

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

INTEL CORPORATION,
LENOVO (UNITED STATES) INC.,
MOTOROLA MOBILITY LLC,
Petitioners,

v.

COLLISION COMMUNICATIONS, INC.,
Patent Owner.

Case No. IPR2025-00302

U.S. Patent No. 7,920,651

**PETITION FOR INTER PARTES REVIEW
OF U.S. PATENT NO. 7,920,651**

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1003	Declaration of Dr. Paul Min
1004	U.S. Patent No. 6,931,052 (“Fuller”)
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1009	Intentionally Omitted
1010	Zha <i>et al.</i> , “Soft-Decision Successive Interference Cancellation CDMA Receiver with Amplitude Averaging and Robust to Timing Errors,” <i>in</i> Proc. IEEE Global Telecommunications Conference, 2001 (GLOBECOM ’01), vol. 2, 2001, pp. 743-747
1011	Sergio Verdu “Computational Complexity of Optimum Multiuser Detection,” <i>Algorithmica</i> (1989)
1012	Verdu, Sergio, “Multiuser Detection,” Cambridge University Press (1998)
1013	Shimon Moshavi, “Multi-User Detection for DS-CDMA Communications,” <i>in</i> IEEE Communications Magazine, Oct. 1996, pp. 124-136
1014	<i>Curriculum Vitae</i> of Dr. Paul Min
1015	Federal Court Management Statistics (September 2024)

1016	Memorandum, Interim Procedure for Discretionary Denials in AIA Post-Grant Proceedings with Parallel District Court Litigation (USPTO June 21, 2022) (“Guidance Memo”)
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1018	Docket Control Order, Dkt. No. 44, <i>Collision Communications, Inc. v. Lenovo Group Ltd</i> , 2-23-cv-00594 (E.D. Tex.)
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LIST OF CHALLENGED CLAIMS

Claim	Limitation
1pre	A joint amplitude estimator for a data stream from multiple users, comprising:
1a	a data stream from said multiple users divided into a plurality of observation intervals;
1b	a plurality of processing modules coupled to said observation intervals, wherein said processing modules calculates interference cancellation values for each of said users and computes a filter for each of said observation intervals, said filter being applied to said data within said observation interval to compute individual amplitude estimates; and
1b	an amplitude estimation unit which processes said individual amplitude estimates and calculates new amplitude estimates, wherein said new amplitude estimates are iteratively passed back to said processing modules either a maximum number of iterations or a desired bit error rate have been reached.
2	The joint amplitude estimator according to claim 1, wherein said final condition is selected from at least one of the group consisting of bit error rate metric level and fixed number of iterations
3	The joint amplitude estimator according to claim 1, wherein said amplitude estimation unit sums and weighs said individual estimates.
4	The joint amplitude estimator according to claim 1, wherein said observation intervals are based on distinguishing attributes selected from at least one of the group consisting of time, code, and frequency

6	A method for processing amplitude estimates for a multiuser data stream divided into a plurality of observation intervals, comprising:
6a	computing a filter for each said observation interval of said data stream;
6b	applying interference cancellation to said data stream for each said observation interval;
6c	applying said filter to said data stream for each said observation interval from said interference cancellation to produce individual amplitude estimates for each said observation interval;
6d	computing new amplitude estimates using said individual amplitude estimates; and
6e	passing said new amplitude estimates back to said filter for iterative processing until either a maximum number of iterations or a desired bit error rate have been reached.
7	The method according to claim 6, wherein said computing further comprises summing said individual amplitude estimates and weighing.
8	The method according to claim 6, wherein said final condition is selected from at least from the group consisting of bit error rate metric level and fixed number of iterations.

I. INTRODUCTION

Petitioners Intel Corporation (“Intel”), Lenovo (United States) Inc., and Motorola Mobility LLC (collectively “Petitioners”) request *Inter Partes* Review (“IPR”) of claims 1-4 and 6-8 of the ’651 patent. Petitioners also file a contingent motion to join the IPR in *Samsung Electronics America, Inc., et al. v. Collision Communications, Inc.*, Case No. IPR2025-00011 (“the Samsung IPR”), in which Samsung is challenging the same claims on the same grounds.¹ Petitioners submit this petition to preserve their motion for joinder or to allow for timely consideration of the prior art presented herein if the Samsung Petition is denied for reasons other than the likelihood of prevailing at trial.

The ’651 patent is directed to purported improvements to the well-known technique of multi-user detection (“MUD”), which allows differentiation of data streams directed to different users where multiple devices transmit signals simultaneously over a common communication channel (also referred to as co-channel communication), each carrying its own information. These devices, which

¹ Petitioners have retained Paul Min, Ph.D. in this proceeding. Ex. 1019. Dr. Min has adopted his prior opinions set forth in Ex. 1003 (submitted in IPR2025-00011) and, for expediency, this Petition cites to Dr. Min’s previously submitted declaration, also presented herein as Ex. 1003.

are all using the same channel, interfere with one another, and techniques are required to demodulate and otherwise ascertain which signal is directed to which user. This technology, MUD, was not invented by the '651 patent. Indeed, the '651 patent acknowledges that prior art describes many techniques for doing so. *See* Ex. 1001, 6:23-29 (“There are various multiuser detectors in the art.”).

Wireless communication technologies allow multiple users to send data over the same transmission channels. Because data may be transmitted to multiple receivers at the same or overlapping times and frequencies, signals can be received as “interfering” signals—*i.e.*, a signal that suffers from interference from multiple users trying to use the same communications resource. Wireless communication technologies, such as cellular communication technologies, incorporate different methodologies of dividing transmissions into multiple parts, each part dedicated to transmitting information for a different user. For example, Code-Division Multiple-Access (“CDMA”) assigns different code waveforms to different users, and each “code” can be used to extract a particular user’s signal from the combined channel. However, these systems are not perfect, and some amount of interference between the multiple transmitted signals will typically still be detected. As the number of concurrent users on the channel increases, the magnitude of the interference will also grow.

MUD techniques have been used since the 1980s to remove interference in a received signal. By the 1990s, researchers developed a wide variety of MUD techniques, including highly efficient techniques capable of achieving superior performance without the need for highly complex and resource intensive processing. Some of these techniques, such as a class of MUDs referred to as “subtractive interference cancellation,” work by separately estimating interference contributed by each interfering user’s signal, and subtracting out that interference from the received signal to determine each individual user’s signal. Specifically, subtractive interference cancellation iteratively determines received symbols for each user by continuously estimating the amplitudes and symbols received for each user, and jointly using those estimates to subtract interference and generate improved estimates in each subsequent iteration.

The ’651 patent is directed to the basic concept of MUD techniques that iteratively compute amplitude and symbol estimates, and update those estimates in each iteration until a final decision is reached—*i.e.*, basic, well-known iterative MUD.

The ’651 patent’s purported improvement over the prior art is simple and not inventive: it uses joint estimation of signal amplitudes and symbols to reduce interference between users, including for large numbers of concurrent users, without the need for prior knowledge about the channel, and in a manner that allows for

practical, real-time processing. *See* Ex. 1001, 6:39-48 (discussing “optimal MUD” technique that is “computationally complex and [] is not possible to accomplish in a real-time environment”), 5:54-61 (describing “decision feedback” techniques that “are incapable of working in supersaturated environments”), 6:23-38 (criticizing linear MUD techniques that “require[] knowledge of all parameters to perform processing”). But the ’651 patent’s purported solution, using a MUD that iteratively performs interference cancellation by estimating individual amplitude estimates, and then computing new amplitude estimates based on the individual estimates, was well known at the time of the purported invention of the ’651 patent, including in the prior art presented in this petition.

This petition presents two primary references: Fuller (Ex. 1004) and Frank (Ex. 1006), both of which teach the MUD techniques claimed in the ’651 patent.

Fuller is a 2001 Nortel Networks patent directed to an “improved parallel interference cancellation” technique (*i.e.*, a type of multi-user detection). Ex. 1004, Abstract. In Fuller’s implementation, an “input signal composed of multiple user signals” is “separated into individual signals corresponding to each of the multiple users and demodulated to recover symbols for each of the individual signals.” *Id.* Each recovered symbol corresponds to an individual amplitude estimate. The individual estimates are weighted and used to produce a regenerated signal for each user (*i.e.*, new amplitude estimates), and the regenerated signals are used to perform

interference cancellation. *Id.* The process is performed “for multiple iterations,” and “[t]he output of the last iteration is used to form the final symbol decisions for each user signal.” *Id.* This process is illustrated in Figure 2 of Fuller, reproduced below:

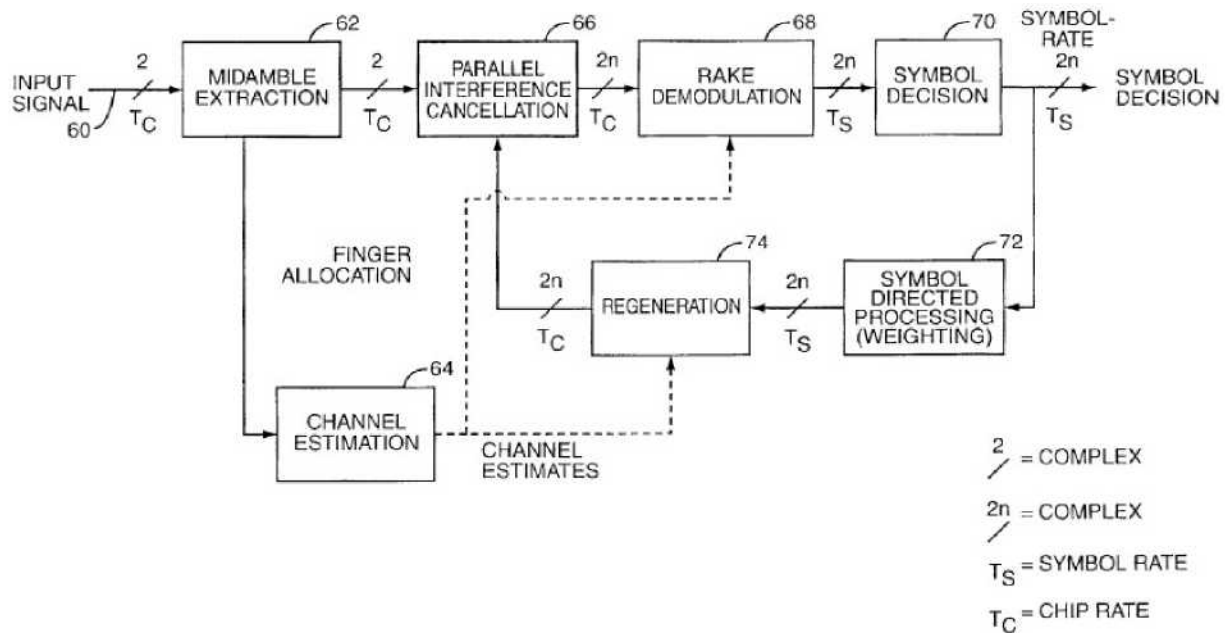


FIG. 2

Frank (Ex. 1006) is a 2001 Motorola patent publication that uses “interference cancellation for symbol determination” in “a CDMA communication system which has a plurality of code channels in use.” Ex. 1006, Abstract. A block diagram of an exemplary system is illustrated in Figure 1, reproduced below.

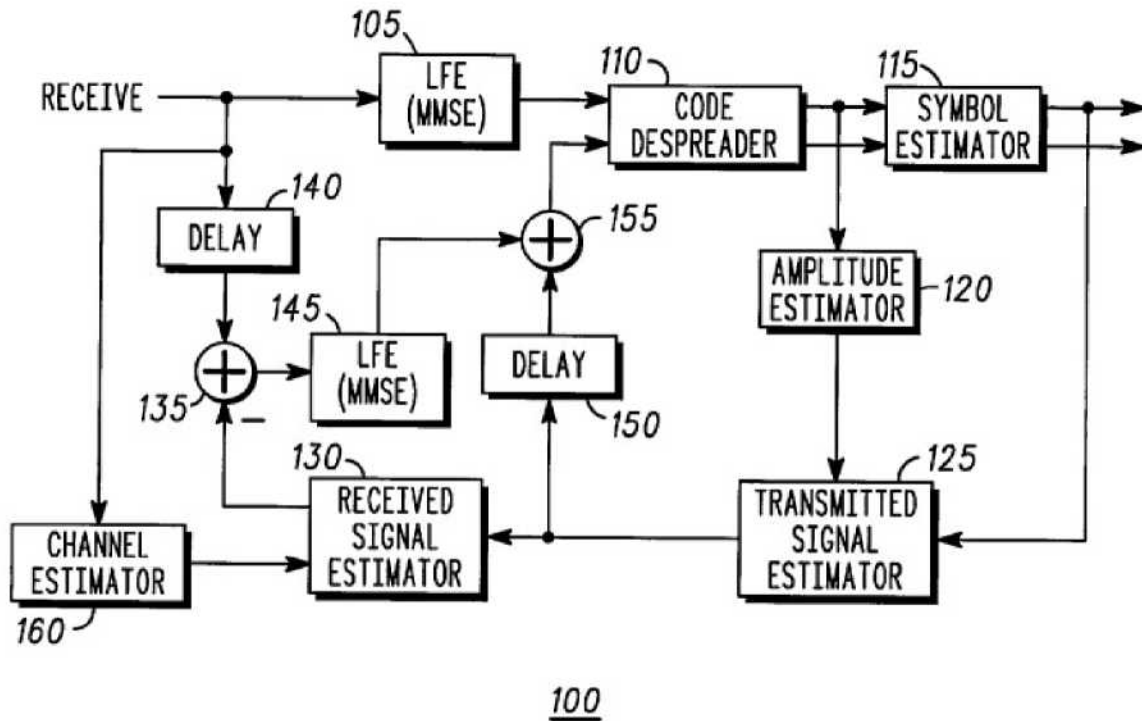


FIG. 1

In the preferred embodiment, “a plurality of symbol estimates” are determined for “all corresponding code channels,” each corresponding to a user. *Id.*, [0008]. “[A]n amplitude estimate for all [code] channels ... and a confidence measure for each symbol estimate ... are also determined.” *Id.* The symbol estimates and amplitude estimates are then used to perform interference cancellation on the original combined signal. *Id.*, [0009]. The process then repeats, iterating one or more additional times to provide successively better symbol estimates “until a desired level of accuracy is achieved.” *Id.*, [0010].

