obtaining improved estimates of the transmitted data by traversing a “trellis path” using the “branch metric values” which provide the likelihood of a transition on the trellis path. A trellis path is a graph that takes every starting state and provides a path for every possible input sequence. The goal is to find the most likely path through the trellis path that represents the transmitted data’s path through the noisy channel to obtain *improved information streams*. The most

likely path is determined using the “branch metric values” that were calculated by the decoder.

125. While Onggosanusi does not expressly disclose that the decoder is a **bank of decoders**, Egnor discloses that “[t]he bit streams from the MUD 180 are passed to a **bank of error correction decoders unit**.” Egnor, ¶59. Egnor further discloses that “[t]he decoders produce **improved processed blocks of data**.” *Id.*, ¶30; see also ¶81 (“The decoder 430 provides **improved data** to each subsequent MUD in the User chain.”). As discussed above, it would have been obvious to combine Onggosanusi with Egnor.

3. Claim 2: The System according to claim 1 wherein said plurality of improved information streams are fed back to said multi-user detector decision unit until a final condition is reached and said bank of decoders output a final data stream.

126. In my opinion, Onggosanusi in view of Egnor renders obvious this limitation.

127. Egnor discloses iterative decoding, *i.e.* **decoded streams fed back to the detector**, until a desired metric is reached. Specifically, Egnor discloses that “[s]oft outputs for each bit of each user from the bank of decoders 185 is **fed back to the multiuser detector** 180 for each iteration, one stream of outputs for each interfering user present in the received signal.” Egnor, ¶60. In combining Egnor with

Onggosanusi, the outputs from the bank of decoders 185 in Egnor must be fed back to the corresponding detectors in Onggosanusi. This must be done through the multiplex in Onggosanusi, which is part of the claimed “multi-user detector decision unit.” A POSITA would have known this fact. This “iterative process continues until a desired metric is reached or a fixed number is reached” at which point, “estimates of the data sequences for all active users are output.” *Id.*

128. As discussed above, a POSITA would have combined this teaching with Onggosanusi to provide feedback to Onggosanusi’s detector selector.

4. **Claim 3: The System according to claim 1 wherein said design criteria is based upon at least one threshold selected from at least one of the group consisting of: number of symbols, correlation matrix between users, expected bit error rate, eigendecomposition of correlation matrix, signal to interference plus noise ratio, and expected SINR.**

129. In my opinion, Onggosanusi discloses this limitation to the extent it is discernable. Specifically I am not sure what “design criteria” means since it is not mentioned in Claim 1. But to the extent it is referring to the “decision criteria” from Claim 1, this claim is disclosed by Onggosanusi.

130. As I discussed above for limitation 1b, Onggosanusi discloses using “channel metric $f(H)$ ” to select a multiuser detector. Onggosanusi further discloses that $f(H)$ can use thresholds of a ***correlation matrix between users*** and ***eigendecomposition of correlation matrix***.

131. Onggosanusi discloses that “[g]enerally, $f(H)$ is a function of the $Q \times P$ matrix H .” Onggosanusi, ¶36. H is a ***correlation matrix between users***. Specifically, “ $H=[h_1 \ h_2 \ \dots \ h_p]$ where h_p is the channel (maybe including multipath combining and equalization) from the p th data source [*i.e. user*] to the receiver.” *Id.*, ¶14. The purpose of $f(H)$ is to determine the “correlations between the $\{h_1 \ h_2 \ \dots \ h_p\}$.” *Id.*, ¶36; *see also* ¶42 (“ $f(H)=MCC(H)$ treats all channel correlations roughly equally, whereas $f(H)=VCC(H)$ emphasizes outliers from the mean, either larger or smaller”). In addition, $f(H)$ is partitioned into “ $N-1$ thresholds ... to define the N regions” for selecting the detector. *Id.*, ¶43.

132. Onggosanusi also discloses an example of $f(H)$ that “computes $H^H H$ and finds the eigenvalues of $H^H H$.” *Id.*, ¶41. A POSITA would understand that the calculation of eigenvalues is an ***eigendecomposition*** of the correlation matrix H .

