

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

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

v.

COLLISION COMMUNICATIONS, INC.,
Patent Owner.

Case No. IPR2025-00285

U.S. Patent No. 6,947,505

PETITION FOR *INTER PARTES* REVIEW OF U.S. PATENT NO. 6,947,505

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EXHIBIT LIST

Ex.	Description
1001	U.S. Patent No. 6,947,505 (“’505 Patent”)
1002	Prosecution History for ’505 Patent
1003	Declaration of Dr. Paul Min
1004	U.S. Patent No. 5,995,499 (“Hottinen”)
1005	WIPO Publication No. 1994/00918 (“Zimmerman”)
1006	U.S. Patent No. 5,905,946 (“Lilleberg”)
1007	Verdu, Sergio, “Multiuser Detection,” Cambridge University Press (1998)
1008	Verdu, Sergio, “Computational Complexity of Optimum Multiuser Detection,” Algorithmica (1989)
1009	Collision’s Preliminary Infringement Contentions, <i>Collision Communications, Inc. v. Samsung Electronics Co. Ltd et al</i> , 2-23-cv-00587 (EDTX), Ex. 3
1010	Dr. Paul Min’s Curriculum Vitae
1011	RESERVED
1012	RESERVED
1013	RESERVED
1014	RESERVED
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”)
1017	Standing Order Regarding Readiness for Scheduling Conference

Ex.	Description
	(Judge Rodney Gilstrap, E.D. Tex., December 20, 2011), <i>available at www.txed.uscourts.gov/sites/default/files/judgeFiles/12-20-11%20Standing%20Order%20%20re%20Readiness%20for%20Scheduling%20Conference.pdf</i>
1018	Docket Control Order, Dkt. No. 44, <i>Collision Communications, Inc. v. Lenovo Group Ltd</i> , 2-23-cv-00594 (E.D. Tex.).
1019	Declaration of Paul S. Min Ph.D.

LIST OF CHALLENGED CLAIMS

Claim	Limitation
1pre	In a multi-user detection system in which interfering signals are purposely allowed to exist,
1a	a parameter estimation unit for use in conjunction with a signal separation unit, in which each received signal has associated channel transfer functions, comprising:
1b	a signal processor for determining said channel transfer functions for each received signal; and,
1c	means coupled to said channel transfer function determining signal processor for providing uninterrupted estimates of the channel transfer function parameters on a real-time basis by first deriving the estimated channel transfer function for each of said interfering signals.
3	The parameter estimation unit of claim 1, wherein the multi-user detection system includes providing an acquisition channel, and wherein the first derived estimated channel transfer function is derived from acquisition channel parameters.
4	The parameter estimation unit of claim 1, wherein said multi-user detection system includes a tracking unit for acquired signals, and wherein in the presence of a new signal in the acquisition channel of said parameter estimation unit estimates the channel transfer function prior to signal switching from an acquisition channel to the traffic channel, with said parameter estimation unit parameters being passed to said tracking unit thereafter.
5	The parameter estimation unit of claim 1, and further including a traffic channel, and wherein for said traffic channel phase is tracked without utilization of the estimates from the acquisition

Claim	Limitation
	channel.
7	The parameter estimation unit of claim 1, wherein after initial estimate generation, said multi-user detection system simultaneously tracks all signals in a traffic channel.
8	The parameter estimation unit of claim 7, wherein said simultaneous tracking includes blocks for parallel recreation of the training signal portions of the traffic channel signal, each parallel processing block isolating a different signal in said traffic channel.
9pre	In a multi-user detection system in which interfering signals are purposely allowed to exist,
9a	a parameter estimation unit for use in conjunction with a signal separation unit for estimating channel transfer function parameters from channel transfer functions, comprising:
9b	a signal processor for determining said channel transfer functions for each received signal; and
9c	means coupled to said channel transfer function determining signal processor for providing uninterrupted estimates of the channel transfer function parameters on a real-time basis,
9d	said multi-user detection system including a tracking unit for acquired signals, and in the presence of a new signal in an acquisition channel of said parameter estimation unit estimating the channel transfer function prior to signal switching from the acquisition channel to a traffic channel, with said parameter estimation unit parameters being passed to said tracking unit thereafter, all received signals having training portions,

Claim	Limitation
9e	a second interfering signal being and assigned to said traffic channel, said parameter estimation unit recreating the training signal portion of every received signal prior to the last received signal and subtracting the recreated training signals from the training portion of the last received signal to provide an estimate solely due to the last received signal during the training signal portion, thus to allow an estimate of the last signal from which to calculate parameters of the last signal.

I. INTRODUCTION

Petitioners Lenovo (United States) Inc. and Motorola Mobility LLC (collectively “Petitioners”) requests *Inter Partes* Review (“IPR”) of claims 1, 3-5, and 7-9 of U.S. Patent No. 6,947,505 (“the ’505 patent”). Petitioners also file a contingent motion to join the IPR in *Samsung Electronics America, Inc., et al v. Collision Communications, Inc.*, Case No. IPR2024-01249 (“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 ’505 patent is directed to a purported improvement 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, each carrying its own information. These devices, which are all using the same channel, interfere with one

¹ Petitioners have retained Paul Min, Ph.D. in this proceeding. EX1019. Dr. Min has adopted his prior opinions set forth in EX1003 (submitted in IPR2024-01249) and, for expediency, this Petition cites to Dr. Min’s previously submitted declaration, also presented herein as EX1003.

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 '505 patent. The prior art describes many techniques for doing so.

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 frequency, time, or phase, 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 the cellular technologies Time-Division Multiple Access (“TDMA”), Frequency Division Multiple Access (“FDMA”) or Code-Division Multiple-Access (“CDMA”), incorporate a methodology of dividing the transmissions into multiple parts, each part dedicated to transmitting information for a different user. TDMA divides a transmission into various time slots, FDMA divides a transmission into different frequency ranges, and CDMA divides a transmission into codes. Each of these techniques allow for more efficient use of bandwidth, but there is still interference from noise and between the multiple signals being transmitted over a single channel.

MUD techniques have been used since the 1980s to remove interference in a received signal by detecting a transmission signal’s *parameters* (i.e., phase, power, frequency, time delay, code) even if there are high levels of noise and interference.

Conventional MUD techniques may compare at least a subset of the signal's detected parameters to one or more known parameters for each user's signal to provide an estimate identifying the signal for each user, which is known as parameter estimating. Once the signal parameters are estimated, various well-known MUD techniques may be used to separate the primary signal from the interfering signals.

The '505 patent is directed to the basic concept of a method for using signal parameters to estimate and separate users' signals in real-time—*i.e.*, basic, well-known MUD.

The patent's purported improvement over the prior art is simple, and in truth is not inventive over the prior art: it performs parameter-estimating in real-time to dynamically estimate signals and separate them while the prior art (as described by the '505 patent) purportedly only performs parameter estimating and signal separation at certain times. EX1001, 1:58-63 (describing prior art as limited to only estimating parameters during certain times or bursts). But the use of dynamic and real-time parameter estimating and signal separation, including in the context of MUD as described in the '505 patent, was well known at the time of the purported invention of the '505 patent, including in the prior art presented in this petition.

This petition presents two primary references: Hottinen (EX1004) and Zimmerman (EX1005), both of which teach the MUD techniques claimed in the '505 patent. The first, Hottinen (EX1004), is a 1999 Nokia patent directed to “a

signal detection method in a receiver of a TDMA mobile system” where the system has “several concurrent co-channel users” with “N transmitters TX1, TX2, . . . , TXN, which all transmit at the same frequency F1 and in the same time slot TS3.” EX1004, 3:8-23, 4:41-65. Hottinen discloses estimating signal parameters for “detecting the primary signal” and separating the primary signal from the other signals. *Id.*, 5:49-54. As shown in Fig. 1A, **multiple users** transmit interfering signals on the same transmission channel that are **received by a receiver**.

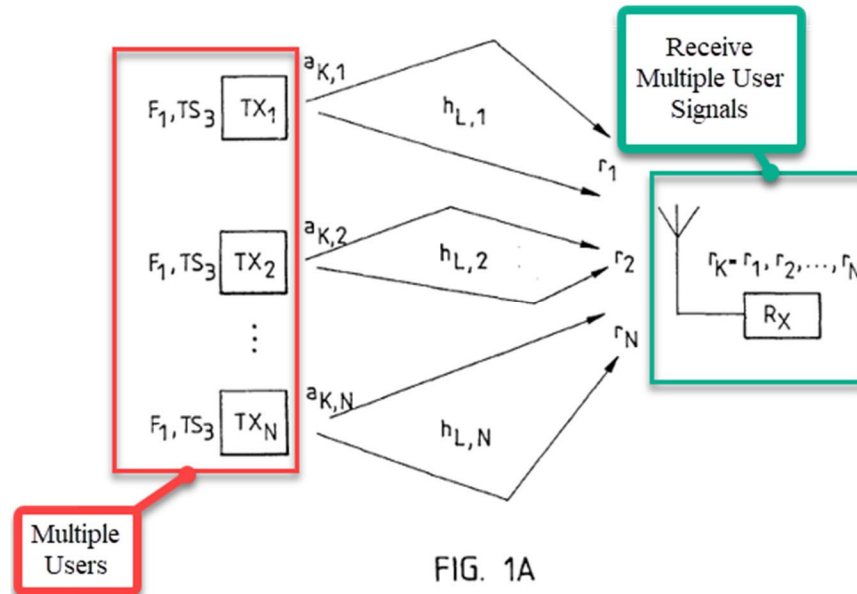
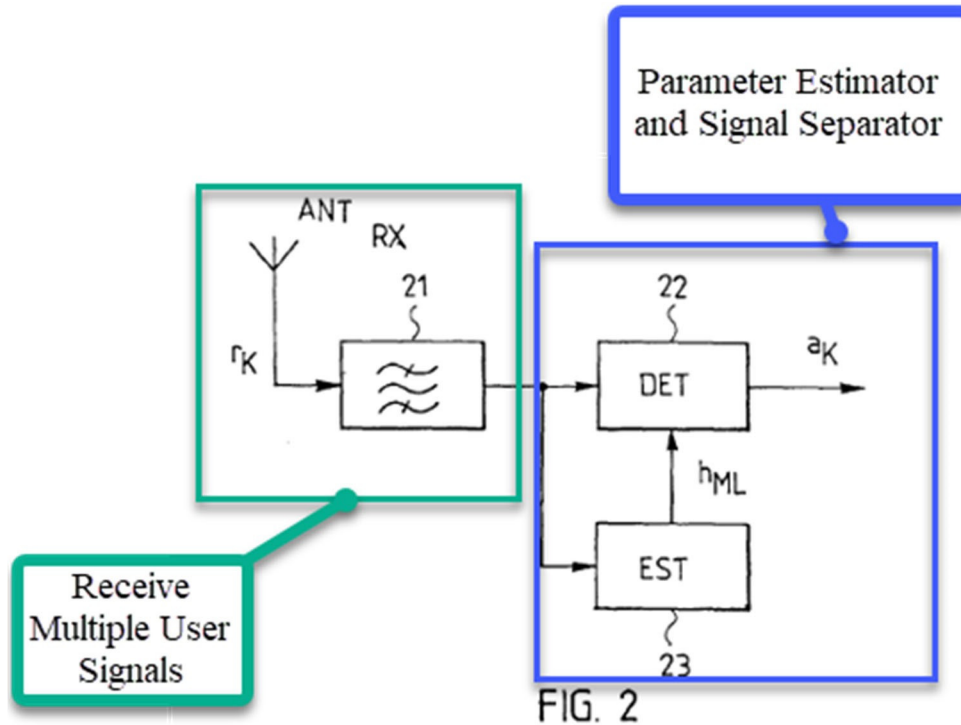
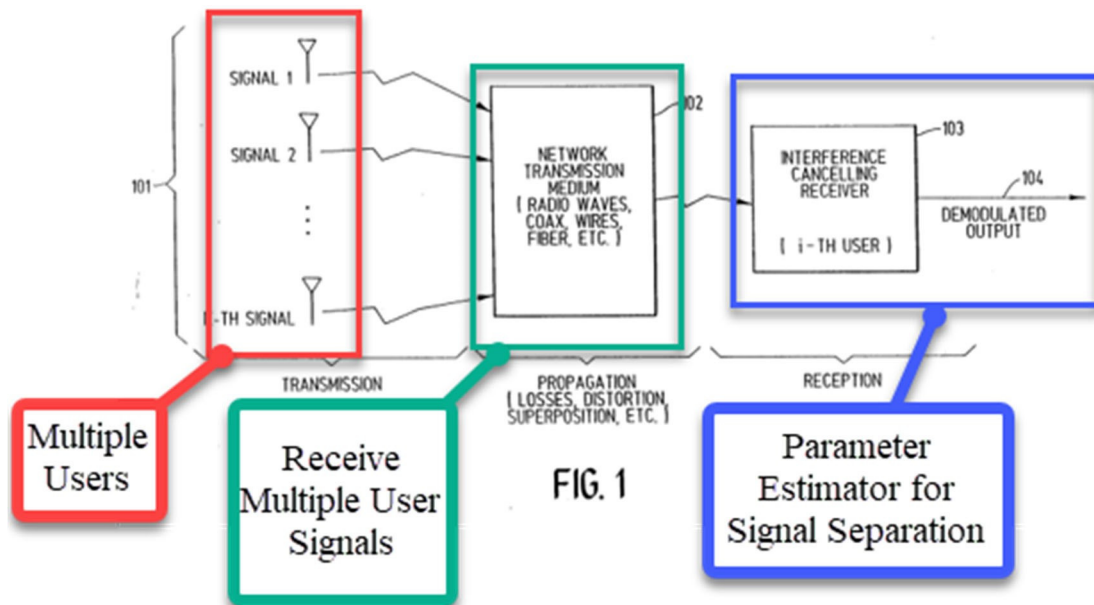


Figure 2 of Hottinen discloses the **receiver** includes a **parameter estimator** that estimates the user signals from interference and then separates the user's signals from the interfering signals using a detector.



The second primary reference in this petition, Zimmerman (EX1005), is a 1994 patent application publication that discloses a dynamic multi-user detector that estimates signal parameters and separates them based on the signal properties. As shown in Fig. 1, Zimmerman discloses **multiple users** transmitting over the **same transmission line**. The interfering signals of the multiple users are **received by the interference cancelling receiver** which performs **parameter estimates** and then separates the user's signals from the interfering signals using a demodulator.



The '505 patent added nothing to this deep body of knowledge. The patent claims and describes the basic concepts of MUD that were well-known at the time.

II. STANDING

Petitioners certify the '505 patent is available for *inter partes* review and they are not estopped.

III. GROUNDS²

Petitioners present two Grounds based on two different primary references. Ground 1 relies on Hottinen, which discloses a MUD system in a TDMA system that

² 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. EX1003, ¶¶187-191. Petitioners reserve the right to address any secondary considerations if raised by Patent Owner.

separates a signal by using parameter estimation and a signal separator. Ground 2 replaces Hottinen with Zimmerman, which similarly discloses a MUD system that separates a signal from interference and noise by using parameter estimation and signal separation while also disclosing signal processors that are used for tracking signal parameters and coding schemes for estimates in a CDMA system. Lilleberg—the secondary reference in both grounds—discloses that MUDs can use parameter tracking of specific signal parameters to provide feedback for future estimates, which is required by all Challenged Claims.

Ground	Basis	Reference(s)	Claims
1	§103	Hottinen, Lilleberg	1, 3-5, and 7-9
2	§103	Zimmerman, Lilleberg	1, 3-5, and 7-9

IV. POSITA

A POSITA at the time of the '505 patent had at least a bachelor's in EE/CE/CS, physics, or equivalent, and two years of experience with cellular telecommunications, radio-access network architectures, protocols and signal propagation in wireless networks. EX1003, ¶¶51-55. More education can supplement practical experience and vice versa. *Id.* Petitioners' expert exceeded this by the priority date. *Id.*

V. BACKGROUND

A. Technical Background (EX1003, ¶¶33-42)

The '505 patent relates to MUD. EX1003, ¶34. MUD techniques have been

known for decades, and documented since at least the 1980s. *Id.* Generally speaking, a MUD system allows users to transmit information over a shared communication path or channel. *Id.* The users' information is transmitted as interfering signals³ over the shared communication path or channel. *Id.* As these signals are interfering, the receiver of the signals must differentiate the signals to correlate them with each user. *Id.* MUD detects the signals for each user by demodulating the interfering signals using signal parameters (*e.g.*, signal phase, power, time delay, frequency, or code) related to each user. *Id.*

One early description of MUD is in a paper by Sergio Verdu titled "Computational Complexity of Optimum Multiuser Detection," *Algorithmica* (1989) (EX1008). EX1003, ¶35. Even by 1989, MUD was well-known for detecting signals for each user in a multi-user system. *Id.* 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

³ Interfering signals are signals that suffer from interference from another signal that overlaps in phase, frequency, time, or power. Interfering signals may include unwanted noise or intentionally overlapping signals from multiple sources.

Interference in a received signal causes the primary signal's parameters to be obscured by the interfering signals.

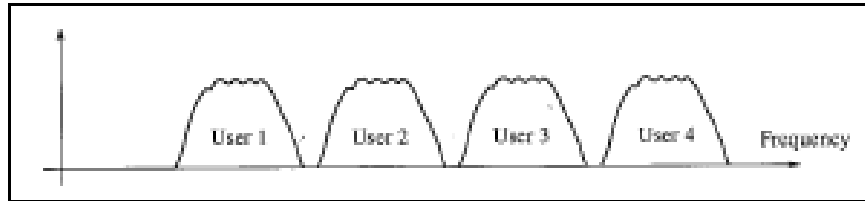
likely transmitted symbols.” EX1008, 304, EX1003, ¶35.

MUD has been used in many familiar wireless technologies that require sending multiple user data streams over a single signal. EX1003, ¶36. 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. *Id.* 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. EX1008, xix, EX1003, ¶36.