The '651 patent adds nothing to these well-known multi-user detection techniques. The patent claims and describes the basic concepts of iterative MUD that were well-known at the time.

II. STANDING

Petitioners certify the '651 patent is available for *inter partes* review and they are not estopped.

III. GROUNDS

Petitioners request review and cancellation of the claims based on the following grounds:

Ground	Basis	Reference(s)	Claims
1	§103	Fuller, Reznik	1-4, 6-8
2	§103	Frank, Zha	1-4, 6-8

IV. POSITA

A POSITA at the time of the '651 patent would have had at least a bachelor's degree in electrical engineering, computer engineering, computer science, physics, or an equivalent field, and two years of experience with cellular telecommunications, radio-access network architectures and protocols, and signal propagation in wireless networks. Ex. 1003, ¶56. More education can supplement practical experience and vice versa. *Id.* Petitioners' expert exceeded this by the priority date. *Id.*, ¶57.

V. TECHNICAL BACKGROUND

The '651 patent relates to multi-user detection, or “MUD.” MUD techniques have been known for decades, and documented since at least the 1980s. Ex. 1003, ¶34. Generally speaking, a MUD system allows users to transmit information over a shared communication path or channel. The users’ information is transmitted as a data stream comprising interfering signals² over the shared communication path or channel. Allowing for interfering signals allows the communication channel to support a much higher capacity—otherwise, the channel would be limited to the number of users that can simultaneously transmit non-interfering signals (*i.e.*, by transmitting on distinct frequencies, or at different times).

Because the signals interfere with each other, though, the receiver in such a system must be capable of differentiating between the different intended signals within the data stream so that each individual user’s original transmission can be extracted. MUD attempts to detect the signal associated with each transmitting user

² Interfering signals are signals that suffer from interference from another signal that overlaps in amplitude, phase, frequency, or time. Interfering signals may include both unwanted noise and intentionally overlapping signals from multiple users. Interference in a received signal causes the primary signal’s parameters to be obscured by the interfering signals.

by using parameters (*e.g.*, amplitude, phase, code, and timing) related to each user to extract each user's signal. *Id.*

One early description of MUD is in a paper by Sergio Verdu titled "Computational Complexity of Optimum Multiuser Detection," *Algorithmica* (1989) (Ex. 1011). Ex. 1003, ¶35. Even by 1989, MUD was well-known for detecting signals for each user in a multi-user system. For example, Verdu described MUD using parameter estimating as "[t]he optimum multiuser receiver can be viewed as a bank of single-user detectors followed by a common algorithm that selects the most likely transmitted symbols." Ex. 1011, 304. Verdu's optimal multiuser detector was "much too complex" for many "practical" systems; however, by the 1990s, researchers had developed a number of different "suboptimal multiuser detector solutions which are more feasible to implement." Ex. 1013, 126; Ex. 1003, ¶42; *see also* Ex. 1001, 6:44-48 ("[O]ptimal processing is a [*sic*] computationally complex and it is not possible to accomplish in a real-time environment.").

MUD has been used in many familiar wireless technologies that require sending multiple user data streams over a single signal. Indeed, since the 1980s, multiuser detection has been implemented in cellular networks, satellite communication, high-speed data transmission lines, digital radio/television broadcasting, fixed wireless local loops, and multitrack magnetic recording. Ex. 1003, ¶36. All of these communication systems are subject to multiaccess

interference and need a detector to determine the user for the data transmitted on the shared network. For example, Qualcomm pioneered the use of Code-Division Multiple-Access (“CDMA”) technology in the 1990s. *Id.*, ¶37. In the CDMA cellular networks, all users can transmit at the same time, and can use the entire available frequency spectrum for transmission. Ex. 1013, 124. In order to differentiate users from each other, each user’s signal is multiplied by a “distinct code waveform” at the transmitter. *Id.* The receiver receives a data stream “composed of the sum of all users’ signals, which overlap in time and frequency,” and extracts each user’s signal by “correlating the entire received signal with [a particular] user’s code waveform.” *Id.*

Even in CDMA systems, however, randomness inherent in the system makes it impossible to eliminate interference between users entirely using the code waveforms. Ex. 1013, 124. “While the [interference] caused by any one user is generally small, as the number of interferers or their power increases, [interference] becomes substantial.” *Id.* In conventional CDMA receivers, interference from other users would be treated as random noise, and conventional techniques for mitigating and accounting for noise on the communication channel would be employed. However, researchers soon realized that “a better detection strategy is one of multi-user detection (also referred to as joint detection or interference cancelation), where “information about multiple users is used jointly to better detect each individual

user.” *Id.* In multi-user detection, other users’ signals are not treated as noise; instead, the receiver attempts to more intelligently detect other users’ signals and eliminate them from the joint signal in order to isolate a particular user’s signal.

By the mid-1990s, researchers developed multiple MUD techniques that could be used to further improve multi-user detection in CDMA systems and overcome interference between users. In general, these solutions could be classified into two categories of techniques: linear multi-user detectors and subtractive interference cancellation detectors. Ex. 1013, 126; Ex. 1003, ¶42. Subtractive interference cancellation is particularly relevant to the ’651 patent and the Grounds described herein. In subtractive interference cancellation, the multi-user detector generates “separate estimates of the [interference] contributed by each user in order to subtract out some or all of the [interference] seen by each user.” Ex. 1013, 130; Ex. 1003, ¶43. Such detectors are often implemented to perform detection iteratively, with the with the output improving after each iteration. Ex. 1013, 130. For example, in successive interference cancellation, “[e]ach stage of [the] detector decisions, regenerates, and cancels out one additional ... user from the received signal, so that the remaining users see less [interference] in the next stage.” *Id.* In parallel interference cancellation, the detector “estimates and subtracts out all of the [interference] for each user in parallel.” *Id.* at 131. The process is “repeated for

multiple stages,” each “tak[ing] as its input the data estimates of the previous stage and produc[ing] a new set of estimates at its output.” *Id.*

VI. OVERVIEW OF THE '651 PATENT

A. Disclosure

The '651 patent is directed to “co-channel communications” and “increasing capacity by allowing interfering channels”—*i.e.*, multi-user detection. Ex. 1001, 1:29-32. Indeed, the patent purports to be related to several applications expressly directed to multi-user detection systems. *Id.*, 1:6-25.

The '651 patent does not purport to invent MUD. To the contrary, the patent acknowledges that the prior art “describe[s] ... multiple user systems” where communications “are processed by a multi-user detector.” *Id.*, 5:12-15. The patent even admits that “[t]here are various multiuser detectors in the art.” *Id.*, 6:23-29. However, the '651 patent asserts that there are various disadvantages to existing multi-user detection schemes. For example, the '651 patent states that certain linear multi-user detectors “suffer[] from a significant disadvantage in that [they] require[] knowledge of all parameters to perform processing.” *Id.*, 6:29-38. “Optimal MUD based on the maximum likelihood sequence estimator” is also criticized for being “computationally complex” and “not possible to accomplish in a real-time environment.” *Id.*, 6:39-47. The '651 patent concedes that “[t]here are several suboptimal multiuser detectors that are less computationally complex and known in

the art,” but asserts that even these systems “fail[] or cases of overloaded multiple access systems,” *e.g.*, “where the number of users is doubled or tripled relative to the existing state of the art.” *Id.*, 6:58-7:9. In sum, the ’651 asserts that “the optimum maximum likelihood multi-user detector ... require[s] too many computations to keep up with real time transmissions,” while “a fast, but inferior, multiuser detection scheme causes poor quality output when there many interferers or users.” *Id.*, 8:20-30.

The ’651 patent purports to improve on prior art multi-user systems by describing a multi-user detection system that “provid[es] high quality real-time processing for multiple access systems, including overloaded situation.” Ex. 1001, 11:34-38. Figure 5, reproduced below, depicts “one embodiment of a hardware implementation ... that parallels the joint estimation based on M observation intervals.” *Id.*, 20:62-66.

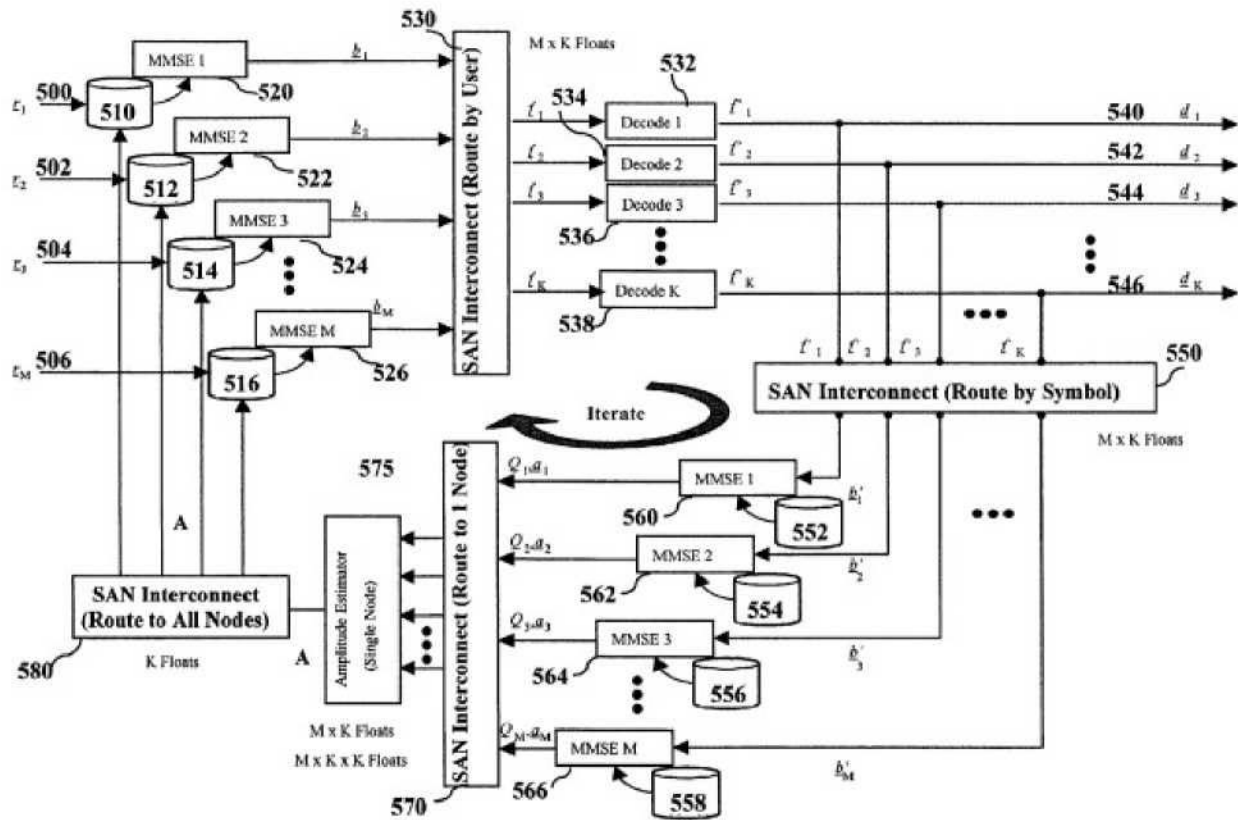


Figure 5

In Figure 5, “[t]he data stream ... is partitioned into M observation intervals.” *Id.*, 20:66-21:3. Each observation interval corresponds to an interval of time, frequency, or code. *Id.*, 18:65-19:1. Of particular relevance to the claims at issue here, a bank of processors can be used for “filter implementation for amplitude estimation, illustrated by processing modules 560, 562, 564, 566.” *Id.*, 22:17-24. Each processing module “computes an amplitude update vector,” which “is passed to a central node that implements the functionality of [an] Amplitude Estimator [575].” *Id.*, 22:32-39. The amplitude estimator weights and sums the individual

amplitude estimates. *Id.*, 20:11-18. Updated amplitude estimates are then used to “perform the symbol estimation processing ... on the next iteration using the new amplitude estimates.” *Id.*, 22:48-64. The process is repeated iteratively “until estimates of the bit error rate metric achieves a certain level or until a fixed number of iterations have been executed.” *Id.*, 22:64-47.

B. Prosecution History

The application that led to the '651 patent was filed on June 25, 2009, and claimed priority back to a provisional application filed on April 14, 2003. Following amendments to the claims to address objections to claims 1, 5 and 6 that the phrase “until a final condition is obtained” was unclear, the application that led to the '651 patent was allowed. *See generally* Ex. 1002.

VII. OVERVIEW OF THE PRIOR ART

A. Fuller (U.S. Patent No. 6,931,052) (Ex. 1004)

The application that issued as Fuller was filed on Nov. 16, 2001, published on May 22, 2003, and issued August 16, 2005. *See* Ex. 1004. Accordingly, Fuller is prior art to the '651 patent under at least §102(e).

Fuller discloses methods and systems for “improved parallel interference cancellation” for “[a]n input signal composed of multiple user signals.” Ex. 1004, Abstract. Fuller discloses that an input signal composed of multiple user signals is

processed over a select time duration, and an iterative process is used with the output of the last iteration being used to form the final symbol decisions for each user signal.

For example, Fuller Fig. 2 discloses a multiple (parallel) access interference cancellation circuitry or “PIC.” Specifically, the PIC of Fig. 2 is referred to as “chip-level” PIC because the interference is cancelled at the chip-rate, with the received signal being “decimated” at the chip-rate so that the input signal 60 is a composite signal represented by chip-rate complex samples. Ex. 1004, 4:37-41, 55-65. Fuller also discloses that “[f]or a specific time duration, or slot, the input signal is separated into M individual signals corresponding to each of the multiple users” as well as “demodulated to recover K symbols for each of the M individual signals.” Ex. 1004, 4:11-23.