5. Claim 4: The System according to claim 3 wherein said threshold is dynamically changeable.

133. In my opinion, Onggosanusi discloses this limitation.

134. Onggosanusi discloses that the threshold can be ***dynamically changed***. Specifically, Onggosanusi discloses that the threshold for “switching between detectors” (rather than initially selecting a detector) “could be subject to hysteresis ... in the sense of the metric must cross the threshold by a minimum amount prior to selecting switching.” Onggosanusi, ¶50. In other words, once a detector is selected,

Onggosanusi dynamically changes the threshold to the threshold plus the minimum amount before selecting a different detector.

6. **Claim 5: The System according to claim 1 wherein said at least two multiuser detectors are selected from the group consisting of: M-algorithm, sphere decoder, T-algorithm, FANO, reduced state Viterbi, Maximum Likelihood, matched filter, minimum mean squared error (MMSE), decorrelator, and combinations thereof.**

135. In my opinion, Onggosanusi discloses this limitation.

136. Onggosanusi discloses that its detectors can be “*maximum likelihood* sequence estimation,” “linear minimum squared error (MMSE),” and/or “iterative MMSE.” Onggosanusi, ¶¶4, ¶30.

7. **Claim 6: The System according to claim 1, further comprising an interleaver unit and a deinterleaver unit coupled between said bank of decoders and said multi-user detectors.**

137. In my opinion, Onggosanusi in view of Egnor renders obvious this limitation.

138. Egnor discloses “an interleaver coupled between the multiuser detector processors and the decoders and a deinterleaver coupled between the decoders and the multiuser detector processors.” Egnor, ¶29. As discussed above, it would have been obvious to combine Egnor’s teaching with Onggosanusi.

8. Claim 7: The System according to claim 2, wherein said final condition is determined by one of a fixed number of iterations and an allowable performance level.

139. In my opinion, Onggosanusi in view of Egnor renders obvious this limitation.

140. Egnor discloses that the “iterative process continues until a desired metric is reached [*i.e. an allowable performance level*] or a fixed number is reached [*i.e. fixed number of iterations*]” at which point, “estimates of the data sequences for all active users are output.” Egnor, ¶60.

9. Claim 8: The System according to claim 1, further comprising a filter unit coupled to said received signals, wherein said filter unit is coupled to said multi-user detector decision unit.

141. In my opinion, Onggosanusi in view of Egnor renders obvious this limitation.

142. Egnor discloses that “[t]he plurality of signals from each antenna 140 [*i.e. received signals*] is processed in a RF front end unit [which] provide[s] **filtering as is known in the art.**” Egnor, ¶53. In Egnor, these signals are sent to the multi-user detector. *Id.*, ¶54. As discussed above, a POSITA would have found it obvious to combine Onggosanusi with Egnor to send the filtered signals to the detector selector, *i.e. multi-user detector decision unit.*

10. Claim 9: The System according to claim 1, further comprising a hard decision unit coupled to said bank of decoders and producing a final data stream

143. In my opinion, Onggosanusi discloses this limitation.

144. Onggosanusi discloses that “a hard decision decoder just directly converts the soft symbol estimates into hard symbol estimates.” Onggosanusi, ¶54. Thus, Onggosanusi discloses a **hard decision unit**. This is identical to how the ’492 patent describes a “hard decision unit,” wherein “the soft output of decoder 255 is passed to the hard decision unit 270 for processing the hard decisions.” Ex. 1001, 15:53-56. Fig. 3d of Onggosanusi also discloses that the **hard decision unit** is coupled to a decoder and can produce the final data stream s(i).

11. 10pre: A hybrid receiver for processing a plurality of received signals, said receiver comprising:

145. In my opinion, Onggosanusi alone discloses or in view of Egnor renders obvious this limitation, to the extent the preamble is limiting. *See* 1pre, *supra*.

a. 10a: a parameter estimation unit coupled to said received signals, wherein said parameter estimation unit extracts received signal information;

146. In my opinion, Onggosanusi alone discloses or in view of Egnor renders obvious this limitation. *See* 1a, *supra*.

147. Onggosanusi's parameter estimation unit estimates a channel estimate H from "baseband received signal" "using known (pilot) symbols," *i.e.* ***extracts received signals***. Onggosanusi, ¶14.