For example, Qualcomm pioneered the use of Code-Division Multiple-Access (“CDMA”) technology in the 1990s. EX1003, ¶37. In the CDMA cellular networks, each user is assigned a signature waveform that can be used to uniquely extract and identify that user’s signal at the receiver. *Id.* However, performance degrades as the number of concurrent users increases. It was well known that multi-user detection could be used in CDMA receivers to improve performance and reduce interference even for large numbers of users. *Id.*

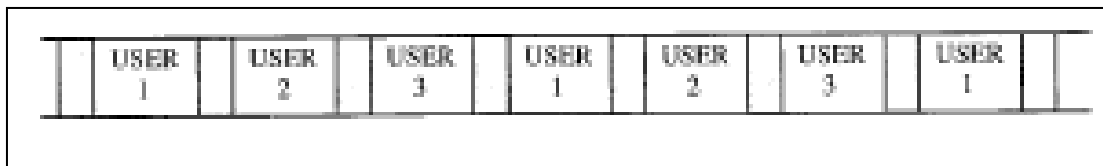
Another system pioneered by Qualcomm in the 1990s was Frequency Division Multiplexing or Frequency Division Multiple Access (“FDMA”). EX1003, ¶38. In FDMA systems, a different carrier frequency is assigned to each user in a network with a shared communication channel so that the resulting signals and

spectra do not overlap. *Id.* This is shown below:



As shown in the above figure, each user has a signal parameter based on carrier frequency. EX1003, ¶39. The receiver can use this carrier frequency to demodulate the signal and correlate it to the user. *Id.*

Yet another system in use in the 1990s was Time Division Multiplexing (“TDMA”) systems. EX1003, ¶40. In such systems, *time* is partitioned into slots assigned to each incoming digital stream in round-robin fashion and demultiplexing is carried out by simply switching on to the received signal at the appropriate times. *Id.* Time division can be used not only to multiplex collocated message sources but also by geographically separated users who have the ability to maintain time-synchronism. *Id.* This is shown below:



As shown in the above figure, each user has a signal parameter based on time division. The receiver can use this time division to demodulate the signal and correlate it to the user. EX1003, ¶41.

In the above CDMA, FDMA and TDMA systems, it was critical to correlate data streams to users. EX1003, ¶42. All of these systems employed MUD, and specifically, utilized parameters to identify the user that corresponds to the data sent over the shared channel. *Id.* All of these systems used signal processors that would identify the signal parameters to estimate the signal and separate the signal from the interfering signals. *Id.* Given bandwidth constraints, security concerns, and possible interference, it was well-known in the 1990s to use parameter estimating to identify and separate the user's signal from interfering signals and noise. *Id.* For example, FDMA and TDMA were well-known multiplexing schemes that would provide parameters for each signal that could be used to estimate the signal and separate it. EX1008, 304; EX1003, ¶42. Solutions to the problem of providing dynamic or realtime parameter estimates were well-known at the time of the '505 patent's alleged invention. EX1003, ¶42.

B. '505 Patent (EX1003, ¶¶43-46)

The '505 patent is directed to a MUD system that uses a parameter estimator to remove interfering signals at the receiver. EX1001, Abstract, EX1003, ¶¶43-46. As the '505 patent admits, parameter estimators were already well-known for performing signal separation in MUD systems. EX1001, 1:17-31. The prior art MUD systems used signal parameters to separate the signals by using the "channel transfer function comprised of the received power, the phase of the oscillator which

generated each received signal, the timing offset relative to the base station clock, any frequency offset of the carrier, and the structure of the multipath replicas.” *Id.*, 1:27-31, EX1003, ¶43. The ’505 patent admits that the prior art systems performed parameter estimation and signal separation serially, so “there are blanks or blackout periods at which time some of the simultaneously-occurring signals are being ignored or are not being tracked.” EX1001, 1:55-57, EX1003, ¶43.

The ’505 patent does not purport to invent MUD. EX1003, ¶44. Instead, the ’505 patent purports to introduce a multi-user system that performs parameter estimation and signal separation by “dynamically adapt[ing] to changing signals.” EX1001, 1:58-61. The ’505 patent notes that “various procedures in the open literature and in use today may be used to perform the parameter estimation on the interference-free signal created by this process.” *Id.*, 2:47-50.

Figure 1 depicts the claimed apparatus for processing and separating the digital stream from multiple users, where the “parameter estimation unit 20” performs the signal processing and then signal separation is performed by the signal separation unit. EX1003, ¶¶45-46.

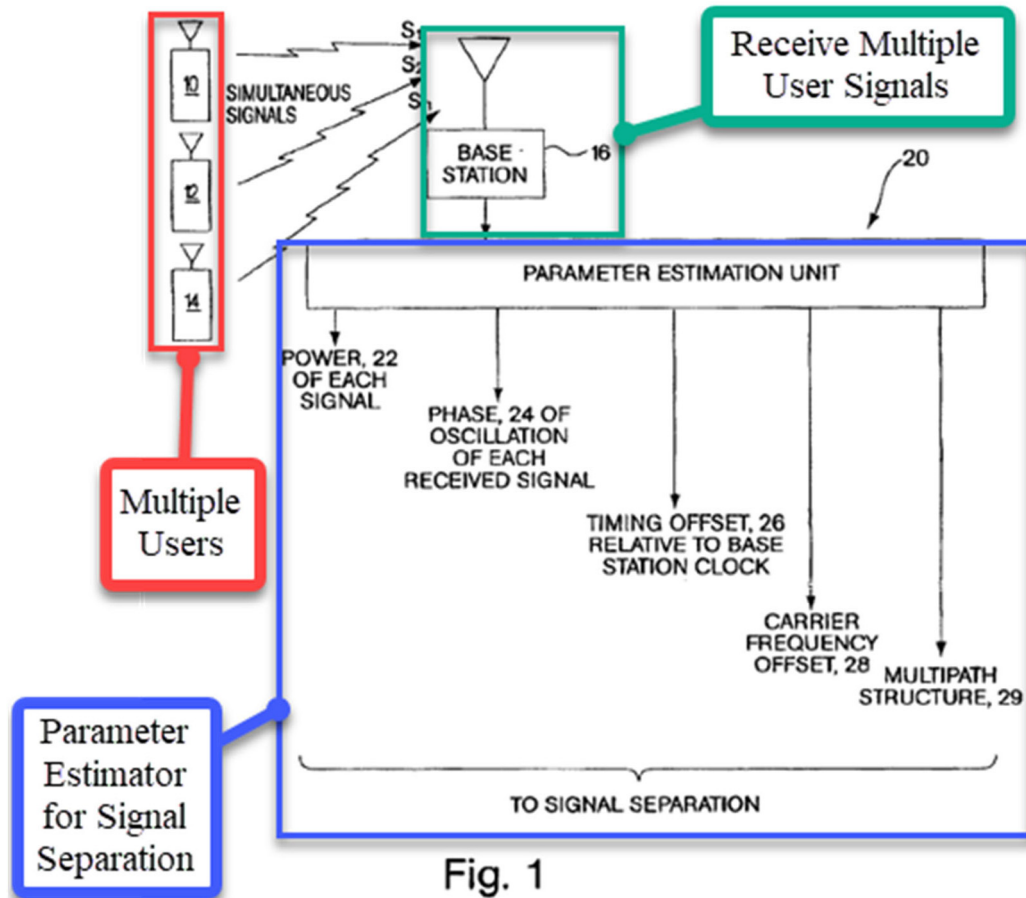


Fig. 1

1. Prosecution History (EX1003, ¶¶47-50)

The application that led to the '505 patent was filed on August 31, 2001, and claimed priority back to a provisional application filed on September 20, 2000. EX1002; EX1003, ¶¶47-48.

The Examiner rejected original claims 1, 2, 3, 9, and 10 as anticipated by U.S. Patent No. 5,710,797 ("Segal") and original dependent claims 5, 6, and 7 as obvious over Segal in view of U.S. Patent Application Publication No. 2001/0026599 ("Hoffmann"). EX1002, EX1003, ¶49. However, the examiner stated the subject matter of dependent claims 4 and 8 was allowable and that incorporating these

limitations in the independent claims would moot the prior art rejections. *Id.* Dependent claim 4 required each received signal to have associated channel transfer functions and “first deriving the estimated transfer function for each of said interfering signals.” *Id.* Dependent claim 8 required the received signals have training portions. *Id.* In response, the applicant amended the independent claims to incorporate the allowable subject matter from both dependent claims. *Id.*

The Examiner then issued a notice of allowance without providing specific reasons for allowance. EX1002, EX1003, ¶50.

2. Claim Construction (EX1003, ¶¶56-62)

Except for the terms discussed below, or unless otherwise indicated, and for this proceeding only, the claim terms should carry their “ordinary and customary meaning,”⁴ which is “the meaning that the term would have to a person of ordinary skill in the art in question” at the time of the invention. *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007) (citation omitted); EX1003, ¶¶56-57.

⁴ Petitioners interpret the challenged claims based on the breadth of Collision’s infringement allegations in the Samsung district court proceeding. EX1009. Petitioners reserve the right to argue in the district court proceeding that Collision’s construction of the terms are incorrect and/or not supported by the ’505 patent specification.

- (a) **“a parameter estimation unit for use in conjunction with a signal separation unit, in which each received signal has associated channel transfer functions, comprising:”**

Claims 1 and 9 of the '505 patent include the term: “a parameter estimation unit for use in conjunction with a signal separation unit, in which each received signal has associated channel transfer functions, comprising” in the first paragraph of the claims. This claim term is *not* part of the preamble—the preamble is “In a multi-user detection system in which interfering signals are purposely allowed to exist”—but to the extent there is any argument that it is, it is limiting at least because it provides antecedent basis to the “parameter estimation unit” and “associated channel transfer functions” terms that are used in the remainder of the body of the claims and is “essential to understanding the structural limitations” of the parameter estimation unit. *Shoes by Firebug LLC v. Stride Rite Children’s Grp., LLC*, 962 F.3d 1362, 1368 (Fed. Cir. 2020) (“[U]se of preamble terms to define positive limitations in the body of claims can evince an inventor’s intent that the preamble limit the scope of the claim.”). EX1003, ¶58.

- (b) **“means coupled to said channel transfer function determining signal processor for providing uninterrupted estimates of the channel transfer function parameters on a real-time basis”**

Claims 1 and 9 of the '505 patent include the term: “means coupled to said channel transfer function determining signal processor for providing uninterrupted

estimates of the channel transfer function parameters on a real-time basis.” EX1003, ¶59. This term is written in means-plus-function (MPF) format and should be construed pursuant to 35 U.S.C. §112, ¶6. “[U]se of the word ‘means’ creates a presumption that §112, ¶6 applies.” *Williamson v. Citrix Online, LLC*, 792 F.3d 1339, 1349 (Fed. Cir. 2015) (en banc). EX1003, ¶59. Petitioners propose the following constructions for this term for purposes of this Petition only and it is the same construction asserted by Patent Owner in district court litigation against Samsung (“the Samsung district court litigation”). EX1009, 23. The function of this MPF term is “providing uninterrupted estimates of the channel transfer function parameters on a real-time basis.” EX1003, ¶59. The structure of this MPF term is “parameter tracking unit and equivalents thereof” as disclosed in the following:

As illustrated at 20, *a parameter estimation unit is to provide the channel transfer function for each of the interfering users at its output*. In the remainder of this description, the parameters that will be required for signal separation are delineated and specified in place of the more general notion of the channel transfer function, although knowing the channel transfer function is equivalent to knowing these parameters. *Specifically the parameter estimation unit 20 provides at its output for each interfering user the received power 22, the phase 24 of the oscillator for each of the*

transmitted signals, the timing offset 26 relative to the base station clock

and transmission distance, the carrier frequency offset 28 and the multipath

structure 29. Each of the signals in the particular traffic channel here labeled

$S_1, S_2, S_3, \dots S_n$, *are identified in realtime as to their various parameters.*

These parameters, when identified, are utilized in the signal separation

process such as described in the aforementioned patent application, assigned

to the assignee thereof.

EX1001, 5:20-40; EX1003, ¶59. This description in the '505 patent refers to

elements numbered in Figure 1, below, where the [parameter estimation unit and](#)

[parameter tracking unit](#) is shown. EX1003, ¶59.

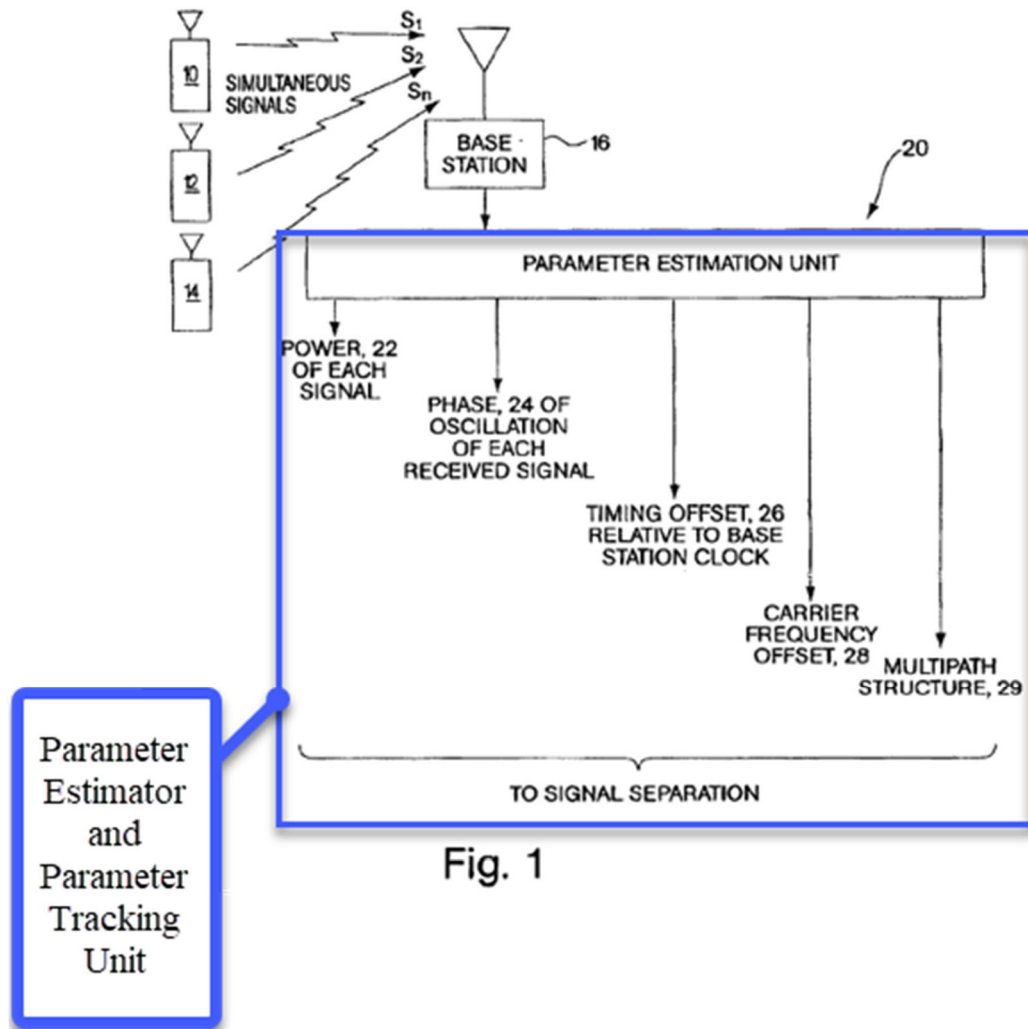


Fig. 1

The '505 patent also describes the structure of the parameter tracking unit in the following:

Also included is a *unit 48, which estimates and tracks the relative phase of the first signal of the traffic channel 40*. Note that *power tracking, timing offset tracking, phase tracking and multipath structure tracking may be done conventionally* as described in "Spread Spectrum Communications Handbook", Simon, Omura, Scholtz and Lebat, McGraw Hill, Inc. 1994, or in any other manner described in the open literature including *methods of*

estimating and/or tracking the entire channel transfer function from a known transmitted signal where the separate estimation of the power, timing offset, phase, frequency offset, and multipath structure is not necessary. The outputs, here designated 50, correspond to the parameter values for the first signal in the channel.