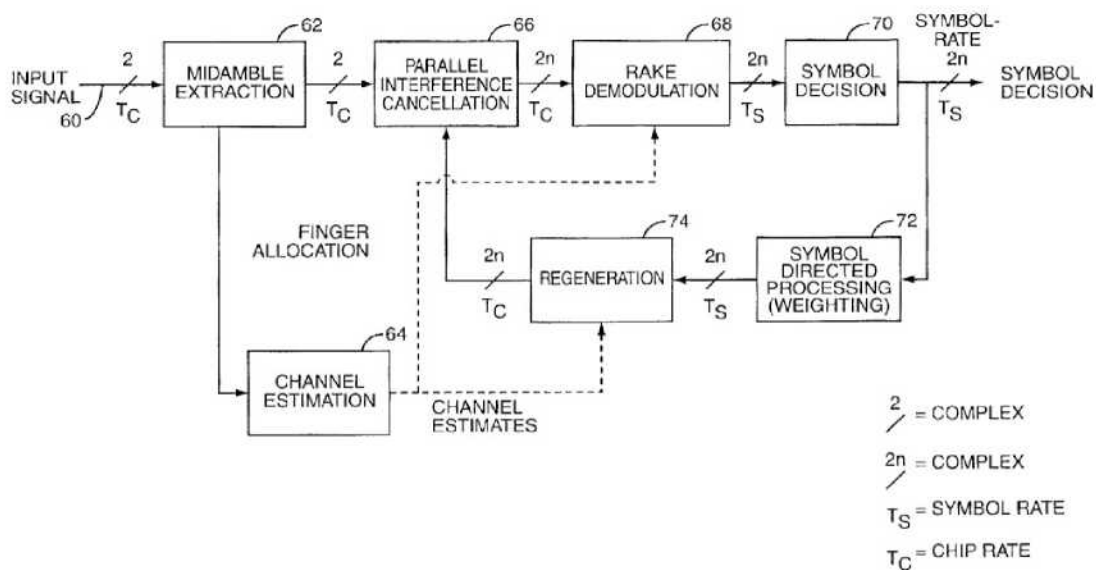


FIG. 2

As shown in Fig. 2, rake demodulation 68 separates the composite input signal 60 into M individual signals corresponding to the respective signals for each user. Ex. 1004, 5:9-18. Symbol-directed processing 72 weighs the latest symbol decision based on the consistency of previous estimates for the given symbol in earlier iterations, and provides individually weighted symbols. *Id.*, 5:31-39. Regeneration 74 “recreates estimates of the individual signals from the weighted symbols for each of the estimated users and individually processes the modulated symbols based on the corresponding channel estimates.” *Id.*, 5:41-45. The regenerated signals are then used in a parallel interference cancellation function to “determine the individual signals for each user during subsequent iterations” by “subtract[ing] the regenerated signals corresponding to all other individual signals from the composite input signal 60 for the given time slot.” *Id.*, 5:12-16.

B. Reznik (U.S. Patent No. 6,724,809) (Ex. 1005)

The application that issued as Reznik was filed on April 22, 2002, published on March 20, 2003, and issued on April 20, 2004. *See* Ex. 1005. Accordingly, Reznik is prior art to the '651 patent under at least §102(a).

Reznik discloses a parallel interference cancellation receiver that reduces impulse response interference using a model of the received signal similar to that used in block linear equalizers. Reznik discloses an interference computation

processor feedback loop for correcting the output of a direct interference canceller, and further discloses observation intervals in the form of “chips.”

Reznik discloses that the data output from a communication receiver *e.g.*, in Fig. 3 “is coupled to a subchannel estimator which estimates the impulse response of each symbol transmitted in a respective sub channel.” Ex. 1005, 2:53-60. Reznik further discloses that “W” is “the communication channel impulse response length in chips,” and that “h(k)” is “the impulse response of the subchannel experienced by user k presented as a vector.” *Id.*, 3:14-15, 3:38-39. Reznik discloses that “[t]he received data vector r is input to a plurality of channel estimators which independently estimate each user's subchannel impulse response.” *Id.*, 6:54-62.

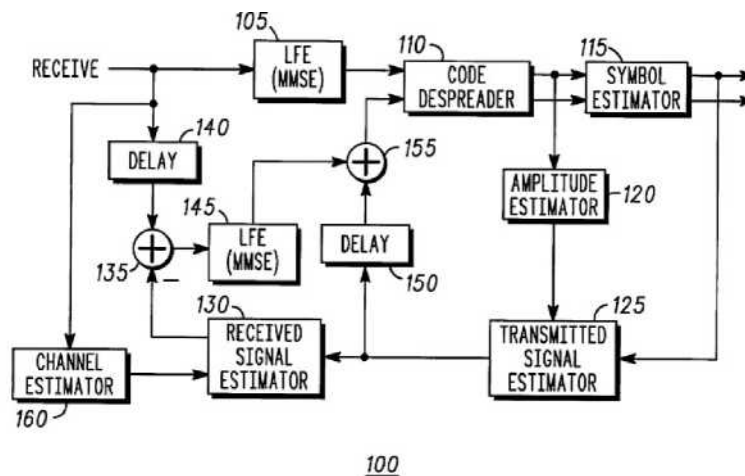
C. Frank (U.S. Patent Pub No. 2003/0035469) (Ex. 1006)

Frank was filed on August 20, 2001 and published on February 20, 2003. Accordingly, Frank is prior art to the '651 Patent under at least §102(a).

Frank is a Motorola patent publication directed to “receivers for code division multiple access (CDMA) communication systems, and more particularly, . . . receivers having linear, minimum mean square error equalization with successive or parallel interference cancellation for mobile communication forward links.” Ex. 1006, [0001].

Frank discloses a system for interference cancellation, using an amplitude estimator, symbol estimator, and transmitted signal estimator as part of a feedback

loop. *Id.*, [0018]-[0022]. Amplitude estimates are used to “weight[] each estimated symbol” and “sum[] the result,” and “produce an estimated transmitted signal.” *Id.*, [0020]. The estimated received signal is used in interference cancellation by subtracting it from the received signal for generating updated symbol estimates. *Id.*, [0022]. An embodiment of Frank’s system is illustrated in Figure 1, reproduced below.



D. Zha (“Soft-Decision Successive Interference Cancellation CDMA Receiver with Amplitude Averaging and Robust to Timing Errors”) (Ex. 1010)

Zha is a paper that was presented at the IEEE Global Telecommunications Conference 2001 (GLOBECOM '01), which took place from November 25 to 29, 2001. Zha was also published in the Proceedings of GLOBECOM '01, published by IEEE in 2001 and made available on IEEE Xplore in August 2002. Accordingly, Zha is prior art to the '651 patent under at least §102(a)-(b).

As discussed by Dr. Min, Exhibit 1010 is a true and correct copy of Zha as published by IEEE on the IEEE Xplore website. Ex. 1003, ¶74. Zha on its face bears a publication date of 2001. Dr. Min opines that this date, which is further corroborated by the date on IEEE Xplore's website, is a highly reliable indicator of public availability. Ex. 1003, ¶¶73-74. In addition, the IEEE Xplore website itself indicates that the paper was uploaded to and made available on IEEE Xplore by August 2002. *Id.*; see also IPR2014- 00527, Paper 41 at 11 (“IEEE is a well-known, reputable compiler and publisher of scientific and technical publications, and we take Official Notice that members in the scientific and technical communities who both publish and engage in research rely on information published on the copyright line of IEEE publications.”).

Zha discloses a “multiuser detection method” using “successive interference cancellation (SIC).” Ex. 1010, 743. Zha explains that it was known as early as 1994 that “amplitude averaging over M bits can result in a significant performance improvement over no averaging for the SIC receiver.” *Id.* (citing reference [3], a 1994 paper). Specifically, “amplitude estimation by averaging over M bits can reduce the noise variance by an order of M ,” which “results in a significant BER [bit error rate] performance improvement over a linear SIC receiver which does not use amplitude averaging.” *Id.*, 744.

Zha proposes an improved multiuser detector that incorporates amplitude averaging. *Id.*, 743. The detector has “multiple interference cancellation stages.” *Id.*, 744. In each stage after the first, each “user’s received signal is estimated by subtracting other users’ regenerated signals from the [combined] received signal”; the “averaged amplitude estimate” is then obtained “by averaging the instantaneous estimate of” a particular user’s “amplitudes over a block of M bits”; and symbol estimates are then estimated and “normalized with respect to the averaged amplitude” to determine a “data bit decision.” *Id.* The data bit decision uses a “soft bit decision rule.” *Id.* The algorithm “is terminated after a desired number of interference cancellation stages.” *Id.*

VIII. CLAIM CONSTRUCTION

For the purposes of this this proceeding, Petitioners contend no claim terms need construction because the claims read on the prior art presented below under any construction consistent with *Phillips*, and should thus be given their plain and ordinary meaning. Ex. 1003, ¶¶59-60.

IX. CLAIMS 1-4 AND 6-8 ARE UNPATENTABLE OVER THE PRIOR ART³

A. Ground 1: Claims 1-4 and 6-8 are Rendered Obvious by Fuller in View of Reznik

Fuller discloses a parallel interference cancellation receiver that receives a data signal comprising multiple individual user signals and iteratively performs joint amplitude estimation. The joint amplitude estimation function uses a plurality of processors processing multiple code-based and time-based observation intervals in parallel to demodulate, filter, and regenerate the individual user signals, and generate updated signal estimates.

Reznik also discloses parallel interference cancellation, and discloses additional filtering steps and conditions for determining when to complete the iterative process and generate final symbol estimates.

As set forth below, it would have been obvious to a POSITA to apply Reznik's teachings to Fuller.

³ Petitioners are not aware of any secondary considerations of non-obviousness identified by Patent Owner, though none would rise to the level of overcoming the invalidity opinions of Dr. Min. Ex. 1003, ¶¶186-190. Petitioners reserve the right to address any secondary considerations if raised by Patent Owner.

1. Motivation to Combine

A POSITA would have been motivated to apply Reznik's teachings relating to interference cancellation to Fuller's parallel interference cancellation system, including Reznik's teachings relating to the use of matched filters to generate amplitude estimates and logic for determining when to complete iterative processing of interference cancellation. Ex. 1003, ¶¶79-84.

As an initial matter, multi-user detection, and parallel interference cancellation specifically, was well known before the '651 patent. Ex. 1003, ¶80; Ex. 1013, 131. Accordingly, a POSITA would have recognized conventional aspects of parallel interference cancellation described in Reznik as known techniques, and would have found it obvious to apply those known techniques to a known method that was ready for improvement, such as Fuller's improved parallel interference cancellation system, to yield predictable results. Ex. 1003, ¶80. For example, a POSITA would have recognized that Reznik's teaching of iterating for a fixed number of iterations or until a desired level of signal correction is achieved are two conventional and commonly used alternatives for iterative interference cancellation, and could readily be applied to Fuller's iterative solution. *Id.* A POSITA would have had a reasonable expectation of success in making such modifications because they merely entail implementing one prior art solution with well-known techniques from prior art in the same field. *Id.* Accordingly, a POSITA

would have understood that these references, as well as the POSITA's knowledge, disclose interrelated teachings based on routine technologies and would have been amenable to various well-understood and predictable combinations.

In addition, both Fuller and Reznik disclose specific improvements to parallel interference cancellation in the context of CDMA communications systems that address problems known in the art. Ex. 1003, ¶81. For example, Fuller teaches that in conventional parallel interference cancellation, "each cancellation iteration involves an attempt to completely cancel out all MAI [multiple access interference]." Ex. 1004, 1:36-38. "However, if the MAI estimate for a particular user is based on an incorrect data decision, then the interference power contributed by that user is artificially increased when interference cancellation is performed." *Id.*, 1:40-43. Fuller thus discloses a weighting technique to weight symbol estimates differently for performing interference cancellation, based on "the consistency of previous estimates of the given symbol." *Id.*, 2:24-27. Reznik, on the other hand, teaches that an "inherent problem with prior art PIC receivers resides in the received signal model that is used." Ex. 1005, 7:42-46. Accordingly, Reznik discloses an improved "parallel interference cancellation receiver system and method" that "reduces impulse response interference using a model of the received signal similar to that used in block linear equalizers." *Id.*, 8:2-5. Because Fuller and Reznik solve different known problems in the same type of CDMA-based parallel interference

cancellation receiver, a POSITA would have been motivated to look to Reznik to further improve Fuller's system. Ex. 1003, ¶81. In particular, Reznik's use of matched filter determine individual amplitude estimates is part of its improved data estimation and interference cancellation technique. *See* Ex. 1005, 9:37-10:15; Ex. 1003, ¶81.

A POSITA would have reasonably expected this combination to succeed. Ex. 1003, ¶83. Filtering and iterative interference cancellation had long been known in the field of multi-user detection and a POSITA would have been familiar with these techniques as described by Reznik. Implementing Reznik's teachings into Fuller would have been well within the capabilities of a POSITA, especially because Fuller already discloses both matched filtering and the use of parameters associated with each interfering signal, such as phase, timing offset, received power, etc. A POSITA would therefore understand Reznik is compatible with Fuller.

Finally, Fuller, Reznik, and the '651 patent are analogous art because all three are directed to the same field of multi-user detection and interference cancellation. *See* Ex. 1003, ¶84; Ex. 1001, 1:29-32 ("The present invention relates to communications and more particularly to co-channel communications, and more particularly to increasing capacity by allowing interfering channels."), 19:46-49 ("Prior to application of the MMSE filter, interference cancellation is performed."), 25:16-30 (describing purported advantages of alleged invention in the context of

CDMA systems); Ex. 1004, 1:7-11 (“The present invention relates to wireless communications, and in particular to enhancing parallel interference cancellation employed in code-division multiple access communication systems.”); Ex. 1005, 1:14-17 (“[T]he invention relates to a parallel interference cancellation receiver system and method for the simultaneous reception of data from multiple users.”), 8:16-18 (“[I]t is an object of the present invention to provide a system and method of receiving and decoding a plurality of signals over a CDMA interface.”).