- b. 10b: a multi-user detector decision unit coupled to said parameter estimator and said received signals, wherein said multi-user detector decision unit selects a multi-user detector based upon at least one threshold;**

148. In my opinion, Onggosanusi alone discloses or in view of Egnor renders obvious this limitation. *See* 1b and claim 3, *supra*.

- c. 10c: a low complexity multi-user detector switchably coupled by said multi-user detector decision unit, wherein said low complexity multi-user detector outputs a plurality of low complexity processed information streams;**

10d: a medium complexity multi-user detector switchably coupled by said multi-user detector decision unit, wherein said medium complexity multi-user detector outputs a plurality of medium complexity processed information streams;

10e: a high complexity multi-user detector switchably coupled by said multi-user detector decision unit, wherein said high complexity multi-user detector outputs a plurality of high complexity processed information streams; and

149. In my opinion, Onggosanusi alone discloses or in view of Egnor renders obvious this limitation. *See* 1b, 1c and 1d, *supra*. The above-referenced limitations in claim 1 recite a plurality of multi-user detectors. Claim 10 is different because it

specifically identifies three multi-user detectors with each one having its own level of complexity.

150. Onggosanusi discloses at least three detectors of varying complexity. Each detector ***outputs processed information streams*** in accordance with the complexity of that detector. As discussed above for limitation 1pre, a POSITA would have understood or considered it obvious that Onggosanusi's detectors also can operate on multi-user signals, not just MIMO signals—alternatively, a POSITA would have combined Onggosanusi with Egnor to achieve multiple multi-user detectors using the same algorithms disclosed in Onggosanusi.

151. Specifically, Onggosanusi lists four detectors “ranked according to their performance and complexity.” Onggosanusi, ¶30. First, Onggosanusi lists a “joint ML detector: best performance, highest complexity,” *i.e. a high complexity multi-user detector*. Onggosanusi, ¶31. Onggosanusi next lists “iterative detectors (IZF/IMMSE)” and “linear detectors (LZF/LMMSE),” *i.e. a medium complexity multi-user detector*. *Id.*, ¶¶32-33. Finally, Onggosanusi lists a “maximum ratio combining (MRC) detector, ... lowest complexity,” *i.e. a low complexity multi-user detector*. *Id.* at ¶34.

- d. 10f: a bank of decoders coupled to said plurality of low complexity processed information streams, said plurality of medium complexity processed information streams, and said plurality of high

complexity processed information streams, wherein said decoders output a plurality of refined information streams.

152. In my opinion, Onggosanusi alone discloses or in view of Egnor renders obvious this limitation. *See* 1e, *supra*. A POSITA would understand that the disclosures of improved information streams also provide disclosures of refined information streams.

12. Claim 11: The hybrid receiver according to claim 10, further comprising a front end section coupled to said received signals and to said received signal information which filters said received signals.

153. In my opinion, Onggosanusi alone discloses or in view of Egnor renders obvious this limitation. *See* claim 8, *supra*.

13. Claim 12: The hybrid receiver according to claim 10, wherein said plurality of refined information streams are fed back to said multi-user detector decision unit for iterative processing until a final condition is reached and said bank of error correction decoders output a final plurality of bit streams.

154. In my opinion, Onggosanusi alone discloses or in view of Egnor renders obvious this limitation. *See* claim 2, *supra*.

14. Claim 13: The hybrid receiver according to claim 10, wherein said multi-user detector decision unit makes a selection determined by design criteria based upon at least one threshold selected from at least one of the group consisting of: number of symbols, correlation matrix between users, expected bit error rate, eigendecomposition

**of correlation matrix, signal to interference plus noise ratio,
and expected SINR.**

155. In my opinion, Onggosanusi alone discloses or in view of Egnor renders obvious this limitation. *See* claim 3, *supra*.

**15. Claim 14: The hybrid receiver according to claim 10,
wherein said threshold is changeable.**

156. In my opinion, Onggosanusi alone discloses or in view of Egnor renders obvious this limitation. *See* claim 4, *supra*.

**16. Claim 15: The hybrid receiver according to claim 12,
wherein said final condition is one of a fixed number of
iterations and an allowable performance level.**

157. In my opinion, Onggosanusi alone discloses or in view of Egnor renders obvious this limitation. *See* claim 7, *supra*.