EX1001, 6:9-23; EX1003, ¶60. This description in the '505 patent refers to elements numbered in Figure 2, below, where the [parameter tracking unit](#) is shown:

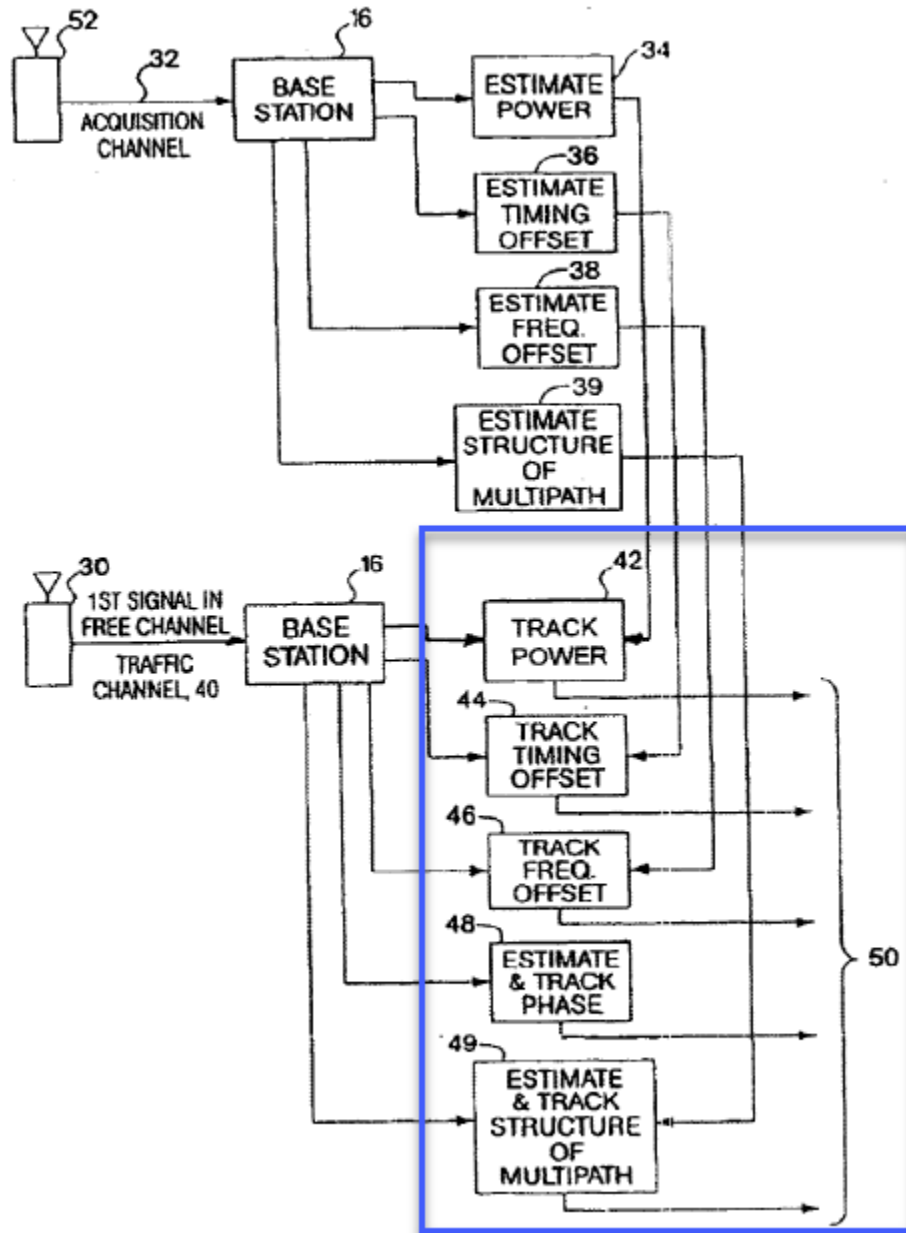


Fig. 2

The '505 patent also describes the structure of the parameter tracking unit in the following:

Referring now to FIG. 4, in order to accommodate a parallel tracking of the interfering signals, assuming that the training sequences are known for

these signals and one has initial estimates of all of the signal parameters such as of course, power, frequency offset, timing offset, and multipath structure, then these parameters can be updated by recalculating parameters associated with the first signal by using the information available from the second and third signals. The reason for the updating is that the parameters change in time. What will be first described is the serial updating scheme in which *the parameter tracking unit of FIG. 3, which include all of the elements and dotted box 90, are duplicated as 90, 90' and 90''.*

EX1001, 7:45-8:40; EX1003, ¶61. This description in the '505 patent refers to elements numbered in Figures 3 and 4, below, where the [parameter tracking unit](#) is shown. EX1003, ¶61.

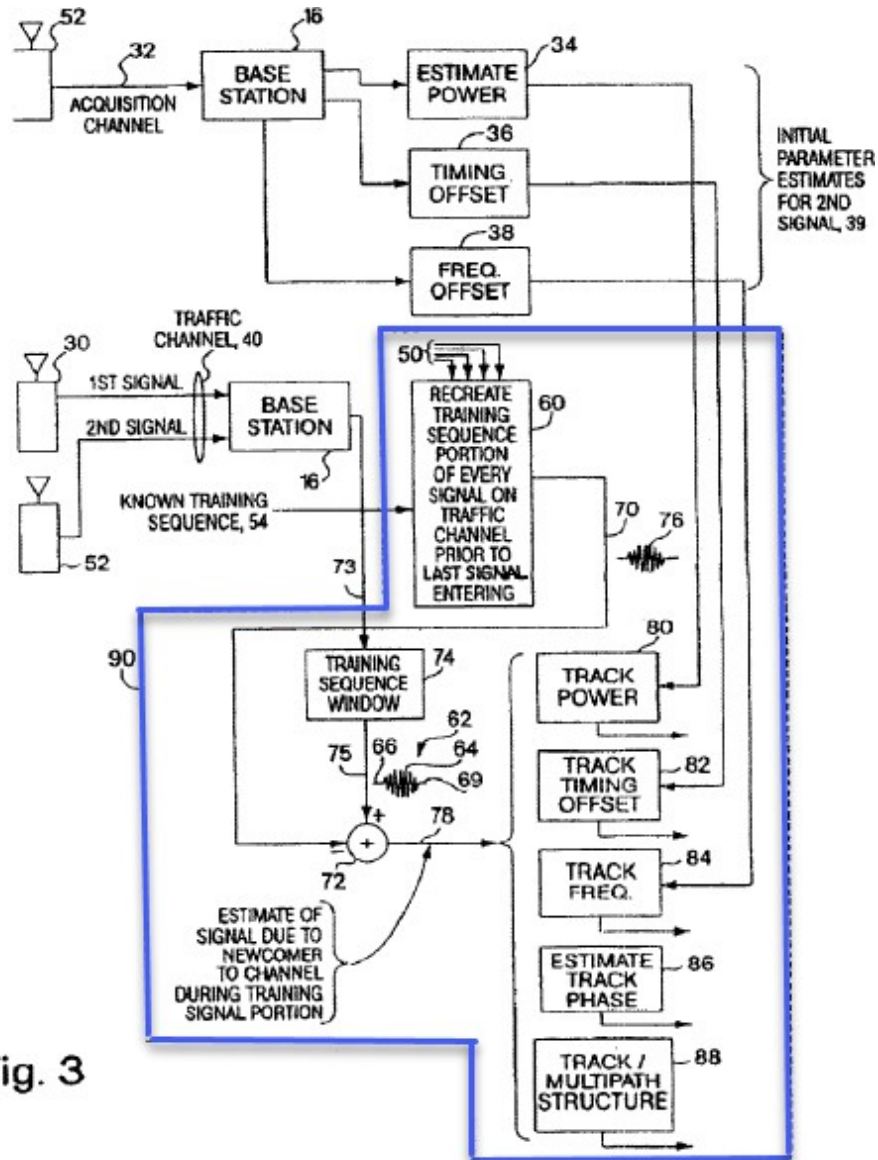


Fig. 3

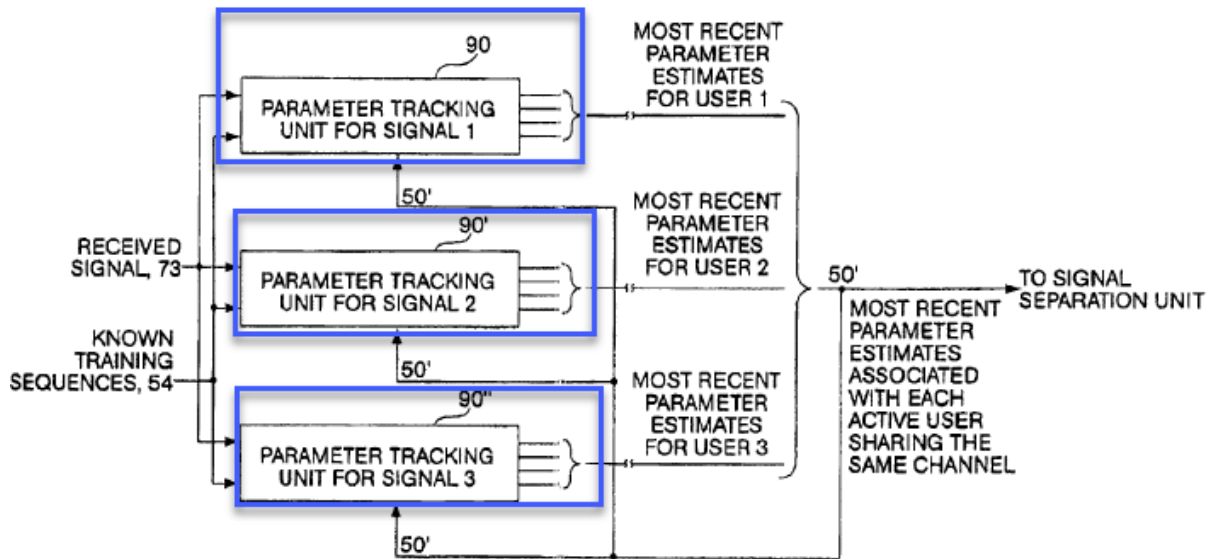


Fig. 4

In each of these disclosures, it is clear that the parameter tracking unit performs the claimed function of “providing uninterrupted estimates of the channel transfer function parameters on a real-time basis.” EX1003, ¶62. Thus, the parameter tracking unit is the corresponding structure for the claimed “means.” *Id.*

C. Prior Art

1. Hottinen (EX1004)

Hottinen (EX1004), a 1999 Nokia patent, discloses a multi-user detection system that dynamically performs parameter estimation to separate the signals. EX1003, ¶64. As shown in Fig. 1A, Hottinen discloses **multiple users** transmitting interfering signals on the same transmission channel that are **received by a receiver**. *Id.*

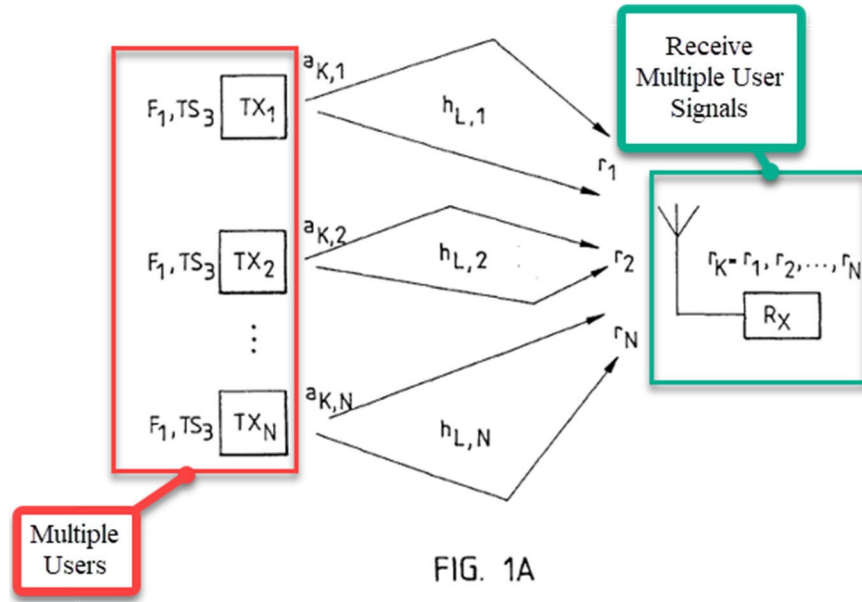
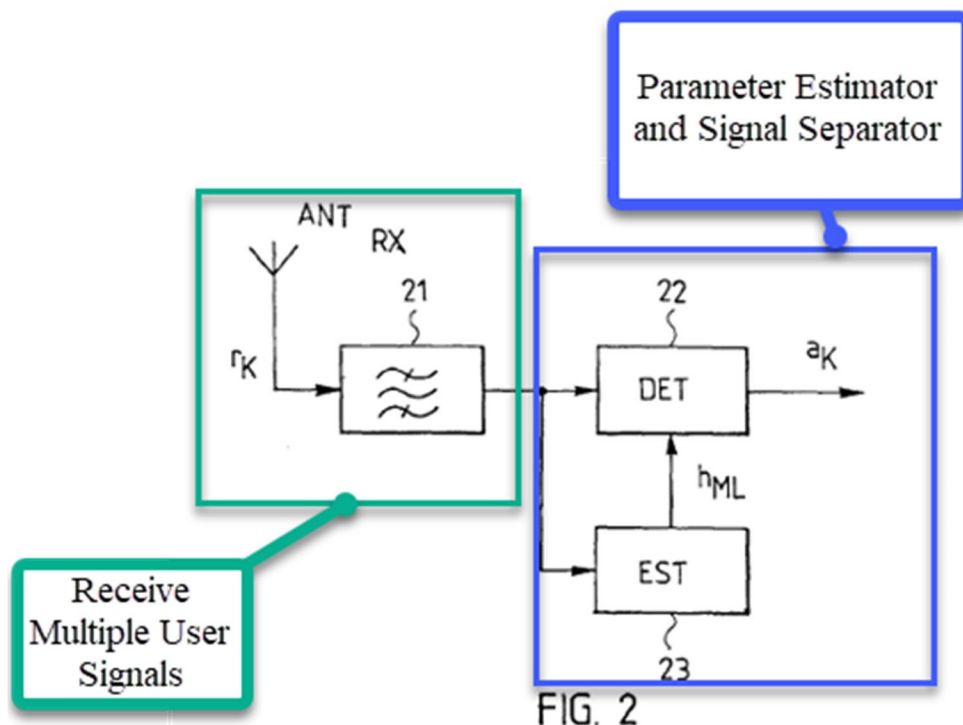


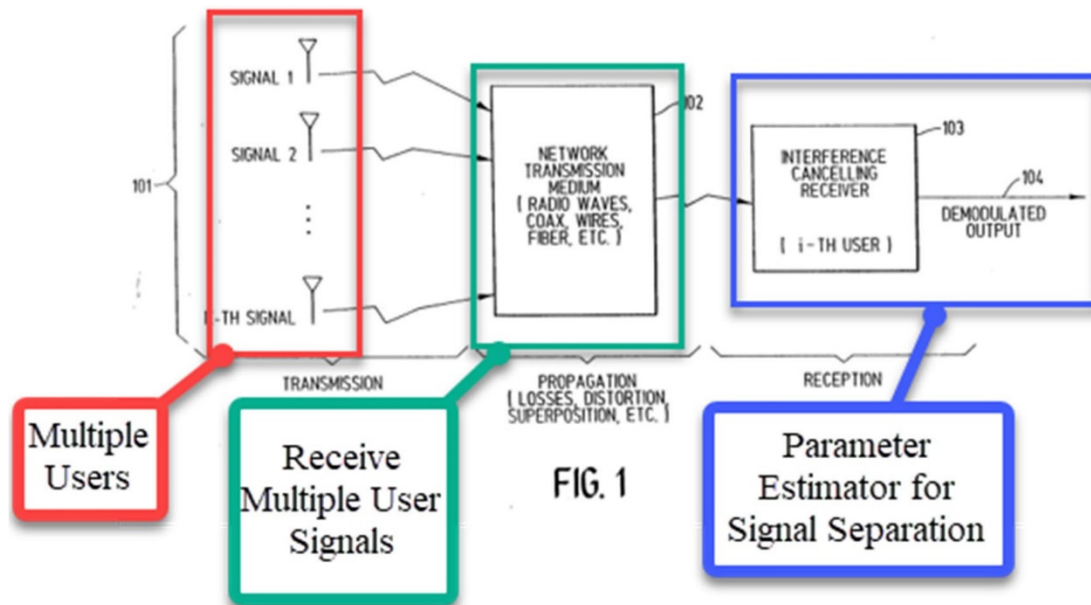
Figure 2 of Hottinen discloses the **receiver** that receives the multiple interfering user signals includes a **parameter estimator** that estimates the user signals from interference and then separates the user's signals from the interfering signals using a **detector**. EX1003, ¶65.



Hottinen discloses that the MUD parameter estimation and signal separation is performed uninterruptedly as it is constantly “determining a transmission channel estimate of the at least one interfering co-channel signal” so every “received signal is continuously cleaned.” EX1004, 3:8-23, 9:46-57; EX1003, ¶66. Additionally, Hottinen notes that “the parameters of the channel or the estimates thereof are known” as the “multipath channels provide a memory which can be advantageously utilized in the detection process.” EX1004, 5:23-33; EX1003, ¶66.

2. Zimmerman (EX1005)

Zimmerman (EX1005), a 1994 patent application publication, discloses a dynamic multi-user detector that estimates signal parameters and separates them based on the signal properties. EX1003, ¶67. As shown in Fig. 1, Zimmerman discloses **multiple users** transmitting over the **same transmission line**. *Id.* The interfering signals of the multiple users are **received by the interference cancelling receiver** which performs **parameter estimates and then separates the user’s signals from the interfering signals using a demodulator**. *Id.*

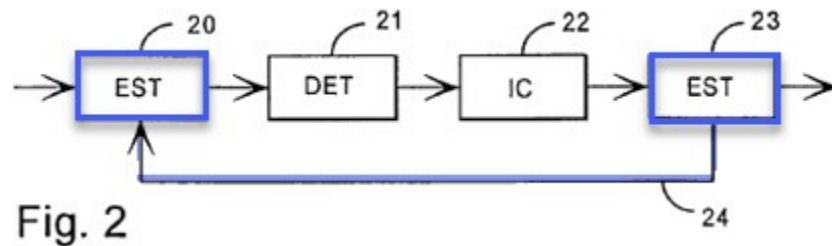


Zimmerman discloses performing the parameter estimation and separation of the signals uninterruptedly as the estimates are performed in a “self-bootstrapping, continuous” mode of operation. EX1005, 25; EX1003, ¶68. Additionally, Zimmerman notes that “estimation techniques could be used in a tracking mode, where the estimate is updated over time using previous estimates” to perform adaptive noise-cancelling and obtain better quality results. EX1005, 21, 24; EX1003, ¶68.

3. Lilleberg (EX1006)

Lilleberg (EX1006), a 1999 Nokia patent, discloses a dynamic multi-user detector that performs parameter estimation to identify signals for each user and eliminating interference. EX1006, Abstract; EX1003, ¶69. Lilleberg discloses the parameter estimator includes a parameter tracker that uses known parameter

estimates and outputs the tracked signal “amplitude and the delay” as well as “phases,” “power,” frequency and multipath structure. EX1006, 2:1-6, 3:19-47; EX1003, ¶69. As shown in Fig. 2, Lilleberg discloses that the **channel parameter estimates from EST 23** are fed back to **EST 20** to be tracked and used for the further channel parameter estimates. EX1003, ¶69.