In addition, both references reflect improvements over and contributions to the field of multi-user detection, a compact field of study related to code division multiplexing methods introduced in cellular standards in the 1990s. Ex. 1003, ¶82. It is the nature of standardized fields such as cellular communications to combine ideas from different references to achieve the best solution, as the resulting solution is widely implemented if the relevant communication method is commercially successful. *Id.* Accordingly, a POSITA would be motivated to combine the above-identified contributions, and variations thereof, to identify acceptable solutions taking into account cost, efficiency and complexity. These combinations would also have been a combination of prior art elements according to known methods and obvious to try given that there were a finite number of identified, predictable solutions in the prior art.

2. Claim 1

(a) [1pre]: “A joint amplitude estimator for a data stream from multiple users, comprising:”

To the extent the preamble is limiting, Fuller discloses a “parallel interference cancellation (PIC) system” where “the input signal is composed of multiple (M) user signals separated by orthogonal codes” (*i.e.*, a **data stream from multiple users**). Ex. 1004, 4:11-13; *see also id.*, 6:9-22 (example where “the input signal 60 is composed of four user signals”); Ex. 1003, ¶¶85-88. Fuller’s “PIC detector circuitry” is illustrated in Figure 2, reproduced below. Ex. 1004, 4:37-39.

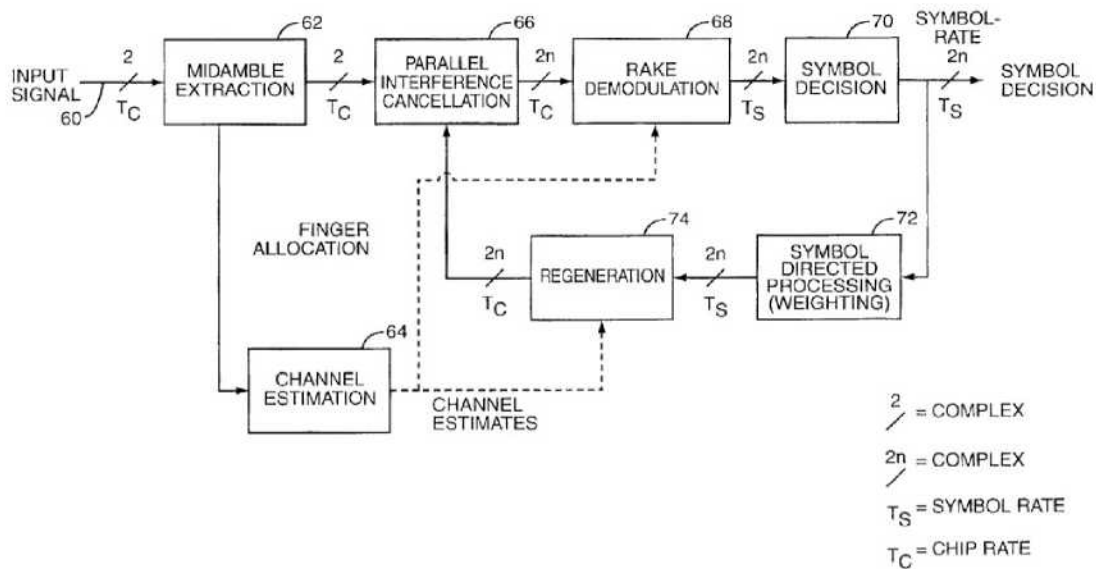


FIG. 2

Fuller’s PIC system comprises the claimed *joint amplitude estimator*, as set forth in detail below. *See* Ex. 1003, ¶87.

(b) [1a]: “a data stream from said multiple users divided into a plurality of observation intervals;”

“a data stream from said multiple users”: Fuller discloses that the “input signal” (*i.e.*, the **data stream**) is “composed of *multiple user signals*.” Ex. 1004, 2:20-21; *see also id.*, 4:58-61 (“[I]nput signal 60 is a *composite signal* represented by chip-rate complex samples.”), 6:9-22 (describing operation in a “four (4) user system” where “the input signal 60 is composed of *four user signals* separated by orthogonal codes in a CDMA system”); Ex. 1003, ¶90.

“divided into a plurality of observation intervals”: Fuller discloses a “rake demodulator 68” that “separates the composite input signal 60 into *M individual signals* corresponding to the respective signals for each user” (*i.e.*, *M observation intervals*). Ex. 1004, 5:9-11. A POSITA would have understood that in a CDMA system as disclosed by Fuller, the individual signal for each user corresponds to a code. Ex. 1003, ¶91. Accordingly, the individual user signals are *observation intervals*, which the ’651 patent defines as intervals “based on distinguishing attributes selected from at least one of the group consisting of: time, *code*, and frequency.” Ex. 1001, 10:16-18.

In addition, Fuller discloses performing parallel interference calculation over multiple iterations. Ex. 1004, 2:32-34 (“The new individual signals are each demodulated and reprocessed for multiple iterations). A given iteration processes the individual user signals corresponding to “a specific time period, or slot,” which

is also an *observation interval*. *Id.*, 6:14-31. “Throughout each iteration, *subsequent slots of data* can be processed in parallel.” *Id.*, 6:41-42. Each slot corresponds to a time interval of the input signal, and thus represents an *observation interval* of the data stream. Ex. 1003, ¶92. Accordingly, the first “slot” and the “subsequent slots” are a *plurality of observation intervals*. *Id.*

- (c) [1b]: “a plurality of processing modules coupled to said observation intervals, wherein said processing modules calculates interference cancellation values for each of said users and computes a filter for each of said observation intervals, said filter being applied to said data within said observation interval to compute individual amplitude estimates; and”

“A plurality of processing modules coupled to said observation intervals”: As illustrated in Figure 3 (reproduced and annotated below), Fuller discloses that each of the individual user signals (*i.e.*, the **observation intervals** based on code) are processed separately and in parallel within the PIC system. Figure 3 “illustrates the logical flow of a four (4) user system taking four iterations to determine the estimated symbols for the respective signals associated with each user.” Ex. 1004, 6:9-11. After the input signal is divided into individual user signals (**observation intervals**), each is demodulated, weighted, regenerated, and subject to parallel interference cancellation. *Id.*, 6:14-31. Figure 3 shows that as the data corresponding to the observation intervals propagates through the system, there are “as many paths as users.” *Id.*, Fig. 3. A POSITA would have understood, and it

would have been obvious, that each “path” is processed separately and in parallel, *i.e.*, by **a plurality of processing modules**. Ex. 1003, ¶95.

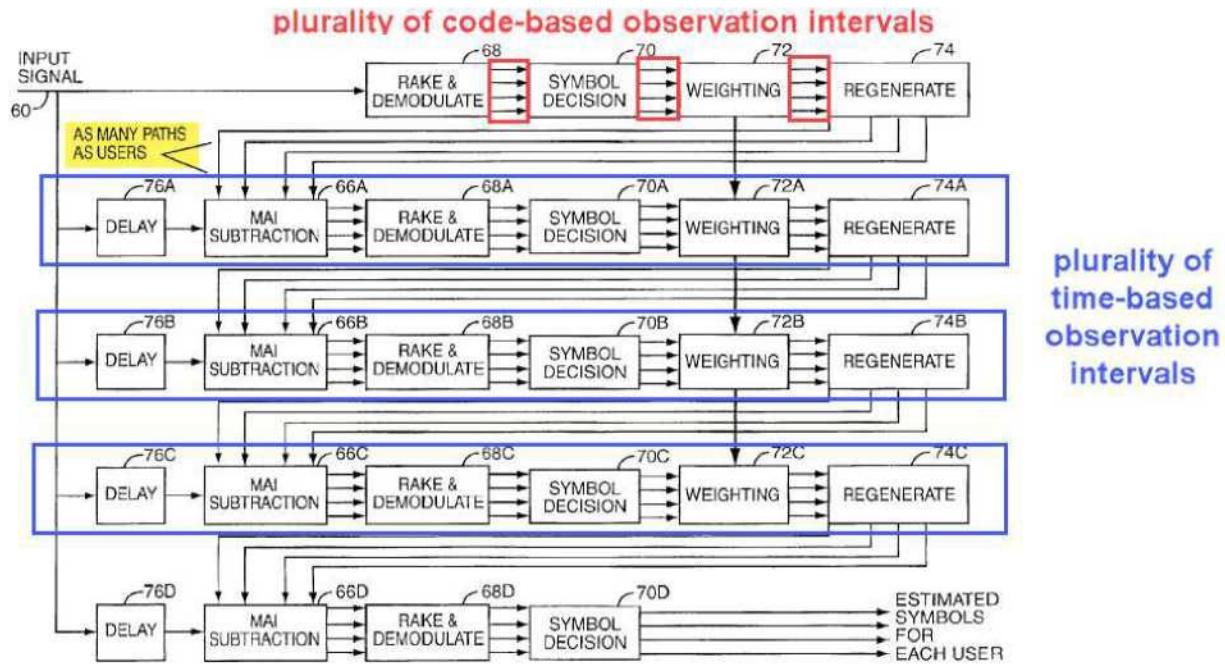


FIG. 3

In addition, as described above for Limitation [1a], Fuller teaches dividing the input signal into multiple time slots. Ex. 1004, 6:41-42 (“Throughout each iteration, **subsequent slots of data** can be processed in parallel.”). Each time slot also corresponds to an **observation interval**, and Fuller discloses that multiple subsequent time slots are **processed in parallel** across iterations of the PIC system, as shown in Figure 3. *Id.*; see also *id.*, claim 3 (“portions of the input signal over subsequent periods are processed **in parallel with** iterative processing of portions of the input signal over previous periods”); Ex. 1003, ¶96.

“wherein said processing modules calculates interference cancellation values for each of said users”: Fuller discloses a “parallel interference cancellation” (PIC) function, represented by block 66 in Figure 2, annotated below. Ex. 1004, 4:49-54. The PIC function “determine[s] the individual signals *for each user*” by, *inter alia*, “subtract[ing] the *regenerated signals corresponding to all other individual signals* from the composite input signal 60 for the given time slot.” *Id.*, 5:12-16. The aggregate regenerated signals corresponding to all other individual signals are **interference cancellation values for each user**. Ex. 1003, ¶97.

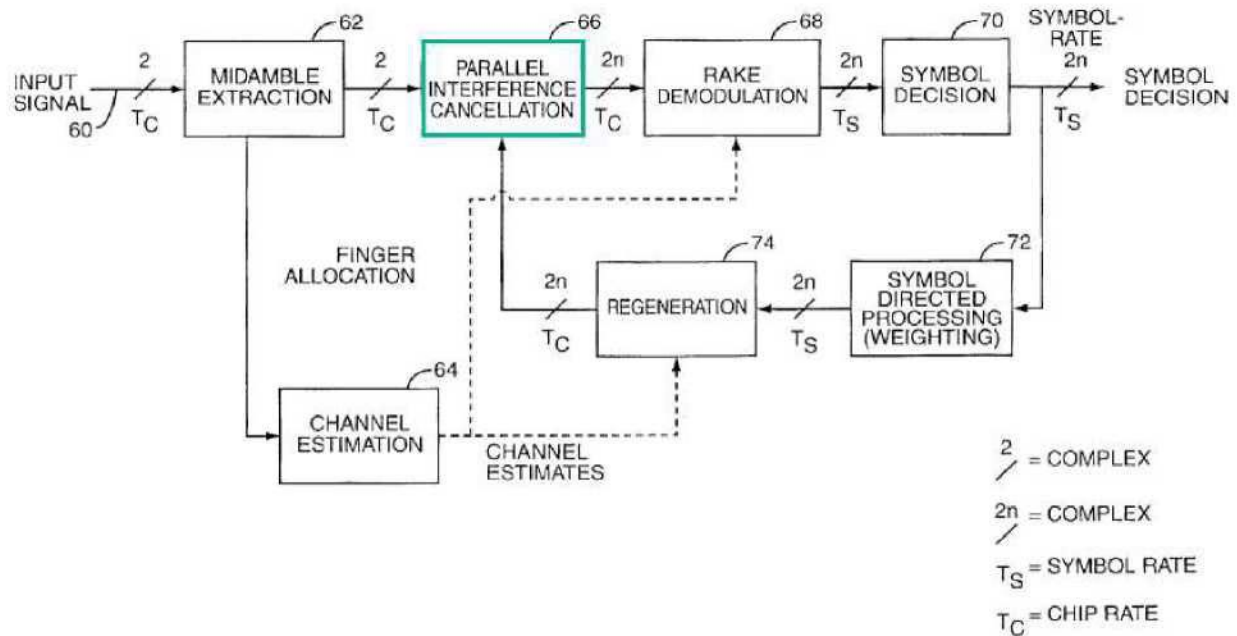


FIG. 2

The PIC function is also represented by the “MAI subtraction” blocks 66A-D in Figure 3. See Ex. 1004, 6:25-29 (describing block 66A as a “PIC function”). The MAI subtraction block “form[s] an estimate for the individual signal” for each user

in each iteration. *Id.*, 6:23-41. As discussed above, a POSITA would have understood that within each iteration, each individual user signal (*i.e.*, each code-based **observation interval**) is processed in parallel because each user signal follows a separate parallel path through the system. Ex. 1003, ¶98. In addition, as discussed above, Fuller expressly teaches that parallel interference cancellation for each user is “processed in parallel” for “subsequent slots of data” (*i.e.*, each time-based **observation interval**). *Id.*; Ex. 1004, 6:41-42.

“wherein said processing modules ... computes a filter for each of said **observation intervals**, said filter being applied to said data within said **observation interval to compute individual amplitude estimates**”: Fuller discloses a rake demodulator that “separates the composite input signal 60 into M individual signals corresponding to the respective signals for each user” (*i.e.*, M code-based **observation intervals**). Ex. 1004, 5:9-12. A POSITA would have understood that each individual signal necessarily includes an amplitude, and that the M individual signals thus correspond to a plurality of individual amplitude estimates. Ex. 1003, ¶99.