**17. Claim 16: The hybrid receiver according to claim 10,
further comprising a hard decision unit coupled to said
bank of decoders and producing a final data stream.**

158. In my opinion, Onggosanusi alone discloses or in view of Egnor renders obvious this limitation. *See* claim 9, *supra*.

**B. Ground 2: Egnor in view of Onggosanusi renders obvious claims 17-
18 under Section 103**

159. As I mentioned above, claim 17 is quite different from claim 1. Claim 17 recites iterative multi-user detection on windows of bits. Specifically, a window of bits in the signal is estimated using a selected multi-user detector, and then the

window is incremented and the signal is further estimated. Because of this substantive difference, I present Egnor's windowing method as modified by Onggosanusi's selection of a MUD as a separate ground.

160. Egnor discloses this a windowing method for pipelining data into a multi-user detector. In particular, Egnor discloses that MUD processes a window of received data, and then processes the next window of received data. Egnor also discloses multiple MUDs. While Egnor does not explicitly disclose selecting between multiple MUDs of varying complexity based on a parameter estimate, as discussed above in Ground 1, Onggosanusi teaches such claimed behavior. It would have been obvious to combine Egnor with Onggosanusi.

1. Motivation to Combine

161. In my opinion, a POSITA would have been motivated to combine Egnor's pipelined multi-user detection and decoding system with Onggosanusi's selection of different detectors of varying complexity based on a channel estimation.

162. As I discussed in Ground 1, Onggosanusi describes a system for selecting from a plurality of detectors of varying complexities depending on the channel estimate H that estimates the correlation between the received signals. As Onggosanusi explains, if the signal has low correlation/interference, then a lower complexity detector is suitable—by contrast, if a signal has high

correlation/interference, then a higher complexity detector may be necessary.

Onggosanusi, ¶¶30-35.

163. In my opinion, Egnor discloses multi-user detection using conventional methods. Thus, a POSITA would have been motivated to incorporate Onggosanusi's system for selecting a MIMO detector because of the benefits described in Onggosanusi and known by ordinary artisans. As Onggosanusi explains, different types of detectors have different levels of performance and complexity—with higher complexity detectors generally requiring higher amounts of power. Onggosanusi, ¶¶35-38. Onggosanusi generally explains that when a channel is “well-behaved” in that the signals have “low correlations among the[m],” “then a low complexity detector ... saves computations and thus energy in battery-operated devices.” *Id.*, ¶37. By contrast, if the transmission channel is “ill-conditioned” in that the signals have “a large correlation,” then “a high complexity detector is selected” because “higher performance overcomes channel condition problems.” *Id.*, ¶38.

164. In other words, Onggosanusi teaches that by selecting among a plurality of detectors of varying complexity, high complexity detectors need only be selected if needed for a noisy channel, whereas less energy-intensive low complexity detectors can be selected when appropriate. A POSITA would understand that this

system provides significant energy savings compared to exclusively using a high complexity detector—and allows for detection of a noisy channel compared to exclusively using a low complexity detector. These benefits would have motivated a POSITA to incorporate Onggosanusi's teachings.

165. Since Egnor discloses a number of MUD processors and decoders in a series (*see* Fig. 5), a POSITA would have been motivated to incorporate Onggosanusi's teachings for all the MUD processors. This would allow the system to gradually use less complex detectors as the signals are processed by subsequent MUD processors that gradually decorrelate the signals.

166. In my opinion, a POSITA would have had a reasonable expectation of success in combining Egnor with Onggosanusi. Onggosanusi provides implementation details that were well-within the capabilities of a POSITA. In particular, Onggosanusi explains that its system calculates the channel estimate H , which was well-known. Onggosanusi also provides details as to how its selector uses the channel estimate H : by using one of a number of transformations $f(H)$ and setting thresholds within the $f(H)$, each one mapped to a particular detector. Onggosanusi, ¶¶36-43.

167. As I discussed above for Ground 1, Egnor, Onggosanusi, and the '492 patent are directed to the same field of endeavor.