VI. GROUNDS OF REJECTION

A. Ground 1: Claims 1, 3-5, and 7-9 are Rendered Obvious by Hottinen in view of Lilleberg

Hottinen discloses a multi-user detection system that separates a signal by using parameter estimation and a signal separator. EX1004, 3:8-23, 9:46-57. Lilleberg discloses that multi-user detectors can use parameter tracking, which is useful in a MUD system like Hottinen because it provides feedback from prior parameter estimates and results in faster and more accurate estimations. EX1006, 2:31-33. It would have been obvious to combine Lilleberg’s MUD parameter tracking with Hottinen’s MUD system with parameter estimation. EX1003, ¶¶71-132.

1. Motivation to Combine

A POSITA would have been motivated to incorporate Lilleberg's teachings of a parameter tracker that implements channel estimation using real-time feedback and output parameters into Hottinen's receiver for processing multi-user signals. EX1003, ¶¶71-72. Hottinen discloses parameter estimation is performed uninterruptedly as it is constantly "determining a transmission channel estimate of the at least one interfering co-channel signal" so every "received signal is continuously cleaned." EX1004, 3:8-23, 9:46-57; EX1003, ¶72. But Lilleberg provides the implementation detail regarding the structure of the parameter tracker used by the multi-user detector to achieve real-time estimation and tracking, as it discloses a parameter tracking unit for channel estimation where the parameter tracking unit outputs "amplitude and the delay" as well as "phases," "power," frequency and multipath structure. EX1006, 2:1-6, 3:19-47; EX1003, ¶72. Lilleberg's parameter tracker provides realtime feedback to the parameter estimator so the signals can be cleaned quicker and more accurately based on prior estimates. EX1006, 2:31-33; EX1003, ¶72.

MUD is a well-known, decades-old type of signal detection and processing that uses signal parameter estimates to identify the user signals and remove interfering signals. EX1003, ¶73. As taught in Lilleberg, MUD uses the signal parameters like signal amplitude, delay, phase, power, frequency, and multipath

structure to identify the signal from interfering signals. EX1006, 2:1-6, 3:19-47; EX1003, ¶73. These signal parameters were well known to allow accurate signal estimations and separations. *Id.* A POSITA would have been motivated to incorporate Lilleberg's teachings of a parameter tracker that implements channel estimation using real-time feedback and output parameters into Hottinen's receiver for processing multi-user signals for at least the following reasons. EX1003, ¶73.

First, Hottinen discloses parameter estimation is performed uninterruptedly as it is constantly "determining a transmission channel estimate of the at least one interfering co-channel signal" so every "received signal is continuously cleaned." EX1004, 3:8-23, 9:46-57; EX1003, ¶74. Additionally, Hottinen discloses that it is configured to enable tracking parameter estimates, as "the parameters of the channel or the estimates thereof are known" and the "multipath channels provide a memory which can be advantageously utilized in the detection process." EX1004, 5:23-33. Hottinen, however, does not expressly teach the real-time tracking structure of the parameter tracking unit includes the output of the parameter tracking unit is used as feedback for successive parameter estimates where the outputs are of the received power, the phase of the oscillator for each of the transmitted signals, the timing offset relative to the base station clock and transmission distance, the carrier frequency offset and the multipath structure. EX1003, ¶74. Lilleberg, on the other hand, teaches that a real-time parameter tracking unit that includes feedback for successive

parameter estimates for channel estimation where the outputs include “amplitude and the delay” as well as “phases,” “power,” frequency and multipath structure, and that this was well-known. EX1006, 2:1-6, 3:19-47; EX1003, ¶74. A POSITA would therefore be motivated to give effect to Hottinen’s teaching of parameter tracking by incorporating Lilleberg’s teachings of the output parameters and feedback of the parameter tracking unit. EX1003, ¶74. In addition, using a parameter tracking unit that includes feedback outputs of the received power, the phase of the oscillator for each of the transmitted signals, the timing offset relative to the base station clock and transmission distance, the carrier frequency offset and the multipath structure would have been a mere design choice. *Id.* A POSITA would have known that using more parameters would result in better estimates, so a POSITA would be motivated to use received power, the phase of the oscillator for each of the transmitted signals, the timing offset relative to the base station clock and transmission distance, the carrier frequency offset and the multipath structure as parameters. *Id.*

Second, a POSITA would have been motivated to use a parameter tracking unit that includes feedback and tracking the parameters of the received power, the phase of the oscillator for each of the transmitted signals, the timing offset relative to the base station clock and transmission distance, the carrier frequency offset and the multipath structure because that would be an efficient method for processing parameter estimates from Hottinen’s parameter estimator. EX1003, ¶75. A POSITA

would have been aware of the benefits of using a parameter tracking unit with a feedback output and using received power, the phase of the oscillator for each of the transmitted signals, the timing offset relative to the base station clock and transmission distance, the carrier frequency offset and the multipath structure. *Id.* A POSITA would have known this was more efficient and significantly faster than performing parameter estimates without any feedback or tracking. *Id.* The benefits of feedback processing and tracking had long been known by the filing date of the '505 patent. *Id.* Lilleberg expressly discloses that these benefits included quicker processing and cleaning of signals, as well as more accurate estimates based on prior estimates. EX1006, 2:31-33; EX1003, ¶75.

Third, a POSITA would have been motivated by the fact that efficiency and speed were very important and desirable for processing wireless communications. EX1003, ¶76. As wireless communication speeds and bandwidth have increased, it is necessary for the processing of such signals to become more efficient in order to process the increased amount of data in real-time. *Id.* Because Hottinen and Lilleberg describe detecting and decoding wireless signals containing data, a POSITA would have found it highly desirable to perform such processing as efficiently and quickly as possible in order to maximize bandwidth. *Id.* Lilleberg expressly discloses that these benefits are achieved by using its parameter tracking unit. EX1006, 2:31-33; EX1003, ¶76.

A POSITA would have had a reasonable expectation of success. EX1003, ¶77.

Both Hottinen and Lilleberg are Nokia patents and describe the same process of performing MUD and then separating the signals. *Id.* Indeed, both Hottinen and Lilleberg describe similar, well-known methods of for parameter estimating. *Id.* For example, both Hottinen and Lilleberg disclose parameter estimators and the benefit of tracking prior parameter estimates. EX1004, 5:23-33; EX1006, 2:31-33. These were well-known parameter estimators and decoders and Lilleberg discloses that a parameter tracker including feedback outputs of the received power, the phase of the oscillator for each of the transmitted signals, the timing offset relative to the base station clock and transmission distance, the carrier frequency offset and the multipath structure was already prior art. EX1003, ¶77. Thus, it would have been well-within the skill of a POSITA to implement Hottinen's parameter estimator using Lilleberg's teachings regarding parameter selection and parameter tracking, since such implementation was well known and conventional. *Id.*

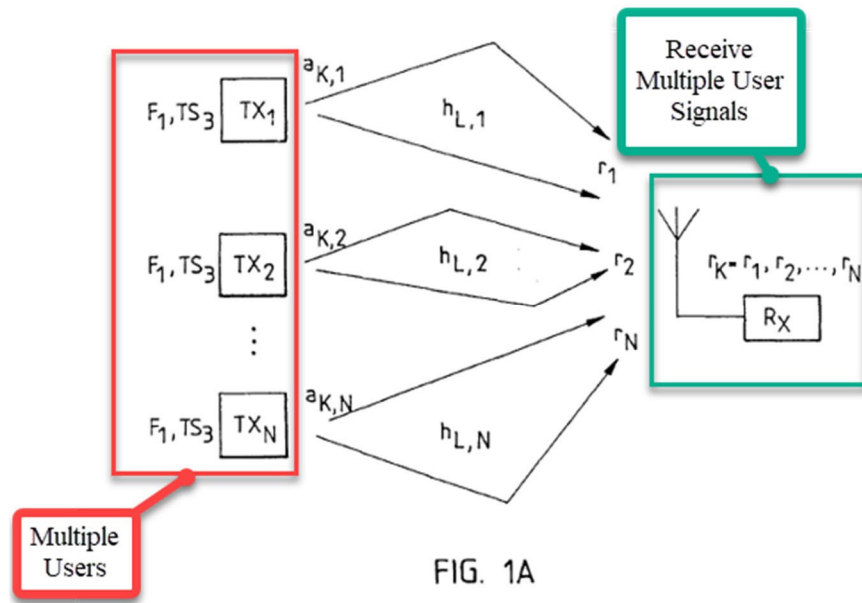
Finally, Hottinen, Lilleberg, and the '505 patent are analogous art because all three are directed to the same field of MUD and parameter estimation, that is, processing a data stream from multiple users using signal parameters for detection. EX1004, 3:8-23, 9:46-57; EX1006, 2:1-6, 3:19-47; EX1001, 2:47-50; EX1003, ¶78.

2. Claim 1

(a) 1pre

Hottinen is directed to “a signal detection method in a receiver of a TDMA mobile system” where the system has “*several concurrent co-channel users*” with “N transmitters TX1, TX2, . . . , TXN, *which all transmit at the same frequency F1 and in the same time slot TS3*” (i.e., “multi-user detection system”). EX1004, 3:8-23, 4:41-65; EX1003, ¶¶79-83. Further, Hottinen expressly teaches that “*a primary signal and at least one interfering co-channel signal are received*, preferably asynchronously, *on the same TDMA channel.*” *Id.* Because each of the transmitters transmit at the same frequency and in the same time slot, the transmissions will include *interfering signals* (as Hottinen expressly confirms). EX1003, ¶81. And as Hottinen makes clear, the signals are *purposely* transmitted as interfering signals (i.e., at the same frequency and time, and on the same TDMA channel). EX1003, ¶81.

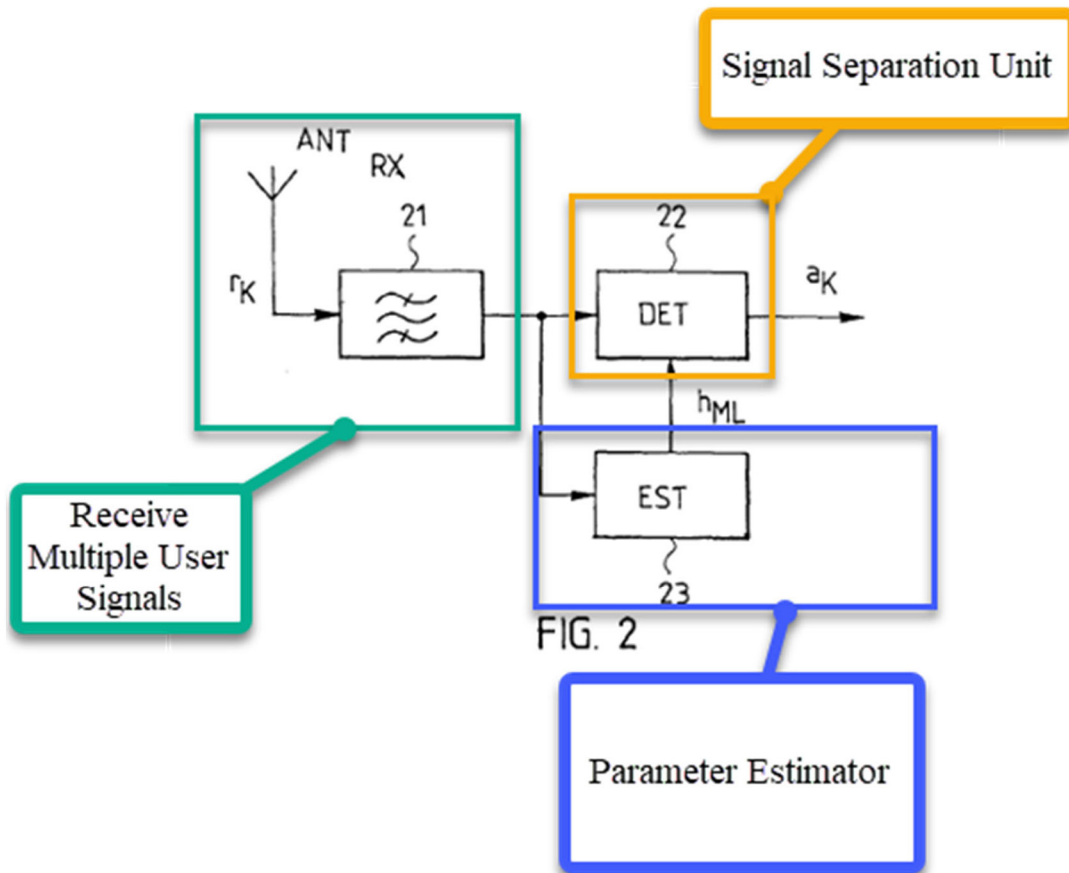
Figure 1A, annotated below, further demonstrates that Hottinen’s system is a multi-user detection system where **multiple users** purposely transmit interfering signals (to be **received by a receiver**) on the same transmission channel. EX1003, ¶82.



(b) 1a

“a parameter estimation unit for use in conjunction with a signal separation unit”: Hottinen discloses “channel estimator 23 provides the channel estimates of the co-channel signals” (i.e., “**parameter estimation unit**”). EX1004, 5:49-54; EX1003, ¶¶84-88. Hottinen discloses that the channel estimator uses signal parameters from training sequences, which include power, phase, timing offset, carrier frequency offset, and structure. EX1004, 5:33-54. The **channel estimator** (i.e., “**parameter estimation unit**”) is used in conjunction with “a **detector DET 22**” (i.e., “**signal separation unit**”). EX1003, ¶85. The **detector DET 22** receives an output from the **channel estimator** “for detecting the primary signal” and separating the primary signal from the other signals. EX1004, 5:49-54. The **channel estimator** (i.e., “**parameter estimation unit**”) and **detector DET 22** (i.e., “**signal separation unit**”)

are shown in Fig. 2, annotated below. EX1003, ¶85.



The '505 patent states that channel estimation is the same as parameter estimation as “knowing the channel transfer function is equivalent to knowing these parameters.” EX1001, 5:23-28; EX1003, ¶86. A POSITA would have understood that Hottinen’s channel estimator is the claimed parameter unit. EX1003, ¶86. Additionally, in its infringement contentions in the Samsung district court litigation, Patent Owner has mapped the parameter estimation unit to “channel estimation” in “4G” (EX1009, Ex. 3 at 1), which is the same as the channel estimator disclosed in Hottinen. EX1004, 5:49-54; EX1003 ¶86. *See, e.g., Philip Morris Products, S.A. v.*

Rai Strategic Holdings, Inc., IPR2020-00921, Paper 13 at 42-44 (Aug. 5, 2021)

(recognizing that petitioner can “rely[] on claim constructions that it believes are incorrect”); *Lewis Machine & Tool Co. v. WHG Properties, LLC*, IPR2020-00373, Paper 6 at 33-34 (July 27, 2020) (“[W]e are not persuaded that our rules prohibit Petitioner from relying on a claim construction it believes is incorrect.”).

“each received signal has associated channel transfer functions”: Hottinen discloses “the parameters of the channel or the estimates thereof are known” for **each received signal** as well as the “different training sequences, which are transmitted through the channels” (*i.e.*, “**associated channel transfer functions**”). EX1004, 5:23-35; EX1003, ¶87. These known signal parameters from the training sequences and known estimates include power, phase, timing offset, carrier frequency offset, and structure. EX1003, 5:33-54; EX1003, ¶¶87-88. These signal parameters are the same as the claimed channel transfer functions, as the ’505 patent states that “channel transfer function comprised of the received power, the phase of the oscillator which generated each received signal, the timing offset relative to the base station clock, any frequency offset of the carrier, and the structure of the multipath replicas.” EX1001, 1:27-31; EX1003, ¶¶43, 87-88.

(c) 1b

Hottinen discloses “the use of **a signal processor**” for performing the channel estimates based on signal parameters (*i.e.*, “**for determining said channel transfer**

functions for each received signal”). EX1004, 6:43-67, 9:46-57; EX1003, ¶¶89-91. For example, Hottinen discloses the **signal processor** determines “the parameters of the channel or the estimates” for each received signal by using the “different training sequences, which are transmitted through the channels.” EX1004, 5:23-35; EX1003, ¶90. Hottinen discloses exemplary equations that use signal parameters as inputs to perform the channel estimates and are performed by the **signal processor**. EX1004, 6:10-58; EX1003, ¶90. Hottinen discloses that in “practical solutions” a “signal processor” is used to implement the “channel estimator” determining different transfer functions. EX1004, 9:46-57; EX1003, ¶¶90-91.

(d) 1c

As discussed in Section V.B,2 above, this claim limitation is subject to 35 U.S.C. § 112, ¶6, with the function “providing uninterrupted estimates of the channel transfer function parameters on a real-time basis by first deriving the estimated channel transfer function for each of said interfering signals” and corresponding structure: parameter tracking unit and equivalents thereof. *See, e.g.*, EX1001, 5:20-40, 6:9-23, 7:45-8:40, Fig. 1, Fig. 3, Fig. 4 (parts 90, 90’, 90’); EX1003, ¶93.