Fuller expressly teaches that the rake demodulation function may be “provided in hardware, software, or a combination thereof.” Ex. 1004, 4:49-54. When the rake demodulation function is provided in software, the software necessarily requires a processor to execute the software. Ex. 1003, ¶100. As

illustrated in Figure 3 (reproduced above), the rake demodulator produces four parallel outputs, one for each user. A POSITA would have understood, and it would have been obvious, that rake demodulation of each individual signal would be performed using a separate **processing module** to enable parallel processing of the path corresponding to each individual signal and increase speed and efficiency. Ex. 1003, ¶100.

Fuller does not expressly teach that the rake demodulator includes a filter. However, it would have been obvious to a POSITA in view of Reznik to use a plurality of matched **filters**, one for each user, to generate the M individual signals (including their **individual amplitude estimates**) corresponding to the M code-based **observation intervals**. Ex. 1003, ¶101. Reznik teaches that “demodulating [a] desired subchannel” (corresponding to a particular user) may be performed using “*matched filter* and RAKE receivers.” Ex. 1005, 2:17-18. Reznik further explains that “[t]o obtain user data $d^{(k)}$ *for a specific user from the combined user data r*, the user data r *must be filtered using a matched-filter* 35 or the like.” *Id.*, 9:47-49. The output of each matched filters is “a first rough *estimate* of the corresponding symbol in the transmitted data vector d.” *Id.*, 9:62-65. Accordingly, it would have been obvious to a POSITA to use a plurality of matched filters to generate Fuller’s individual signals (comprising amplitude estimates) from the composite input signal. Ex. 1003, ¶101. Further, where generation of the individual signals is performed in

software (as taught by Fuller), a POSITA would have understood that the matched filters are computed by the processors. *Id.*

Fuller also discloses a “signal regeneration” function that independently satisfies this limitation. *See* Ex. 1004, 5:41-63. The regeneration function “recreates *estimates* of the *individual signals* ... for each of the estimated users and individually processes the modulated symbols based on the *corresponding channel estimates*.” *Id.*, 5:41-44. A POSITA would have understood that the channel estimates include amplitude estimates, and that the estimated individual signals include at least estimated amplitudes. Ex. 1003, ¶102. As illustrated in Figure 3, the signal regeneration function is applied within each iteration (*i.e.*, for each time-based **observation interval**) to separately produce individual signal estimates (including **individual amplitude estimates**) for each user. Ex. 1004, Fig. 3; *see also id.*, 6:23-31. Fuller expressly teaches that the regeneration function includes, “for each user,” “**filtering** the spread and scrambled signal with the user’s channel estimate.” *Id.*, 5:44-45, 5:51-52. As with the rake demodulator, Fuller’s regeneration function (including filtering) may be implemented in software. *Id.*, 4:49-54. A POSITA would have understood, and it would have been obvious, that regeneration and filtering for each user signal would be performed using separate **processing modules** to enable parallel processing of each regenerated signal and increase speed and efficiency. Ex. 1003, ¶102. In addition, since each signal is

filtered using “the user’s channel estimate” (Ex. 1004, 5:51-52), a POSITA would have understood that the filter must be separately computed for each user. *Id.*

A POSITA would have been motivated to combine Fuller and Reznik, and would have reasonably expected the combination to succeed, for the reasons provided in Section IX.A.1.

- (d) [1c]: **“an amplitude estimation unit which processes said individual amplitude estimates and calculates new amplitude estimates, wherein said new amplitude estimates are iteratively passed back to said processing modules either a maximum number of iterations or a desired bit error rate have been reached.”**

“an amplitude estimation unit which processes said individual amplitude estimates and calculates new amplitude estimates”: Fuller discloses a “symbol-directed processing” function that “provides a weighting for each regenerated chip based on the consistency of previous estimates.”⁴ Ex. 1004, 9:31-40; Ex. 1003, ¶106.

⁴ Although this disclosure relates to an “alternative embodiment” illustrated in Figure 10, the relevant difference between the embodiment of Figure 10 and the embodiments of Figures 2 and 3 is that the order of the weighting and regeneration functions are reversed. Ex. 1004, 8:28-30. The relevant operation of the parallel interference cancellation function, the rake demodulation function, and the regeneration function are otherwise substantially the same as described with respect

For each time-based observation interval (*i.e.*, each iteration in Fuller's system, corresponding to a time slot), the symbol-directed processing function receives "estimates of the individual signals from the estimated symbols for each of the estimated users" (*i.e.*, **individual amplitude estimates**), as illustrated in Figure 10, reproduced below. Ex. 1004, 9:10-14, 9:31-33.

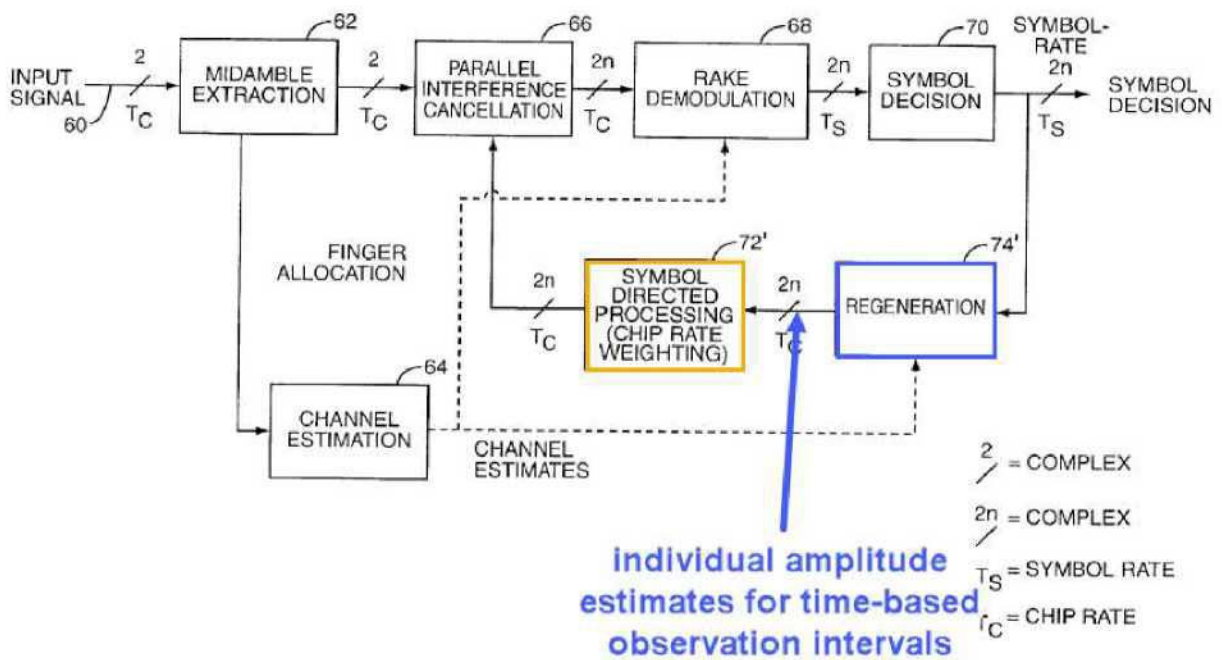


FIG. 10

The symbol-directed processing function then "provides a ***weighting*** for each regenerated chip based on the consistency of previous estimates for the given chip from earlier iterations." *Id.*, 9:35-40. "In effect, the symbol-directed processing 72' to Figure 2 and Figure 3. Ex. 1003, ¶107. Accordingly, Fuller's embodiment based on Figure 10 would disclose all of the foregoing limitations of claim 1. *Id.*

provides *regenerated signals for each user having individually weighted symbols* based on the consistency of the symbols over multiple iterations.” *Id.*, 9:40-43. A POSITA would have understood that the weighted signal estimates include **new (weighted) amplitude estimates**. Ex. 1003, ¶108.

Alternatively, as discussed in Limitation [1b], for each code-based observation interval, Fuller’s rake modulation function (as modified in view of Reznik) “separates the composite input signal 60 into M individual signals corresponding to the respective signals for each user” (*i.e.*, M code-based **observation intervals**), each of which includes an **individual amplitude estimate**. Ex. 1004, 8:55-58; Ex. 1003, ¶109; *see also* Limitation [1b]. The symbol decision function, regeneration function, and symbol directed processing function collectively comprise an **amplitude estimation unit** for these code-based observation intervals, as illustrated in Figure 10 (annotated below). Ex. 1003, ¶109. Specifically, the symbol decision function determines symbol estimates for each user; the regeneration function “recreates estimates of the individual signals from the estimated symbols for each of the estimated users,” and the symbol-directed processing function “provides a weighting for each regenerated chip,” thereby calculating **new amplitude estimates** based on the **individual amplitude estimates** determined by the rake modulation function. Ex. 1004, 9:4-43.

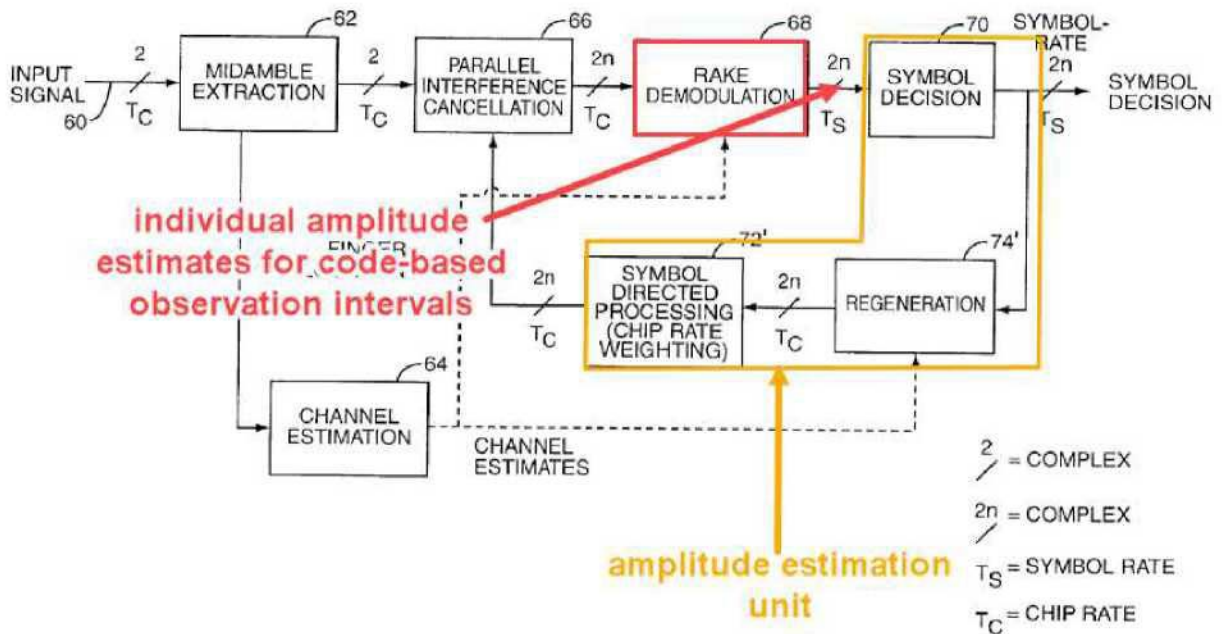


FIG. 10

“wherein said new amplitude estimates are iteratively passed back to said processing modules”: As shown in Figure 3, Fuller discloses that the new amplitude estimates output by the symbol-directed processing function are passed back to the processing modules, including the parallel interference cancellation function that calculates interference cancellation values, the rake demodulation function and/or the regeneration function that perform filtering to compute individual amplitude estimates. Ex. 1003, ¶110; *see also* Ex. 1004, 8:62-64 (“The weighted signals for each user are fed back via the regeneration and symbol-directed processing functions 74’, 72’), 9:37-38 (“The resulting signal is then provided to the PIC function 66 for cancellation.”).

“either a maximum number of iterations or a desired bit error rate have been reached”: Fuller discloses that its iterative parallel interference cancellation process involves an iterative process. Ex. 1004, Abstract (“The new individual signals are each demodulated and reprocessed for multiple iterations.”), 3:1-3 (Fig. 3 is a logical illustration of a cancellation process for four users over four iterations.”). Fuller discloses that the process may be repeated “for as many iterations as desired.” *Id.*, 4:24-26. A POSITA would have understood that this entails iterating a fixed number of times, until **a maximum number of iterations** has been reached. Ex. 1003, ¶111.

To the extent PO argues that Fuller does not disclose this limitation, it would have nevertheless been obvious in view of Reznik. Reznik discloses parallel interference cancellation where the “iterative interference subtraction process may be repeated m times depending upon the degree of desired signal correction.” Ex. 1005, 10:16-29. “After m iterations, the interferers are removed” and the system outputs the data “for final output symbol generation.” *Id.* A POSITA would understand from this disclosure **both** that (1) a maximum number of iterations (m) is used, and (2) the number of iterations correspond to a desired signal correction (*i.e.*, **error rate**). Ex. 1003, ¶112. A POSITA would have understood that error rate for wireless communications is typically measured as bit error rate. *Id.*

A POSITA would have been motivated to combine Fuller and Reznik, and would have reasonably expected the combination to succeed, for the reasons provided in Section IX.A.1.

3. Claim 2: “The joint amplitude estimator according to claim 1, wherein said final condition is selected from at least one of the group consisting of bit error rate metric level and fixed number of iterations.”

As discussed above for Limitation [1c], Fuller discloses iterating until a predetermined (**fixed**) number of iterations is reached. Ex. 1004, Abstract (“The new individual signals are each demodulated and reprocessed for multiple iterations.”), 3:1-3, 4:24-26; Ex. 1003, ¶116.

To the extent PO argues Fuller does not disclose this limitation, it would have been obvious in view of Reznik. As discussed above for Limitation [1c], Reznik discloses iterating for “m” iterations (*i.e.*, a fixed number) in order to achieve a desired signal correction (*i.e.*, **bit error rate**). Ex. 1005, 10:16-29; Ex. 1003, ¶117.