2. 17pre: A method for processing signals from multiple users with raw digitized data, comprising:

168. To the extent the preamble is limiting, in my opinion, Egnor discloses this limitation.

169. Egnor discloses “Data In” which “represents waveforms from *multiple users* transmitting signals which are received and *processed* by the receiver units.” Egnor, ¶69. Egnor discloses that the received “aggregate signal is collected at the receiver, down-converted and digitized,” which a POSITA would understand to be *raw digitized data*. *Id.*, ¶55.

a. 17a: performing parameter estimation of said raw digitized data;

170. In my opinion, Egnor discloses this limitation.

171. Egnor discloses that “[t]he MUD processors 410 are coupled to some form of parameter estimator 420 to obtain signal information for processing the data, as well as an interconnection to a priori information.” Egnor, ¶79. Egnor discloses that the parameter estimator “processes the various parameters for the received raw data,” and is generally “known in the art” and “is a broad description for a unit that provides information to the MUD and decoders such as convolutional code, signatures, multiplexing format.” *Id.*, ¶58.

b. 17b: grabbing a window of bits from said raw digitized data;

172. In my opinion, Egnor discloses this limitation.

173. Egnor discloses “MUD processors 305 ... has a ‘window’ or frame region 300 in which it processes data.” Egnor, ¶70. The “MUD window 300 processes small chunks of data.” *Id.* The data refers to “received signals from a corresponding plurality of users,” *i.e. raw digitized data*. *Id.*, ¶26; *see also id.*, ¶50 (“antennas 45 receive the transmitted signals $r(t)$... [*i.e.*] received signal $r(t)$ for each user.”).

c. 17c: subtracting any known bits from said window of bits;

174. In my opinion, Egnor discloses this limitation.

175. Egnor discloses that when a user’s block “has already been processed and decoded data,” it will “leave [that data] alone” and instead process and decode another user’s data. Egnor, ¶84. A POSITA would understand that the “already ... decoded data” are known bits, and thus they are excluded from processing. Thus, Egnor teaches *subtracting any known bits from said window of bits*.

d. 17d: selecting a multi-user detector;

176. In my opinion, Egnor in view of Onggosanusi renders obvious this limitation.

177. As I discussed above for limitation 1c in Ground 1, Onggosanusi discloses selecting between a plurality of multi-user detectors. discloses a module

that “compute[s] channel condition metric” and “select[s a] detector.” Onggosanusi, Fig. 2 (annotated below). In particular, “[f]or a given channel estimation, H, the **preferred embodiment detector** computes a channel metric $f(H)$, and based on $f(H)$ **selects one of the N detectors** by setting the multiplexer and demultiplexer.” *Id.*, ¶36. The selection of the detector is based on the channel being “well-behaved” or “ill-conditioned,” with “ $f(H)$... partitioned into N regions with each region corresponding to one of the N detectors.” *Id.*; see also, limitation 1c, *supra*.

178. It would have been obvious to combine Egnor with Onggosanusi’s disclosure of selecting a multi-user detector, as I discuss above in the motivation to combine section.

e. 17e: estimating unknown bits from said window of bits using said multi-user detector;

179. In my opinion, Egnor renders obvious this limitation.

180. Egnor describes that the “partial frame of data” is processed by “MUD₀.” Egnor, ¶80; see Fig. 5. Further, “[u]pon completion of any complete frame, the output from the MUD₀ is an input to the decoding algorithm such as BJCR.” *Id.* Egnor describes that “[t]he information passed from the MUD processors 410 to the decoders 430 encompass the decisions made as part of the MUD processing in establishing the most probable conditional values for the data in the frames,” *i.e. estimating unknown bits from said window of bits.* *Id.*, ¶81.

Indeed, a POSITA would understand that the entire purpose of a decoder is to estimate unknown bits.

f. 17f: incrementing to a next window of bits;

181. In my opinion, Egnor renders obvious this limitation.

182. Egnor discloses that after a window is processed, a subsequent window is processed. Egnor, ¶73. Specifically, in “a subsequent processing,” a new “processing window 325” is processed by the MUDs. *Id.*, ¶75. In the Figure 5 combination of Egnor, each MUD receives subsequent windows per the description in Figure 4. *Id.*, ¶¶80-81; *see also* ¶79 (“MUD processors 410 are coupled to the *incoming frames* of data 400.”).

g. 17g: repeating said steps of subtracting, selecting, estimating and incrementing until there are no more windows and outputting a set of symbol estimates.