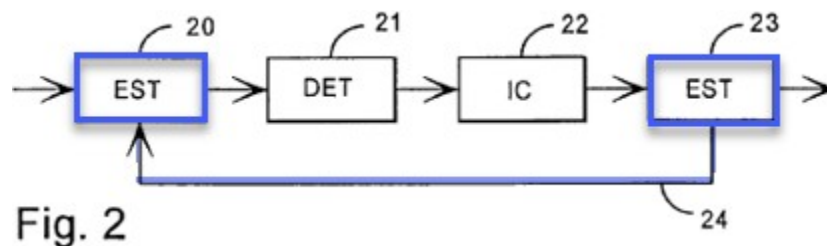
“providing uninterrupted estimates of the channel transfer function parameters on a real-time basis by first deriving the estimated channel transfer function for each of said interfering signals”: Hottinen discloses the channel

estimation function (*i.e.*, “**estimates of the channel transfer function parameters**”) are performed uninterruptedly as it is constantly “determining a transmission channel estimate of the at least one interfering co-channel signal” so every “received signal is continuously cleaned” (*i.e.*, “**providing uninterrupted estimates ... on a real-time basis**”). EX1004, 3:8-23, 9:46-57; EX1003, ¶¶92-97. Hottinen discloses that “joint estimation of channel parameters can be carried out for instance by means of different training sequences, which are transmitted through the channels” as the first step of “determining a transmission channel estimate of the at least one interfering co-channel signal” (*i.e.*, “**by first deriving the estimated channel transfer function for each of said interfering signals**”). EX1004, 3:8-23, 5:33-35; EX1003, ¶94

“parameter tracking unit and equivalents thereof”: Hottinen discloses “the parameters of the channel or the estimates thereof are known” as the “multipath channels provide a memory which can be advantageously utilized in the detection process” (*i.e.*, “**parameter tracking unit**”). EX1004, 5:23-33; EX1003, ¶95. As Hottinen discloses a memory for storing the channel parameters and uses these stored parameters in providing estimates, a POSITA would have understood that it is tracking the parameters. EX1003, ¶95. Hottinen also discloses that the memory for storing the channel parameters is coupled to the signal processor, as the signal processor accesses the memory to get “the parameters of the channel or the

estimates” for each received signal and using the “different training sequences, which are transmitted through the channels” (*i.e.*, “**coupled to said channel transfer function determining signal processor**”). EX1004, 5:23-35; EX1003, ¶95. This is the same structure as the claimed parameter tracking unit as it is a memory with stored parameters for estimates. *Id.*

While Hottinen does not expressly disclose the implementation detail regarding the structure of the parameter tracker used by the multi-user detector to achieve real-time estimation and tracking, Lilleberg discloses a parameter tracking unit for channel estimation where the parameter tracking unit outputs “amplitude and the delay” as well as “phases,” “power,” frequency and multipath structure. EX1006 2:1-6, 3:19-47; EX1003, ¶96. As shown in Fig. 2, Lilleberg discloses that the **channel parameter estimates from EST 23** are fed back to **EST 20** to be tracked and used for the further channel parameter estimates. EX1003, ¶96.

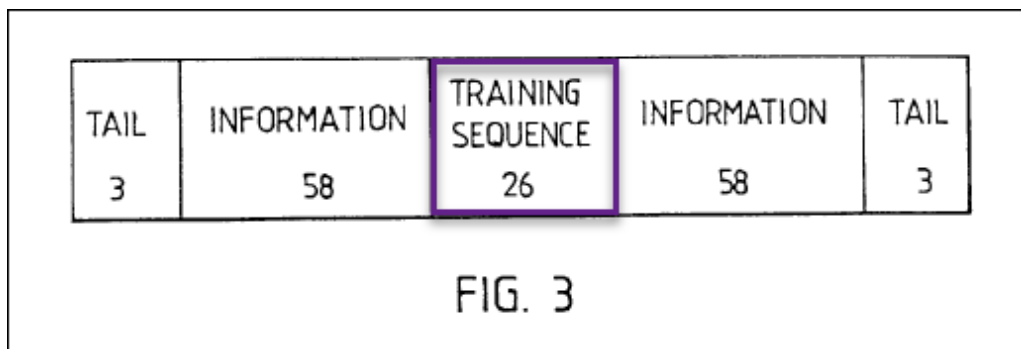


As discussed above, it would have been obvious to combine Hottinen with Lilleberg. EX1003, ¶97, ¶¶72-78.

3. Claim 3

“the multi-user detection system includes providing an acquisition

channel”: Hottinen discloses a channel for transmitting the “training sequence” that is the signal for parameter estimation (*i.e.*, “**acquisition channel**”) and the “training sequence is located in the middle of the burst” and so has a “midamble” channel. EX1004, 5:60-67; EX1003, ¶¶98-102. Fig. 3 shows the “training sequence” channel that transmits the signal for parameter estimation (*i.e.*, “**acquisition channel**”). EX1003, ¶98.



In its infringement contentions in the Samsung district court litigation, Patent Owner has mapped the acquisition channel to “Synchronization Signal Block” in “LTE” (EX1009, Ex. 3 at 33), which is the same as the training sequence midamble disclosed in Hottinen. EX1004, 5:60-67; EX1003, ¶100. *See, e.g., Philip Morris Products, S.A. v. Rai Strategic Holdings, Inc.*, IPR2020-00921, Paper 13 at 42-44 (Aug. 5, 2021) (recognizing that petitioner can “rely[] on claim constructions that it believes are incorrect”); *Lewis Machine & Tool Co. v. WHG Properties, LLC*, IPR2020-00373, Paper 6 at 33-34 (July 27, 2020) (“[W]e are not persuaded that our rules prohibit Petitioner from relying on a claim construction it believes is incorrect.”).

“the first derived estimated channel transfer function is derived from acquisition channel parameters”: Hottinen discloses deriving “the parameters of the channel or the estimates” (*i.e.*, “**derived estimated channel transfer function**”) for each received signal by using the “different training sequences, which are transmitted through the channels” (*i.e.*, “**acquisition channel parameters**”). EX1004, 5:23-35; EX1003, ¶¶101-102.

4. Claim 4

“multi-user detection system includes a tracking unit for acquired signals”: Hottinen discloses “the parameters of the channel or the estimates thereof are known” as the “multipath channels provide a memory which can be advantageously utilized in the detection process” (*i.e.*, “**tracking unit for acquired signals**”). EX1004, 5:23-33; EX1003, ¶¶103-108. As Hottinen discloses a memory for storing the channel parameters and signals, it is tracking the signals and parameters. EX1003, ¶¶103-108.

“in the presence of a new signal in the acquisition channel of said parameter estimation unit estimates the channel transfer function prior to signal switching from an acquisition channel to the traffic channel”: Hottinen discloses “channel estimator 23 provides the channel estimates of the co-channel signals” (*i.e.*, “**parameter estimation unit**”). EX1004, 5:49-54; EX1003, ¶105. Hottinen discloses that the channel estimator uses signal parameters from training sequences (*i.e.*, “**new signal in the acquisition channel**”), which include power, phase, timing

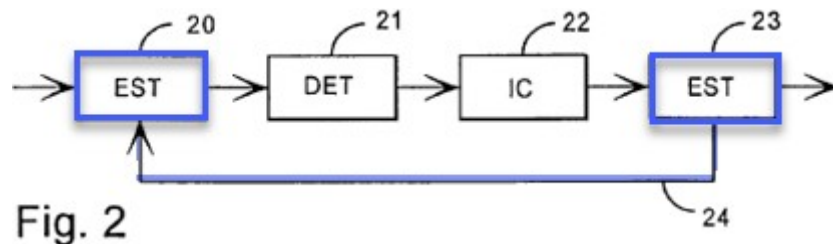
offset, carrier frequency offset, and structure. EX1004, 5:33-54; EX1003, ¶105. The channel estimator (*i.e.*, “**parameter estimation unit**”) “determin[es] a transmission channel estimate of the at least one interfering co-channel signal” (*i.e.*, “**estimates the channel transfer function**”). EX1004, 3:8-23; EX1003, ¶105. Hottinen discloses that the “estimation and regeneration of co-channel signals may also take place as a parallel process” and uses the training sequence before the signal switches to the traffic channel (*i.e.*, “**estimates the channel transfer function prior to signal switching from an acquisition channel to the traffic channel**”). EX1004, 4:7-10; EX1003, ¶105.

“said parameter estimation unit parameters being passed to said tracking unit thereafter”: Hottinen discloses “the parameters of the channel or the estimates thereof are known” as the “multipath channels provide a memory which can be advantageously utilized in the detection process” (*i.e.*, “**tracking unit for acquired signals**”). EX1004, 5:23-33; EX1003, ¶106. As Hottinen discloses a memory for storing the channel parameters and signals, a POSITA would understand that it is configured to track the signals and parameters by receiving the parameters after estimating as it is being used to store or track the signals as part of the detection process. EX1003, ¶106.

This limitation would have also been obvious in view of Lilleberg. EX1003, ¶107. Lilleberg discloses multi-user detectors that use parameter estimators and

trackers “utiliz[ing] feedback 24 from the second estimation means 23 to the first estimation means 20.” EX1006, 3:39-47; EX1003, ¶107. Lilleberg discloses that “[e]stimation results obtained from the second estimation means can thus be utilized when preliminary estimates are computed ... by supplying the channel parameters obtained from the second estimation means concerning sample b_n to the first estimation means as default values for computing preliminary channel parameters for the next sample b_{n+1} .” EX1006, 3:39-47; EX1003, ¶107. The

parameter estimator and tracker in Lilleberg are shown below:



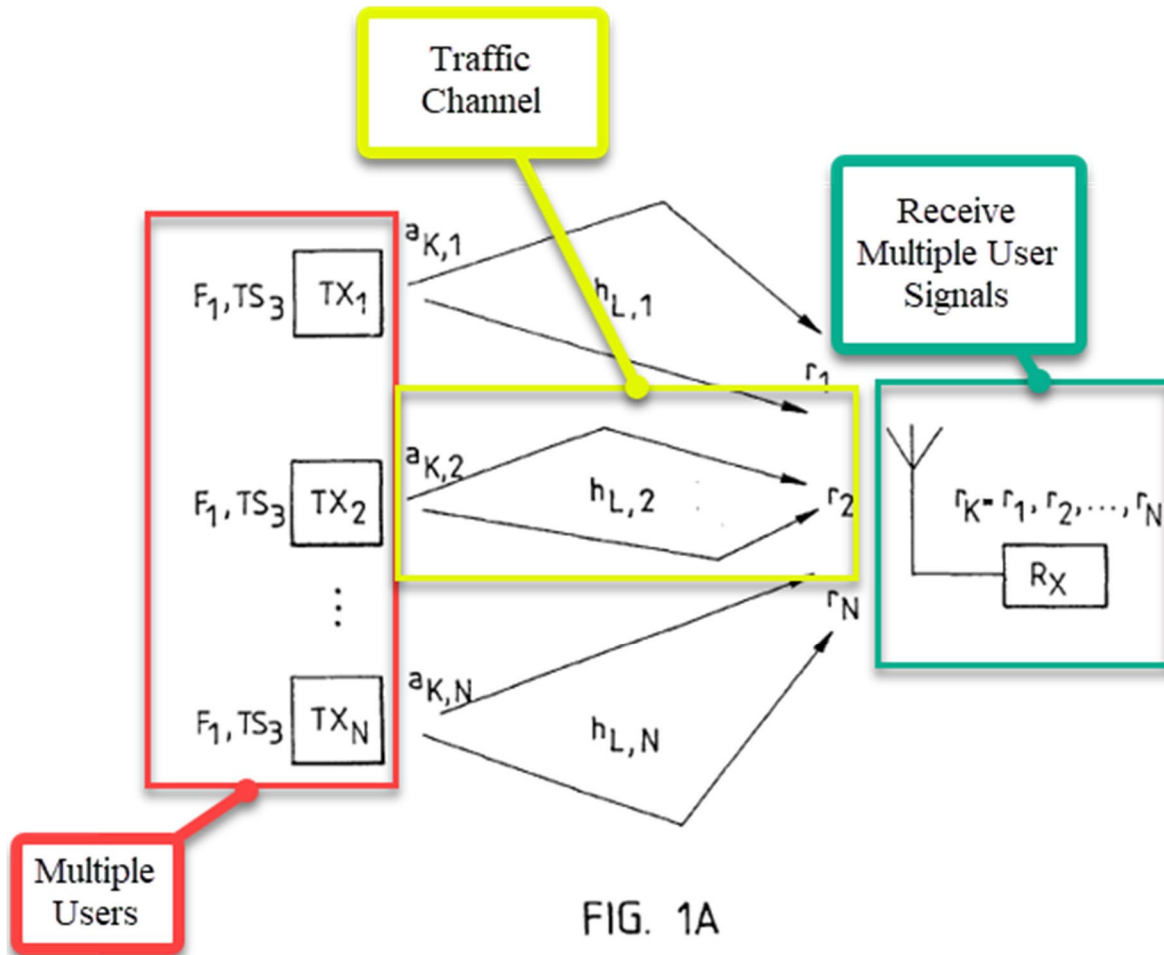
As discussed above, a POSITA would have found it obvious to combine Hottinen and Lilleberg. EX1003, ¶108, ¶¶72-78.

5. Claim 5

“a traffic channel”: Hottinen discloses a “multipath channel” that has “a certain impulse response and which provides a unique wave form coding for the signal” (*i.e.*, “**traffic channel**”). EX1004, 4:57-63; EX1003, ¶¶109-113. “The signal sequences $a_{k,1} \dots a_{k,N}$ transmitted in FIG. 1A travel through multipath channels $h_{L,1} \dots h_{L,N}$, respectively, whereby wave form coded signals $r_1 \dots r_N$ are received in the receiver Rx.” *Id.* Fig. 1a shows the “multipath channel” that has “a certain

impulse response and which provides a unique wave form coding for the signal”

(i.e., “**traffic channel**”). EX1003, ¶110.



“for said traffic channel phase is tracked without utilization of the estimates from the acquisition channel”: Hottinen discloses “the parameters of the channel or the estimates thereof are known” as the “multipath channels provide a memory which can be advantageously utilized in the detection process” and the training sequence channel is a separate channel as it is the “midamble” position (i.e., “tracked without utilization from the acquisition channel”). EX1004, 5:23-33,

5:60-67; EX1003, ¶111. As Hottinen discloses a memory for storing the channel parameters and signals, it is tracking the signals for each channel individually. EX1003, ¶111. For example, Hottinen discloses detectors, channel estimators, and memory for each primary signal and interfering signal received on each channel. EX1004, 9:20-30; EX1003, ¶111.

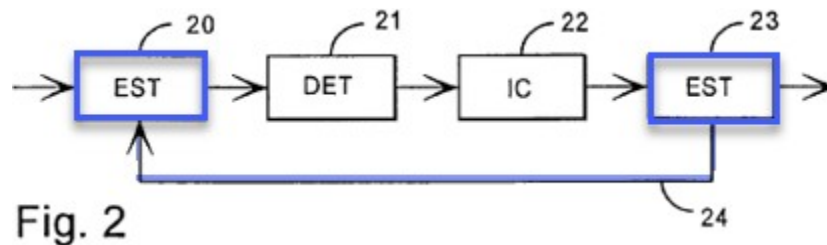
In its infringement contentions in the Samsung district court litigation, Patent Owner has mapped the acquisition channel to “Synchronization Signal Block” in “LTE” and the traffic channel to a “connected mode” (EX1009, Ex. 3 at 44-45), which is the same as the training sequence midamble and the connected channel disclosed in Hottinen. EX1004, 5:60-67; EX1003, ¶112. *See, e.g., Philip Morris Products, S.A. v. Rai Strategic Holdings, Inc.*, IPR2020-00921, Paper 13 at 42-44 (Aug. 5, 2021) (recognizing that petitioner can “rely[] on claim constructions that it believes are incorrect”); *Lewis Machine & Tool Co. v. WHG Properties, LLC*, IPR2020-00373, Paper 6 at 33-34 (July 27, 2020) (“[W]e are not persuaded that our rules prohibit Petitioner from relying on a claim construction it believes is incorrect.”).

6. Claim 7

Hottinen discloses “the parameters of the channel or the estimates thereof are known” as the “multipath channels provide a memory which can be advantageously utilized in the detection process” (*i.e.*, “**after initial estimate generation**”).

EX1004, 5:23-33; EX1003, ¶¶114-117. Hottinen discloses after the initial estimate is generated, a memory for storing the channel parameters and signals tracks all the signals for each channel (*i.e.*, “**multi-user detection system simultaneously tracks all signals in a traffic channel**”). EX1004, 9:20-30; EX1003, ¶115. Hottinen discloses tracking all signals simultaneously as “the detection of multiple co-channel signals with simultaneous ISI compensation” and detection and tracking of all signals is performed as “parallel processes.” EX1004, 7:51-55, 9:45-50; EX1003, ¶115.

This limitation would have also been obvious in view of Lilleberg. EX1003, ¶116. Lilleberg discloses multi-user detectors that use parameter estimators and tracking “two simultaneously received signals that comprise time slots 60-63 and 64-67 respectively.” EX1006, 5:34-35; EX1003, ¶116. The [parameter estimator and tracker](#) in Lilleberg are shown below.



As discussed above, a POSITA would have found it obvious to combine Hottinen and Lilleberg. EX1003, ¶117; ¶¶72-78.

7. Claim 8

Hottinen discloses “the parameters of the channel or the estimates thereof are known” as the “multipath channels provide a memory which can be advantageously utilized in the detection process” (*i.e.*, “**simultaneous tracking**”). EX1004, 5:23-33; EX1003, ¶¶118-120. Hottinen discloses tracking all signals simultaneously as “the detection of multiple co-channel signals with simultaneous ISI compensation” and detection and tracking of all signals is performed as “parallel processes.” EX1004, 7:51-55, 9:45-50; EX1003, ¶119. In the parallel processes, there **a detector (“DET”) and estimator (“EST”) blocks for isolating different signals in the channel** (*i.e.*, “**blocks for parallel recreation of the training signal portions of the traffic channel signal, each parallel processing block isolating a different signal in said traffic channel**”). EX1003, ¶119.