A POSITA would have been motivated to combine Fuller and Reznik, and would have reasonably expected the combination to succeed, for the reasons provided in Section IX.A.1.

4. Claim 3: “The joint amplitude estimator according to claim 1, wherein said amplitude estimation unit sums and weighs said individual estimates.”

Fuller discloses that its symbol-directed processing function, which comprises at least part of the **joint amplitude estimator** (*see* Limitation [1c]) “provides a

weighting for each regenerated chip based on the consistency of previous estimates for the given chip from earlier iterations.” Ex. 1004, 9:35-40; *see also* Ex. 1003, ¶121. “In effect, the symbol-directed processing 72’ provides regenerated signals for each user **having individually weighted symbols** based on the consistency of the symbols over multiple iterations.” Ex. 1004, 9:40-43. As discussed in Limitation [1c], the **individual amplitude estimates** are the input into Fuller’s joint amplitude estimator, and are thus weighted by the symbol-directed processing function.

In addition, Fuller discloses that the weighting factors used to weight each estimate may be computed in a number of different ways based on prior symbol estimates, which are in turn based on and derived from the **individual amplitude estimates**. Ex. 1004, 6:54-7:12, Figs. 5-7; Ex. 1003, ¶122. At least the weighting algorithm illustrated in Figure 6 involves **summing** prior symbol estimates and their corresponding individual amplitude estimates. *See* Ex. 1004, Fig. 6; Ex. 1003, ¶122.

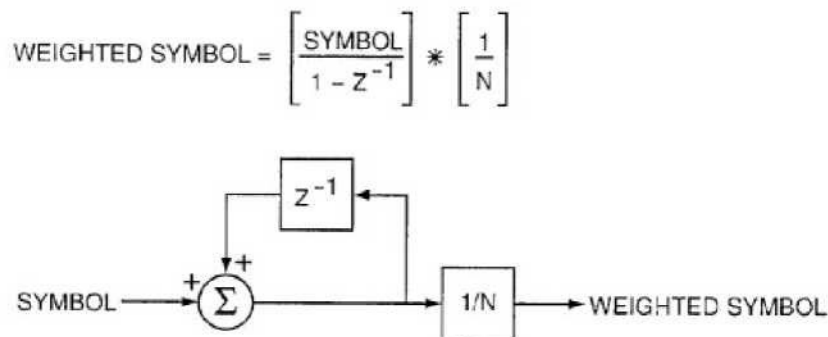


FIG. 6

5. **Claim 4: “The joint amplitude estimator according to claim 1, wherein said observation intervals are based on distinguishing attributes selected from at least one of the group consisting of time, code, and frequency.”**

See Limitation [1a], which explains how Fuller discloses observation intervals based on time and based on code.

6. **Claim 6**

- (a) **[6pre]: “A method for processing amplitude estimates for a multiuser data stream divided into a plurality of observation intervals, comprising:”**

See Limitation [1pre], which explains how Fuller discloses a joint *amplitude estimator* (*i.e.*, processing amplitude estimates) for a data stream from *multiple users* (*i.e.*, a *multiuser data stream*).

See Limitation [1a], which explains how Fuller discloses dividing the data stream into time-based and code-based observation intervals.

- (b) **[6a]: “computing a filter for each said observation interval of said data stream”**

See Limitation [1b], which explains how Fuller, alone or in combination with Reznik, discloses computing a filter for each observation interval.

- (c) **[6b]: “applying interference cancellation to said data stream for each said observation interval”**

See Limitation [1b], which explains how Fuller discloses performing interference cancellation for each observation interval.

- (d) [6c]: “applying said filter to said data stream for each said observation interval from said interference cancellation to produce individual amplitude estimates for each said observation interval”

See Limitation [1b], which explains how Fuller discloses applying the filter to each observation interval to produce amplitude estimates for each observation interval.

As shown in Figure 3, the filter is applied to the data stream from the interference cancellation. Specifically, as discussed in Limitation [1b], for the code-based observation intervals, the filtering is performed at Fuller’s rake demodulation function (as modified in view of Reznik), annotated in red below; and for the time-based observation intervals, filtering is performed at Fuller’s regenerate function, annotated in blue below. Figure 3 shows that both functions operate on the data stream from the interference cancellation (*i.e.*, the MAI subtraction function annotated in yellow below). Ex. 1003, ¶129.

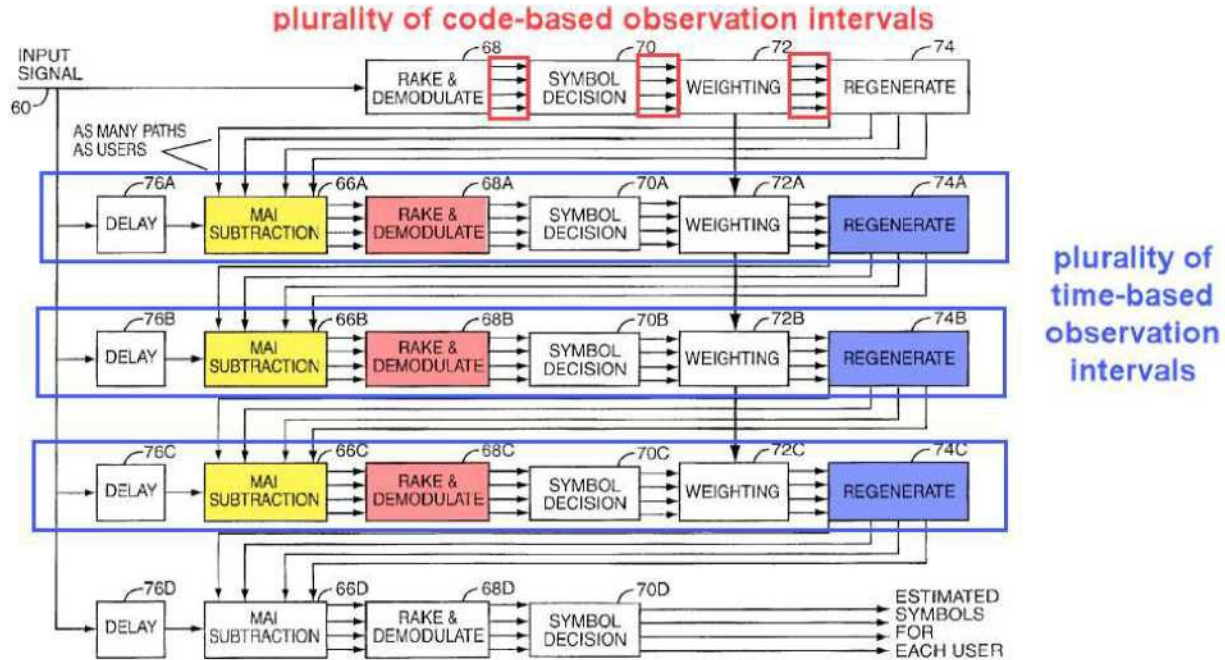


FIG. 3

- (e) [6d]: “computing new amplitude estimates using said individual amplitude estimates; and”

See Limitation [1c], which explains how Fuller discloses computing new amplitude estimates using individual amplitude estimates.

- (f) [6e]: “passing said new amplitude estimates back to said filter for iterative processing until either a maximum number of iterations or a desired bit error rate have been reached.”

See Limitation [1c], which explains how Fuller discloses iteratively passing the new amplitude estimates back to the filter, and which explains how Fuller alone or in combination with Reznik discloses iterating until a maximum number of iterations or a desired bit error rate has been reached.

7. **Claim 7: “The method according to claim 6, wherein said computing further comprises summing said individual amplitude estimates and weighing.”**

See Claim 3.

8. **Claim 8: “The method according to claim 6, wherein said final condition is selected from at least from the group consisting of bit error rate metric level and fixed number of iterations.”**

See Claim 2.

B. Ground 2: Claims 1-4 and 6-8 are Rendered Obvious by Frank in view of Zha

Frank discloses a receiver that includes a multi-user detection algorithm comprising linear MMSE equalization with successive or parallel interference cancellation. Zha discloses an improvement to successive interference cancellation in multi-user detection algorithms by averaging amplitude estimates over multiple samples (*i.e.*, joint amplitude estimation). As set forth below, it would have been obvious to a POSITA to apply Zha’s teachings to Frank.

1. Motivation to Combine

A POSITA would have been motivated to apply Zha’s amplitude averaging methods and soft bit decision rule to Frank’s CDMA receiver with MMSE equalization and interference cancellation. Ex. 1003, ¶¶134-137.

Frank expressly teaches a CDMA receiver for multi-user detection that employs parallel or successive interference cancellation. Ex. 1006, [0009]. Zha

teaches specific improvements to CDMA systems that perform successive interference cancellation (SIC). Ex. 1003, ¶135. Specifically, Zha teaches that “amplitude estimation by averaging over M bits can result in significant performance improvement over no averaging for the SIC receiver.” Ex. 1010, 743. In addition, Zha proposes a data bit decision rule “that combine[s] the advantages” of soft-decision rules and hard-decision rules to “achieve a performance close to that of the single user bound.” *Id.* These express teachings would motivate a POSITA to apply Zha’s improvements using amplitude averaging and decision rules for interference cancellation to Frank’s system using successive interference cancellation in order to achieve similar, predictable improvements in Frank’s CDMA receiver. Ex. 1003, ¶135. Further, Zha’s improvements are complementary to those proposed by Frank. *Id.* Frank improves on conventional interference cancellation by adding linear MMSE equalization. Ex. 1006, [0007]. Zha provides a further improvement on top of Frank’s linear MMSE equalization by adding amplitude averaging and improved bit decision rules to further improve performance. Ex. 1003, ¶135.

A POSITA would have reasonably expected this combination to succeed. Successive interference cancellation was well known in the field prior to the ’651 patent. Ex. 1003, ¶136. Zha discloses specific improvements to well-known successive interference cancellation techniques, which a POSITA could have readily applied to the particular receiver disclosed by Frank. *Id.* Implementing Zha’s

improvements in Frank’s system would have been well within the capabilities of a POSITA. *Id.*

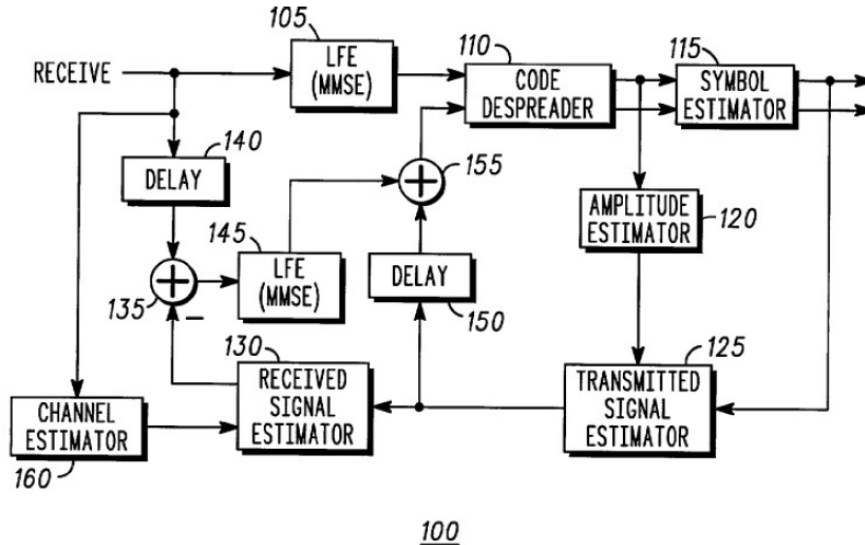
Finally, Frank, Zha, and the ’651 patent are analogous art because all three are directed to the same field of multi-user detection, that is, processing a data stream from multiple users using joint signal detection techniques. Ex. 1003, ¶137; Ex. 1006, [0001] (“The present invention relates, in general, to receivers for code division multiple access (CDMA) communication systems”), [0005] (CDMA ... has multiple users plus noise in the channel.”); Ex. 1010, 743 (“Successive interference cancellation (SIC) is a low-complexity multiuser detection method for DS/CDMA systems. ... We propose a new soft-decision rule to be used with amplitude averaging.”); Ex. 1001, 1:29-32 (“The present invention relates to communications and more particularly to co-channel communications, and more particularly to increasing capacity by allowing interfering channels.”).

2. Claim 1

(a) [1pre]: “A joint amplitude estimator for a data stream from multiple users, comprising:

To the extent the preamble is limiting, Frank discloses “receivers for code division multiple access (CDMA) communication systems.” Ex. 1006, [0001]. CDMA communication systems include **data streams from multiple users**. Ex. 1003, ¶139. Indeed, Frank explains that CDMA systems have “multiple users plus noise in the channel.” Ex. 1006, [0005]; *see also id.*, [0007] (describing how

the invention enables “increasing the number of users who may be served”). Frank’s system is illustrated in Figure 1, reproduced below.



As shown above, Frank expressly discloses an **amplitude estimator**. As explained in detail below, in the combined system, Zha’s teachings are applied to provide a **joint amplitude estimator**. Ex. 1003, ¶140.

(b) [1a]: “a data stream from said multiple users divided into a plurality of observation intervals;”

“a data stream from said multiple users”: Frank discloses that the CDMA communication system in which its receivers operate have “**multiple users** plus noise in the channel” (*i.e.*, the **data stream**). Ex. 1006, [0005]; *see also id.*, [0007] (describing how the invention enables “increasing the number of users who may be served”), [0019] (describing how a received signal is despread “**for all users** or all

logical channels in use”), [0028] (describing how the system “is implemented to “despread all symbols from **all users**”); Ex. 1003, ¶143.

“**divided into a plurality of observation intervals**”: Frank discloses the received signal (*i.e.*, the **data stream**) is “correlated with ... orthogonal (Walsh) codes or, equivalently, with any other set of channelization codes” to “despread all symbols from all users.” Ex. 1006, [0028]. A POSITA would have understood that in a CDMA system as disclosed by Frank, each code corresponds to an **observation interval**, and that correlating the received signal with the orthogonal (Walsh) codes **divides** it into a **plurality of observation intervals**. Ex. 1003, ¶144. That is consistent with the ’651 patent, which teaches that observation intervals are “based on distinguishing attributes selected from at least one of the group consisting of: time, *code*, and frequency.” Ex. 1001, 10:16-18.