183. In my opinion, Egnor renders obvious this limitation.

184. Egnor discloses that as each window is processed and decoded through the plurality of MUDs (which in the combination with Onggosanusi are selected), this occurs “until the last stage at which point the output from the BCJR is the output values of the system, Data Out. The Data Out is the symbol stream of improved and processed data.” Egnor, ¶80.

3. Claim 18: The method according to claim 17, wherein said multi-user detector is selectable from the group consisting of high complexity multi-user detectors, medium complexity

**multi-user detectors, low complexity multi-user detectors
and matched filters.**

185. In my opinion, Egnor in view of Onggosanusi renders obvious this limitation.

186. Onggosanusi discloses high complexity, medium complexity, and low complexity multi-user detectors and matched filters. As I discussed in Ground 1, a POSITA would have understood or considered it obvious that Onggosanusi's detectors also can operate on multi-user signals, not just MIMO signals.

187. Onggosanusi lists four detectors "ranked according to their performance and complexity." Onggosanusi, ¶30. First, Onggosanusi lists a "joint ML detector: best performance, highest complexity," *i.e. a high complexity multi-user detector*. Onggosanusi, ¶31. Onggosanusi next lists "iterative detectors (IZF/IMMSE)" and "linear detectors (LZF/LMMSE)," *i.e. a medium complexity multi-user detector*. *Id.*, ¶¶32-33. Finally, Onggosanusi lists a "maximum ratio combining (MRC) detector, ... lowest complexity," *i.e. a low complexity multi-user detector*. *Id.* at ¶34. As I discussed above in the motivation to combine section, it would have been obvious to combine these teachings in Onggosanusi with Egnor.

188. Also, it is my opinion that Egnor further discloses that the detector can be a "matched filter," for example, "[t]he input data represents a vector of data,

transferred at some rate (e.g., the symbol rate), and this data is typically transmitted to a matched filter.” Egnor, ¶57.

VIII. Secondary Considerations of Non-obviousness

189. I am not aware of any secondary considerations, or so-called “objective indicia of non-obviousness” for the challenged claims.

190. Secondary considerations could include things like commercial success of a product due to the merits of the claimed invention; a long felt need for the solution provided by the claimed invention; unsuccessful attempts by others to find the solution provided by the claimed invention; copying of the claimed invention by others; unexpected and superior results from the claimed invention; acceptance by others of the claimed invention as shown by praise from others in the field or from the licensing of the claimed invention; teaching away from the conventional wisdom in the art at the time of the invention; independent invention of the claimed invention by others before or at about the same time as the named inventor thought of it; and other evidence tending to show obviousness.

191. Patent Owner has not identified any such secondary considerations, and I am not independently aware of any. For example, Patent Owner has no commercial products embodying the ’492 patent that I am aware of. Additionally, as discussed throughout, the claimed features reflect predictable results of combining known elements according to their known functions, and thus, there are

no unexpected and superior results from the claimed invention. Also, there are no licenses of the '492 patent of which I am aware.

192. Further, even if Patent Owner were to assert that secondary considerations exist, given the strong reasons that the challenged claims are obvious in light, including the motivations to combine the references set forth above, I do not believe any such secondary considerations would rise to the level of overcoming the invalidity opinions I have expressed.

193. I understand that Patent Owner may address the issue of secondary considerations more fully in the future. I reserve the right to respond to any specific bases for such secondary considerations that Patent Owner may identify.

IX. Conclusion

194. For the reasons set forth above, I believe claims 1-20 of the '492 patent are unpatentable in view of the prior art. In signing this declaration, I understand that the declaration will be filed as evidence in a contested case before the Patent Trial and Appeal Board of the United States Patent and Trademark Office. I acknowledge that I may be subject to cross-examination in this case and that cross-examination will take place within the United States. If cross-examination is required of me, I will appear for cross-examination within the United States during the time allotted for cross-examination.

195. I declare that all statements made herein of my knowledge are true, 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 1, 2024

By: 
Paul S. Min, Ph.D.