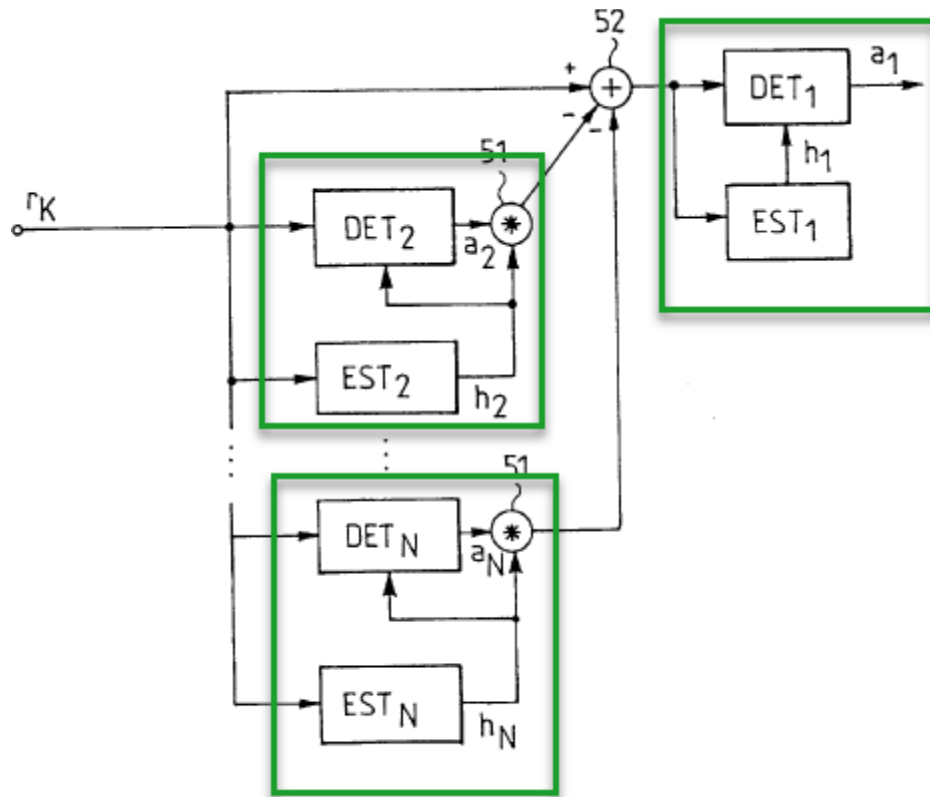


FIG. 5

Additionally, Lilleberg discloses “[t]he method of the invention can also be applied in a multistage receiver in which all the users received are processed in parallel” (*i.e.*, “**simultaneous tracking**”). EX1006, 4:36-41; EX1003, ¶120. Lilleberg discloses “the receiver comprises three successive receiver stages 47-49, and in each stage are estimated the symbol estimates of the incoming signal. The later stages always produce a more accurate result than the earlier stages” (*i.e.*, “**blocks for parallel recreation of the training signal portions of the traffic channel signal, each parallel processing block isolating a different signal in said**

traffic channel”). EX1006, 4:47-52; EX1003, ¶120.

8. *Claim 9*

(a) 9pre

See 1pre. EX1003, ¶121.

(b) 9a

See 1a. EX1003, ¶122.

(c) 9b

See 1b. EX1003, ¶123.

(d) 9c

See 1c. EX1003, ¶124.

(e) 9d

See Claim 4. EX1003, ¶¶125-126. Claim element 9c is the same as Claim 4 except it includes an additional limitation “all received signals having training portions.”

“all received signals having training portions”: Hottinen discloses “a primary signal and at least one interfering co-channel signal are received ... on the same TDMA channel, the signals having different but known training sequences” (*i.e.*, “all received signals having training portions”). EX1004, 3:8-23; EX1003, ¶126.

(f) 9e

“a second interfering signal being and assigned to said traffic channel”:

Hottinen discloses the traffic channel includes “a primary signal and at least one interfering co-channel signal.” EX1004, 3:8-15; EX1003, ¶¶127-132. Hottinen further discloses that the traffic channel includes and is assigned “interfering signal R_2 ... R_n .” EX1004, 9:20-24; EX1003, ¶128.

“said parameter estimation unit recreating the training signal portion of every received signal prior to the last received signal”: Hottinen discloses “a transmission channel estimate of the at least one interfering co-channel signal” includes “regenerating an interfering signal from the received signal by utilizing the transmission channel estimate of the interfering co-channel signal” (i.e., ***“said parameter estimation unit recreating the training signal portion of every received signal”***). EX1004, 3:15-21; EX1003, ¶129. A POSITA would understand that for multiple interfering co-channel signals, the transmission channel estimate for each interfering signal would be recreated. EX1003, ¶129. Hottinen discloses “the regenerated interfering signals ... are subtracted from the received signal in a subtraction means” (i.e., ***“prior to the last received signal”***). EX 1004, 9:36-40. As the “regenerated signal” is subtracted from the “received signal,” the regeneration is done prior to the last received signal. EX1003, ¶129.

“subtracting the recreated training signals from the training portion of the last received signal to provide an estimate solely due to the last received signal during the training signal portion”: Hottinen discloses “the regenerated interfering

signals ... are subtracted from the received signal in a subtraction means” (*i.e.*, “**subtracting the recreated training signals from the training portion of the last received signal**”). EX1004, 9:36-40; EX1003, ¶130. Hottinen discloses “[a]fter this, the channel estimator EST of the primary signal calculates the multi-path channel estimate h of the primary signal from the output of the subtraction means 52, and the detector DET detects the transmitted sequence a of the primary signal” (*i.e.*, “**provide an estimate solely due to the last received signal during the training signal portion**”). EX1004, 9:40-44; EX1003, ¶130.

“thus to allow an estimate of the last signal from which to calculate parameters of the last signal”: Hottinen discloses “the channel estimator EST of the primary signal calculates the multi-path channel estimate h of the primary signal from the output of the subtraction means 52, and the detector DET detects the transmitted sequence a of the primary signal” (*i.e.*, “**allow an estimate of the last signal from which to calculate parameters of the last signal**”). EX1004, 9:40-44; EX1003, ¶¶131-132.

B. Ground 2: Claims 1, 3, 4, 5, 7, 8, and 9 are Rendered Obvious by Zimmerman in view of Lilleberg

Zimmerman discloses a multi-user detection system that separates a signal by using parameter estimation and a signal separator. EX1005, 19, 25; EX1003, ¶¶133-134. Lilleberg discloses that multi-user detectors can use parameter tracking, which is useful in a MUD system like Zimmerman because it provides feedback from prior

parameter estimates and results in faster and more accurate estimations. EX1006, 2:31-33, EX1003, ¶¶133-134. It would have been obvious to combine Lilleberg's MUD parameter tracking with Zimmerman's MUD system with parameter estimation. *Id.*

1. Motivation to Combine

A POSITA would have been motivated to incorporate Lilleberg's teachings of a parameter tracker that implements channel estimation using real-time feedback and output parameters into Zimmerman's receiver for processing multi-user signals. EX1003, ¶¶135-141. Zimmerman discloses parameter estimation is performed uninterruptedly as the estimates are performed in a "self-bootstrapping, continuous" mode of operation. EX1005, 25; EX1003, ¶135. But Lilleberg provides the implementation detail regarding the structure of the parameter tracker used by the multi-user detector to achieve real-time estimation and tracking, as it discloses a parameter tracking unit for channel estimation where the parameter tracking unit outputs "amplitude and the delay" as well as "phases," "power," frequency and multipath structure. EX1006, 2:1-6, 3:19-47; EX1003, ¶135. Lilleberg's parameter tracker provides realtime feedback to the parameter estimator so the signals can be cleaned quicker and more accurately based on prior estimates. EX1006, 2:31-33; EX1003, ¶135.

MUD is a well-known, decades-old type of signal detection and processing

that uses signal parameter estimates to identify the user signals and remove interfering signals. EX1003, ¶136. MUD uses the signal parameters like signal amplitude, delay, phase, power, frequency, and multipath structure to identify the signal from interfering signals. *Id.* These signal parameters were well known to allow accurate signal estimations and separations. *Id.* A POSITA would have been motivated to incorporate Lilleberg's teachings of a parameter tracker that implements channel estimation using real-time feedback and output parameters into Zimmerman's receiver for processing multi-user signals for at least the following reasons. *Id.*

First, Zimmerman discloses parameter estimation is performed uninterruptedly as it is performed in a "self-bootstrapping, continuous" mode of operation. EX1005, 25; EX1003, ¶137. Additionally, Zimmerman discloses that it is configured to enable tracking parameter estimates, as "estimation techniques could be used in a tracking mode, where the estimate is updated over time using previous estimates" and implementing it using a "LMS-type amplitude-tracking loops to the CCPLL interference canceller" to perform "adaptive noise-cancelling." EX1003, ¶137. Zimmerman, however, does not expressly teach the real-time tracking structure of the parameter tracking unit includes the output of the parameter tracking unit is used as feedback for successive parameter estimates where the outputs are the received power, the phase of the oscillator for each of the transmitted signals, the

timing offset relative to the base station clock and transmission distance, the carrier frequency offset and the multipath structure. *Id.* Lilleberg, on the other hand, teaches that a real-time parameter tracking unit that includes feedback for successive parameter estimates for channel estimation where the outputs include “amplitude and the delay” as well as “phases,” “power,” frequency and multipath structure, and that this was well-known. EX1006, 2:1-6, 3:19-47; EX1003, ¶137. A POSITA would therefore be motivated to give effect to Zimmerman’s teaching of parameter tracking by incorporating Lilleberg’s teachings of the output parameters and feedback of the parameter tracking unit. In addition, using a parameter tracking unit that includes feedback outputs of the received power, the phase of the oscillator for each of the transmitted signals, the timing offset relative to the base station clock and transmission distance, the carrier frequency offset and the multipath structure would have been a mere design choice. EX1003, ¶137. A POSITA would have known that using more parameters would result in better estimates, so a POSITA would be motivated to use received power, the phase of the oscillator for each of the transmitted signals, the timing offset relative to the base station clock and transmission distance, the carrier frequency offset and the multipath structure as parameters. *Id.*

Second, a POSITA would have been motivated to use a parameter tracking unit that includes feedback and tracking the parameters of the received power, the phase of the oscillator for each of the transmitted signals, the timing offset relative

to the base station clock and transmission distance, the carrier frequency offset and the multipath structure because that would be an efficient method for processing parameter estimates from Zimmerman's parameter estimator. EX1003, ¶138. A POSITA would have been aware of the benefits of using a parameter tracking unit with a feedback output and using received power, the phase of the oscillator for each of the transmitted signals, the timing offset relative to the base station clock and transmission distance, the carrier frequency offset and the multipath structure. *Id.* A POSITA would have known this was more efficient and significantly faster than performing parameter estimates without any feedback or tracking. *Id.* The benefits of feedback processing and tracking had long been known by the filing date of the '505 patent. *Id.* Lilleberg expressly discloses that these benefits included quicker processing and cleaning of signals, as well as more accurate estimates based on prior estimates. EX1006, 2:31-33; EX1003, ¶138.

A POSITA would also be motivated by the fact that efficiency and speed were very important and desirable for processing wireless communications. EX1003, ¶139. As wireless communication speeds and bandwidth have increased, it is necessary for the processing of such signals to become more efficient in order to process the increased amount of data in real-time. *Id.* Because Zimmerman and Lilleberg describe detecting and decoding wireless signals containing data, a POSITA would have found it highly desirable to perform such processing as

efficiently and quickly as possible in order to maximize bandwidth. *Id.* Lilleberg expressly discloses that these benefits are achieved by using its parameter tracking unit. EX1006, 2:31-33; EX1003, ¶139.

Finally, a POSITA would have had a reasonable expectation of success. EX1003, ¶140. Both Zimmerman and Lilleberg describe the same process of performing MUD and then separating the signals. *Id.* Indeed, both Zimmerman and Lilleberg describe similar, well-known methods of for parameter estimating. *Id.* For example, both Hottinen and Lilleberg disclose parameter estimators and the benefit of tracking prior parameter estimates. EX1005, 19, 25; EX1006, 2:31-33; EX1003, ¶140. These were well-known parameter estimators and decoders and Lilleberg discloses that a parameter tracker including feedback outputs of the received power, the phase of the oscillator for each of the transmitted signals, the timing offset relative to the base station clock and transmission distance, the carrier frequency offset and the multipath structure was already prior art. EX1003, ¶140. Thus, it would have been well-within the skill of a POSITA to implement Zimmerman's parameter estimator using Lilleberg's teachings regarding parameter selection and parameter tracking, since such implementation was well known and conventional. *Id.*

Finally, Zimmerman, Lilleberg, and the '505 patent are analogous art because all three are directed to the same field of MUD and parameter estimation, that is,

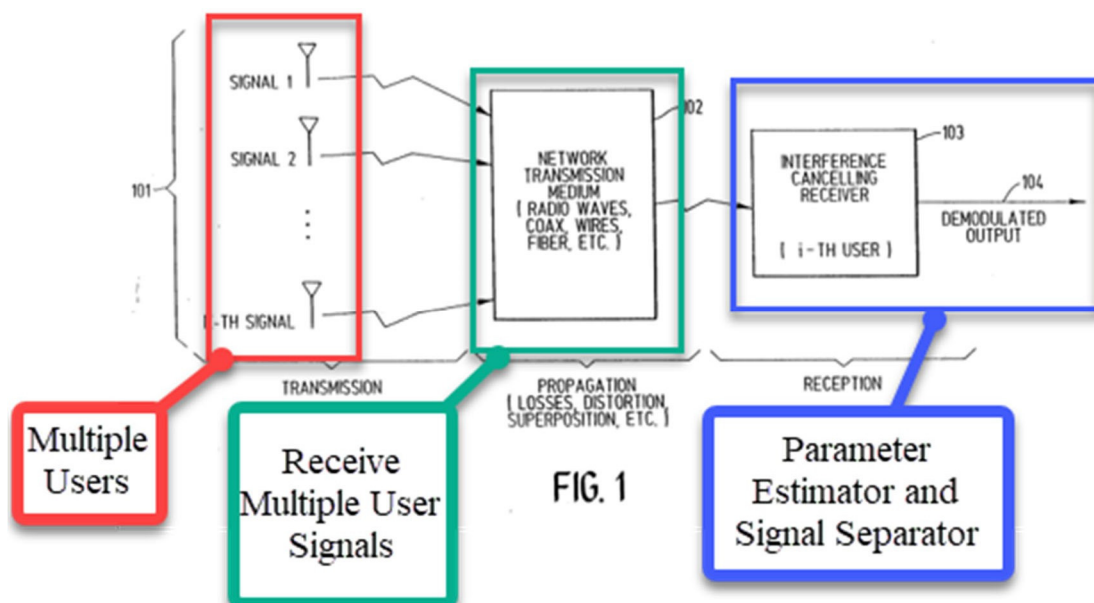
processing a data stream from multiple users using signal parameters for detection.

EX1005, 21, 24; EX1006, 2:1-6, 3:19-47; EX1001, 2:47-50; EX1003, ¶¶141.

2. Claim 1

(a) 1pre

“In a multi-user detection system in which interfering signals are purposely allowed to exist”: Zimmerman discloses a “multiaccess communication system” that “permit[s] multiple users to share the same or overlapping frequency assignments” (*i.e.*, **“multi-user detection system in which interfering signals are purposely allowed to exist”**). EX1005, Abstract; EX1003, ¶¶142-144. Zimmerman discloses that the multi-user signals are detected by “use of interference cancelling receivers to receive each user’s desired signal in the presence of interference” (*i.e.*, **“multi-user detection system”**). EX1003, ¶143. The multi-user detection system is shown below in Fig. 1 where the **multiple users** transmit multiple interfering signals over

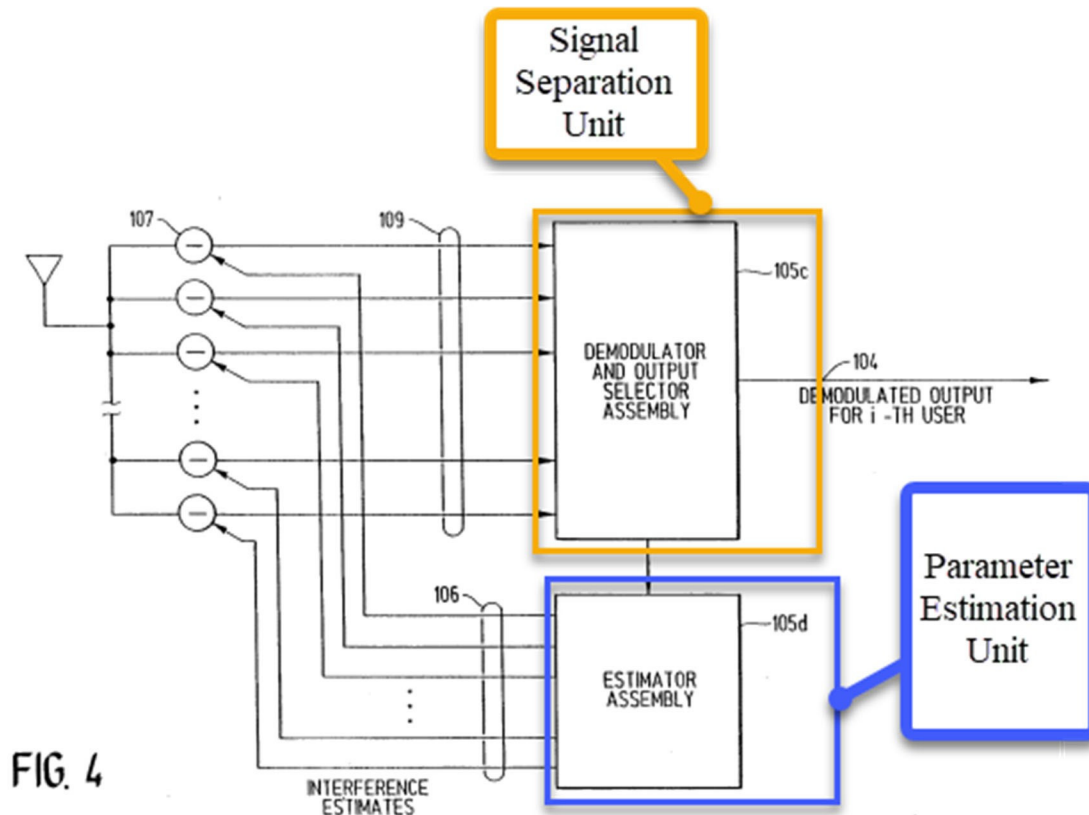


the same transmission channel to a receiver that includes an interference canceller using parameter estimations to separate the signals using a demodulator. *Id.*

(b) 1a

“a parameter estimation unit for use in conjunction with a signal separation unit”: Zimmerman discloses “independent interference estimators 105d are provided for each of the interference signals from the family of signals” (*i.e.*, “**a parameter estimation unit**”). EX1005, 19; EX1003, ¶¶145-148. Zimmerman notes that the interference estimator estimates signal parameters as the “[e]stimation of the amplitudes of the received signals in our interference cancelling receivers is, in fact, a way of estimating the channel propagation loss of each signal.” EX1005, 19; EX1003, ¶146. Zimmerman further discloses that the “receiver separates interfering signals by means of estimating the propagation loss” (*i.e.*, “**parameter estimation unit for use in conjunction with a signal separation unit**”). EX1005, 19; EX1003, ¶146. Zimmermann discloses that “[i]nterfering signals would then be separated by identifying the channel loss characteristics associated with each of them” (*i.e.*, “**signal separation unit**”). EX1005, 21; EX1003, ¶146. Zimmerman discloses that the signal separation is performed by a demodulator and output selector assembly and “a demodulator/estimator 105c, 105d is needed for each interfering signal” (*i.e.*, “**parameter estimation unit for use in conjunction with a signal separation unit**”). EX1005, 15; EX1003, ¶146. Fig. 4 of Zimmerman shows the interference

estimator assembly (i.e., “parameter estimation unit”) and demodulator and output selector assembly (i.e., “signal separation unit”). EX1003, ¶146.