In addition, as discussed in more detail in Limitation [1c] below, in the proposed combination, Zha’s amplitude averaging methods are applied to Frank’s receiver. Zha’s algorithm for amplitude averaging includes, for each user, “averaging the instantaneous estimate of [the user]’s amplitudes over a block of M bits after despreading.” Ex. 1010, 744. The block of M bits is divided into time intervals (**observation intervals**), corresponding to the number of bits (M). *Id.*, 743 (decomposing the received signal into of a sequence of values $A_k(i)$, corresponding to each user’s “signal amplitude, phase shift and data bit for the i th time interval,”

and computing a “received signal corresponding to the m th observation interval”),
744 (“The received signal vectors r over the $(M + 1)$ observation intervals provides
the sufficient statistics for detecting the transmitted data bits from all the K users.”);
Ex. 1003, ¶145.

- (c) [1b]: “a plurality of processing modules coupled to said observation intervals, wherein said processing modules calculates interference cancellation values for each of said users and computes a filter for each of said observation intervals, said filter being applied to said data within said observation interval to compute individual amplitude estimates; and”

“A plurality of processing modules coupled to said observation intervals”: Frank discloses that its CDMA receiver includes a “processor 310” that implements the “[v]arious functions of the present invention.” Ex. 1006, [0048]. The processor may include a **plurality of processing modules**, such as “a plurality of integrated circuits or other components connected, arranged or grouped together, such as microprocessor, digital signal processors (‘DSPs’), custom ICs, application specific integrated circuits (‘ASICs’), field programmable gate arrays (‘FPGAs’), associated memory (such as RAM and ROM), and other ICs and components,” and thus “include[s] ... [an] arrangement of custom ICs, ASICs, processors, microprocessors, controllers, FPGAs, or some other grouping of integrated circuits which perform the functions discussed ... with reference to FIGS. 1-2.” *Id.*, [0049]. In view of this disclosure, a POSITA would have understood, and at a minimum it

would have been obvious, that each of the plurality of processing modules described by Frank is **coupled to an observation interval** (*e.g.*, a code corresponding to a user, or a time interval in the block of data in the proposed combination with Zha). Ex. 1003, ¶148.

“wherein said processing modules calculates interference cancellation values for each of said users”: Frank discloses that the functions implemented on its processor (*i.e.*, the **processing modules**) performs **interference cancellation**. *See, e.g.*, Ex. 1006, [0018] (“FIG. 1 is a block diagram illustrating a preferred receiver **100** for MMSE equalization with parallel interference cancellation.”), [0025] (similar for Fig. 2), [0040] (“The receivers **100** and **200** may be implemented in a successive interference cancellation mode.”), [0049] (the processor “perform[s] the functions discussed above with reference to FIGS. **1-2**”). Interference cancellation is performed for each “code channel” (*i.e.*, **for each user**). Ex. 1006, [0040] (“This successive interference cancellation generally removes multiple access interference from code channels in the order of strongest to weakest.”); Ex. 1003, ¶149.

In addition, as discussed in more detail in Limitation [1c] below, in the proposed combination, Zha’s amplitude averaging methods are applied to Frank’s receiver. Frank’s receiver is thereby improved by using the averaged amplitude estimates for each user to calculate interference cancellation values for each user.

Ex. 1003, ¶150. Specifically, Zha describes how the averaged amplitude estimates (highlighted in yellow below) are used to iteratively compute “the k -th user’s received signal” by “subtracting other users’ regenerated signals from the received signal $\mathbf{r}(i)$ ” according to the following equation:

$$\begin{aligned}\tilde{\mathbf{r}}_k^{v+1} = & \mathbf{r} - \sum_{l=1}^{k-1} \sum_{i=1}^M e^{j\theta_l} \bar{A}_l^{v+1} \hat{b}_l^{v+1}(i) \mathbf{d}_l(i) \\ & - \sum_{l=k+1}^K \sum_{i=1}^M e^{j\theta_l} \bar{A}_l^v \hat{b}_l^v(i) \mathbf{d}_l(i)\end{aligned}$$

Ex. 1010, 744; Ex. 1003, ¶150. As shown in the equation above, an estimated received signal is calculated for each user k by calculating and summing interference cancellation values for each other user. Ex. 1003, ¶151.

“wherein said processing modules ... computes a filter for each of said observation intervals, said filter being applied to said data within said observation interval to compute individual amplitude estimates”: Frank discloses filtering the received signal using a “linear feedforward equalizer (‘LFE’).” Ex. 1006, [0018] (discussing the “filter coefficients” of the LFE); *see also id.*, [0019] (describing subsequent functional blocks as processing the “filtered signal”), [0021] (LFE 145 “is also preferably implemented as a MMSE equalizer or as a **matched**

filter”). Frank also performs “correlation or **filtering**” for “all orthogonal (Walsh) codes available or in use” (*i.e.*, for each code-based **observation interval**) to “despread all symbols from all users.” *Id.*, [0028]. The result of the correlation/filtering process includes an **individual amplitude estimate** for each observation interval. *Id.*, [0029] (referring to “the *amplitudes* of the outputs of the correlators for these code channels”); Ex. 1003, ¶152. As discussed above, Frank discloses that this functionality is implemented on a processor comprising a plurality of **processing modules**. *See* Ex. 1006, [0048]-[0049].

In addition, as discussed in more detail in Limitation [1c] below, in the proposed combination, Zha’s amplitude averaging methods are applied to Frank’s receiver. As discussed in Limitation [1a], Zha discloses dividing the received signal into a plurality of observation intervals corresponding to different time intervals. Ex. 1010, 743-44. Thus, in the combined system, Frank’s **filters**, as described above, would be **computed** and **applied** to each time-based **observation interval** to compute **individual amplitude estimates**. Ex. 1003, ¶153. In addition, Zha discloses obtaining an “averaged amplitude estimate” by averaging “the instantaneous estimate of [a user]’s amplitudes” (*i.e.*, **individual amplitude estimates**) “over a block of M bits” (*i.e.*, M time-based **observation intervals**). Ex. 1010, 744. Zha provides the following formula for the calculation of the averaged amplitude estimate for a user k :

$$\bar{A}_k^{v+1} = \frac{1}{M} \sum_{i=1}^M \text{abs} \left(\text{Re} \left(e^{-j\hat{\theta}_k} (\mathbf{d}_k(i))^H \tilde{\mathbf{r}}_k^{v+1} \right) \right)$$

Id., 744. In the above equation, the term in the summation corresponds to the individual amplitude estimate for a given observation interval. As shown above, the individual amplitude estimate for each observation interval is computed by applying a filter, $\mathbf{d}_k(i)$, based on the k th user's spreading codes and time delay. *Id.*, 744; Ex. 1003, ¶154.

- (d) [1c]: “an amplitude estimation unit which processes said individual amplitude estimates and calculates new amplitude estimates, wherein said new amplitude estimates are iteratively passed back to said processing modules either a maximum number of iterations or a desired bit error rate have been reached.”

“an amplitude estimation unit which processes said individual amplitude estimates and calculates new amplitude estimates”: Frank does not expressly disclose an amplitude estimation unit that processes individual amplitude estimates and calculates new amplitude estimates. However, it would have been obvious to a POSITA to include such an amplitude estimation unit in Frank's system in view of Zha. Ex. 1003, ¶¶157-160.

Zha discloses a “SIC [successive interference cancellation] receiver with amplitude averaging” that “has multiple interference cancellation stages, starting from stage $v = 1$.” Ex. 1010, 744. “During the $(v+1)$ st stage”—*i.e.*, in each iteration

after the initial iteration, “the averaged amplitude estimate” (**new amplitude estimate**) is processed for each user “by averaging the instantaneous estimate of [the user’s] amplitudes [*i.e.*, **said individual amplitude estimates**] over a block of M bits after despreading.” *Id.* The computation of the new amplitude estimate for each user k in the $(v + 1)$ th iteration is shown below:

$$\bar{A}_k^{v+1} = \frac{1}{M} \sum_{i=1}^M \text{abs} \left(\text{Re} \left(e^{-j\theta_k} (\mathbf{d}_k(i))^H \tilde{\mathbf{r}}_k^{v+1} \right) \right)$$

Id., 744; Ex. 1003, ¶158.

The calculation performed by Zha is equivalent to the calculation of updated amplitude estimates described in the ’651 patent. For example, the ’651 patent explains that the joint amplitude estimator “combines individual [amplitude] estimates, $\Delta \underline{a}_m$ ” which are “the individual estimates ... for each [observation] interval 1- M .” Ex. 1001, 19:60-20:20. Zha’s averaged amplitude estimates similarly process “ $(M + 1)$ observation intervals” by “averaging [*i.e.*, combining] the instantaneous estimate of” a given user’s individual “amplitudes over a block of M bits.” Ex. 1010, 744; Ex. 1003, ¶159. The process disclosed by Zha is repeated at each stage (iteration) of the receiver after the first, and re-estimates the amplitudes based on the previous iteration of interference cancellation in order to **produce new amplitude estimates**. Ex. 1010, 744; Ex. 1003, ¶159.

A POSITA would have been motivated to apply Zha’s teachings regarding averaged amplitude estimation to Frank’s system, and would have reasonably expected to be successful in doing so, for the reasons provided in Section IX.B.1 above.

“wherein said new amplitude estimates are iteratively passed back to said processing modules”: As discussed in Limitation [1b], Frank discloses processing modules that, *inter alia*, calculate interference cancellation values for each user. The interference cancellation values are computed by “regenerating” an “estimated transmitted signal,” which is used “to remove multiple-access interference from the symbol estimates.” Ex. 1006, [0035]-[0036]. Zha similarly discloses performing interference cancellation by “subtracting other users’ regenerated signals from the received signal $r(i)$ ” for each time interval i in the block of M bits. Ex. 1010, 744. As shown in Zha, each user’s regenerated signal is computed using the new amplitude estimates from the previous iteration (highlighted in yellow below):

$$\begin{aligned}\tilde{\mathbf{r}}_k^{v+1} &= \mathbf{r} - \sum_{l=1}^{k-1} \sum_{i=1}^M e^{j\theta_l} \bar{A}_l^{v+1} \hat{b}_l^{v+1}(i) \mathbf{d}_l(i) \\ &\quad - \sum_{l=k+1}^K \sum_{i=1}^M e^{j\theta_l} \bar{A}_l^v \hat{b}_l^v(i) \mathbf{d}_l(i)\end{aligned}$$

Id., 744; Ex. 1003, ¶161. Thus, in the combined system, the new amplitude estimates as taught by Zha would be iteratively passed back to Frank’s processing modules to calculate interference cancellation values in the subsequent iteration. Ex. 1003, ¶162.

“either a maximum number of iterations or a desired bit error rate have been reached”: Frank teaches that interference cancellation is performed until “an iteration limit [*i.e.*, **a maximum number of iterations**] has been exceeded.” Ex. 1006, [0042]. Zha similarly teaches that the interference cancellation process “terminate[s] after a desired number of cancellation stages [*i.e.*, **a maximum number of iterations**].” Ex. 1010, 744. Accordingly, in the combined system, interference cancellation (including calculation of new amplitude estimates) would continue until a maximum number of iterations is reached. Ex. 1003, ¶163.

3. Claim 2: “The joint amplitude estimator according to claim 1, wherein said final condition is selected from at least one of the group consisting of bit error rate metric level and fixed number of iterations.”

As discussed above for Limitation [1c], in the combined system, interference cancellation continues until a **final condition** is met, corresponding to a **fixed number of iterations**. Ex. 1003, ¶166. Specifically, Frank discloses performing interference cancellation until “an iteration limit has been reached” (Ex. 1006, [0042]), and Zha discloses iteratively calculating new amplitude estimates and

interference cancellations for “a desired number of cancellation stages” (Ex. 1010, 744).

4. Claim 3: “The joint amplitude estimator according to claim 1, wherein said amplitude estimation unit sums and weighs said individual estimates.”

As discussed above for Limitation [1c], a POSITA would have been motivated to apply Zha’s teachings regarding averaged amplitude estimation to Frank’s system, and would have reasonably expected to be successful in doing so, for the reasons provided in Section IX.B.1 above.

Zha discloses the formula below for performing averaged amplitude estimation for each user k across M observation intervals. Ex. 1010, 744. Zha’s formula includes summing the individual estimates (reflected by the summation term, annotated in yellow below), and weighing the individual estimates (as indicated by the weight term for each individual estimate, annotated in red below).

$$\bar{A}_k^{v+1} = \frac{1}{M} \sum_{i=1}^M \text{abs} \left(\text{Re} \left(e^{-j\theta_k} (\mathbf{d}_k(i))^H \tilde{\mathbf{r}}_k^{v+1} \right) \right)$$

Id., 744; Ex. 1003, ¶¶170-171. To the extent PO argues red annotated term above does not correspond to a weight, Zha at a minimum discloses weighing each individual amplitude estimate equally, insofar as Zha calculates an average (*i.e.*, by dividing the sum of the individual amplitude estimates by the number of observation intervals M). Ex. 1003, ¶172.

5. **Claim 4: “The joint amplitude estimator according to claim 1, wherein said observation intervals are based on distinguishing attributes selected from at least one of the group consisting of time, code, and frequency.”**

See Limitation [1a], which explains how Frank discloses observation intervals based on code, and how Zha discloses observation intervals based on time in the combined system.

6. **Claim 6**

- (a) **[6pre]: “A method for processing amplitude estimates for a multiuser data stream divided into a plurality of observation intervals, comprising:”**

See Limitation [1pre], which explains how Frank in view of Zha discloses a joint *amplitude estimator* (*i.e.*, **processing amplitude estimates**) for a data stream from *multiple users* (*i.e.*, a *multiuser data stream*).