“each received signal has associated channel transfer functions”:

Zimmerman discloses that each received signal has signal parameters as the “[e]stimation of the amplitudes of the received signals in our interference cancelling receivers is, in fact, a way of estimating the channel propagation loss of each signal.” EX1005, 19; EX1003, ¶147. Zimmerman includes a “phase detector 121, loop gain and filter 122, and a numerically controlled oscillator (NCO) 123” as well as “amplitude estimator” using the known signal parameters as inputs for interference

estimation and separation (*i.e.*, “**associated channel transfer functions**”). EX1005, 55; EX1003, ¶147. A POSITA would understand that each of these is a known characteristic of a channel function. EX1003, ¶¶147-148. These signal parameters are the same as the claimed channel transfer functions, as the ’505 patent states that “channel transfer function comprised of the received power, the phase of the oscillator which generated each received signal, the timing offset relative to the base station clock, any frequency offset of the carrier, and the structure of the multipath replicas.” EX1001, 1:27-31; EX1003, ¶¶43, 147-148.

(c) 1b

Zimmerman discloses the use of a “phase-locked loop (PLL) of conventional design, comprised of a phase detector 121, loop gain and filter 122, and a numerically controlled oscillator (NCO) 123” as well as “amplitude estimator” (*i.e.*, “**signal processor**”). EX1005, 55; EX1003, ¶¶149-150. A POSITA would understand that a PLL is a type of signal processor and is implemented using a signal processor. EX1003, ¶149. Zimmerman processes the signal to determine known signal parameters like amplitude, phase, time delay, and multipath structure (*i.e.*, “**associated channel transfer functions**”). EX1003, ¶¶149-150.

(d) 1c

As discussed in Section V.B,2 above, this claim limitation is subject to 35 U.S.C. § 112, ¶6 with the function: “providing uninterrupted estimates of the channel

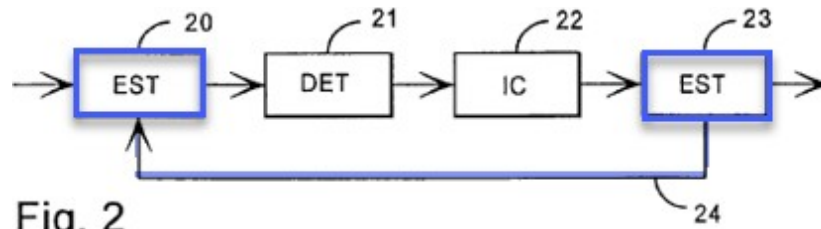
transfer function parameters on a real-time basis by first deriving the estimated channel transfer function for each of said interfering signals” and corresponding structure: parameter tracking unit and equivalents thereof. *See, e.g.*, EX1001, 5:20-40, 6:9-23, 7:45-8:40, Fig. 1, Fig. 3, Fig. 4 (parts 90, 90’, 90’); EX1003, ¶151.

“providing uninterrupted estimates of the channel transfer function parameters on a real-time basis by first deriving the estimated channel transfer function for each of said interfering signals”: Zimmerman discloses the interference estimate function (*i.e.*, “**estimates of the channel transfer function parameters**”) are performed uninterruptedly as the estimates are performed in a “self-bootstrapping, continuous” mode of operation (*i.e.*, “**providing uninterrupted estimates ... on a real-time basis**”). EX1005, 25; EX1003, ¶¶152-155. Zimmerman discloses using the known signal parameters as the “[e]stimation of the amplitudes of the received signals in our interference cancelling receivers is, in fact, a way of estimating the channel propagation loss of each signal.” EX1005, 19. Zimmerman includes a “phase detector 121, loop gain and filter 122, and a numerically controlled oscillator (NCO) 123” as well as “amplitude estimator” using the known signal parameters as inputs for interference estimation and separation (*i.e.*, “**by first deriving the estimated channel transfer function for each of said interfering signals**”). *Id.*, 55; EX1003, ¶152.

“parameter tracking unit and equivalents thereof”: Zimmerman discloses

“estimation techniques could be used in a tracking mode, where the estimate is updated over time using previous estimates” and implementing it using a “LMS-type amplitude-tracking loops to the CCPLL interference canceller” to perform “adaptive noise-cancelling.” (*i.e.*, “**parameter tracking unit**”). EX1005, 21, 24; EX1003, ¶153. Zimmerman also discloses that the tracking loop is coupled to the signal processor, as the signal processor accesses the tracking loop and previous estimates so “the estimate is updated over time using previous estimates” (*i.e.*, “**coupled to said channel transfer function determining signal processor**”). EX1005, 21, 55; EX1003, ¶153. This is the same structure as the claimed parameter tracking unit as it is a parameter tracker with stored parameters for estimates. *Id.*

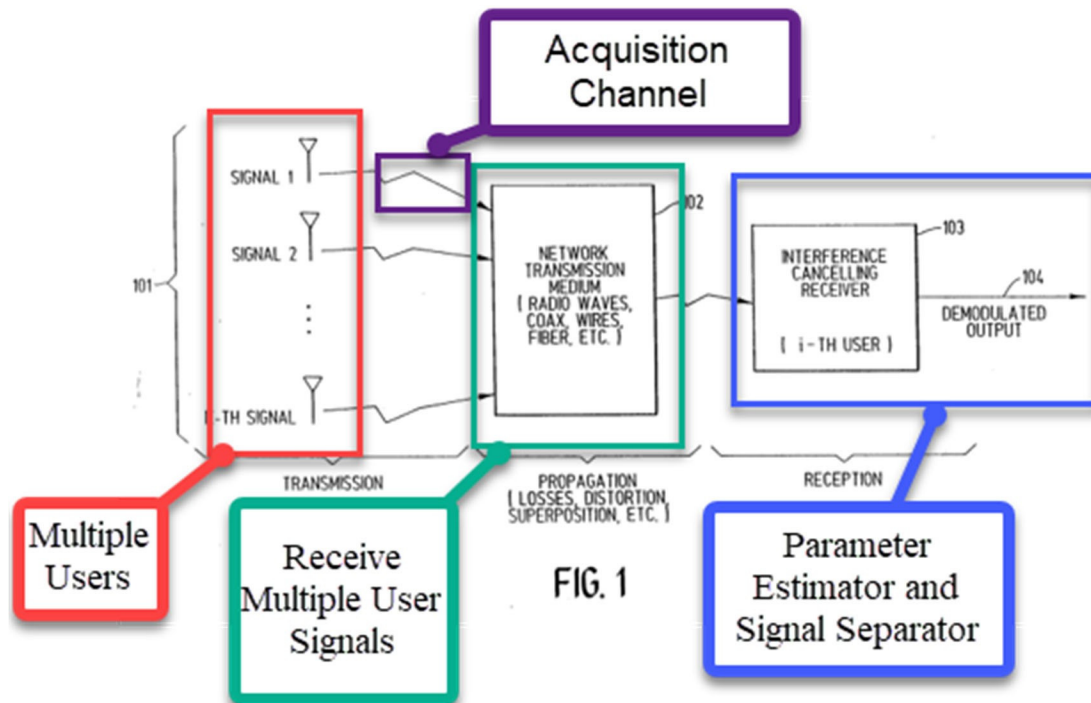
While Zimmerman does not expressly disclose the implementation detail regarding the structure of the parameter tracker used by the multi-user detector to achieve real-time estimation and tracking, Lilleberg discloses a parameter tracking unit for channel estimation where the parameter tracking unit outputs “amplitude and the delay” as well as “phases,” “power,” frequency and multipath structure. EX1006, 2:1-6, 3:19-47; EX1003, ¶154. As shown in Fig. 2, Lilleberg discloses that [the channel parameter estimates from EST 23](#) are fed back to [EST 20](#) to be tracked and used for the further channel parameter estimates. EX1003, ¶154.



As discussed above, it would have been obvious to combine Zimmerman with Lilleberg. EX1003, ¶155, ¶¶135-141.

3. Claim 3

“the multi-user detection system includes providing an acquisition channel”: Zimmerman discloses “acquisition is a two-stage process” and includes the channel that “propagate corresponding signals (Signal 1, Signal 2 ... Signal K) via” the channel for an acquisition stage (*i.e.*, “**acquisition channel**”). EX1005, 14; EX1003, ¶¶156-159. Additionally, Zimmerman discloses “resultant signals are received by an interference cancelling receiver 103, or a plurality of such receivers and demodulated output for a selected signal is available on line 104 for the *i* th user in a family of multiple users.” EX1005, 14; EX1003, ¶156. Zimmerman Fig. 1 shows the **acquisition channel** propagates Signal 1 in the acquisition stage. EX1003, ¶156.



In its infringement contentions in the Samsung district court litigation, Patent Owner has mapped the acquisition channel to “Synchronization Signal Block” in “LTE” and the traffic channel to “connected mode” in “LTE” (EX1009, Ex. 3 at 33), which is the same as the acquisition stage and connection stage disclosed in Zimmerman. EX1005, 14; EX1003, ¶157. *See, e.g., Philip Morris Products, S.A. v. Rai Strategic Holdings, Inc.*, IPR2020-00921, Paper 13 at 42-44 (Aug. 5, 2021) (recognizing that petitioner can “rely[] on claim constructions that it believes are incorrect”); *Lewis Machine & Tool Co. v. WHG Properties, LLC*, IPR2020-00373, Paper 6 at 33-34 (July 27, 2020) (“[W]e are not persuaded that our rules prohibit Petitioner from relying on a claim construction it believes is incorrect.”).

“the first derived estimated channel transfer function is derived from

acquisition channel parameters”: Zimmerman discloses performing the interference estimate on the signal from the acquisition channel by using one of the “two identically designed PLL’s ... during acquisition” (*i.e.*, “**first derived estimated channel transfer function is derived from acquisition channel parameters**”). EX1005, 27; EX1003, ¶158. The PLL in Zimmerman using the signal parameters or the acquisition channel signal as it includes a “phase detector 121, loop gain and filter 122, and a numerically controlled oscillator (NCO) 123” as well as “amplitude estimator” using the known signal parameters as inputs for interference estimation and separation. EX1005, 55; EX1003, ¶¶158-159.

4. Claim 4

“multi-user detection system includes a tracking unit for acquired signals”:

Zimmerman discloses “estimation techniques could be used in a tracking mode, where the estimate is updated over time using previous estimates” and implementing it using a “LMS-type amplitude-tracking loops to the CCPLL interference canceller” to perform “adaptive noise-cancelling.” (*i.e.*, “**tracking unit for acquired signals**”). EX1005, 21, 24; EX1003, ¶¶160-165. Zimmerman tracks “both the amplitude and phase of the interfering signals” so “the full separation of the interfering signals can be exploited. EX1005, 18; EX1003, ¶160. Additionally, Zimmerman tracks signal “power” to “maintain a strict power hierarchy” in the estimates and separation. EX1005, 19; EX1003, ¶160.

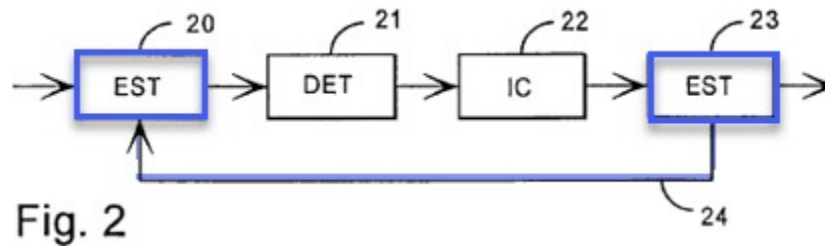
“in the presence of a new signal in the acquisition channel of said parameter estimation unit estimates the channel transfer function prior to signal switching from an acquisition channel to the traffic channel”: Zimmerman discloses that each received signal has signal parameters as the “[e]stimation of the amplitudes of the received signals in our interference cancelling receivers is, in fact, a way of estimating the channel propagation loss of each signal” (i.e., “**parameter estimation unit**”). EX1005, 19; EX1003, ¶161. Zimmerman includes a “phase detector 121, loop gain and filter 122, and a numerically controlled oscillator (NCO) 123” as well as “amplitude estimator” using the known signal parameters as inputs for interference estimation (i.e., “**new signal in the acquisition channel**”). *Id.* Zimmerman discloses “estimation techniques could be used in a tracking mode, where the estimate is updated over time using previous estimates” and implementing it using a “LMS-type amplitude-tracking loops to the CCPLL interference canceller” to perform “adaptive noise-cancelling.” (i.e., “**estimates the channel transfer function**”). EX1005, 21, 24; EX1003, ¶161. Zimmerman tracks “both the amplitude and phase of the interfering signals” so “the full separation of the interfering signals can be exploited” and, after the acquisition stage, transmits the signal in the connected stage (i.e., “**estimates the channel transfer function prior to signal switching from an acquisition channel to the traffic channel**”). EX1005, 18; EX1003, ¶161. Additionally, Zimmerman tracks signal “power” to “maintain a strict

power hierarchy” in the estimates and separation. EX1005, 19; EX1003, ¶161.

“said parameter estimation unit parameters being passed to said tracking unit thereafter”: Zimmerman discloses “estimation techniques could be used in a tracking mode, where the estimate is updated over time using previous estimates” and implementing it using a “LMS-type amplitude-tracking loops to the CCPLL interference canceller” to perform “adaptive noise-cancelling.” EX1005, 21, 24; EX1003, ¶¶162-163. Zimmerman tracks “both the amplitude and phase of the interfering signals” so “the full separation of the interfering signals can be exploited.” EX1005, 18; EX1003, ¶162. Additionally, Zimmerman tracks signal “power” to “maintain a strict power hierarchy” in the estimates and separation. EX1005, 19; EX1003, ¶162.

This limitation would have also been obvious in view of Lilleberg. EX1003, ¶¶164-165. Lilleberg discloses multi-user detectors that use parameter estimators and trackers “utiliz[ing] feedback 24 from the second estimation means 23 to the first estimation means 20.” EX1006, 3:39-47; EX1003, ¶164. Lilleberg discloses that “[e]stimation results obtained from the second estimation means can thus be utilized when preliminary estimates are computed ... by supplying the channel parameters obtained from the second estimation means concerning sample b_n to the first estimation means as default values for computing preliminary channel parameters for the next sample b_{n+1} .” EX1006, 3:39-47; EX1003, ¶164. The

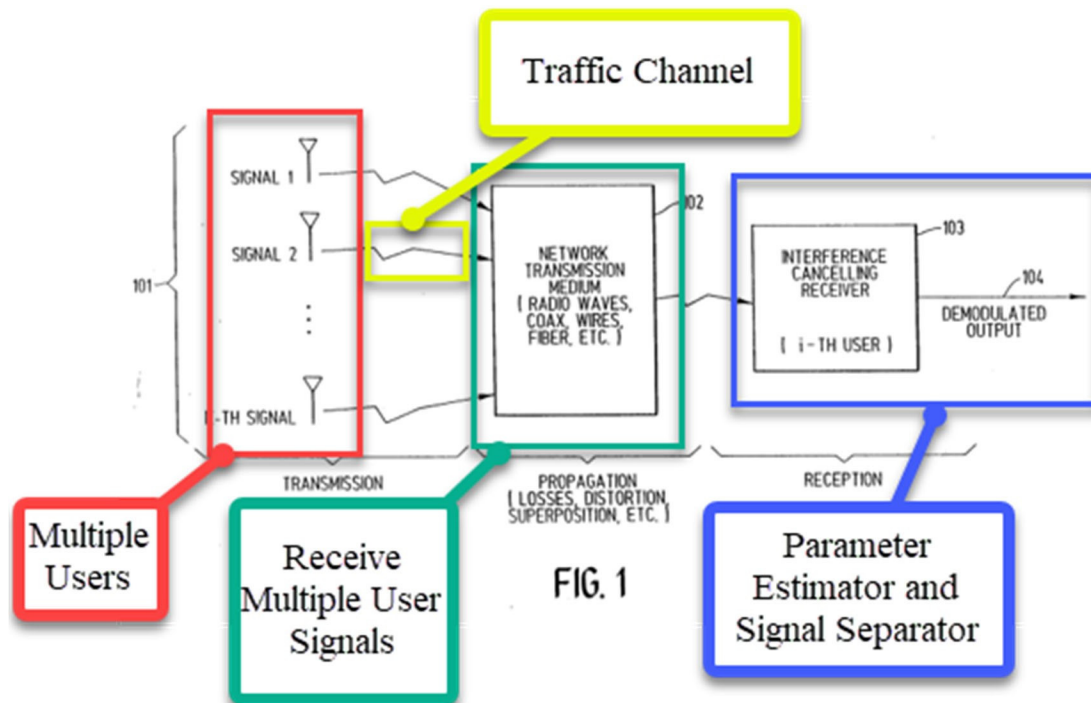
parameter estimator and tracker in Lilleberg are shown below. EX1003, ¶164.