See Limitation [1a], which explains how Frank discloses dividing the data stream into code-based observation intervals, and how, in the combined system, Zha further discloses dividing the data stream into time-based observation intervals.

- (b) **[6a]: “computing a filter for each said observation interval of said data stream”**

See Limitation [1b], which explains how Frank, alone or in combination with Zha, discloses computing a filter for each observation interval.

(c) [6b]: “applying interference cancellation to said data stream for each said observation interval”

See Limitation [1b], which explains how Frank discloses performing interference cancellation for each observation interval (*e.g.*, each code channel).

In addition, in the proposed combination, interference cancellation is applied for each time-based observation interval (*i.e.*, each time interval in the block of M bits). As discussed above, a POSITA would have been motivated to apply Zha’s teachings regarding averaged amplitude estimation to Frank’s system. Zha discloses that its averaged amplitude estimates are used to calculate interference cancellation values corresponding to “other users’ regenerated signals.” Ex. 1010, 744. Interference cancellation is then applied to “the received signal $r(i)$ ” by computing interference cancellation values for each time-based observation interval (reflected by the summation terms from $i=1$ to M). *Id.*, 743-744; Ex. 1003, ¶¶178-179.

(d) [6c]: “applying said filter to said data stream for each said observation interval from said interference cancellation to produce individual amplitude estimates for each said observation interval”

See Limitation [1b], which explains how Frank, alone or in combination with Zha, discloses applying the filter to each observation interval to produce individual amplitude estimates for each observation interval.

As shown in Figure 1, the filter disclosed in Frank (*i.e.*, LFE 145) is applied to the data stream from the interference cancellation (*i.e.*, the received data stream after subtracting the estimated received signal at 135). Ex. 1003, ¶181.

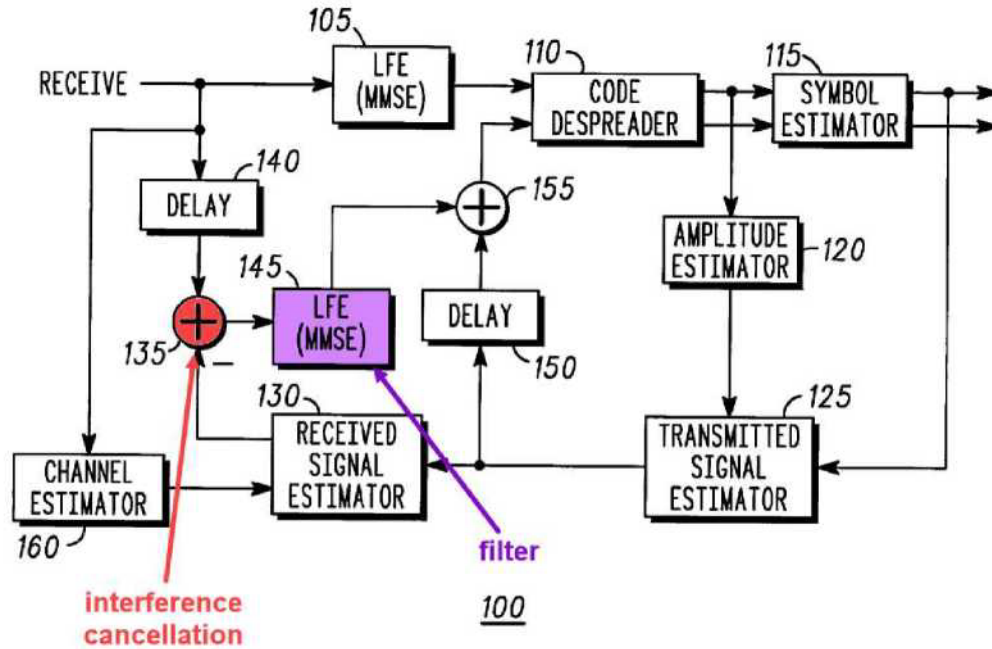


FIG. 1

Similarly, Zha discloses that as part of calculating averaged amplitude estimates, a filter (annotated in purple below) is applied to the received data stream after interference cancellation (annotated in red below). Ex. 1010, 744; Ex. 1003, ¶182.

$$\bar{A}_k^{v+1} = \frac{1}{M} \sum_{i=1}^M \text{abs} \left(\text{Re} \left(e^{-j\theta_k} (\mathbf{d}_k(i))^H \tilde{\mathbf{r}}_k^{v+1} \right) \right)$$

(e) [6d]: “computing new amplitude estimates using said individual amplitude estimates; and”

See Limitation [1c], which explains how Zha discloses computing new amplitude estimates using individual amplitude estimates.

(f) [6e]: “passing said new amplitude estimates back to said filter for iterative processing until either a maximum number of iterations or a desired bit error rate have been reached.”

See Limitation [1c], which explains how Frank in combination with Zha discloses iteratively passing the new amplitude estimates back to the filter, and iterating until a maximum number of iterations.

7. Claim 7

See Claim 3.

8. Claim 8

See Claim 2.

X. THE BOARD SHOULD NOT EXERCISE ITS DISCRETION TO DENY INSTITUTION

A. *Fintiv*

The Board balances six factors in considering discretionary denial under 35 U.S.C. § 314(a) when parallel litigation exists. *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 (PTAB Mar. 20, 2020) (precedential). To the extent the Board institutes the Samsung IPR that Petitioners seek to join, *Fintiv* is not relevant. If the

Board were to consider Petitioners’ petition in the first instance, the *Fintiv* factors would favor institution.

Factor 1—potential stay of the district court litigation—is neutral because Lenovo Group Limited (“Lenovo”), the defendant in the district court, has not requested a stay. *VMWare, Inc. v. Intellectual Ventures I LLC*, IPR2020-00470, Paper 13 (PTAB Aug. 18, 2020), at 17 (finding in the absence of a stay motion that this factor “does not weigh for or against discretionary denial”).

Factor 2—district court trial date and the Board’s statutory deadline—weigh against denial. The Guidance Memo states that this factor weighs against denial “if the median time-to-trial is around the same time or after the projected statutory deadline for the PTAB’s final written decision.” Ex. 1016. This petition is filed in December 2024, so a final written decision would likely issue by June 2026. The median time-to-trial in the Eastern District of Texas is 22 months. Ex. 1015. Although the Complaint against Lenovo was filed on December 12, 2023, the Complaint was not served until April 26, 2024. This unusually long delay in serving the Complaint has already once pushed back all case deadlines because the response date to a Complaint is based on the date of service, *see* Fed. R. Civ. P. 12(a), and Judge Gilstrap does not hold a scheduling conference until after there has been a response to the Complaint, *see* Standing Order Regarding Readiness for Scheduling Conference, Ex. 1017. The four-month delay in service combined with the 22-

month time-to-trial statistic results in a likely February-March 2026 trial date. The date currently set for jury selection—January 5, 2026, Ex. 1018—does not support denial where, as here, it is close in time to the final written decision, and the time-to-trial statistics and other evidence suggest that additional delays are likely. *See Dish Network v. Broadband iTV*, IPR 2020-01280, Paper 17 at 16 (PTAB Feb. 4, 2021) (“We cannot ignore the fact that the currently scheduled trial date is more than nine months away and much can change during this time”).

Factor 3—investment in the district court proceedings—weighs heavily against discretionary denial. The associated district court case is still in the very early stages of litigation. Because Lenovo, a Chinese company, has challenged the district court’s personal jurisdiction, the parties have been engaged in jurisdictional discovery, with the court’s jurisdictional authority still to be decided. Even if the court has personal jurisdiction over Lenovo, a claim construction hearing is not scheduled until July 15, 2025, so a claim construction order will not issue prior to the PTAB’s projected institution decision date in June 2025. Ex. 1018. Fact discovery will still be open, and dispositive motions and expert reports will be months away. *Id.* Accordingly, the district court will not invest significant resources or issue substantive orders related to the challenged patent prior to the issuance of an institution decision. *See Fintiv*, IPR2020-00019, Paper 11 at 9-12.

Factor 4—overlap in the parallel proceedings—is neutral. Petitioners acknowledge that the grounds of invalidity asserted here are also asserted in the district court. But if “the Board will address the overlapping validity issues prior to the district court reaching them at trial, the Board’s final written decision will simplify or fully resolve the issues for trial in the litigation,” which weighs in favor of institution. *GAF Materials LLC v. Kirsch Rsch. and Dev., LLC*, IPR2021-00192, Paper 14 at 14–15 (PTAB May 25, 2021).

Factor 5—overlapping parties—is neutral because while the petitioners are different from the named defendant, Lenovo (United States) and Motorola Mobility LLC manufacture the accused products at issue in the litigation, and named defendant Lenovo Group Limited is their ultimate parent and holding company, and Patent Owner has identified Intel products as infringing.

Factor 6—other considerations—weighs against discretionary denial. None of the grounds asserted here were previously considered by either the Office or the district courts. *Cf. Comcast Cable Commc’ns, LLC v. Rovi Guides, Inc.*, IPR2019-00231, Paper 14 at 11 (PTAB May 20, 2019) (obviousness challenges not “previously considered by the Office or by any court” weigh in favor of not denying institution). Moreover, the ’651 patent is currently asserted in a district court case. Institution of this IPR provides the opportunity for narrowing and simplifying the litigation for the district court.

Discretionary denial is also not warranted because this petition presents compelling evidence of unpatentability. As discussed above, the '651 patent admits that multi-user detectors were well known in the art. The '651 patent only purports to add several enhancements to well-known multi-user detection techniques, such as joint amplitude estimation. These enhancement techniques, however, are clearly taught and rendered obvious by Fuller, Reznik, Frank, and Zha.

Accordingly, the Board should decline to exercise its discretion under *Fintiv* and institute trial.

B. § 325(d)

If the Samsung Petition is denied for procedural reasons, the same or substantially the same prior art arguments will not have been previously presented to the Office. The Examiner cited U.S. 6,956,893 ("Frank '893") in a Notice dated September 4, 2008, issued along with the Examiner's Notice of Allowance. However, the Examiner did not rely on Frank '893 as a ground of rejection, nor did the Examiner rely on Frank '893 in combination with other prior art, as this Petition relies on Frank in combination with Zha. Fuller, Reznik, and Zha were also not before the Examiner. Accordingly, the grounds here are different from the prior art of record that were before the Examiner during prosecution of the '651 patent.

XI. MANDATORY NOTICES AND FEES

A. Real Party-In-Interest

Intel Corporation, Lenovo (United States) Inc., and Motorola Mobility LLC, are real parties-in-interest and, solely because it is named as a defendant in a co-pending district court case listed below, Lenovo Group Limited is also a real party-in-interest.

B. Related Matters

The '651 patent is the subject of civil actions, *Collision Communications, Inc. v. Samsung Electronics Co. Ltd. et al.*, 2-23-cv-00587 (E.D. Tex.), filed December 12, 2023 (pending), and *Collision Communications, Inc. v. Lenovo Group Ltd.*, 2-23-cv-00594 (E.D. Tex.), filed December 12, 2023 (pending). The '651 patent is also the subject of IPR2025-00011, filed October 2, 2024 (pending).

Petitioners are not aware of any other disclaimers, reexamination certificates, or IPR petitions addressing the '651 patent.

C. Counsel and Service Information

Petitioners provide the following counsel and service information. Petitioners consent to electronic service to the email addresses listed in the table below. Pursuant to 37 C.F.R. § 42.10(b), Powers of Attorney accompany this Petition.

LEAD COUNSEL	BACK-UP COUNSEL
Vincent Y. Ling (Reg. No. 67,145) vincent.ling@mto.com MUNGER, TOLLES & OLSON LLP 350 South Grand Ave., 50 th Floor Los Angeles, CA 90071 Tel: (213) 683-9100 Fax: (213) 687-3702	Heather Takahashi (Reg. No. 78,418) Adam Kwon (Reg. No. 75,653) Zach Briers (<i>pro hac vice</i> pending) Peter Gratzinger (<i>pro hac vice</i> pending) MUNGER, TOLLES & OLSON LLP 350 South Grand Ave., 50th Floor Los Angeles, CA 90071 Tel: (213) 683-9100 Fax: (213) 687-3702 lenovo-collision@mto.com Timothy Riffe, Reg. No. 43,881 Jennifer Huang, Reg. No. 64,297 Whitney Reichel, Reg. No. 59,173 Lawrence Jarvis, Reg. No. 74,636 Fish & Richardson P.C. 60 South Sixth Street, Suite 3200 Minneapolis, MN 55402 Tel: 202-783-5070 Fax: 877-769-7945 PTABInbound@fr.com IPR55851-0027IP1@fr.com

D. Payment of Fees

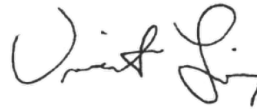
Petitioners state that the fee set forth in 37 C.F.R. § 42.15(a) for this Petition has been paid by electronic funds transfer, and Petitioners further authorize payment for any additional fees from the same account.

XII. CONCLUSION

For the reasons above, *inter partes* review is requested.

Date: December 12, 2024

Respectfully submitted,



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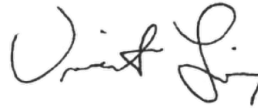
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**CERTIFICATE OF COMPLIANCE WITH TYPE-VOLUME
LIMITATION, TYPEFACE REQUIREMENTS, AND TYPE STYLE
REQUIREMENTS**

1. This Petition complies with the type-volume limitation of 14,000 words, comprising 12,359 words, as counted using the Microsoft Word software that was used to prepare this paper, excluding the parts exempted by 37 C.F.R. § 42.24(a).

2. This Petition complies with the general format requirements of 37 C.F.R. § 42.6(a) and has been prepared using Microsoft® Word 2016 in 14-point Times New Roman.

Date: December 12, 2024



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CERTIFICATE OF SERVICE

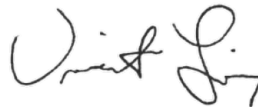
The undersigned hereby certifies that on December 12, 2024, true and correct copies of the foregoing document and supporting materials were served in its entirety on the Patent Owner at the following address of record as listed on PAIR via Priority Mail Express® or Express Mail:

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