As discussed above, a POSITA would have found it obvious to combine Zimmerman and Lilleberg. EX1003, ¶165, ¶¶135-141.

5. Claim 5

“a traffic channel”: Zimmerman discloses a channel that “propagate[s] corresponding signals (Signal 1, Signal 2 ... Signal K) via” the channel in a connected mode (*i.e.*, **“traffic channel”**). EX1005, 14; EX1003, ¶¶166-169. This connected mode (*i.e.*, “traffic channel”) is different from the acquisition or tracking mode (“acquisition channel”). EX1005, 19; EX1003, ¶166. Additionally, Zimmerman discloses “resultant signals are received by an interference cancelling receiver 103, or a plurality of such receivers and demodulated output for a selected signal is available on line 104 for the *i* th user in a family of multiple users.” EX1005, 19; EX1003, ¶166. Zimmerman Fig. 1 shows the **traffic channel** that propagates Signal 2. EX1003, ¶166.



“for said traffic channel phase is tracked without utilization of the estimates from the acquisition channel”: Zimmerman discloses “estimation techniques could be used in a tracking mode, where the estimate is updated over time using previous estimates” and implementing it using a “LMS-type amplitude-tracking loops to the CCPLL interference canceller” to perform “adaptive noise-cancelling.” (*i.e.*, “**for said traffic channel phase is tracked**”). EX1005, 21, 24; EX1003, ¶167. Zimmerman also discloses that the “interference estimates are subtracted from a single input channel” so any estimates from one channel would not be used for the other channels (*i.e.*, “**without utilization of the estimates from the acquisition channel**”). EX1005, 14, 55; EX1003, ¶167.

In its infringement contentions in the Samsung district court litigation, Patent

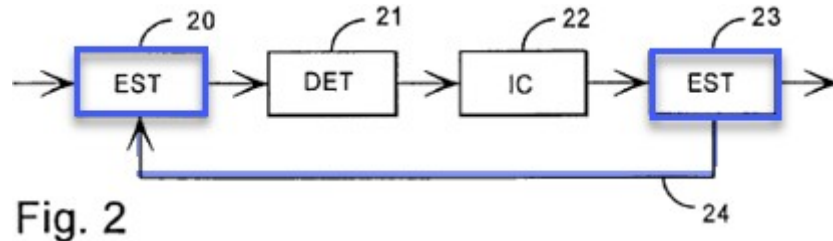
Owner has mapped the acquisition channel to “Synchronization Signal Block” and the traffic channel to “connected mode” in “LTE” (EX1009, Ex. 3 at 33), which is the same as the acquisition stage and connection stage disclosed in Zimmerman. EX1005, 21, 24; EX1003, ¶168. *See, e.g., Philip Morris Products, S.A. v. Rai Strategic Holdings, Inc.*, IPR2020-00921, Paper 13 at 42-44 (Aug. 5, 2021) (recognizing that petitioner can “rely[] on claim constructions that it believes are incorrect”); *Lewis Machine & Tool Co. v. WHG Properties, LLC*, IPR2020-00373, Paper 6 at 33-34 (July 27, 2020) (“[W]e are not persuaded that our rules prohibit Petitioner from relying on a claim construction it believes is incorrect.”).

6. Claim 7

Zimmerman discloses “estimation techniques could be used in a tracking mode, where the estimate is updated over time using previous estimates” and implementing it using a “LMS-type amplitude-tracking loops to the CCPLL interference canceller” to perform “adaptive noise-cancelling” (*i.e.*, “**after initial estimate generation**”). EX1005, 21, 24; EX1003, ¶¶170-172. Zimmerman discloses after the initial estimate is generated, tracking the channel parameters and signals for all channel (*i.e.*, “**multi-user detection system simultaneously tracks all signals in a traffic channel**”). EX1005, 21, 24; EX1003, ¶170.

This limitation would have also been obvious in view of Lilleberg. Lilleberg discloses multi-user detectors that use parameter estimators and tracking “two

simultaneously received signals that comprise time slots 60-63 and 64-67 respectively.” EX1006, 5:34-35; EX1003, ¶171. The **parameter estimator and tracker** in Lilleberg are shown below. EX1003, ¶171.

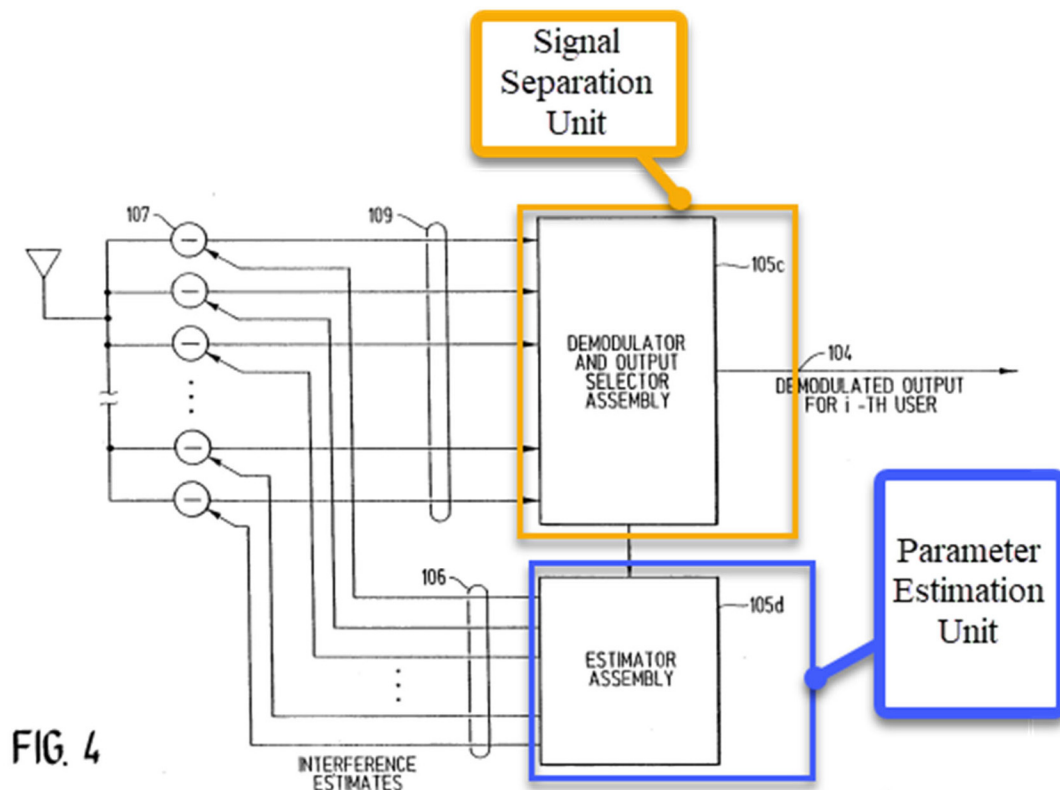


As discussed above, a POSITA would have found it obvious to combine Zimmerman and Lilleberg. EX1003, ¶¶172, ¶¶135-141.

7. Claim 8

Zimmerman discloses “estimation techniques could be used in a tracking mode, where the estimate is updated over time using previous estimates” and implementing it using a “LMS-type amplitude-tracking loops to the CCPLL interference canceller” to perform “adaptive noise-cancelling.” (*i.e.*, “**simultaneous tracking**”). EX1005, 21, 24; EX1003, ¶¶173-174. A POSITA would understand that adaptive noise-cancelling would perform simultaneous tracking as it is updating the estimates in real time using previous estimates. EX1003, ¶173. Zimmermann discloses that “[i]nterfering signals would then be separated by identifying the channel loss characteristics associated with each of them” (*i.e.*, “**blocks for parallel recreation of the training signal portions of the traffic channel signal, each parallel processing block isolating a different signal in said traffic channel**”).

EX1005, 21. Zimmerman discloses that the signal separation is performed by a demodulator and output selector assembly and “a demodulator/estimator 105c, 105d is needed for each interfering signal” *Id.*, 15. Figure 4 of Zimmerman shows the signal separation is performed by a demodulator and output selector assembly. EX1003, ¶173.



Additionally, Lilleberg discloses “[t]he method of the invention can also be applied in a multistage receiver in which all the users received are processed in parallel” (*i.e.*, “**simultaneous tracking**”). EX1006, 4:36-41; EX1003, ¶174. Lilleberg discloses “the receiver comprises three successive receiver stages 47-49, and in each stage are estimated the symbol estimates of the incoming signal.

EX1003, ¶174. The later stages always produce a more accurate result than the earlier stages” (*i.e.*, “**blocks for parallel recreation of the training signal portions of the traffic channel signal, each parallel processing block isolating a different signal in said traffic channel**”). EX1006, 4:47-52; EX1003, ¶174.

8. Claim 9

(a) 9pre

See 1pre. EX1003, ¶175.

(b) 9a

See 1a. EX1003, ¶176.

(c) 9b

See 1b. EX1003, ¶177.

(d) 9c

See 1c. EX1003, ¶178.

(e) 9d

See Claim 4. EX1003, ¶¶179-180. Claim element 9c is the same as Claim 4 except it includes an additional limitation “all received signals having training portions.” EX1003, ¶179.

“all received signals having training portions”: Zimmerman discloses that each received signal has signal parameters as the “[e]stimation of the amplitudes of the received signals in our interference cancelling receivers is, in fact, a way of estimating the channel propagation loss of each signal” (*i.e.*, “**all received signals**

having training portions”). EX1005, 19; EX1003, ¶180.

(f) 9e

“a second interfering signal being and assigned to said traffic channel”:

Zimmerman discloses the traffic channel including multiple interfering signals as “both mutually interfering signals could potentially be received” by the interference estimator. EX1005, 19; EX1003, ¶¶181-186.

“said parameter estimation unit recreating the training signal portion of every received signal prior to the last received signal”: Zimmerman discloses “estimation techniques could be used in a tracking mode, where the estimate is updated over time using previous estimates” and implementing it using a “LMS-type amplitude-tracking loops to the CCPLL interference canceller” to perform “adaptive noise-cancelling” where the signal is recreated (*i.e.*, “**said parameter estimation unit recreating the training signal portion of every received signal**”). EX1005, 21, 24; EX1003, ¶182. Zimmermann discloses that “[i]nterfering signals would then be separated by identifying the channel loss characteristics associated with each of them” (*i.e.*, “**prior to the last received signal**”). EX1005, 21; EX1003, ¶182. A POSITA would understand that interference cancellation sequentially uses every prior received signal to estimate a newly received signal as Zimmerman discloses “the estimate is updated over time using previous estimates” and interference cancellation is “adaptive noise-cancelling.” EX1005, 21, 24; EX1003, ¶182.

“subtracting the recreated training signals from the training portion of the last received signal to provide an estimate solely due to the last received signal during the training signal portion”: Zimmermann discloses “subtracting an estimate of interfering signals from the incoming corrupted signal to produce a clean output” (*i.e.*, **“subtracting the recreated training signals from the training portion of the last received signal ”**). EX1005, 22; EX1003, ¶183. Zimmermann discloses that “[i]nterfering signals would then be separated by identifying the channel loss characteristics associated with each of them” and “a demodulator/estimator 105c, 105d is needed for each interfering signal” (*i.e.*, **“provide an estimate solely due to the last received signal during the training signal portion”**). EX1005, 15, 21; EX1003, ¶183. A POSITA would understand that interference cancellation sequentially provides an estimate solely due to last received signal as every prior received signal is used to estimate a newly received signal as Zimmermann discloses “the estimate is updated over time using previous estimates” and interference cancellation is “adaptive noise-cancelling.” EX1005, 21, 24; EX1003, ¶183.

“thus to allow an estimate of the last signal from which to calculate parameters of the last signal”: Zimmermann discloses that “[i]nterfering signals would then be separated by identifying the channel loss characteristics associated with each of them” and “a demodulator/estimator 105c, 105d is needed for each interfering signal” (*i.e.*, **“allow an estimate of the last signal from which to**

calculate parameters of the last signal”). EX1005, 15, 21; EX1003, ¶184.

Additionally, Lilleberg discloses “[t]he method of the invention can also be applied in a multistage receiver in which all the users received are processed in parallel” (*i.e.*, “**simultaneous tracking**”). EX1006, 4:36-41; EX1003, ¶185. Lilleberg discloses “the receiver comprises three successive receiver stages 47-49, and in each stage are estimated the symbol estimates of the incoming signal. The later stages always produce a more accurate result than the earlier stages” (*i.e.*, “**provide an estimate solely due to the last received signal during the training signal portion**”). EX1006, 4:47-52; EX1003, ¶¶185-186.

VII. DISCRETIONARY DENIAL IS NOT WARRANTED

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. Moreover, the *Fintiv* factors below 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.” EX1016. 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. EX1015. Although the Complaint against Lenovo was filed on December 12, 2023, the Complaint was not served until April 29, 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, EX1017. 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, EX1018—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. EX1018. 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 Research 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.

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 Commn’s, LLC v. Rovi Guides, Inc.*, IPR2019-00231, Paper 14 at 11 (PTAB May 20, 2019) (obviousness challenges not “previously considered by the Office or any court” weigh in favor of not denying institution). Moreover, the ’505 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. During prosecution, the independent claims were amended to include features of claims indicated as allowable—namely, portions of claim elements 1c and 9d-9e. These features, however, are clearly taught and rendered obvious by Hottinen, Zimmerman, and Lilleberg. Moreover, as discussed above, the ’505 patent admits that multi-user detectors of varying complexity were known and that parameter estimation was known and only purports

to invent using the parameter estimation for real-time detection. However, Hottinen and Zimmerman clearly teach this.

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

B. *General Plastic*

Factor 1: While a prior petitioner (Samsung Electronics Co., Ltd.) challenged the '505 patent in IPR2024-01249, Petitioners are neither the same petitioner nor a real party-in-interest. Rather, Petitioners and Samsung do not have a “significant relationship ... with respect to [the challenged patent].” *Valve Corp. v. Elec. Scripting Prods., Inc.*, IPR2019-00062, Paper 11 at 2, 9 (PTAB Apr. 2, 2019) (precedential).

Factors 2-5: The remaining *General Plastic* factors are “necessarily outweigh[ed]” when the different petitioners have no “significant relationship.” *Videndum Prod. Sols., Inc. v. Rotolight Ltd.*, IPR2023-01218, Paper 12, at 6 (PTAB Apr. 19, 2024) (Vidal) (“[W]here, as here, the first and second petitioners are neither the same party, nor possess a significant relationship under *Valve*, *General Plastic* factor one necessarily outweighs the other *General Plastic* factors.”) (emphasis added); see also *Toshiba Am. Info. Sys., Inc. v. Walletex Microelectronics Ltd.*, IPR201801538, Paper 11, at 21 (PTAB Mar. 5, 2019). *Videndum* is controlling here.

Factors 6-7: Factors 6-7 favor institution. Petitioners seek to join the Samsung IPR and are not raising new arguments and will participate in an inactive/understudy role so that there should be no material impact on the Board's finite resources or its ability to issue a final determination within one year. *General Plastic Industrial Co., Ltd. v. Canon Kabushiki Kaisha*, IPR2016-01357, Paper 19 at 15-19 (PTAB Sept. 6, 2017).

Thus, discretionary denial under *General Plastic* is not warranted.

VIII. MANDATORY NOTICES AND FEES

A. Real Party-In-Interest

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 Ltd. is also a real party-in-interest.

B. Related Matters

The '505 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 '505 patent is also the subject of IPR2024-01249, filed August 1, 2024 (pending).

Petitioners are not aware of any other disclaimers, reexamination certificates, or IPR petitions addressing the '505 Patent.

C. Lead and Backup Counsel

Petitioners provides the following counsel and service information.

Petitioners consent to electronic service the email addresses listed in the table below. Pursuant to 37 C.F.R. § 42.10(b), a Power of Attorney accompanies this Petition.

Lead Counsel	Backup counsel
Timothy Riffe, Reg. No. 43,881 Fish & Richardson P.C. 60 South Sixth Street, Suite 3200 Minneapolis, MN 55402 Tel: 202-783-5070 Fax: 877-769-7945 Email: IPR55851-0024IP1@fr.com	Jennifer Huang, Reg. No. 64,297 Whitney Reichel, Reg. No. 59,173 Lawrence Jarvis, Reg. No. 74,636 60 South Sixth Street, Suite 3200 Minneapolis, MN 55402 Tel: 202-783-5070 Fax: 877-769-7945 PTABInbound@fr.com

D. Service Information

Please address all correspondence and service to the address listed above.

Petitioners consent to electronic service by email at IPR55851-0024IP1@fr.com
(referencing No. 55851-0024IP1 and cc'ing PTABInbound@fr.com).

E. Payment of Fees

The undersigned authorizes the Office to charge the fee required for this Petition for Inter Partes Review to Deposit Account No. 06-1050. Any additional fees that might be due are also authorized.

IX. CONCLUSION

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

Respectfully submitted,

Dated: December 12, 2024

/Timothy W. Riffe/

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CERTIFICATION UNDER 37 CFR § 42.24

Under the provisions of 37 CFR § 42.24(d), the undersigned hereby certifies that the word count for the foregoing Petition for *Inter Partes* Review totals 13,977 words, which is less than the 14,000 allowed under 37 CFR § 42.24.

Dated: December 12, 2024

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CERTIFICATE OF SERVICE

Pursuant to 37 CFR §§ 42.6(e)(4)(i) *et seq.* and 42.105(b), the undersigned certifies that on December 12, 2024, a complete and entire copy of this Petition for *Inter Partes* Review, Motion for Joinder, and all supporting exhibits were provided by Federal Express, to the Patent Owner, by serving the correspondence address of record as follows:

Official Correspondence Address
Collision Communications, Inc.
20 Depot Street
Suite 2A Peterborough, NH
UNITED STATES

Courtesy copies were also sent via electronic mail to Patent Owner's counsel of record in the related district court proceeding:

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